X-RAY SELECTED AGN FROM THE EXTENDED MEDIUM SENSITIVITY SURVEY*

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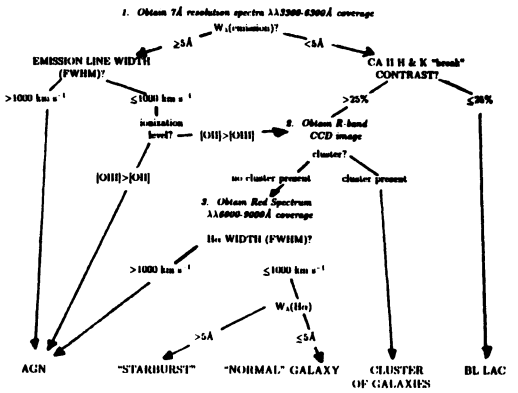
The spectroscopic identification of the Extended Medium Sensitivity Survey (EMSS) sources now provides ~350 X-ray selected QSOs and Seyfert galaxies (AGN in our working definition) and 30 BL Lac objects. Almost all of the AGN are spectroscopically similar to AGN found by other means but a few resemble normal galaxies so closely that they would not be identified as AGN easily by any other method.

The EMSS is a large homogeneous and flux-limited sample of X-ray sources serendipitously discovered in high galactic latitude images taken with the Imaging Proportional Counter on board the Einstein Observatory. The survey covers the flux range $7 \times 10^{-14} - 10^{-11}$ erg cm^{-2} s^{-1}, in the 0.3-3.5 keV band, and a total area of sky of 780^0. A description of the survey and of the selection criteria for the inclusion of IPC images and X-ray sources is given in Gioia et al. (1988). The relevant parameters of the EMSS are given in Table 1. At the time of this writing (July 1988) 693 sources out of 835 have been spectroscopically identified.

Table 1

Einstein Extended Medium Survey	
Sources detected	835
Significance of detection	$\geq 4\sigma$
Total area of sky (sq.deg.)	780
IPC images analyzed	1435
Area for IPC field (sq.deg.)	0.54
Flux range	7×10^{-14} - 10^{-11} erg cm^{-2} s^{-1}
Energy range	0.3 - 3.5 keV
Sources identified (July '88)	693
Sources with radio data	616

OPTICAL SPECTROSCOPY CLASSIFICATION OF X-RAY SOURCES:



To spectroscopically identify the sources, classification spectra of 7Å resolution and a wavelength coverage of 3300-6300Å were obtained. Depending on the equivalent width and ionization level of the emission lines and the CaII H & K "break contrast", where present, each X-ray source has been classified as shown in the flow chart above. R-band CCD images (Whipple 0.61m telescope) help discriminate clusters of galaxies from the AGN. Red spectra (6000-9000Å) are now being obtained to help resolve the 25 odd sources whose nature is ambiguous based upon our identification procedure. These objects are either: (1) Very low luminosity AGN/ "normal" galaxies(?); (2) Very obscured AGN or (3) Very weak-lined AGN or marginal BL Lacs(?).

A photometric classification of the AGN is also possible using the IPC X-ray flux, the optical V magnitude and the 6cm radio flux (Fig. 1). 600 EMSS sources north of -45^0 declination have now been observed with the VLA-C to a 5σ flux limit of 1 mJy. One quarter of the AGN are

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detected at this flux level. By contrast all the BL Lacs (except one) are detected. Fig. 1 shows that for almost all sources this flux limit is sufficient to characterize the AGN as radio loud or quiet and to clearly distinguish the Lacertids. Notice that the Lacertids are contained within a very narrow range in $\alpha_{ro} = 0.3$ to 0.5. Again a few ambiguous cases are present. Table 2 summarizes the classification breakdown of the 82% of the survey now identified.

Table 2

EMSS optical classification
(82% complete)

Total sources	835
Identified	693
Active Galactic Nuclei:	343
Radio loud AGN:	42
Radio quiet AGN:	301
BL Lacs:	32
Clusters of galaxies:	84
Normal galaxies:	16
Stars:	218

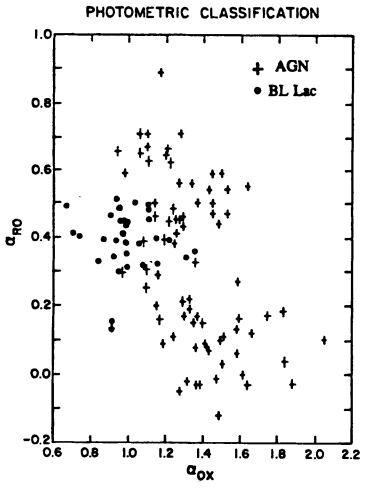

Figure 1. α_{ro} versus α_{ox} for AGN and BL Lacs

The redshift and optical luminosity distributions of EMSS AGN are weighted towards low redshift ($< z >= 0.4$) and low luminosity ($< Mv >= -24$) objects (Gioia and Maccacaro 1983) so that many of the X-ray selected objects come from the boundary region between "classical" quasars and Seyfert galaxies. The X-ray flux distributions of AGN and BL Lacs are significantly different; 70% of the BL Lacs have a flux in excess of 10^{-12} ergs cm^{-2} s^{-1} while only 20% of the AGN do. Even if still incomplete at the low flux end, there is no doubt that the two distributions will remain significantly different.

A study of the X-ray energy distribution (Maccacaro et al. 1988) of AGN and BL Lacs has shown that these objects are characterized, in the 0.3-3.5 keV band, by a variety of spectral indices with an average value for $\alpha_{energy} = 1.0$ and a dispersion of 0.3. Wilkes and Elvis (1987) using a different approach have also found that QSO's show a variety of spectral slopes in the same soft X-ray band. The spectral index derived from the EMSS data is steep, certainly steeper than the canonical value of 0.7 derived for local Seyfert galaxies in the 2-10 keV band (e.g. Mushotzky 1984).

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