# An X-ray Look to the Syl Galaxy Mrk 590: XMM-Newton and Chandra reveal the Fe K complex

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We report on a partially simultaneous observation of the bright Seyfert 1 Galaxy Mrk 590, performed by XMM-Newton and Chandra. The long exposure (100 ks) allows to investigate with great detail the Fe K complex at 6-7 keV and the presence of soft X-ray spectral features. We have analysed XMM-Newton data from EPIC in the 0.5-12 keV band and from RGS in the 0.35-2.5 keV band, and Chandra data from HETGs. UV and optical data from OM onboard XMM-Newton are also included in the analysis. The broad band spectrum is well described by an unabsorbed power law and three unresolved Fe K lines in the 6-7 keV range. The presence of a Compton reflection component and of a narrow FeK line at 6.4 keV is consistent with an origin via torus reflection. The Fe K lines at 6.7 and 7 keV are instead most likely originated by scattering on a warm and ionised gas. The Chandra data confirm this scenario. As expected in type 1 AGN, the soft X-ray spectrum appears to be almost featureless due to the very bright continuum emission, except for one emission line identified as OVIII Ly$\alpha$ detected at 19 Å by both RGS and Chandra-MEG.

Mrk 590 is a bright Seyfert 1 galaxy at z=0.026 observed by Einstein, Exosat and by HEAO 1 as part of the Piccinotti sample.No observation by ASCA and BeppoSAX have been performed and therefore its spectral properties have remained almost unknown until a 10 ks XMM-Newton observation has revealed the presence of a narrow Fe K in the EPIC data (Gallo et al. 2005). A quasi-simultaneous observation of this source performed by XMM-Newton and Chandra for about 100 ks unveils unprecedented details on the structure of the Fe K complex.

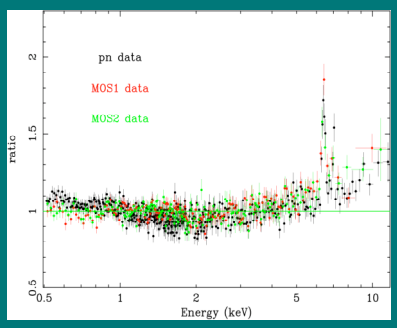


Fig 1: Residuals of the 0.5-12 keV EPIC spectrum fitted by a power law with $\Gamma$~1.76 and Galactic Nh $2.7*10^{20}$ cm$^{-2}$

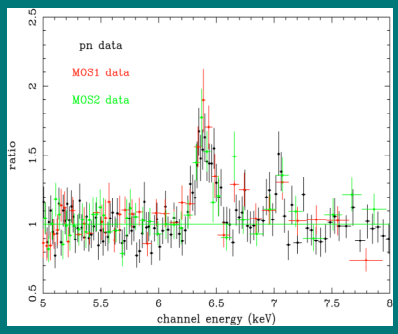


Fig 2: Zoom of the ratio of 2-10 keV power law: 3 Fe K lines detected at 6.4, 6.7 and 7 keV

## XMM-Newton Best fit 0.5-12 keV

- Power law with $\Gamma$~1.76
- 3 narrow Fe K lines detected by XMM: 6.4, 6.7 and 7 keV (Table 1, Fig.2-3)
- Compton Reflection component with R~1.3
- No absorption required in the spectrum
- Blackbody component with temperature kT~0.15 keV

In the Chandra data, due to lower photon statistic, only the neutral line at 6.4 keV is detected (Fig 4), but the upper limits on the other two lines are fully consistent with XMM-Newton results.

No features were found in the soft X-ray spectrum, other than the OVIII Ly$\alpha$, detected in emission by both RGS and Chandra-MEG.
The $\lambda$-shift of this feature observed only in RGS data is not taken into account for any science speculation.

EPIC 2-10 keV best-fit: plaw+3 zgauss

| $E_{Line}$ (keV) | $\sigma$ (eV) | EW (eV) | Flux ($\times 10^{-6}$ ph cm$^{-2}$s$^{-1}$) | Gamma - | $\chi^2$/dof |
|---|---|---|---|---|---|
| $6.39^{+0.02}_{-0.02}$ | $36^{+18}_{-24}$ | $121^{+11}_{-16}$ | 9.62±1.07 | $1.62^{+0.02}_{-0.02}$ | 948/964 |
| $7.02^{+0.02}_{-0.02}$ | <57 | $52^{+15}_{-12}$ | $3.61^{+1.02}_{-0.89}$ | idem | |
| $6.70^{+0.04}_{-0.04}$ | 0 | $18^{+10}_{-10}$ | $1.61^{+0.88}_{-0.94}$ | idem | |

**Table 2.** Fe K lines parameters in the best-fitting model of the EPIC data. (Energies are rest-frame. The parameters with no errors have been fixed).

Table 1: Fe K lines Parameters

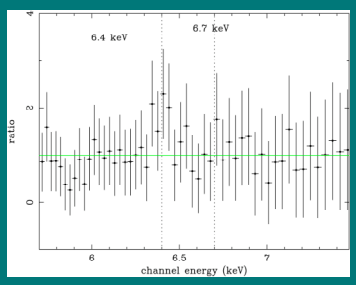


Fig 4: Ratio of the Chandra-HEG spectrum fitted with a power law with $\Gamma$~1.68

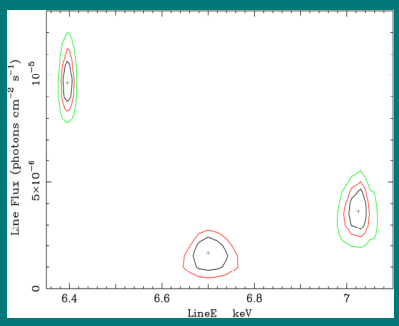


Fig 3: Confidence contours at 68, 90, 99% levels of confidence for the Fe K lines

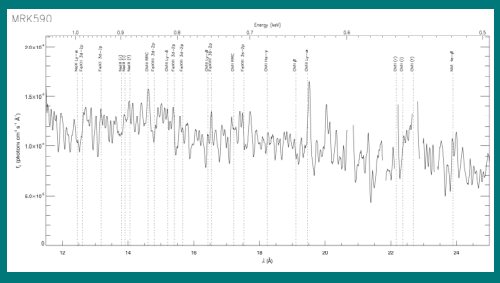


Fig. 5: Emission lines spectrum at high resolution (RGS data)

**Details in Longinotti et al. 2006, in preparation**

**Summary of results**

- Compton Reflection and 6.4 keV Fe K line likely produced in molecular torus
- 6.7 and 7 keV Fe k lines emitted by photoionised gas far away from nucleus. Transitions from Fe XXV and XXVI, (possibly blended with neutral Fe K$\beta$)
- No evidence for soft X-ray absorption, but emission from OVIII Ly$\alpha$ detected
- No line variability observed

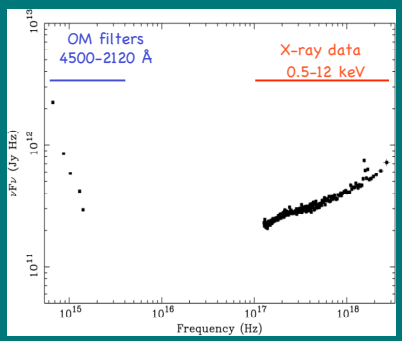


Fig 6: SED constructed from the OM fluxes (B, U, UVW1, UVM2, UVW2 filters) and the X-ray data

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