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X-RAYS AND INFRARED SELECTED AGN

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RESUMEN. En la búsqueda de núcleos activos galácticos (NAG) oscurecidos, seleccionamos una muestra de galaxias emisoras de rayos S infrarrojos, la mayoría de las cuales son vistas de perfil. La espectroscopía óptica de la región nuclear de las galaxias seleccionadas revelan que el 76% de ellas muestran líneas de emisión. La clasificación de los espectros de acuerdo a los anchos y a la intensidad de cocientes de líneas muestran que existen 34 NAG, 34 objetos de tipo de transición y 34 galaxias de la región con núcleos de tipo región H II. Entre los NAG, 3 son del tipo Seyfert I y las otras son del tipo 2. Sugerimos que los objetos identificados como NAG de líneas angostas son objetos tipo Seyfert I oscurecidos.

ABSTRACT. Looking for obscured active galactic nuclei (AGN), we selected a sample of infrared/X-rays emitting galaxies, most of which are seen as edge-on. Optical spectroscopy of the nuclear region of the selected galaxies revealed that 76 % of them show emission lines. Classification of the spectra according to the widths and line intensity ratios shows that there are 34 AGN, 34 transition type objects and 43 nuclear HII-like region galaxies. Among the AGN, three are Seyfert type 1 and the others are type 2 objects. We suggest that the objects identified as narrow line AGN are obscured Seyfert 1.

Key words: GALAXIES-ACTIVE — X-RAYS-GENERAL

I. INTRODUCTION

The majority of the known Seyfert Galaxies (SGs) were discovered throught optical surveys. Keel (1980) showed that there is a paucity of edge-on galaxies among the Seyferts. A plausible explanation is that optical radiation coming from the active nucleus is absorbed in the galactic plane of a galaxy seen as edge-on. The distribution of axial ratio for a large sample of SGs shows that edge-on objects of both classes, Sy 1 and Sy2, are missing (Kirhakos and Steiner 1989a); that indicates that both BLR and NLR are affected by obscuration.

To find the missing edge-on SGs, we propose to search for hard X-rays and/or infrared emission, because photons from these wavelengths are not absorbed. We applied the following criteria: to select IRAS galaxies from "Cataloged Galaxies and QSOs observed with IRAS survey" (Lonsdale et al. 1985) that lie inside/close to the error boxes of hard X-rays sources **not optically identified** yet (HEAO-1; Wood et al. 1984). This way, 144 IRAS galaxies were selected.

We measured the axial ratio for the X-ray/infrared selected sample from the Palomar/ESO photographic plates. As a comparison sample, 260 infrared emitting galaxies were

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randomly selected from Lonsdale et al. (1985). From the distribution of axial ratio, showed in Figure 1, is clear an excess of edge-on objects in the selected sample. If we assume that the part of the histogram with b/a > 0.5 is similar to the control sample, we can estimate that at least 30 IRAS galaxies are associated to the HEAO-1 sources.

II. OPTICAL SPECTROSCOPY

Spectrophotometric observations were obtained at the 1m telescope of the Cerro Tololo Interamerican Observatory with the Cassegrain spectrograph and two-dimensional photon counting detector (2D-Frutti). The observed wavelength was 3900 A to 7000 A with a spectral resolution of ~ 5 A (see Kirhakos and Steiner 1989b for more details).

Classification of the nuclear spectra was done using widths and relative intensity of the emission lines, according to the criterion:

Active Galactic Nuclei (AGN):
[NII] λ6584/Hα $\geq$ 1.0 and/or
FWHM ([OIII] λ5007, Hα) $\geq$ 300 km s^{-1}

Transition objects (Trans):
0.6 $\leq$ [NII]/Hα < 1.0 and/or
200 $\leq$ FWHM ([OIII], Hα) < 300 km s^{-1}

Nuclear HII regions (HII):
[NII]/Hα < 0.6 and
FWHM ([OIII], Hα) < 200 km s^{-1}

According to this classification scheme there are 34 AGN, 34 transition objects and 43 HII region-like galaxies. Among the AGN, there are three Seyfert type 1 and 31 narrow emission line galaxies.

