Optical emission line profiles and X-ray properties of Type 1 AGN

G. La Mura

S. Ciroi

V. Cracco

D. Ilić

L. Č. Popović

P. Rafanelli

COST Action MP0905 – Black Holes in a violent Universe

3rd Working Groups Meeting 12 -13 April 2011, Bologna – Italy

COST OFFICE

EUROPEAN SCIENCE FOUNDATION

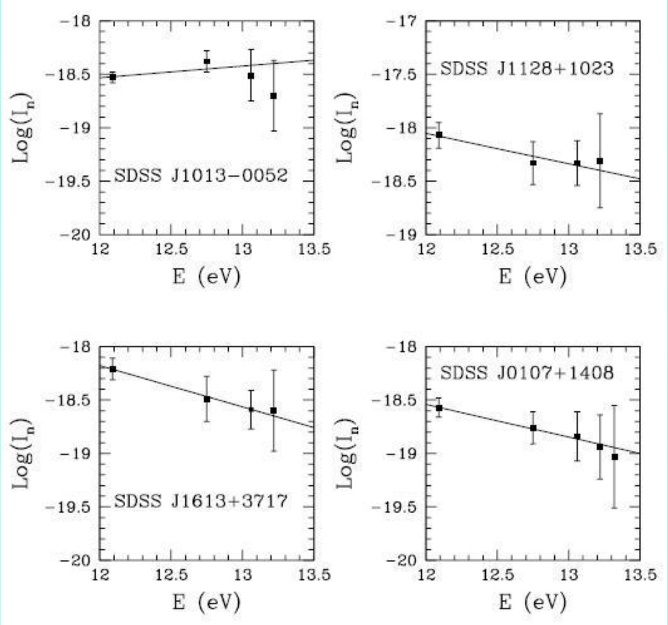
Balmer lines and Boltzmann Plots

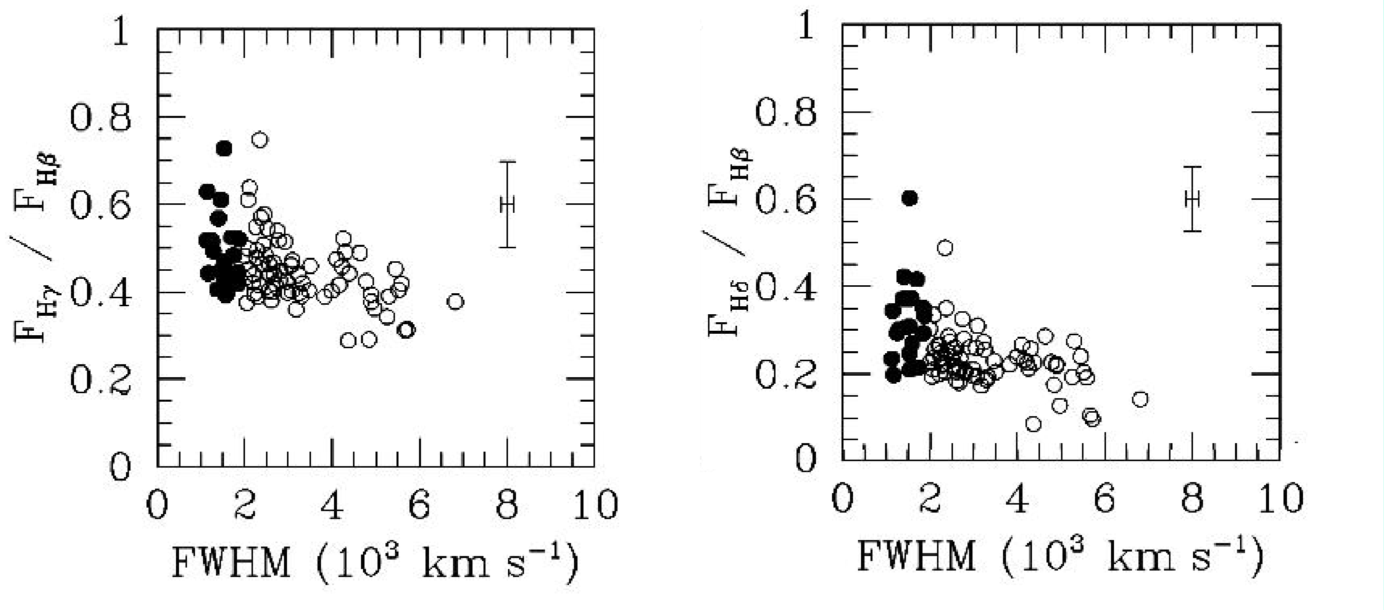
The Boltzmann Plot: given the normalized line intensity

