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PROGRAM AND ABSTRACTS

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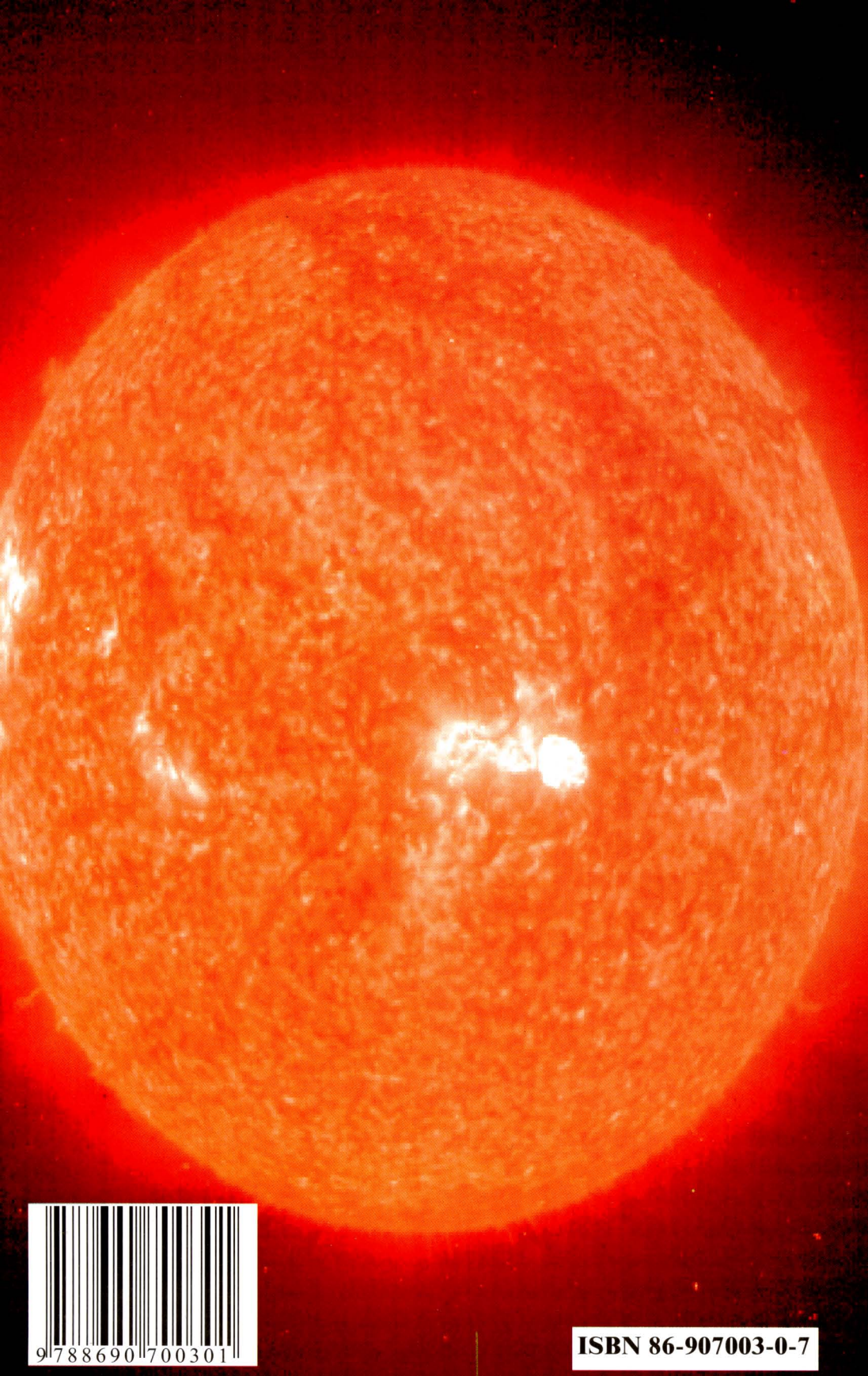

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Invited lecture

INFLUENCE OF GRAVITATIONAL MICROLENSING ON BROAD EMISSION LINES OF QUASARS

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The change in the continuum flux of quasars by stars or compact object in intervening galaxies (gravitational microlensing) is a well-established observational phenomenon. X-Ray and Optical observational evidences about microlensing on broad emission lines (BEL) have very recently appeared. Using different kinematic and geometrical models for the broad line and the continuum regions we study the effects of microlensing on the light curves of the continuum and BEL of quasars at high optical depth in several known lens system. We also study the correlation between the BEL and continuum amplification according to these models.

