



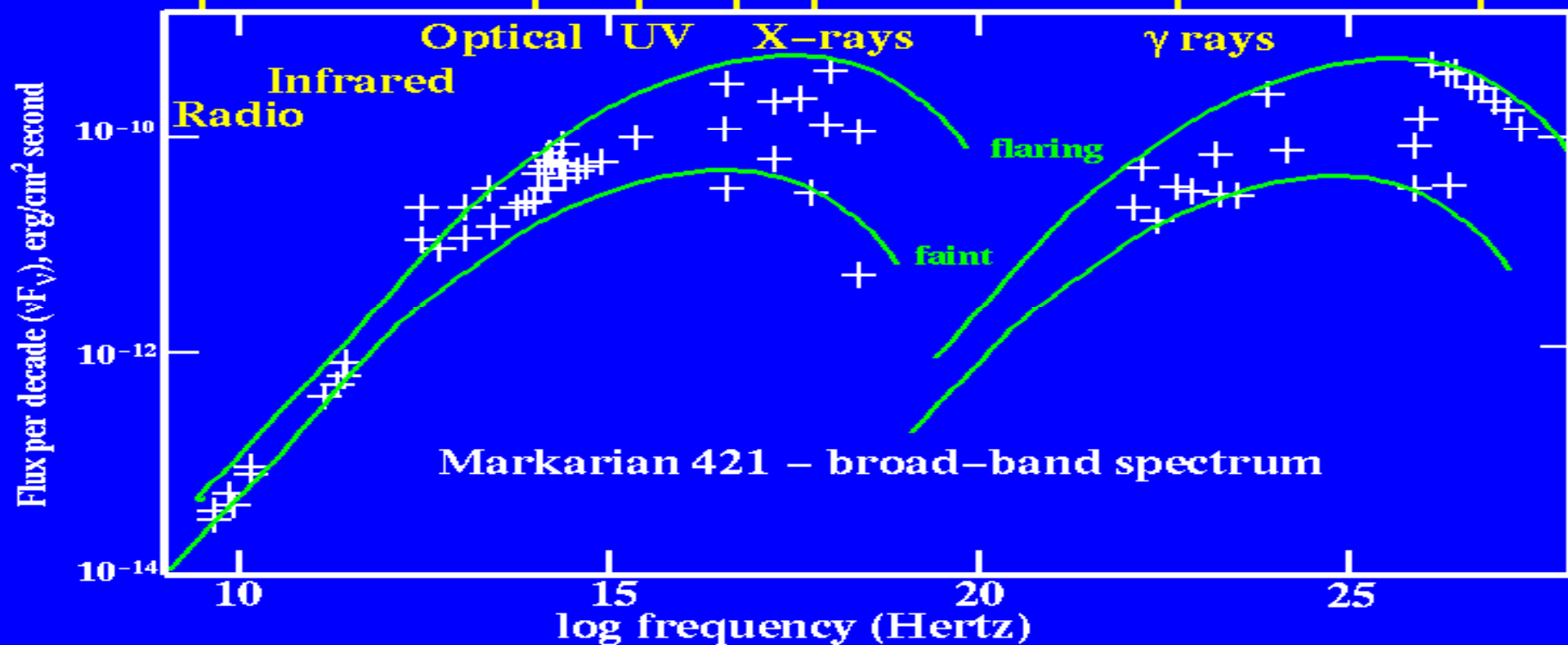
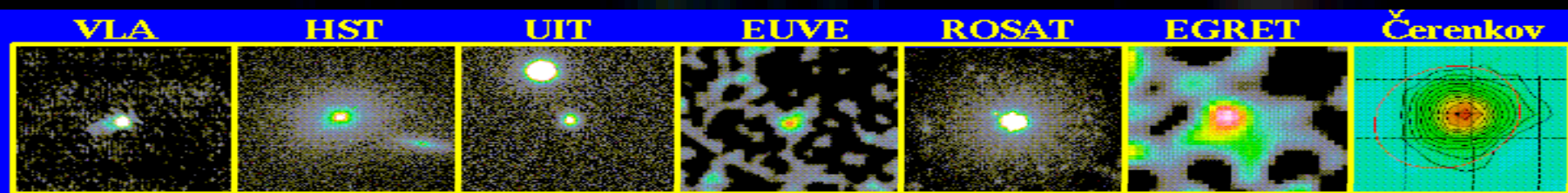
# 1st workshop on AGN and GL

Luka Č. Popović

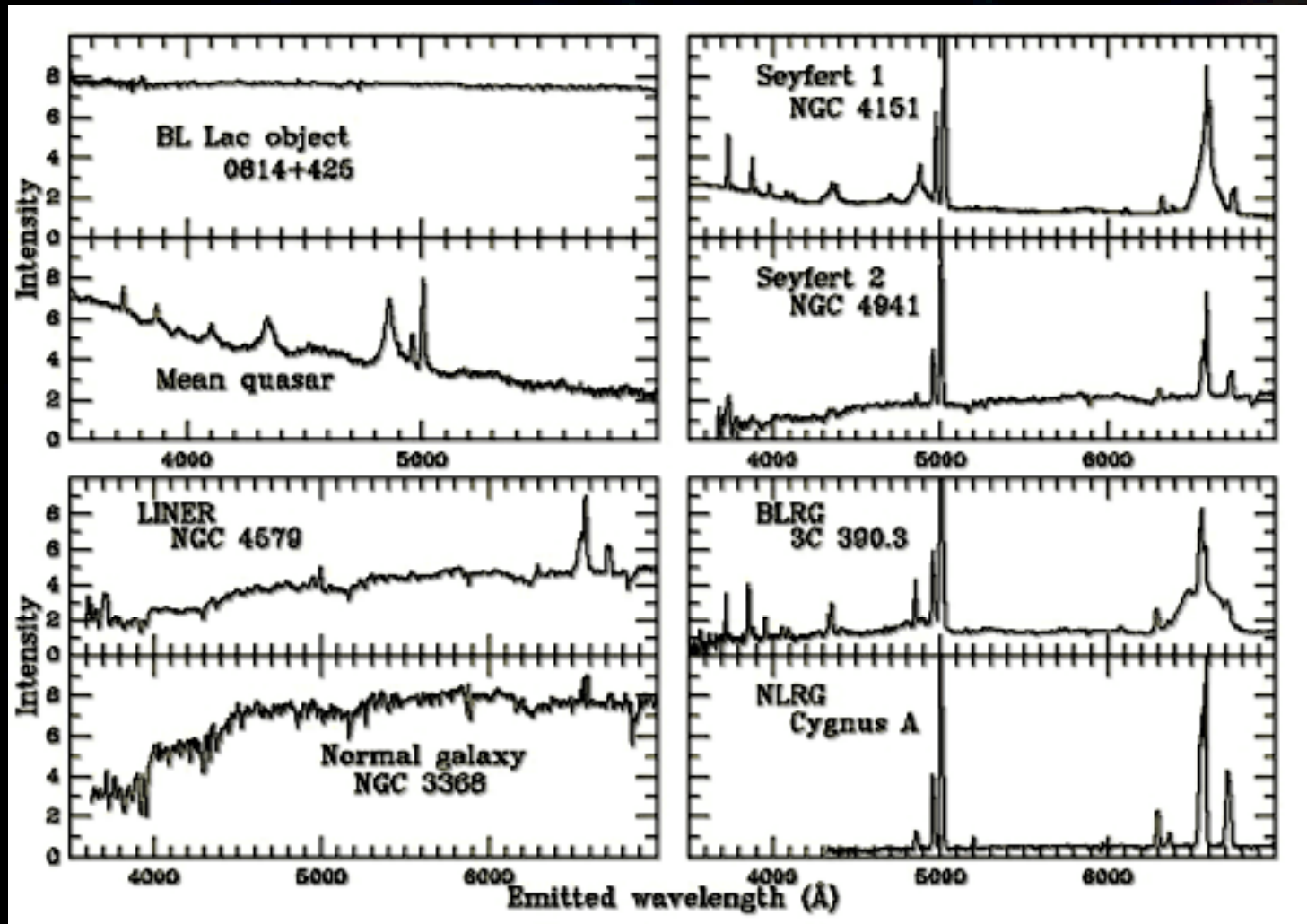
*Astronomical Observatory, Belgrade, Serbia*

*Kosmaj, Babe, July 07-11, 2010, MP0905*

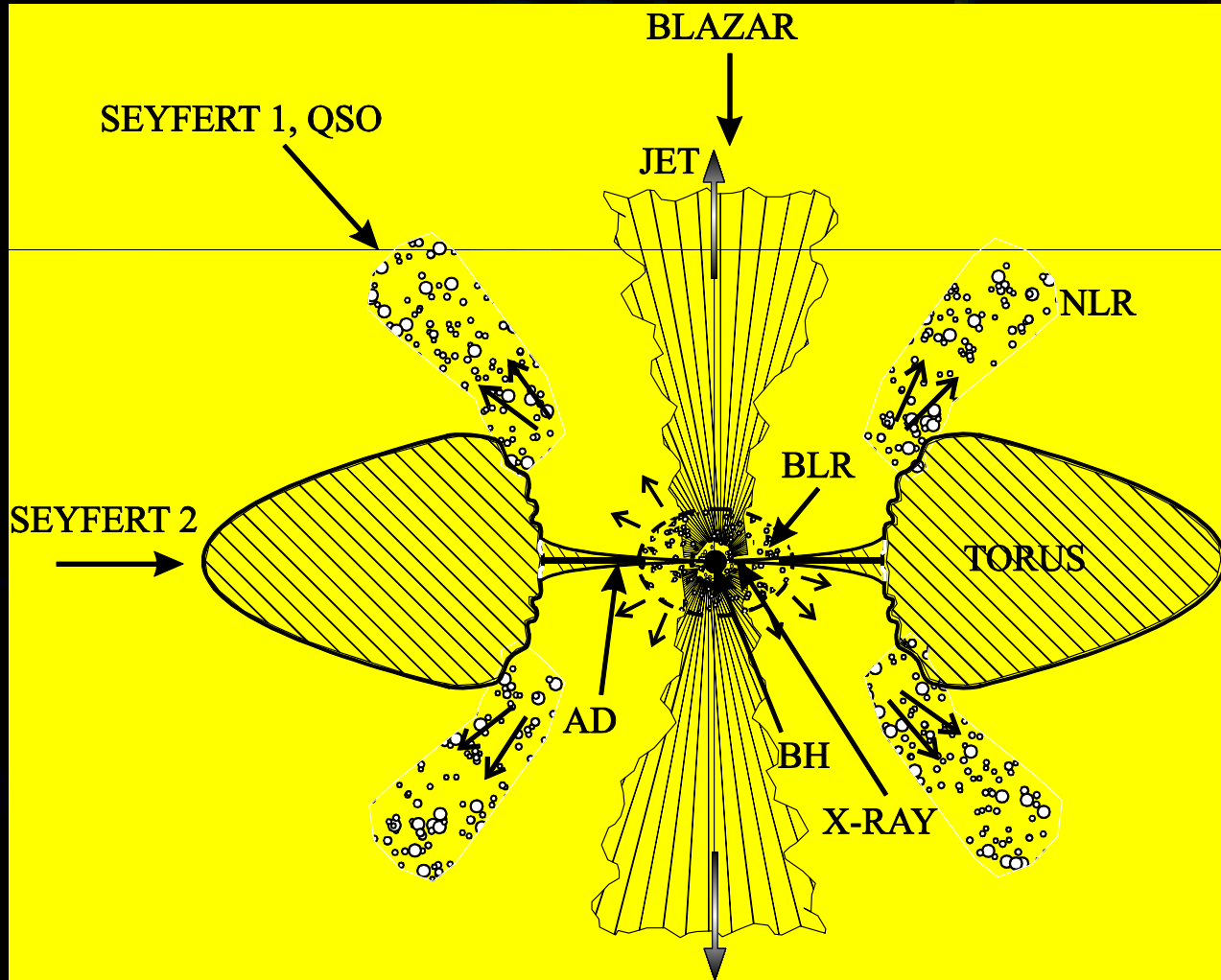
QSOs (AGN) emit radiation at a range of wavelengths from the radio to the X-ray ( $\gamma$ -ray)