$$I_n = \frac{\lambda_{ul} F_{ul}}{A_{ul} g_u}$$

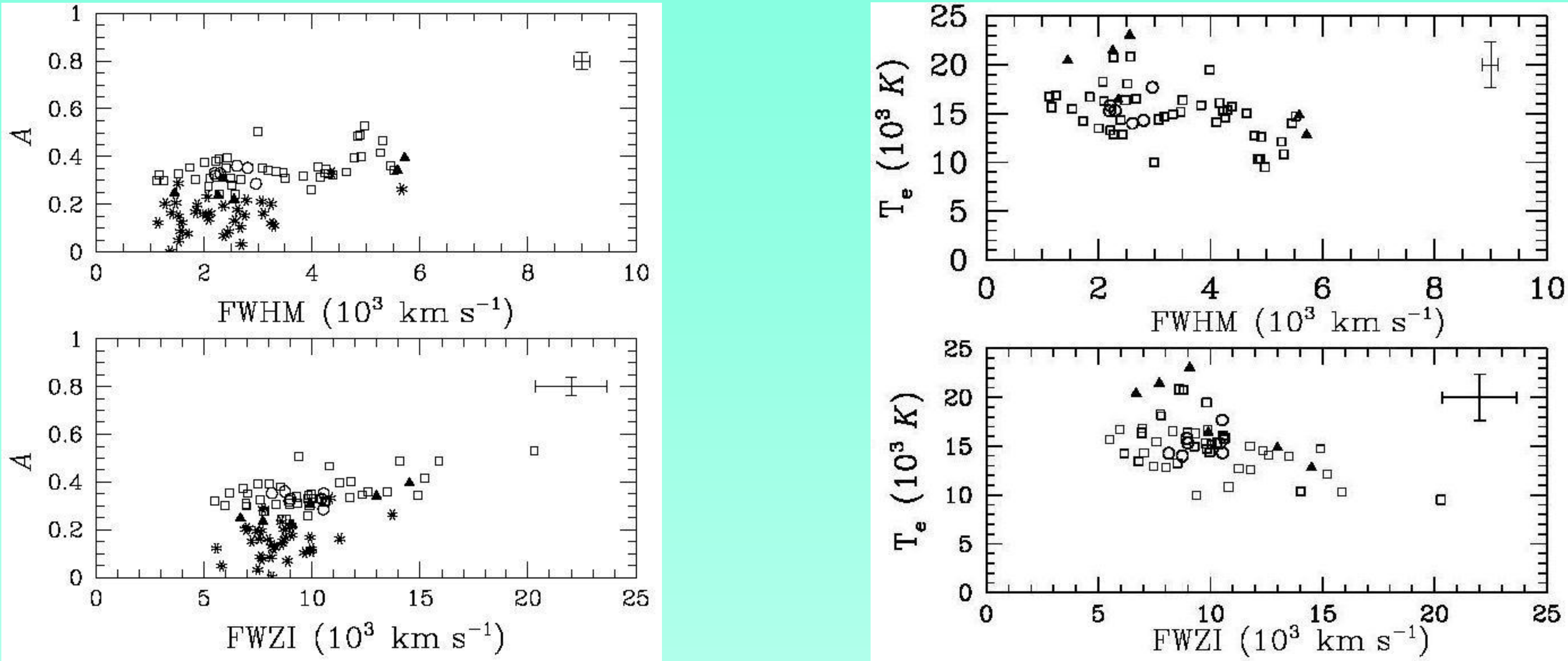
the logarithm of I_n for a particular transition series, in an optically thin plasma, is a linear function of the upper level's excitation energy, with a slope that depends on the plasma electron temperature