Invited lecture

THE IMPORTANCE OF ALKALI LINE BROADENING IN BROWN DWARF ATMOSPHERES

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We present theoretical calculations of absorption profiles of sodium and potassium perturbed by helium and molecular hydrogen. The profiles have been included in model atmospheres of brown dwarfs to predict synthetic spectra which have been compared to previous calculations based upon Lorentz profiles and the classic van der Waals approximation. We find that the unified profiles provide increased opacities in the optical spectra of methane brown dwarfs, in agreement with previously reported missing opacities in the models. Moreover, we find that the satellite of the interaction between the potassium doublet at 0.77 μm and H_2 produces a spectral feature around 0.69μm which might have been observed in the composite spectrum of the T-type brown dwarf binary system Eps Indi B.

Invited lecture

SPECTROSCOPIC STUDY OF PLASMA FLOWS CREATED BY A MAGNETOPLASMA COMPRESSOR

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The results of spectroscopic investigations of compression plasma flows generated by gas-discharge and erosive magnetoplasma compressors are presented. The spatially- and time-resolved measurements of temperature and electron concentration of compression plasma flows in such quasi-stationary plasma accelerators (plasma guns) are considered. To characterize the quasi- stationary plasma flow, the special dynamic coefficients were introduced. These coefficients are calculated on the basis of the obtained temporal evolution of the electron density and temperature in plasma.

Invited lecture

OVERVIEW OF SUPERNOVA MODELING WITH PHOENIX

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I describe the use of the generalized stellar atmosphere code PHOENIX to model both Type Ia and Type II supernovae and present results that shows that both types of supernovae can play an important role in our understanding of cosmology.

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INTERACTION POTENTIALS FOR SPECTRAL LINE SHAPES IN PLASMA

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In the standard formalism of Stark impact broadening of spectral lines and of cross sections, the electrostatic Coulomb potential is used to describe the interaction between the perturbing electrons and the emitting atom. Electronic correlations (screening effects) are usually taken into account by introducing a cut-off in the interaction when the electron-atom distance exceeds the Debye radius. A more consistent treatment to describe collective effects is the Debye-Hückel potential where the two-particle Coulomb field is shielded by the ensemble of the surrounding electrons. This is a good approximation only for high temperature and low density plasmas (weakly non ideal plasmas), while for strongly non ideal plasmas, the Coulomb cut-off potential or the ion sphere potential are more appropriate. These potentials, which can be written as the Coulomb potential with one or two correcting terms, are used for Stark impact broadening. New semi-classical collisional functions are derived for both the transition probability and the cross section, using the classical path approximation.

The Coulomb potential is expanded in multipolar components and only the long range part is retained in the perturbation theory and in addition only the dipole term is retained for the calculation of the cross-sections between the levels that are dipolar electric transitions.

Using the parametrization of the straight path trajectory in the collision frame, the semi-classical collisional functions for isolated neutral lines $A(z)$ and $a(z)$ are expressed in terms of the modified Bessel functions $K_0(z)$ and $K_1(z)$, these functions are revised when using the cutoff or ion sphere potential.

We have compared the effects of the Coulomb, cut-off and ion sphere potentials on the different collisional functions. The numerical results show that the increase in the screening leads to a decrease in these functions, especially for the lower values of the impact parameter.

We investigate also a full quantum model based on quasiparticles treatment to describe the electron ion interaction in a non ideal plasma. We developed this simplified quantum formalism of the emission which take into account the interaction between particles such that it becomes applicable to a weakly non ideal plasma. We give analytic expression of the line width and explain the non linearity of the width via the density observed in some experiments.

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SPECTROSCOPY OF THE DISCHARGES CREATED AND MAINTAINED BY A SURFACE-WAVE

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The discharges created and maintained by a surface-wave (SWD) are of a special type of microwave discharge, characterized by having dimensions higher than the wavelength of the electromagnetic field that is maintaining them, and the coupler device of the microwave energy. From an experimental point of view, the surface wave discharge has several characteristics that make it especially useful in the research of basic plasma physics, and can also be applied in different fields of science and technology. These characteristics are a) the wide range of pressure (mTorr-some atmospheres) and frequency (MHz-GHz), b)the use of different atomic (Ar, He, Kr, Xe) and molecular (N_2 and O_2) gases and their mixtures, with flows lower than 0.5 l/min against several l/min that another plasma type such as the ICP ($\sim$ 10l/min), c) the discharge extension outside the exciter device and, in this way, long plasma columns, and d) also, to point out, the absence of the significant fluctuations and instabilities and a very good reproducibility.