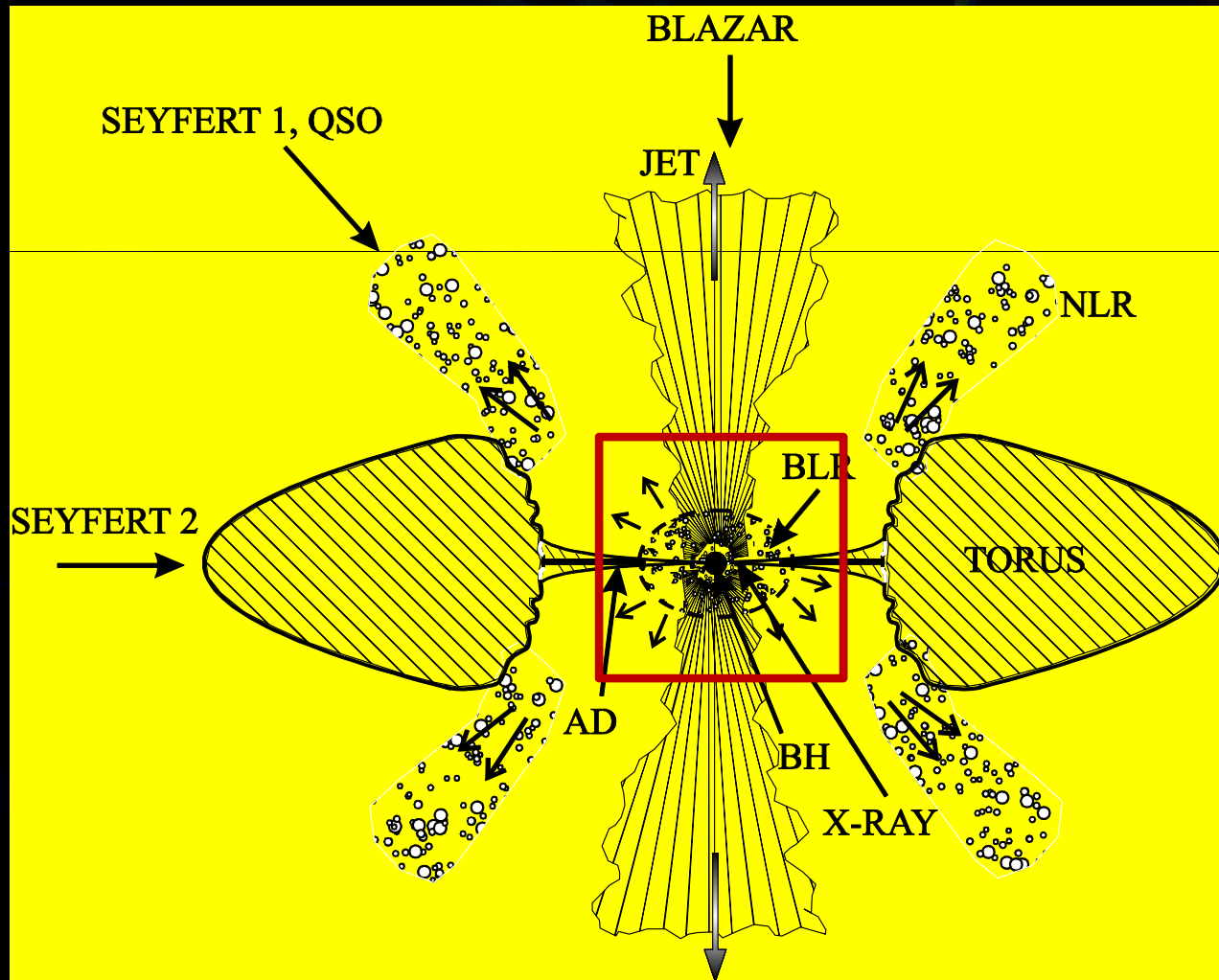
# Spectra of extragalactic objects



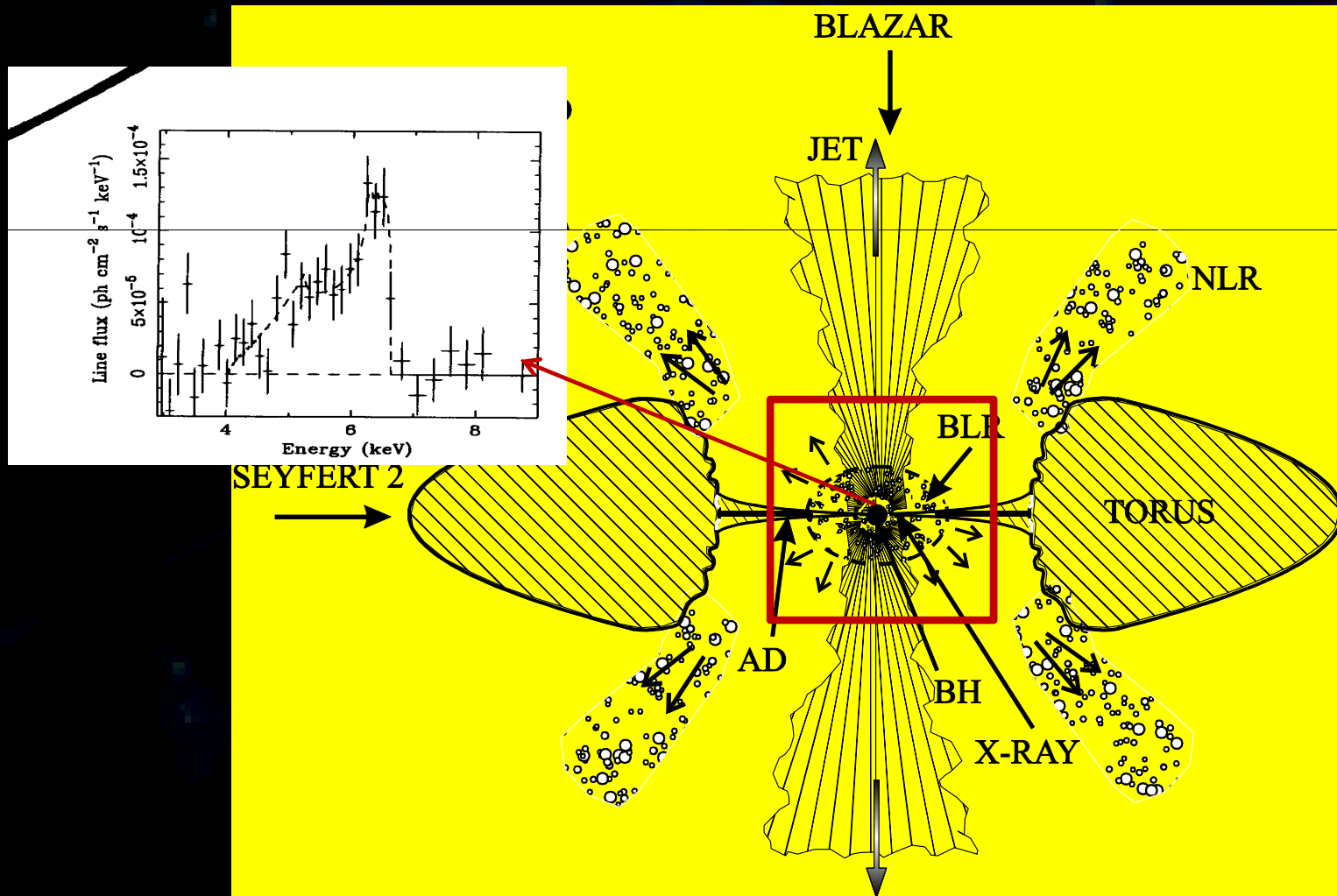
# Model (Jovanovic & Popovic, in book Black Holes: Properties, Formation and Features, 2009)