$$\log I_n = -\frac{\log e}{k_B T_e} E_u + \text{const.}$$





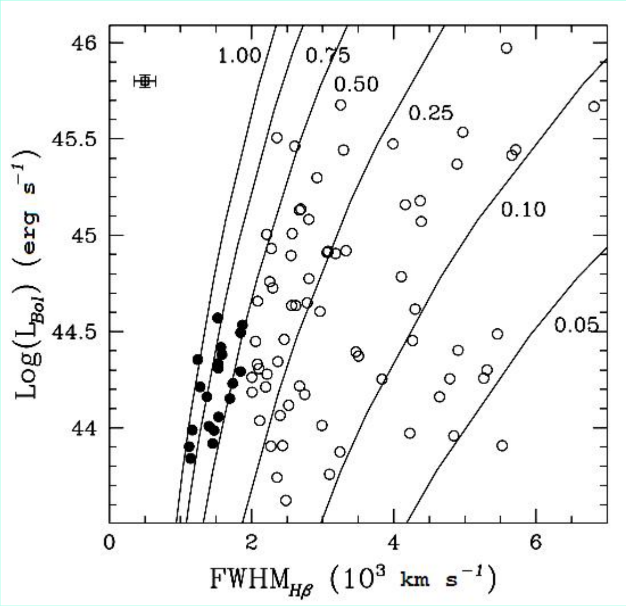
Balmer lines and Boltzmann Plots

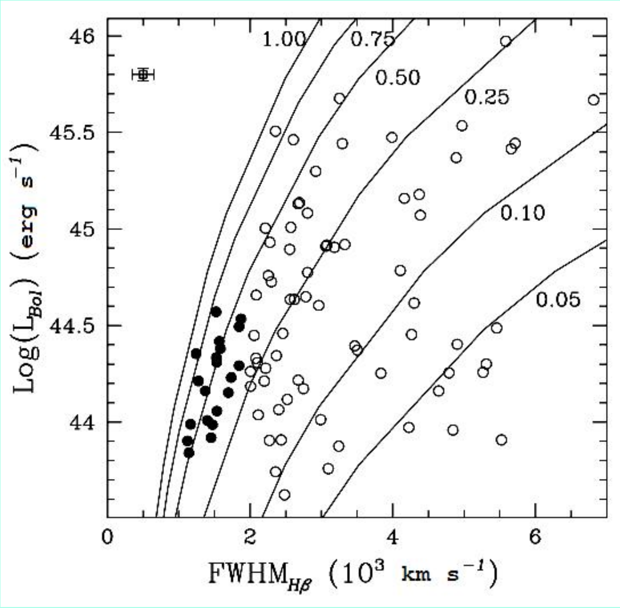


Boltzmann Plot slopes as a function of line profile widths (left panel), with the corresponding plasma temperature estimates (right panel).

The Boltzmann Plot assumptions only hold in a fraction of the selected AGN sample (~ 30%), preferably in the range of broad line emitting sources. In narrow lined objects the analysis points towards stronger ionization and higher plasma temperatures (La Mura et al. 2007, ApJ, 671, 104)