In recent years, SWDs are used in an increasing number of applications, such as surface treatment (formation and deposition of thin material films in the manufacturing of, for example, electronic devices), light sources, emission of laser radiation, sterilization and spectrochemical analyses. Knowing the processes (internal kinetics) which take place in the plasmas is essential if we want correctly to carry out these applications. The processes in the plasma depend on the parameter values of the plasma such as temperatures and densities. For measuring these parameters, we can use techniques of passive spectroscopy, because the wide range and intensity of the spectral lines emitted by the atoms and ions into the discharge. Starting from intensities, broadenings and shifts of the spectral lines we obtain information about the basic parameters of the plasma, such as electron density (n_e) and temperature (T_e), gas temperature (T_g) and the densities of excited atoms ($n(p)$) of the discharge such as the metastable atoms.

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THE HIDDEN NATURE OF NARROW-LINE SEYFERT 1 GALAXIES

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Narrow-Line Seyfert 1 (NLS1) galaxies are relatively rare objects among type 1 nearby Active Galactic Nuclei (AGN), and after almost two decades since their first classification, they are still a matter of debate. Their peculiar properties, like narrow permitted emission lines (FWHM(H_beta)<2000 km/s), steep slopes and rapid variability in the soft X-ray domain, and the optical/UV Big Blue Bump shifted towards higher energy, are currently interpreted as active nuclei younger than "classical" Seyfert 1 (S1) galaxies, powered by smaller supermassive Black-Holes ($M_BH\ 10^6 - 10^7\ M_sun$), and accreting at higher rates. To date this paradigma is not yet proved. Other possible scenarios were proposed and several authors challenged this topic from different points of view. I will present a short review about the optical spectroscopic properties of NLS1s and recent results obtained within our group in investigating the BH-bulge relation of AGNs as a test for the NLS1-paradigma.

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A NEW MODELING APPROACH FOR DACs AND SACs REGIONS IN THE ATMOSPHERES OF HOT EMISSION STARS

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The presence of Discrete Absorption Components (DACs) or Satellite Absorption Components (SACs) is a very common phenomenon in the atmospheres of hot emission stars (see Danezis et al. 2003, Lyratzi & Danezis 2004) and result to the complex line profiles of these stars. The shapes of these lines are interpreted by the existence of two or more independent layers of matter nearby a star. These structures are responsible for the formation of a series of satellite components for each spectral line. Here we will present a model reproducing the complex profile of the spectral lines of Oe and Be stars with DACs and SACs (Danezis et al. 2003, Lyratzi & Danezis 2004). In general, this model has a line function for the complex structure of the spectral lines with DACs or SACs and include a function L that considers the kinematic (geometry) of an independent region. In the calculation of the function L we have considered the rotational velocities of the independent regions, as well as the random velocities within them. This means that the new function of L is a synthesis of the rotational distribution and a physical Gaussian. Finally, we calculate the optical depth (τ) and the column density (d) of each independent density region.

References

Danezis, E., Nikolaidis, D., Lyratzi, V., Stathopoulou, M., Theodossiou, E., Kosionidis, A., Drakopoulos, C., Christou G. & Koutsouris, P.: 2003, *Ap&SS*, **284**, 1119.

Lyratzi, E. and Danezis, E. 2004, AIP Conference Proceedings 740, pp. 458-473 [THE PHYSICS OF IONIZED GASES: 22nd Summer School and International Symposium on the Physics of Ionized Gases, Bajina Bašta, 23-27 August 2004, eds. Lj. Hadzijevski, T. Grozdanov, N. Bibić].

Invited lecture

THE ROLE OF LINE PROFILES IN ANALYZING SPECTRA OF SUPERNOVAE

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It is intended to show how the measurement of absorption and emission line profiles from supernova envelopes can be used as diagnostic tools. In various ways they allow one to draw quantitative conclusions about physical conditions in the expanding envelope and in the surrounding gas. Various applications have given information on: dust formation and its distribution in the envelopes; on shock interaction with the circum-stellar material in which both forward and reverse shocks may be present; on stratification of material and particular elements in the expanding envelopes; on the distribution of material surrounding supernovae.

