ASCA observations of LINERs

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1. Introduction

ASCA observations reveled the presence of low luminosity AGN in ∼10 LINERs as a hard point source at the nucleus. The X-ray continuum shape (photon index ~ 1.8) are very similar to Seyfert galaxies (Makishima et al. 1996, Serlemitsos et al. 1996). An iron emission line is observed from heavily absorbed low luminosity AGNs (Makishima et al. 1996), while M81 is the only object among small intrinsic absorption from which an iron line detected (Ishisaki et al. 1996) because of limited photon statistics for other objects.

2. composite spectrum of LINERs

We summed up the *ASCA* spectra of 5 LINERs which host low luminosity AGN of low intrinsic absorption to search for an iron emission line. We used 7 observations of 5 objects (NGC1097, NGC3310, NGC3998, NGC4450, and NGC4594) to make a composite spectrum. All the objects has very similar X-ray characteristics (spectral slope, intrinsic absorption, no short time scale variability; Iyomoto et al. 1996, Serlemitsos et al. 1996).

We fitted this spectrum with power-law model in 2–10keV band, since most of the *ASCA* spectra of LINERs indicate thermal emission from a hot gas of $kT \sim 0.5$ keV and such a component is negligible above 2keV.

The best fit photon index is 1.79±0.04. Only upper limit of equivalent width (EW) of 140eV was obtained for an additional narrow Gaussian at 6.4keV or 6.7keV, which corresponds to nearly neutral and He-like iron, respectively (90% confidence limit for one parameter of interest).

3. Discussion

From the prototypical LINER M81, a broad iron emission line (equivalent width ∼300eV, Gaussian line width $\sigma \sim 0.2 - 0.3$keV) is clearly detected at ~ 6.7 keV (Serlemitsos et al. 1996, Ishisaki et al. 1996), which is compatible with an accretion disk origin (Serlemitsos et al. 1996) as observed from Seyfert 1 galaxies (e.g. Nandra et al. 1996). However these parameters are inconsistent with the averaged LINER spectrum.

If the optically thick accretion disk is present in LINERs as in Seyfert galaxies in spite of very low Eddington ratio (e.g. $\sim 7\times10^{-6}$ for NGC4258; Makishima

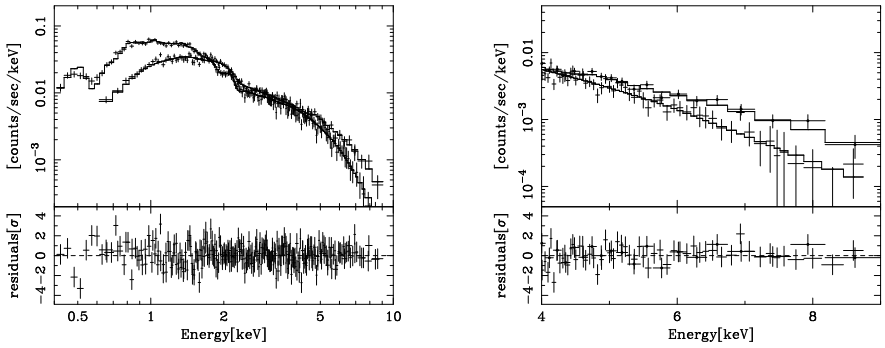

Figure 1. The ASCA data and the best fit power-law plus thin thermal plasma model.

et al. 1994, Miyoshi et al. 1995), weakness of iron lines in LINERs would be explained by inclination and/or ionization state dependence of EW. When iron line is originated from cold disk, EW decreases as inclination becomes large (George & Fabian 1991). Furthermore the iron line profile from a relativistic disk with higher inclination becomes very broad (Fabian et al. 1989). Thus iron lines from highly inclined disk are hard to be detected.

Effective fluorescence yield of iron becomes small for FeXVII–FeXXIII due to resonant trapping effect (e.g. Życki & Czerny 1994, Ross & Fabian 1993). When the ionization state of the iron lies in this range, iron emission is suppressed. In this case, strong iron line in M81 could be interpreted as from more highly ionized species which have larger effective fluorescence yield.

Alternatively it is also possible that LINERs have no standard accretion disk (Mushotzky 1993). The absence of the reprocessor around the nucleus easily explains lack of the iron line. In this case, however, the origin of the iron line in M81 may be a problem.

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