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Sv. 43

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Astronomical Observatory in Belgrade

**ACTIVITIES
AND
ABSTRACTS OF PAPERS
1980-1990**

Astronomska opservatorija u Beogradu

**AKTIVNOSTI
I
KRATKI SADRŽAJI RADOVA
1980-1990**

**Edited by O. Atanacković-Vukmanović
and
M. S. Dimitrijević**



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FOREWORD

The aim of the present Volume "Astronomical Observatory in Belgrade — Activities and Abstracts of Papers (1980–1990)" is to offer a more complete insight into the fields and the contents of the recent researches performed at this Observatory.

Although of great diversity the Observatory's activity may be classified into the following research entities:

- Fundamental Astrometry
- Earth's Rotation
- Dynamical and Statistical Investigations on Celestial Bodies
- Astrophysical Researches.

The bulk of the Observatory's research activity consists in the acquisition of its own observational data, their processing and analysis as well as the forwarding of the obtained results to the international centres. Further activity consists in the theoretical research in astrometry, astrophysics and related fields (plasma physics, theoretical mechanics) along with the treatment of the observational data obtained from other astronomical centres.

The importance of research at the Belgrade Observatory arises from the fact that it is the only one in this country pursuing on a permanent basis observations of celestial bodies, necessary for the elaboration of stellar catalogues and astronomical ephemeris, for defining the celestial quasi-inertial coordinate frame, time and geographic coordinates determination, for the study of the Earth's rotation and for application in geodesy and geophysics. Multidisciplinary study of the variations in the Belgrade mean geographic coordinates is carried out conjointly with several institutes for geomagnetism, geophysics and seismology. Fundamental research performed at the Observatory in the astronomical spectroscopy finds its application in the physics and technology of plasma and its laboratory sources as well as in the physics and technology of thermonuclear fusion and the light sources.

Considerable part of the Observatory's researches is achieved through fruitful international cooperation. This is evidenced by many joint papers of our and foreign authors. In addition to direct cooperation, realized with a large number of domestic and foreign institutions, the Observatory is a member of several international services while participating in many research programmes under the auspices of the International Astronomical Union.

Among its key supports in the scientific and research activity is the Observatory's library, possessing the richest holdings of astronomical literature in the country: over 4.000 periodicals and 10.000 books.

The Observatory is the editor of *Bulletin de l'Observatoire Astronomique de Belgrade* (founded in 1936), dedicated to publishing the scientific articles and professional papers, and of *Publications de l'Observatoire Astronomique de Belgrade* (founded in 1947) containing chiefly monographs or conference proceedings. The exchange of these editions is effected with about 400 scientific institutions, more than 350 of them from abroad.

To provide a broader insight into the Observatory's interest subjects and activities presented herein is also a list of lectures and seminars having been held at the Observatory in the period 1980-1990.

Considering the thematic and phenomenological diversity of the Observatory's scientific and research activity, which is in steady growth, we hope that the publication thus arranged will, on one hand, furnish useful information to those interested in the current research pursued at this Observatory and, on the other, secure the necessary information to those wishing to better comprehend the development of astronomy on this soil.

Readers interested in more detailed survey of the development and of scientific activity of the Observatory since its foundation in 1887 to our days may refer to the "Publications de l'Observatoire astronomique de Belgrade" No. 36 — "The Hundred Years of Astronomical Observatory in Belgrade".

Editors

PREDGOVOR

Publikacija „Astronomska opservatorija u Beogradu — Aktivnosti i kratki sadržaji radova (1980–1990)“ ima za cilj da pruži potpuniji uvid u oblasti i sadržaje najnovijih istraživanja vršenih na ovoj opservatoriji.

Iako vrlo raznovrsna, aktivnost na Opservatoriji se može grupisati u sledeće istraživačke celine:

- fundamentalna astrometrija
- Zemljina rotacija
- dinamička i statistička istraživanja nebeskih tela
- astrofizička istraživanja.

Najveći deo naučno-istraživačke aktivnosti Opservatorije čini prikupljanje sopstvenih posmatračkih podataka, njihova stručna i naučna obrada, kao i dostavljanje dobijenih rezultata međunarodnim centrima. Ostalu aktivnost čine teorijska istraživanja u astrometriji, astrofizici i srodnim naučnim oblastima (fizici plazme, teorijskoj mehanici), kao i obrada posmatračkih podataka dobijenih iz drugih astronomskih centara.

O značaju rada Astronomske opservatorije govori činjenica da ona jedina u zemlji vrši stalna posmatranja nebeskih tela neophodna za sastavljanje zvezdanih kataloga i astronomskih efemerida, za definisanje nebeskog kvazi-inercijalnog koordinatnog sistema, za određivanje vremena i geografskih koordinata, za izučavanje Zemljine rotacije i primene u geodeziji i geofizici. Multidisciplinarna istraživanja promena srednjih geografskih koordinata Beograda vrše se zajedno sa više instituta iz oblasti geomagnetizma, geofizike i seizmologije. Fundamentalna istraživanja koja se na Opservatoriji vrše u oblasti astronomske spektroskopije nalaze primenu u fizici i tehnologiji plazme i njenih laboratorijskih izvora, kao i u fizici i tehnologiji termonuklearne fuzije i izvora svetlosti.

Značajan deo astronomskih istraživanja na Opservatoriji ostvaruje se u okviru plodne međunarodne saradnje. O tome svedoči veliki broj zajedničkih radova domaćih i stranih autora. Pored neposredne saradnje koju ostvaruje sa velikim brojem ustanova u zemlji i inostranstvu, Opservatorija je član nekoliko međunarodnih službi, a u okviru Međunarodne astronomske unije učestvuje u više istraživačkih programa.

Jedan od značajnih oslonaca naučno-istraživačke aktivnosti je biblioteka Opservatorije, koja poseduje najbogatiji fond astronomske literature u zemlji: preko 4.000 naslova periodike i 10.000 knjiga.

Opservatorija izdaje *Bulletin de l'Observatoire astronomique de Belgrade* (osnovan 1936. godine) u kome se štampaju naučni i stručni radovi, i *Publications de l'Observatoire astronomique de Belgrade* (osnovane 1947. godine) koje sadrže monografije ili zbornike radova. Razmenu svojih izdanja Opservatorija vrši sa oko 400 naučnih institucija, od kojih sa više od 350 u inostranstvu.

Da bi se stekao širi uvid u interesovanja i aktivnosti na Opservatoriji u ovoj Publikaciji je dat i pregled predavanja i seminara održanih na Astronomskoj opservatoriji u periodu 1980–1990. godine.

S obzirom na tematsku i pojavnu raznovrsnost naučno-istraživačke aktivnosti Astronomске opservatorije, koja je u stalnom porastu, nadamo se da će ovako priredjena publikacija, s jedne strane, pružiti korisne informacije zainteresovanima za savremena istraživanja koja se vrše na Opservatoriji u Beogradu, a sa druge, obezbediti potrebne podatke onima koji žele da bolje sagledaju razvoj astronomije na ovom tlu.

Čitaocima koji su zainteresovani za detaljniji pregled razvoja i naučne aktivnosti Opservatorije od njenog osnivanja 1887. godine do danas preporučujemo Publikaciju br. 36 „Sto godina Astronomске opservatorije u Beogradu“.

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1. BIBLIOGRAPHY OF STELLAR CATALOGUES AND MAPS 1. BIBLIOGRAFIJA ZVEZDANIH KATALOGA I KARATA

B. M. Ševarlić, G. Teleki: *Katalozi paralaksi, sopstvenih kretanja i radialnih brzina*, VII Kongres matematičara, fizičara i astronoma Jugoslavije, Saopštenja, Budva-Bečići, (1980), III-12.

B. Ševarlić, G. Teleki, Z. Knežević: *Bibliography of the photographic catalogues of star positions*, in G. Teleki, B. Ševarlić (eds.), *Epitome fundamentorum astronomiae, Pars II, "Photographic catalogues and charts of star positions"*, Publ. Obs. Astron. Belgrade **29** (1982), 71-97.

B. Ševarlić, G. Teleki, Z. Knežević: *Bibliography of stellar atlases, maps and charts*, in G. Teleki, B. Ševarlić (eds.), *Epitome fundamentorum astronomiae, Pars II, "Photographic catalogues and charts of star positions"*, Publ. Obs. Astron. Belgrade **29** (1982), 99-124.

B. M. Ševarlić, G. Teleki: *Epitome fundamentorum astronomiae III — Catalogues of Stellar Parallaxes, Proper Motions and Radial Velocities*, Hvar Obs. Bull. Suppl. **6** (1982) 1, 123-125.

O. Atanacković: *Le troisième volume d'Epitome fundamentorum astronomiae*. Bull. Inform. CDS **28** (1985), 15-16.

The plans for the third volume of the "Epitome fundamentorum astronomiae" are described. The volume deals with catalogs on radial velocities, parallaxes and proper motions.

G. Teleki, I. Pakvor: *Digital designations of catalogues and surveys of star positions (Series I)*, Publ. Astron. Obs. Belgrade **140** (1989), 131-140.

Digital designations for first 60 catalogues and surveys of star positions are given. The designations contain 16 information groups with a total of 50 digits for observational catalogues and 10 groups with a total of 36 digits for other catalogues (derived, fundamental) and surveys.

B. Ševarlić, G. Teleki, O. Atanacković-Vukmanović, I. Pakvor: *Bibliography of catalogues and papers on parallaxes*, Publ. Obs. Astron. Belgrade **40** (1990), 79-128.

A comprehensive list of catalogues and articles on parallaxes, containing 763 bibliographical entries is given.

B. Ševarlić, G. Teleki, I. Pakvor, O. Atanacković-Vukmanović: *Bibliography of catalogues and papers on proper motions*, Publ. Obs. Astron. Belgrade **40** (1990), 129-238.

Bibliography of catalogues and articles on proper motions containing 1617 entries is given.

B. Ševarlić, G. Teleki, O. Atanacković-Vukmanović, I. Pakvor: *Bibliography of catalogues and papers on radial velocities*, Publ. Obs. Astron. Belgrade **40** (1990), 239-285.

Bibliography of catalogues and articles on radial velocities containing 686 entries is given.

2. DEVELOPMENT AND HISTORY OF ASTRONOMY

2. RAZVOJ I ISTORIJA ASTRONOMIJE

S. Sadžakov: *Influence of the progress in science and technology in astrometry*, Bull. Applied Math. (BAM), Budapest, **54** (1980), 85-90.

The accuracy of astrometric measurements has achieved a high degree. Astrometry is used today for the purpose of studying the nonuniformities in the Earth's rotation and in the Universal Time, as well as the terrestrial polar motion; attempts are done in order to notice movements of the continents, to investigate fine effects of various motions of the Earth. New directions in technology make the field of astrometric application more extensive, so that a new era in astrometric development begins which lies in the field of fundamental astrometry.

M. S. Dimitrijević: *Milutin Milanković and an attempt for explaining Michelson-Morley's experiment*, Dijalektika **15** (3-4), Beograd, (1980).

Milutin Milanković, famous astronomer, mathematician and geophysicist, whose name bears a crater on the invisible side of the Moon, the first Serbian doctor of technical sciences, of same age as Einstein, the first lecturer of the Relativity theory at the University of Beograd, did not accept immediately some of the Einstein's ideas. He published two papers in which he tried to explain the negative result of the Michelson-Morley's experiment in the framework of the classical mechanics, considering that relativistic interpretation can be replaced "without a collision with the experience" starting with another set of assumptions. These two papers are presented and reviewed.

G. Teleki: *O astronomskoj aktivnosti u periodu 1660-1880*, VII kongres matematičara, fizičara i astronoma Jugoslavije, Saopštenja, Budva-Bečići, (1980), III-12.

G. Teleki: *Astronomija danas i sutra — u svetu i kod nas*, VII kongres matematičara, fizičara i astronoma Jugoslavije, Saopštenja, Budva-Bečići, (1980), III-12.

G. Teleki: *An outlook on future development of the fundamental astrometry*, Zbornik "Zadachi sovremennoj astrometrii v sozdanii inertsial'noj sistemy koordinat", Izd. "Fan", Tashkent, (1981), 362-367.

S. Sadžakov: *Organization of specialized education in our country and the position of astronomy in it*, Publ. Obs. Astron. Sarajevo, 1 (1981), 51-57.

The topic is the idea and the direction of changes in pedagogy and education in this country. Formation of an educational system as a unique system of permanent education which is in accordance with the necessities of our society is mentioned as well:

G. M. Popović: *Aktivnost astronomske opservatorije u Beogradu od 1972. godine do 1981. godine na projektu podizanja visinske astronomske stanice*, Publ. Obs. Astron. Belgrade 31 (1981), 7.

G. Teleki: *Csillagaszat az egyes délszláv területeken a XIX. Század végén és a XX. század elején*, Vasi Szemle, Szombathely, XXXV, évf. (1981), 550.

G. Teleki: *On the instrumentation-observational development of astrometry in Yugoslavia*, Hvar Obs. Bull. Suppl. 6 (1982) 1, 91-97.

Proceeding from the present-day tendencies in astrometry, prospective development trends of astrometry in Yugoslavia, bearings upon instrumentation and observation, are analysed. With regard to the material, technical and manpower capabilities, the continuations with the already existing instruments is suggested, with the proviso, however, their programmes are strictly selected. Yugoslavia should join, in the years ahead, the VLBI stations network and the Hipparcos programme.

G. Teleki: *Astrometrical activity in the period 1600 to 1880*, "Compendium in Astronomy", D. Reidel Publ. Comp., Dordrecht-Boston-London, (1982), 23.

M. Protić, V. Protić-Benišek: *Milutin Milanković i astronomska opservatorija u Beogradu (Milutin Milankovitch et l'Observatoire astronomique à Belgrade)*, Zbornik radova "Život i delo Milutina Milankovića 1879-1979", Naučni skupovi Srpske akademije nauka i umetnosti, knj. XII, Predsedništvo, knj. 3 (1982), 181-190.

Le nom du Prof. M. Milankovitch est très étroitement lié aux tentatives et aux efforts entrepris pour élever à Belgrade un Observatoire astronomique moderne, dont l'équipement coûteux a été commandé et déjà livré.

G. Teleki: *Kozmikus asztrometria: a Hipparcos és Tycho tervek*, Csillagászati Evkönyv 1984, Gondolat, Budapest, (1983), 169.

G. Teleki: *Kozmikus asztrometria*, Letnja škola mađarskih astronoma, Višegrad, (1983), 15.

G. Teleki: *A fundamentalis rendszer problémái*, Letnja škola mađarskih astronoma, Višegrad (1983), 3.

M. S. Dimitrijević: *Milutin Milanković i pokušaj objašnjenja Majkelson-Morlijevog ogleđa*, Matematičko-fizički list **140** (1) (1984/85), 5.

V. Protić-Benišek: *Astronomical Observatory in Belgrade during 1941-1945*, VII Nac. konf. jug. astr. Beograd 1984, Publ. Astr. društva Ruđer Bošković **4** (1985).

M. S. Dimitrijević, A. Tomić: *Radovan Danić — popularizator astronomije: I — Štampani radovi*, VII Nac. konf. jug. astr. Beograd 1984, Publ. Astr. društva Ruđer Bošković **4** (1985), 41.

A. Tomić, M. S. Dimitrijević: *Radovan Danić — popularizator astronomije: II — Predavanja i kursevi*, VII Nac. konf. jug. astr. Beograd 1984, Publ. Astr. društva Ruđer Bošković **4** (1985), 47.

G. M. Popović: *Prilog pregledu astronomskih izraza s kraja 18. stoleća u slavensko-srpskom jeziku*, VII Nac. konf. jug. astr. Beograd 1984, Publ. Astr. društva Ruđer Bošković **4** (1985), 111.

V. Trajkovska: *A note on Copernicus from 1837*, VII Nac. konf. jug. astr. Beograd 1984, Publ. Astr. društva Ruđer Bošković **4** (1985), 127.

This paper contains description of proposal dating from 1837 to build a monument to N. Copernicus.

Dj. Teleki, O. Atanacković: *Rast znanja o astronomskoj refrakciji*, VII Nac. konf. jug. astr. Beograd 1984, Publ. Astr. društva Ruđer Bošković **4** (1985), 151-155.

S. Sadžakov, M. Dačić: *Istorijski razvoj zvezdanih kataloga u svetu i kod nas*, VII Nac. konf. jug. astr. Beograd 1984, Publ. Astr. društva Ruđer Bošković **4** (1985), 181.

V. Kršljanin: *Contemporary cosmology and philosophy (Some aspects of relationships and possibilities of overcoming the present difficulties)*, Publ. Obs. Astron. Belgrade **33** (1985), 107.

Experimentally proved and uncontrovertable part of contemporary cosmological theories is considered in the feed-back with the philosophical principles, especially with the principles of materialistic dialectics. A survey is presented of ideas and facts which are, according to the author, most relevant for this relation (definition of the subject of cosmology, relation of cosmology to other fundamental fields of physics; relation of the scientific cosmology to the old prejudiced ideas, especially in connection with infinity; vulgar-materialistic superficiality and creationistic speculations).

Most attention is paid to some latest theories and results (instability of proton; inapplicability of energodominancy to actual polarisation of vacuum, which resulted in de Sitter-Starobinsky solution without initial singularity)

which, together with heuristic philosophical principles, served as the basis for suggesting the solutions of some problems and for the possibility to consider relations of cosmology and philosophy more systematically.

S. Ninković: *On Astrophysics Teaching in the Secondary Schools*, Publ. Obs. Astron. Belgrade, **33** (1985), 116.

The author presents his own three-year-long experience in astrophysics teaching at a Belgrade secondary school. Special attention is paid to the interest expressed by pupils in this subject and, their, in recent time, increased interest in performing their professional praxis in the field of astrophysics.

G. Teleki: *Growth of the knowledge of stellar positions*, Bull. Obs. Astron. Belgrade **135** (1985), 40-44.

An analysis is performed of the growth of the number of catalogues of star positions, the number of the catalogue positions, as well as the accuracy of the observational and fundamental catalogues. One of the conclusions is that the accuracy has been increasing faster than the number of catalogue positions and also faster than the number of the stars in the fundamental catalogues (FC-NFK-FK3-FK4 series).

G. Teleki: *Bibliography of papers of the Belgrade Astronomical Observatory research associates published in the period 1980-1983*, Bull. Obs. Astron. Belgrade **135** (1985), 64-70.

In the four years period 1980-1983 the researching results of the present and retired associates of the Belgrade Astronomical Observatory were published under 205 titles (articles, notes, abstracts, observations data) in a number domestic and foreign periodicals and editions.

G. Teleki: *A Kozmikus Csillagászat Fejlődése*, Fizikai Szemle, Budapest, (1986), 129.

G. Teleki: *The need for better co-operation and intercomparison in fundamental astrometry*, in "Astrometric Techniques", H. K. Eichhorn and R. J. Leacock (eds.), (1986), 749-755.

The present status and practice in the fundamental astrometry are analysed, and relying upon the findings the author suggests the organization of an international action aimed at achieving better co-operation in the star position observations and celestial reference system determinations, as well as performing the intercomparison of the different techniques and methods.

M. Djokić: *How the Observatory of the High School in Beograd was founded*, "Vasiona", Revue d'Astronomie, **8** (1987), 3-7.

The history of the actions lead by Milan Nedeljković from 1887 to 1891 which resulted by the foundation of the Astronomical and Meteorological observatory in Beograd is presented.

M. Djokić: *How the instruments for the Observatory of the High School and the University of Belgrade were obtained*, "Vasiona", Revue d'Astronomie 8 (1987), 91-95.

It is described how the astronomical instruments of the Belgrade High School and University observatory were obtained from reparation after First world war.

V. Protitch-Benishek: *Centenary of the Astronomical observatory in Belgrade*, Vasiona, 3-4 (1987), 64-70.

The history of the Astronomical observatory in Belgrade is presented.

G. Teleki: *Bibliography of papers of the Belgrade Astronomical observatory research associates published in the period 1984-1986*, Bull. Obs. Astron. Belgrade 137 (1987), 91-98.

Bibliography of papers of the Belgrade astronomical observatory research associates published in the period 1984-1986 is presented and analyzed.

S. Tolchel'nikova-Murri, S. Sadžakov, M. Dačić, Z. Cvetković: *The present situation with absolute methods of observations in fundamental astronomy*, Colloq. 100 IAU, Beograd, (1987).

M. S. Dimitrijević: *II workshop: Astrophysics in Yugoslavia*, Bull. Obs. Astron. Belgrade 139 (1988), 72.

M. Djokić: *Belgrade University observatory between 1924 and 1926*, IX Nacionalna konferencija astronoma Jugoslavije, Zbornik rezimeza, Sarajevo, (1988), 42.

The data concerning the Observatory of Belgrade University between 1924 and 1926 are presented. That time is characterised by the division of the Observatory between an astronomical and meteorological one as well as by the constituting of the Astronomical Observatory as a separate establishment.

M. B. Protitch, V. Protitch-Benishek: *Data revision of the Babylonian and some Arabian lunar and solar eclipses used in the Newcomb's researches*, IX Nacionalna konferencija astronoma Jugoslavije, Sarajevo, (1988).

On the basis of Ptolomy's original manuscripts concerning Babilonian-Hellenic observations of lunar eclipses and analysing some Arabian notes about solar and lunar eclipses — for which S. Newcomb determined considerable deviations from the appropriate theory — the re-analysis of his results and conclusions was undertaken. The results of ancient data revision are also based on Newcomb's alternative presumption that such discrepancies are caused by one or more unknown long-term inequalities in the motion of the Moon. A quantitative result of analyse of ancient eclipse observations unambiguously indicates that these observations are, by no means, to be rejected. Of course, if they are interpreted in an appropriate way.

M. Mitrović, J. Arsenijević, I. J. Pakvor: *1987 — the hundredth year of Belgrade astronomical observatory life time*, Publ. Astron. Obs. Beograd **36** (1989), 13–22, (srpskohrvatski).

The activities concerning hundred years anniversary celebration are presented.

B. Ševarlić, J. Arsenijević: *One hundred years of activity of Belgrade Astronomical Observatory*, Publ. Obs. Astron. Belgrade **36** (1989), 25–37, (srpskohrvatski).

The short report about the foundation and scientific activity of Belgrade Astronomical Observatory during one hundred years of its life is presented.

R. Grujić: *Latitude group of Belgrade Astronomical Observatory*, Publ. Obs. Astron. Belgrade **36** (1989), 41–44, (srpskohrvatski).

A short review on the work on the geographic latitude determination for Belgrade from the beginning (in 1947) until nowadays is given. An information on the programme of latitude derivation resulted from the changes done in the framework of the service itself, as well as in the framework of the IAU (MERIT) is given. It is also given another information concerning the state in the service at the moment of introducing of the new technic in the world. Furthermore, we inform on the results of comparison programme observations aimed at the declination determination for zenith stars. The results are positive and in such a way they indicate that such instruments should be also used in the future for these purposes, both in Yugoslavia and throughout the world. A short review on the development of the service viewed in the light of the accuracy of the latitude determination and of the declination determination for zenith stars, as well as one on the service direction in the course of time, is presented.

G. M. Popović, D. J. Zulević: *Double stars Group*, Publ. Astron. Obs. Belgrade **36** (1989), 51–62, (srpskohrvatski).

S. Sadžakov: *Work on Meridian Circle of the Belgrade Astronomical Observatory*, Publ. Obs. Astron. Belgrade **36** (1989), 63–71, (srpskohrvatski).

The review of the activity on the Meridian Circle of the Belgrade Astronomical Observatory is presented. The instrument rectification, the results of the investigation of vital parts of the instrument, the first observations as well as the results of the observations during last twenty years are described. Also, some data about the members of the group and their scientific results are given. The future work is mentioned too.

M. Mijatov, V. Trajkovska: *Activity of the Absolute Declination Group*, Publ. Astron. Obs. Belgrade **36** (1989), 71–81, (srpskohrvatski).

In this paper is presented the activity of the Group of Absolute Declinations since its formation in 1960 until nowadays. The main task of the group has been observation with the Large Vertical Circle. This instrument was received

from Germany after the first World War as a result of the war reparations, but because of lack of money it was not mounted before 1960. However, the regular observations were initiated as late as in 1976 due to serious problems, at first with the pavilion, itself, and later on because of technical disadvantages of the instrument. The instrument was prepared for observations as late as after a detailed reconstruction done by the chief engineer of Pulkovo Observatory, D. S. Usanov in late 1974. The reconstruction comprised changes concerning the functioning of the vertical axis and of the horizontal one. During 1976–1980 an absolute catalogue comparing 308 northern stars (declination zone $+65^{\circ}$ – $+90^{\circ}$) from FK4 and BS catalogues was compiled. All the stars were observed both in the upper and lower culminations. The average number of observations per star was 10. The analysis is still being done. During the period 1983–1985 213 stars from FK4 catalogue were observed (declination zone -30° – $+90^{\circ}$) by use of the absolute method. A major part of the observations was carried out in the Küstner series. All the stars satisfying $\delta > +60^{\circ}$ were observed in the lower culmination, too. The average number of observations per star was 8. The analysis is still being done. Since 1982 meridian observations of the major and minor planets have been done by use of the quasiabsolute method and of the relative one. In addition to the observations an extended refraction research has been done. This kind of research has been mostly done by Dr G. Teleki, who was Chairman of the Working Group for the Study of Astronomical Refraction of Commission 8 of the IAU since its foundation in 1971 until his death in early 1987. Two parts of a multivolume edition of the bibliography of star catalogues "Epitome fundamentorum astronomiae" have been published and the third part is in preparation. In addition to the mentioned work the members of the group have dealt with testing of the instruments and equipment, with the problems of latitude and climatology, as well as with history, development and teaching astronomy. In the future the observations will be continued and in addition to the already existing ones other actual programmes of international importance, which can be done with the instrument, will be accepted.

I. J. Pakvor: *Activity of absolute right ascensions division*, Publ. Astron. Obs. Beograd **36** (1989), 83–87, (srpskohrvatski).

A complete history of the activity of Absolute Right Ascensions Division is given. Development of the Division is very close to the development of the Large Transit Instrument and its investigations. One of the most important point of this development is the foundation of vacuum meridian marks, an international recognized contribution.

V. Protić-Benišek: *Fifty years of activity: minor planets, comets and satellites department of Belgrade Astronomical Observatory*, Publ. Obs. Astron. Belgrade **36** (1989), 89–96, (srpskohrvatski).

This paper presents a review of the scientific and observational work in the Department of minor planets, comets and satellites since 1935 till today at the Astronomical Observatory of Belgrade.

J. Arsenijević: *Astrophysical Group of the Astronomical Observatory*, Publ. Obs. Astron. Belgrade **36** (1989), 97–101, (srpskohrvatski).

The activity of Astrophysical Group since its foundation in 1960. is briefly presented. Its scientific work has been covering three topics: physics of variable stars, solar physics and spectroscopy of astrophysical plasma. Short note about the future development has been given.

D. Petrović, J. Arsenijević: *The Observatory library*, Publ. Obs. Astron. Belgrade **36** (1989), 103–106, (srpskohrvatski).

The main data about the Observatory library, the richest astronomical library in Yugoslavia, are presented.

M. Djokić: *How the Observatory of the High School in Belgrade was founded*, Publ. Obs. Astron. Belgrade **36** (1986), 143–151, (srpskohrvatski).

The foundation of the Belgrade High School Observatory is described and some characteristic archives' documents are presented.

V. Protić-Benišek, M. Djokić: *Dr V. V. Michkovitch and his election at the Belgrade faculty of philosophy in 1925*, Publ. Obs. Astron. Belgrade **36** (1989), 153–158.

Professor and Academician Dr. Vojislav V. Michkovitch was born in Fužine, Croatia, on 18th January 1892. The following year his parents moved to Serbia, where he graduated from high school in 1910 (Novi Sad) and took up his studies in Budapest and Göttingen. At the end of World War I, as one of the survived warriors of famous Serbian "students battalion", was sent to France where he graduated studies in astronomy in 1919 and obtained the position of an assistant of the Observatory in Marseille. Then, in 1922 he joined the staff of the Nice Observatory. He got Doctor's degree in 1924 on the thesis "Etudes de Statistique stellaire" (Study on Stellar Statistics). In 1926 he came back to Yugoslavia and was appointed professor of Practical Astronomy at the University of Belgrade. By his initiative a modern Astronomical observatory was erected in Belgrade in 1932. In 1939 he became elected regular member of the Serbian Academy of Sciences (from 1929 he was corresponding member), and soon, the General Secretary of this institution. He had become the member of International Astronomical Union in 1935. During World War II professor Mishkovitch was imprisoned by Gestapo.

His principal concerns were minor planets, especially the identifications of those insufficiently observed. In that scope he published a good number of studies and articles. He was a founder of the Astronomical Institute of Serbian Academy of Sciences. Also, he initiated and was editor-in-chief for a lot of scientific publications. Among them worth to mention are: "Annuaire", which cover ephemeris of 240 stars for International Time Service, "Bulletin de l'Observatoire Astronomique de Belgrade", and others. In his final years he turned his attention to the history of astronomy and his several studies in this field were published by Serbian Academy of Sciences. He died on 25 November 1976 at the age of 85.

I. J. Pakvor: *An episode from the history of the foundation of modern astronomical observatory in Belgrade*, Publ. Astron. Obs. Beograd **36** (1989), 159–165, (srpskohrvatski).

Sixty years ago an attempt was done to build modern Astronomical Observatory outside of urban locality, on the mountain Fruška gora, 70 kms north-west from Belgrade, at place called Zmajevac. A group of eminent professors from Belgrade University entered into negotiations with local authorities, unfortunately without positive solution.

G. M. Popović: *From the observer's notebook of P. Djurković*, Publ. Obs. Astron. Belgrade **36** (1989), 165–176, (srpskohrvatski).

M. Djokić: *The archives' documents about Belgrade High School and University Observatory in the period 1887–1924*, Publ. Obs. Astron. Belgrade **36** (1989), 177–326, (srpskohrvatski).

The selection of archives documents about Belgrade High School and University Observatory from time of its foundation in the 1887 until 1924 — the year of dividing the Observatory into Astronomical Observatory and Meteorological Observatory — were presented.

G. Ivanišević, N. Djokić: *Bibliography of the papers published by Belgrade Astronomical Observatory*, Publ. Obs. Astron. Belgrade **36** (1989), 333–397, (srpskohrvatski).

M. S. Dimitrijević, A. Kubičela, J. Arsenijević, V. Kršljanin: *Position of astrophysics at the Astronomical observatory in Belgrade*, III Seminar „Astrofizika u Jugoslaviji“, Zagreb, (1989), 17.

S. Sadžakov, S. A. Tolchel'nikova-Murri: *A contribution to the problem of the choice of observational methodics and international cooperation in fundamental astrometry*, Problemy postroeniya koordinatnykh sistem v astronomii, GAO AN SSSR, Leningrad, (1989), 79–87.

In order to make the international cooperation in fundamental astrometry efficient it is necessary to solve the two following problems:

1. To explain the role of absolute methods of reference frame formation as means to divide the observed relative motions of celestial bodies into the own ones, existing for various observed bodies, and parallactic ones due to the displacements of terrestrial reference objects and of the Earth. This will enable an essential simplification in solving the problem of relationship among various reference frames including also the new ones based on space and radio observations.
2. To extend the compilation methodics of the fundamental catalogue on the basis of a suitable planning of observations for the following epoch. Observations of such kind can be organised on the basis of optical services of terrestrial rotation.

V. Protitch-Benishek: *Astronomical photography in Serbia*, Publ. SANU, No. 69, (1990).

3. INSTRUMENTS AND DATA REDUCTION METHODS

3. INSTRUMENTI I METODI OBRADJE PODATAKA

T. Sotirović, M. S. Dimitrijević: *Problem analize i sinteze trakastih vodova*, 23 ETAN u pomorstvu, Zadar 1981, 272.

Lj. Varga, V. Protić-Benišek: *Transistorised servo-regulator of the Askania astrograph drive mechanism of the Belgrade Observatory*, Proceedings of the National Conference of Yugoslav astronomers, Publ. Obs. Astron. Sarajevo 1 (1981), 153-155.

After one serious defect of the centrifugal servo-regulator in 1977, it was decided to remove it and to equip the instrument with DC electromotor drive with a transistorized control system. During 1977 an experimental drive was constructed. It was found that this drive system had a satisfactory stability over long time intervals. This is important in view of the instrument having constructive deficiencies, especially concerning its balance system.

L. A. Mitić: *Investigation of the level division inequalities with an extrafocally adjusted collimator*, Bull. Obs. Astron. Belgrade 131 (1981), 9-12.

Graduation of two astronomical 1" levels has been investigated from close distance (4.7 m) with a collimator (8/100 cm) whose micrometer was adjusted extrafocally by 32 cm. High precision of settings of the level graduation lines (mean error of settings ranged from $\pm 0''0020$ to $\pm 0''0014$) permitted the inequalities in the division values to be firmly established. These inequalities, however, rarely exceed $\pm 0''02$.

V. Trajkovska: *An analysis of the division errors of the Belgrade Large Meridian instrument*, Publ. Astron. Obs. Sarajevo 1 (1981), 85.

An account is given of the results of investigation of the circle division errors of the Belgrade Observatory Large Meridian instrument. By the linear correlation method, interrelation of the circle corrections, found from the investigations carried out in 1966, 1968 and 1977, is established. In employing the spectral analysis method (Blackman-Tukey method) a periodic component with 2° period has been identified, supposed to be a consequence of the way of circle manufacturing.

A. Kubičela, M. Rakić: *Fotodioda PS-100-30 kao senzor položaja u astronomiji*, Saopšteno na VI Nacionalnoj konferenciji jugoslovenskih astronoma, Hvar, 1983.

Z. Stančić, M. Mijatov: *Nova određivanja kolimacije i savijanja na VMK AO u Beogradu*, VIII Kongres MFAJ i VIII Nacionalna Konf., Priština, (1985).

Dj. Bozhichkovich: *An Efficient Method of Determining and Removing the Inclination of the Microscope-Micrometers*, Astron. Tsirk. No. 1395 (1985), 4-5.

The use of plane-parallel glass is suggested for determining and removing the inclination of the microscope-micrometers.

A. Kubičela, M. Rakić: *Photodiode PS-100-30 as a position sensor in astronomy*, Publ. Obs. Astron. Belgrade **33** (1985), 23.

Position-sensing photodiode PS-100-30 has been preliminarily tested as the position encoder at a spectrogram measuring machine. It has been found that it would be necessary to keep determining the calibration constants as well as some systematic corrections depending on the position. Only taking care of such precautions the micrometer accuracy might be achieved.

V. Trajkovska: *Investigation of the graduation error of the Belgrade Meridian Circle*, Bull. Obs. Astron. Belgrade **136** (1986), 126.

Account is given of the organization and analysis of investigation of the graduation of the Belgrade Meridian Circle performed in 1977. Measurements are made at half-degree spacing, Bruns' method having been applied. Inquiry is made for possible temperature effects on the measurements.

D. Olević, S. Šegan and R. Pavlović: *Accuracy of the astrographic positions obtained with the Belgrade short-focus astrograph*, Bull. Obs. Astron. Belgrade **136** (1986), 36–39.

