SUZAKU observations of bright Compton-Thin Seyfert2

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ABSTRACT

We present preliminary results of recent Suzaku observations of three bright Compton-Thin Seyfert2 galaxies. The sources are part of an on going program of Suzaku observations of local bright Seyfert2 galaxies, selected from the Swift/BAT high-latitude survey, with a hard X-ray flux ~10^{-10}erg cm^{-2}s^{-1} (5 mCrab), to form a flux-limited sample of Seyfert2s. Thanks to the unprecedented band-pass and sensitivity of Suzaku over the 0.4-70 keV energy range a high signal to noise spectrum has been accumulated, which allows us to determine the nature of the iron K line complex and accurately measure the reflection hump expected if there is reprocessing in Compton-thick matter, outside the direct line of sight.

INTRODUCTION

Past and present X-ray observations have revealed that the majority of AGN are obscured in the X-ray band, implying a large covering factor for the absorbing matter.

To first order these studies have confirmed the widely accepted Unified Model of AGN (Antonucci 1993), which accounts for the difference between type 1 and type 2 AGNs through orientation effects. However, high resolution X-ray spectral and spectral-monitoring observations of bright, nearby Seyfert 2s have shown that the structure of the absorber is more complex than the uniform and cold torus of the Unified Model of AGN. These observations revealed that the emission below 3 keV is dominated by the presence of emission lines from highly ionized (He and H-like) elements (Sambruna et al. 2001, Sako et al. 2000, Braito et al. 2007), likely produced by photoionized/photoexcited matter (Guainazzi & Bianchi 2007). This ionized material may also be responsible for scattering of the primary X-ray continuum (the so-called "warm mirror").

The absorption and emission lines detected highlight different ionization states of the circumnuclear matter and they suggest a structure more complex than the simple cold torus and are indicative of multiple absorbers and reflecting mirrors being present. This is complemented by recent detections of column density variations in Seyfert 2 galaxies over time-scales of a few hours (NGC 4388, Elvis et al. 2004, NGC 1365, Risaliti et al. 2005, 2007), which strongly suggest that the cold component of the absorber is not homogeneous and is located, at least in part, as close to the central source as the broad line clouds.

NGC 6300

Suzaku observed the Seyfert 1.9 galaxy NGC 6300 (z=0.0037) for ~80ksec.
The 15-70 keV flux observed by Suzaku is ~7.5x10^{-11} erg cm^{-2} s^{-1}, while 2-10 keV flux is ~1.5x10^{-11} erg cm^{-2} s^{-1}) and they are similar to the fluxes observed with BeppoSAX and XMM.
The baseline continuum is composed by an absorbed power law component (Γ ~1.7, N_H~ ~2x10^{22}cm^{-2}), a reflection component (R~0.7) and a scattered soft power law component. An unresolved iron line is detected at ~6.4 keV with an EW~100eV.
The best fit parameter are similar to the value found with the XMM (Matsumoto et al. 2004) and BeppoSAX observations (Risaliti 2002, Dadina 2007).

Two soft emission line are required at E~0.87 keV (EW~100 eV) and E~1.1 keV (EW~20 eV). The possible identification of the former is L-shell emission from Fe XVII or OVIII RRC, while the latter may be Ne X or L shell emission from Fe XXI.

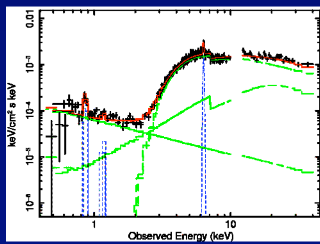


Fig 1 Suzaku XIS and HXD-pin spectra of NGC 6300.

NGC4507

Suzaku observed the Seyfert 1.9 galaxy NGC4507 (z=0.0118) for ~90ksec.

The 15-70 keV flux observed by Suzaku is ~9x10-11 erg cm-2 s-1 and it is similar to the the SWIFT/BAT and to the BeppoSAX measurement, while 2-10 keV flux (~5x10^{-12} erg cm^{-2} s^{-1}) is a factor of 2 lower than in the XMM-Newton observation.

The broad band energy distribution is shown in Fig2 (left panel). The baseline continuum consists of a hard power-law component (Γ ~1.7) absorbed by a neutral column density of ~8x10^{23}cm^{-2}, a strong reflection component from neutral material (R~2), and a soft power-law component (Γ~3.0) absorbed only by the Galactic column density. We confirm the presence of two cold circum-nuclear regions; one Compton thin, the absorber, responsible for the low energy photoelectric cut-off and one Compton thick responsible for the reflection component emerging above 10 keV.