Invited lecture

WHISTLER WAVE – PARTICLE INTERACTION IN A TEMPERATE IONOSPHERE-LIKE PLASMA

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Whistler waves are produced when beam electrons, produced by a lightning strike near one of earths magnetic poles, approach the opposite pole and the associated increase in magnetic field. Bound whistlers, called 'helicon waves', have been used to produce high-density, large-area plasmas. The nature of the wave-plasma interaction has received considerable investigation. Particularly contentious has been experimental verification of production of beams of hot electrons in an opposite-analogous method to the formation of whistlers. Measurements of the plasma-wave-fields and rf-phase-resolved optical emission spectroscopy has been used to demonstrate that bunched electrons are produced, and that the electrons propagate axially resonant with the propagating EM wave.

Invited lecture

EFFECTS OF LINE PROFILES IN T DWARFS

PETER HAUSCHILDT

Invited lecture

PROCESSES OF ATOM – ATOM (n – n')-MIXING INFLUENCE ON HYDROGEN ATOM RYDBERG STATES POPULATIONS IN STELLAR ATMOSPHERES

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The $(n - n')$-mixing processes in $H^*(n) - -H(1s)$ collisions, have been considered from the aspect of their influence on of the $H^*(n >> 1)$ atom states in the weakly ionized layers of stellar atmospheres. These processes have been treated by the mechanism of the resonant energy exchange within the electron component of the considered collisional system. It was shown that these processes must have significant influence in comparison with corresponding electron-atom collision processes, on the populations of hydrogen Rydberg atoms in Solar photosphere and lower chromosphere (ionization degree of the order of 10^{-4}). From obtained results follows that the examinated $(n - n')$ mixing processes have to be included in the modelisation of Solar and cooler stars atmospheric plasma.

Invited lecture

RADIO SPECTROSCOPY OF ACTIVE GALACTIC NUCLEI

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Radio spectroscopy offers a number of tools for studying a large variety of astrophysical phenomena, ranging from stars and their environment to interstellar and intergalactic medium, active galactic nuclei (AGN) and distant quasars. Main targets of extragalactic radio spectroscopy are molecular and dust material in galaxies, HII regions, and maser emission originating in the dense, circumnuclear regions. These studies cover all galactic types and span an impressive range of angular scales and distances. Molecular emission, hydrogen absorption and maser lines have become the tools of choice for making an assessment of physical conditions in the nuclear regions of galaxies. In this contribution, some of the recent advances in the aforementioned fields will be reviewed and discussed in connection with future radio astronomical facilities.

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Invited lecture

A NEW APPROACH FOR THE STRUCTURE OF Hα REGIONS IN 120 Be STARS

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The spectra of a fraction of Oe and Be stars have Discrete Absorption Components (DACs) or Satellite Absorption Components (SACs) which create complex line profiles of these stars. The shapes of these lines are interpreted by the existence of two or more independent layers of matter nearby a star. These structures are responsible for the formation of a series of satellite components for each spectral line. First, here we will shortly present a model reproducing the complex profile of the spectral lines of Oe and Be stars with DACs and SACs (Danezis et al. 2003, Lyratzi & Danezis 2004). In general, this model has a line function for the complex structure of the spectral lines with DACs or SACs and include a function L that considers the kinematic (geometry) of an independent region. We have developed the model considering random velocities in the calculation of the function L. With this modification, the model can explain the complex structure of all line forming independent regions, until the regions where the Mg II lines are created. However, with this model it is not possible to explain the structure of the Hα forming region, i.e. the model cannot appropriate fit the complex Hα line profiles of Be stars. Here we will present a new approach of the model which is able to explain the complex structure of Hα regions. The new approach of the model is based on a synthesis of Hα lines using the fact that sub-regions have random, radial and rotation velocities, but also that some atomic (collisional) processes can contribute to the line wings (it brings a Voigt profile). Moreover, we study Hα lines of a sample of 120 Be stars and we obtained the radial and rotational velocities of the independent regions in which the satellite components are created. Finally, we calculate the optical depth (τ) and the column density (d) of each independent density region and we discuss the correlations between obtained parameters of sub-regions in the sample.

References

Danezis, E., Nikolaidis, D., Lyratzi, V., Stathopoulou, M., Theodossiou, E., Kosionidis, A., Drakopoulos, C., Christou G. and Koutsouris, P.: 2003, *Ap&SS*, **284**, 1119.