By analyzing astrographic position obtained with the Belgrade short-focus astrograph (Zeiss, $D = 16$ cm, $F = 80$ cm) the following has been established: a) Higher accuracy is reached by making reduction according to Turner's method involving 3 coefficients ($T(3)$) than the one associated with the reduction of Turner's equations involving 6 coefficients ($T(6)$); b) Considerably higher accuracy is reached in declination $|\Delta\delta| = 0''3 \pm 0''3$ in comparison with the one in right ascension $|\Delta\alpha| = 0''7 \pm 0''7$, attributable, in the authors' opinion, to defects in the measuring engine; c) Chief prerequisite for expecting optimum results lies in such a selection of reference stars that the object is placed not beyond 43 arc minute from their gravity centre, and d) The plate ought to be measured in two positions differing by 180° .

Z. Stančić, M. Mijatov: *Variations of collimation and flexure of the Belgrade Large Meridian Circle under the daytime conditions*, Bull. Obs. Astron. Belgrade **137** (1987), 85–90.

Results of the laboratory examination of the collimation and flexure constants of the Belgrade Large Meridian Circle (LMC) in the periods 1977–1980 and 1984–1985 are presented. Thereby are established: significant effects of the medium in which the instrument is placed; significant systematic differences in the measurements made at different hours of the day; significant seasonal variations; a difference between the laboratory evaluations of these quantities and their values resulting from the regular star observations; and a difference between the values obtained in the two periods. The measuring accuracy in the second period was twice better than the one in the first period.

B. Jovanović: *An approximation of tabulated function*, Publications de l'Institut Mathématique, Nouvelle série, tome **41** (55) (1987), 143–148.

Using a recurrent approach a method for approximate analytical representation of tabulated function as the sum of linear function, harmonics and

pairs of exponential functions is derived. The method is demonstrated by two examples.

B. Jovanović: *An analytical representation of ephemeris data*, *Celestial Mechanics* **45** (1989), 317–320, Kluwer Academic Publishers.

An algebraic method for the resolution of tabulated function into a class of elementary functions is examined on the high precision ephemeris data from the JPL DE 200.

S. Sadžakov: *Behaviour of second levels in the field of horizontal temperature gradients*, *Bull. Obs. Astron. Belgrade* **140** (1989), 31–36.

On the basis of level examinations, done in a laboratory and during star observations, a nonnegligible temperature influence on the measuring results is found. For practical purposes, such as reductions of observational materials, expressions are proposed which should be taken into account in coordinate derivations of observed celestial bodies and, in our case, in the derivation of the geographic latitude.

S. Sadžakov: *Behaviour of levels in the conditions of asymmetrical heating*, *Bull. Obs. Astron. Belgrade* **142** (1990), 79–81.

The subject of the paper is the earlier and present importance of second level examinations. The data of a general analysis are presented. They indicate not only some problems of second levels, but also give informations on level triers whose properties are weakly known at present.

4. ASTROMETRY

4. ASTROMETRIJA

4.1. Large Meridian Circle

4.1. Veliki meridijanski krug

4.1.1. *Determination of Star Positions and Proper Motions*

4.1.1. *Određivanje položaja i sopstvenih kretanja zvezda*

M. Dačić, K. G. Gnevisheva: *Preliminary results of an investigation of the declination system of the Belgrade Observatory Meridian Circle*, *Izv. GAO AN SSSR Pulkove* **197** (1980), 40–42.

The declination system of the meridian circle in Belgrade was obtained from twenty two series of observations of fundamental stars with declinations from -25° to $+90^\circ$ and including lower culminations to 65° . The systematic errors $\Delta\delta_s$ are due mainly to the horizontal flexure of the instrument which during some rights is as large as $2''-3''$. Residuals of the observed declinations from those of the fundamental catalogue on the average have a total amplitude of about $0''.5$. The position of the instrument (circle-east, circle-west) does not significantly affect the system of the instrument.

S. Sadžakov, G. Kosin, V. A. Fomin: *An estimation of proper motions of stars of the compiled catalogue of latitude stars and AGK3*, Izv. GAO AN SSSR Pulkove 197 (1980), 12-16.

On the basis of a comparison with ILS data (observations made during 1899-1972) the $\Delta\mu_\alpha$ systematic errors (Table 3) were derived for proper motions of the compiled catalogue of latitude stars and AGK3. The data in the table are given as 10 year proper motions in 0''001.

S. Sadžakov, D. Šaletić, M. Dačić: *Properties of the NPZT star catalogue*, VII Kongres MFAJ i V Nacionalna Konf., Bečići, (1980).

S. Sadžakov, M. Dačić, D. Šaletić: *Programme of observations of the catalogue of double and Pulkovo stars with the Belgrade Large Meridian Circle*, VII Kongres MFAJ i V Nacionalna Konf., Bečići, (1980).

S. Sadžakov, D. Šaletić, M. Dačić: *An examination of $\Delta\delta_\alpha$ type systematic errors for the preliminary Belgrade catalogue of NPZT programme stars*, Trudy 21 Astrometr. Konf. SSSR, Tashkent, (1981), 157-160.

The Preliminary Star Position Catalogue has resulted from observations performed with the Large Meridian Circle of Belgrade Observatory during 1972-1978. It is compared with KŠZ, SKŠZ, AGK3 and with Yasuda's preliminary catalogue. On the basis of the obtained results existence of systematic errors in the preliminary Belgrade catalogue, as well as in the PZT latitude observations of various observatories in the northern hemisphere, is apparent.

S. Sadžakov, V. A. Fomin: *On the Belgrade catalogue of the NPZT stars*, Astr. Cirk. AN SSSR, Moskva, 1194 (1981), 7-8.

A survey of the works performed for the NPZT Catalogue is given. The root-mean-square error of a single observation is $\varepsilon_\alpha \cos \delta = \pm 0^s.038$ and $\varepsilon_\delta = \pm 0''.26$. The root-mean-square error of position is $\pm 0^s.015$ and $\pm 0''.10$. The mean observational epoch is 1977.0 and 1976.8.

S. Sadžakov, D. Šaletić, M. Dačić: *Catalogue of NPZT programme stars*, Publ. Obs. Astron. Belgrade 30 (1981), 1-88.

The catalogue of NPZT stars is obtained on the basis of the observational material compiled by use of the Meridian Circle of Belgrade Astronomical Observatory during 1973-1980. It contains 1838 stars with magnitudes $6.5 \leq m \leq 8.5$. The mean epoch of observations is 1977.02 in α and 1978.78 in δ . The rms-error of the right ascension $\varepsilon_\alpha \cos \delta$ is $\pm 0^s.030$ and of declination ε_δ is $\pm 0''.26$. Comparison with the FK4 of about 340 stars yields an error in α of $\pm 0^s.015$ and in δ of $\pm 0''.14$.

S. Sadžakov, D. Šaletić, M. Dačić, V. Trajkovska: *Characteristics of the preliminary results obtained in elaborating the catalogue of NPZT stars*, Publ. Obs. Astron. Sarajevo 1 (1981), 167-172.

Results of the comparison are given of the right ascension and declination of fundamental stars, as obtained from observations undertaken within the elab-

oration of the catalogue of NPZT stars, with the corresponding coordinates in the FK4.

In addition the comparison is accomplished of the coordinates of the programme stars, obtained in the preliminary catalogue of NPZT stars, with those obtained at Moscow, Hamburg and Richmond latitude stations.

The results obtained reveal that the systematic difference of coordinates are affected by the "instrument's system" and there could be discerned the existence of the systematic errors of the $\Delta\alpha_\alpha$ and $\Delta\delta_\alpha$ types.

S. Sadžakov, V. A. Fomin: *A comparison of the AGK3 star catalogue declinations with the results of latitude observations with Zenith-Telescopes and Photographic Zenith Tubes*, Izv. GAO AN SSSR Pulkove **199** (1982), 36–40.

A comparison of the AGK3 catalogue declinations with the declinations obtained from 27 northern sky latitude programs observations during the last 15–20 years is made. The results of the comparison show that the $\Delta\delta_\alpha$ systematic errors may be present both in the declination system of the AGK3 catalogue and in the declinations deduced from latitude observations.

S. Sadžakov, M. Dačić, V. A. Fomin: *An investigation of the systematic errors of the Belgrade NPZT and AGK3 catalogues on the basis of modern PZT observations*, 18 IAU General Assembly, Patras, (1982).

S. Sadžakov, M. Dačić, D. Šaletić, B. Ševarlić: *Results of comparison of the Belgrade and the Bordeaux catalogs of the northern PZT stars*, Bull. Obs. Astron. Belgrade **132** (1982), 7–13.

Results are presented of comparison the NPZT star catalogs compiled in Belgrade and Bordeaux, systematic differences between them derived and analysed with respect to the right ascension, declination, apparent magnitudes and spectral classes.

S. Sadžakov, D. Šaletić, M. Dačić: *Properties of the north PZT star catalogue*, Hvar Obs. Bull. Suppl., Vol. 6, **1** (1982), 99.

Observations of the north PZT stars with the Belgrade Large Meridian Circle have been carried out in the period from June 1973 to May 1980. There were in all 283 observing tours about 16000 recorded transits. The determination of both coordinates, that is, right ascensions and declinations, proceeded simultaneously.

An observing tour lasted at least three hours and at the most five hours. The number of the programme stars observed within the scope of one tour varied from about 60 to about 100, while that of the reference stars amounted to at least 12. The stars of this programme were observed within five zones: (+10, +25), (+35, +38), (+39, +45), (+47, +52) and (+53, +59). The reference stars (owing to their scarcity within the corresponding zones) had to be taken from wider zones than those just indicated.

From the results obtained it follows that the error of a single determination of right ascension is $\varepsilon_\alpha \cos \delta = \pm 0''.038$ and that of declination $\varepsilon_\delta = \pm 0''.26$.

The catalogue, with the corresponding discussion, is due to appear as Volume N. 30 of the Publications of the Belgrade Observatory.

S. Sadžakov, M. Dačić, D. Šaletić: *Programme of observations of the catalogue of double and Pulkovo stars with the Belgrade Large Meridian Circle*, Hvar Obs. Bull. Suppl., Vol. 6, 1 (1982), 101–105.

Criteria are presented of the selection of a double and Pulkovo stars programme, composed in Pulkovo and U.S. Naval Observatory, along with their distribution according to zones. The programme will be observed by relative method with the Belgrade Large Meridian Circle in the period 1981 to 1985. Each star will be observed four times.

S. Sadžakov, M. Dačić: *Variation in time of the parameters ($u + m$) and M_0 of the Belgrade Meridian Circle*, Bull. Applied Math. (BAM), Budapest, 190 (1983), 13–17.

Dependence of the parameters ($u + m$) and M_0 on the time of observation has been investigated using the methods of the correlation analysis.

The hypothesis of absence of a linear correlation between the Bessel constant ($u + m$) and the time of observation, as well as the same hypothesis relating to M_0 (equator point) and the time of observation, has been confirmed in the most of the observed series. The absence of a non-linear correlation has been confirmed with the for lesser number of star series, an indication of how necessary it is to find out the variation in time, as reliable as possible of the quantities ($u + m$) and M_0 for each individual observing night.

S. Sadžakov, M. Dačić, V. A. Fomin: *A comparison of star positions in the Belgrade catalogue with those in the AGK3 on latitude measurements*, Bull. Applied Math. (BAM), Budapest, 151 (1983), 119–126.

The results obtained on the basis of the comparison indicate existence of the systematic errors of $\Delta\alpha_\alpha$ and $\Delta\delta_\alpha$ types which may have a seasonal character in the Belgrade Catalogue of NPZT stars. Systematic errors in the proper motions of the AGK3 stars are also apparent on high declinations.

S. Sadžakov, M. Dačić: *Systematic errors of Belgrade NPZT programme star catalogue*, Bull. Applied Math. (BAM), Budapest, 197 (1983), 121–126.

Results of a comparison — Belgrade NPZT programme star catalogue to six other catalogues, compiled by use of meridian circles of the same, or similar properties are given. Existence of small systematic errors of $\Delta\alpha_\alpha$ and $\Delta\delta_{sp}$ type is found.

S. Sadžakov, M. Dačić, D. Šaletić: *On the catalogue of the stars positions in the NPZT programme*, Astrometr. Astrophys. Kiev 48 (1983), 58–59.

The paper deals with compilation of the catalogue of the NPZT stars in Belgrade. Some characteristics of this catalogue are given. The catalogue has

been already used in compiling the general catalogue of the NPZT stars by Yasuda.

S. Sadžakov, M. Dačić: *Primena korelacione analize na ispitivanje tačaka ekvatora i (u+m) fundamentalnih zvezda merenih sa meridijanskim krugom u Beogradu*, VI Nacionalna Konf., Hvar, (1983).

M. Dačić: *Sistem meridijanskog kruga u Beogradu*, VI Nacionalna Konf., Hvar, (1983).

S. Sadžakov, M. Dačić: *Sistematske greške beogradskog kataloga zvezda programa SFZT*, VI Nacionalna Konf., Hvar, (1983).

S. Sadžakov, M. Dačić, V. A. Fomin: *Investigation of the systematic errors of the Belgrade NPZT and AGK3 catalogues*, Astron. Astrophys. Suppl. Ser. 52 (1983), 455-462.

Systematic errors of the $\Delta\alpha_\alpha$ and $\Delta\delta_\alpha$ types are derived by comparing star positions in the NPZT and AGK3 catalogues with those deduced from the observations made with the PZTs at ten latitude stations.

S. Sadžakov, M. Dačić, V. A. Fomin: *Comparison of the Potsdam PZT catalogue with four NPZT catalogues*, VI Intern. Lohrmann Colloq., Dresden, (1983).

M. Dačić: *Instrument system of the Belgrade Meridian Circle*, Bull. Obs. Astron. Belgrade 134 (1984), 1-8.

Investigation has been executed of the systematic difference "FK4 system minus instrument system" of the Belgrade meridian circle. The data, used in the present analysis, were acquired during two periods — 1973/75 and 1977/78 — by the observation of Küstner series, with a total of about 1000 transits. The data processing was accomplished in two stages. The first stage consisted in the instrument parameters being calculated by the method of least squares. In the second stage ($O - C$) deviations in both coordinates have been determined. The instrument system is presented in the form $\Delta\alpha_\delta \cos \delta$ and $\Delta\delta_\delta$. Thus it was established that the instrument systems at both clamps were close to each other and that the mean instrument system kept steady over several years.

S. Sadžakov, V. A. Fomin, M. Dačić: *Comparison of Tokyo PZT catalogues with AGK3 and with three other independent catalogues*, Sympos. 109 IAU "Astronomic Techniques" Gainesville, Florida, (1984).

S. Sadžakov, M. Dačić: *Značaj određivanja položaja zvezda u okolini radio izvora*, VII Nacionalna Konf., Beograd, (1984).

S. Sadžakov, M. Dačić: *Preliminary results of observations of double stars and the stars near radio sources with the Belgrade Meridian Circle*, 19 IAU General Assembly, New Delhi, (1985).

S. Sadžakov: *Analysis of systematic $\Delta\delta_\alpha$ deviations of GCLS and AGK3 catalogues from 20 catalogues obtained from latitude observations*, 19 IAU General Assembly, New Delhi, (1985).

S. Sadžakov, M. Dačić: *Position determination of stars in the neighbourhood of radio sources*, Bull. Applied Math. (BAM), Budapest, **296** (1985), 149–152.

The forming of the inertial coordinate system implied, at the present-day status of astrometry two stages. In the first stage one achieves what called fundamental system of the mean equator coordinates while in the second stage its absolute rotation is ascertained up to an anticipated accuracy. As a result, an inertial coordinate system is approximated.

S. Sadžakov, M. Dačić, Z. Stančić: *Ocena tačnosti položaja zvezda u katalogu dobijenom pomoću automatskog meridijanskog kruga u Brorfeldu*, VIII Kongres MFAJ i VIII Nacionalna Konf., Priština, (1985).

S. Sadžakov, M. Dačić: *Sistematske greške sopstvenih kretanja u katalogima GC, IKŠZ i AGK3*, VIII Kongres MFAJ i VIII Nacionalna Konf., Priština, (1985).

S. Sadžakov, V. A. Fomin, M. Dačić: *Issledovanie sistematičeskikh oshibok belgradskogo kataloga SFZT*, XXIII Astrom. Konf., Leningrad, (1985).

S. Sadžakov, M. Dačić: *Predvaritel'nye rezul'taty meridiannykh nablyudenij po programmam "dvojnye zvezdy" i "opornye zvezdy v okrestnostyakh radioistochnikov"*, XXIII Astrom. Konf., Leningrad, (1985).

S. Sadžakov: *Analysis of systematic $\Delta\delta_\alpha$ deviations of GCLS and AGK3 catalogues from 20 catalogues obtained from latitude observations*, Bull. Applied Math. (BAM), Budapest, **426** (1986), 1–10.

To enable as dependable an estimate as possible of the quality of positions and proper motions of stars contained in GCLS (IKSZ, Sadžakov, 1978) and AGK3 (1975) catalogues we compared them with their homologues in 20 latitude stars catalogues listed in the enclosed Tables.

S. Sadžakov, M. Dačić, V. A. Fomin: *Investigation of systematic $\Delta\alpha_\alpha$ and $\Delta\delta_\alpha$ type errors of Bucharest NPZT catalogue*, in: Bucharest Catalogue of NPZT Stars, Declination Zone $+49^\circ$ to $+50^\circ$, Equinox 2000.0 (E. Toma, M. Tudor, M. Liculescu), Central institute of physics, Bucharest astronomical observatory, Center for astronomy and space science, Bucharest, (1986), 73–78.

Results are presented of the comparison of Bucharest NPZT Catalogue in the zone $+41^\circ$ to $+63^\circ$ declination with the catalogues obtained from latitude observations with PZTs and meridian circles. Systematic $\Delta\alpha_\alpha$ and $\Delta\delta_\alpha$ errors are stated in both PZT and meridian circle observations. Seasonal effects are prominent in all the cited catalogues, some of the catalogues (Herstmonceux) even having their coordinate origins shifted in reference to the origins of the majority of other catalogues.

Z. Stančić: *Instrumental systems of the Belgrade Large Meridian Circle in the period 1981–84*, Bull. Obs. Astron. Belgrade **136** (1986), 119–125.

Results are exposed of determination of the Belgrade Large Meridian Circle's instrumental systems in right ascension and declination from the Küstner series observations performed in the period 1981–1984. Comparison is also made of the collimation error and of the flexure values as furnished by the Küstner series observations during 1984 to those resulting from the laboratory measurements.

S. Sadžakov, M. Dačić, V. A. Fomin: *Comparison of the Potsdam PZT catalogue with four NPZT catalogues*, Astron. Astrophys. Suppl. Ser. **65** (1986), 379–381.

Comparison is made of the Potsdam PZT star catalogue with four NPZT star catalogues. A clear systematic deviation of the Potsdam catalogue positions with respect to all four catalogues, in addition to the random differences, has been established.

S. Sadžakov, M. Dačić: *Comparison of Tokyo PZT catalogues with AGK3 and with three other independent catalogues*, Astrometric Techniques by the IAU, (1986), 571–580.

Results are presented of the comparison of five Tokyo PZT catalogues with the AGK3 and three independent catalogues obtained with meridian circles.

S. Sadžakov: *Systematic errors in visual and photographic latitude star catalogues*, Astron. Nachr. **308** (1987), 363–374.

The point discussed is the importance of investigation of the systematic errors of $\Delta\delta_\alpha$ and $\Delta\mu_\alpha$ types and their effects on stellar positions as obtained from visual and photographic observations.

S. Sadžakov, M. Dačić, Z. Cvetković: *A catalogue of double stars compiled from observations with the Belgrade Meridian Circle*, Colloq. 100 IAU, Beograd, (1987).

S. Sadžakov: *Investigation of the systematic errors in the Belgrade General Catalogue of Latitude Stars (IKŠZ)*, Sympos. 133 IAU, Prag, (1987).

S. Sadžakov, M. Dačić, Z. Cvetković: *Characteristics of the catalogue containing stars situated in the vicinity of radio sources*, Colloq. 100 IAU, Beograd, (1987).

S. Sadžakov, M. Dačić: *Preliminary results of meridian observations in the framework of the programmes "Double Stars" and "Reference Stars in the Vicinity of Radio Sources"*, Sovremennaya astrometriya, AN SSSR, Leningrad, (1987), 64–66.

The topics is observational programmes of Double stars and stars in the vicinity of radio sources. The distribution of stars in right ascension (every six hours) and declination (every 30°) is presented in a table. The values of the mean errors of star coordinates in FK4, as well as of the quantities $u + m$

and M_0 obtained from observations of double stars and those in the vicinity of radio sources, are presented.

S. Sadžakov, M. Dačić, V. A. Fomin: *An investigation of systematic errors of the Belgrade NPZT stars catalogue within the declination zone 35°-40°*, Izv. GAO AN SSSR, Pulkove **204** (1987), 41-47.

The results of comparison of the Belgrade NPZT Stars catalogue and the AGK3 catalogue with 5 Tokyo PZT stars lists compiled in 1959-1978 reveal some significant systematic $\Delta\alpha_\alpha$ and $\Delta\delta_\alpha$ errors of the Belgrade NPZT stars catalogue within the declination zone 35°-40°.

S. Sadžakov, D. Šaletić: *Systematic differences in positions and proper motions between ILS catalogues and the main astrometric catalogues*, Astron. Astrophys. Suppl. Ser. **74** (1988), 53-61.

Using the results of many authors (see Refs.), we carried out direct comparison of the declination of star pair centres of the IKŠZ (AGK3) catalogue with the declination of star pairs centres obtained by latitude observations on ILS stations.

S. Sadžakov: *Characteristics of the General Latitude Star Catalogue*, Bull. Acad. Serbe Sci. Arts **30** (1988), 11-22.

The values of declinations and proper motions in General Catalogue were derived on the basis of about 36000 star positions, the rms error of their determination from 0''20 to 0''62 with the average being $\pm 0''35$. The rms error of the determination of a single position is $\varepsilon_\delta = \pm 0''08$ and the proper motion $\varepsilon_\mu = \pm 0''005$ with a mean epoch of 1954.44. The systematic differences for the errors in proper motions exist in the AGK3, GC, N30, FK4. The error of determination of $\Delta\delta_\delta$, $\Delta\delta_\alpha$, $\Delta\mu_\alpha$ indicate existence positions and proper motion. Existence of small $\Delta\delta_\alpha$ type systematic errors for the catalogue of the order up to $\pm 0''2$ and $\Delta\mu$ of the order up to $\pm 0''01$ is seen.

S. Sadžakov, M. Dačić: *Preliminary results of observations of double stars and the stars near radio sources with the Belgrade Meridian Circle*, Bull. Acad. Serbe Sci. Arts **16** (1988), 17-22.

Some particulars on the double stars (DS) programme and of the one stars surrounding the radio sources (RS) are presented. Preliminary results of the relevant observations, currently under way, with the Belgrade Meridian Circle, are given.

S. Sadžakov: *Tačnost određivanja položaja zvezda dobijenih posmatranjima sa VMK u Beogradu*, IX Nacionalna Konf., Sarajevo, (1988).

S. Sadžakov, M. Dačić: *Estimate of proper motions for 453 double stars of Belgrade catalogue*, 20 IAU General Assembly, Baltimore, (1988).

S. Sadžakov, M. Dačić, Z. Cvetković, G. Damljanović: *Karakteristike beogradskog kataloga rektascenzija i deklinacija fundamentalnih zvezda (FK4)*, IX Nacionalna Konf., Sarajevo, (1988).

S. Sadžakov, M. Dačić, Z. Stančić: *Accuracy of the corrections determined for FK4 stars*, Bull. Obs. Astron. Belgrade **139** (1988), 7-14.

The results of observations of fundamental stars in series (zones) at the corresponding MC position are presented. The errors are $\varepsilon_{\alpha} \cos \delta = \pm 0^{\circ}022$, $\varepsilon_{\alpha+m} \cos \delta = \pm 0^{\circ}005$ in the right ascension, $\varepsilon_{\delta} = \pm 0''32$, $\varepsilon_{M_0} = \pm 0''08$ in the declination.

S. Sadžakov: *Application of Brosche's method to examinations of coordinate differences for stars of two catalogues*, Bull. Obs. Astron. Belgrade **139** (1988), 14-21.

A short review concerning the method, itself, is presented, as well as the results obtained from the comparison of the IKSZ Catalogue with the FK4, N30 and AGK3 ones.

S. Sadžakov, M. Dačić, Z. Stančić: *Analysis of results obtained from observations with meridian circles in Belgrade and Brorfelde*, Bull. Obs. Astron. Belgrade **138** (1988), 9-13.

Characteristics of the instruments used for the purpose of compilation of the here analysed observational material are given. The systematic errors of $\Delta\alpha$ and $\Delta\delta$ types in the right ascension, declination, magnitude and spectrum are determined.

S. Sadžakov, M. Dačić, Z. Cvetković, Z. Čatović: *Characteristics of the Belgrade double stars catalogue*, Sympos. 141 IAU, Leningrad, (1989).

S. Sadžakov, M. Dačić, Z. Cvetković: *A presentation of the work performed with the Belgrade Large Meridian Circle during the period 1968-1988*, Sympos. 141 IAU, Leningrad, (1989).

R. S. Izmailov, N. G. Litkevich, S. Sadžakov, V. D. Simonenko, T. I. Suchkova, S. A. Tolchel'nikova-Murri, V. L. Turenko: *The comparison of the accuracy of the determination of right ascension by means of transit instruments of different types*, Sympos. 141 IAU, Leningrad, (1989).

S. Sadžakov, S. R. Izmailov, N. T. Litkevich, V. D. Simonenko, S. A. Tolchel'nikova-Murri: *A comparison of the accuracy of the right ascension determination with transit instruments of different types*, Inertial coord. system on the sky, Reidel Publ., (1990), 456.

A special series of observations of the groups of stars performed in Pulkovo, Chile, Kharkov and Belgrade were used to compare the mean errors of the right ascension by means of the method eliminating the influence of the errors

of the source catalogue. The results show the advantage of the small transit instruments over transit circle of the classical type.

S. Sadžakov, M. Dačić: *A catalogue of right ascension and declination of FK4 stars*, Astron. Astrophys. Suppl. Ser. **77** (1989), 411.

This catalogue contains the positions of 576 FK4 stars observed 1981–87. The mean epoch is 1983.90 for α and 1983.84 for δ with mean errors for a single observation of $\pm 0^{\circ}.022$ in α and $\pm 0''.32$ in δ .

S. Sadžakov, M. Dačić, Z. Cvetković, Z. Čatović: *Characteristics of the Belgrade double star catalogue*, Bull. Obs. Astron. Belgrade **141** (1989), 1–5.

The results of the comparison of the Belgrade catalogue to a few others, as well as the systematic errors of the types $\Delta\alpha$, $\Delta\delta$, are presented.

S. Sadžakov, M. Dačić: *Belgrade catalogue of double stars*, Publ. Obs. Astron. Belgrade **38** (1990), 1–110.

In the period between March 1981 and April 1987, 1576 stars were observed in Belgrade during the Double Star Programme. The measurements and the treatment of the observational material were performed by use of the relative method. Both coordinates α and δ were observed simultaneously, on the average every three minutes. The rms error of a single observation of double stars between -30° to $+60^{\circ}$ is $\varepsilon_{\alpha} \cos \delta = \pm 0^{\circ}.026$ and $\varepsilon_{\delta} = \pm 0''.32$.

S. Sadžakov, Z. Cvetković, M. Dačić: *A presentation of the work performed with the Belgrade Large Meridian Circle during the period 1968–1988*, Inertial coord. system on the sky, Reidel Publ., (1990), 489–491.

The work performed with the Belgrade Large Meridian Circle and the results obtained during the last twenty years are presented.

S. Sadžakov, M. Dačić, Z. Cvetković: *A catalog of positions of 290 stars situated in the vicinity of radio sources*, Astron. Journal **101** (1991), 713–733.

With the Large Meridian Circle of the Belgrade Observatory we carried out in the period 1982–1987 visual measurements by using the relative method of the coordinates of 290 stars from 78 parts of the sky situated in the vicinity of radio sources. Each program star was observed on the average 5.5 in α and 5.8 times in δ . The rms-error of a single observation in right ascension is $\varepsilon_{\alpha} \cos \delta = \pm 0^{\circ}.024$ and in declination $\varepsilon_{\delta} = \pm 0''.30$. A comparison between the fundamental stars observed and those from the FK4 yields a position error of $\pm 0^{\circ}.010$ in α and $\pm 0''.13$ in δ .

4.1.2. *Observations of the Sun and Planets*4.1.2. *Posmatranja Sunca i planeta*

S. Sadžakov, M. Dačić, D. Šaletić: *Results of observation of the Sun, Mercury and Venus 1974 to 1979*, Publ. Obs. Astron. Sarajevo **1** (1981), 69–79.

Description is given of the equipment and the procedure of observation, along with the mean ($O-C$) values of the right ascensions and declinations, according to years, and computed corrections to the orbital elements. It is inferred that the quality of the observations is satisfactory.

S. Sadžakov, M. Dačić, D. Šaletić: *Positions of the Sun and inner planets obtained with the Meridian Circle of the Belgrade Observatory*, European Regional Meeting in Astronomy, VI ERMA, Dubrovnik, (1981).

The results of observations of the Sun, Mercury and Venus during the eight years period (1973–1981) are given. The corrections ΔA , $\Delta \delta_0$, ΔL_0 , $\Delta \pi$ and $\Delta \epsilon$ with respective mean square errors are derived.

The mean square error of a single observation, calculated for the equinox, ranges from: $\pm 0''16$ to $\pm 0''40$ and $\pm 0^{\circ}015$ to $\pm 0^{\circ}028$ for the Sun, $\pm 0''16$ to $\pm 0''50$ and $\pm 0^{\circ}026$ to $\pm 0^{\circ}040$ for Mercury and $\pm 0''24$ to $\pm 0''43$ and $\pm 0^{\circ}012$ to $\pm 0^{\circ}036$ for Venus.

S. Sadžakov, M. Dačić, D. Šaletić: *Results of observations of the Sun, Mercury and Venus with the Belgrade Large Meridian Instrument*, Bull. Obs. Astron. Belgrade **132** (1982), 45–53.

The apparent right ascensions and declinations of the Sun and two planets obtained from our observations are compared with the ephemeris positions and the results are given in Tables 1, 2, 3.

S. Sadžakov, M. Dačić, D. Šaletić, B. Ševarlić: *Observations of the Sun and inner planets with the Large Meridian Circle in Belgrade*, Sun and Planetary System, Reidel Publ., (1982), 445–446.

Observed apparent right ascensions and declinations of the Sun and the planets; the corrections of the orbital elements Sun, Mercury, Venus and the errors (σ) of their determination, based on the observations in the period 1975–1981.

S. Sadžakov, M. Dačić, D. Šaletić: *Observations of the Sun, Mercury and Venus with the Belgrade Meridian Circle in the period 1979 to 1981*, Bull. Obs. Astron. Belgrade **133** (1983), 45–50.

The results of observations of the Sun, Mercury and Venus with the Belgrade large meridian instrument in the period from 1979 to 1981, are presented.

S. Sadžakov, M. Dačić: *Observations of the Sun and planets with the Belgrade Large Meridian Circle*, Bull. Obs. Astron. Belgrade **135** (1985), 47–54.

Results are presented of the Sun, Mercury, Venus and Mars observations made with Large Meridian Circle of the Belgrade Observatory in the period September 1981 – November 1983.

S. Sadžakov, M. Dačić: *Nablyudeniya Solntsa i bol'schikh planet na meridiannom krugu v Belgrade*, XXIII Astron. Konf., Leningrad, (1985).

S. Sadžakov, M. Dačić: *Observations of the Sun and inner planets with the Large Meridian Circle Belgrade*, Colloq. 100 IAU, Beograd, (1987).

S. Sadžakov, M. Dačić: *Observations of the Sun and of planets with the Belgrade Meridian Circle*, *Sovremennaya astrometriya*, AN SSSR, Leningrad, (1987), 325–329.

On the basis of the differences $(O - C)_\alpha$ and $(O - C)_\delta$ we determined the corrections of the equinox and equator, as well as some of the corrections of orbital elements for the Earth, Mercury and Venus.

S. Sadžakov, M. Dačić, Z. Stančić: *Results of diurnal measurements for the Sun, Mercury, Venus and Mars obtained in the period 1984–1986*, *Bull. Obs. Astron. Belgrade* **138** (1988), 78–85.

In the paper we present the results $(O - C)_\alpha$ and $(O - C)_\delta$ obtained in the period 1984–1986 in Belgrade from diurnal observations of the Sun, Mercury, Venus and Mars with the large meridian circle "Askania" No 88077, $2r = 190$ mm, $f = 2578$ mm.

M. Dačić, S. Sadžakov, Z. Cvetković: *Observations of the Sun and planets with the Belgrade Large Meridian Circle*, *Bull. Obs. Astron. Belgrade* **140** (1989), 49–53.

Results are presented of the Sun, Mercury, Venus and Mars observations made with Large Meridian Circle of the Belgrade Observatory in the period March 1987 – Sept. 1988.

4.2. Large Vertical Circle:

Determination of Absolute Declinations of Stars and Planets

4.2. Veliki vertikalni krug:

Određivanje apsolutnih deklinacija zvezda i planeta

Dj. Bozhichkovich: *New method of measurement for the corrections determination of the totality of circle diameters*, *Publ. Astron. Obs. Sarajevo* **1** (1981), 93.

Instead of the classical procedure of measurements for the determination of the circle division corrections it is proposed that a uniform rotation be imparted to the circle under investigation. From the registered times of transit of the individual division lines in front of the photoelectrical gadgets, the division lines corrections would be determined by some of the currently existing methods. The efficiency of the method of measurements proposed may be judged from this author's estimate that all the measurements, requisite for the correction determination by Bruns' method of 5400 diameters, associated with 2' circle division, would require only 105 hours of actual measurements.

Dj. Bozhichkovich: *Determination of declinations with a uniformly rotating vertical or meridian circle*, Publ. Astron. Obs. Sarajevo 1, No. 1 (1981), 103.

Instead of the standard method of declination determination, implying a *static* instrument (the vertical or meridian circle), it is proposed that the necessary measurements be performed with the instrument (the tube and the circle as a whole) uniformly *rotating* about its horizontal axis during the star's passage over the field of view. It is estimated that the mean error of a single declination determination, using the method suggested, would be less than $\pm 0''10$.

M. Mijatov, Dj. Bozhichkovich, G. Teleki: *Preliminary results of Determinations of 308 Bright Stars Declinations in the Zone from $+65^\circ$ to -90° obtained with the Vertical Circle of the Belgrade observatory*, Zbornik Zadachi savremenoj astrometri v sazdanu inertsial'noj sistemy koordinat, Izd. Fan, Tashkent, (1981), 154.

M. Mijatov, Dj. Bozhichkovich: *Preliminary results of the flexure investigation of the Belgrade Large Vertical Circle in the period 1976-1979*, Bull. Obs. Astron. Belgrade 132 (1982), 3.

An account is given of the preliminary results of the flexure determinations of the Large Vertical Circle of the Belgrade observatory, carried out regularly under the observing program of bright stars in the period 1976-1979. A satisfactory accuracy of the measurements is stated, except for the year 1976, namely $\pm 0''20$. Of particular importance is the finding that the flexure of our LVC keeps its properties over longer time intervals. More intense investigations of this parameter is recommended.

Dj. Bozhichkovich, M. Mijatov: *Investigation of the divided circle of the Belgrade Large Vertical Circle*, Bull. Obs. Astron. Belgrade 134 (1984), 16.

