Emission Lines in Active Galaxies: New Methods and Techniques
ASP Conference Series, Vol. 113, 1997
B.M. Peterson, F.-Z. Cheng, and A.S. Wilson (eds.)

AGN Properties and Their Contribution to the Cosmic X-Ray Background

M. Matsuoka

The Institute of Physical and Chemical Research (RIKEN), Wako-shi, Saitama 351-01, Japan

Abstract. We have investigated the characteristics of AGN using data from *ASCA* X-ray observations and considered their contribution to the CXB. There are mainly four specific topics that need to be considered: (1) the absorption edges due to warm gas, (2) the complex spectra of Seyfert 2 galaxies, (3) the broad iron emission line, and (4) the soft X-ray excess.

The CXB can be explained by superposing AGN spectra according to cosmological distance, but so far the distant quasars ($z > 1$) that have been observed show spectra in the 2–10 keV band that are steeper than the spectrum of the CXB. Recent observations have been more clearly defining the properties of the AGN one by one. We have more than 80 high-quality AGN spectra, but their properties are not well-balanced due to poor sampling of low-luminosity AGN. A large number of low-luminosity AGN might be the main contributors to the CXB.

1. Seyfert Galaxies and Distant Quasars with ASCA

Four properties of AGN are clearly defined by recent *ASCA* and *ROSAT* observations: (1) *ASCA* has confirmed the existence of a reflection component (Cappi et al. 1996a); (2) warm-absorption structures produce absorption edges of O VII and O VIII (e.g., Fabian et al. 1994); (3) broad iron line features have been clearly detected (Tanaka et al. 1995); and (4) a soft X-ray excess is present in some AGN (Otani 1995; Boller et al. 1996; Wang et al. 1996).

The spectrum of a typical Seyfert 2 galaxy NGC 5252 (Cappi et al. 1996b) is similar to that of the Seyfert 1.5 NGC 4151, which has a flatter spectral index of $\Gamma = 1.45$–1.6 (Weaver et al. 1994; Leighly et al., in preparation). The best-fit model for the two sources involves complex absorption, e.g., Poisson absorption (i.e., partial covering absorption), plus an intrinsic absorption.

ASCA has observed more than 10 high-redshift quasars. The X-ray spectra of these high-z quasars are generally well-fitted with a single power law with absorption, but some of them show a larger column density, in excess of the Galactic column (Cappi et al. 1996c). Their spectral photon indices are in the range of 1.5–2.1. The photon indices of radio-quiet sources are steeper than those of radio-loud quasars, but all the spectra of high-redshift AGN are not significantly steeper than that of the CXB (Ohta et al. 1996; Mathur et al. 1995). The spectra with large absorbing columns appear to become flatter.

2. Superposition Method of AGN for the CXB Interpretation

The interpretation that the CXB spectrum can be represented by superposing AGN spectra has been well accepted (Morisawa et al. 1990) and recently developed by revised works (Comastri et al. 1995). We need to examine the X-ray spectra of distant AGN in order to verify this interpretation. Thus *ASCA* observed distant AGN to obtain their spectral shapes. Although one may expect that the spectrum of AGN in the 2–10 keV band gets flatter with increasing distance, the observed X-ray spectra of distant AGN ($z > 1$) do not show any significant flattening. The average photon index for ten distant quasars is $\Gamma = 1.73 \pm 0.15$, which is definitely larger than the index of the CXB.

It is noted that the present sample of AGN is not covered uniformly, and is selected from bright sources. The photon-index distribution of low-luminosity AGN is scattered over a wide range, $\Gamma = 1$–2, while that of high-luminosity AGN is not as broad. We have no data for low-luminosity AGN on account of selection effects. Therefore, if low-luminosity AGN with flat spectra are numerous at high z, they might contribute significantly to the CXB.

3. Conclusion

Considering that from the $\log N$–$\log S$ plot obtained by *ROSAT*, AGN contribute for at least about 60% of the CXB energy flux (Hasinger et al. 1993), some categories of AGN with weak X-ray fluxes can be the main contributors to the CXB. Somehow, low-luminosity AGN with a plausible average luminosity of the order of 10^{43} ergs s^{-1} could be the major candidates of the CXB component. These AGN may not be necessarily described in the unified picture or may not have a canonical index.

References

Cappi, M., et al. 1996a, ApJ, 458, 149.
Cappi, M., et al. 1996b, ApJ, 456, 141.
Cappi, M., et al. 1996c, ApJ, submitted.
Comastri, A., et al. 1995, AA, 296, 1.
Fabian, A. C., et al. 1994, PASJ, 46, L59.
Hasinger, G., et al. 1993, AA, 275, 1.
Leighly, K. M., et al. 1996, ApJ, in press.
Mathur, S., et al. 1995, ApJL, 455, L9.
Morisawa, K., et al. 1990, AA, 236, 299.
Ohta, K., et al. 1996, ApJL, 458, L57.
Otani, C., 1995, Ph.D. Thesis, University of Tokyo.
Tanaka, Y., et al. 1995, Nature, 375, 659.
Wang, T., et al. 1996, MNRAS, submitted.
Weaver, K., et al. 1994, ApJL, 346, L27.