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Invited lecture

GLOBULAR CLUSTERS OF THE MILKY WAY: THEIR FATE AND CHEMICAL COMPOSITION

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It is very well known that in the framework of the Milky Way there are about 150 globular clusters. In this review one presents and discusses the basic data on them. A special attention is paid to their chemical composition.

Invited lecture

LINE SHAPES FOR THE SPECTRA OF BROWN DWARFS

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Accurate pressure broadened profiles of alkali resonance doublets perturbed by H_2 and He are of crucial importance for the modelling of atmospheres of late M, L and T type brown dwarfs and for generating their synthetic spectra in the region 600 - 900 nm. The dominant lines are the Na I 589.0/589.6 nm and K I 766.5/769.9 nm doublets but there can also be significant contributions from less abundant alkalis such as Li, Rb and Cs, and from subordinate doublets such as Na I 818.3/819.5 nm. The non-Lorentzian profiles of the strongly broadened Na I and K I doublets have been recently studied by Burrows and Volobuyev and Allard *et al*, with the emphasis on approximate or unified semiclassical models that can describe the far wings of the profiles. However highly accurate calculations of the central Lorentzian cores are needed (Pavlenko, private communication) in order to estimate the effects of dust in brown dwarf atmospheres. We will report results for the Lorentzian alkali line profiles broadened by helium perturbers. They are based on a fully quantum-mechanical close-coupling description of the colliding atoms, the Baranger theory of lineshapes and new *ab initio* potentials for the alkali-rare gas interaction.

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ANOMALOUS DOPPLER BROADENING OF HYDROGEN LINES DUE TO EXCITATION BY FAST NEUTRALS IN LOW PRESSURE TOWNSEND DISCHARGES

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For many years weak Doppler boradened wings were observed on hydrogen lines emitted from low pressure discharges. Explanations were usually related to dissociative processes or excitation by ions. Petrovic and Phelps were the first to perform the measurements in Townsend discharges and by observing the emission along the axis of the discharge two groups of fast particles were observed one going towards the cathode and away from the cathode. Current dependence ruled out excitation by electrons of the fast atoms produced in dissociative charge transfer collisions. Thus the results could only be explained by excitation by fast neutrals produced either in charge transfer collisions or by neutralization and reflection of ions at the surface. The energies of up to the total available energy (potential fall) were found, though the reflected component had typically 3 times smaller energy. Even more pronounced effects were found at lower E/N in mixtures of hydrogen and argon and methane and argon, though similar effects were observed with other light rare gases. These effects as found in Grimm discharges were studies in great detail by Konjevic and coworkers. In additions some implications for cold fusion were recently analyzed in the literature. we shall, however, discuss the implications of this process in plasma etching of integrated circuits.

Invited lecture

3D SPECTROSCOPY OF EMISSION LINE SPECTRA OF PLANETARY NEBULAE: DIAGNOSTIC TOOLS FROM THE MILKY WAY TO NEARBY GALAXIES AND BEYOND

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Planetary nebulae (PN) have been introduced to study stellar populations and the chemical evolution of galaxies based on individual objects, rather than on integrated light properties of a galaxy under study. The comparison of predicted spectra from photoionization models with observed PN spectra allows us to derive physical parameters and the chemical composition of the nebula. The high emission line luminosity at the post-AGB stage is practically the only way to access individual intermediate mass stars spectroscopically at the distance of local group galaxies and beyond, e.g. the intracluster medium of the Virgo cluster. We discuss an ongoing programme to test the validity of extragalactic planetary nebulae as tracers of intermediate mass stellar populations, using modern observing techniques like integral field ("3D") spectroscopy, and theoretical tests with time-dependent radiation-hydrodynamical simulations, and the effects of departure from the assumption of spherical symmetry, constant density, and thermal and ionization equilibrium on the conventional PN diagnostics.

Invited lecture

PULSATIONS IN THE ATMOSPHERES OF Ap STARS

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We present recent results of the observational study of rapidly oscillating Ap (roAp) stars. Spectacular progress in this field has been achieved by considering high time resolution spectroscopy in addition to the classical high-speed photometric measurements. Spectroscopic observations of roAp pulsations led to the discovery of a multitude of unexpected phenomena, generally pointing to an extreme vertical chemical nonuniformity of the atmospheres of magnetic CP stars. Detailed analysis of spectroscopic pulsational behaviour allows us to establish relashionship between pulsations and vertical stratification of chemical elements.