Corrections for 1080 diameters at $10'$ spacing of the $2'$ divided circle of the Belgrade Large Vertical Circle are determined according to Nikolić's method. All the diameter corrections are within $\pm 1''5$ limits, the accuracy being ± 0.11 . The values of the corrections are tabulated and illustrated graphically.

M. Mijatov, V. Trajkovska: *Analysis of some characteristics of the levels of the Belgrade Vertical Circle*, Bull. Obs. Astron. Belgrade 134 (1984), 9.

On the basis of laboratory examinations of the levels of the Belgrade Vertical Circle, executed in the period 1963 to 1981, mean division values, as well as their dependence on time, air temperature and bubble length, are derived. The formulae (4) and (5) are proposed for use in the reduction of astronomical observations. The level division values, as derived by laboratory measurements, proved to fit in the regular astronomical observations made with our Vertical Circle.

V. Trajkovska: *Preliminary results of planet observations with the Belgrade Vertical Circle*, Bull. Obs. Astron. Belgrade 136 (1986), 100.

Account is given of the method, organization and results of observations of outer planets with the Belgrade Vertical Circle, carried out in the period

April 1983 to November 1984. The $O - C$ differences for all the observed planets, as well as the mean errors of observations are given.

Dj. Bozhichkovich: *Investigation of levels of the Belgrade Vertical Circle*, Bull. Obs. Astron. Belgrade **136** (1986), 40.

Two levels attached to the Belgrade Vertical Circle have been investigated both on the examiner and on the instrument itself. Data obtained by both methods are analysed. It could be found that the results provided by the measurements on the instrument itself, using the mercury horizon, were notably more realistic than those obtained with the examiner under laboratory conditions. In addition to the accounting for the temperature and the bubble length effect on the level division value determination and accounting for the systematic effects of the irregularities in the inner sliding surface and its graduation is suggested.

B. Jovanović, Dj. Bozhichkovich: *On division errors of the Belgrade Vertical and Meridian Circles*, Bull. Obs. Astron. Belgrade **137** (1987), 41.

By using the spectral analysis method the corrections of the division for the Meridian Circle and for the Vertical Circle of Belgrade Observatory are treated. A prominent term of a period of two degrees has been found for the former instrument, but not for the latter one. Both instruments were produced by "Askania".

V. Trajkovska: *Results of planet observations with the Belgrade Vertical Circle (Supplement I)*, Bull. Obs. Astron. Belgrade **138** (1988), 85.

Results of observations of five major planets with the Belgrade Vertical Circle, carried out in the period April 1985 to December 1986, are presented. The $O - C$ differences for the observed planets, as well as the mean errors of observations are given. Differences of the observed apparent and the ephemeris apparent semi-diameters of the planets Mars, Jupiter and Saturn are given, too.

M. Mijatov, V. Trajkovska: *Flexure of the Belgrade Large Vertical Circle in the period 1976-1980*, Bull. Obs. Astron. Belgrade **140** (1989), 37-42.

In the present paper an analysis of the variations in the flexure of the Large Vertical Circle of Belgrade Observatory between 1976 and 1980 is given. The examinations show a very prominent temperature dependence a significant variation during an observation night, and a dependence on observers and on quality of measurements; no dependence on meteorological parameters such as the pressure and humidity, as well as on weather conditions under which the measurements were made (cloudiness, wind, etc.) was found. Seasonal variations, being most prominent during the autumn season, are found. The most important systematic influences are collimator displacement and the tube refraction. The accuracy of the flexure determination is $\epsilon_b = \pm 0''.22$.

4.3. Large Transit Instrument: Determination of Absolute Right Ascensions

4.3. Veliki pasažni instrument: Određivanje apsolutnih rektascenzija

I. Pakvor: *On the Observations of the Bright Polar Stars with the Large Transit Instrument at the Belgrade Observatory*, Publ. Astron. Obs. Sarajevo 1 (1981), 79–85.

The first regular observation program which is being carried out at the LTI of the Belgrade Observatory contains the determination of absolute right ascension of stars in the northern declination zone 70° – 90° . The application of the vacuum meridian marks gives special interest to this program. The analysis of the instrument's constants is shown.

I. Pakvor: *Progress Report on Vacuum Meridian Marks*, Mitt. Lohrmann Obs. Tech. Univ. Dresden 6, 51 (1984), 127–130.

I. Pakvor: *Progress report on the Belgrade catalog of absolute R.A.s of bright polar stars*, Trans. IAU, Proc. XIX IAU GA 1985, New Delhi.

A progress report on the *Belgrade Catalog of Absolute RA's of Bright Polar Stars* was given by I. Pakvor, Belgrade Observatory, Yugoslavia. He indicated that the observations of absolute RA's of bright polar stars from the list of 308 stars in the declination zone $+65^{\circ}$ to $+90^{\circ}$ with the Large Transit Instrument (LTI) of the Belgrade observatory were finished early in 1983. This is the first absolute RA catalog observed by the LTI of Belgrade observatory. These observations involve the first use of vacuum meridian marks for determining the values of differential azimuth and collimation errors. The annual variations of these constants were given. Reductions are in progress and the chain method is in use.

I. Pakvor: *The stability analysis of the vacuum meridian marks of the Large Transit Instrument at Belgrade Observatory*, Bull. Obs. Astron. Belgrade 136 (1986), 75–78.

The stability analysis of the vacuum meridian marks of the Large Transit Instrument at Belgrade Observatory is shown using the variation of the angle between the southern and northern meridian mark. The review of similar examinations at some other observatories and the comparison of the results are given. For Belgrade meridian marks a significant annual variation is determined.

L. Mitić, I. Pakvor: *Vacuum meridian marks at Belgrade Observatory*, Proc. IAU Symp. 109, "Astrometric Techniques", Gainesville, Florida, D. Reidel Publ. Comp. (1986), 525–527.

More than a dozen years ago vacuum meridian marks were built for the Belgrade Large Transit Instrument with the purpose of completely keeping the air from interfering with the meridian mark readings. Information is presented on the favorable results achieved as regards both accidental and systematic accuracy.

5. EARTH ROTATION 5. ZEMLJINA ROTACIJA

5.1. Small Transit Instrument: Time Determination

5.1. Mali pasažni instrument: Astronomsko određivanje vremena

M. Jovanović, L. Djurović: *Svodka astronomičeskih nablyudenij sluzhb vremeni. Sluzhba vremeni BL (Belgrad)*, Vsemirnoe Vremya, Byulleten' E 21-E 24, Moskva, 1980.

(M. Jovanović), (L. Djurović), *Daily values of UTO-UTC. transit instrument — Belgrade*, Monthly Notes of the Int. Polar Motion Service, Mizusawa, Nos. 1-12, 1980.

M. Jovanović: *Analiza vremenskih serija posmatranja na pasažnom instrumentu u Beogradu*, VII Kongres matem., fiz. i astronoma Jugoslavije, Budva-Bečići, (1980), III-6.

M. Jovanović, L. Djurović: *Svodka astronomičeskih nablyudenij sluzhb vremeni. Sluzhba vremeni BL (Belgrad)*, Vsemirnoe Vremya, Byulleten' E 25-E 28, Moskva, 1981.

(M. Jovanović), (L. Djurović), *Daily values of UTO-UTC. transit instrument — Belgrade*, Monthly Notes of the Int. Polar Motion Service, Mizusawa, Nos. 1-12, 1981.

M. Jovanović, L. Djurović: *Détérmination astronomique de l'heure*, Bull. Obs. Astron. Belgrade **131** (1981), 45-48.

M. Jovanović, L. Djurović: *Sistematske greške rezidua pri određivanju geografskih koordinata dužine i širine astronomskim promatranjima*, in: M. Muminović (ed.), Proceedings of the IV Nat. Conf. of Yugoslav Astronomers, Sarajevo, 1979 = Publ. Astron. Obs. Sarajevo **1** (1981).

M. Jovanović, L. Djurović: *Svodka astronomičeskih nablyudenij sluzhb vremeni. Sluzhba vremeni BL (Belgrad)*, Vsemirnoe Vremya, Byulleten' E 29-E 32, Moskva, 1982.

(M. Jovanović), (L. Djurović): *Daily values of UTO-UTC transit instrument — Belgrade*, Monthly Notes of the Int. Polar Motion Service, Mizusawa, Nos. 1-12, 1982.

M. Jovanović, L. Djurović, B. Jovanović, D. Djurović: *Svodka astronomičeskih nablyudenij sluzhb vremeni. Sluzhba vremeni BL (Belgrad)*, Vsemirnoe Vremya, Byulleten' E 33-E 36, Moskva, 1983.

(M. Jovanović), (L. Djurović), (B. Jovanović), (D. Djurović): *Daily values of UTO-UTC. Transit instrument — Belgrade*, Monthly Notes of the Int. Polar Motion Service, Mizusawa, Nos. 1-12, 1983.

M. Jovanović: *Selenografija i selenologija*, Vojna enciklopedija, Beograd, (1983):

U radu je data savremeno shvatanje naučnog dostignuća najbližeg Zemljinog suseda Meseca. Takođe je dat osvrt na sastav i oblik zemljinog suseda.

(M. Jovanović), (B. Jovanović), (L. Djurović): *Daily values of UTO-UTC. Transit instrument — Belgrade*, Monthly Not. of the Int. Polar Motion Service, Mizusawa Nos. 1-12, 1984.

M. Jovanović, B. Jovanović, L. Djurović: *Svodka astronomičeskih nablyudenij sluzhb vremeni. Sluzhba vremeni BL (Belgrad)*, Vsemirnoe vremya, Byulleten' E 37-E 40, Moskva, 1984.

M. Jovanović, B. Jovanović: *Sluzhba vremena Astronomske opservatorije u Beogradu — polje rada, problemi, perspektive*, in: Proc. VIII Gen. Assembly, Union of Societies of Mathematicians, Physicists and Astronomers of Yugoslavia (VIII Kongres matematičara, fizičara i astronoma Jugoslavije — Saopštenja), Priština, (1985), 351.

M. Jovanović, L. Djurović: *A survey of meridian observations carried out with the transit instrument of the Belgrade Observatory in the period 1952 to 1983*, Bull. Obs. Astron. Belgrade **136** (1986), 130-132.

M. Jovanović, B. Jovanović, L. Djurović: *Svodka astronomičeskih nablyudenij sluzhb vremeni, Sluzhba vremeni BL (Belgrad)*, Vsemirnoe vremya, Bulletin' E 41-E 44, 1985.

(M. Jovanović), (B. Jovanović), (L. Djurović), *Daily values of UTO-UTC, Transit instrument — Belgrade*, Monthly Not. of the Int. Polar Motion Service, Mizusawa, Nos. 1-12, 1985.

M. Jovanović, B. Jovanović, L. Djurović: *Svodka astronomičeskih nablyudenij sluzhb vremeni. Sluzhba vremeni BL (Belgrade)*, Vsemirnoe vremya, Bulletin' E 45-E 48, 1986.

(M. Jovanović), (B. Jovanović), (L. Djurović): *Daily values of UTO-UTC, Transit instrument — Belgrade*, Monthly Not. of the Int. Polar Motion Service, Mizusawa, Nos. 1-12, 1986.

5.2. Zenith Telescope: Latitude Determination

5.2. Zenit teleskop: Određivanje geografske širine

Dj. Teleki, R. Grujić: *O EW-WE efektu kod Beogradskih širinskih posmatranja*, VII Kongres matematičara, fizičara i astronoma Jugoslavije, Saopštenja, Budva-Bečići, (1980), III-5.

R. Grujić, Dj. Teleki: *Analiza karakteristika Talkotovih libela Beogradskog zenit-teleskopa*, VII Kongres matematičara, fizičara i astronoma Jugoslavije, Saopštenja, Budva-Bečići, (1980), III-5.

B. Kolaczek, G. Teleki: *On reference coordinate systems used in polar motion determinations*, E. M. Gaposchkin and B. Kalaczek (eds.), *Reference Coordinate Systems for Earth Dynamics*, (1981), 165-173.

A short review of the reference pole presently used in polar motion determinations by classical astrometric methods is followed by a discussion of the systematic differences between systems of polar coordinates and the influence of the mean latitude of stations on pole position. The importance of homogenous processing astrometric data is stressed.

V. Milovanović, G. Teleki, R. Grujić: *On the influence of the external factors on the accuracy of determination of latitude variations*, *Publ. Obs. Astron. Sarajevo* **1** (1981), 131-141.

In the period 1968-1970 certain alterations have been implemented in the Latitude Service of the Belgrade Observatory, aimed at reducing, to maximum possible degree, the influence of the external factors on the latitude determinations. These alterations are related to: thermal insulation of the zenith-telescope, improving the construction of its pavilion and the modification of the observing procedure and the data processing. Explanation is given as to what necessitated these changes and why a wider astrometric significance is attached to them. The analysis of the observational data, acquired with this instrument, showed that the effects of the external factors can successfully be reduced, resulting in a considerably increased accuracy of the determination of the latitude variations. To that purpose comparisons were made with the observational results of other zenith-telescopes (with those obtained at International Latitude Service stations in particular).

M. Djokić: *Comparison of the micrometer screw corrections of the Belgrade zenith telescope in the different systems*, *Pub. Obs. Astron. Sarajevo* **1** (1981), 163-166.

For estimating the validity of the different observation programs used the micrometer screw correction of the Belgrade zenith telescope were analysed in the catalog system AGK3 and SAO.

R. Grujić, M. Djokić: *Observations à la lunette zenithale (de 110 mm) du Service de la latitude de l'Observatoire de Beograd en 1979*, *Bull. Obs. Astron. Belgrade* **131** (1981), 43-44.

The results of latitude observations under new Belgrade latitude program for 1979 are presented.

R. Grujić, M. Djokić: *Observations à la lunette zenithale (du 110 mm) du Service de latitude de l'Observatoire de Belgrade en 1980*, *Bull. Obs. Astron. Belgrade* **132** (1982), 53-54.

On présente les valeurs de latitude ainsi que quelques données météorologiques prises au cours d'observations.

B. Kolaczek, G. Teleki: *On investigations of mean latitude variations*, Sun and Planetary System, D. Reidel Publ. Comp. Dordrecht, Holland – Boston, U.S.A. – London, England, (1982), 191.

S. Sadžakov, V. Fomin, M. Dačić, D. Šaletić: *Systematic errors in latitude observations of various observatories*, 18 IAU General Assembly, Patras, (1982).

G. Teleki, R. Grujić: *Investigations of the EW-WE effect in the latitude determinations with the Belgrade zenith-telescope*, Hvar Obs. Bull. Suppl., Vol. 6, 1 (1982), 61–69.

Belgrade latitude data have been analysed with regard to the possible sources of the EW-WE effect whereby the equation (1) has been utilized. The strongest source proved to be the instrument itself, especially its levels, but other sources are not negligible either: the observer, declination system, seasonal changes.

R. Grujić, G. Teleki: *An analysis of the characteristics of the Talcott levels of the Belgrade zenith-telescope*, Hvar Obs. Bull. Suppl., Vol. 6, 1 (1982), 71–80.

It has been established by laboratory investigations that the mean division angular values of the Belgrade zenith-telescope levels are systematically undergoing changes with time. The reality of these changes has been confirmed by using the inclination values as determined in the course of latitude observations with this zenith-telescope.

M. Djokić: *Analysis of the latitude differences obtained from the subgroups of the new Belgrade's latitude program*, Suppl. Obs. Bull. Hvar 6 (1982), 81–90.

Temperature induced differences in the latitudes obtained from the subgroups of the new Belgrade latitude program are considered.

M. Djokić: *Closing errors of the Belgrade latitude observations and temperature influences*, Astrophysics and Space Science Library 96 (1982), 195–196.

The correlations between temperature differences and closing errors of latitudes under old Belgrade's observation program were demonstrated.

R. Grujić, M. Djokić: 1982, *Observations à la lunette zenithale (de 110 mm) du Service de latitude de l'Observatoire de Belgrade en 1980*, Bull. Obs. Astron. Belgrade 132 (1982), 53–54.

The results of latitude observations under new Belgrade latitude program for 1980 are presented.

R. Grujić, R. Krga, Z. Stančić: *Ispitivanje „greške noći“ kod beogradskih širinskih posmatranja u periodu 1960–1980*, VI Nacionalna Konf., Hvar, (1983).

R. Grujić, G. Teleki: *Investigation of wind effects on the Belgrade latitude observations*, Bull. Obs. Astron. Belgrade **134** (1984), 26-31.

It is demonstrated that the alterations (thermal insulation of the zenith telescope, rebuilding of the pavilion improvements in the observational procedure and data processing) effected in the period 1968-1970 (Milovanović et al., 1981) resulted in a notable reduction of the wind effects on the Belgrade latitude observations and a general enhancement of the accuracy of observation. It is found that in the period 1976-1981 the systematic effects of winds from N-W quadrant are stronger than those produced by winds from S-E quadrant (most of our observations are made by S-E winds). The suitability to application of some expressions for the calculation of wind effects on latitude is considered.

R. Grujić, R. Krga, Z. Stančić: *"Night error" in the Belgrade latitude observations made in the period 1960-1980*, Publ. Obs. Astron. Belgrade **33** (1985), 62-65.

"Night error" in the Belgrade latitude observations, made in the period 1960 through 1980, has been investigated and found that, being significant prior to the instrumental and methodical improvements implemented in 1969-1971, it has substantially been reduced in the subsequent period. The dependence of this error on the observer has been demonstrated, too.

M. Djokić: *Correction to the angular value of the screw revolution of the Belgrade zenith-telescope micrometer derived from latitude observations*, Publ. Obs. Astron. Belgrade **33** (1985), 70-74.

Correction to the angular value of the screw revolution of the Belgrade zenith-telescope micrometer is being determined and discussed for period 1971.9-1982.5.

G. Teleki, R. Grujić: *Effects of the level bubble length variation on the latitude values*, Publ. Obs. Astron. Belgrade **33** (1985), 66-69.

The level bubblelength variations during observation are found to affect the latitude values derived by Talcott method. The real amount of these effects is hard to bring out. Hence, one has to be careful at deducing the daily variations of latitude as these effects must not be ignored.

R. Grujić, Dj. Teleki: *O katalogu deklinacije Beogradskih zenitskih zvezda*, VIII Kongres matematičara, fizičara i astronoma Jugoslavije, Saopštenja, Priština, (1985), 345.

M. Djokić: *Constant of aberration from the latitude observations with the Belgrade zenith-telescope*, Bull. Obs. Astron. Belgrade **136** (1986), 29-30.

Values of the constant of aberration are determined from the latitude observed under the new Belgrade latitude program and compared with those derived from observations under the old program as well as the results obtained at other observatories.

R. Grujić, G. Teleki: *Investigations of the EW-WE effect in the latitude determinations with the Belgrade zenith-telescope in the period 1969.0–1981.0*, Bull. Obs. Astron. Belgrade **137** (1987), 11–29.

The EW-WE effect in the latitude determinations with the Belgrade zenith-telescope in the period 1969.0–1981.0 have been analysed and it was concluded that they are smaller ones as well as more accurately determined than in the period 1960.0–1969.0 (Teleki, Grujić, 1982). This is due to alterations (thermal insulation of the instrument, rebuilding of the pavilion improvements in the observational procedure and data processing) executed in the period 1968–1970 (Milovanović et al., 1981). The results obtained by formula (3) point to several sources giving rise to the EW-WE effects, but it can be proved that the influences of these sources are remarkably weaker in the period 1969.0–1981.0 than before that.

R. Grujić, G. Teleki, B. Jovanović: *Declination variations of zenith stars*, IAU Coll. 100, Belgrade, Sept. 8–11, (1987).

G. Teleki, R. Grujić: *Catalogues of declinations and proper motions of 36 Belgrade zenith stars*, Astron. Astrophys. **177** (1987), 313–316.

Using observations made with the Belgrade zenith telescope in the period 1960.0–1981.0, catalogues (in three systems) of the declination and proper motions in declination of 36 zenith stars were calculated for the equinox and epoch of 1970.0. Analyses show that, relatively, the most accurate are the system 1 declinations (BZS₁₇₀). The declinations systems of our catalogues are in good agreement with the corresponding FK4 system. But the system of proper motions in declination is less comparable with the FK4 system. It follows that the Belgrade zenith telescope is capable of yielding star declinations with relatively high precision (currently about 0''22).

G. Teleki, R. Grujić: *Belgrade catalogues of declinations and proper motions of zenith stars*, Bull. Obs. Astron. Belgrade **137** (1987), 5–10.

The analyses are given of three Belgrade catalogues of declinations and proper motions in declination of 36 zenith stars for the equinox and epoch 1970.0. These stars were observed with zenith telescope. The catalogues are based on the observation data collected in the period 1960.0–1981.0. The conclusion is that the results are highly satisfying.

R. Grujić, G. Teleki: *The widened Belgrade latitude observational programme and its characteristics*, Bull. Obs. Astron. Belgrade **137** (1987), 14–29.

The original Belgrade latitude observational programme (Ševarlić, Teleki, 1960), which was observed from 1960.0, needed some improvement and therefore a widened programme was developed. The paper gives some informations on the characteristics of this new, widened programme. The preliminary value of systematic differences between the latitudes obtained in the complete and the original programmes is 0''010.

R. Grujić, M. Djokić, B. Jovanović: *Analysis of the change in the geographic latitude between 1969.0 and 1975.0*, IX Nac. konf. astronoma Jug., Zbornik rezimea, Sarajevo, (1988), 29.

Period 1969.0-1975.0 is chosen to be analysed because it is the most favourable one taking into account the program of observation, the influence of the error in the micrometer screw revolution and the number of observations.

It is represented the change of mean latitude ($0''1$) and annul z-term which is correlated with the change of Talcott levels inclination.

G. Teleki, R. Grujić: *Personal errors of observer in visual determinations of latitude by the Talcott method*, Kinem. i Fiz. Nebesn. Tel, Vol. 4, 1 (1988), 71-74.

Using latitude data obtained with the Belgrade Astronomical Observatory zenith telescope during 1960.0-1986.0, we investigated latitude differences determined by two experienced observers. It was established that these differences (the result of the observers' individual errors) are significant and that they correlate with the inclination of the moving micrometer hair. Certain recommendations pertaining to organization of observations are given.

R. Grujić, M. Djokić, R. Krga, S. Šegan, N. Djokić: *Observations à la lunette zenithale (de 110 mm) du Service de latitude de de l'Observatoire de Belgrade en 1981, 1982, 1983, 1984, 1985*, Bull. Obs. Astron. Belgrade 140 (1989), 69-81.

On présente les valeurs de latitude ainsi que quelques données météorologiques prises au cours d'observations.

6. EARTH'S ATMOSPHERE

6. ZEMLJINA ATMOSFERA

6.1. Astronomical Refraction

6.1. Astronomska refrakcija

G. Teleki: *Evolution of the Earth's atmosphere and the astronomical refraction*, Publ. Astron. Obs. Sarajevo 1 (1981), 111-114.

The author reaches the conclusion that the evolution of the Earth's atmosphere over the last millenniums did not practically affect the value of the refractive influences and that the same might be expected in the near future. Thus, the present-day (good) tables of refraction may well continue to be used unchanged during the time of mankind's civilisation.

G. Teleki: *On the modern investigations of refraction influences*, Zbornik Zadachi sovremenoj astrometrii v sozdanii inertial'noj sistemy koordinat, Izd. Fan, Tashkent, (1981), 423-427.

G. Teleki: *New tendencies of the research into the astronomical refraction*, Bull. Obs. Astron. Belgrade **131** (1981), 3–8.

A review is given of the more recent researches into the refractive influences, with special emphasis on those new tendencies in studying or eliminating the influence of the astronomical refraction (prevention, three-dimensional refraction, multi-wave methods, the use of the artificial satellites) of which it is expected to considerably promote our knowledge of this phenomenon.

G. Teleki, J. Saastamoinen: *Problems of three-dimensional refraction in astrometry*, Sun and Planetary System, D. Reidel Publ. Comp., Dordrecht, Holland – Boston, U.S.A. – London, England, (1982), 455.

G. Teleki, O. Atanacković: *The growth of knowledge on astronomical refraction I*. Rep. No. 19, Dep. of Geodesy, Univ. of Uppsala, Sweden, (1983), 255–271.

After the short historical survey on astronomical refraction, the growth of knowledge of this phenomenon is assessed proceeding from the number of the published papers dealing with that matter as well as the accuracy of the refraction tables. The growth of the published papers in the course of time has had a non-uniform pattern, being, however, very fast after the Second World War. The accuracy of the refraction tables has been increasing since Tycho's time up to the present, the time of doubling being about 26 years. It is demonstrated that the accuracy growth of the refraction tables proceeded at a slower rate than that of the observational catalogues of stellar positions. It is therefore understandable that the obstacles in the accounting for the atmospheric — the refractive ones inclusive — effects on the astrometric observations set limits to the development of the ground-based astrometry.

G. Teleki: *Progress report on the astronomical refraction*, Bull. Obs. Astron. Belgrade **134** (1984), 39–47.

A presentation is given of works on astronomical refraction, published in the period 1979 to 1982. Particular emphasis is given to research currently of special interest to astrometry, as for instance that relating to three dimensional refraction, atmospheric turbulence etc.

A. Yu. Yatsenko, G. Teleki: *Harzer's works on astronomical refraction viewed from today's standpoint*, Bull. Obs. Astron. Belgrade **135** (1985), 1–15.

A detailed survey and a critical analysis of P. Harzer's ideas and methods of computation of astronomical refraction in a three-dimensional medium is presented. On stating that Harzer's conceptions were of interest, ways of their possible application in the current astronomical practice are indicated.

G. Teleki: *Sadašnje mogućnosti u određivanju refrakcijskih uticaja*, VIII Kongres matematičara, fizičara i astronoma Jugoslavije, Saopštenja, Pristina, (1985), 350.

G. Teleki: *Optical refraction: terminology and standards*, Publ. Astron. Obs. Belgrade **35** (1987), 338–342.

In continuation of the fundamentals and definitions advanced earlier by this author (Teleki, 1974), two more definitions relating to the optical refraction: “real (astronomical) refraction” (astronomical refraction taking place in the naturally distributed air layers of the Earth global atmosphere) and “OL (Oriani-Laplace) refraction” (refractive influences over zenith distances less than 70° are suggested. Standards associated with the atmospheric models, pure refraction and OL refraction are given.

G. Teleki, C. Sugawa: *On the nature of astronomical refraction*, Publ. Astron. Obs. Belgrade **35** (1987), 1–16.

A survey is presented of factors — astrometric and meteorological — illuminating the nature of astronomical refraction. As a result of the general circulation of the atmosphere, the tilting of equal refractivity in the troposphere is really compensated by the reversed tilt in the lower stratosphere. From all the analysis there follows a general conclusion that, provided the surface airstrata are not excessively perturbed, the actual refraction influences are — for zenith distances under 70° — representable by the pure (normal) refraction with an error less than $0''.1$. The Oriani-Laplace's theorem proves to be applicable on the (mean) three-dimensional atmosphere too.

G. Teleki: *Present-day potentialities of refraction influences determination and perspective developments*, Bull. Obs. Astron. Belgrade **136** (1986), 61–72.

A critical survey and analysis is presented of those questions that are of acute interest in the astronomical refraction investigation. Special weight is accorded to the development and the present accuracy in the refraction determination as well as to the prospective ways of its further improvement. Regarding further development put under scrutiny are: implementation of more accurate formulae in the refraction calculus; introduction of atmospheric models better matching the reality, accounting for the refraction influences within an instantaneous meteorological field; instrumental determination and the suppression of refraction influences; prevention and more rigorous turning to advantage of the laws governing the radiation propagating. The effects associated with the radio refraction are discussed separately. The conclusion is derived that a marked accuracy improvement in the determination of the refraction influences might be expected in the years ahead.

6.2. The Quality of the Atmosphere — Site Testing

6.2. Kvalitet atmosfere — site testing

J. Arsenijević: *Selection of potential high altitude sites for an optical astronomical station*, Publ. Obs. Astron. Belgrade **31** (1981), 87.

A set of parameters relevant in selecting an astronomical observing station has been considered and a three-step procedure proposed. The first step is

shown in detail. A review of 7 different parameters in 17 regions qualifying a site for the next selecting steps has been given. Qualification of different sites according to four of those parameters has been applied. The mean rank gave the priority sequence of sites (the last column in Table I) from the aspect of their suitability for astronomical observations. The first five sites are in Macedonia, followed by two sites in Serbia.

J. Arsenijević, A. Kubičela, I. Vince, G. Djurašević, Z. Ivanović: *Some results of site-testing photometric measurements*, Publ. Obs. Astron. Belgrade **31** (1981), 89.

Stellar fluxes, extinction coefficients and sky brightness have been measured at Belgrade Astronomical Observatory and several potential mountain observatory sites in SR Serbia during 1976–1980 period. All measurements, although not frequent, point to the very poor observing conditions at Belgrade and much better ones at the mountain sites. The photometrical differences among the potential observatory sites seem to be unsubstantial. The influence of urban sky glow of Prokuplje and Niš at Vidojevica have been examined more thoroughly and a definite location of the future high altitude station has been proposed at Jovanova Glava, 1020m above the sea level.

I. Vince, A. Kubičela: *Polarimetric measurements of relative air turbidity*, Publ. Obs. Astron. Belgrade **31** (1981), 49.

Based on measurements of sky polarization parameters a method for comparing various observatory sites according to their for daylight and one for night observations have been constructed. The observations during 1978 preliminarily indicate Preslap as the best considered location. The method is suitable for long-term monitoring of large-scale air pollution.

G. Teleki: *Astrometric site selection*, Sun and Planetary System, D. Reidel Publ. Comp., Dordrecht, Holland – Boston, U.S.A. – London, England, (1982), 483.

J. Arsenijević: *Seasonal variations of the Hvar extinction coefficients*, Publ. Obs. Astron. Belgrade **33** (1985), 36.

Mean monthly values of the extinction coefficients, measured at the Hvar Observatory in the period 1972–78, and the gas density of some atmospheric layers at +45° latitude are discussed. High anticorrelation of these quantities over the atmospheric layers up to 7.5km is stated. The amount of the gas component in total extinction is variable during the year, being minimum in the summer period when the extinction coefficient is maximum. The seasonal variations of the extinction are mainly the result of the aerosol component variations. The gas component causes a lessening of the effect of aerosol component variation in the total extinction.

O. Atanacković: *Preliminary investigation of the image motion at the Belgrade Observatory*, Publ. Obs. Astron. Belgrade **33** (1985), 83–87.

Image motion at different zenith distances has been investigated on the basis of star trails recorded photographically. Correlation between the image motion and meteorological parameters has been established. Correlation proved

rather close with the wind velocity and with relative humidity. The image motion amplitude is several tenths of arc second and its average period about 2.5 sec for the zenith distances 0° through 70° .

G. Teleki: *Atmospheric effects and selection of places for astrometric stations*, Kinematika i fizika nebesnih tel 1, No. 2 (1985), 85-91.

The paper deals with the Earth's atmosphere effect on astrometric instruments and on the stellar seeing. The problems of the protection against the atmospheric effect as well as the criteria for selection of places for astrometric stations are discussed.

7. PLANETARY SYSTEM

7. PLANETSKI SISTEM

7.1. Origin and Dynamics of the Earth-Moon System

7.1. Poreklo i dinamika sistema Zemlja-Mesec

P. Savić, G. Teleki: *Origin and dynamics of Earth's core*, Acta Geodaet., Geophys. et Montanist. Hung., Budapest, 20, 1 (1985), 13.

P. Savić, G. Teleki: *Comments on "The origin of the Earth-Moon system"*, Earth, Moon and Planets 36, 2 (1986), 139.

M. B. Protitch, V. Protitch-Benishek: *Quelques remarques sur l'hypothèse de la nonuniformité de la rotation terrestre*, IAU Colloquium No. 100 "Fundamentals of astrometry", (1987), Belgrade, Yugoslavia.

V. Protitch-Benishek, M. Protitch: *On the lunar secular acceleration: a possible approach*, Proc. of the 141st Symposium of IAU "Inertial Coordinate system on the Sky", Leningrad, (1990), 201-202.

On the basis of an original approach to the problem of secular acceleration of the Moon and fluctuations, lunar observations in the period 1861-1985 are analysed.

V. Protitch-Benishek, M. B. Protitch: *An approach to the problem of secular acceleration of the Moon*, Bull. Obs. Astron. Belgrade 142 (1990), 17-21.

If we adopt the solution of extended method in the Delaunay theory of the Moon as real and entirely logical and substitute the square term in the Moon's mean longitude by the very long period inequality, the remaining residuals — fluctuations — can be treated as the consequence of collected effect of a few other inequalities. The frequencies of these periodical terms correspond to the identical relative positions of the Moon's node, Sun and Earth. On the basis of such an approach to the problem of secular acceleration of the Moon and fluctuations, lunar observations in the period 1681-1985 are analysed. The results are quite consistent with values presented by other authors.

7.2. Astrometric Aspects of Eclipses, Transits and Occultations

7.2. Astrometrijski aspekti pomračenja, prolaza i okultacija

V. Protitch-Benishek: *Occultations of stars by the Moon observed at the Belgrade astronomical observatory in the years 1978 and 1979*, Bull. Obs. Astron. Belgrade **131** (1981), 38–39.

During the period 1978–79, 63 occultations of stars by the Moon were observed at the Belgrade Astronomical Observatory with Askania refractor 135/1600 by the author. The UTC timings, corrected for personal equation in amount of $0^{\text{s}}.3$, $O - C$ residual distances of the stars from the computed positions of the Moon's outline for the given times of occultations, and all other relevant data are presented in two tables.

V. Protitch-Benishek: *Occultation de la planète Venus par la Lune du 20 janvier 1980 observée à Belgrade*, Bull. Obs. Astron. Belgrade **131** (1981), 40–42.

This paper gives the results of the observation of occultation of Venus by the Moon on 1980 January 20th, made with Askania astrograph of Belgrade Astronomical Observatory.

V. Protitch-Benishek: *Some results of the Mercury transit observations in 1970 and 1973 at Belgrade observatory*, in: W. Fricke, G. Teleki (eds.), Sun and Planetary System, D. Reidel Publ. Comp. (1982), 447–448.

The transits of Mercury across the solar disk in 1970 and 1973 have been observed at the Belgrade Observatory too. The photographs in 1970 have been taken in the focal plane of the refractor 650/10550 mm, whereas those in 1973 were achieved with the refractor guidescope of the astrograph 11/128 mm to which a special solar camera was attached. 56 in 1970 and 28 photographs in 1973 were obtained. Even though the revision of the observations of Mercury's transits made in Belgrade has been undertaken principally with the aim of deducing solar parallax in spite of the long prevailing view of the unsuitability of these transits for such refined calculation, we determined also other parameters connected with this phenomenon. In this paper the times of the contacts, the time of the least angular distance of centers and the semi-diameters of the Sun and Mercury are given.

V. Protitch-Benishek: *Transits of Mercury: results of Belgrade observations in 1970 and 1973*, Astron. Nachr. **304**, 6 (1983), 313–315.

Photographic observations of the transits of Mercury over the solar disk in 1973 at the Belgrade Observatory were used not only in order to determine the classical parameters, as the times of contacts and least distances to determine the apparent radii of the Sun and Mercury. The mean value of the Sun semi-diameter reduced to the distance unit differs from Auwers' value by about $1''.3$ while radius of the Mercury is in good agreement with Le Verrier's value. On the basis of quite homogenous observational material and precise observing data it was possible to derive the parallax of the Sun by means of the angular distance changes due to the parallactic effect in the course of transit. The

values are determined as: $8''800 \pm 0''008$ (1970) and $8''788 \pm 0''032$ (1973). The mean value resulting from the two transits is $\pi_s = 8''794 \pm 0''013$, an amount in striking agreement with that currently used.