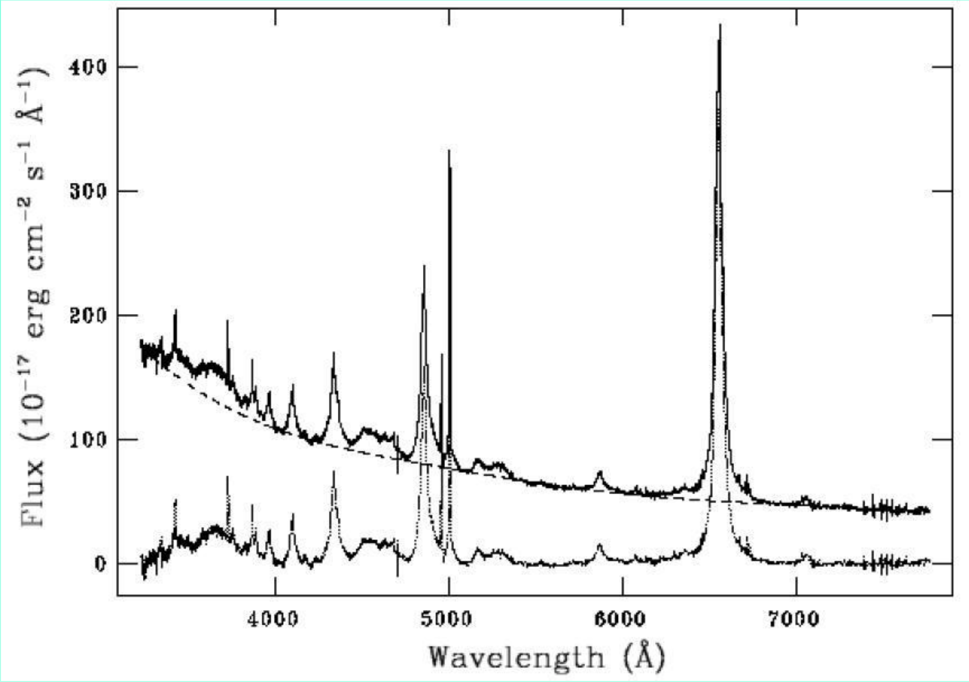
Optical observations



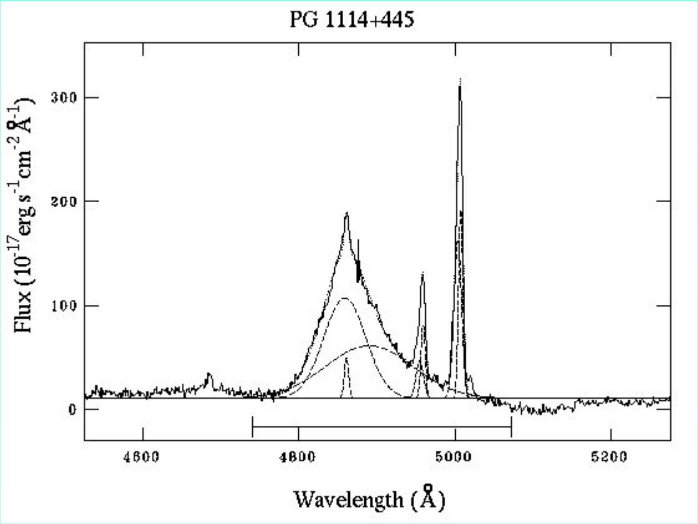


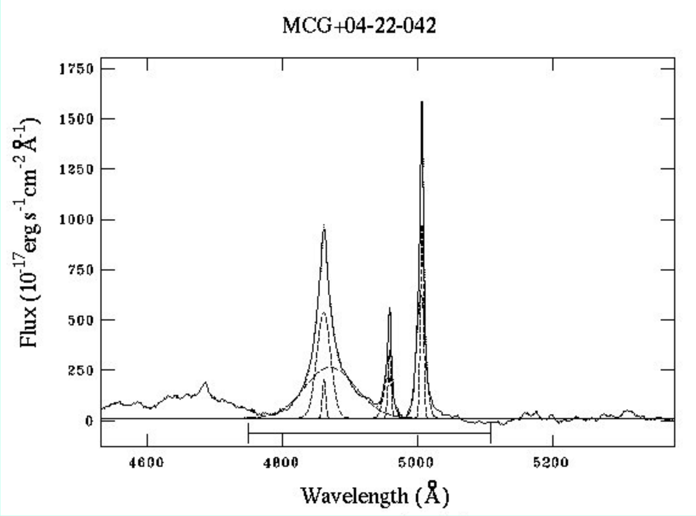
Bolometric luminosities vs. FWHM(Hβ) according to the structural models of Kaspi et al. (2005, left panel) and Bentz et al. (2006, right panel). Filled circles are NLS1 galaxies, while the continuous lines represent SMBH, having masses in the range from $10^6\,M_\odot$ to $10^9\,M_\odot$ and accreting at the labeled Eddington ratios. These observations suggest that objects with narrow emission lines are more commonly powered by low mass black holes working at very high accretion rates.

