Nuclear X-ray sources in nearby galaxies

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1. Introduction and methodology

The "search for dwarf Seyfert nuclei" of Ho *et al.* (1995; 1997) has resulted in the publication of a statistically complete sample of $\sim$ 470 spectrally classified nearby galaxy nuclei (hereafter referred to as the HFS sample). The demographics of this sample show that 11% of nearby galaxies have a Seyfert-type nucleus, 33% harbour a Low Ionisation Nuclear Emission-line Region (LINER) and 42% have a nucleus characterised by HII emission. The remainder of the galaxies showed no nuclear optical emission lines (NOEL). Here, we present the initial results of an examination of the X-ray properties of the HFS sample. This has been achieved by cross-correlating the HFS sample with the WGACAT (White *et al.* 1994), a catalogue of the soft X-ray sources detected in the pointed observation phase of the *ROSAT* PSPC. Though this catalogue has incomplete sky coverage and a bias towards observations of AGN, the results of the correlation still allow us to discern possible trends in the X-ray properties of the sub-samples and to identify individual sources of potential interest.

We have only considered WGACAT sources within the central 18′ radius of the PSPC detector and observations with at least 8 ks integration time. This reduced catalogue was cross-correlated with the HFS galaxies, and a total of 58 coincidences of an X-ray source within 30″ of a galactic nucleus were found. A further 7 HFS galaxies within PSPC fields were not detected; a 95% upper limit on their nuclear X-ray flux was found by inspection of archival data.

2. Preliminary results

Fig. 1 shows clear trends in the luminosity ranges encompassed by the various HFS sub-samples. This is confirmed in Table 1, which gives the median luminosity for each sub-sample. Clearly, HII galaxies are the X-ray faintest sub-sample, whereas the broad-line nuclei (including both classical Seyferts and LINERs) are the brightest. Hardness ratios were calculated for all the detected sources from the WGACAT data. The 0.1 - 0.4 keV vs 0.4 - 0.9 keV hardness ratio (HR1) shows little distinction between classes, but there is some difference between the 0.4 - 0.9 keV vs 0.9 - 2 keV (HR2) values. The median values of HR2 are equivalent to an unabsorbed power-law continuum with $\Gamma \approx 1.7$ for the broad-line Seyfert/LINERs, and $\Gamma \approx 2.3$ for their narrow-line counterparts. This is consistent with the central regions of the galaxy being unobscured in the case of broad-line nuclei (with the hard X-ray AGN power-law continuum being directly visible). The softer spectra of the narrow-line nuclei may arise from thermal emission or in the reprocessing of the nuclear continuum in material surrounding the galactic nucleus. The NOEL nuclei *are* seen to have X-ray counterparts, which are quite luminous. These nuclei tend to be seen in elliptical host galaxies; thus it may be that the nuclear X-ray source is in fact the peak of bright extended emission from the hot ISM in these galaxies.

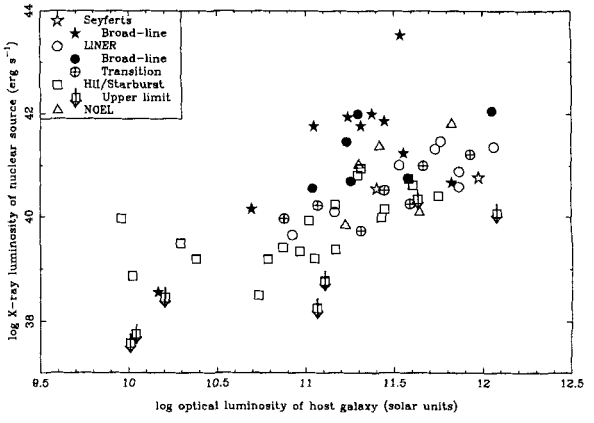

Fig. 1. Host galaxy luminosity plotted against nuclear X-ray source luminosity.

Table 1. Median properties of the spectral sub-samples

Nuclear type	N°.	log L_X	HR1	HR2
Seyfert/LINER				
Broad-line	16	41.6	-0.42	0.21
Narrow-line	10	40.8	-0.52	-0.03
Transition LINER	7	40.3	-0.48	0.04
HII	27	39.4	-0.49	0.07
NOEL	5	41.0	-0.43	-0.04

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