X-RAY OBERVATION OF THE NORMAL SPIRAL GALAXIES NGC2903 AND NGC628 WITH ASCA

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1.Introduction

X-ray emission from spiral galaxies without activity is thought to consist of low-mass X-ray binaries (LMXBs), and the Einstein observations established the relation between X-ray (0.2–4 keV) and optical luminosities as $\log(\frac{L_X}{L_B}) \sim -4$ (Fabbiano, 1992). This relation has been used when discussing the activity other than LMXBs (Iyomoto, 1996). However, spectral information of Einstein Observatory was rather poor above 3 keV, where LMXBs would emit significant energy flux. Therefore we performed ASCA observations of two normal spirals, NGC2903 and NGC628, in order to better calibrate the $L_X - L_B$ relation.

2. Spectral Analysis

For both galaxies, the spectrum was extracted from a circular region centered on the source center and background spectrum was made from the source free region. The summary of the fit result are listed table 1 and 2.

3. Discussion

We compared L_X/L_B ratios of both garaxies with that of M31 (Makisnima, 1989). When comparing X-ray and optical luminosities, we calcurated X-ray luminosity of a hard component (L_X^{hard}) of energy band 2-10 keV, at this band LMXBs emit significant energy flux. Comparison are summarized in table 3. The L_X/L_B ratios of M31 and NGC628 are similar to the value obtained by Einstein ($\sim$ -4.4), but for NGC2903 ASCA exhibits smaller value than Einstein ($\sim$ -3.9) and the scattering of L_X/L_B ratios of these three galaxies becomes smaller. This is owing to the fact that ASCA has sensitivity up to 10 keV, and separated the LMXBs emission from the soft component. About these three sources, $\log(\frac{L_X}{L_B}) \sim -4.4$.

References

Fabbiano, G. et al. 1992 ApJS 80 531
Makishima, K. et al. 1989 PASJ 41 697
Iyomoto, N. et al. 1996 PASJ 48 231
Tully, R.B. Nearby galaxies catalog (Cambridge Univ. Press)

Parameter	bremss + Raymond-Smith	powerlaw + Raymond-Smith
kT (keV) of bremss or photon index	$8.2^{+3.7}_{-2.0}$	$1.62^{+0.07}_{-0.05}$
kT (keV) of Raymond-Smith	$0.44^{+0.05}_{-0.03}$	$0.47^{+0.06}_{-0.04}$
abundance	0.20 ± 0.03	$0.28^{+0.05}_{-0.04}$
flux of hard component (erg/s/cm^2, 2–10keV)	6.14×10^{-13}	6.86×10^{-13}

TABLE 1. best fit parameters and single-parameter 90% confidence limits of NGC2903.

Parameter	bremss	powerlaw
kT (keV) or photon index	$12.1^{+18.5}_{-6.1}$	$1.56^{+0.15}_{-0.12}$
flux (erg/s/cm^2, 2–10keV)	2.43×10^{-13}	2.49×10^{-13}

TABLE 2. best fit parameters and single-parameter 90% confidence limits of NGC628.

	M31	NGC2903	NGC628
L_X (erg/s, 2-10 keV)	3.9×10^{39}	2.9×10^{39}	2.7×10^{39}
L_B (erg/s)	1.1×10^{41}	5.2×10^{43}	8.0×10^{43}
$\log(\frac{L_X}{L_B})$	-4.5	-4.3	-4.5

TABLE 3. comparison of X-ray and optical luminosities from three normal spiral galaxies. X-ray luminosity is calculated from the 2–10 keV flux of thermal bremsstrahlung model. Optical luminosities are taken from Tully (1988). X-ray luminosity of M31 are calculated from the Ginga result (Makishima 1989).