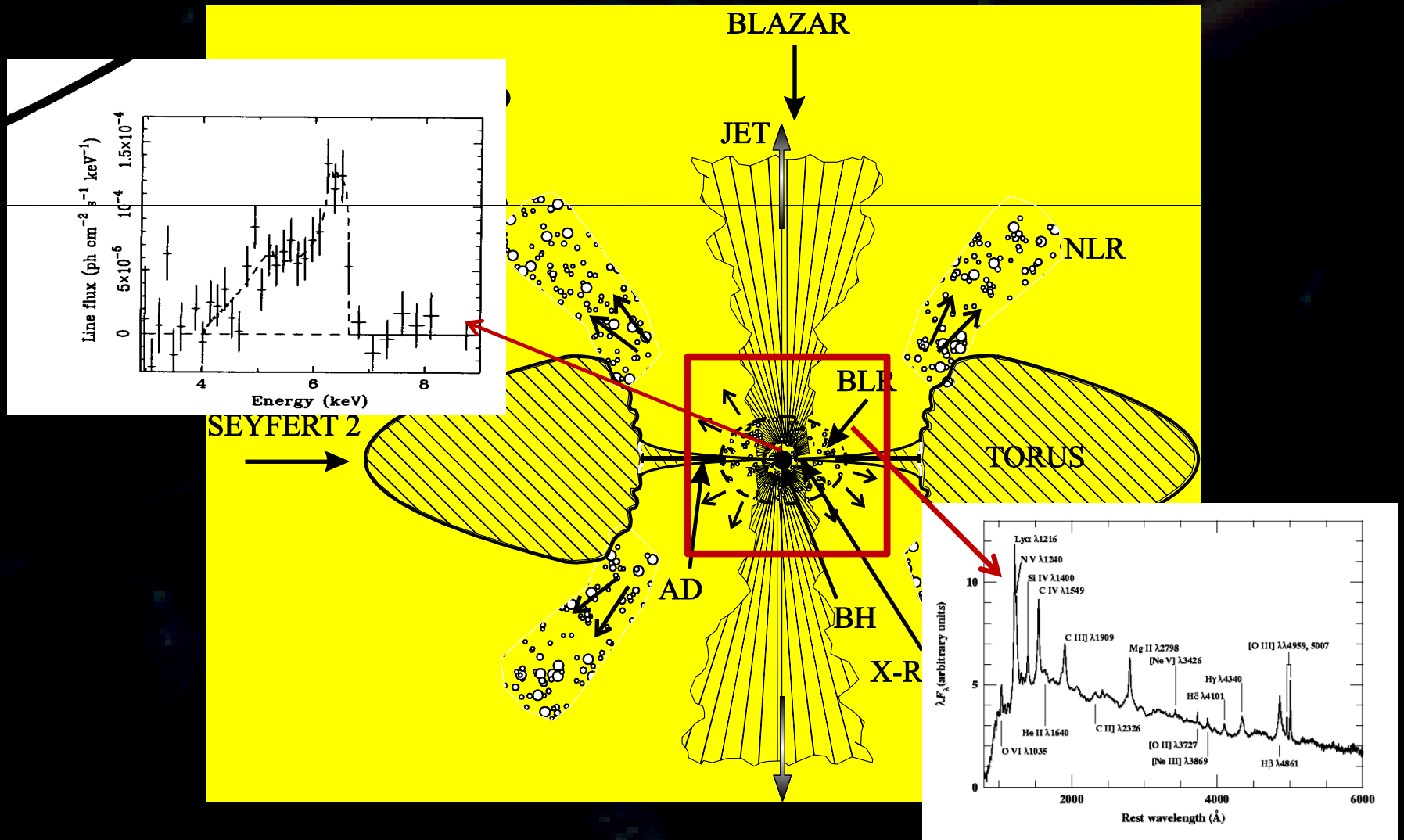
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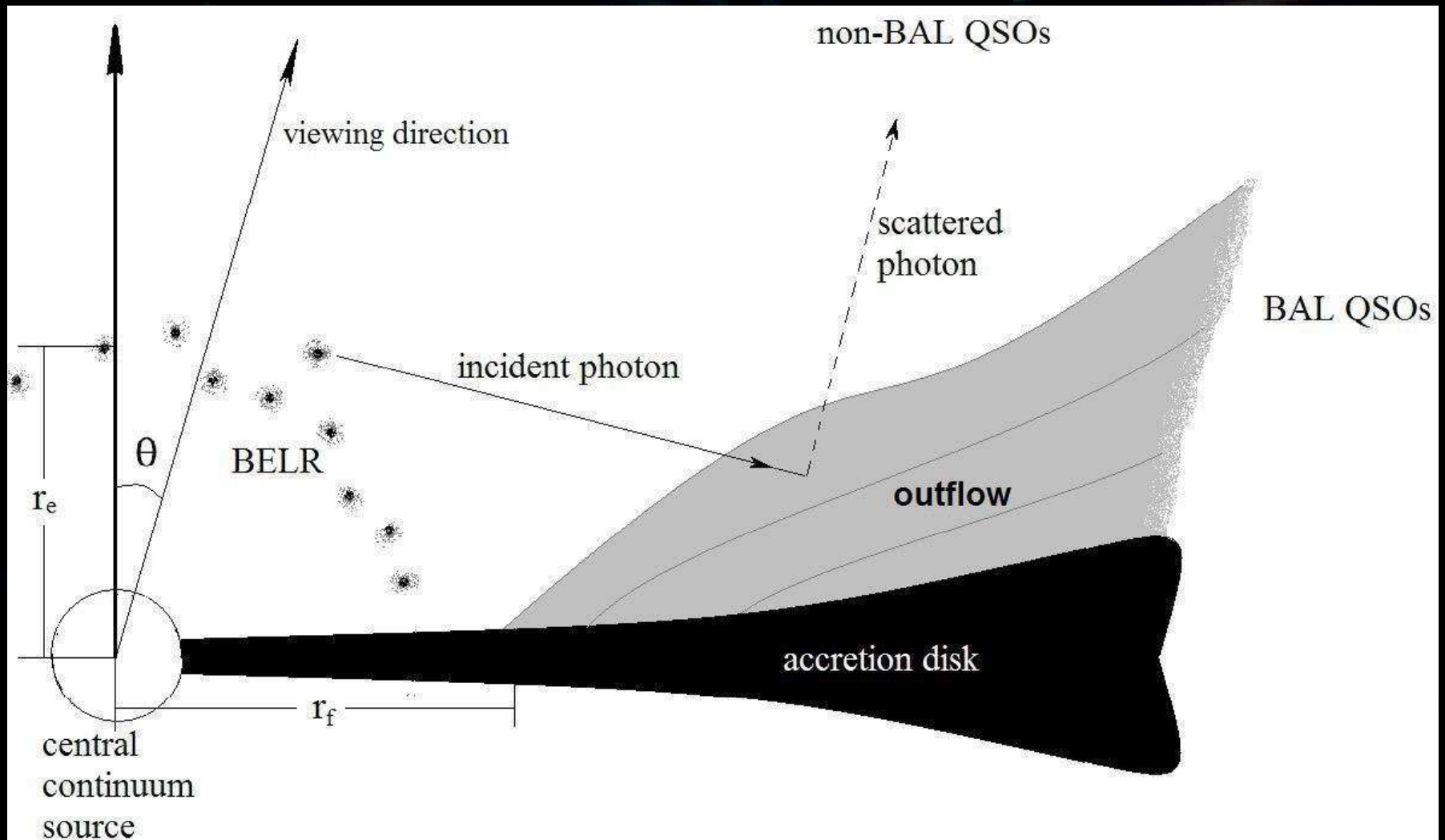
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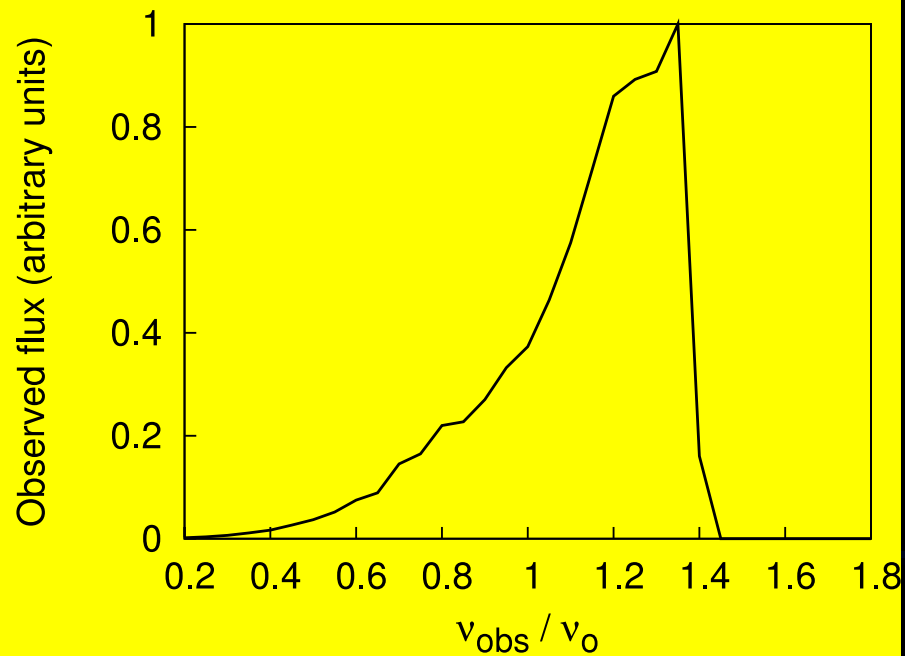
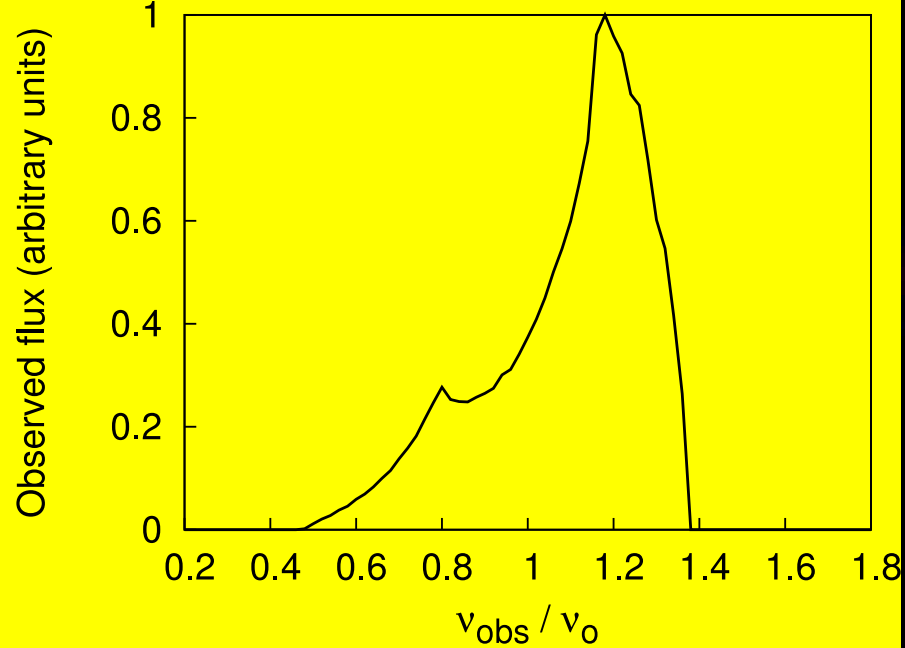
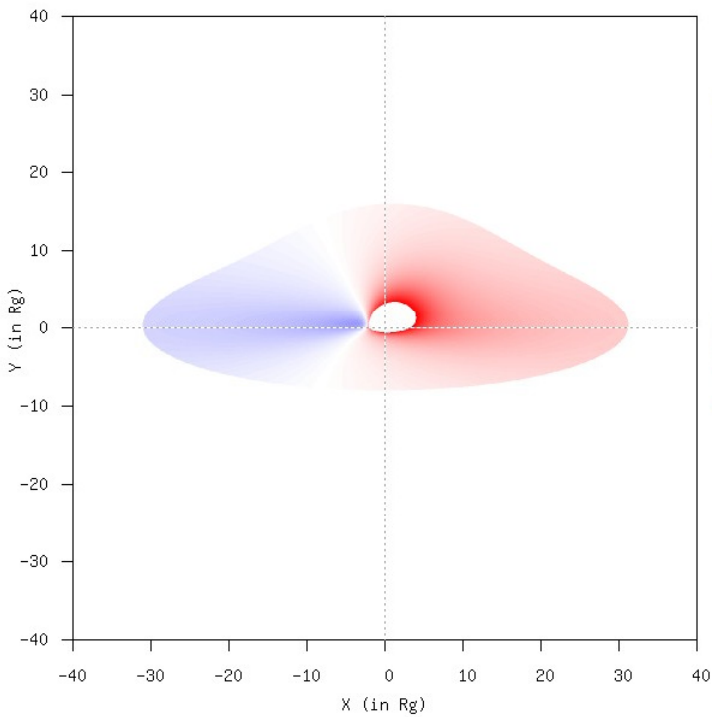
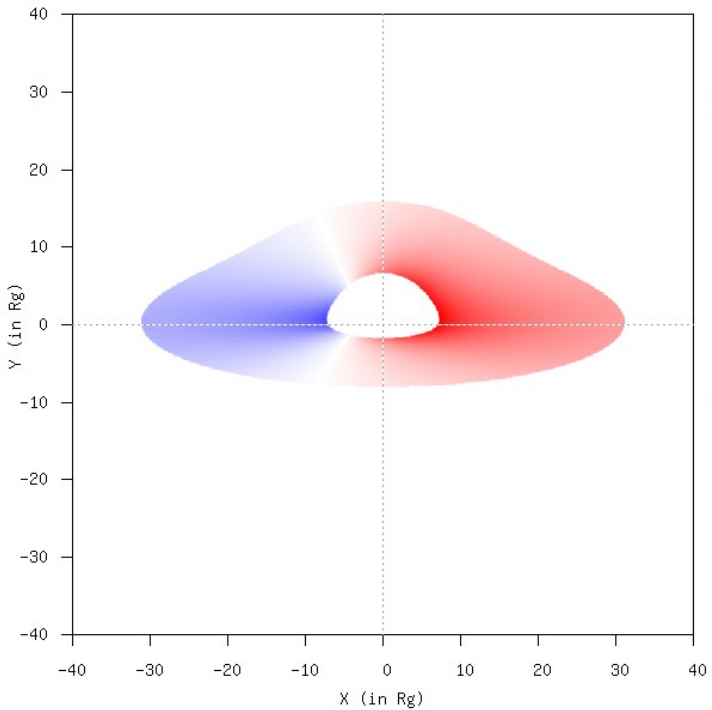
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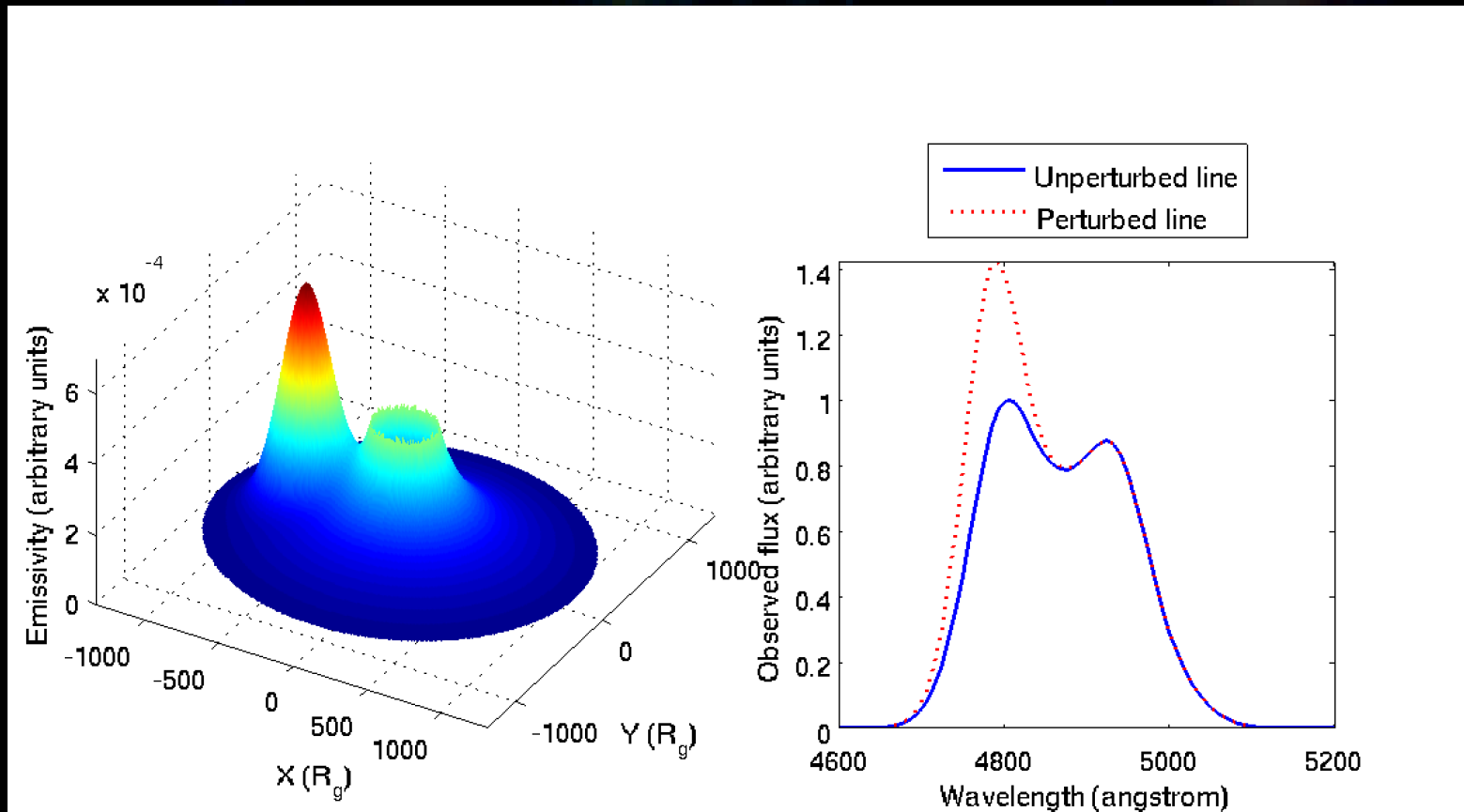
# What is the structure of the BLR



