Hard X-ray observation of the M81 nucleus with Suzaku

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1.Abstract

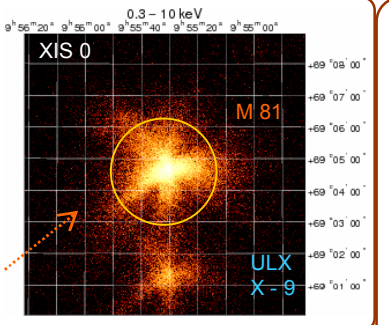
We report spectral and timing results from a long (~ 100 ks) Suzaku observation of the M81 nucleus, a typical low-luminosity active galactic nucleus, conducted on 2006 May 7. The 2--10 keV luminosity in our observation hit a historical minimum, ~ 1.4x10^{41} erg/s. Althogh the flux is only a quarter of that at the BeppoSAX observation on 1998, the Hard X-ray Detector (HXD) successfully detected its signal up to ~ 30 keV. The X-ray flux varied by 10% during the observation.

The 2-10 keV spectrum measured with the XIS is well described by a power law continuum and an iron Kα emission line complex. The complex cannot be modeled by a single broad line, but can be represented successfully by three narrow lines at energies of 6.4, 6.7, and 6.9 keV, with the equivalent widths of ~47, ~49, and ~34 eV, respectively. The result is consistent with those of XMM (Page et. al. 2004).

Despite of its low flux, the HXD clearly detects hard X-ray emission up to 30 keV. The spectra is consistent with the power law extension of that of the XIS, taking into account the current systematic error in the background estimation.

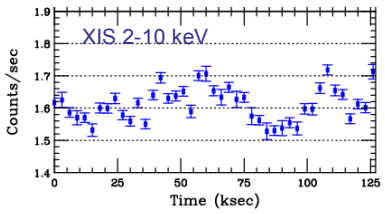
2. observation

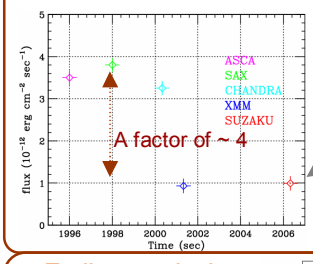
AO-1 target (PI Takeshi itoh)
Observed date
May 7, 2006 23:57 (START)
May 9, 2006 12:30 (STOP)
EXPOSURE
XIS: 103.6 ks HXD: 77.2 ks
Data process
XIS PIN: rev 1.2
The source region of XIS is extracted from a cricle r = 2'.



3. Light Curve

Background substracted XIS **LightCurve** (1 bin 3 ks)



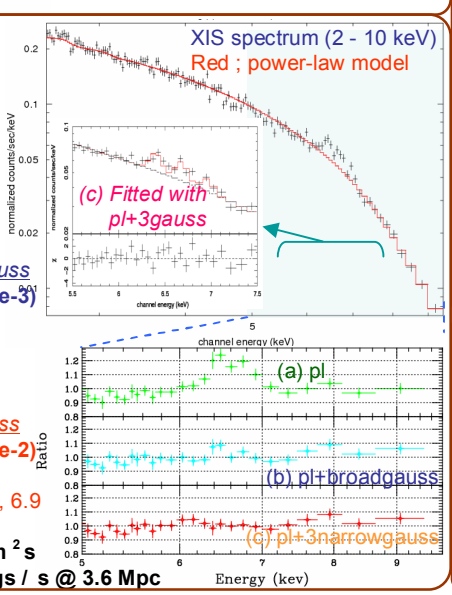


The 2-10keV flux is the lowest.

PIN (12-30 keV) lightcurve is consistent with constant flux.