V. Protitch-Benishek: *Merkurovi prolazi i paralaksa Sunca (Transits of Mercury and Solar Parallax)*, (M.Sc. Thesis) (monografija sa bibliografijom), Publ. Obs. Astron. Belgrade **32** (1984), 1-159.

V. Protitch-Benishek, H. Božić: *Occultation of Sigma Sagittarii by Venus on 17 november 1981 observed from Hvar observatory*, Bull. Obs. Astron. Belgrade **136** (1986), 82-83.

Essentials are reported of the occultation of Sigma Sagittarii (Nunki) by Venus on November 17, 1981 observed at Hvar Observatory (Yugoslavia). The parameters of such exceptional phenomenon are given and analysed.

V. Protitch-Benishek: *Occultations of stars and planet Venus by the Moon observed at the Belgrade Astronomical Observatory in the years 1980-1984*, Bull. Obs. Astron. Belgrade **139** (1988), 67-69.

The paper contains results of visual observations of hundred stellar occultations and planet Venus by the Moon during the years 1980-1984 with Askania refractor 135/1600 at the Belgrade Observatory. The timings of Sigma Sagittarii occultation by Venus on 17 November 1981, observed from Hvar observatory, are also given.

7.3. Asteroids

7.3. Asteroidi

Z. Knežević: *Positions of minor planets obtained in 1979*, Bull. Obs. Astron. Belgrade **131** (1981), 33-37.

K. Pavlovski, Z. Knežević, M. Muminović: *Photometry of the asteroid (5) Astraea*, Proceedings of the IV Nat. Conf. of Yugoslav Astronomers, Sarajevo 1979, Publ. Astron. Obs. Sarajevo **1** (1981), 225-230.

Z. Knežević: *Observations made at Belgrade*, Minor Planet Circular, No. 5255.

Z. Knežević: *Observations made at Belgrade*, Minor Planet Circular, No. 7067.

Z. Vizi, Z. Knežević: *Observations made at Piskestet*, Minor Planet Circular, No. 7107.

Z. Knežević, V. Zappala: *An improved representation of the average opposition magnitudes of asteroids*, in: W. Fricke, G. Teleki (eds.), Sun and Planetary System, D. Reidel Publ. Comp., (1982), 299-302.

Z. Knežević: *Variation of the mean and median inclinations in the numbered minor planet sample*, Bull. Astron. Inst. Czech. **33** (1982), 267-231.

Z. Knežević, G. Djurašević, K. Pavlovski: *A review of photoelectric photometry of asteroids made at Hvar observatory*, Hvar Obs. Bull. **6** (1982) 1, 141-146.

A brief review is presented of results of the photoelectric observations of asteroids made at Hvar. The lightcurves are shown, and the interpretation of data demonstrated. Special attention is paid to the unusual case of 216 Kleopatra.

D. Olević, D. Djurović: *Contribution to the statistical analysis of Kirkwood's gaps*, Bulletin T. LXXIX de l'Académie Serbe des Sciences et des Arts — 1982, Classe des Sciences mathématiques et naturelles, Sciences mathématiques **12**.

On the sample of 2042 numbered asteroids the statistical stability of width of Kirkwood's gaps (KG) has been investigated. On the basis of those data the authors show that asteroids the absolute magnitude $B(1,0)$ of which is greater than 13.0 do not affect the KG width. The correlation between the angle of eccentricity and the width of KG has been identified. The population density of the external side of vicinity of KG is greater than the internal one.

V. Zappala, M. di Martino, F. Scaltriti, G. Djurašević and Z. Knežević: *Photoelectric analysis of asteroid 216 Kleopatra: Implications for its shape*, Icarus **53** (1983), 458-464.

In some recent theoretical papers it has been suggested that gravitationally bound "rubble piles" in hydrostatic equilibrium possibly exist among the asteroids. For a higher-than-critical value of the angular momentum acquired by such a body, the instability phenomena can produce fission into a binary system. S. J. Weidenschilling [*Icarus* **44**, 807-809 (1980)] suggested that 216 Kleopatra may represent a binary asteroid, since it has a large light curve amplitude (1.3-1.4 mag). In this paper new observations of Kleopatra are presented suggesting the equal plausibility of the single triaxial ellipsoid model. Namely when phase and aspect effects are taken into account, the actual maxiellipsoid model. Namely when phase and aspect effects are taken into account, the actual maximum amplitude is reduced to about 0.9 mag at 90° of aspect which is close to the value predicted by theory for the instability limit. Moreover, multiple-scattering effects [M. Poutanen, E. Bowell, and K. Lumme, *Bull. Amer. Astron. Soc.* **13**, 725 (1981)] can reduce the axial ratio a/b even more. If the single-body model is adopted, the density of Kleopatra should be on the order of 1.7 g/cm^3 . This low value seems reasonable for "rubble pile" models.

V. Zappala, Z. Knežević: *Photoelectric investigations of asteroids: selected observational programs for 1984*, Minor Planet Bull. **4** (1983), 29-31.

Z. Knežević: *The minor planet premature and related discoveries*, Bull. Obs. Astron. Belgrade **133** (1983), 16-26.

V. Zappala, P. Farinella, Z. Knežević, P. Paolicchi: *Collisional origin of the asteroid families: mass and velocity distributions*, *Icarus* **59** (1984), 261–285.

V. Zappala, Z. Knežević: *Rotation axes of asteroids: results for 14 objects*, *Icarus* **59** (1984), 436–455.

V. Zappala, M. Di Martino, Z. Knežević, and G. Djurašević: *New evidence for the effect of phase angle on asteroid lightcurve shape: 21 Lutetia* (research note), *Astron. Astrophys.* **130** (1984), 208–210.

New observations of the asteroid 21 Lutetia, obtained in 1981 and 1983 apparitions, are presented. They allowed a definitive value of the rotation period (8^h17) to be deduced, instead of the previously adopted value of 6^h133 . A comparison between 1962 and 1981 lightcurves, obtained at nearly the same ecliptic coordinates, revealed new convincing evidence for the phase angle effect on the lightcurve shape. This effect is very important for understanding asteroid morphology, but it sometimes leads to erroneous determinations of rotation periods.

Z. Knežević, P. Farinella: *Recent work on asteroid families*, XIX IAU Gen. Assembly, Commission 15, New Delhi, 1985.

M. Geffert, S. Wagner, S. Ninković: *Photographic observations of Minor Planets*, *Acta Astronomica* **35** (1985), 181.

40 positions of 11 minor planets are given which were measured on plates of the astrograph at Hoher List Observatory.

H. Debehogne, V. Protitch-Benishek: *135 precise astrometric positions of minor planets obtained at the GPO telescope of ESO — La Silla*, *Bull. Obs. Astron. Belgrade* **135** (1985), 56–63.

135 precise astrometric positions of minor planets observed at the GPO ($F = 4\text{ m}$, $D = 40\text{ cm}$) of the European Southern Observatory (ESO), La Silla, Chile, during February–March 1984 are presented. The observations have been made by H. Debehogne and G. G. Vieira. Two new asteroids were discovered during this mission. The plates were measured on the Ascorecord Zeiss measuring machine of the Observatoire Royal de Belgique. The reductions were performed with the Univac 9200 computer of the Observatoire Royal de Belgique, Institute Royal météorologique and Institute d'Aeronomie Spatiale, using the dependence method by means of five reference stars. Data on reference stars, including dependences, are also given.

Z. Knežević: *Comparison of the asteroid proper elements obtained from various theories*, in: *Asteroids, Comets, Meteors II* (C. I. Lagerkvist, B. A. Lindblad, H. Lundstedt, H. Rickman, Eds.), (1986), 129–134.

D. Olević, S. Šegan and R. Pavlović: *Fundamental asteroid positions obtained with the Belgrade Zeiss astrograph*, *Bull. Obs. Astron. Belgrade* **136** (1986), 104.

Presented are 147 geocentric positions of the “fundamental” asteroids observed in the period 1967 to 1983. The reduction was implemented by the

method of dependences using 4 to 11 reference stars whose positions are taken from AGK3 and SAO catalogues.

H. Debehogne, V. Protitch-Benishek, D. Olević: *275 precise astrometric positions of minor planets obtained at the GPO telescope of ESO — La Silla*, *Acta Astronomica* **36**, 3–4 (1986), 457–462.

Precise astrometric positions of minor planets: 120 Lachesis, 366 Vincentina, 659 Nestor, 883 Mattarania, 1254 Erfordia, 1273 Helma, 1280 Baillauda, 2759 Idomeneus, 1984 SN 4, 1984 SO 4, 1984 SP 4 and 1984 SQ 4 obtained at the Grand Prism Objectif (GPO, $f = 4$ m, $D = 40$ cm) of the European Southern Observatory (ESO), La Silla, Chile, during September–October 1984 are presented here. Four new asteroids were discovered during this second mission in 1984 (see *Bull. Obs. Astron. Belgrade* **135**).

P. Farinella, P. Paolicchi, Ch. Froeschlè, Cl. Froeschlè, R. Gonczi, M. Carpino, V. Zappalá, and Z. Knežević: *Numerical experiments on the orbital evolution of family asteroids*, *Bull. Amer. Astron. Soc.* **18** (1986), 792.

V. Zappalá, Z. Knežević: *Pole coordinates of the asteroid 511 Davida as determined via the amplitude-magnitude method*, *Icarus* **65** (1986), 122–128.

Z. Knežević: *Comparison of the asteroid proper elements obtained from various theories*, in: *Asteroids, Comets, Meteors* (C. I. Lagerkvist, B. A. Lindblad, H. Lundstedt, and H. Rickman, Eds.), (1986), 129–134.

A. Milani, Z. Knežević: *Asteroid proper elements and secular perturbations: a second order theory*, *Bull. Amer. Astron. Soc.* **20** (1988), 864.

Z. Knežević: *Asteroid mean orbital elements*, *Bull. Obs. Astron. Belgrade* **139** (1988), 1–6.

Z. Knežević, M. Carpino, P. Farinella, Ch. Froeschlè, Cl. Froeschlè, R. Gonczi, B. Jovanović, P. Paolicchi, and V. Zappalá: *Asteroid short-periodic perturbations and the accuracy of mean orbital elements*, *Astron. Astrophys.* **192** (1988), 360–369.

Z. Knežević, B. Jovanović: *Asteroid short-periodic perturbations: critical eccentricity and inclination for analytically derived mean semimajor axes*, *Proceedings 10th ERAM: Interplanetary matter* (Z. Ceplecha and P. Pecina, Eds.), (1988), 107–109.

Cl. Froeschlè, P. Farinella, M. Carpino, Ch. Froeschlè, R. Gonczi, P. Paolicchi, V. Zappalá, and Z. Knežević: *Asteroid families*, in: *The Few-Body Problem* (M. Valtonen, Ed.), D. Reidel Publ. Co., Dordrecht, (1988), 101–116.

P. Farinella, Cl. Froeschlè, and Z. Knežević: *The puzzle of asteroid families*, in: *Long-Term Dynamical Behaviour of Natural and Artificial N-Body Systems* (A. E. Roy, Ed.), Kluwer Acad. Publ., (1988), 237–244.

H. Debehogne, V. Protitch-Benishek: *Orbite elliptique de l'asteroide E 3776 decouvert a La Silla*, Acta Astronomica **38** (1988), 153-155.

This paper contains the precise photographic observations of the new discovered minor planet with the Grand Prism Objective (GPO) at the ESO, La Silla in September 1986. On the basis of such minor planet positions the elliptic orbit is derived by Gauss-Encke method.

Z. Knežević: *Sopstveni elementi malih planeta kao parametri klasifikacije u familije*, Ph.D. thesis. Belgrade Univ., (1989).

Z. Knežević: *Report on the workshop "Proper elements and dynamical families of asteroids"*, in: Asteroids, Comets, Meteors III (C. I. Lagerkvist, H. Rickman, B. A. Lindblad, M. Lindgren, Eds.), Uppsala Univ., (1989), 599-600.

P. Farinella, M. Carpino, Ch. Froeschlè, Cl. Froeschlè, R. Gonczi, Z. Knežević, and V. Zappalá: *The ages of asteroid families*, Astron. Astrophys. **217** (1989), 298-306.

Z. Knežević: *Asteroid long-periodic perturbations: the second order Hamiltonian*, Celestial Mechanics **46** (1989), 147-158.

G. B. Valsechi, A. Carusi, Z. Knežević, L. Kresàk, and J. G. Williams: *Identification of asteroid dynamical families*, in: Asteroids II (R. P. Binzel, T. Gehrels and M. S. Matthews, Eds.), Univ. Arizona Press, Tucson, (1989), 368-385.

Z. Knežević, A. Milani: *Asteroid proper elements from an analytical second order theory*, in: Asteroids II (R. P. Binzel, T. Gehrels and M. S. Matthews, Eds.). Univ. Arizona Press, Tucson, (1989), 1073-1089.

H. Debehogne, V. Protitch-Benishek: *Precise minor planet positions obtained at ESO — La Silla in February 1985*, Bull. Obs. Astron. Belgrade **140** (1989), 53-68.

During the first mission in 1985, 258 accurate positions of minor planets were obtained from observations in February by GPO telescope of ESO, La Silla, Chile. The measurements were carried out on a measuring machine Optronics at ESO, Garching and with Ascorecord Zeiss of the Observatoire Royal de Belgique. Three new minor planets were discovered.

H. Debehogne, D. Olević, V. Protitch-Benishek: *546 precise astrometric positions of minor planets obtained at the GPO telescope of ESO — La Silla*, Bull. Obs. Astron. Belgrade **141** (1989), 15-45.

Precise astrometric positions of minor planets: 383 Janina, 1111 Reinmuthia, 1586 Thiele, 1674 Groeneveld, 2682 Soromundi, 2911 1938 GJ, 3009 Coventry, 3032 Evans and 19 new ones, which provisional designations 1986 QB₁ - 1986 QC₃ have been given by the Minor Planet Center, are presented in this paper. Photographic observations of minor planets were carried out in August

and September 1986 with Grand Prism Objective (GPO) at the European Southern Observatory, La Silla, Chile, by H. Debehogne.

H. Debehogne, V. Protitch-Benishek, D. Olević: *Les orbites elliptiques des petites planètes E 3777 et E 3778 découvertes a La Silla*, Acta Astronomica 40 (1990), 4.

In this paper the precise astrometric positions of two new-discovered minor planets, observed with GPO at the ESO — La Silla in 1986, are presented. On the basis of such positions the elliptic orbits are calculated by Gauss-Encke method.

V. Zappalà, A. Cellino, P. Farinella, Z. Knežević: *Asteroid families. I. Identification by hierarchical clustering and reliability assessment*, Astron. J. 100, 6 (1990), 2030.

Substantial discrepancies between the existing classifications and inconsistencies with the results of physical studies have motivated a research program aimed at deriving an improved classification of asteroids in dynamical families. We analyzed a set of 4100 numbered asteroids, whose proper elements had been computed by a new second-order, fourth-degree secular perturbation theory [Milani and Knežević 1990, Celestial Mech. (submitted)], and checked with numerical integrations to assess their long-term stability. A multivariate data analysis technique (*hierarchical clustering*) was applied to build for each zone of the belt a *dendrogram* in the space of proper elements, with a distance function related to the incremental velocity needed for orbital change after ejection from a fragmented parent body. Families were then identified by comparing this dendrogram with a similar one, derived for a quasirandom distribution of elements matching the large-scale structure of the real distribution. A significance parameter was associated with each family, measuring its departure from random concentrations, and two robustness parameters were obtained by repeating the classification procedure after varying the elements by small amounts (consistent with the results of numerical tests of their long-term stability) and changing the coefficients of the distance function. The most significant and robust families are those associated with Themis, Eos, and Koronis, that collectively include about 14% of the known main-belt population; but 12 more reliable and robust families were found throughout the belt, most of which partially match those found in previous classifications. In the Flora region of the inner belt, a reliable identification of families is difficult, since the background has a high density and the accuracy of proper eccentricities and inclinations is poor, mainly because of the proximity to the strong ν_6 secular resonance. Other results include: a relatively populous Eunomia family, lacking large C-type members; a small family having Vesta as its largest object; the disappearance of the unlikely association in one family (Nysa-Hertha) of M, F, and E types; the existence of two small, but robust families with sizeable largest members in the Themis region, at moderate inclinations.

A. Milani, Z. Knežević: *Secular perturbation theory and computation of asteroid proper elements*, Celestial Mechanics and Dynamical Astronomy 49 (1990), 347–411.

A new theory for the calculation of proper elements, taking into account

terms of degree four in the eccentricities and inclinations, and also terms of order two in the mass of Jupiter, has been derived and programmed in a self contained code. It has many advantages with respect to the previous ones. Being fully analytical, it defines an explicit algorithm applicable to any chosen set of orbits. Unlike first order theories, it takes into account the effect of shallow resonances upon the secular frequencies; this effect is quite substantial, e.g. for Themis. Short periodic effects are corrected for by a rigorous procedure. Unlike linear theories, it accounts for the effects of higher degree terms and can thus be applied to asteroids with low to moderate eccentricity and inclination; secular resonances resulting from the combination of up to four secular frequencies can be accounted for. The new theory is self checking: the proper elements being computed with an iterative algorithm, the behaviour of the iteration can be used to define a quality code. The amount of computation required for a single set of osculating elements, although not negligible, is such that the method can be systematically applied on long lists of osculating orbital elements, taken either from catalogues of observed objects or from the output of orbit computations. As a result, this theory has been used to derive proper elements for 4100 numbered asteroids, and to test the accuracy by means of numerical integrations. These results are discussed both from a quantitative point of view, to derive an a posteriori accuracy of the proper elements sets, and from a qualitative one, by comparison with the higher degree secular resonance theory.

7.4. Comets

7.4. Komete

V. Protić-Benišek: *Parabolic orbit of the comet 1977m – Kohler*, Proceedings of the National Conference of Yugoslav astronomers, Publ. Obs. Astron. Sarajevo 1 (1981), 287–291.

On the basis of photographic observations of the comet 197m – Kohler, carried out at the Belgrade Observatory from 3 October to 22 November 1977, its parabolic orbit was derived. The Olbers' method, adjusted to the given case, was employed. Three positions, equidistant with respect to the mean time of observations, were selected from the whole series and the first system of elements was derived. The $(O - C)$ values were then smoothed and a final system established. A good accordance of our orbital elements with those of B. Marsden, derived on the basis of a large number of observations of this comet, covering a considerable longer time interval, can be stated.

V. Protitch-Benishek: *Comet astrographic positions obtained at Belgrade astronomical observatory during 1977–1982*, Bull. Obs. Astron. Belgrade 135 (1985), 54.

During the period 1977–1982 the photographic observations of the four bright comets: 1977 m Kohler, 1979 l Bradfield, 1980 u Panther and 1982 f Chyrymov-Gerasimenko were carried out with the Askania astrograph of the Belgrade Astronomical Observatory. 43 astrographic positions for the equinox 1950.0 were obtained.

V. Protitch-Benishek: *Observations of comet Panther from Belgrade astronomical observatory*, Minor Planet Circular, No. 9437, (1985).

V. Protitch-Benishek: *Observations of comet Chyrymov-Gerasimenko from Belgrade astronomical observatory*, Minor Planet Circular, No. 9513, (1985).

V. Protitch-Benishek: *Precise astrophotographic positions of comet Giacobini-Zinner observed from Belgrade astronomical observatory*, Minor Planet Circular, Nos. 9981, 9988, 9989, (1985).

The comet Giacobini-Zinner was observed over a nearly two months period, from 22 July to 14 September 1985, mostly with the 125/1000 mm Askania photo-visual equatorial. According to the number of its observations this Observatory stands at the 27th place among 61 participants in the Giacobini-Zinner comet imaging. These astrophotographic positions, together with observations of other observatories, served for establishing accurate comet's orbit (IHW orbit No 31), shortly before its encounter with the ICE spacecraft. A curious event took place on 14 September: the comet Giacobini-Zinner approached apparently Halley as closely as 2° . However, since it was Halley that we tracked, a diffuse Giacobini-Zinner comet's trail appears on our photograph in consequence of its apparent motion having been considerably faster.

V. Protitch-Benishek: *Observations of comet P/Halley from Belgrade astronomical observatory*, Minor Planet Circulars, Nos. 10209-10211, (1985).

This paper contains the results of comet Halley observations from September 11, 1985 until 27 May 1986, when it was observed as many as 75 times. On 9 December 1985 the occultation of BD +6°5207 by Halley was observed.

V. Protitch-Benishek: *Results of comet Halley observations at the Belgrade observatory*, Proc. 20th ESLAB Symposium on the Exploration of Halley's Comet, Heidelberg, 27-31 October 1986, ESA SP-250 (1986), 265-266.

With fifty years experience and tradition in Comet observation and research the Belgrade Observatory joined the International Halley Watch as soon as the Comet got within the reach of its instruments — actually not earlier than September 1985. Comet Halley observations were carried out from September 1985 through June 1986, 75 plates in all having been acquired during this period. The resulting precise astrophotographic positions were immediately communicated to the IHW Center. The periodic comet Giacobini-Zinner was also systematically observed during the period June-September 1985, the observations having particularly been intensified in the interval just preceding the ICE spacecraft's closest approach to it. On 9 December 1985 the occultation of BD +6°5207 by Halley was observed. The results of observing this event are briefly reviewed in the present paper.

V. Protitch-Benishek: *Precise astrophotographic positions of Halley comet*, Minor Planet Circular, No. 10331, (1986).

Some of astrophotographic precise positions of comet Halley after its perihelion passage are presented.

- Komete — svedoci prošlosti*, editori: J. Arsenijević i Dj. Teleki, Astronomska opservatorija i Astronomsko društvo "Ruđer Bošković", Beograd, (1986), pp. 142.
- V. Kršljanin: *Nastanak i poreklo kometa*, 7.
 - Dr. M. Dimitrijević: *Izgled i struktura kometa*, 33.
 - Mr. I. Vince: *Stanje materije u kometama*, 45.
 - Dr. V. Vujnović: *Otkuda potječe svijetlost kometa*, 55.
 - Dr. M. Dimitrijević: *Uticaj kometa na Zemlju*, 63.
 - S. Jankov: *Prošlost Halejeve komete*, 69.
 - Dr. Dj. Teleki: *Ujedinjenim snagama u istraživanje Halejeve komete*, 79.
 - N. Čabrić: *Vidljivost Halejeve komete iz Beograda*, 99.
 - Mr. V. Protić-Benišek: *Prvi plodovi istraživanja Halejeve komete u 1985-86. god.*, 105.
 - N. Janković: *Kometa u srpskim zapisima i létopisima*, 111.
 - M. Protić: *Smrt jedne komete*, 121.
 - Mr. J. Arsenijević: *Neki podaci o kometama*, 125.
 - Mr. V. Protić-Benišek: *Posmatranja kometa sa Astronomske opservatorije u Beogradu*, 127.
 - M. Prosen: *Astronomi-amateri i komete*, 135.
 - M. Djokić: *O nastanku termina kometa i neki stari pokušaji objašnjenja komet-skih pojava*, 141.

V. Protitch-Benishek: *Comet astrometry in the post-Halley era*, IX Nacionalna konferencija astronoma Jugoslavije, Sarajevo, (1988).

This paper presents a brief review on the major astrometric results collected during the IHW Astrometric Network and attention is drawn to different aspects of such future investigations.

8. SUN

8. SUNCE

A. Kubičela, J. Arsenijević, S. Manola, Z. Stokić, N. Uzelac, I. Vince: *Flash spectrum observations during total solar eclipse, 1980*, Proc. Symp. Phys. Ion. Gases (SPIG), Ed. B. Čobić, 298 (1980).

A. Kubičela: *Ortogonalne komponente prividne godišnje precesije Sunca*, Saopšteno na VII Kongresu MFA Jugoslavije, Bečići, (1980).

A. Kubičela, M. Karabin: *Detailed treatment of syndic solar rotation*, Publ. Dept. Astron. Univ. Beograd 11 (1981), 35.

Begining with a previous vectorial results about the synodic solar rotation dependance on the inclination of solar equator, the classical definition of synodic solar rotation has been reconsidered in some detail. The angular difference between one synodic and sidereal solar rotation turn, $\Delta\lambda$, as a function of the longitude of the Earth and the inclination of the solar equator,

β , indicates a substantially different nature of trigonometric and vectorial definition of synodic solar rotation. Only a long-term mean value of $\Delta\lambda$ does not depend on β . For the extreme case, $\beta = 90^\circ$, $\Delta\lambda$ shows a purely geometrical discontinuity. On the contrary, the sidereal, apparent annual and synodic rotations of the solar globe are smooth and can be described by the corresponding vectorial angular velocities.

A. Kubičela, M. Karabin: *Line-of-sight velocity field of synodic solar rotation*, Saopšteno na VI Evropskom regionalnom astronomskom sastanku, Dubrovnik, (1981).

A. Kubičela, M. Karabin: *An integral supergranular contribution to the global-scale photospheric line-of-sight velocity field*, Publ. Astron. Obs. Sarajevo **1** (1981), 185.

Taking the contribution of an unresolved supergranular line-of-sight velocity of a given sign as proportional to the mean velocity and to the relative area under the same given velocity, and taking into account the curvature of the photosphere within a supergranule, a new integral effect of higher contribution of approaching velocities in supergranules has been found. It is not negligible near the limb and must be of certain importance in photospheric global-scale velocity and limb effect observations.

A. Kubičela: *Observation of total solar eclipse of 16. February 1980*, Observation of the Total Solar Eclipse of February 16th 1980, ed. S. K. Trehan, Indian National Sci. Academy (1981), 16.

The electronic and photographic equipment used by Belgrade solar expedition in India to observe the partial phases of the eclipse, the flash spectrum, and the polarization of the corona, as well as the obtained results have been described.

A. Kubičela, V. Ruždjak: *Near future research in solar physics in Yugoslavia*, Near Future Plans for Solar Research, ed. C. Jordan, Oxford, (1981), 78.

The research programs in solar physics of Belgrade Astronomical Observatory and Hvar observatory in 1980-ies have been envisaged. The former one is concentrated on very large scale photospheric velocity research observing with the existing equatorial solar spectrograph. In cooperation with Ondřejeov Observatory, the last one focuses its interest on various photospheric and chromospheric physical aspects of active regions. The need for young astrophysicists and international cooperation has been stressed.

A. Kubičela, M. Karabin: *Line-of-sight velocity field of synodic solar rotation*, Proc. VI European Regional Meeting in Astronomy, ed. W. Fricke, G. Teleki, Reidel Publ. Co., (1982), 73.

Angular velocity components of synodic solar rotation have been treated as vectors. A colinear and a perpendicular components with respect to the solar

rotation axis have been found. Factor $\cos 7^\circ 25'$ has been introduced into the apparent effect of the Earth's orbital motion.

A. Kubičela: *Orthogonal components of the apparent yearly precession of the Sun*, Hvar Obs. Bull. Suppl., **1** (1982), 39.

Starting from the apparent yearly precession of the Sun described elsewhere, the components of that motion in the plane of the solar disk have been calculated. A westward apparent velocity amounting up to 2.2 ms^{-1} has been found.

A. Kubičela, I. Vince: *Effects of extrafocal observation with the solar spectrograph of the Belgrade astronomical observatory, I. Solar Rotation, Line-of-sight Velocities*, Bull. Obs. Astron. Belgrade **133** (1983), 1.

The optical averaging of line-of-sight velocities in regions $3'8 \times 3'8$ at the solar disk has been numerically imitated. The contributions of local line-of-sight velocities at any point of the disk have been assumed as proportional to the photospheric continuum intensity at the same point. Such a procedure yields systematically smaller line-of-sight velocities of the solar rotation. The necessary corrections depending on heliographic parameters P and B_0 have been found.

A. Kubičela, M. Karabin: *Another view of synodic solar rotation*, Solar Phys., **84** (1983), 389.

Adding the angular velocity of sidereal solar rotation and the apparent rotational effect of the Earth's revolution vectorially, a new synodic solar rotation vector has been obtained. The sidereal and synodic solar rotation axes (and equators) are separated. Using the known parameters of the Earth's orbital motion, the synodic rotation angular velocity and the inclination of the synodic equator, the corresponding sidereal rotation parameters have been calculated ($\omega = 2.915 \times 10^{-6} \text{ rad s}^{-1}$ and $i_1 = 6^\circ 76'$). Various linear rotational velocities at the solar globe are briefly described.

A. Kubičela, I. Vince: *Effects of extrafocal observation with the solar spectrograph of the Belgrade astronomical observatory, II. Cases of Various Wavelengths and Space-resolutions*, Bull. Obs. Astron. Belgrade **134** (1984), 37.

According to an already published procedure, the space-averaging of the solar image within square regions from $3'8$ to $0'5$ side and for wavelengths 630 nm, 500 nm and 400 nm have been calculated. For a selected sample of P and B_0 the effect has been found amounting up to 33 ms^{-1} .

A. Kubičela: *Dva prodora u dinamici sunčeve fotosfere*, Pregledno predavanje na VIII Kongresu MFA Jugoslavije, Priština, 1985.

A. Kubičela, M. Karabin, Z. Ivanović: *Merenje radijalnih brzina tačkica na Sunčevom disku*, Saopšteno na VIII Kongresu MFA Jugoslavije, Priština, 1985.

A. Kubičela, I. Vince, Z. Ivanović: *Effects of extrafocal observation with the solar spectrograph of the Belgrade astronomical observatory, III. Integration of the limb effect*, Bull. Obs. Astron. Belgrade **135** (1985), 21.

Besides six already known limb effect functions, another one (the Belgrade-Oxford function) has been evaluated. Simulating numerically extrafocal observations of the solar disk, a set of corrections for space-integration of solar radiation within the squares of 3'8, 2'0 and 1'0 sides has been calculated for all the limb effect functions. The corrections amount up to 112 ms^{-1} (or up to 4 ms^{-1} in the case of Belgrade observations).

Z. Ivanović, I. Vince: *Correction to the solar line-of-sight velocities for topocentric motion of the observer*, Publ. Obs. Astron. Belgrade **33** (1985), 19–22.

Method for determining the radial velocity of an observer moving around the Sun is described. The Julian day (JD) as a unique independent variable is used. The method is developed for the reduction of data obtained at Belgrade astronomical observatory in the course of the solar spectral line shift observations. The accuracy is about $\pm 0.1 \text{ m/s}$.

A. Kubičela, M. Karabin, I. Vince, Z. Ivanović: *Further Belgrade results of the large-scale photospheric velocity research*, Bull. Obs. Astron. Belgrade **136** (1986), 1.

From a series of FeI 630.25 nm Doppler shift observations solar equatorial rotational velocity of $2.82 \mu\text{rad s}^{-1}$ has been found. There is a difference between the active and quiet photosphere. The central meridian and equatorial limb effect curves as well as the meridian excess have been evaluated and discussed.

A. Kubičela: *Problem sinodičke rotacije Sunca*, Saopšteno na I Seminaru "Astrofizika u Jugoslaviji", Ljubljana, (1986).

A. Kubičela: *Relation between solar sidereal and synodic rotation axes*, Solar Phys. **106** (1986), 403.

Kinematic picture concerning the solar synodic and sidereal rotation axes has been considered in some detail. Large changes in the synodic rotation pole have been found for some hypothetical cases of out-of-ecliptic intra-Mercurian orbits. The influence of solar differential rotation and variable planetary velocity along the orbit have been taken into account and a continuous set of co-existing synodic poles oscillating around a mean position has been found. The relevant numerical values for the Earth are given and the possibility of detecting the existence of the two rotation axes has been pointed out.

M. Vukićević-Karabin, J. Arsenijević: *Solar and stellar activity phenomena*, Bull. Obs. Astron. Belgrade **136** (1986), 53.

A review is presented of highlights in the solar and stellar activity researches based on latest information, published in the works of other authors, and on the measurements carried out at the Belgrade Observatory. New assumptions

are advanced concerning discrete magnetic solar field of 1–2 KG strength in tubes of 200–400 km diameter. Dependence is outlined of the stellar rotation rate and magnetic activity on stellar age. It is demonstrated that stars with convective zone display magnetic activity which in some of the stars is cyclically repetitive.

E. Ribes, J.-C. Ribes, I. Vince, Ph. Merlin: *On the oscillation of the solar diameter*, C. R. Acad. Sci. Paris **307**, Serie II (1988), 1195–1201.

Systematic visual measurements of the solar diameter (both polar and equatorial) made with the meridian circle have been carried out at the Belgrade astronomical observatory from 1975. The measurements indicate an oscillation similar to that obtained by Laclare with the astrolabe measurements, i.e. a similar period, phase and amplitude. This result confirms the solar (or terrestrial atmosphere) nature of the observed oscillation, thus eliminating the personal equation and instrumental biases.

E. Ribes, J.-C. Ribes, I. Vince, Ph. Merlin: *A survey of historical and recent solar diameter observations*, Adv. Space Res. Vol. **8**, No. 7 (1988), 129–132.

We report new observational evidence of periodic changes in the solar diameter. Progress has been made at two levels:

— Systematic measurements of the solar diameter (both horizontal and vertical) have been made using a Meridian Circle at the Belgrade Observatory, from 1974 to 1986. An oscillation (amplitude of ± 0.20 arcsec, period of about 900 days) is present in both diameters. Although the data are fewer and noisier than the astrolabe measurements made by Laclare (1987), they provide an independent confirmation of the presence of the damped oscillation reported by Delache et al. (1985), with the same phase, period and amplitude.

— A Fourier analysis of the solar diameters observed by La Hire (6.797 values), from 1683 to 1718, has been made. The analysis exhibits a number of peaks, all of which are present in the power spectrum of modern diameter data. In particular, a peak at 9.6 years is clearly visible. This result indicates that the solar cycle occurred during the Maunder minimum, although the dearth of sunspots at the solar surface is confirmed. Some possible implications of these findings are suggested with respect to climatic variability on Earth.

A. Kubičela: *Problem of synodic solar rotation*, Bull. Obs. Astron. Belgrade **140** (1989), 105.

The problem of combining solar sidereal rotation and Earth's revolution in order to determine the solar synodic rotation is pointed out. The early attempts to solve the problem — the hypothesis of the apparent yearly precession and the projection of angular velocity vectors onto the solar rotation axis — are reviewed, and the ripening of the Belgrade hypothesis of separate synodic and sidereal solar rotation axes, as well as some of its results, are presented.

E. Ribes, I. Vince, E. Ferreira: *Meridian Circulation and Solar Rotation Over Solar Cycle 21.*, in: *The Sun and Cool Stars: Activity, Magnetism, Dynamics*, IAU Colloquium 130 (1990), 51.

M. Vuletić, P. Cugnon, J. Arsenijević: *Changes in residual polarization of the corona and the solar activity cycle*, Proc. 6th Europ. Meeting on Solar Phys., *The dynamic Sun*, Debrecen, ed. L. Dezső, (1990), 106.

9. STARS

9. ZVEZDE

9.1. Double and Multiple Star Systems

9.1. Dvojni i višestruki zvezdani sistemi

S. Křiž, J. Arsenijević, J. Grygar, P. Harmanec, J. Horn, P. Koubský, K. Pavlovski, J. Zverko, F. Ždárský: *Strongly interacting binary RX Cas*, Bull. Astron. Inst. Czech. **31**, 5 (1980), 284.