Optical observations



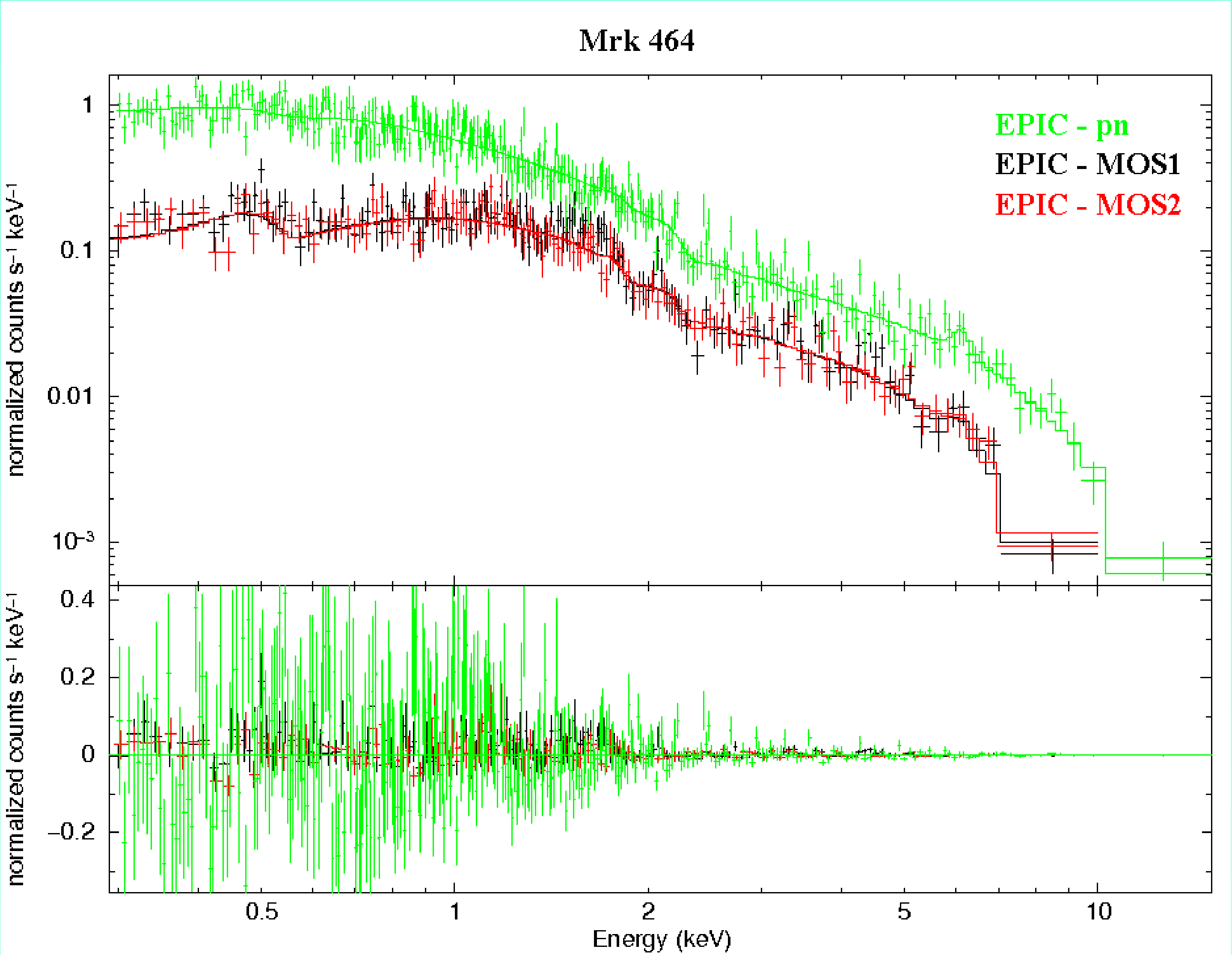
An SDSS observation carries several contributions in the spectrum, which are blended together with the BLR signal and must be accounted for, in order to study the broad emission lines. This example illustrates the subtraction of the underlying continuum in the spectrum of 2MASS J03221390+0055134.