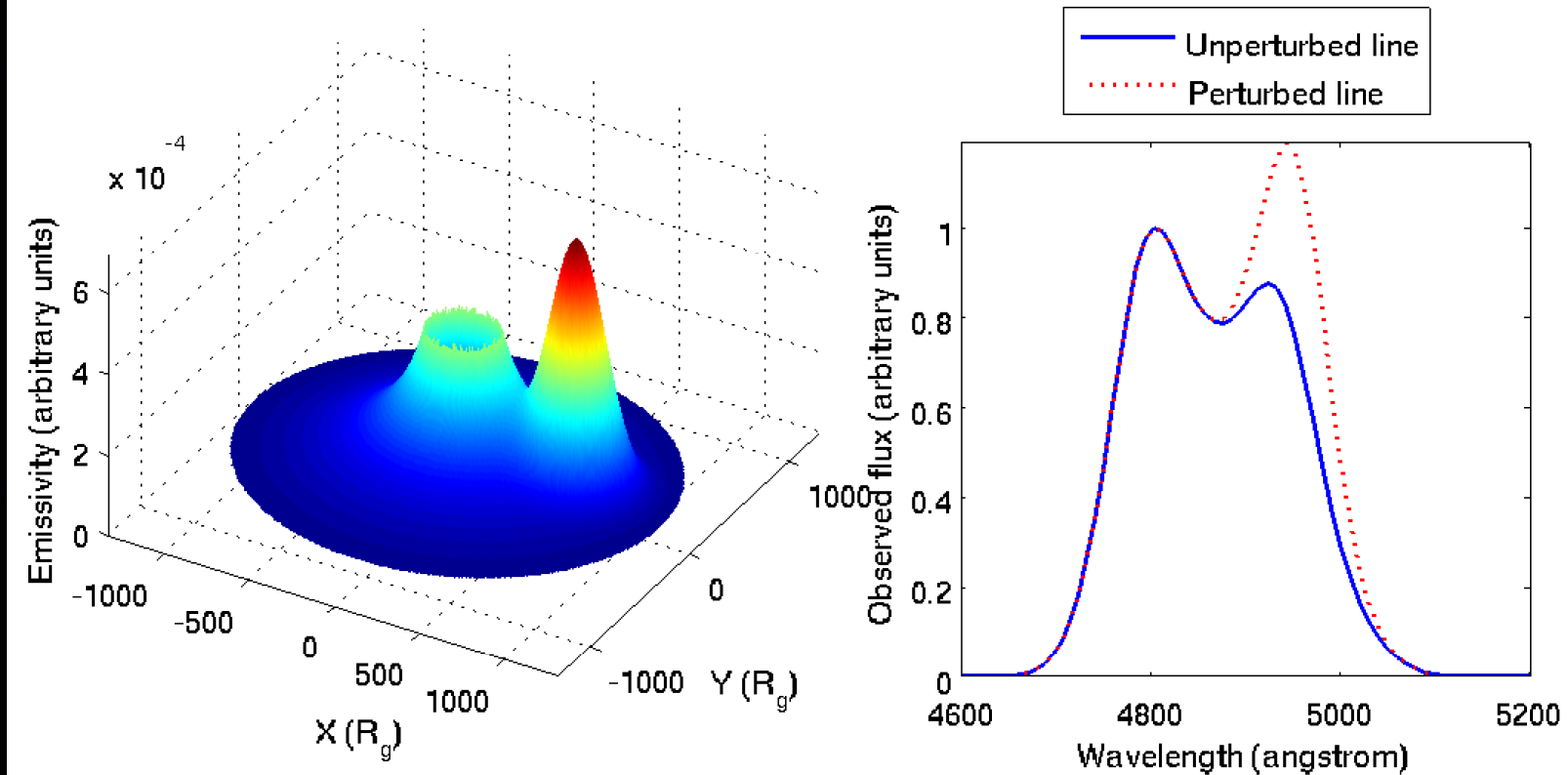




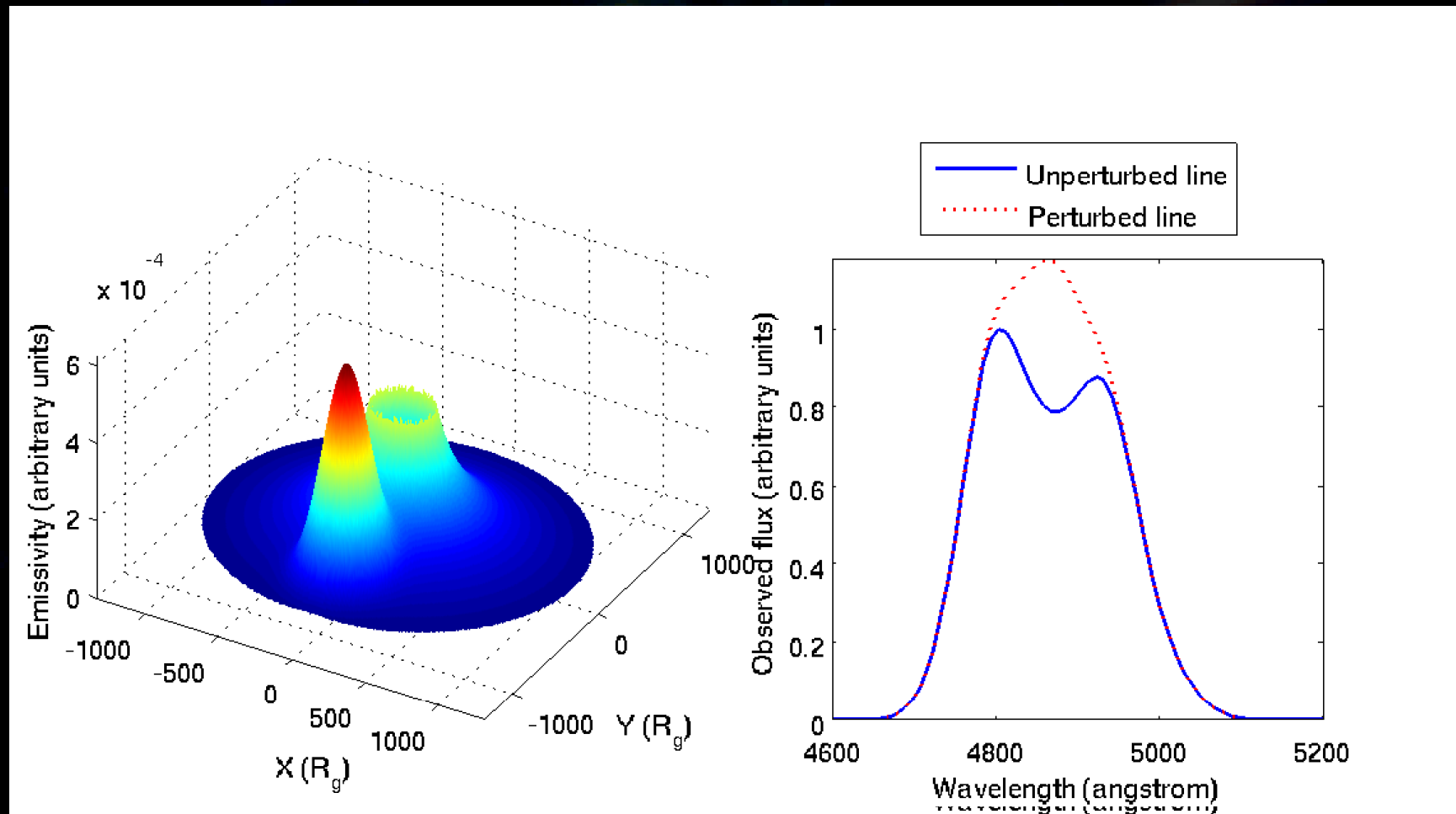
# Perturbation in AD (Jovanovic, Popovic, Stalevski, Shapovalova 2010, ApJ, just published)



