X-ray properties of polar-scattered Seyfert 1 galaxies

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We present the results on an XMM-Newton systematic analysis of a sample of nine Seyfert 1 galaxies. When observed in polarised light, the spectra of the selected sources are similar to those of Seyfert 2 galaxies. This peculiarity strongly suggests that these AGN are viewed with an inclination comparable with the torus opening angle. Our results in the X-ray band, are consistent with this scenario and, taking advantage of this favourable geometrical condition, we are able to investigate in detail the physical properties and the distribution of the circumnuclear gas in these sources.

1. Polarisation properties of Seyfert galaxies

Spectropolarimetric studies show that Type 1 and 2 Seyfert galaxies are intrinsically the same class of objects view from different orientation angles. However:

Polarisation in Seyfert 2: is compatible with being originated in a conical-like structure align with the polar axis (NGC1068, Miller et al. 1991)

Polarisation in Seyfert 1: ***NOT*** consistent with polar scattering.

Smith et al (2002) proposed the presence of the so-called *equatorial* scattering region to explain the properties of polarized light of Seyfert 1 galaxies (see Figures 1 & 2).

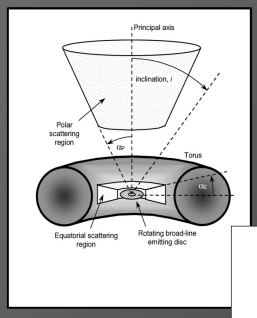
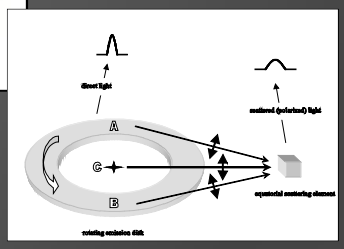
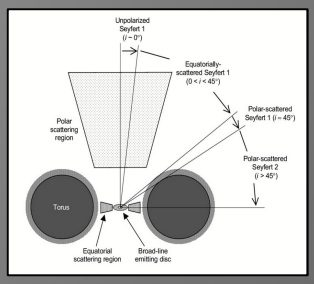


Fig. 1 Location of polar and equatorial scattering regions for Seyfert galaxies. From Smith et al. 2002.

Fig. 2 Scattering in the equatorial region. From Smith et al. 2002.



2. Polar-scattered Seyfert 1 galaxies



A peculiar type of Seyfert 1 galaxies exhibit polarised spectra similar to those of Seyfert 2 galaxies, i.e. dominated by polar scattering. According to the Smith et al. (2002) model, these *polar scattered Seyfert 1* should be observed at an inclination comparable to the torus opening angle, and suffered only a moderate extinction through the torus rim.

X-ray studies of this distinctive galaxies are a powerful tool to prove the basis of the model proposed by Smith et al. (2002) and therefore to further test the scheme of Unified Models for AGN.

3. X-ray properties of the sample

We have analysed the nine objects with available X-ray data from the twelve *polar scattered Seyfert 1* discovered by Smith et al. (2004) (see the table below). We present for the first time, XMM-Newton data of four of them (marked in red in the table).

	WA	Cold Abs.	Flux(2-10keV)	Broad Fe
Fairall 51	✓	1.5×10^{22} cm^{-2}	9.5×10^{-11} cgs	✓
ESO 323-G077	✓	6×10^{22} cm^{-2}	2.5×10^{-11} cgs	✓
Mrk 704	✓	3×10^{22} cm^{-2}	1×10^{-11} cgs	✓
IRAS 15091-2107	✓	7×10^{21} cm^{-2}	8.6×10^{-12} cgs	×
NGC 4593	✓	-	4.4×10^{-11} cgs	×
Mrk 231	✓ (?)	2×10^{24} cm^{-2}	7×10^{-13} cgs	
NGC 3227	✓	7×10^{22} cm^{-2}	7.6×10^{-12} cgs	×
Mrk 766	✓	-	$(1\text{-}2)\times10^{11}$ cgs	✓
Mrk 1239	×	3×10^{23} cm^{-2}	-	×

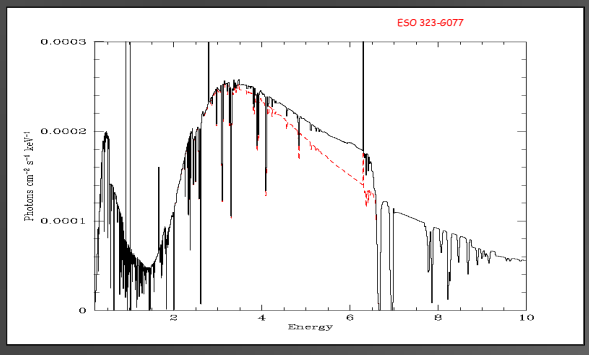


Fig. 4 XMM-Newton spectrum of ESO 323-G077. Several absorption features caused by warm gas at low and high energy are present. The galaxy also presents a relativistic ally Fe-Ka line

4. Results of the X-ray Analysis

- Four galaxies has been study in the X-ray band with XMM-Newton based on a sample of 12 polar-scattered Seyfert galaxies.
- *XMM-Newton* observations reveal the imprints of either warm or cold absorption or a combination of both: one or more WA have been detected in 4 out of the 4 sources and cold absorption in 3 of the 4 sources (except IRAS 15091-2107).
- The hard band spectra of the source shows the presence of a broad iron line in 2 of the 4 studied sources (ESO323-G077 and Fairall 51) and a marginal detection in Mrk 704.
- Combining our results with another 5 already observed polar-scattered Seyfert galaxies we address that the presence of warm and/or cold absorption signatures is nearly ubiquitous.
- The X-ray properties of polar-scattered Seyfert galaxies are peculiar in comparison with Type I objects and favour the Smith model based on orientations effects to explain the polarization properties of their optical spectra, i.e. The Unified Models