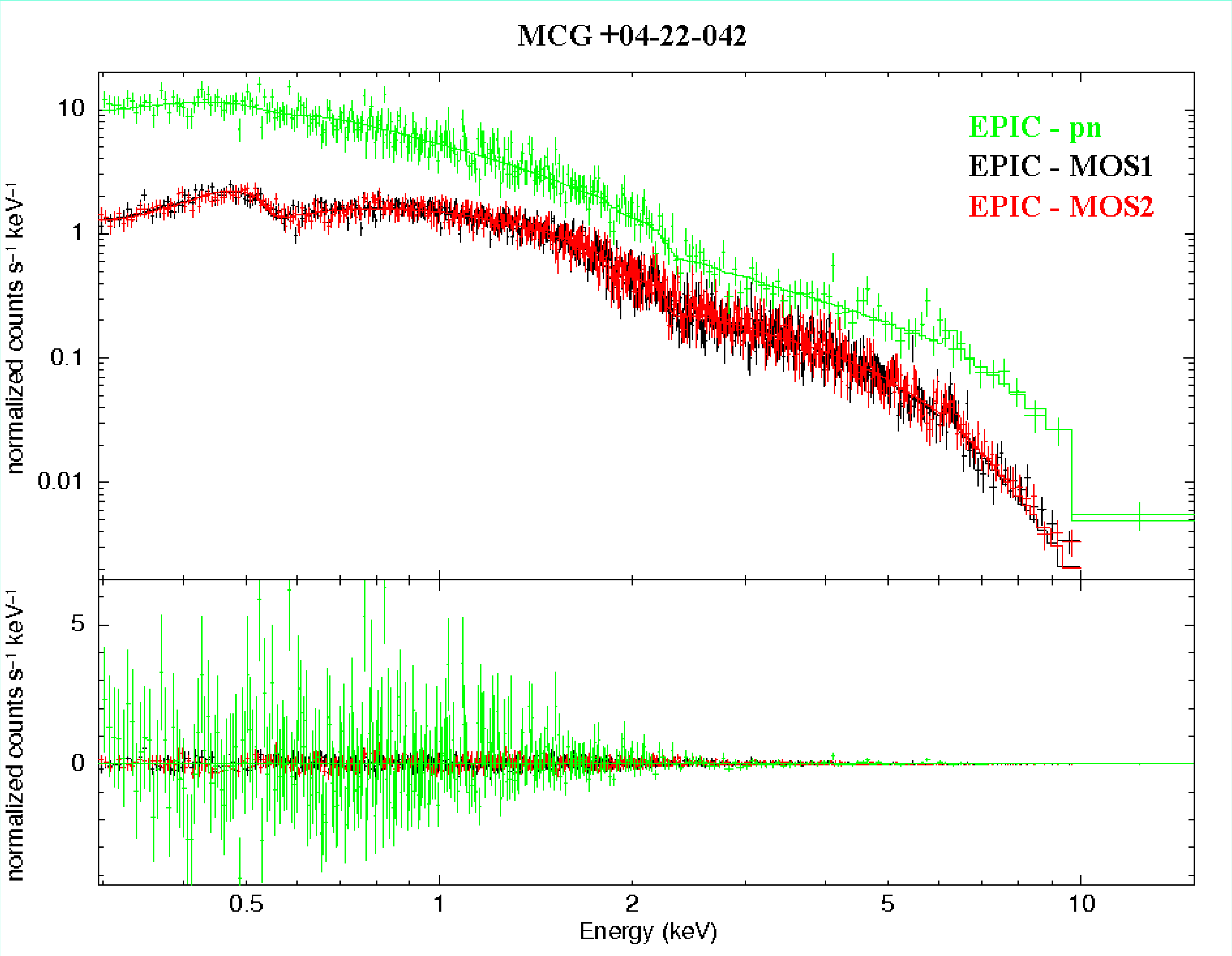
Examples of multiple component emission line fits for broad and narrow line S1 galaxies

X-ray spectral modeling: Broad Line Seyfert 1



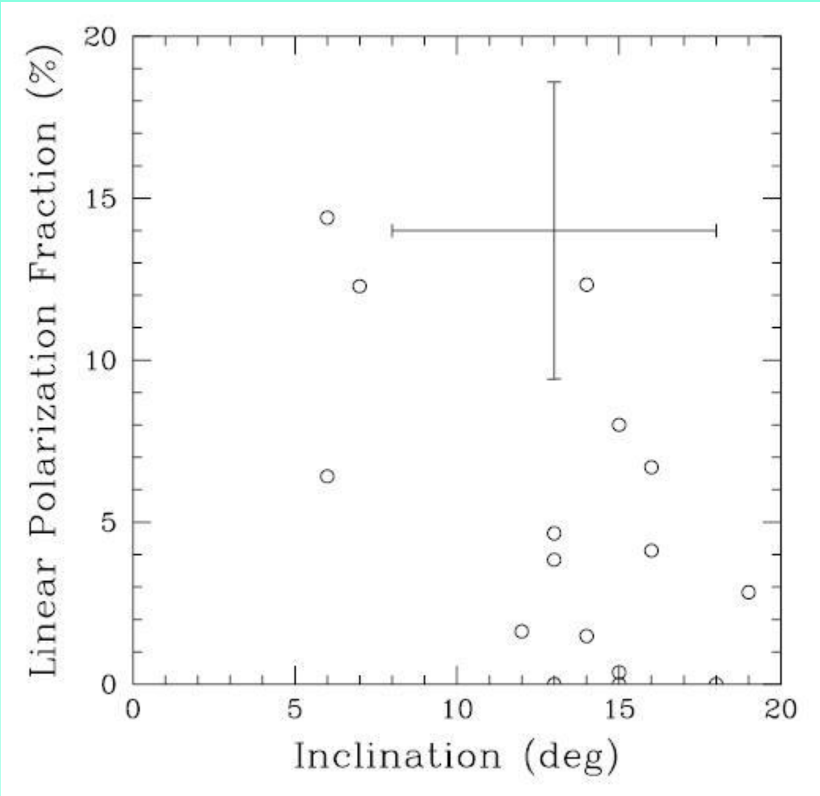
The soft X-ray spectra of BLS1 show a complex thermal component in the soft band, little or no evidence of absorption and a hard X-ray power-law component. A low ionization Fe Kα can usually be detected.