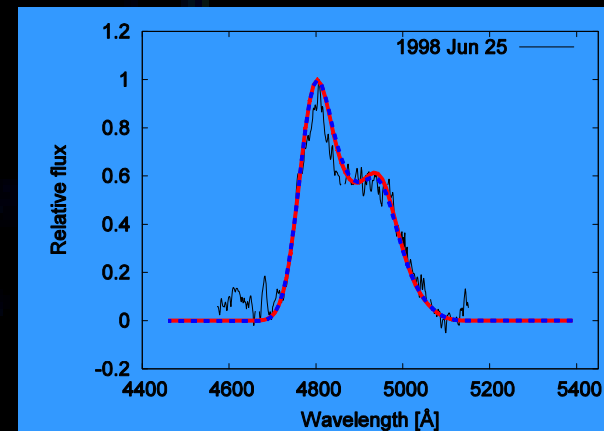
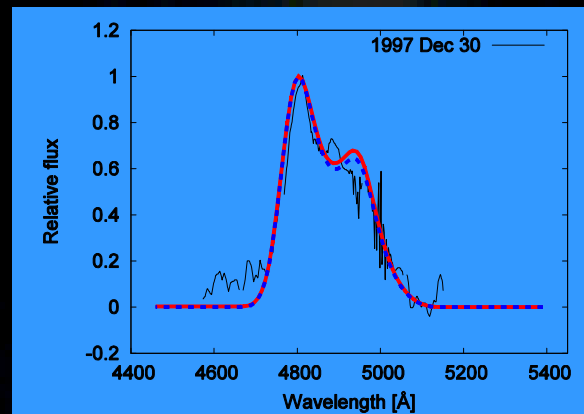
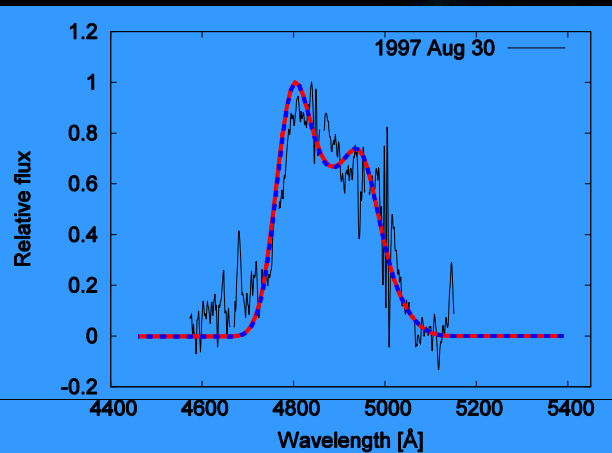
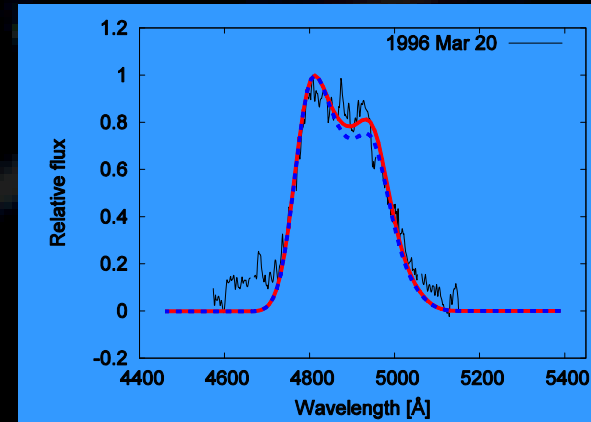
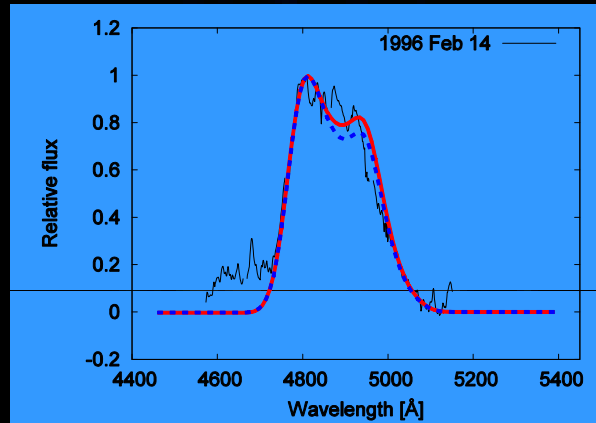
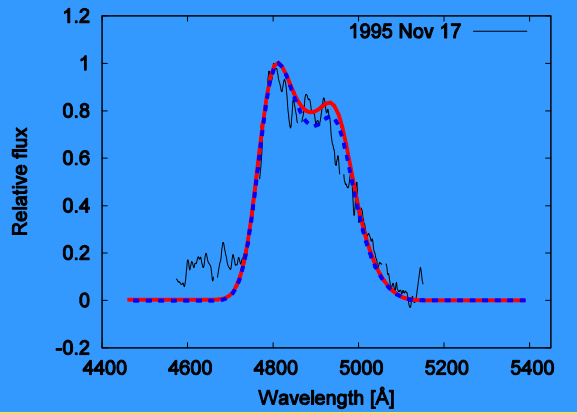
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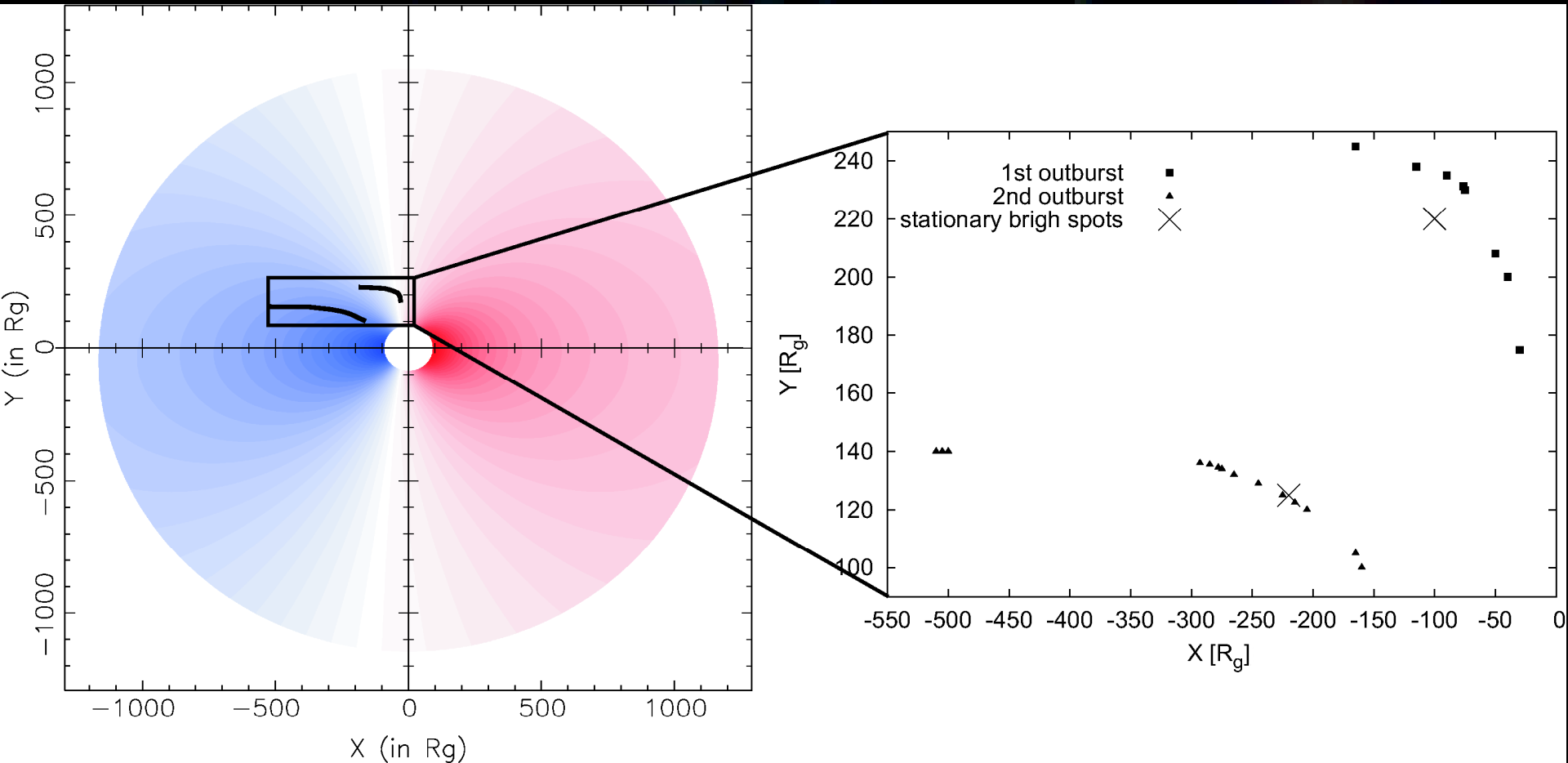
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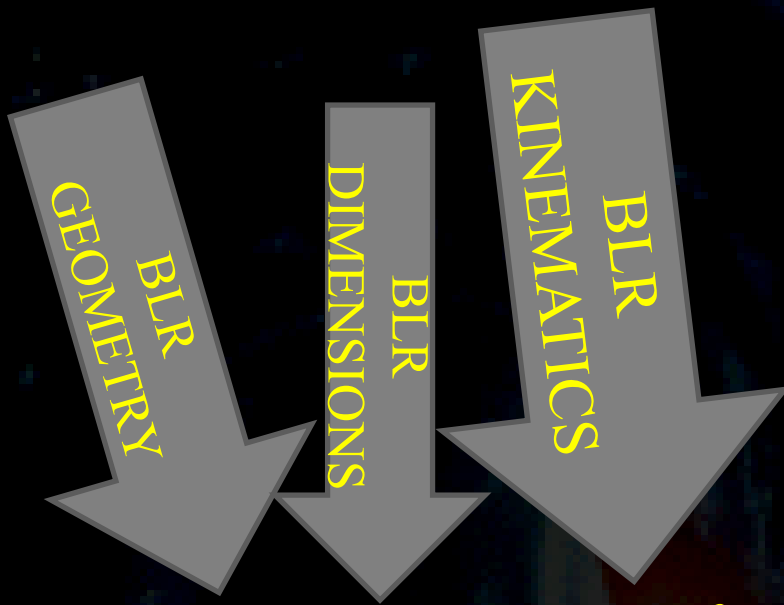
# Model vs. observations: 3C390.3 (Shapovalova, Popovic, et al. 2010, A&A, accepted, Jovanovic, Popovic, Stalevski 2010, ApJ)