UBV photoelectric observations of RX Cas made in the years 1975 to 1977 at Hvar and Skalná Pleso Observatories are presented. The asymmetry of the light curve and the long-term light variations with the period of 516 days are most conspicuous in the U colour. The high increase of the orbital period ($\Delta P/P = 6.3 \times 10^{-7}$ per cycle) leads to an estimated rate of mass exchange greater than 10^{-6} m/year. The spectroscopic elements by Struve (1944) are re-computed. The case B of mass transfer or the second reverse transfer seems to be appropriate for RX Cas. Possible explanations of light anomalies are discussed.

G. M. Popović: *Orbites nouvelles (ADS 1976)*, Circ. Inf., No. 81, UAI, Comm. des Etoiles Doubles, (Juin 1980).

G. M. Popović: *Étoiles doubles nouvelles (GP 156)*, Circ. Inf., No. 81, UAI, Comm. des Etoiles Doubles, (Juin 1980).

D. J. Zulević: *Orbites nouvelles (ADS 1548, 8145, 10085, 16368)*, Circ. Inf., No. 81, UAI, Comm. des Etoiles Doubles, (Juin 1980).

V. Erceg: *Orbites nouvelles de ADS 2301 = A 2414*, Circ. Inf., No. 81, UAI, Comm. des Etoiles Doubles, (Juin 1980).

V. Erceg: *Les orbites de deux étoiles doubles visuelles. (ADS 2301 = A2414 et ADS 2531 = A 829)*, Bull. Obs. Astron. Belgrade **131** (1981), 20-22.

The autor presents: the orbitae elements, the dynamical parallaxes, the Thiele-Innes constants, the masses, the absolute magnitudes and the ephemerides.

V. Erceg: *Orbite nouvelle de ABS 1345 = A 1*, Circ. Inf., No. 85, UAI, Comm. des Etoiles Doubles, (Oct. 1981).

V. Erceg: *Orbites nouvelles de ADS 674 = A 921AB*, Circ. Inf., No. 85, UAI, Comm. des Etoiles Doubles, (Oct. 1981).

V. Erceg: *Orbites nouvelles de ADS 1393 = HU 804*, Circ. Inf., No. 85, UAI, Comm. des Etoiles Doubles, (Oct. 1981).

D. J. Zulević: *Orbits of five visual binaries*, Bull. Obs. Astron. Belgrade **131** (1981), 15.

Orbits and dynamical parallaxes are presented for five visual binary systems: ADS 1548, ADS 8145, ADS 10085, ADS 16131 and ADS 16368. Calculated positions are compared with observations and ephemerides are given for each system.

D. J. Zulević: *Micrometer measures of double stars (ser. 32)*, Bull. Obs. Astron. Belgrade **131** (1981), 27.

Presented here are 153 measures of 78 Double Stars made with 65/1055 cm refractor of Belgrade Observatory.

D. J. Zulević: *Orbites nouvelles (ADS 1371, 7758, 11989, 16877)*, Circ. Inf., No. 85, UAI, Comm. des Etoiles Doubles, (Oct. 1981).

G. M. Popović: *Orbites nouvelles (ADS 3174)*, Circ. Inf., No. 85, UAI, Comm. des Etoiles Doubles, (Oct. 1981).

G. M. Popović: *Étoiles doubles nouvelles (GP 158, 162, 163, 161, 157, 165)*, Circ. Inf., No. 85, UAI, Comm. des Etoiles Doubles, (Oct. 1981).

G. M. Popović: *New double stars discovered in Belgrade with the Zeiss refractor 65/1055 cm, Supplement VI*, Bull. Obs. Astron. Belgrade **131** (1981), 23.

G. M. Popović: *Glavni pravci i dostignuća savremenih ispitivanja višestrukih sistema*, Publ. Astron. Obs. Sarajevo **1**, No 1, (1981), 269.

D. Olević, D. Djurović: *The periodicity of residuals $\Delta\rho$ and $\Delta\theta$ of the double star ADS 11520*, Publ. Department of Astronomy, Univ. Belgrade **11** (1981).

The periodical variations of the residuals of radius $(O - C)_\rho$ and positional angle $(O - C)_\theta$ of double star ADS 11520 was remarked. From the observations made in period 1900-1976 the corrections of Van den Boss's orbital elements are computed and it is shown that the periodical variations of residuals relative to the new orbital elements exist.

V. Erceg: *Les orbites de trois étoiles doubles visuelles: (ADS 674=A921AB, ADS 1445=AL et ADS 1393=HU 804)*, Bull. Obs. Astron. Belgrade **132** (1982), 22.

The autor presents: the orbital elements, The Thiele-Innes constants, the dynamical parallaxes, the masses and ephemerides.

V. Erceg: *Orbites nouvelles de ADS 2609AB=BU 787AB*, Circ. Inf., UAI, Comm. des Etoiles Doubles.

V. Erceg: *Orbites nouvelles de ADS 3058 = HU 302*, Circ. Inf., No. 88, UAI, Comm. des Etoiles Doubles, (Oct. 1982).

D. J. Zulević: *Orbits of four visual binaries*, Bull. Obs. Astron. Belgrade **132** (1982), 17.

Orbits and dynamical parallaxes are presented for four visual binary systems: ADS 1373, ADS 7758, ADS 11989 and ADS 16877. Calculated positions are compared with observations and ephemerides are given for each system.

D. J. Zulević: *Micrometer measures of double stars (ser. 33)*, Bull. Obs. Astron. Belgrade **132** (1982), 25.

Presented here are 289 measures of 134 Double Star made with 65/1055 cm refractor of Belgrade Observatory.

G. M. Popović: *An unidentified object in the constellation Cetus from 1911*, Bull. Inf. Cent. Données Stellaires, No. 22 (1982), 96.

G. M. Popović: *Orbites nouvelles (ADS 5958)*, Circ. Inf., No. 86, UAI, Comm. des Etoiles Doubles (Février 1982).

G. M. Popović: *Étoiles doubles nouvelles, (GP 169, 171, 170, 172)*, Circ. Inf., No. 88, UAI, Comm. des Etoiles Doubles, (Octobre 1982).

G. M. Popović: *Orbital elements of visual binary systems Σ 248 = ADS 1786 and Σ 535 = ADS 3174*, Bull. Obs. Astron. Belgrade **132** (1982), 13.

G. M. Popović: *Micrometer measures of double stars (series 34)*, Bull. Obs. Astron. Belgrade **132** (1982), 34.

V. Erceg: *Orbites nouvelles de ADS 2111 = BU 83*, Circ. Inf., UAI, Comm. des Etoiles Doubles, (1983).

V. Erceg: *Orbites nouvelles de GLE 1 = IDS 04148S6072*, Circ. Inf., No. 91, UAI, Comm. des Etoiles Doubles, (1983).

V. Erceg: *Orbite nouvelle de ADS 8636 = A3009*, Circ. Inf., No. 91, UAI, Comm. des Etoiles Doubles, (Oct. 1983).

V. Erceg: *Orbite nouvelle de HU 1566 = IDS 05312S5108*, Circ. Inf., No. 91, UAI, Comm. des Etoiles Doubles, (Oct. 1983).

G. M. Popović: *Orbites nouvelles (ADS 13028AB)*, Circ. Inf., No. 91, UAI, Comm. des Etoiles Doubles, (Oct. 1983).

G. M. Popović: *Étoiles doubles nouvelles (GP 178 AB, AC, 173)*, Circ. Inf., No. 91, UAI, Comm. des Etoiles Doubles, (Oct. 1983).

G. M. Popović: *Orbital elements of the binary system ADS 5958 = Σ 170*, Bull. Obs. Astron. Belgrade **133** (1983), 27.

G. M. Popović: *Micrometer measures of double stars (series 35)*, Bull. Obs. Astron. Belgrade **133** (1983), 31.

D. J. Zulević: *Orbites nouvelles (ADS 4)*, Circ. Inf., No. 91, UAI, Comm. des Etoiles Doubles, (1983).

D. J. Zulević: *Micrometer measures of double stars (ser. 36)*, Bull. Obs. Astron. Belgrade **133** (1983), 38.

Presented here are 167 measures of 77 double stars made with 65/1055 cm refractor of Belgrade Observatory.

V. Erceg: *Les orbites de quatre Etoiles doubles visuelles. (ADS 2111 = BU 83, ADS 2609AB = BU 787AB, ADS 3058 = HU 302, GLE 1)*, Bull. Obs. Astron. Belgrade **134** (1984), 54.

The autor presents: the orbital elements, the Thiele-Innes constants, the dynamical paralaxes, the masses and ephemerides.

V. Erceg: *Orbites nouvelles de ADS 5707AB = A 3042*, Circ. Inf., No. 93, UAI, Comm. des Etoiles Doubles, (Juin 1984).

D. Olević, V. Erceg: *Orbites nouvelles de ADS 8718 = HU 641*, Circ. Inf., No. 95, UAI, Comm. des Etoiles Doubles, (Feb. 1984).

D. J. Zulević: *Micrometer measures of double stars (ser. 38)*, Bull. Obs. Astron. Belgrade **134** (1984), 64.

Presented are 262 measures of 107 double stars made with the 65/1055 cm refractor of Belgrade Observatory.

D. J. Zulević: *Orbits of two visual binaries*, Bull. Obs. Astron. Belgrade **134** (1984), 58.

Orbits and dynamical parallaxes are presented for the binaries ADS 4,974. Calculated positions are compared with observations and ephemerides are given for each system.

D. J. Zulević: *Orbites nouvelles (ADS 2446)*, Circ. Inf., No. 93, UAI, Comm. des Etoiles Doubles, (1984).

G. M. Popović: *Micrometer measures of double stars (series 37)*, Bull. Obs. Astron. Belgrade **134** (1984), 60.

D. Olević, V. Erceg: *Orbite nouvelle de 8926 = A 1789*, Circ. Inf., No. 95, UAI, Comm. des Etoiles Doubles, (Feb. 1985).

V. Erceg, D. Olević: *Orbite nouvelle de SLR 19 = IDS 14012S4924*, Circ. Inf., No. 96, UAI, Comm. des Etoiles Doubles, (Juin 1985).

V. Erceg: *Les orbites de trois étoiles doubles visuelles. (ADS 3686, IDS 05312S5108, ADS 5707AB)*, Bull. Obs. Astron. Belgrade **135** (1985), 45–46.

The author presents: the orbital elements, the Thiele-Innes constants, the dynamical parallaxes, the masses and the ephemerides.

D. J. Zulević: *Étoiles doubles nouvelles (Lunette de 65 cm Belgrade)*, Circ. Inf., No. 96, UAI, Comm. des Etoiles Doubles, (1985).

G. M. Popović: *IDS triple systems*, Publ. Obs. Astron. Belgrade **33** (1985), 88.

G. Djurašević: *Critical equipotential surfaces in close binary systems*, Astrophys. Space Sci. **124** (1986), 5–25.

The well-known problem of reckoning the critical surfaces (equipotential zero-velocity surfaces) in the close binary systems is approached by an independent method. The formulation of the problem is based on the assumptions of the binary's matter consisting of ionized hydrogen, the system possessing black-body radiation, a potential magnetic field, being in adiabatic equilibrium. Total pressure and total internal energy are examined. The model, implying synchronous rotation of the components, is described by hydromagnetic equations. For a statical case, however, it is representable by the equation of motion alone. Next, the temperature field is reproduced whereby the ratio $P_r/P_g = \alpha$ is playing part of a free parameter. The resulting potential functions, applied to particular binaries, furnish the Lagrangian collinear points, critical surfaces and potentials over them in terms of α . The families of surfaces thus obtained, compared with those originating from the Roche model, differ qualitatively in their geometry, position of the collinear equilibrium points, number of possible equilibrium states and the values of critical potentials. At identifying the allowed and forbidden regions of the gas motion new areas have been disclosed across which the gas outflow can take place and more possibilities of shell forming both around the individual components and the system as a whole. As the gas enthalpy and radiation are increased, the surface geometry is undergoing changes. The method enables the intensity of gas velocity to be ascertained at any point in the system. The results of the method outlined here complement the picture of possible equilibrium states in the close binary systems in the presence of radiation and magnetic field.

V. Erceg and D. Olević: *Orbits of four visual double stars ADS 8718, ADS 8926, IDS 14012S4924, IDS 14571S4012*, Bull. Obs. Astron. Belgrade **136** (1986), 78–81.

Presented are preliminary orbital elements, dynamical parallaxes, absolute magnitudes, masses, ephemeris and residuals of four visual double stars.

V. Erceg, D. Olević: *Orbite nouvelle de I 1262 = IDS 14571S4012*, Circ. Inf., No. 98, UAI, Comm. des Etoiles Doubles, (Feb. 1986).

V. Erceg, D. Olević: *Orbites nouvelles de HU 657 = ADS 9711*, Circ. Inf., No. 100, UAI, Comm. des Etoiles Doubles, (Oct. 1986).

D. J. Zulević: *Orbites nouvelles (ADS 8242, 10459)*, Circ. Inf., No. 98, UAI, Comm. des Etoiles Doubles, (1986).

D. J. Zulević: *Orbites nouvelles (ADS 10385)*, Circ. Inf., No. 99, UAI, Comm. des Etoiles Doubles, (1986).

D. J. Zulević: *Micrometer measures of double stars (Ser. 40)*, Bull. Obs. Astron. Belgrade **136** (1986), 91-99.

Presented here are 289 measures of 103 double stars made with 65/1055 cm refractor of Belgrade Observatory.

G. M. Popović: *Orbite nouvelle: ADS 15007*, Circ. Inf., No. 98, UAI, Comm. des Etoiles Doubles, (1986).

G. M. Popović: *Étoiles doubles nouvelles (GP 192, 193, 191, 188, 190)*, Circ. Inf., No. 98, UAI, Comm. des Etoiles Doubles, (1986).

G. M. Popović: *Orbite nouvelle: ADS 9595*, Circ. Inf., No. 100, UAI, Comm. des Etoiles Doubles, (1986).

G. M. Popović: *New double stars discovered at Belgrade observatory with the Zeiss refractor 65/1055 cm. Supp. VII*, Bull. Obs. Astron. Belgrade **136** (1986), 49-52.

G. M. Popović: *Micrometer measures of double stars (Series 39)*, Bull. Obs. Astron. Belgrade **136** (1986), 84-90.

D. Olević, V. Erceg: *Orbits of two visual double stars. (IDS 15428N5059 and IDS 16358S3653)*, Bull. Obs. Astron. de Belgrade **137** (1987), 80-81.

The authors present: the orbital elements, the Thiele-Innes constants, the dynamical parallaxes, the masses and the ephemerides.

V. Erceg, D. Olević: *Orbites nouvelles de SEE 318 = IDS 16594S3829*, Circ. Inf., No. 103, UAI, Comm. des Etoiles Doubles, (Oct. 1987).

V. Erceg, D. Olević: *Orbites nouvelles de I 600 = IDS 17225S6022*, Circ. Inf., No. 103, UAI, Comm. des Etoiles Doubles, (Oct. 1987).

G. Djurašević: *Light curve variabilities of close binaries*, Publ. Astron. Institute of Czechosl. Acad. Sciences **70** (1987).

In the paper is considered a possibility of the determination of the parameters of close binaries of the type RS CVn by means of the comparison of the light

curve derived from photoelectric measurements to a synthetic curve obtained on the basis of a model of a binary system. The inverse problem method based on the nonlinear least square method is used. A few test examples and a shorter analysis of the proposed method are given.

D. J. Zulević: *Orbites nouvelles (IDS 16594S3829)*, Circ. Inf., No. 102, UAI, Comm. des Etoiles Doubles, (1987).

S. Ninković, G. M. Popović: *Unseen Companions to Stars*, Bull. Obs. Astron. Belgrade, **137** (1987), 44.

The existing data concerning 32 unseen companions are compiled and presented in Table I of the paper. The contribution of unseen companions to the local mass density is estimated. A value of $0.0044 \mathcal{M}_{\odot} \text{pc}^{-3}$ is found. Only one of the stars listed in Table I (Barnard's star) seems to be a strong candidate to possess a planetary system, according to the accepted criteria.

G. M. Popović: *Étoiles doubles nouvelles (GP 194, 197)*, Circ. Inf., No. 103, UAI, Comm. des Etoiles Doubles, (1987).

G. M. Popović: *The binary star $\Sigma 2799 = \text{ADS } 15007$* , Bull. Obs. Astron. Belgrade **137** (1987), 82–84.

D. J. Zulević: *Micrometer measurements of double stars (Ser. 42)*, Bull. Obs. Astron. Belgrade **138** (1988), 63–75.

Presented here are 420 measurements of 154 double stars made with 65/1055 cm refractor of Belgrade Observatory.

D. J. Zulević: *Orbites nouvelles (ADS 15988)*, Circ. Inf., No. 106, UAI, Comm. des Etoiles Doubles, (1988).

G. M. Popović, V. Trajkovska: *Relative motion of the components of the system GP 34 AB*, Bull. Obs. Astron. Belgrade **139** (1988), 65.

The rectilinear trajectory and ephemeris of the GP 34 AB to the 2020.0 are given. Relative proper motion of the component B, i.e. BD $+34^{\circ}3568$ star, of $0''.116/\text{year}$ in the direction $341^{\circ}5$ results from the trajectory elements.

G. M. Popović: *Micrometer measurements of double stars (Series 41)*, Bull. Obs. Astron. Belgrade **138** (1988), 55–62.

D. J. Zulević: *Orbites nouvelles (ADS 12631)*, Circ. Inf., No. 107, UAI, Comm. des Etoiles Doubles, (1989).

G. M. Popović, D. J. Zulević: *Micrometer measurements of triple stars (Ser. 43)*, Bull. Obs. Astron. Belgrade **140** (1989), 83.

326 measurements of triple systems from the Belgrade Survey of triple Systems, IDS Catalogue (up to 200 pc) and from the Leningrad Programme of Nearby Triple Stars are communicated.

D. J. Zulević: *Micrometer measurements of double stars (Ser. 44)*, Bull. Obs. Astron. Belgrade **140** (1989), 99.

Presented here are 156 measurements of 74 double stars made with 65/1055 cm refractor of Belgrade observatory.

G. M. Popović, Z. Čatović: *Orbite nouvelle: ADS 10838*, Circ. Inf., No. 107, UAI, Comm. des Etoiles Doubles, (1989).

G. M. Popović, Z. Čatović: *Orbite nouvelle: ADS 10429*, Circ. Inf., No. 109, UAI, Comm. des Etoiles Doubles, (1989).

G. M. Popović, D. J. Zulević: *Micrometer measurements of triple star systems — Series No. 43*, Bull. Obs. Astron. Belgrade **140** (1989), 83–97.

G. M. Popović, V. Trajkovska: *Relative proper motions of components of 16 triple star systems*, Bull. Obs. Astron. Belgrade **140** (1989), 43–46.

By comparing the proper motions determined from meridian measurements with the relative proper motions obtained from rectilinear trajectories it is concluded that out of 16 examined triple systems 11 systems have at least one optical component.

D. J. Zulević: *Orbites nouvelles (ADS 6582)*, Circ. Inf., No. 111, UAI, Comm. des Etoiles Doubles, (1990).

D. J. Zulević: *Orbites nouvelles (ADS 9425)*, Circ. Inf., No. 112, UAI, Comm. des Etoiles Doubles, (1990).

G. M. Popović, Z. Čatović: *Orbite nouvelle: ADS 16242*, Circ. Inf., No. 112, UAI, Comm. des Etoiles Doubles, (1990).

Ž. P. Anosova, G. M. Popović: *Programma izucheniya trojnykh zvezd. Vydelenie sistem s fizicheski svyazanimi komponentami*, Kinematika i fizika nebesnykh tel, VINITI, No. 5694-B89, (1990).

Ž. P. Anosova, G. M. Popović: *Discovery of triple stars with physically connected components*, Kinematika i fizika nebesnykh tel, 1990/1.

9.2. Variable Stars

9.2. Promenljive zvezde

J. Arsenijević, A. Kubičela, I. Vince: *Surprisingly high optical polarization of μ Cephei*, Inf. Bull. Var. Stars, 1859, (1980).

J. Arsenijević: *Optical polarization of some cool supergiants*, Publ. Obs. Astron. Belgrade **28** (1980), 1.

Mathematical description of linearly polarized light is briefly presented in this paper. Also, some mechanisms of the origin of polarized radiation in stars

are described. In the case of six late spectral type supergiants the optical polarization has been measured. The analysis of the measured polarization of all observed stars has led to the positive conclusion about the existence of the intrinsic polarization changes originating in the circumstellar envelopes.

J. Arsenijević: *Polarimetry in astronomy*, Proc. IV National Conf. Yugoslav Astronomers, Sarajevo, (1981), 181.

Polarization as one of the fundamental properties of radiation and polarimetry as a method capable of giving important informations in astronomy has been presented. The complementary character of polarimetric and photometric methods is stressed. Some results of variable stars polarimetry are shown.

J. Arsenijević: *Synchronous changes of polarization, brightness and radial velocities of α Andromedae*, Bull. Obs. Astron. Belgrade **131** (1981), 13.

The complex event on the star α And in the interval of time JD 2442700-800 is analysed. It seems likely that synchronous changes of linear optical polarization, brightness and radial velocities were observed.

J. Horn, P. Koubský, J. Arsenijević, J. Grygar, P. Harmanec, J. Krpata, S. Kříž, and K. Pavlovski: *Radial-velocity and photometric variations of α And: Critical evaluation of possible periods*, Be stars, Proc. IAU Simp. 98, eds. M. Jachske, H. G. Groth, (1982), 315.

All available data on radial velocities and, photometric measurements in the visible region are collected and evaluated periodicities are reported.

J. Arsenijević: *A possible eruptive event on M-supergiant μ Cephei*, Astron. Astrophys. **145** (1985), 430.

A sudden fast brightening of μ Cep amounting to 0.034 magnitude in V spectral region has been observed on August 3, 1981 at 0^h31^m9 UT. The observation was done with the Belgrade polarimeter using 4^s integration intervals. Standard deviation of the measurements was ± 0.011 mag. The shape and duration of the disturbed portion of the light curve of the observed event evokes those of an ordinary M-dwarf flare. New complex observations of μ Cep are necessary.

J. Arsenijević, S. Jankov, G. Djurašević, I. Vince: *Promene optičke polarizacije nekih Be zvezda*, Saopštenja, VIII Kongres fiz. mat. astronoma Jugoslavije, (1985), 341.

M. Vukićević-Karabin, J. Arsenijević: *Aktivni fenomeni na Suncu i zvezdama*, Saopštenja, VIII Kongres fiz. mat. i astron. Jugoslavije, (1985), 342.

G. Djurašević, J. Arsenijević, Z. Knežević: *Short-term variations of α And?*, Bull. Obs. Astron. Belgrade **135** (1985), 32-39.

Photoelectrical observations of α And revealed this object probably having short-term variations (on a time scale of 0.1 days) of low amplitude (about

0.01 magnitude), superimposed on the variations of longer (on the time scale of 1 day) periods. These short-term variations, if assumed to be a consequence of a pulsating mechanism in the star and treated as such, furnish a period consistent with the observed one.

J. Arsenijević, S. Jankov, G. Djurašević, I. Vince: *Variations of the linear optical polarization of κ Draconis*, Bull. Obs. Astron. Belgrade **136** (1986), 6-11.

It is demonstrated that the slow going variations in the linear intrinsic polarization of the star κ Dra in the spectral band V were present in the period 1979 to 1984.

The variations were within approximately 0.13 and 0.61 polarization percent, the minimum having taken place during 1980. The position angle varied between 5° and 22° . As of 1981 the polarization percent is continuously increasing while the position polarization percent has been occasioned by the emission from the shell which is largely unpolarized.

J. Arsenijević, S. Jankov, I. Vince and G. Djurašević: *Optical polarization changes of 88 Her in the period 1974-1985*, Bull. Obs. Astron. Belgrade **137** (1987), 49.

Linear optical intrinsic polarization of 88 He (HD 16273) measured with the Belgrade polarimeter in the period 1974-1985 has been presented. The polarization percentage changed from 0.15% (1976) to 0.56% (1979). Small values of polarization percentage corresponded to the period with negligible envelope effects. The maximum polarization has been found during the early period of a strong shell phase, about one year after brightness minimum. The polarization position angle varies between 58 and 83 degrees. An indication of the correlation between polarization percentage and H-alfa emission line intensities is demonstrated.

J. Arsenijević, A. Kubičela, I. Vince: *Be stars-challenge to the observers and theoreticians*, II Workshop Astrophysics in Yugoslavia, Abstracts, Beograd, Ed. M. Dimitrijević, (1987), 1.

J. Arsenijević, S. Jankov, G. Djurašević: *Long-term polarization changes of 88 Her*, Proc. IAU Coll. 92, Physics of Be Stars, (Eds. A. Slettebak, T. P. Snow), (1987), 200.

Linear optical polarization of 88 Her has been measured in V spectral region during the period 1974-1985. The mean annual values of the intrinsic polarization parameters are presented. The polarization percentage changes from 0.15% (1976) to 0.56% (1979). Small values of the polarization percentage correspond to the period when the envelope effect is negligible. The maximum of polarization percentage has been found during the early period of strong shell phase. The polarization position angle varies between 53 and 83 degrees.

S. Jankov, B. Foing: *Indirect imaging of active RS CVn stars*, Proc Cambridge Workshop: Cool Stars, Stellar Systems and the Sun, (eds. J. L. Linsky and R. E.

Stencel), Springer-Verlag, Berlin-Heidelberg (1987), 528.

The RS CVn system HR 1099 has been monitored over the orbital period to study spectroscopic variability in photospheric lines and in $H\alpha$. The information provided by the variability of profiles, together with the limits of the Doppler imaging method are also presented. Different inversion algorithms were applied to test the image reconstruction of HR 1099, showing the role of such constraints as chi-square adjustment of the spectra and maximum entropy of the input image.

B. Foing, S. Jankov: *Doppler imaging, MUSICOS (Multi Site Continuous Spectroscopy)*, Proc. Meudon Workshop, eds. C. Catala and B. Foing, (1987).

R. Duemmler, A. Kubičela, V. Doazan, B. Bourdonnau and J. Arsenijević: *The development and weakening of the shell spectrum of 88 Herculis (1977–1987). I. A radial velocity study*, Astron. Astrophys. Suppl. Ser. **75** (1988), 311.

We present new radial velocity measurements of 88 Her during 1977–1987, when the shell spectrum first developed and subsequently weakened. The data show that: (i) the radial velocity variations of the blue Balmer shell lines continued without any detectable change of the 86.72 day period; (ii) the radial velocity of the $H\alpha$ shell line of the new set of data seems to follow the same behaviour as the blue Balmer shell lines; (iii) the V/R at $H\alpha$ shows a clear trend toward values < 1 when the blue Balmer lines are more negative than the gamma velocity, and conversely; (iv) the FeII shell lines follow the same periodic behaviour as the Balmer shell lines, with a suggestion of slightly more negative values; (v) the radial velocities of the CaII (K) and NaI (D1 and D2) lines are variable, but they do not follow the periodic radial velocity curve of the blue Balmer shell lines. Their mean values are significantly more negative than that of all the other shell lines studied in this paper.

J. Arsenijević, A. Kubičela and I. Vince: *Be stars — a challenge to the observers and theoreticians*, Bull. Obs. Astron. Belgrade **138** (1988), 31.

The main historical steps in the investigation of the B stars with emission lines, starting with the year 1922 when IAU Commission 29 introduced the name “Be stars” at the first General Assembly of the Union in Rome and closing with the IAU Colloquium No. 92 “Physics of Be Stars” organized in August 1986 in Boulder, are briefly reviewed. The enormous quantity of the existing observational data and their significant characteristics over broad spectral region from X-ray to radio wavelengths are discussed. One of the main characteristics — photometric and spectral time variability — is analysed with a special attention to long-term changes. The correlation of long-term photometric and spectral changes with the polarimetric ones for some stars has been mentioned. Observational results in confrontation with the theoretical interpretations from Struve’s hypothesis to the contemporary empirical Be stars models are presented.

J. Arsenijević, S. Jankov, G. Djurašević, I. Vince: *Long-term changes of linear optical polarization of Be stars*, Bull. Obs. Astron. Belgrade **140** (1989), 1.

As a part of a more extensive research program at Belgrade Astronomical

Observatory, the first results of ten-year optical polarization measurements of α And, 88 Her, κ Dra and γ Cas have been shown. The existence of slow changes of polarization parameters has been established in all four stars. For two of them, 88 Her and κ Dra, the intrinsic polarization has been determined. A further analysis of these results is in preparation.

J. Arsenijević, A. M. Hubert, S. Jankov, I. Vince: *Common properties of some Be stars observational parameters*, Abstracts, Treći seminar Astrofizika u Jugoslaviji, Zagreb, ed. V. Vujnović, (1989).

J. E. Neff, F. M. Walter, S. L. Skinner, A. Brown, K. G. Strassmeier, M. Rodono, G. Cutispoto, S. Jankov, S. Char: *Ultraviolet, visible and radio observation EI Eri*, Proc. IAU Coll. 106, Evolution of Peculiar Red Giant Stars, eds. H. R. Johnson and Zuckerman, (1989).

B. Foing, S. Jankov: *Imagerie Doppler d'étoiles active de types RS CVn*, Proc. MUSICOS Workshop, Meudon, (1989), 6.

J. Arsenijević, S. Jankov, G. Djurašević: *Changes of some envelope characteristics of Be star gamma Cas*, Contributed papers, XV SPIG, Dubrovnik, ed. D. Veža, (1990), 374.

J. Arsenijević, S. Jankov: *Long-term polarimetric activity of cold supergiant μ Cep*, Abstracts, IAU Coll. 130, The Sun and cool Stars, (1990), 104.

S. Jankov, B. Foing: *ESO remote control observations from Garching for MUSICOS'89 campaign*, Proc. II MUSICOS Workshop, eds. C. Catala and B. Foing, Meudon, (1990), 65.

B. Foing, S. Char, S. Jankov, C. Catala, D. S. Zhai: *First results from MUSICOS'89 campaign: Active surface structure and flares on HR1099*, Proc. II MUSICOS workshop, eds. C. Catala, and B. Foing, Meudon, (1990), 117.

10. STAR CLUSTERS AND GALAXIES

10. ZVEZDANA JATA I GALAKSIJE

S. Ninković: *Disc-to-Halo Nonthermal Emissivity Ratio according to a Study of the Radio Background at 10 MHz*, Publ. Astron. Obs. Sarajevo **1** (1981), 219.

An analysis of the data of Caswell's (1976) map aimed at determining the disc-to-halo nonthermal emissivity ratio is undertaken. A comparison with Fenkart's (1977) results gives indications in favour of the existence of a correlation between disc-to-halo mass ratio and disc-to-halo nonthermal emissivity ratio.

S. Ninković: *On the Study of the Globular Cluster ω Cen*, Bull. Appl. Math. **193** (1983), 53.

A short report on a study of the globular cluster ω Cen is given. Examinations on the basis of the virial theorem and a tidal radius determination show that

a large mass, like that obtained in a paper by Ogorodnikov et al. in 1976, is possible for this cluster. An empirical model of the cluster, indicating that the largest fraction of the total mass is present near the centre, is constructed, as well.

S. Ninković: *On Eccentricities of Globular Cluster Galactocentric orbits*, *Astron. Nachr.* **304** (1983), 305.

The House-Wieganndt method is modified and applied to a large sample of globular clusters belonging to our Galaxy. The results obtained indicate high orbital eccentricities for them, but clearly demonstrating the differences among globular clusters of different chemical composition.

P. Brosche, M. Geffert, S. Ninković: *Lessons from the Globular Cluster NGC 5466*, *Publ. of the Astron. Inst. of the Czechosl. Acad. Sciences* **56** (1983), 145.

NGC 5466 is a "loose" globular cluster (large core radius) with low metallicity. Its absolute velocity has been measured and leads to perigalactic distances around 6 kpc. The value of the observed "tidal radius" is clearly too large in comparison with the theoretical value.

S. Ninković: *Opređenje mass sferičkih skupljenij po sobstvenym dvizheniyam*, *Astrofizika* **20** (1984), 283.

A determination for globular cluster masses for M 15, M 92 and M 13 by use of the methods proposed by Naumova and Ogorodnikov and by applying the virial theorem is made. A discussion of obtained results is presented as well.

S. Ninković: *Results of the Galactocentric Orbit Calculation for a Globular Cluster NGC 5466*, *Pub. Obs. Astron. Belgrade* **33** (1985), 32.

In the calculation in addition to the other data, the proper motion of NGC 5466, recently determined at Bonn observatory, is also used. In spite of a large proper motion error the obtained results clearly indicate an orbit, highly inclined to the galactic plane ($80^\circ \pm 10^\circ$) and highly elongated (eccentricity 0.7).

S. Ninković: *On the Structure and Mass of the Galactic Halo*, *Astrophys. Space Sci.* **110** (1985), 379.

On the basis of a globular cluster study a crude estimate of the total mass of the galactic halo within 20 kpc from the centre is done. It gives a minimal halo mass of the order of $10^{10} M_\odot$, yielding possibilities for a mass as large as $10^{11} M_\odot$. The content of the interstellar matter in the halo is estimated too. It is found that the gas content is a few percents the minimal mass, the gas temperature is very high-about 1×10^6 K, the magnetic field weak-about 0.25 nT. A weak nonthermal radio emission might be expected from such a halo.

S. Ninković: *On Tidal Radius Determination for a Globular Cluster*, *Astron. Nachr.* **306** (1985), 237.

A tidal radius determination for a globular cluster based on its density minimum, which is caused by the galactic tidal forces and derivable from a model of the Galaxy, is proposed. Results obtained on the basis of the Schmidt model for two clusters are in a satisfactory agreement with those obtained earlier by means of other methods. A mass determination for the clusters through the tidal radius, when the latter one is identified with the cluster perigalactic distance, yields unusually large mass values. Probably, the tidal radius should be identified with the instantaneous galactocentric distance. Use of models more recent than the Schmidt one indicates that a globular cluster may contain a significant portion of an invisible interstellar matter.

P. Brosche, M. Geffert, A. R. Klemola, R. S. Ninković: *One more Space Motion of a Globular Cluster: NGC 147*, *Astron. J.* **90**, 2033 (1985), 126.

From measurements of 39 stars with respect to the extragalactic Lick reference system, we derived the absolute proper motion of NGC 4147 and—using in addition the radial velocity — the space velocity with respect to various standards. The membership of individual stars of special astrophysical interest is discussed. Parameters of the cluster's galactic orbit are presented together with those of the previously treated cluster NGC 5466. Among these, the relatively low angular momenta seem to be especially remarkable.

S. Ninković: *K otsenke orbital'nogo ékstsentriziteta*, *Astrofizika* **24** (1986), 411.

A Criterion for orbital eccentricity evaluating for objects moving in a spherically symmetric force field with mass distribution $\mathcal{M}ar^\beta$, based on the radial component rate in total kinetic energy is proposed. The latter quantity preserves a nearly constant value over a sufficiently large fraction of the orbit, admitting thus its instantaneous value to be a measure of the eccentricity.

S. Ninković: *A Further Study of the Globular Cluster M 71*, *Bull. of Astron. Inst. of Czech.* **38** (1987), 147.

For the purpose of determining the galactocentric orbit and tidal radius of the globular cluster M 71 (NGC 6838) is used, inter alia, the most recent observational material: the proper motion and heliocentric distance, determined by Cudworth. An attempt aimed at mass determination is done, too, whereby, inter alia, the method proposed by Naumova and Ogorodnikov is used.