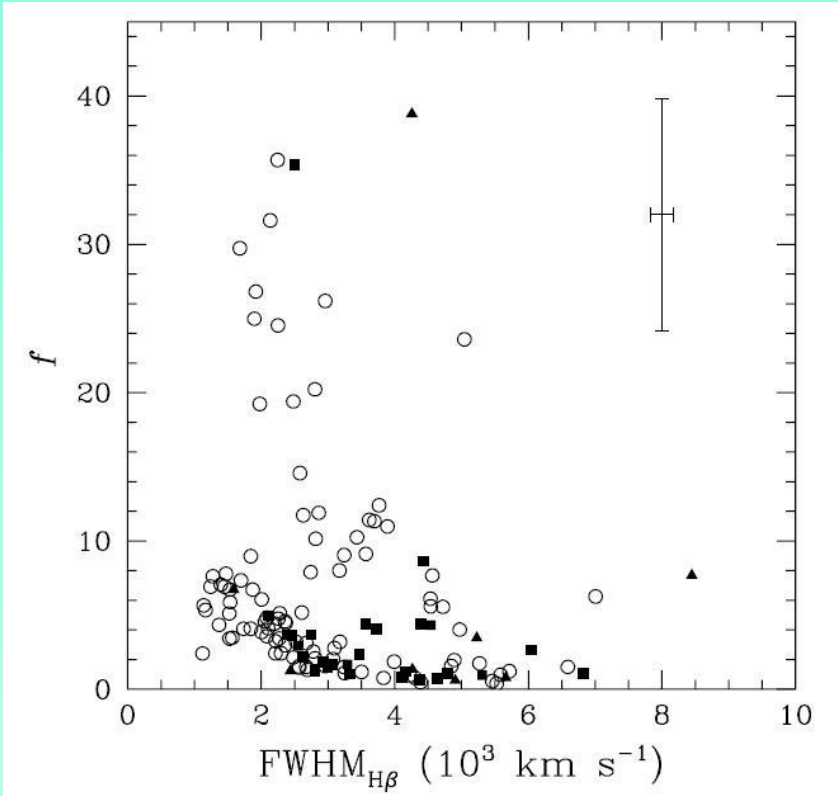
X-ray spectral modeling: Narrow Line Seyfert 1



The soft X-ray spectra of NLS1 show a complex thermal component in the soft band, no evidence of absorption and the hard X-ray power-law component. The Fe Kα emission line is detected as the product of reflection by a high ionization medium.

The role of geometry in the line profiles





Left panel: Degree of linear polarization in the radio observations of Type 1 AGN as a function of the inferred BLR inclination with respect to the observational line of sight. Right panel: Geometrical factors predicted by composite Disk + Isotropic BLR kinematical model as a function of H*β* FWHM (from La Mura et al. 2009, ApJ, 693, 1437)

Preliminary Results

Using the FWHM of the Hβ emission line as a flag to investigate the degree of ionization, corresponding to the Fe Kα energy, it is found that the degree of matter ionization increases while moving from the domain of BLS1 galaxies to that of NLS1 objects. Indications for an origin of Fe emission in ionized material have also been pointed out (Romano et al. 2002, ApJ, 564, 162), but a larger sample of observations is still required to assess whether the degree of ionization is actually connected with the optical emission line profiles, as it is suggested by our preliminary results.