In Fig2 (right panel) we show the iron line profile as measured with the XIS; the profile shows a strong core at E~6.4 keV, there is no evidence of an underlying broad component (σ<50 eV, EW~ 500 eV). A narrow Fe Kβ is also clearly detected .

Furthermore the observation confirms the presence of several soft emission line from O, Ne Mg and Si, already discovered with the XMM observation (Matt el al. 2004); their EWs range for 50 eV to 150 eV. We found that to account for these emission linee two ionized media are required: one with higher ionization state responsible for the O and Ne lines, and one with a lower ionization which account for the Mg and Si lines.

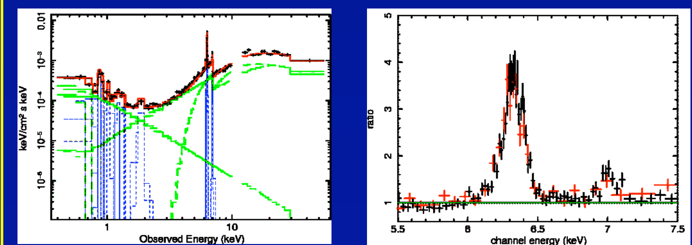
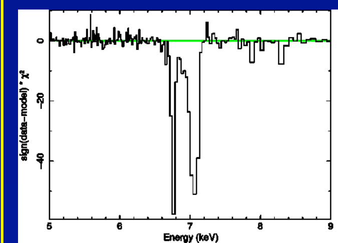


Fig 2 left panel: Suzaku XIS and HXD-pin spectra of NGC4507. Right panel: ratio between the data and the best-fit continuum model at the energy of the Fe line; both the Fe Kα and Kβ are clearly visible

Another surprise from NGC 1365

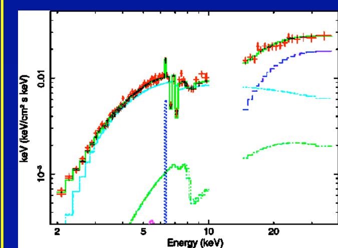
NGC 1365 (z=0.0055) is a remarkable Seyfert 2 with extreme X-ray variability, switching from reflection-dominated to transmission-dominated state on timescale shorter than two days. Another peculiarity of the X-ray emission of NGC 1365 is the presence of variable absorption lines in the 6.7-8 kev energy range, indicative of a variable high ionization high velocity outflow.
Red and blue-shifted absorption lines due presence of highly ionized gas in- and/or out-flowing at relativistic velocities have been reported for several AGN. The peculiarity of NGC 1365 is their high EW and extreme variability.



Suzaku observed NGC1365 for ~150 ksec.

NGC 1365 was found in high and Compton-Thin state.

The Suzaku data confirm the presence of the absorption features due to blue shifted He and H-like Fe kα and Kβ.
The inferred outflow velocity is ~3300km/s



The main result of the Suzaku observation is the detection of a factor of 3-5 increase in flux above 10 keV with respect to the extrapolation of the 0.5-10 keV best fit model.

To account for this hard X-ray emission a high column density absorber, possibly located close to the X-ray source, is required.

NGC 4507 another case of N_H variability

Comparing the Suzaku observation with the previous XMM-Newton pointing (performed in 2001), we found evidence of variability of the 2-10 keV emission of NGC 4507.

Fig 3 shows that soft X-ray emission remained at the same level, while the 2-10 keV emission varied in flux and curvature; in particular between the two observations the amount of neutral absorption varied from ~4x10^{23}cm^{-2} to ~8x10^{23}cm^{-2}. A possible scenario is that the variable absorber changes in covering factor as expected in the hypothesis of a clumpy absorber.

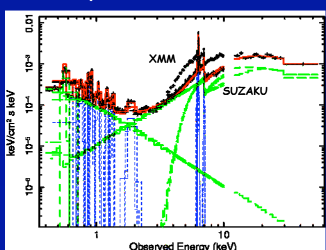


Fig 3 Comparison between the XMM and Suzaku spectra. The soft X-ray emission is indistinguishable between the two observations, while the XMM 2-10 keV data are clearly above the Suzaku data and best-fit model.

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