Main results:

i) The cluster moves almost in the galactic plane, along a low-eccentricity orbit. The orbital eccentricity is most likely equal to 0.2, with a possible uncertainty limit of 0.1; apo- and perigalactic distances are most likely equal to 7.7 kpc and 5.1 kpc, respectively.

ii) The tidal radius appears to be within the limits 19–46 pc depending on the assumed concept.

iii) The mass value of $3 \times 10^4 \mathcal{M}_\odot$ expected on the basis of the luminosity, seems justified, though the possibility of a higher mass cannot be excluded.

S. Ninković: *Orbital Eccentricity Study for the Spherical Component of our Galaxy*, *Astrophys. Space Sci.* **136** (1987), 299.

An analysis of the data concerning high-velocity stars from Eggen's catalogue aimed at a determination of the approximate slope of the mass function for the spherical component of our Galaxy, and at estimating the local circular velocity, as well as the local rotation velocity, as by-products, has been performed. Our conclusions are that:

- (i) a linear dependence of the mass on the radius is very likely;
- (ii) the value of the limiting radius is most likely equal to (40 ± 10) kpc
- (iii) the two local velocities are approximately equal to each other, being both equal to (230 ± 30) km s^{-1} .
- (iv) the local escape velocity appears to be most likely equal to (520 ± 30) km s^{-1} ;
- (v) the total mass of a corona, obtained in this way, is $(5 \pm 1) \times 10^{11} \mathcal{M}_\odot$.

S. Ninković: *Dynamical Constants for our Galaxy*, *Publ. of the Astron. Inst. Czechosl. Acad. Sciences* **69** (1987), 317.

According to the present author's results a following system of the galactic dynamical constants is proposed: local escape velocity $u_e = (520 \pm 30)$ km s^{-1} , local circular velocity, $u = (230 \pm 30)$ km s^{-1} , local angular velocity of rotation, $\omega = (25 \pm 5)$ $\text{km s}^{-1} \text{ kpc}^{-1}$, local circular frequency of planar oscillations, $\kappa_p = (40 \pm 10)$ $\text{km s}^{-1} \text{ kpc}^{-1}$, local circular frequency of vertical oscillations, $\kappa_z = (70 \pm 20)$ $\text{km s}^{-1} \text{ kpc}^{-1}$. The value of (9 ± 1) kpc is assumed for the galactocentric distance of the Sun. The latter three values yield $(0.09 \pm 0.03) \mathcal{M}_\odot \text{ pc}^{-3}$ for the local matter density, a value very close to the density obtained by use of statistical methods. On the basis of the proposed value it is concluded that the dark matter should be present in the form of a large, rarefied, massive, spherical corona.

S. Ninković: *Galactocentric Orbit and Tidal Radius of M 22*, *Bull. Obs. Astron. Belgrade* **139** (1988), 21.

The globular cluster M 22 (6656) appears to be in a not very eccentric orbit — $e = 0.5 \pm 0.2$ — especially not highly inclined to the galactic plane — $i = 150^\circ \pm 20^\circ$, as predicted by the present author (Ninković, 1983) on the basis of a statistical study. The tidal radius is found to be within the limits 28–86 pc depending on the cluster's mass and tidal radius concept assumed.

S. Ninković, A. D. Chernin, M. B. Shakenov: *O raspredelenii skrytykh mass v Mestnoj grupe galaktik*, *Astron. Tsirk.* **1541** (1989), 1.

Dynamical models of the Local Group of galaxies involving various types of distribution of dark matter have been studied with numerical simulation. The

results have proved to be in favour of models with individual massive coronae around the two major galaxies of the Group.

S. Ninković: *On the Flattening of the Galactic Corona*, Bull. Astron. Inst. Czech. **41** (1990), 236.

A possible flattening of the galactic (dark) corona is examined. It was found that, if the corona makes an essential contribution to the local density of the galactic matter, it should be at least as flattened as 0.1.

11. THEORETICAL ASTROPHYSICS AND PLASMA PHYSICS 11. TEORIJSKA ASTROFIZIKA I FIZIKA PLAZME

11.1. Radiative Transfer

11.1. Prenos zračenja

O. Atanacković, E. Simonneau: *Effects of elastic collisions on the local frequency redistribution in the transfer of resonant line photons*, Annales de Physique, Colloque No. 3, Vol. **11** (1986), 137-138.

The effects of elastic collisions on the local frequency redistribution of resonant line photons are shown through the behaviour of the velocity distribution function of the excited atoms, emission profile coefficient and radiation intensity.

O. Atanacković: *Analiza nelokalnih efekata u ne-LTR prenosu zračenja u rezonantnim linijama zvezdanih atmosfere*, Magistarski rad, Beograd, Decembar 1986.

O. Atanacković-Vukmanović, E. Simonneau: *Kinetic effects in non-LTE line transfer in stellar atmospheric conditions*, Bull. Obs. Astron. Belgrade **137** (1987), 66-79.

A survey of the main stages in the development of radiative transfer theory is given. Special attention is dedicated to an analysis of kinetic (local and non-local) effects of the transport of the excited atoms in two approximations of the general, selfconsistent solution. In both cases, emission profile coefficient is coherently derived proceeding from the velocity distribution function of the excited atoms.

O. Atanacković-Vukmanović, E. Simonneau: *Parameters characterizing non-LTE line radiative transfer in some astrophysical conditions*, Bull. Obs. Astron. Belgrade **137** (1987), 58-65.

In this paper, the values of three dimensionless parameters: ε , ζ and η , characterizing non-LTE line formation, and measuring, respectively, the importance of inelastic collisions, elastic collisions and streaming of excited atoms, are estimated for different astrophysical conditions. The estimation is performed for the atmospheres of main sequence stars, those of white dwarfs and gaseous

nebulae and for the resonance lines formed therein. It is shown that in all cases except for the Lyman α line, for which kinetic non-local effects can be significant, local "classical" partial redistribution theory should be used.

O. Atanacković-Vukmanović, M. S. Dimitrijević, E. Simonneau: *Karakteristike prenosa zračenja u pražnjenjima visokog pritiska koja se koriste u svetlosnim izvorima*, Zbornik radova sa 29. Simpozijuma "Etan u pomorstvu", Zadar, (1987), 282–284.

O. Atanacković-Vukmanović, E. Simonneau: *An approximative solution in the frame of kinetic non-LTE approach of Lyman alpha line transfer in chromospheric conditions*, II Workshop "Astrophysics in Yugoslavia", Beograd, (1987), 21–22.

O. Atanacković, J. Borsenberger, J. Oxenius, E. Simonneau: *Resonance line transfer and transport of excited atoms — III. Self-consistent solutions (2)*, J. Quant. Spectrosc. Radiat. Transfer **38** (1987), 427–446.

In this last part of our study on non-LTE line transfer with convective transport of excited atoms, we present self-consistent solutions of the radiative transfer equation and the kinetic equation of the excited two-level atoms when the excited atoms undergo elastic velocity-changing collisions. We assume pure Doppler broadening of the spectral line and investigate reflecting and destroying boundaries for the excited atoms. Concerning elastic collisions of the excited atoms, our study covers all cases, from a collisionless gas (free particle streaming) discussed in Part II of this series of papers, to a collision — dominated gas with the limiting case of complete redistribution. We present arguments that the streaming pattern of the gas of excited atoms does not depend critically on the shape of the line profile. Therefore, our results for a pure Doppler profile may also be used for other line profiles (Voigt, Lorentz) in a first approximation, at least when the streaming parameter η is not too large.

O. Atanacković: *Non-LTE radiative transfer*, Bull. Obs. Astron. Belgrade **140** (1989), 127–130.

A brief review is given of some basic points in the development of non-LTE radiative transfer theory along with some remarks concerning the activity in this field at Belgrade Observatory.

E. Simonneau, O. Atanacković-Vukmanović: *Iteration factors in the solution of the NLTE line transfer problem*, in: *Stellar atmospheres: Beyond classical models*, NATO Advanced Research Workshop, Trieste, (1990); Pré-publication No. 333 (1990), Institut d'Astrophysique de Paris.

11.2. Spectral Line Shapes in Astrophysics and Plasma Physics

11.2. Profili spektralnih linija u astrofizici i fizici plazme

M. Dimitrijević: *Stark broadening and its astrophysical applications*, XI Int. School for Young Astronomers, Hvar, (1980), 22.

M. Dimitrijević, N. Konjević: *Modified semiempirical formula for the electron-impact width of ionized atom lines*, V. Int. Conf. on Spectral Line Shapes, Berlin, (1980), Program and Abstracts 53.

N. Konjević, M. S. Dimitrijević: *On the systematic trends of Stark broadening parameters of isolated ion lines*, V Int. Conf. on Spectral Line Shapes, Berlin, (1980), Program and Abstracts 55.

M. S. Dimitrijević, N. Konjević: *Uticaj oblika spektralne linije na interakciju zračenja sa plazmom*, 22 ETAN u pomorstvu, Zadar, (1980), Vol. 2, 365.

M. Dimitrijević, N. Konjević: *Semiempirical Stark line widths of alkali like ions*, X SPIG, Dubrovnik, (1980), 204.

M. S. Dimitrijević, N. Konjević: *Stark broadening of NII, NIII and NIV lines*, V ESCAMPIG, Dubrovnik, (1980), 88.

M. S. Dimitrijević, D. P. Grubor: *Stark line widths of some lithium isoelectronic sequence ions*, V ESCAMPIG, Dubrovnik, (1980), 89.

M. S. Dimitrijević: *Semiclassical calculations of the Stark widths of CIII and CIV*, V ESCAMPIG, Dubrovnik, (1980), 90.

M. S. Dimitrijević, N. Konjević: *Stark widths of doubly- and triply-ionized atom lines*, J. Quant. Spectrosc. Radiat. Transfer **24** (1980), 451-459.

In this paper, we report modifications of well known semiempirical and semiclassical approximation formulas for Stark line-width calculations. Comparisons with experiments for doubly ionized atoms yield, as an average ratio of measured to calculated widths 1.06 ± 0.31 for a modified semiempirical formula and 0.96 ± 0.24 for a modified semiclassical formula. For triply ionized atoms these ratios are 0.91 ± 0.42 and 1.08 ± 0.41 , respectively. Comparison with other theoretical calculations have also been made.

M. S. Dimitrijević and N. Konjević: *Semiempirical Stark linewidths of alkali like ions*, Astron. Astrophys. **102** (1981), 93.

In this paper we have tested the applicability of modified semi-empirical formula with newly proposed Gaunt factors for evaluation of Stark linewidths of alkali like ions. The comparison with experiments and other, already tested theoretical approaches indicates that these new Gaunt factors can be used successfully for Stark linewidth calculations.

M. S. Dimitrijević and N. Konjević: *On the Stark broadening of ionized nitrogen lines*, J. Quant. Spectrosc. Radiat. Transfer **25** (1981), 387.

In this paper, we report an analysis of the experimental procedure and results obtained in a recently published paper on the Stark broadening of singly, doubly-, and triply-ionized nitrogen lines. The results of this analysis indicate that the influence of self-absorption on the line profiles is not taken into account properly and that therefore the results of Ref. 6 cannot be applied with confidence. Comparison of experimental results with numerous theoretical calculations have also been performed.

M. S. Dimitrijević, N. Feautrier and S. Sahal-Bréchet: *Comparison between quantum and semiclassical calculations of the electron impact broadening of the Li I resonance line*, J. Phys. B: At. Mol. Phys. **14** (1981), 2559.

We present quantum mechanical calculations of Stark broadening parameters for the Li I $2s^2S-2p^2P$ line. Semiclassical calculations have also been performed and both have been compared with other available results. A detailed analysis of Stark broadening parameters as functions of the impact electron angular momentum quantum number and of the temperature is carried out. The influence of the polarisation potential and of the completeness of the set of energy levels on the Stark broadening parameters is investigated. The low temperature behaviour of the half width is discussed too.

N. Konjević, M. S. Dimitrijević: *Širenje spektralnih linija u plazmi*, Savremena istraživanja u fizici, redaktor V. Urošević, Institut za fiziku i Naučna knjiga, Beograd, (1981), 191.

M. S. Dimitrijević, N. Konjević: *Modified semiempirical formula for the electron-impact width of ionized atom lines*, in: Spectral line shapes, ed. B. Wende, Walter de Gruyter, Berlin, (1981), 211.

N. Konjević, M. S. Dimitrijević: *On the systematic trends of Stark broadening parameters of isolated lines in plasmas*, in: Spectral line shapes, ed. B. Wende, Walter de Gruyter, Berlin, (1981), 241.

M. S. Dimitrijević, D. P. Grubor, N. Konjević: *Electron impact broadening of multiply charged ion lines*, 2 Colloque sur l'influence des processus collisionnels sur le profil des raies spectrales, Orleans, (1981), 9.

M. S. Dimitrijević, N. Feautrier, S. Sahal-Bréchet: *Quantum and semiclassical Stark width calculation for the Li I resonance line*, 2 Colloque sur l'influence des processus collisionnels sur le profil des raies spectrales, Orleans, (1981), 8.

M. S. Dimitrijević: *Electron impact broadened line widths in a supermultiplet*, IECAP, Heidelberg, (1981), 529.

M. S. Dimitrijević: *Štarkovo širenje jonskih linija u sudarnoj aproksimaciji*, II Jugoslovenski seminar o fizici atomskih sudara, Stubičke Toplice, (1981).

M. S. Dimitrijević: *Stark broadening of some OIII lines*, Proc. IV Nat. Conf. Yug. Astronomers, Sarajevo, Publ. of the Astronomical Observatory of Sarajevo **1**, Sarajevo, (1981), 215.

M. S. Dimitrijević: *Similarities of Stark line widths within a given spectrum and irregular energy level structure*, Hvar. Obs. Bull. **6** (1982), 185.

M. S. Dimitrijević: *Stark broadening of non hydrogenic ion lines within the impact approximation*, in: The Physics of Ionized Gases, Ed. G. Pichler, Institute of Physics of the University, Zagreb, (1982), 397.

In this talk various methods for Stark broadening parameter estimation will be examined and their limitations will be discussed. This will be done on the basis of comparison with experimental data for singly, doubly and triply ionized atoms.

M. S. Dimitrijević, N. Feautrier, S. Sahal-Bréchet: *Influence of different kinds of collisions on the Stark broadening of the Li I resonance line*, XI SPIG, Dubrovnik, (1982), 277.

M. Dimitrijević, M. Cornille, N. Feautrier, S. Sahal-Bréchet: *Resonant scattering (autoionization) contributions to Stark broadening of ion lines*, XI SPIG, Dubrovnik, (1982), 281.

M. S. Dimitrijević, S. Sahal-Bréchet: *Stark broadening parameters for infrared lines of He I*, 6th Conf. on Spectral Line Shapes, Boulder, (1982), 281.

N. Konjević, M. S. Dimitrijević: *On the Stark broadening of non-hydrogenic spectral lines of heavy elements in plasmas*, 6th Conf. on Spectral Line Shapes, Boulder, (1982), 23.

M. S. Dimitrijević, S. Sahal-Bréchet: *Stark broadening of the He I resonance lines*, XI SPIG, Dubrovnik, (1982), 273.

M. S. Dimitrijević: *On the variation of Stark line widths within a supermultiplet*, Astron. Astrophys. **112** (1982), 231.

In order to find out if similarities among Stark broadening parameters within a supermultiplet are apparent to such a degree that accurate interpolation of new data and critical evaluation of experimental results are possible, the exceptions to this rule in the available theoretical data have been analysed and reasons for such situations have been discussed. The reasons may be divided into two categories: (i) irregular atomic energy level structure and (ii) inadequacy of the used model of the emitter structure. For the O II 3s-3p quartets, semi-classical calculations for Stark broadening parameters have been performed taking into account the emitter structure properly.

M. S. Dimitrijević: *Stark broadening of heavy ion solar lines*, in: Sun and Planetary System, eds. W. Fricke and G. Tekei, Astrophysics and Space Science Library **96**, D. Reidel PC, Dordrecht, (1982), 101.

M. S. Dimitrijević and N. Konjević: *Semiclassical calculations of electron impact Stark widths of S(III), Cl(III) and S(IV) isolated lines*, J. Quant. Spectrosc. Radiat. Transfer **27** (1982), 65.

In this paper we report results of semiclassical calculations of electron impact Stark widths of doubly-ionized sulfur and chlorine and of triply-ionized sulfur. Comparison with available experimental data yields an average ratio of measured to calculated line widths of 0.73 and 0.74 for S(III) and Cl(III), respectively, and of 0.50 for a single S(IV) line.

M. Dimitrijević: *Stark broadening of heavy solar lines*, VI ERMA, Dubrovnik, (1982), 32.

M. S. Dimitrijević, N. Konjević: *On the Stark broadening of heavy non-hydrogenic neutral atom lines in plasmas*, Int. Conf. on Plasma Physics, Göteborg, (1982), 343.

M. Dimitrijević, A. Mihajlov: *Istraživanje oblika kalijumovih linija u praznjenjima srednjeg i visokog pritiska*, 25. ETAN u pomorstvu (1983), 530.

M. Dimitrijević, M. Cornille, J. Dubau, N. Feautrier, S. Sahal: *Diagnostic spectroscopique des plasmas denses: contribution des resonances d'autoionisation a l'élargissement Stark des raies émises par des ions*, Collisions et Rayonnement, Orleans, (1983), P27.

M. S. Dimitrijević, S. Sahal-Bréchet: *L'élargissement Stark des raies de l'hélium neutre*, Collisions et Rayonnement, Orleans, (1983), P26.

M. S. Dimitrijević, S. Sahal-Bréchet: *Stark broadening parameters for He II infrared lines*, in: Spectral Line Shapes, Vol. 2, ed. K. Burnett, Walter de Gruyter Co., Berlin-New York, (1983), 103.

N. Konjević, M. S. Dimitrijević: *On the Stark broadening of non-hydrogenic lines of heavy elements in plasmas*, Vol. 2, ed. in: Spectral line shapes, K. Burnet, Walter de Gruyter Co., Berlin - New York, (1983).

I. Vince, M. S. Dimitrijević: *Doprinos limb-efektu raznih mehanizama širenja spektralnih linija u seriji Na I ($4s^2S - np^2P$)*, VI Nac. Konf. Astr. Jugoslavije, Hvar, (1983), 123.

M. S. Dimitrijević: *Astrofizičke primene izučavanja profila spektralnih linija*, VI Nac. Konf. Astr. Jugoslavije, Hvar, (1983), 13.

I. Vince: *On the telluric lines position instability*, Bull. Obs. Astron. Belgrade **133** (1983), 5-15.

On the ground of the observational data as well as the measurements of the relative positions of the telluric lines in the solar spectrum it has been established that these lines have an unstable position. To a position change during

a day corresponds a Doppler velocity of 100 ms^{-1} . The existence is pointed out of the diurnal position variations of the telluric lines and there is some indication of the diurnal variation being superimposed by some long-periodical or irregular changes. The aerological factors are found to contribute to the position instability of the telluric lines, while the instabilities of the position differences of the investigated spectral lines of water vapor and molecular oxygen can practically completely be accounted for by the convective motion of air masses. The possibility of the position instability of telluric lines being only a consequence of the instrumental errors has also been examined.

M. S. Dimitrijević, N. Konjević: *Stark broadening of isolated spectral lines of heavy elements in plasmas*, J. Quant. Spectrosc. Radiat. Transfer **30** (1983), 45.

In this paper we present results of semiclassical calculations of Stark broadening parameters for some lines of heavy neutral atoms. Comparisons with experiment show large discrepancies previously undetected for lighter elements. Critical evaluation of experimental data indicate that in most cases the experiment must be blamed for these discrepancies.

M. S. Dimitrijević, N. Feautrier and S. Sahal-Bréchet: *Influence of different collisional processes on the Stark broadening*, Fizika **15** (1983), 205.

Using a semiclassical formalism, elastic, inelastic and strong collision's contributions to the electron impact width of the Li I ($2s^2S-2p^2P^0$; $\lambda = 670.78 \text{ nm}$) resonance line have been computed for different angular momenta of the incoming perturbing electron and for $T = 2500, 10000$ and 20000 K . On the basis of the obtained results, the relative importance of elastic, inelastic and strong collision's contributions to the line width are discussed.

M. S. Dimitrijević: *Stark broadening of Si II and Si III spectral lines*, Astron. Astrophys. **127** (1983), 68.

Modified semiempirical and approximative semiclassical methods have been used for the calculation of recently measured Si II and Si III Stark line widths in order to test both methods, as well as the new experimental data (Kusch and Schröder, 1982).

V. Vujnović, Č. Vadla, V. Lokner and M. S. Dimitrijević: *Half-widths of neutral fluorine spectral lines*, Astron. Astrophys. **123** (1983), 249.

The profiles of 29 fluorine spectral lines from seven transitions, emitted by a wall-stabilized arc, were measured and the electron impact broadening half-widths of the transitions were calculated using the semiclassical perturbation approach. The plasma conditions were given by $T = 14.000 \text{ K}$ and $N_e = 10^{23} \text{ m}^{-3}$. A close agreement between the experimental results and the calculations was found, depending on the calibration of the electron concentration and on the evaluation approach.

M. S. Dimitrijević, N. Konjević: *On the dependence of Stark width and shift on the ionization potential*, Z. Naturforsch **39a** (1984), 553.

The simple relations between the Stark broadening parameters and the ionization potential derived by Purić et al. are discussed, and attention is drawn to the serious limitations for their application. The periodic dependence of the Stark width and shift on nuclear charge number obtained by the same authors is also explained.

N. Konjević, M. S. Dimitrijević and W. L. Wiese: *Experimental Stark widths and shifts for spectral lines of neutral atoms (a Critical Review of selected Data for the Period 1976 to 1982)*, J. Phys. Chem. Ref. Data **13** (1984), 619.

A critical review of all experimental data on Stark widths and shifts of spectral lines of neutral elements published during the period 1976–1982 has been carried out. This work represents an extension and update of an earlier review which covered the period before 1976. Data tables containing the selected experimental Stark broadening parameters are presented together with estimated accuracies. Comparisons with comprehensive calculations based on the semiclassical theory are made whenever possible.

N. Konjević, M. S. Dimitrijević and W. L. Wiese: *Experimental Stark widths and shifts for spectral lines of positive ions (a Critical Review and Tabulation of Selected Data for the Period 1976 to 1982)*, J. Phys. Chem. Ref. Data **13** (1984), 649.

A new critical review of the available experimental data on the Stark widths and shifts for lines of non-hydrogenic ionized spectra has been carried out which covers the period from 1976 to the present and represents a continuation of an earlier critical review. The relevant literature, compiled by the NBS Data Center on Atomic Lines Shapes and Shifts as well as by the present authors, was critically evaluated, and data tables containing the selected experimental Stark broadening parameters have been assembled. The data are arranged according to spectra and elements and these are presented in alphabetical order. The accuracy of the experimental data is estimated on the basis of guidelines developed during the previous review. Comparisons with theoretical results are made whenever possible since the comparison with theory has often been a principal motivation for the experiments.

M. S. Dimitrijević, S. Sahal-Bréchet: *Stark broadening of neutral helium lines*, J. Quant. Spectrosc. Radiat. Transfer **31** (1984), 301.

Using a semiclassical approach for the Stark broadening of atomic lines, we have calculated electron and proton impact line widths and shifts of 56 neutral He lines in the ultraviolet, visible and i.r. region of the spectrum. The comprehensive set of results obtained is used for investigation of Stark-broadening parameter regularities within the spectral series.

M. S. Dimitrijević: *Electron impact line widths of the resonance lines of Be-like ions*, Astron. Astrophys. **131** (1984), 327.

Analytical expressions recently obtained for the collision strengths of reso-

nant transitions of Be-like ions are used for the calculation of Stark broadening parameters.

M. S. Dimitrijević: *The trajectory effect in calculations of the phaseshift for binary collisions and broadening of neutral atom lines*, J. Phys. B: At. Mol. Phys. **17** (1984), L283.

The trajectory effect for $C_n r^{-n}$ ($n = 2, 3$ and 4) potential is estimated and compared with the results obtained according to the approximate method of Valey et al. based on the use of effective rectilinear trajectories.

M. S. Dimitrijević, S. Sahal-Bréchet: *Stark broadening of neutral helium lines of astrophysical interest. Regularities within spectral series*, Astron. Astrophys. **136** (1984), 289.

Following our earlier work, and using a semiclassical perturbation formalism for the Stark broadening of atomic lines, we have calculated electron and proton impact line widths and shifts of 36 neutral He lines. Stark broadening parameters were calculated for lines originating from upper energy levels with 4 to 10, and for an electron density of 10^{13} cm^{-3} . The comprehensive set of results obtained is used for the investigation of line-broadening parameter regularities within the spectral series.

M. S. Dimitrijević, S. Sahal-Bréchet: *Semiclassical calculation of the He I Stark broadening parameters*, XVI ICPIG, Düsseldorf (1983), 630.

M. S. Dimitrijević, S. Sahal-Bréchet: *Approximative electron and proton-impact line widths within a spectral series*, XVI ICPIG, Düsseldorf, (1983), 628.

M. S. Dimitrijević, S. Sahal-Bréchet: *Élargissement des raies spectrales par collisions avec les électrons et les protons: Formule asymptotique de la largeur lorsque le nombre quantique principal augmente*, Collisions et Rayonnement, Orleans (1983) p. 25.

M. S. Dimitrijević: *The trajectory effect and broadening of neutral atom lines*, XIIth SPIG, Šibenik (1984), 465.

I. Vince, M. S. Dimitrijević, V. Kršljanin: *Collisional broadening and solar limb effect: Na I $3p^2P^0 - ns^2S$ lines*, 7th Conf. on Spectral Line Shapes, Aussois (1984), F4.

M. S. Dimitrijević, S. Sahal-Bréchet: *Stark broadening of He I lines of astrophysical interest: Regularities within spectral series and influence of Debye shielding*, 7th Conf. on Spectral Line Shapes, Aussois (1984), A10.

M. Dimitrijević, N. Konjević: *Elektronnoe ushirenije spektral'nykh linij ionizirovannykh atomov*, Fotoprocessy, vzbuzhdeniya i jonizacii, Leningrad, (1984), 41.

M. Dimitrijević, N. Konjević: *O Shtarkovskom ushirenii linij nejtral'nykh atomov rubidiya, kadmiya i cinka*, Fotoprocessy, vzbuzhdeniya i jonizacii, Leningrad, (1984), 47.

M. S. Dimitrijević: *Dependence of Stark widths and shifts on the ionization potential: $np^{k-1}(n+1)s - np^4$ resonance transitions*, Astron. Astrophys. **145** (1985), 439-442.

Simple relations between the Stark broadening parameters and the ionization potential are derived for $np^{k-1}(n+1)s - np^4$ resonance transitions of singly ionized emitters, using the semiclassical approach. The relations obtained are compared with those derived by Purić et al. (1980).

M. S. Dimitrijević, N. Konjević: *A simple formula for estimating Stark broadening parameters of neutral atom lines*, Collisions et Rayonnement, Orleans, (1985), 21.

S. Jankov: *Instrumental profile of the Belgrade solar spectrograph*, Bull. Obs. Astron. Belgrade **135** (1985), 25.

The instrumental profile of the Belgrade solar spectrograph is determined using the O_2 telluric lines. The Fourier transform method is applied. A procedure of simultaneous use of several calibration curves has been developed for minimizing the errors, occasioned by the photographic calibration. The telluric line absorption coefficient is approximated by Voigt function. A procedure of normalisation of the natural profile, suitable for computer processing, has been developed. The actual resolving power of the spectrograph is 106780 and 134040 in the 4th and 5th order spectrum, which makes about 37% of its theoretical value.

M. S. Dimitrijević, S. Sahal-Bréchet: *Comparison of measured and calculated Stark broadening parameters for neutral-helium lines*, Physical Review A, **31** (1985), 316.

Stark broadening parameters for neutral helium lines obtained using a semiclassical perturbation formalism are compared with critically selected experimental data. Our data are also compared with the results of Benett and Griem as well as with the semiclassical convergent calculations of Bassalo, Cattani, and Walder.

I. Vince, M. S. Dimitrijević: *Influence of different line broadening mechanisms on the limb-effect within Na I ($4s^2S - np^2P^0$) series*, Publ. Obs. Astron. Belgrade **33** (1985), 15.

M. S. Dimitrijević: *Astrophysical significance of spectral line shapes investigation*, Publ. Obs. Astron. Belgrade **33** (1985), 11.

M. S. Dimitrijević, V. Kršljanin: *Semiempirical Stark shifts of ion lines*, XVII ICPIG, Budapest, (1985), 975.

M. S. Dimitrijević, S. Sahal-Bréchet: *Stark broadening of Na I lines: Regularities within a spectral series*, XVII ICPIG, Budapest, (1985), 978.

M. S. Dimitrijević, Truong-Bach: *Sur l'inégalité des largeurs Stark à l'intérieur d'un multiplet ou supermultiplet de l'argon*, Collisions et Rayonnement, Orleans 1985, P 23.

V. Kršljanin, I. Vince: *Zastupljenost natrijuma u sunčevoj atmosferi*, VIII Congress of the Mathematicians, Physicists and Astronomers of Yugoslavia, ed. Dj. Teleki, SDMFAJ, Priština, (1985), 340.

I. Vince, V. Kršljanin: *Uticaj sudarnih procesa na limb efekt u pegama: linija Na I $3p^2P^0 - 6s^2S$* , VIII Congress of the Mathematicians, Physicists and Astronomers of Yugoslavia, ed. Dj. Teleki, SDMFAJ, Priština, (1985), 341.

M. S. Dimitrijević, S. Sahal-Bréchet: *Stark broadening of neutral sodium lines*, J. Quant. Spectrosc. Radial. Transfer **34** (1985), 149–161.

A semiclassical approach has been used to evaluate Stark broadening of atomic lines and also electron- and proton-impact line widths and shifts of 30 neutral sodium lines. The results are used to investigate Stark broadening-parameter regularities within the spectral series.

I. Vince, M. S. Dimitrijević, V. Kršljanin: *Pressure broadening and solar limb effect*, J. E. Beckman and L. Crivellari (eds.), Progress in Stellar Spectral Line Formation Theory (1985), 373–380.

The pressure broadening contribution to the solar limb effect has been discussed for the case of a spectral series using Na I $3p$ -ns and $4p$ -ns series as an example. We have found that the influence of the pressure broadening on the solar limb effect is reduced due to different signs of hydrogen and electron impact shifts in the case considered. We have discussed also the behaviour of pressure broadening contribution to the solar limb effect within a spectral series and we have compared our results with simple radial-current theory predictions.

M. S. Dimitrijević: *Electron impact broadening dependence on the ionization potential: $np^{k-1}(n+1)s - np^k$ resonance transitions*, II ECAMP, Amsterdam, (1985), 206.

M. S. Dimitrijević, S. Sahal-Bréchet: *L'élargissement Stark des raies du potassium neutre*, Collisions et Rayonnement, Orleans, (1985), P 22.

M. S. Dimitrijević, S. Sahal-Bréchet: *Stark broadening of He I lines of astrophysical interest: Regularities within spectral series and influence of Debye shielding*, Spectral Line Shapes III, W. de Gruyter, Berlin – New York, (1985), 53.

I. Vince, M. S. Dimitrijević, V. Kršljanin: *Collision broadening and solar limb effect: Na I $3p^2P^0 - ns^2S$ lines*, Spectral Line Shapes III, W. de Gruyter, Berlin – New York, (1985), 649.

V. Kršljanin, M. S. Dimitrijević: *Modified semiempirical approach as a source for Stark broadening data in astrophysics: Li-like lines in stellar atmospheres*, Coll.

on Atomic Spectra and Oscillator Strengths for Astrophysics and Fusion Research, Toledo, (1986), 84.

M. S. Dimitrijević: *On the Stark broadening within a F I transition array*, Astron. Astrophys. Suppl. Ser. **64** (1986), 591-594.

Using a semiclassical formalism, electron impact widths and shifts within 3s-3p transition array of F I have been computed. A detailed analysis of Stark broadening parameters as functions of the impact electron angular momentum quantum number and the temperature is carried out. On the basis of the results obtained, the differences between the contribution of elastic, inelastic and strong collisions to the line widths within a transition array are discussed, as well as the Stark shift and width behaviour of the various components.

I. Vince, M. S. Dimitrijević: *Influence of spectral lines pressure shift on the convective layer diagnostic*, XIII SPIG, Šibenik, (1986), 325.

M. S. Dimitrijević, S. Sahal-Bréchet: *L'élargissement Stark des raies du potassium neutre*, Annales de Physique, Coll. No. 3, Suppl. au No. 3, Vol. 11 (1986), 181.

Nous avons calculé les largeurs et les déplacements de 50 raies spectrales de K I, dus aux collisions avec les électrons, les protons et Ar II, dans l'approximation des impacts. Les résultats obtenus sont utilisés pour étudier les comportements des paramètres d'élargissement dans une série spectrale.

M. S. Dimitrijević, N. Konjević: *Simple formulae for estimating Stark broadening parameters of neutral atom lines*, Annales de Physique, Coll. No. 3, Suppl. au No. 3, Vol. 11 (1986), 197.

Simple formulae for estimating Stark width and shift of neutral atom lines are presented.

M. S. Dimitrijević, Truong-Bach: *Sur l'inégalité des largeurs Stark à l'intérieur d'un multiplet ou supermultiplet de l'argon II*, Annales de Physique, Coll. No. 3, Suppl. au No. 3, Vol. 11 (1986), 183.

Les paramètres Stark de divers composants à l'intérieur du multiplet $4s^2P - 4p'^2P$ et du supermultiplet $4p - 4d$ ($^2P - ^2P$, $^2P - ^2D$, $^2D - ^2D$) de l'Argon II sont calculés suivant un formalisme semi-classique. La possibilité de différence entre ces largeurs ou déplacements est discutée en fonction de l'effet d'écran Debye et des irrégularités dans le diagramme des niveaux d'énergie.

M. S. Dimitrijević, Truong-Bach: *On the Stark broadening of singly ionized argon lines*, Z. Naturforsch. **41a** (1986), 772-776.

Using a semi-classical formalism which includes Debye shielding, Stark broadening parameters of various components within the $4s^2P - 4p'^2P^0$ multiplet and the $4p - 4d$ ($^2P^0 - ^2P$, $^2D^0 - ^2P$, $^2D^0 - ^2D$) supermultiplet of Ar II are computed. We show that when various components of a multiplet (supermultiplet or transition array) are broadened inequally by an embedded close-lying

perturbing level, use of a perturber parameter cut-off at the Debye length can restrain the calculated differences between Stark widths within the multiplet.

M. S. Dimitrijević, V. Kršljanin: *Electron-impact shifts of ion lines: modified semiempirical approach*, *Astron. Astrophys.* **165** (1986), 269–274.

A simple method for calculation of ion line shifts produced by electron impacts, based on the modified (Dimitrijević and Konjević, 1980) semiempirical (Griem, 1968) approach is presented. Obtained relations have been applied to a number of Be II, Mg II, Al II, Ar II and Ca II lines and the results are compared with semiclassical and semiempirical values as well as with critically selected experiments.

M. S. Dimitrijević, N. Konjević: *Simple formulae for estimating Stark widths and shifts of neutral atom lines*, *Astron. Astrophys.* **163** (1986), 297–300.

Formulae for estimating Stark widths and shifts of neutral atom lines, based on the simple method of Freudenstein and Cooper and the GBKO semiclassical theory, are presented. For the calculations, most of the available personal computers are sufficient. Obtained formulae have been applied to He I and Mg I lines and results are compared with calculations of Bennett and Griem and values obtained according to the method of Freudenstein and Cooper.