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# Mass of SMBH



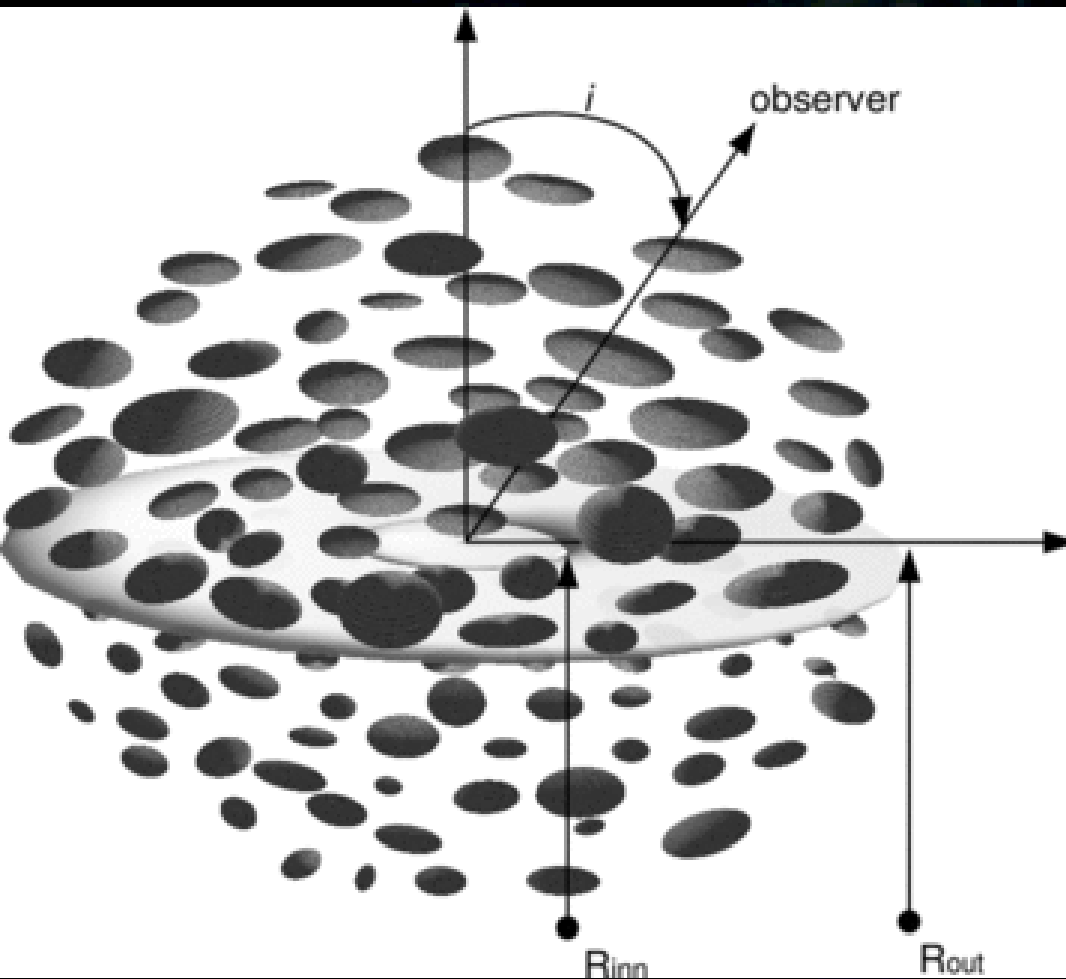
- $MBH = f * r_{BLR} FWHM^2 / G$
- $r_{BLR} = a * (L5100)^\gamma \text{ pc}$
- where L5100 is the continuum luminosity ( $\lambda L \lambda$ ) at 5100 Å in  $10^{46} \text{ erg s}^{-1}$
- and  $\gamma = 0.6 \pm 0.1$ , constant  $a$  depends on the line in question. For H $\beta$ ,  $a \simeq 0.4 \text{ pc}$  (e.g, Bentz et al. 2009)

# PROBLEMS - geometry

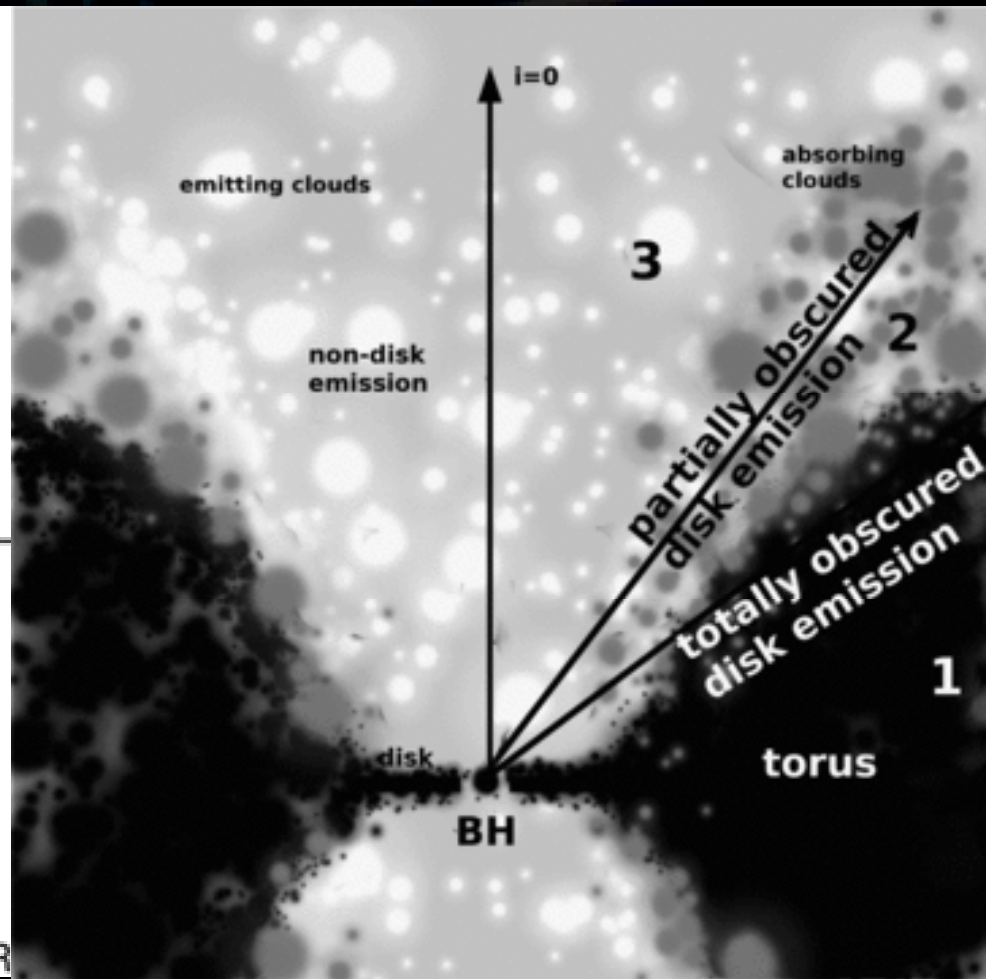
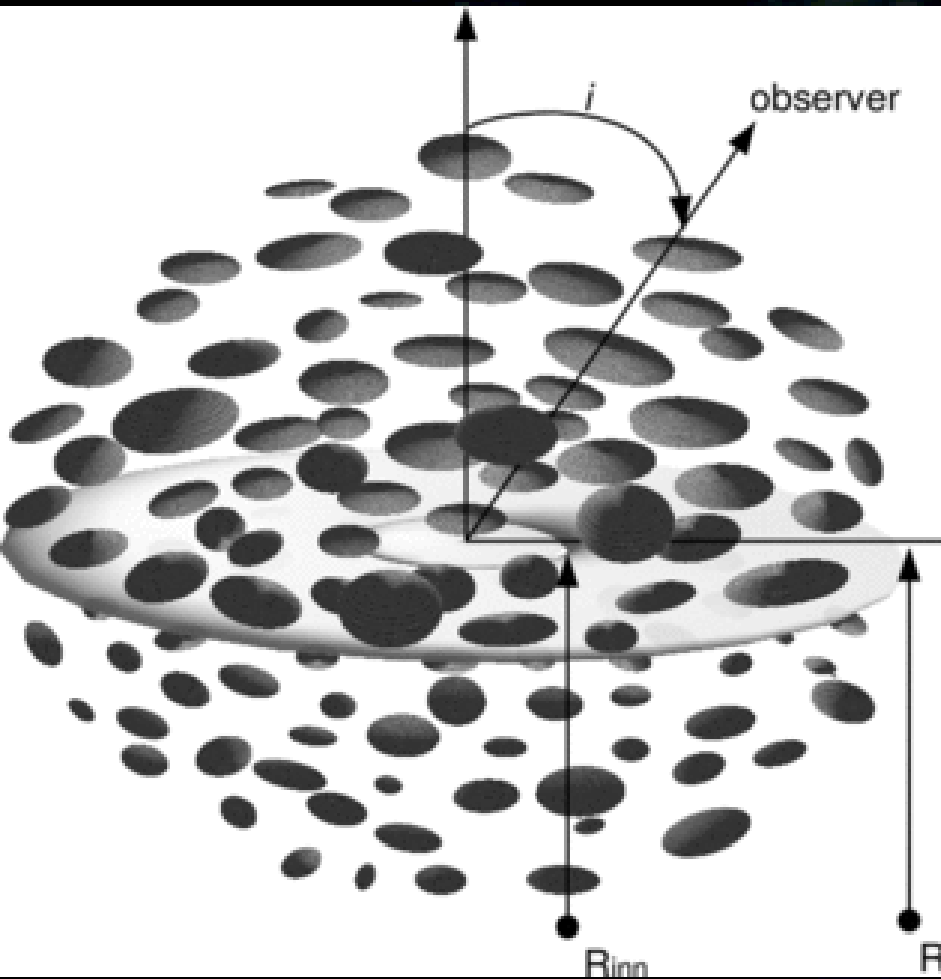
- Geometry can be very complex (e.g. disk+smt. See e.g. Bon, Popovic et al. MNRAS 400, 924)
- The role of the torus