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ATMOSPHERES OF CP STARS: MAGNETIC FIELD EFFECTS

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We present the resent calculations of magnetic field effects in atmospheres of CP stars. The calculations are based on *LLmodels* stellar model atmosphere code which implements direct treatment of the opacities due to the bound-bound transitions and ensures an accurate and detailed description of the line absorption. In these studies we focus on two general problems: the calculations of anomalous Zeeman splitting and the effects of Lorentz force in stellar atmospheres. First, we investigate the influence of the enhanced line blanketing due to the Zeeman effect on model structure, energy distribution, photometric colors, metallic line spectra and the hydrogen Balmer line profiles. The results are discussed with respect to those of non-magnetic models. As a next step we modelled the Lorentz force results from the interaction between the stellar magnetic field and the electric currents induced by time evolution of global dipolar-like field. This additional force may modify the pressure-temperature structure influences the formation of absorption spectral features, especially the Balmer line profiles. The results of this study are investigated using resent observations of A0p star θ Aur obtained with BOES echelle spectrograpth of the 1.8 m telescope of the Korean Astronomy Observatory.

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Invited lecture

QUASAR ABSORPTION LINES AND THE INTERGALACTIC MEDIUM

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The space between galaxies and clusters is anything but empty, as evidenced by the many absorption lines in the spectra of quasars at cosmological distances. There is a variety of astrophysical phenomena associated with these absorption lines, ranging from bareley detectable density fluctuations of neutral hydrogen in the true intergalactic medium to the rich absorption spectra of (proto-)galactic disks.

I will start with a brief introduction into the phenomenology and basic diagnostics of quasar absorption lines, leading to identify some of the most acute current astrophysical problems connected to IGM research. I will then highlight some of the work currently done in our group, which includes the measurement of the transverse proximity effect and the search for the counterparts of damped Lyman alpha absorbers.

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BLACK HOLES: THEORY VERSUS OBSERVATIONS – ANALYSIS OF THE Fe K_α LINES AND PRECISE ASTROMETRICAL OBSERVATIONS

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Recent X-ray observations of microquasars and Seyfert galaxies reveal broad emission lines in their spectra, which can arise in the innermost parts of accretion disks. Simulations indicate that at low inclination angle the line is measured by a distant observer as characteristic two-peak profile. However, at high inclination angles ($> 85^0$) two additional peaks arise. This phenomenon was discovered by Matt et al. (1993) using the Schwarzschild black hole metric to analyze such effect. They assumed that the effect is applicable to a Kerr metric far beyond the range of parameters that they exploited. We check and confirm their hypothesis about such a structure of the spectral line shape for the Kerr metric case. We use no astrophysical assumptions about the physical structure of the emission region except the assumption that the region should be narrow enough. Positions and heights of these extra peaks drastically depend on both the radial coordinate of the emitting region (annuli) and the inclination angle. It was found that these extra peaks arise due to gravitational lens effect in the strong gravitational field, namely they are formed by photons with some number of revolutions around black hole. This conclusion is based only on relativistic calculations without any assumption about physical parameters of the accretion disc like X-ray surface emissivity etc. We discuss how analysis of the iron spectral line shapes could give an information about an upper limit of magnetic field near black hole horizon. Based on results of numerical simulations we discussed origins of double peaked and double horned profiles and clarified the Müller and Camenzind hypothesis (2003).

Recently Holz & Wheeler (2002) considered a very attracting possibility to detect retro-MACHOs, i.e. retro-images of the Sun by a Schwarzschild black hole. In this paper we discuss glories (mirages) formed near rapidly rotating Kerr black hole horizons and propose a procedure to measure masses and rotation parameters analyzing these forms of mirages. In some sense that is a manifestation of gravitational lens effect in the strong gravitational field near black hole horizon and a generalization of the retro-gravitational lens phenomenon. We analyze the case of a Kerr black hole rotating at arbitrary speed for some selected positions of a distant observer with respect to the equatorial plane of a Kerr black hole. Some time ago Falcke (2000) suggested to search shadows at the Galactic Center. We also propose to use future radio interferometer RADIOASTRON facilities (and future X-ray interferometer MAXIM) to measure shapes of mirages (glories) and to evaluate the black hole spin as a function of the position angle of a distant observer.