4. Fe line analysis

exclude blow 2 keV
b/c, contamintatioin from Galactic components,
(N_H is fixed 4 x 10^{20} cm^{-2})
(a). power-law
χ / deg =
269.4 / 136 (7.9e-11)
Photo Index Γ = 1.83
(b). power-law + broad gauss
χ / deg = 180.1 / 133 (1.3e-3)
Photo Index Γ = 1.89
Centor Energy = ~ 6.6
Sigma = 353 eV
(c). power-law
+ narrow three gauss
χ / deg = 166.1 / 130 (1.7e-2)
Photo Index Γ = 1.88
CentarEnergy = ~6.4, 6.7, 6.9
(EW = 47, 49, 34 eV)
Flux 9.76x10^{12} ergs / cm^2 s
Luminosity 1.4x 10^{41} ergs / s @ 3.6 Mpc

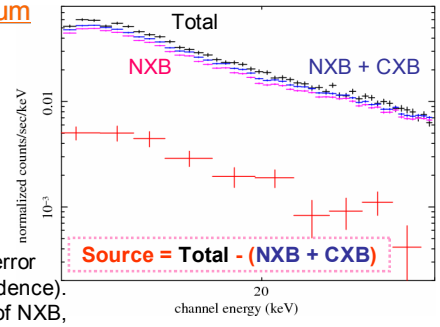


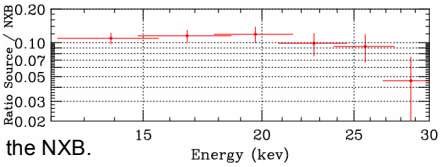
5.HXD-PIN Spectrum

Although the flux is low (= 1/ 4 BeppoSAX), HXD-PIN detects it up to ~30 keV.

power-law fit goes Γ ~ 2.4 -0.4 / +0.6, which is relatively soft.

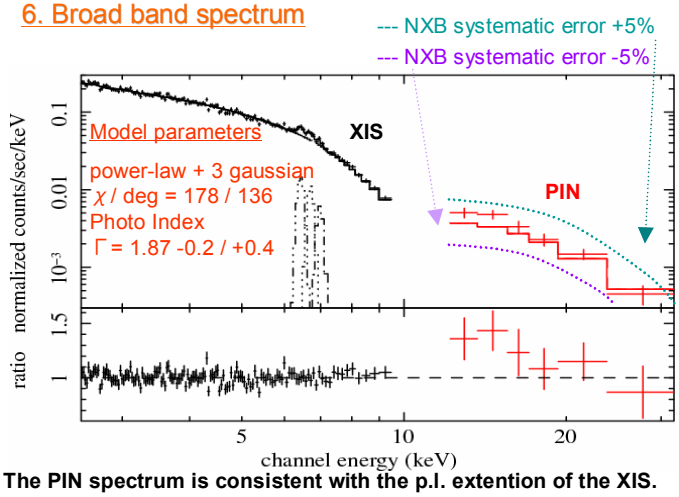
NXB model systematic error is about 5% (90% confidence). Since the flux is ~ 10% of NXB, the detection is firm.





Source flux is ~10% of the NXB.

6. Broad band spectrum



The PIN spectrum is consistent with the p.l. extention of the XIS.

NOTES: Since the best estimated NXB provides slight excess emission above 10 keV, we tried introducing reflection component (pexrav). Fit with the reflection do provide better fit to the data (163/134). Although we cannot rely on the result now, it shows that the statistics is high enough to deduce these parameters. With improved BGD modeling in future, we will be able to survey the evidences for reflection components.

7. Discussion

Fe line feature

The 2-10 keV spectrum is well described by a power-law and an iron emission line complex which is similar to that observed by *XMM*-Newton. While the complex cannot be modeled by a single broad line, it can be represented successfully by three narrow lines.

Braod band spectrum

Although the flux is four times lower than that observed by BeppoSAX (Pellegrini et. al. 2000), the photon indices are very similar between the two observations; Γ ~ 1.84 and Γ ~ 1.86 for SAX and XIS-HXD, respectively. Thus, Γ is invariable regardless of the total flux. Improving the reproducibility of NXB of the HXD will bring more accurate spectrum model argument.

Reference

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