# PROBLEMS - geometry



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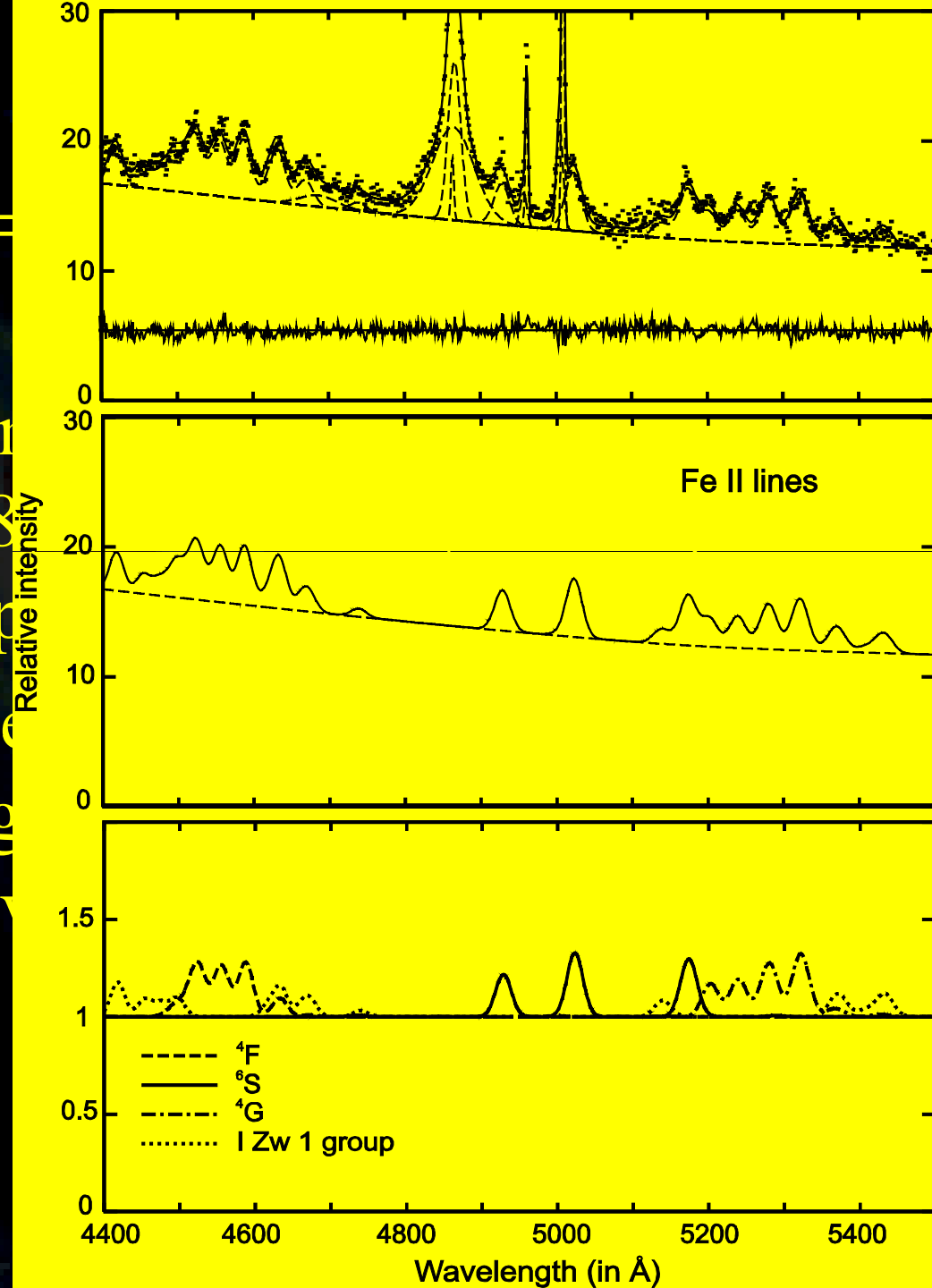


# PROBLEMS = size of the BLR

- Monitoring programs (see e.g. Shapovalova, Popovic et al. 2008, 2009, 2010a,b A&A) – reverberation mapping
- Different sizes of emitting regions, e.g. Fe II line emission region, e.g. Kovacevic, Popovic, Dimitrijevic, 2010, ApJ S 189, 15

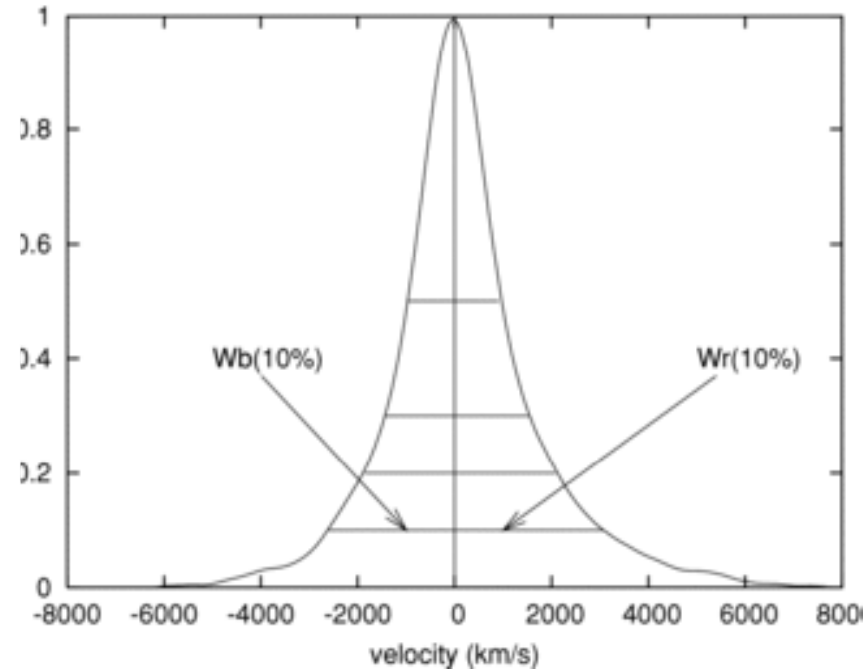
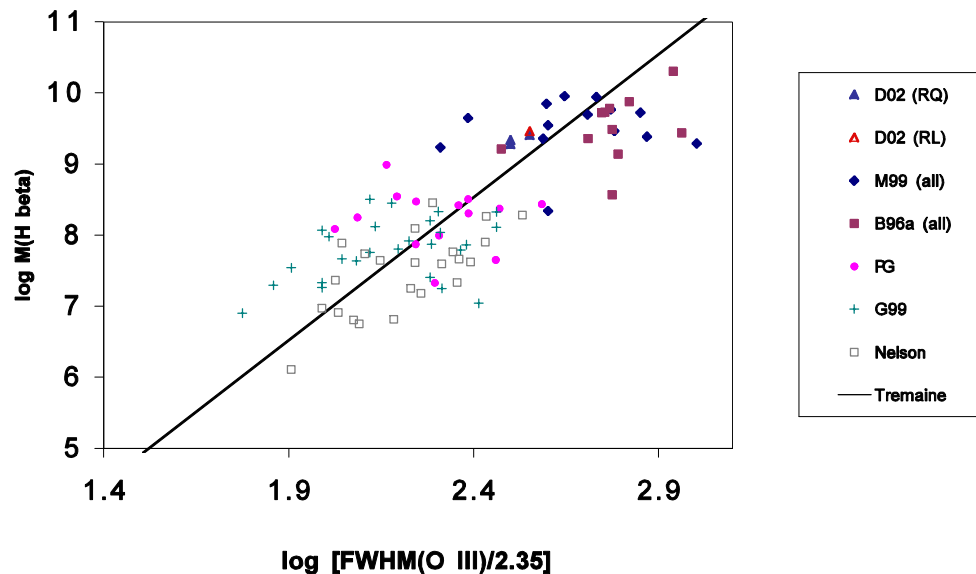
# PROBLEMS

- Monitoring program  
Popovic et al. 2008  
reverberation mapping
- Different sizes of  $\tau$   
II line emission region  
Popovic, Dimitrijević

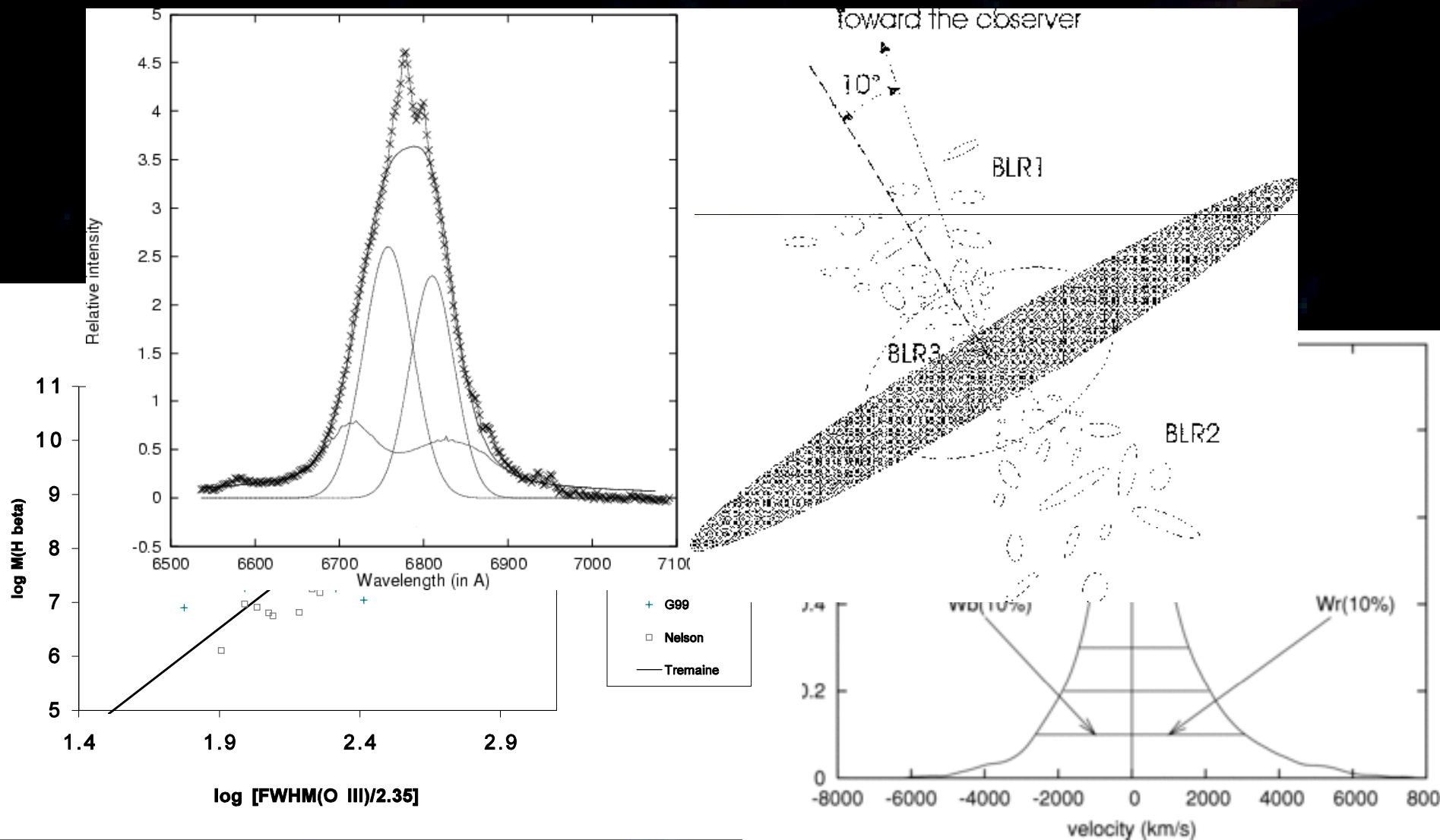


# PROBLEMS – kinematics

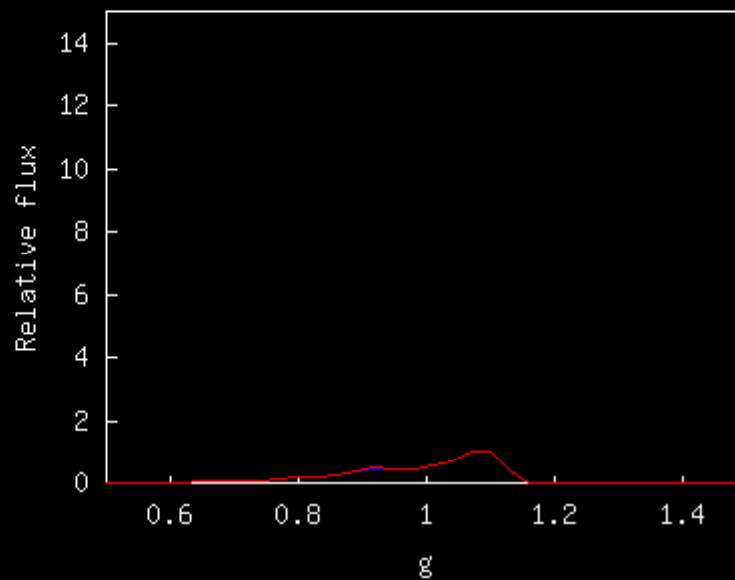
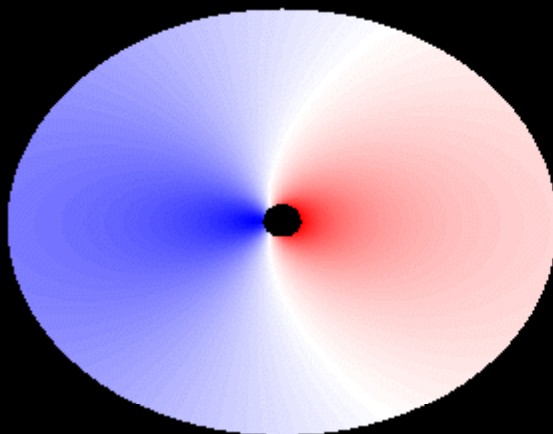
- Estimate kinematics (measuring line widths)