M. S. Dimitrijević, V. Kršljanin: *Modified semiempirical estimates of ion lines Stark shifts: spectra of hot DA white dwarfs*, XIII SPIG, Šibenik, (1986), 321.

M. S. Dimitrijević, M. C. Artru: *Stark broadening of Ga II and Ga III spectral lines*, XIII SPIG, Šibenik, (1986), 317.

M. S. Dimitrijević, N. Konjević: *Ion line Stark broadening in stellar plasmas*, XIII SPIG, Šibenik, (1986), 313.

M. S. Dimitrijević, N. Feautrier, S. Sahal-Bréchet: *Resonance structures in electron scattering cross sections and Stark broadening*, XIII SPIG, Šibenik, (1986), 303.

B. Grabowski, M. S. Dimitrijević: *Trajectory effects on the phase shift in the impact approximation*, XIII SPIG, Šibenik, (1986), 299.

M. S. Dimitrijević, A. A. Mihajlov, M. Popović: *On the electron-impact broadening for the resonance lines of the alkalis*, VIII ESCAMPIG, Greifswald, (1986), 89.

M. S. Dimitrijević, S. Sahal-Bréchet: *Stark broadening of KI: Regularities within spectral series*, VIII ICSSL, Williamsburg, (1986), A10.

M. S. Dimitrijević, N. Konjević, V. Kršljanin: *Modified semiempirical estimates of ion lines Stark broadening: I Theory*, VIII ICSSL, Williamsburg, (1986), A11.

M. S. Dimitrijević, N. Konjević, V. Kršljanin: *Modified semiempirical estimates of ion line Stark broadening: II Application*, VIII ICSSL, Williamsburg, (1986), A12.

A. Kubičela, I. Vince, M. S. Dimitrijević, R. Dümmler: *Differential Fe I limb effect around $\lambda = 630.2$ nm*, VIII ICSLS, Williamsburg, (1986), DA1.

I. Vince, M. S. Dimitrijević: *Solar spectral line asymmetries and pressure broadening*, VIII ICSLS, Williamsburg, (1986), DA2.

M. S. Dimitrijević: *Stark broadening of spectral lines in the spectrum of Am 15 Vulpeculae*, IAU Colloq. No. 94, Physics of Formation of Fe II Lines Outside LTE, ed. R. Viotti, Capri, (1986), 47.

S. Jankov: *Restauration des spectrogrammes astronomiques en application de la fonction de filtration selon Wiener dans les conditions du manque d'information a priori sur l'objet de recherche*, Master Science Thesis, Univ. Beograd, (1986) (in serbo-cr.).

I. Vince: *Uticaj sudarnih procesa na limb-efekt (Influence of Collisional Proceses on the Limb-effect)*, doktorska disertacija, (Ph. D. Thesis), Univ. Beograd, (1986).

I. Vince: *A részecskeütközések hatása a nap- és a csillagkonvekció diagnosztikájára, Magyarok szerepe a világ természettudományos és műszaki haladásában* (eds. Fodor O., Nagy F., Stefkóné Vermes J.), Budapest, (1986), 897.

V. Kršljanin, I. Vince: *Collision broadening and microturbulence sensitivity of some Na I non-resonant lines*, Bull. Obs. Astron. Belgrade 136 (1986), 12–19.

Profiles of six weak and moderate weak Na I lines in the centre and on the limb of the solar disk have been synthesized using the Smirnov-Roueff potential. The sensitivity has quantitatively been examined of a variety of parameters of the spectral line profiles (equivalent width, central intensity, half-width and line shape parameter) to microturbulent velocity variations. The results are displayed both numerically and graphically. Inadequate knowledge of the collision broadening can lead to the value of the microturbulence velocity, obtained from these spectral lines being significantly distorted.

V. Kršljanin: *Štarkov pomak jonskih linija kod toplih zvezda*, M. Sc. Thesis, Faculty of Sciences, Belgrade University, (1986), 1–151.

J. Arsenijević, M. Karabin, A. Kubičela, I. Vince: *Beginning of a study of long-term changes of selected Fraunhofer spectral lines*, Abstracts, II Workshop, Astrophysics in Yugoslavia, Beograd, Ed. M. Dimitrijević, 31, (1987).

J. Arsenijević, M. Karabin, A. Kubičela, I. Vince: *A Belgrade program for monitoring of activity-sensitive spectral lines of the Sun as a star*, Abstracts, Fifth Europ. Meeting on Solar Phys., Solar and Stellar Physics, Titisee, FRG, (1987), P5.

M. S. Dimitrijević, G. Peach: *Regularities in line widths due to neutral nonresonant collisions*, in: Radiative Excitation and Ionization Processes, ed. V. Vujnović, Institute of Physics, Zagreb, (1987), 19.

M. S. Dimitrijević, V. Kršljanin: *An approximate method for electron impact shift calculation*, in: Radiative Excitation and Ionization Processes, ed. V. Vujnović, Institute of physics, Zagreb, (1988), 22–25.

M. S. Dimitrijević, S. Sahal-Bréchet: *Stark broadening of highly excited C IV lines*, in: Radiative Excitation and Ionization Processes, ed. V. Vujnović (Proc. of lectures given at a seminar held in Zagreb), Institute of Physics, Zagreb, (1987), 76.

M. S. Dimitrijević, S. Sahal-Bréchet: *Stark broadening of K I: Regularities within spectral series*, in: Spectral Line Shapes, Vol. 4, ed. R. J. Exton, A. Deepak Publ., Hampton, Virginia, (1987), 61.

S. Jankov: *Imagerie indirecte des étoiles à partir des observations spectroscopiques et photométriques*, DEA Astrophysique et Techniques Spatiales, Université Paris VII (1987).

I. Vince, M. S. Dimitrijević: *Solar spectral line asymmetries and pressure broadening*, in: Spectral Line Shapes, Vol. 4, ed. R. J. Exton, Deepak Publ., Hampton, Virginia, USA, (1987), 621.

It is confirmed that the convection is the major cause of solar line asymmetries and wavelength shifts. However, the influence of pressure broadening on solar line shapes must be taken into account in some cases. E.g. convective motions of solar granulation are manifested in the spatially unresolved spectrum as slight asymmetries and wavelength shifts of photospheric spectral lines. For the investigation of this effect the line bisectors (medians), i.e. the loci of points midway between equal-intensity points on either side of the line are commonly used. Consequently, it is important to know the influence of pressure broadening on the bisector shape formation. Here, we investigate the influence of collisional processes on solar Na I 616.1nm line bisector. Our results are compared also with observational data. We calculated line bisectors for different positions on the solar disk by solving the radiative transfer equation using HSRA solar atmosphere model. Shift produced by absorber-neutral atom collisions is calculated using Smirnov-Roueff exchange potential. For Stark broadening contribution semiclassical data are used.

M. S. Dimitrijević, A. A. Mihajlov, and M. M. Popović: *Stark broadening trends along homologous sequences*, Astron. Astrophys. Suppl. Ser. **70** (1987), 57–61.

Using a semiclassical formalism, a detailed analysis of Stark broadening parameters as a function of the impact electron angular momentum quantum number and the temperature is carried out for resonance lines of the alkalis. On the basis of the results obtained, the differences between the contribution of elastic, inelastic and strong collisions to the line widths for analogous transitions in homologous atoms are discussed.

M. S. Dimitrijević, S. Sahal-Bréchet: *Stark broadening of neutral potassium lines*, J. Quant. Spectrosc. Radiat. Transfer **38** (1987), 37–45.

Using a semiclassical approach, we have calculated electron-proton and Ar II impact line widths and shifts of 50 neutral potassium lines. The compre-

hensive set of results obtained is used for investigation of Stark-broadening-parameter regularities within the spectral series.

M. S. Dimitrijević, N. Konjević: *Simple estimates for Stark broadening of ion lines in stellar plasmas*, *Astron. Astrophys.* **172** (1987), 345–349.

Simple analytical expressions for estimation of Stark widths and shifts of ionized atom lines have been derived from the low temperature limit of a modified semiempirical formula.

A. Kubičela, I. Vince, M. S. Dimitrijević, R. Dümmler: *Differential Fe I limb effect around $\lambda = 630.2 \text{ nm}$* , in: *Spectral Line Shapes*, Vol. 4, ed. R. J. Exton, Deepak Publ., Hampton, Virginia, USA, (1987), 619.

For heliocentric angles up to 52° a relative limb effect of Fe I 630.15 nm and 630.25 nm, amounting to 50 ms^{-1} has been found. The differential pressure broadening shifts have been estimated as negligible. The observed differential limb effect is probably caused by some unresolved photospheric velocities.

M. S. Dimitrijević, N. Feautrier, S. Sahal-Bréchet: *On neutral oxygen lines formation in γ Cas*, II Workshop: *Astrophysics in Yugoslavia*, Beograd, (1987), 39.

Y. Vitel, M. Skowronek, M. S. Dimitrijević, M. M. Popović: *Electron-impact broadening along homologous sequences of noble gases*, II Workshop: *Astrophysics in Yugoslavia*, Beograd, (1987), 15.

I. Vince, M. S. Dimitrijević: *On the C IV line profiles in the white dwarfs*, II Workshop: *Astrophysics in Yugoslavia*, Beograd, (1987), 5.

T. Lanz, M. S. Dimitrijević, M.-C. Artru: *Influence of Stark broadening on equivalent widths of Si II visible lines in stellar atmospheres*, II Workshop: *Astrophysics in Yugoslavia*, Beograd, (1987), 33.

I. Vince, M. S. Dimitrijević: *Uticaj sudarnih procesa na profile linija natrijuma u sunčevim i zvezdanim spektrima*, V Jug. skup iz fizike atomskih sudara, Kopaonik, (1987), G1.

M. S. Dimitrijević: *Mehanizam formiranja linija neutralnog kiseonika u zvezdanim omotačima*, V Jug. skup iz fizike atomskih sudara, Kopaonik, (1987), G2.

M. S. Dimitrijević, N. Feautrier, S. Sahal-Bréchet: *On lines formation in stellar envelopes*, VII Gen. Conf. European Phys. Soc. "Trends in Physics", Helsinki, (1987), 165.

M. S. Dimitrijević, S. Sahal-Bréchet: *On the Stark broadening of C IV lines*, VII Gen. Conf. European Phys. Soc. "Trends in Physics", Helsinki 1987, 171.

M. S. Dimitrijević, N. Konjević, V. Kršljanin: *Modified semiempirical estimates of ion lines Stark broadening, I. Theory*, in: *Spectral Line Shapes*, Vol. 4, ed. R. J. Exton, A. Deepak Publ., Hampton, Virginia, (1987), 63.

M. S. Dimitrijević, N. Konjević, V. Kršljanin: *Modified semiempirical estimates of ion lines Stark broadening II. Application*, in: Spectral Line Shapes, Vol. 4, ed. R. J. Exton, A. Deepak Publ., Hampton, Virginia, (1987), 65.

I. Vince, M. S. Dimitrijević: *Influence of non-resonant collisions with neutral atom on the Na I lines in the solar spectrum*, in: Radiative Excitation and Ionization Processes, Inst. Phys. Univ., Zagreb, (1987), 84.

M. S. Dimitrijević, S. Sahal-Bréchet: *On the Stark broadening of Si IV lines: Regularities within spectral series*, IX Int. Conf. Spectr. Line Shapes, Toruń, (1988), A12.

M. S. Dimitrijević, G. Peach: *Line width regularities and systematic trends due to collisions with neutral perturbers*, IX Int. Conf. Spectr. Line Shapes, Toruń, (1988), D9.

M. S. Dimitrijević, M. M. Popović: *Stark broadening of noble gas ions as a function of the ionization potential*, XIV SPIG, Sarajevo, (1988), 289.

M. S. Dimitrijević, G. Peach: *Line widths due to neutral non-resonant collisions within a homologue sequence: An investigation of the Van der Waals formula*, XIV SPIG, Sarajevo, (1988), 321.

M. S. Dimitrijević, A. A. Mihajlov, B. Grabowski: *The influence of Debye shielding on the Stark widths and shifts of ion lines in the adiabatic limit*, XIV SPIG, Sarajevo, (1988), 329.

M. S. Dimitrijević, S. Sahal-Bréchet: *Comparison between calculated, and measured Stark widths of C IV lines*, XIV SPIG, Sarajevo, (1988), 333.

M. S. Dimitrijević: *Classical trajectory method in line shapes investigations*, Int. Conf. on Classical Dynamics in Atomic and Molecular Physics (CDAMP), Brioni, (1988), 21.

M. S. Dimitrijević: *Stark broadening of the Fe II lines in the solar and stellar spectra*, R. Viotti et al. (eds.), Physics of Formation of Fe II Lines Outside LTE (1988), 211–216.

Recently developed modified semiempirical approach (Dimitrijević and Konjević, 1980, 1986; Dimitrijević and Kršljanin 1986) is applied to the Stark broadening calculation of Fe II lines in the Solar spectrum and the spectrum of Am 15 Vulpeculae.

M. S. Dimitrijević, Z. Djurić, A. A. Mihajlov: *Electron-impact broadening of Cu IV lines from an electrodynamic macroparticles accelerator arc plasma*, Int. Conf. on Phys. of Multiply Charged Ions, Grenoble, (1988), 2.16.

Y. Vitel, M. Skowronek, M. S. Dimitrijević, and M. M. Popović: *Stark broadening along a homologous sequence of noble gas atomic lines in dense plasmas*, *Astron. Astrophys.* **200** (1988), 285–290.

We present experimental results on the broadening and shift of some rare gas atomic lines emitted by high electron density plasmas created in linear flash-tubes. From a semiempirical formula, we find a theoretical dependence of the Stark broadening parameters on the ionisation potential for lines broadened by electron impacts. Experimentally, a non-linear dependence is found between the Stark width w and shift d , and the electron density. At the lowest electron density, our values of w and d agree with other experimental determinations. We have observed a regularity of w and d for analogous lines of homologous atoms.

M. S. Dimitrijević: *Comparison between different approximate approaches for the calculation of Stark widths of doubly- and triply-charged ion lines of astrophysical importance*, *Bull. Obs. Astron. Belgrade* **139** (1988), 31–58.

Stark widths of spectral lines from 127 astrophysically important multiplets of doubly- and triply-charged ions were calculated by means of the Griem's (1968) semiempirical method, Griem's simplified semiclassical method (1974), and a modified version of this latter method (Dimitrijević and Konjević, 1980). Obtained results were compared with those (Dimitrijević, 1988) derived by using the modified semiempirical method (Dimitrijević and Konjević, 1980).

M. S. Dimitrijević: *Electron-impact widths of doubly and triply charged ion lines of astrophysical importance*, *Astron. Astrophys. Suppl. Ser.* **76** (1988), 53–59.

A recently developed modified semiempirical approach (Dimitrijević and Konjević, 1980, 1987; Dimitrijević and Kršljanin, 1986) is applied to the Stark broadening of spectral lines from 127 astrophysically important multiplets of doubly and triply charged ions.

T. Lanz, M. S. Dimitrijević, and M. C. Artru: *Stark broadening of visible Si II lines in stellar atmospheres*, *Astron. Astrophys.* **192** (1988), 249–254.

The Stark broadening of visible Si II lines is studied and its consequence on the intensity of the stellar absorption is analyzed. A complete set of atomic data concerning the Stark widths, is elaborated for 19 multiplets of Si II of astrophysical importance. Previous available determinations are reviewed and new Stark widths are calculated by means of the semi-classical impact theory. The accuracy of different theoretical and empirical methods are discussed.

The new adopted Stark widths are applied, in several examples, to the analysis of stellar absorption lines. These widths are generally smaller than the previous theoretical estimates for the low-excitation transitions of Si II. But it leads to reduce only slightly (less than 10%) the equivalent widths, even with enhanced silicon. The only exception is the multiplet 1, whose equivalent width could be reduced from 10% to 35%. On the other hand, the influence of the large Stark widths obtained for the high-excitation multiplets, is shown

to be critical for the abundance analysis. The example of the 4d-8f transition, at 4201 Å, is detailed.

Radiative widths are also given for these 19 multiplets and could be as large as 40 times the classical damping. Such widths affect particularly the low-excitation transitions and increase the equivalent widths up to 30% with respect to those calculated with the classical value.

M. S. Dimitrijević: *Classical trajectory method in line shapes investigations*, Proc. of the International Conference on Classical Dynamics in Atomic and Molecular Physics CDAMP'88, Eds. T. Grozdanov, P. Grujić, P. Krstić, (1988), 403.

The use of classical perturber trajectories within semiclassical and classical approaches to the line shapes and frequency shift calculations is briefly reviewed and discussed with special emphasis on the deviation of the perturber motion from the uniform one.

V. Kršljanin: *Ion lines Stark shifts in spectra of hot stars*, (M. Sc. Thesis Paper), IX National Conference of Yugoslav Astronomers Abstract Book, Sarajevo (1988), 3.

V. Kršljanin: *Stark broadening of resonance lines for the lithium isoelectronic sequence and some astrophysical applications*, in: Radiative Excitation and Ionization Processes, ed. V. Vujnović, Inst. Phys. Univ. Zagreb, (1988), 80-83.

M. S. Dimitrijević: *On the Stark broadening of C IV lines*, Bull. Obs. Astron. Belgrade **139** (1988), 70-71.

In this paper, results of semiclassical calculations of electron impact Stark widths within C IV multiplets are reported. A comparison with available experimental and theoretical data is performed too.

M. S. Dimitrijević, G. Peach: *An investigation of Van der Waals formula within a homologous sequence*, IX Nat. Conf. Yug. Astr., Sarajevo, (1988), 7.

M. S. Dimitrijević: *Critical selection of line broadening data for astrophysicists*, IX Nat. Conf. Astr. Yug., Sarajevo, (1988), 8.

J. Arsenijević, A. Kubičela, I. Vince and S. Jankov: *Belgrade program for monitoring of activity-sensitive spectral lines of the Sun as a star I. An analog solar scanning monochromator*, Bull. Obs. Astron. Belgrade **138** (1988), 1.

A scanning attachment for the Belgrade equatorial solar spectrograph based on a tipping glass rotation in front of the focal plane is described. An analog position encoder and an X-Y recorder complete the system of a solar scanning monochromator. The reduction procedure is reviewed and some instrumental parameters estimated, e.g. the flexure, the expected temperature influence, the range of flat field factors, the distortion of the wavelength scale, and certain components of the instrumental scattered light.

J. Skuljan, S. Erkapic, I. Vince, A. Kubičela: *Beogradski program za praćenje spektralnih linija osetljivih na aktivnost kod Sunca kao zvezde, III. Prvi spektrofotometrijski rezultati*, Saopšteno na IX Nacionalnoj konferenciji jugoslovenskih astronoma, Sarajevo, oktobar, 1988.

I. Vince, A. Kubičela, J. Arsenijević: *Belgrade program for monitoring of activity-sensitive spectral lines of the Sun as a star, II. Selection of Fraunhofer lines and beginning of a study of their long-term changes*, Bull. Obs. Astron. Belgrade **139** (1988), 25.

The selection of program spectral lines, preceded by a short review of some earlier results, and progress report on their Belgrade observations are given. The lines are selected according to their various responses to the physical conditions in the photosphere and listed in Table I. Eight series of observations were done during 1987 covering the period of minimal solar activity. The first spectrophotometric errors have been estimated and research aims for the near future have been pointed out.

V. Kršljanin, M. S. Dimitrijević: *Modified semiempirical Stark shifts of ArII lines*, Z. Phys. D – Atoms, Molecules and Clusters **14** (1989), 273–280.

Stark shifts for 47 multiplets of ArII are calculated according to modified semiempirical approach, and compared with critically selected experimental data, as well as with semiclassical values of Jones et al. (1971) when available. Mean experimental to theoretical (modified semiempirical) shift ratio 1.38 ± 0.60 is obtained.

M. S. Dimitrijević, A. A. Mihajlov, Z. Djurić, B. Grabowski: *On the influence of Debye shielding on the Stark broadening of ion lines within the classical model*, J. Phys. B: At. Mol. Opt. Phys. **22** (1989), 3845–3850.

The influence of Debye shielding on the Stark line shift to width ratio is demonstrated in the case of ion lines. The Coulomb cut-off potential, especially suitable for a non-ideal plasma and for highest densities, has been used.

I. Vince: *Investigation of the collisional limb effect and shape of solar spectral lines at the Astronomical observatory in Belgrade*, Bull. Obs. Astron. Belgrade **140** (1989), 117–121.

Besides other research programs, at the Belgrade Astronomical Observatory we investigate the absorber-perturber collision effects on solar limb effect and on spectral line profile. A short review of our method of calculation and some examples of our results of the work on effect of atomic collision processes on the solar limb effect and solar spectral line bisectors are given here.

M. S. Dimitrijević, S. Sahal-Bréchet: *On the Stark broadening parameters for Li-like ions*, Collisions et Rayonnement, Orleans, (1989).

M. S. Dimitrijević, O. Atanacković-Vukmanović: *Plasma screening effects on Stark broadening of ion lines at the adiabatic limit*, Collisions et Rayonnement, Orleans, (1989).

I. Vince: *A Nap sugarának változásai*, A Magyarok szerepe a világ természettudományos és műszaki haladásában (eds. Fodor O., Füzeseri A., Stefokné Vermes J.), II. Tudományos találkozó, Országos műszaki információs központ és könyvtár, (1989), 753-756.

M. S. Dimitrijević: *Stark broadening in astrophysics*, Bull. Obs. Astron. Belgrade **140** (1989), 111-116.

The importance of Stark broadening in astrophysics is briefly reviewed. A short review of results of Yugoslav research workers on this field is also presented.

M. S. Dimitrijević, M. M. Popović: *Estimates of Stark width along a homologous sequence*, Astron. Astrophys. **217** (1989), 201-203.

A simple analytical expression for Stark widths as a function of the ionization potential suitable for critical evaluation of existing experiments and interpolation of new data along homologous ion sequences at low temperature limit, has been derived.

V. Kršljanin, M. S. Dimitrijević: *Modified semiempirical Stark widths and shifts of Ar II lines*, Bull. Obs. Astron. Belgrade **140** (1989), 7-14.

The modified semiempirical approach (Dimitrijević and Konjević, 1980; Dimitrijević and Kršljanin, 1986) was used for calculation of Stark widths and shifts for Ar II lines. Comparison has been made with semiclassical results of Jones et al., (1971) as well as with critically selected experimental data. Since the good average accuracy of the present results has been achieved, tabulation of modified semiempirical Stark broadening parameters for 50 Ar II multiplets is also given.

I. Vince, M. S. Dimitrijević: *Pressure broadening and solar spectral line bisectors*, R. J. Rutten and G. Severino (eds.), in: *Solar and Stellar Granulation* (1989), 93-97.

In order to show that pressure broadening (atomic collisional processes) may have an important contribution to the spectral line asymmetries in some cases, what is of interest especially for the solar granulation studies, bisectors for Na I $3s^2S - np^2P^0$ solar lines have been calculated for different positions on the solar disk. Our numerical results clearly demonstrate that in the case of the examined spectral series the influence of pressure broadening has not a negligible role for the convective layer diagnostic.

M. S. Dimitrijević, Z. Djurić, A. A. Mihajlov: *Electron-impact broadening of Cu IV lines for the diagnostic of the arc plasma of electrodynamic macro-particle ac-*

celerator, Journal de Physique, Coll. C1, Suppl. au No. 1, Tome 50 (1989), C1-623.

Using a model method of loss energy simulation on the boundary surfaces, temperature and composition of an electrodynamic macroparticle accelerator arc plasma created by the evaporation of a Cu foil, have been calculated. Stark widths for Cu IV lines of interest for the arc plasma diagnostic have been calculated also, by using the modified semiempirical method.

V. Kršljanin: *On pressure shifts of Fe I lines in stellar atmospheres*, in: Solar and Stellar Granulation, eds. R. J. Rutten and G. Severino, Kluwer, Dordrecht, (1989), 91.

Calculated pressure shifts (with hydrogen- and electron-impact contributions taken into account) of two Fe I lines in spectra of A-G main sequence stars are presented and their importance in diagnostics of dynamical processes, particularly in hot stellar atmospheres is emphasized.

V. Kršljanin: *The spectral line synthesis study in Belgrade*, Bull. Obs. Astron. Belgrade 140 (1989), 123-125.

Investigation of both solar and stellar atmospheres using the spectral line synthesis method in the Astrophysical group of the Belgrade Astronomical Observatory started in 1983. The study of the pressure broadening in the astrophysical plasma and related topics are the main research orientation. Corresponding computer programs are developed. A review of the first results and the current investigations concerning line asymmetries and shifts caused by pressure, abundance determinations and microturbulence is given here.

V. Kršljanin: *Inversion of solar absorption lines*, 3rd Workshop: Astrophysics in Yugoslavia, ed. V. Vujnović, Inst. Phys. Univ. Zagreb, (1989), 9.

V. Kršljanin: *Ion lines Stark shifts in spectra of hot stars*, Publ. Obs. Astron. Belgrade 37 (1989), 1-114.

High-resolution UV spectroscopy from spacecrafts reveals different stellar spectral line features connected with line shifts and asymmetries. These features are mainly caused by dynamics of stellar envelopes, mass loss, convective motions and gravitation. Purpose of this work is to determine the contribution of pressure (i.e. Stark) broadening to such effects in spectra of hot ($T_{\text{eff}} \geq 20000$ K) main sequence and high gravity stars ($4.5 \leq \log g \leq 9.0$). In that order, modified semiempirical theory for calculation of ion lines electron-impact shifts is developed. The method is tested via comparison with results of the semiclassical and semiempirical theories as well as with critically selected experiments. Stark shifts of astrophysically important Si, C, N, O, ion lines in spectra of hot stars are calculated. Simple analytical expressions for resonance lines Stark shifts in lithium isoelectronic sequence are obtained. Contribution of the Stark shifts to the stellar spectral line shifts mainly by mass loss, gravitation and stellar atmospheric motions is estimated and importance of this contribution is discussed.

M. S. Dimitrijević, M. M. Popović: *Štarkovo širenje duž homolognog niza alkalnih metala*, VI Jug. Skup. iz Fizike Atomskih Sudara, Brioni, (1989), 36.

M. S. Dimitrijević: *Približni metodi za dobijanje parametara Štarkovog širenja*, (Uvodno predavanje), VI Jug. Skup. iz Fizike Atomskih Sudara, Brioni, (1989), 35.

V. Kršljanin, M. S. Dimitrijević: *Modified semiempirical Stark shift examination: Ar II Stark line shifts*, XIX IGPIG, Beograd, (1989), 330.

V. Kršljanin, M. S. Dimitrijević: *Modified semiempirical Stark shift examination: II. Alkali-like singly charged ion lines Stark shifts*, XIX ICPIG, Beograd, (1989), 332.

M. S. Dimitrijević, S. Sahal-Bréchet: *On the semiclassical Stark widths of C IV lines*, XIX IGPIG, Beograd, (1989), 334.

M. S. Dimitrijević, S. Sahal-Bréchet: *On the Stark broadening of Si IV lines: influence of different collisional processes*, XIX ICPIG, Beograd, (1989), 336.

M. S. Dimitrijević, M. M. Popović: *Stark broadening data along a homologous sequence of earth alkali metal ion lines*, XIX ICPIG Beograd, (1989), 338.

M. S. Dimitrijević, V. Vujnović: *Stark broadening of Cu I lines — New calculation and a review of old results*, XIX ICPIG, Beograd, (1989), 340.

V. Kršljanin, M. S. Dimitrijević: *Modified semiempirical theory of Stark broadening in astrophysics: Ar II line shifts in spectra of B stars*, III Seminar Astrofizika u Jugoslaviji, Zagreb, (1989), 11.

M. S. Dimitrijević, S. Sahal-Bréchet: *Semiclassical calculations of astrophysically important Stark broadening parameters*, III Seminar Astrofizika u Jugoslaviji, Zagreb, (1989), 10.

M. S. Dimitrijević, S. Sahal-Bréchet: *Stark broadening of He I lines*, Astron. Astrophys. Suppl. Ser. **82** (1990), 519–529.

Using a semiclassical approach for the Stark broadening of atomic lines, we calculated electron-, proton and ionized helium-impact line widths and shifts for 77 neutral helium multiplets in the ultraviolet, visible and infrared regions of the spectrum.

S. Djurović, N. Konjević, and M. S. Dimitrijević: *Stark broadening of halogen atom lines from (¹D)np levels*, Z. Phys. D — Atoms, Molecules and Clusters **16** (1990), 255–260.

We report results of a study of the Stark broadening of halogen atom lines from (¹D)np levels. Wall stabilized arc is used as a plasma source. Electron densities $2.2\text{--}3.2 \times 10^{22} \text{ m}^{-3}$ are determined from the width of H_{β} line and electron temperature 9300–10000 K from plasma composition data. The agreement with the results of simple semiclassical calculations is within the

limits of the estimated errors of both experiment and theory. And explanation for the large discrepancy between theory and experiment detected for three Br I lines is offered.

M. S. Dimitrijević: *Line shapes investigations in Yugoslavia 1962–1985 (Bibliography and citation index)*, Publ. Obs. Astron. Belgrade **39** (1990), 1–214.

First part of the publication contains review and analysis of the results of spectral line shapes investigations in Yugoslavia in the period 1962–1985, with special emphasis on the importance of such investigations. In the second part, the bibliography of the contributions of Yugoslav scientists is given, together with the citation index.

M. S. Dimitrijević, S. Sahal-Bréchet: *Stark broadening of Li(I) lines: Regularities within a spectral series*, 22 EGAS, Uppsala, (1990), 478.

M. S. Dimitrijević: *Approximate methods for line broadening calculations*, IAU Symposium 145, “Evolution of stars: the photospheric abundance connection”, Zlatni Pjasci (Družba), (1990), 16.

V. Kršljanin, M. S. Dimitrijević: *Stark broadening of C IV λ 1549 lines and carbon abundance in hot DA white dwarfs*, IAU Symposium 145, “Evolution of stars: the photospheric abundance connection”, Zlatni Pjasci (Družba), (1990), 82.

M. S. Dimitrijević, G. Peach: *An examination of regularities in neutral atom broadening*, 10th ICSLS, Austin, (1990), 57.

M. S. Dimitrijević, N. Ben-Nessib: *Simple convergent formulae for estimating Stark widths of neutral atom lines*, 10th ICSLS, Austin, (1990), 161.

S. Djurović, N. Konjević, M. S. Dimitrijević: *Plasma broadening of Br I and II lines from (1D_2) np levels*, 10th ICSLS, Austin, (1990), 26.

M. S. Dimitrijević, S. Sahal-Bréchet: *Profiles of neutral lithium lines: broadening by charged particles*, 12th European Regional Astronomy Meeting of IAU, Davos, (1990), III 6.

M. S. Dimitrijević, Vladimir Kršljanin: *On the use of the modified semiempirical approach: the case of close perturbing levels*, XV SPIG, Dubrovnik, (1990), 201.

M. S. Dimitrijević, V. Vujnović: *On the Stark broadening of Cu I lines — the influence of the oscillator strength values*, XV SPIG, Dubrovnik, (1990), 241.

M. Karabin, A. Kubičela, J. Skuljan, I. Vince: *Activity cycle variation of some photospheric lines*, Proc. of the E.P.S. 6th European Solar Meeting *The Dynamic Sun*, Publ. of Debrecen Heliophysical Obs. **7** (1990), 104.

The equivalent widths, W , of 10 Fraunhofer lines, observed at Belgrade Astronomical Observatory, have been studied from 1987 till 1990. Four lines

show no change. The lines MnI 539.47 nm, ScII 552.68 nm and FeI 557.61 nm steadily decrease in W from 2.4% to 4.4% per year. The other three, TiII 533.68 nm, CaI 560.13 nm and NaI 568.82 nm slowly increase in W from 2.2% to 6.2% per year. It is assumed that these changes are correlated to the solar activity.

I. Vince: *Contribution of atomic collisions to the solar limb effect*, XV Summer School and International Symposium on the Physics of Ionized Gases (ed. Veža D.), (1990), 128.

M. S. Dimitrijević: *Semiclassical and approximate methods for Stark broadening investigations of astrophysical and laboratory spectra*, XV SPIG, Dubrovnik, (1990), 322.

V. Kršljanin: *Broadening of NaI lines due to collisions with atomic hydrogen*, in: 22nd EGAS, ed. A. Wannstrom, Univ. Uppsala, (1990), 760-762.

V. Kršljanin: *Simple estimates for Stark widths and shifts of neutral atom lines*, in: 22nd EGAS, ed. A. Wannstrom, Univ. Uppsala, (1990), 757-759.

V. Kršljanin, I. Vince and S. Erkapčić: *FeI line asymmetries and shifts caused by pressure broadening and diagnostics of solar convective motions*, in IAU Colloquium 130, The Sun and Cool Stars: Activity, Magnetism, Dynamos; Programme and Abstracts, Helsinki, (1990), 68.

V. Kršljanin, S. Marković-Kršljanin: *On Stark line shifts in spectra of hot main sequence stars*, in: XV SPIG Contributed Papers, ed. D. Veža, Inst. Phys. Univ. Zagreb, (1990), 370-371.

V. Kršljanin: *Hydrogen-impact broadening and solar abundance of sodium*, in: IAU Symposium 145, Evolution of Stars: The Photospheric Abundance Connection, Abstracts of Presented Papers, Golden Sands, Bulgaria, (1990), 26.

V. Kršljanin: *Hydrogen-impact broadening of NaI Fraunhofer lines and solar photospheric abundance of sodium*, Ph. D. Thesis Paper, in: 12th ERAM of the IAU Abstract Book, Davos, Switzerland, (1990), p. PD-2.

M. S. Dimitrijević: *Accuracy of line broadening data*, in: Accuracy of Element Abundances from Stellar Atmospheres, (ed. R. Wehrse), Lecture Notes in Physics 356 (1990), 31-44.

The line broadening calculations for spectral lines broadened by collisions with charged and neutral particles has been reviewed. The accuracy of existing calculations and the possibilities of theoretical approaches suitable for acquisition of new data useful in astrophysics has been discussed.

11.3. Atoms and Atomic Collisional Processes

11.3. Atomi i atomski sudarni procesi

M. S. Dimitrijević, P. Grujić: *An investigation of e-He double ionization near the threshold. The classical trajectories method*, X SPIG, Dubrovnik, (1980), 22.

M. S. Dimitrijević, P. Grujić: *Electron-hydrogen collisions in a homogeneous magnetic field: classical calculations*, ECAP Heidelberg, (1981), 735.

M. S. Dimitrijević, P. Grujić, S. Vučić: *Elastic e-He ($2s^2$) scattering: classical treatment*, ECAP Heidelberg, (1981), 764.

M. S. Dimitrijević, P. Grujić: *Classical investigations of $e^+ + H \rightarrow H^+ + e^- + e^+$ reaction near the threshold*, 5th Gen. Conf. EPS, Istanbul, (1981), 84.

M. S. Dimitrijević, P. Grujić: *Electron-helium double ionisation near the threshold: numerical investigations*, J. Phys. B: At. Mol. Phys. **14**, (1981), 1663.