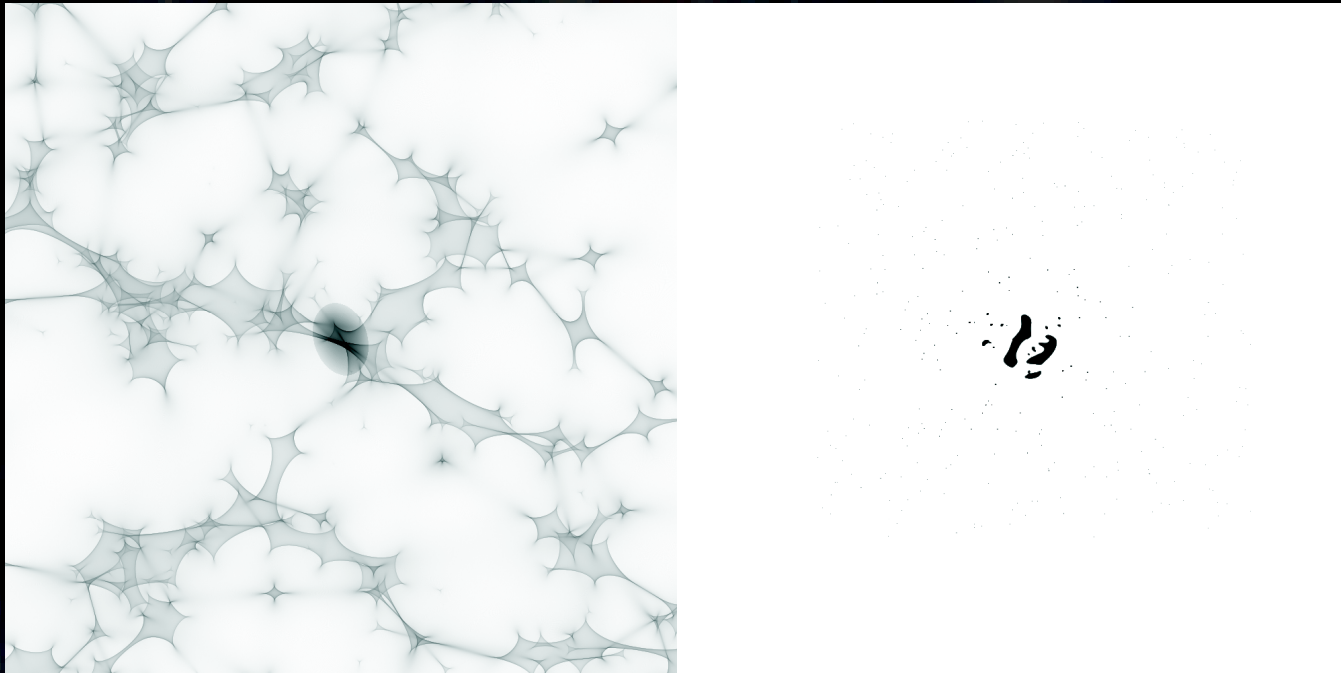
# PROBLEMS – kinematics



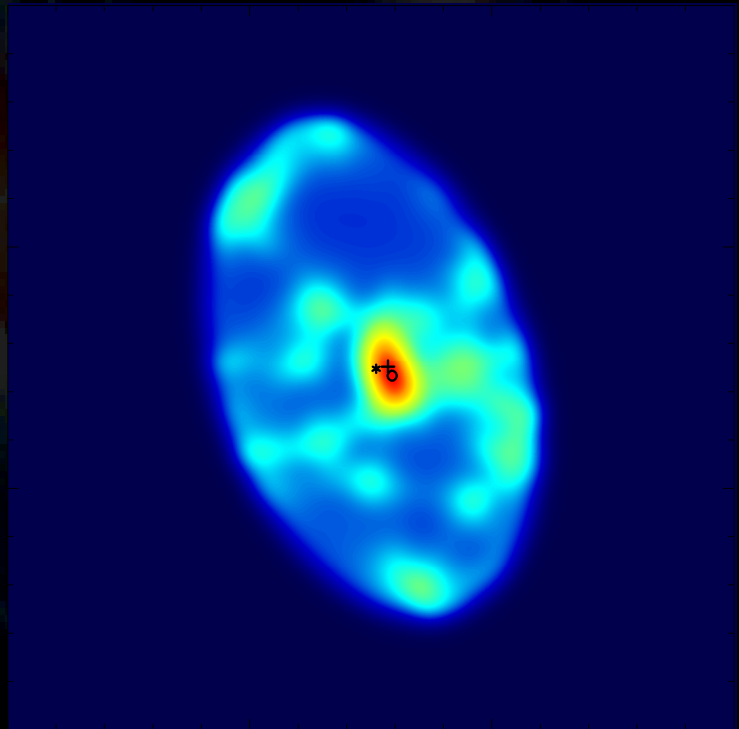
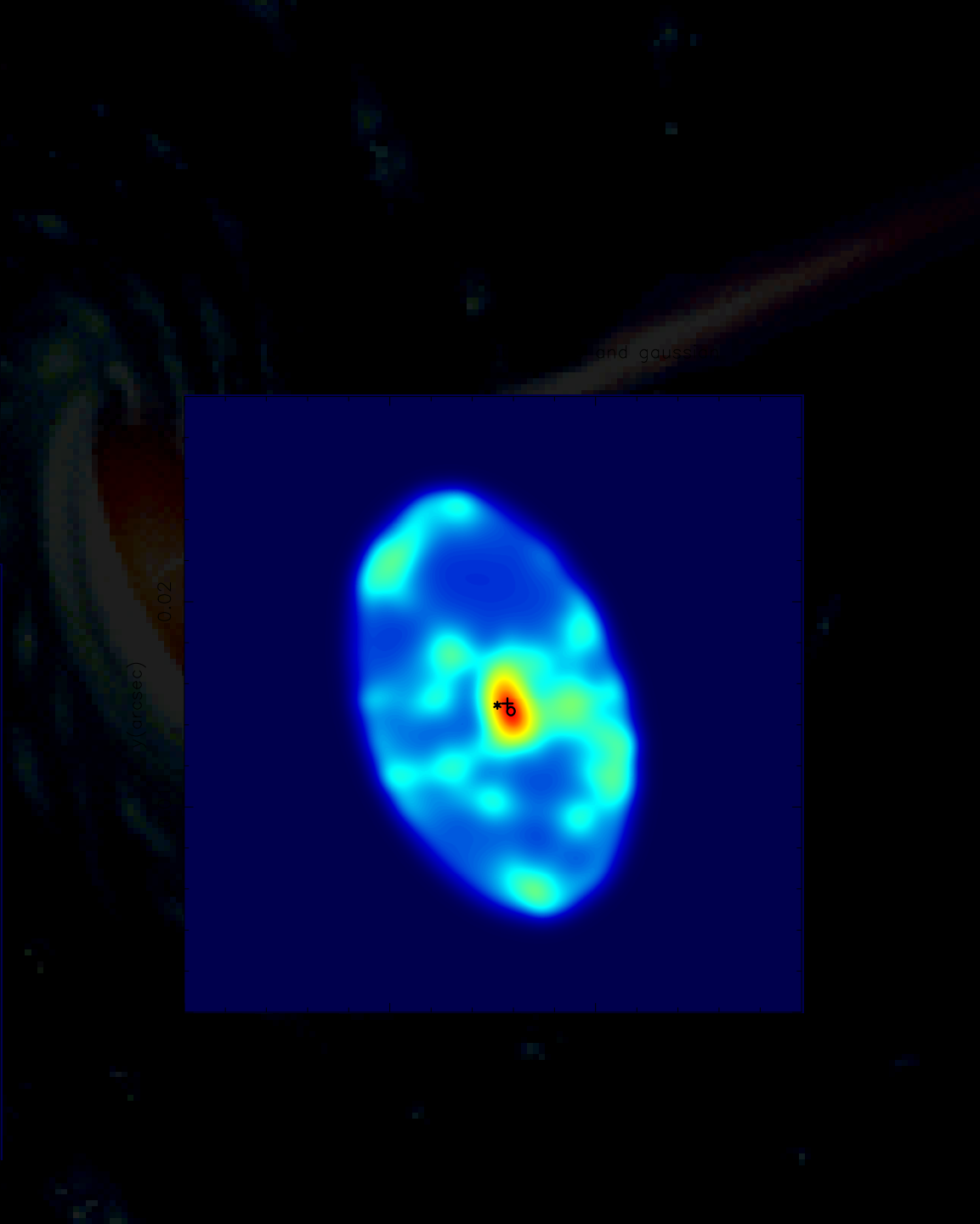
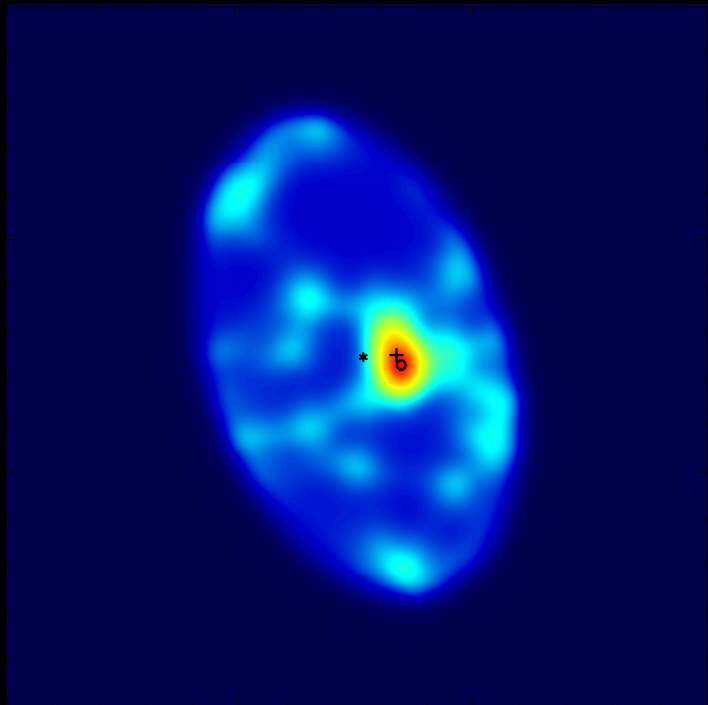
# The X-ray accretion disk – microlensing



# Gravitational lensing







# 8<sup>th</sup> SCSLSA, Serbia, 6-10 June 2011

- 8<sup>th</sup> Serbian Conference on Spectral Line Shapes (SCSLSA)
- [www.scslsa.matf.bg.ac.rs](http://www.scslsa.matf.bg.ac.rs)
- spectral lines and black holes?