The classical trajectory method is applied to the investigation of low-energy $e+He \rightarrow He^{2+}+3e$ collisions. In contrast to the hydrogenic case numerical calculations appear unable to derive the ionisation threshold law by varying one or two initial parameters. Final electron energies appear as linear functions, of the initial time parameter and it is conjectured that the energy distribution should be uniform within the total energy interval: $0.544 \leq E \leq 6.75$ eV. Calculated angular correlations between the three escaping electrons conform to the full central symmetry at very small energies, but go over to axially symmetric configurations as the energy rises. The final angular momenta acquire large values, with dramatic enhancement at the edges of an ionisation interval, where momentum exchange becomes particularly strong. Finally, the applicability of the classical model to non-hydrogenics is discussed, as well as some stochastic effects encountered.

M. S. Dimitrijević, P. Grujić and S. Vučić: *A classical model for e-He ($2s^2$) elastic scattering*, Fizika **13** (1981), 321.

Two variants of the free fall model for helium in the first autoionizational site have been proposed for calculating differential cross section for e-He ($2s^2$) elastic scattering. At $E = 7$ eV impact energy the cross sections are evaluated numerically, making use of the classical trajectory method and are found systematically higher for the case of the asynchronous atomic electrons motion than for the synchronous one.

M. S. Dimitrijević, P. Grujić: *The classical trajectory study of $e^+ + A \rightarrow A^+ + e^- + e^+$ reaction near the threshold*, J. Phys. B: At. Mol. Phys. **16** (1983), 297.

Numerical investigations of the positron-atom ionisational collisions near the threshold have been carried out within the classical trajectory method. It is found that for an infinitely heavy target the threshold law reads: $I \sim E^{2.49}$, whereas recent analytical calculations predict a value of 2.65 for the exponent. However, in the case of a hydrogen-atom target, the value 1.64 has been

obtained, indicating that the resting target mass assumption, as employed in all previous analytical investigations of $e^\pm - A$ processes near the ionisation threshold, breaks down in the case of the positron-light-atom collisions. The energy distribution of the outgoing particles appears non-zero and uniform in larger parts of available energy regions: $e^+[E/2, E]$, $e^- [0, E/2]$, but turns out, surprisingly, to be zero around $E/2$. The calculated energy dependence of the mutual angle is consistent with the analytically predicted $\theta_{+-} \sim E^{1/4}$ behaviour.

M. S. Dimitrijević: *Energy distribution in the near-threshold positron impact ionization of atoms*, XII SPIG, Šibenik, (1984), 109.

M. S. Dimitrijević, P. Grujić: *Langmuir's helium-like models revisited*, Z. Naturforsch **39A** (1984), 930.

Classical two-electron configurations, proposed by Langmuir in the days of Old Quantum Theory as models for heliumlike atoms, have been examined making use of modern semiclassical theory for the periodic orbits quantization. Combining both analytical and numerical investigations, energy spectra for the rotor-like and oscillator-like models have been evaluated for the nuclear charges $Z = 1, 2, 3, 6$. No essential improvement of the original result (for $Z = 2$) is obtained, signifying that either configuration turns out to be inferior to the simple Bohr's planetary model. Stability of these systems with respect to small perturbations has been examined and a general criterion for selection classical models as candidates for atomic orbitals within the semiclassical theory is discussed.

M. S. Dimitrijević, P. Grujić: *An old two-electron-system model revisited*, SPIG, Šibenik (1984), 112.

A. Mihajlov, M. Dimitrijević: *Determination of the cross section for elastic scattering of the electrons on cut off Coulomb potential in quasi classical method*, XII SPIG, Šibenik (1984), 416.

M. S. Dimitrijević, P. Grujić: *Classical spectrum of an oscillatory helium model*, Fizika **17** (1985), 1.

A generalization of an oscillatory two-electron atomic system, first proposed by Langmuir, has been studied numerically, by calculating electron classical orbits. By applying semiclassical quantization procedure, energy spectrum of the system is evaluated.

A. A. Mihajlov, M. S. Dimitrijević: *Uticaj jon-atomskih sudara na apsorpciju zračenja u atmosferama zvezda A tipa*, VIII Kongres MFAJ, Priština, (1985), 344.

A. Mihajlov, M. Dimitrijević, D. Djordjević: *Kvaziklasično i klasično određivanje preseka za rasejanje čestica na odsečenom Kulonovom potencijalu*, IV, JS FASP, Plitvice, (1985).

A. A. Mihajlov, M. S. Dimitrijević: *Influence of ion-atom collisions on the absorption of radiation*, *Astron. Astrophys.* **155** (1986), 319–322.

It is shown that for the interpretation of the continuum absorption spectra, of A type stars, the processes $H_2^+ + \hbar\omega \rightarrow H + H^+$ and $H + H^+ + \hbar\omega \rightarrow H + H^+$ must be considered together since their contribution is comparable. The corresponding absorption coefficients are also determined.

N. Simonović, P. Grujić, M. Dimitrijević: *Triatom fragmentation near the break up threshold*, *Collision dynamics of clusters and long-lived states*, Brioni, (1986).

A. A. Mihajlov, M. S. Dimitrijević, D. Djordjević, M. Luft, W. D. Kraeft; *Quasi-classical and classical cross sections for the scattering of electrons on the Coulomb cut-off potential*, *Contrib. Plasma Phys.* **27**, 1 (1987), 1–13.

The elastic scattering of electrons on the cut-off Coulomb potential $U_c(r) = -1/r + 1/r_c$, for $r \geq r_c$ and $U_c(r) = 0$, for $r < r_c$. has been considered. It has been shown that for $\varepsilon > 0.5/r_c$ (ε is the energy of free electrons in atomic units) the analytical quasi-classical expressions describe quite well the behaviour of transport, differential and total cross sections for elastic scattering. It has been shown moreover, that in the energy range considered, transport cross sections could be determined with practically the same accuracy already by means of classical, analytical expressions. Born approximations show larger deviations from exact quantum calculations.

M. S. Dimitrijević, P. Grujić, G. Peach, N. Simonović: *Near-threshold CID processes: numerical studies*, I CDAMP, Brioni, (1988), 48.

A. A. Mihajlov, M. S. Dimitrijević: *Coulomb cut-off potential and modeling of radiation and collision processes in dense plasmas*, I CDAMP, Brioni, (1988), 25.

M. S. Dimitrijević, P. Grujić: *Threshold laws for the fourfold ionization by electrons*, I CDAMP, Brioni, (1988), 47.

Lj. M. Ignjatović, A. A. Mihajlov, M. S. Dimitrijević: *Electron elastic scattering on the cut-off Coulomb and Debye potential*, XV SPIG, Dubrovnik, (1990), 37.

A. A. Mihajlov, M. S. Dimitrijević: *Influence of $H-H^-$ collisions on the continuum absorption spectra of cool stars*, 12th European Regional Astronomy Meeting of IAU, Davos, (1990), III 17.

M. S. Dimitrijević, A. A. Mihajlov: *Influence of ion-atom collisions on the stellar continuum absorption spectra*, XV SPIG, Dubrovnik, (1990), 368.

M. S. Dimitrijević, P. Grujić, G. Peach and N. Simonović: *Small-energy three-body systems: IV. Classical trajectory calculations for the near-threshold behaviour of collision-induced dissociation*, *J. Phys. B: At. Mol. Opt. Phys.* **23** (1990), 1641–1653.

Near-threshold collision induced dissociation is simulated numerically for the process $Xe + Xe_2 \rightarrow 3Xe$ by carrying out detailed classical trajectory calculations. A static model of the target is chosen and the system is assumed to

have zero total angular momentum. Then by varying a single parameter, the threshold law $\sigma \sim E^{1.6}$ for the cross section is derived, and this is consistent with analytical results obtained previously. We also consider the distributions of energy, mutual angles and individual angular momenta in the final channel.

M. S. Dimitrijević, P. Grujić, and N. Simonović: *Fourfold ionization by electrons near the threshold*, Z. Phys. D — Atoms, Molecules and Clusters **15** (1990), 203–209.

Threshold law for the process $e + A^{q+} \rightarrow A^{(q+4)+} + 5e$ has been derived within the classical theory. For neutral targets ($q = 0$) the threshold exponent assumes value 5.08 consistent with previous calculations for ionizations of lower orders. The method fails for $q < -4$. The results are compared with recent experimental measurements, which considerably underestimate theoretical findings. An empirical formula for n -fold ionization is provided, which predicts values for the threshold exponent $k = 7.8$ and 12.5 for $n = 5, 6$ respectively.

11.4. Laser Produced and Laboratory Plasmas 11.4. Laserski proizvedene i laboratorijske plazme

M. S. Dimitrijević, N. Konjević: *Uticaj predimpulsa na oštećenje prozračne mete laserskim zračenjem*, 22 ETAN u pomorstvu, Zadar, (1980), Vol. 2, 371.

M. S. Dimitrijević, N. Konjević: *The importance of the pulse shape for the laser-beam target interaction*, Optics and Laser Technology **12** (1980), 145.

Theoretical analysis of a pulsed CO₂ laser beam aluminium target interaction demonstrates increased efficiency if the main laser pulse is preceded by a pulse of enough power to induce breakdown in air and create plasma in front of the metal target surface.

M. S. Dimitrijević, N. Konjević: *O proceni optičke prozračnosti plazme koja nastaje prilikom obrade metala snažnim laserskim zračenjem*, 23 ETAN u pomorstvu, Zadar, (1981), 323.

M. S. Dimitrijević, N. Konjević: *Uticaj oblika laserskog impulsa na profil plazme ispred metalnih meta*, 23 ETAN u pomorstvu, Zadar, (1981), 330.

B. Lončarević, S. Jovićević, M. S. Dimitrijević, N. Konjević: *Apsorpcija laserskog zračenja na metalnoj meti u prisustvu proboja ispred mete*, 23 ETAN u pomorstvu, Zadar, (1981), 335.

S. Jovićević, B. Lončarević, V. Knežević, S. Manola, M. S. Dimitrijević, N. Konjević: *Spektroskopsko proučavanje laserski proizvedene plazme*, 23 ETAN u pomorstvu, Zadar, (1981), 348.

S. Jovičević, M. S. Dimitrijević, N. Konjević: *Uticao talasne duzine lasera na apsorpciju zracenja na metalu u prisustvu plazme*, 24 ETAN u pomorstvu, Zadar, (1982), 374.

M. S. Dimitrijević, N. Konjević: *Uloga predimpulsa kod praga za oštećenje metalne mete laserskim zračenjem*, 24 ETAN u pomorstvu, Zadar, (1982), 367.

P. K. Cibin, M. S. Dimitrijević: *Influence of electron collisions on the propagation of guided electron plasma waves along the cylindrical interface between two plasmas*, Int. Conf. Plasma Physics, Göteborg, (1982), 319.

N. Konjević, M. S. Dimitrijević: *On the Stark broadening of non-hydrogenic lines of heavy elements in plasmas*, in: Spectral Line Shapes Vol. II, ed. K. Burnett, Walter de Gruyter, Berlin – New York, (1983), 137.

M. S. Dimitrijević: *Apsorpcija laserskog zracenja na metalima u prisustvu plazme ispred mete*, 25 ETAN u pomorstvu, Zadar 1983, 522.

A. Mihajlov, M. Dimitrijević, M. M. Popović: *Determination of electrical conductivity of plasma by the use of classical transport cross-sections calculated on the basis of the cut-off Coulomb potential model*, XII SPIG, Šibenik, (1984), 420.

A. Mihajlov, M. Dimitrijević, M. M. Popović: *Determination of electrical conductivity of plasma on the basis of the cut-off Coulomb potential model*, XVII ICPIG, Budapest, (1985), 357.

A. A. Mihajlov, M. S. Dimitrijević, D. Djordjević, M. M. Popović: *Absorption of electro-magnetic radiation during collisions between lithium atoms and ions in low temperature plasma*, IX Int. Conf. on Gas Discharges, Venezia, (1988), 587.

A. A. Mihajlov and M. S. Dimitrijević: *Cut-off Coulomb potential in atomic and plasma physics*, Proceedings of the International Conference on Classical Dynamics in Atomic and Molecular Physics, Brioni, Yugoslavia, eds. T. Grozdanov, P. Grujić, P. Krstić, (1988).

A P P E N D I X
D O D A T A K

**LECTURES HELD AT THE ASTRONOMICAL
OBSERVATORY IN THE PERIOD 1980-1990**

**PREDAVANJA I SEMINARI
ODRŽANI NA ASTRONOMSKOJ OPSERVATORIJI
U BEOGRADU U PERIODU 1980-1990**

3.03.1980.

V. A. Fomin (GAO AN SSSR, Pulkovo, Lenjingrad)
RADIOTELESKOP RATAN - 600 I NJEGOVO KORIŠĆENJE ZA ODREĐI-
VANJE TAČNIH KOORDINATA UNUTRAŠNJIH PLANETA

19.03.1980.

D. Olević
a) RASPODELA MASA U ASTEROIDNOM PRSTENU
b) ANALIZA KIRKWOODOVIH PRAZNINA

4.06.1980.

Dj. Teleki
AKUMULACIJA ZNANJA O POLOŽAJIMA ZVEZDA

22.12.1980.

B. Kovačević (Elektrotehnički fakultet, Niš)
INTERNI VREMENSKI SISTEMI

26.02.1981.

S. Sadžakov, M. Dačić, D. Šaletić
REZULTATI ISPITIVANJA SISTEMATSKIH GREŠAKA ZVEZDA NPZT
PROGRAMA BEOGRADA I BORDOA

30.03.1981.

L. Vušković (Institut za fiziku, Beograd)
PRIKAZ ISTRAŽIVAČKOG RADA U OKVIRU VASIONSKEG PROGRAMA
U JPL (Pasadena)

9.11.1981.

J. Moczko (Direktor širinske astronomske opservatorije, Borowiec, Poljska)
O RADOVIMA OPSERVATORIJE U BOROWIEC-U

31.03.1982.

A. Kubičela, M. Vukičević-Karabin (Institut za astronomiju PMF-a, Beograd)
NOVI POGLED NA SINODIČKU ROTACIJU SUNCA

7.04.1982.

A. Kubičela, I. Vince
EFEKAT VANFOKUSNOG POSMATRANJA NA SUNČEVOM SPEKTROGRAFU ASTRONOMSKE OPSERVATORIJE U BEOGRADU

29.04.1982.

Z. Knežević
RANA I KASNA OTKRIĆA MALIH PLANETA

11.08.1982.

S. Sadžakov, V. Fomin (GAO AN SSSR, Pulkovo, Lenjingrad), M. Dačić
a) AN INVESTIGATION OF THE SYSTEMATIC ERRORS OF THE BELGRADE NPZT AND AGK3 CATALOGUES ON THE BASIS OF MODERN PZT OBSERVATIONS
b) SYSTEMATIC ERRORS IN LATITUDE OBSERVATIONS OF VARIOUS OBSERVATORIES

28.10.1982.

V. Zappala, M. DiMartino, F. Scaltriti (Astronomska opservatorija, Torino),
Z. Knežević, G. Djurašević
PRIRODA ASTEROIDA 216 KLEOPATRA NA OSNOVU NOVIH FOTOMETRIJSKIH POSMATRANJA

17.11.1982.

V. Škodrov (Astronomski odsek Akademije nauka Bugarske)
ASTRONOMSKA ISTRAŽIVANJA U BUGARSKOJ

11.01.1983.

R. Grujić, Dj. Teleki
ISPITIVANJA UTICAJA VETRA NA MERENJA KOD BEOGRADSKIH ŠIRINSKIH POSMATRANJA

18.01.1983.

B. Kovačević, Lj. Golubović (Elektrotehnički fakultet, Niš)
a) PRENOS VREMENSKIH SIGNALA PREKO SATELITA I PRECIZNO ODREĐIVANJE NJIHOVOG MESTA
b) TEHNIČKA OPREMLJENOST ČASOVNE SLUŽBE ASTRONOMSKE OPSERVATORIJE I MOGUĆNOSTI NJENOG OSAVREMENJAVANJA

3.03.1983.

Dj. Božičković

KATALOG APSOLUTNIH DEKLINACIJA 213 FK4 ZVEZDA U ZONI OD
-30° DO +90°

4.05.1983.

a) V. Kršljanin

SAVREMENA KOSMOLOGIJA I FILOZOFIJA

b) N. Čabrić, A. Tomić (Narodna opservatorija, Beograd)

OKULTACIJA JUPITERA 6. MARTA 1983.

c) A. Tomić, N. Čabrić (Narodna opservatorija, Beograd)

FIKTIVNI DNEVNI METEORSKI RADIJANTI

d) A. Tomić, N. Čabrić (Narodna opservatorija, Beograd)

DENSITOMETAR SA He Ne LASEROM I LDR

e) S. Ninković

REZULTATI IZRAČUNAVANJA GALAKTOCENTRIČNE ORBITE GLOBU-
LARNOG JATA NGC 5466

7.09.1983.

a) I. Pakvor

IZVEŠTAJ O STANJU RADOVA NA VAKUUMSKIM MERIDIJANSKIM
MIRAMA

b) S. Sadžakov, V. A. Fomin (GAO AN SSSR, Pulkovo, Lenjingrad), M. Dačić
SISTEMATSKE GREŠKE TIPA $\Delta\alpha_\alpha$ I $\Delta\delta_\alpha$ POTSDAMSKOG PZT KATA-
LOGA ZVEZDA

17.11.1983.

I. Almár (Konkoly Opservatorija, Budimpešta)

INFORMACIJE O SATELITSKO-GEODETSKIM MERENJIMA I O NJI-
HOVOJ GEODINAMIČKOJ PRIMENI U MAĐARSKOJ

23.11.1983.

V. A. Fomin (GAO AN SSSR, Pulkovo, Lenjingrad)

ISPITIVANJE SISTEMATSKIH GREŠAKA $\Delta\alpha_\alpha$, $\Delta\delta_\alpha$ TOKIJSKIH KATA-
LOGA FZT

9.12.1983.

L. Sehnal (Opservatorija Ondřejov, Čehoslovačka)

OTPOR ATMOSFERE KRETANJU VEŠTAČKIH SATELITA I NOVI MOD-
ELI ATMOSFERE

29.12.1983.

R. Grujić, R. Krga

ISPITIVANJE „GREŠKE NOĆI“ KOD BEOGRADSKIH ŠIRINSKIH PO-
DATAKA U PERIODU 1949—1960

10.02.1984.

A. Yu. Yatsenko (Opservatorija Engelhardt, Kazan, SSSR)

- a) O TATARSKOJ SSR
- b) O KAZANSKOJ OPSERVATORIJI

11.04.1984.

B. Kovačević (Elektrotehnički fakultet, Niš)

UNAPREĐENJE ČASOVNE SLUŽBE NA ASTRONOMSKOJ OPSERVATORIJI

17.05.1984.

J. Vondrak (Opservatorija Ondřejov, Čehoslovačka)

- a) OPSERVATORIJA ONDŘEJOV
- b) UTICAJ PLANETA NA PRECESIJU I NUTACIJU

22.05.1984.

a) I. Vince, M. Dimitrijević, V. Kršljanin

SUDARNO ŠIRENJE I LIMB EFEKAT NA SUNCU: LINIJE $\text{NaI } 3p^2P^0 - ns^2S$

- b) Dj. Božičković
- ODREĐIVANJE NAGIBA MIKROSKOPA

14.06.1984.

A. Yu. Yatsenko (Opservatorija Engelhardt, Kazan, SSSR)

ISTRAŽIVANJA PAVILJONSKE REFRAKCIJE NA ASTRONOMSKOJ OPSERVATORIJI ENGELHARDT

21.06.1984.

V. Zappala (Astronomska opservatorija, Torino), P. Farinella (Univerzitet, Pisa)
ROTATIONAL PROPERTIES AND COLLISIONAL EVOLUTION OF ASTEROIDS

31.08.1984.

I. Vince, M. Dimitrijević, V. Kršljanin

ŠIRENJE PRITISKOM I LIMB EFEKAT NA SUNCU

12.10.1984.

A. Yu. Yatsenko (Opservatorija Engelhardt, Kazan, SSSR), Dj. Teleki
SAVREMENI POGLED NA HARZEROVE RADOVE O ASTRONOMSKOJ REFRAKCIJI

22.10.1984.

Y. Andrillat (Direktor Observatoire Haute-Provence, Francuska)

THE OBSERVATORY HAUTE-PROVENCE

24.10.1984.

H. Debehogne (Observatoire Royal de Belgique)
PLATE REDUCTIONS AND MODERN ALGEBRA. ACCURACY ON LA
SILLA-ESO PLATES BY THE TEST-STARS METHOD

25.10.1984.

Y. Andrillat (Direktor Observatoire Haute-Provence, Francuska)
Be ZVEZDE

7.12.1984.

M. Dimitrijević
PARISKA OPSERVATORIJA

11.12.1984.

P. Paquet (Observatoire Royal de Belgique)
PROGRAM „MERIT“: DOBIJENI REZULTATI I OČEKIVANJA

19.12.1984.

A. Lesage (Opservatorija Paris-Meudon, Francuska)
VEROVATNOĆE PRELAZA I NJIHOV ZNAČAJ U ASTROFIZICI

31.01.1985.

a) A. Kubičela, I. Vince, Z. Ivanović (IX gimnazija, Beograd)
EFFECTS OF EXTRAFOCAL OBSERVATION WITH THE SOLAR SPEC-
TROGRAPH OF THE BELGRADE ASTRONOMICAL OBSERVATORY. III:
INTEGRATION OF THE LIMB EFFECT

b) G. Djurašević, J. Arsenijević, Z. Knežević
OMIKRON ANDROMEDAE — BRZE PROMENE

28.02.1985.

D. Olević, S. Šegan (Institut za astronomiju PMF-a, Beograd)
PROCENA TAČNOSTI ASTROGRAFSKIH POLOŽAJA DOBIJENIH KRAT-
KOFOKUSNIM ASTROGRAFOM BEOGRADSKE OPSERVATORIJE

7.03.1985.

S. Sadžakov, M. Dačić

a) REZULTATI POSMATRANJA ZVEZDA ZA KATALOG DS PROGRAMA
I U OKOLINI RADIO-IZVORA

b) POSMATRANJA SUNCA I PLANETA NA MERIDIJANSKOM KRUGU
U BEOGRADU

2.04.1985.

M. S. Dimitrijević
ZAVISNOST ŠTARKOVIH ŠIRINA I POMAKA OD JONIZACIONOG PO-
TENCIJALA: $np^{k-1}(n+1)s - np^k$ REZONANTNI PRELAZ

15.04.1985.

J. Vondrak (Opservatorija Ondřejov, Čehoslovačka)
IMPROVEMENT OF POSITIONS AND PROPER MOTIONS OF THE
STARS FROM THE PZT OBSERVATIONS AT ONDŘEJOV OBSERVATORY

18.04.1985.

V. Kršljanin, I. Vince
SUDARNO ŠIRENJE I OSETLJIVOST SINTETIZOVANIH PROFILA NEKIH
NEREZONANTNIH LINIJA NEUTRALNOG NATRIJUMA NA PROMENE
MIKROTURBULENTNE BRZINE

30.05.1985.

A. Čadež (Institut za fiziku, Ljubljana)
GRAVITACIONI TALASI OD PULSARA

3.07.1985.

M. S. Dimitrijević, V. Kršljanin
SEMIEMPIRIJSKA FORMULA ZA ŠTARKOV POMAK SPEKTRALNIH
LINIJA JONA

28.08.1985.

M. S. Dimitrijević
a) JEDNOSTAVNA FORMULA ZA PRORAČUN PARAMETARA ŠTARKO-
VOG ŠIRENJA LINIJA NEUTRALNIH ATOMA
b) O NEJEDNAKOSTI ŠTARKOVIH PARAMETARA UNUTAR JEDNOG
MULTIPLETA I SUPERMULTIPLETA A_{rII}
c) ŠTARKOVO ŠIRENJE SPEKTRALNIH LINIJA NEUTRALNOG KALI-
JUMA

4.09.1985.

O. Atanacković
EFEKTI ELASTIČNIH SUDARA NA LOKALNU FREKVENTNU PRERAS-
PODELU FOTONA U REZONANTNIM LINIJAMA

12.09.1985.

a) G. Roberti (Astronomska opservatorija, Napulj)
THE FORMATION OF THE KI 7699 RESONANCE LINE IN NON-LTE
CONDITIONS
b) G. Severino (Astronomska opservatorija, Napulj)
THE EFFECTS OF WAVES ON THE KI 7699 RESONANCE LINE

17.09.1985.

Dj. Alpar (Direktor Kosmičke geodezijske opservatorije u Pencu, Mađarska)
O DOPLER TEHNICI

18.09.1985.

Dj. Alpar (Direktor Kosmičke geodezijske opservatorije u Pencu, Mađarska)
O ANALIZI VREMENSKIH SERIJA

20.09.1985.

T. Kiseleva (GAO AN SSSR, Pulkovo, Lenjingrad)

PRIMENA DUGOFOKUSNIH TELESKOPA ZA ODREĐIVANJE TAČNIH KOORDINATA SATELITA VELIKIH PLANETA, DVOJNIH ZVEZDA I PARALAKSI

24.10.1985.

F. K. Brunner (Wild Heerbrugg, Švajcarska)

EFFECTS OF THE IONOSPHERE AND THE TROPOSPHERE ON GHZ SIGNAL

28.10.1985.

B. Grabovski (Institut Fizyki WSP Opole, Poljska)

„ASTROFIZIČKE“ I „RELATIVISTIČKE“ MASE BELIH PATULJAKA

29.10.1985.

M. Il (Direktor Astronomske opservatorije u Baji, Mađarska)

AKTIVNOST ASTRONOMSKE OPSERVATORIJE U BAJI

1.11.1985.

a) Z. Knežević

NOVI REZULTATI ISTRAŽIVANJA FAMILIJA MALIH PLANETA

b) I. Pakvor

PROGRESS REPORT ON THE BELGRADE CATALOG OF ABSOLUTE RA'S OF BRIGHT POLAR STARS

6.11.1985.

S. Sadžakov

PRELIMINARNI REZULTATI POSMATRANJA DVOJNIH ZVEZDA I ZVEZDA U OKOLINI RADIO-IZVORA

16.12.1985.

A. Kubičela

VEZA IZMEĐU SUNČEVE SIDERIČKE I SINODIČKE OSE ROTACIJE

26.12.1985.

G. I. Pinigin (GAO AN SSSR, Pulkovo, Lenjingrad)

HORIZONTALNI MERIDIJANSKI KRUG

27.03.1986.

P. Sotirovski (Opservatorija Paris-Meudon, Francuska)

HALEJEVA KOMETA

1.04.1986.

S. Murri-Tolcheljnikova (GAO AN SSSR, Pulkovo, Lenjingrad)

O PROBLEMU KLASIFIKACIJE SAVREMENIH METODA ODREĐIVANJA REKTASCENZIJA ZVEZDA

3.04.1986.

S. Murri-Tolcheljnikova (GAO AN SSSR, Pulkovo, Lenjingrad)
OSNOVNI PRINCIPI POSTAVKE SFERNIH SISTEMA KOORDINATA U
ASTROMETRIJI

21.05.1986.

Lj. Dačić (Université de Paris XI, Francuska)
INFORMACIJA O RAČUNSKOM CENTRU PARISKOG UNIVERZITETA 11
— ORSAY

9.07.1986.

a) I. Pakvor
ANALIZA STABILNOSTI VAKUUMSKIH MIRA VELIKOG PASAŽNOG IN-
STRUMENTA U BEOGRADU

b) V. Trajkovska
REZULTATI ISPITIVANJA PODELE LIMBA VELIKOG MERIDIJANSKOG
KRUGA U BEOGRADU NA 0°5.

27.08.1986.

P. Brault (Opservatorija Paris-Meudon, Francuska)
ASTROPHYSICAL INTEREST OF MOLECULAR AND ATOMIC PHYSICS

7.10.1986.

a) Cl. Froeschle (Astronomska opservatorija, Nice, Francuska)
GRAVITACIONA EVOLUCIJA ASTEROIDNOG PRSTENA

b) P. Farinella (Astronomska opservatorija, Pisa, Italija)
OTVORENA PITANJA ASTEROIDNIH FAMILIJA

8.10.1986.

D. Egret (Centar za zvezdane podatke (CDS), Strasbourg, Francuska)
O AKTIVNOSTI CENTRA ZA ZVEZDANE PODATKE U STRASBOURGU

16.10.1986.

P. Sotirovski (Opservatorija Paris-Meudon, Francuska)
DANAŠNJI MODELI SUNCA I PROBLEMI NEUTRINA

17.10.1986.

Y. Requième (Observatoire de l'Université de Bordeaux) PROGRAM HIPAR-
HA BUDUĆA BAZA ZA ASTROMETRIJU

29.10.1986.

Dj. Sadecki Kardos (Institut za geodeziju u Sopronu Mađarske akademije
nauka)

ASTROGEODETSKI RADOVI U MAĐARSKOJ I OKOLNIM ZEMLJAMA

12.11.1986.

B. Grabovski (Institut Fizyki WSP Opole, Poljska)
JONIZACIONI BALANS U ZVEZDANIM ATMOSFERAMA

19.12.1986.

a) E. Simonneau (Institut za astrofiziku, Paris, Francuska)

UOPŠTENA EDDINGTONOVA APROKSIMACIJA ZA REŠAVANJE JEDNAČINE PRENOSA ZRAČENJA PRI SFERNOJ GEOMETRIJI

b) B. Kovačev (predsednik Nacionalnog komiteta za astronomiju Bugarske)

ASTRONOMIJA U BUGARSKOJ

11.03.1987.

V. Doazan (Opservatorija Paris-Meudon, Francuska)

THE LOCAL STELLAR ENVIRONMENT

31.03.1987.

A. Jovanovic (Prirodno-matematički fakultet, Kragujevac)

ASTRONOMSKI PROGRAM „NAUTILUS“

3.04.1987.

H. K. Eichhorn (Department of Astronomy, Gainesville, Florida, USA)

ESTABLISHMENT OF COMPREHENSIVE STAR CATALOGUES

13.05.1987.

D. Djurović (Institut za astronomiju PMF-a, Beograd)

Seriya predavanja: SAVREMENE METODE U OBRADI PODATAKA

20.05.1987.

D. Djurović (Institut za astronomiju PMF-a, Beograd)

Seriya predavanja: SAVREMENE METODE U OBRADI PODATAKA

II deo: IZRAVNANJE POSMATRAČKIH PODATAKA METODOM VITEKERA-ROBINSONA-VONDRAKA

27.05.1987.

a) D. Djurović (Institut za astronomiju PMF-a, Beograd)

Seriya predavanja: SAVREMENE METODE U OBRADI PODATAKA

III deo: FURIJEOVE TRANSFORMACIJE U PRAKTIČNOJ PRIMENI

b) D. Petruševski (TV Beograd)

ELEKTRONSKI HRONOGRAF

18.11.1987.

S. Ninković

NEKA PITANJA MODELOVANJA GALAKSIJE

23.03.1988.

S. Ninković

SPLJOŠTENOST GALAKTIČKE KORONE

24.03.1988.

D. Slavić (Elektrotehnički fakultet, Beograd), N. Čabrić (Zavod za udžbenike i nastavna sredstva, Beograd)

PREZENTACIJA PC SKY ATLASA

7.06.1988.

a) I. Vince

ŠIRENJE USLED PRITISKA I BISEKTORI SUNČEVIH SPEKTRALNIH LINIJA

b) I. Pakvor

KATALOG APSOLUTNIH REKTASCENZIJA

30.06.1988.

G. Popović

ANALIZA RELATIVNOG KRETANJA PARA GP 34

21.03.1989.

J. Henrard (Université de Namur, Belgija)

DYNAMICS IN THE 2 : 1 RESONANCE

22.03.1989.

A. Kiseljev, A. Šaht (GAO AN SSSR, Pulkovo, Lenjingrad)

a) PROGRAM ZAJEDNIČKIH ISPITIVANJA VIZUALNO-DVOJNIH ZVEZDA I SATELITA VELIKIH PLANETA PULKOVSKE I BEOGRADSKJE OPSERVATORIJE

b) AUTOMATSKA KASETA ZA FOTOGRAFSKA POSMATRANJA DVOJNIH ZVEZDA POMOĆU VELIKOG REFRAKTORA

S. Sadžakov: FUNDAMENTALNA ASTROMETRIJA

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SAVREMENI PROBLEMI ZEMLJINE ROTACIJE I GEODINAMIKE

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Z. Knežević: MALE PLANETE, ELEMENTI, NEBESKA MEHANIKA

D. Olević: ASTROFOTOGRAFIJA

19.04.1989.

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ISTRAŽIVANJA OBLIKA LINIJA U ASTROFIZIČKIM SPEKTRIMA

10.05.1989.

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ZVEZDANI SISTEMI

31.05.1989.

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SUNCE KAO ZVEZDA — BEOGRADSKA ISTRAŽIVANJA

14.06.1989.

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GALAKTOCENTRIČNE PUTANJE GLOBULARNIH JATA

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DIFERENCIJALNA ROTACIJA B I Be ZVEZDA

S. Ninković

JEDNA PRIMENA TEOREME VIRIJALA NA NAŠU GALAKSIJU

4.10.1989.

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FOTOSFERSKA KRETANJA VELIKIH RAZMERA

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RAD NA BEOGRADSKOM VELIKOM MERIDIJANSKOM KRUGU U TO-
KU 1968–1988

c) Z. Cvetković

KARAKTERISTIKE BEOGRADSKOG KATALOGA DVOJNIH ZVEZDA

1.11.1989.

S. Jankov

DOPPLER IMAGING SA TEORIJSKOG I POSMATRAČKOG ASPEKTA

15.11.1989.

M. Djokić

PREGLED RAZVOJA ISTRAŽIVAČKIH AKTIVNOSTI NA ASTRONOM-
SKOJ OPSERVATORJI U BEOGRADU

12.12.1989.

M. Marković (Rudarsko-geološki fakultet Univerziteta u Beogradu) O RADU
EVROPSKE FONDACIJE ZA NAUKU (ECF)

27.12.1989.

Z. Knežević

ANALITIČKE TEORIJE SEKULARNIH POREMEĆAJA KRETANJA MA-
LIH PLANETA

21.02.1990.

G. Djurašević

IZUČAVANJE AKTIVNIH TESNIH DVOJNIH SISTEMA

7.03.1990.

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BELI FLEROVI

21.03.1990.

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GALAKTIČKI RADIO-HALO

25.04.1990.

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TOPLE ZVEZDE SA EMISIONIM LINIJAMA

9.05.1990.

O. Atanacković-Vukmanović

PRENOS ZRAČENJA U ZVEZDANIM ATMOSFERAMA

16.05.1990.

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INVERZIJA PROFILA ZVEZDANIH SPEKTRALNIH LINIJA

2.07.1990.

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POSMATRAČKE MOGUĆNOSTI NACIONALNE OPSERVATORIJE ROZHEN (BUGARSKA)

19.09.1990.

J. Sanz Subirana, R. Cubarsí Morena (Katalonski politehnički univerzitet, Barcelona)

REŠAVANJE BOLTZMANNOVE JEDNAČINE ZA NAŠU GALAKSIJU

25.10.1990.

S. Sadžakov

ULOGA FUNDAMENTALNE ASTROMETRIJE U ASTRONOMSKIM ISTRAŽIVANJIMA

7.11.1990.

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ODREĐIVANJE POLOŽAJA ZVEZDA U OKOLINI RADIO IZVORA

21.11.1990.

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O PRIMENLJIVOSTI DŽINSOVOG KRITERIJUMA

5.12.1990.

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RAZVOJ ISTRAŽIVANJA PROFILA SPEKTRALNIH LINIJA U JUGOSLAVIJI

26.12.1990.

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SATELITSKA ASTRONOMIJA

27.12.1990.

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