Diagrams of log N x log F_{Hx} for Sy 1 and Sy 2 identified as hard X-rays sources are shown in Figure 2. Hard X-ray fluxes F_{Hx} (2 - 10 keV) were obtained from Wood et al.

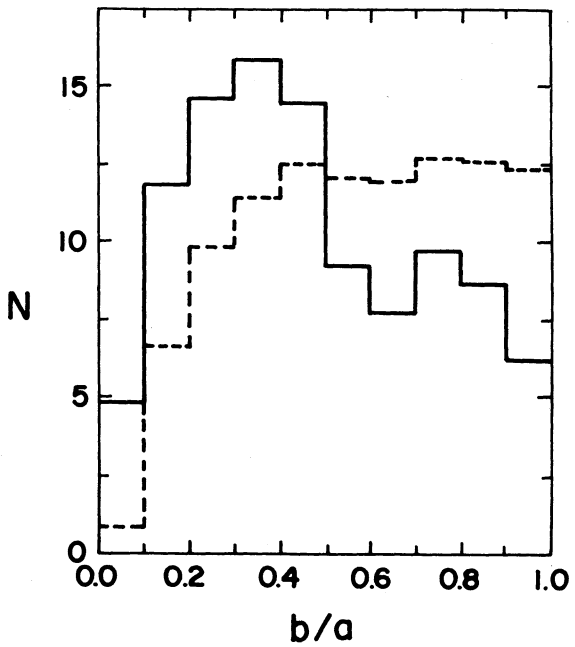

Fig. 1. Distribution of axial ratios for the IRAS target galaxies (solid line) and the control sample (dashed line). A triangular filter was applied to the distribution and the distributions and the control sample was normalized to the total number of target galaxies.

(1984). In this figure, a large incompletenes of Sy 2 is seen. Including the newly identified AGN, as showed in Figure 3, we see that te sample of the X-ray emitting Seyfert 2 galaxies is fairly complete till a flux limit of log $F_{Hx} \sim -10.8$.

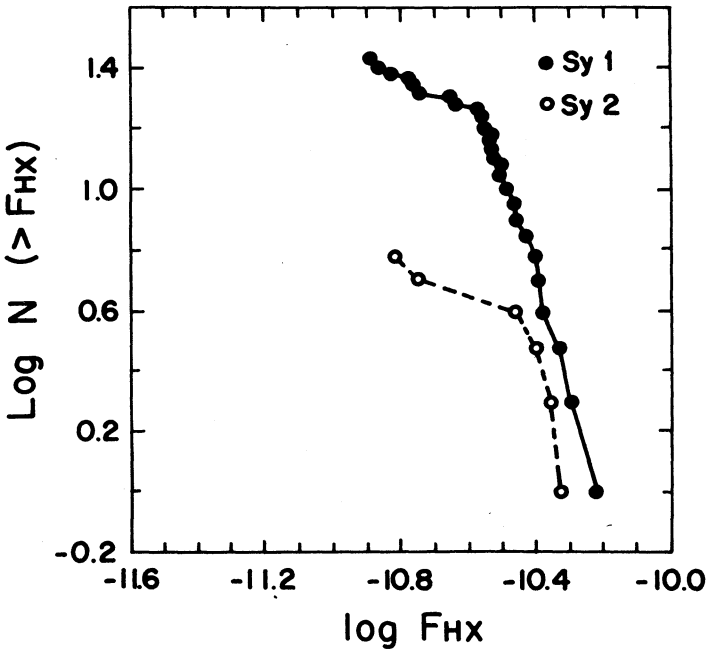

Fig. 2. The log N - log F_{Hx} distribution for Sy 1 and Sy 2 identified as HEAO-1 sources. The units of flux are erg cm^{-2} s^{-1}.

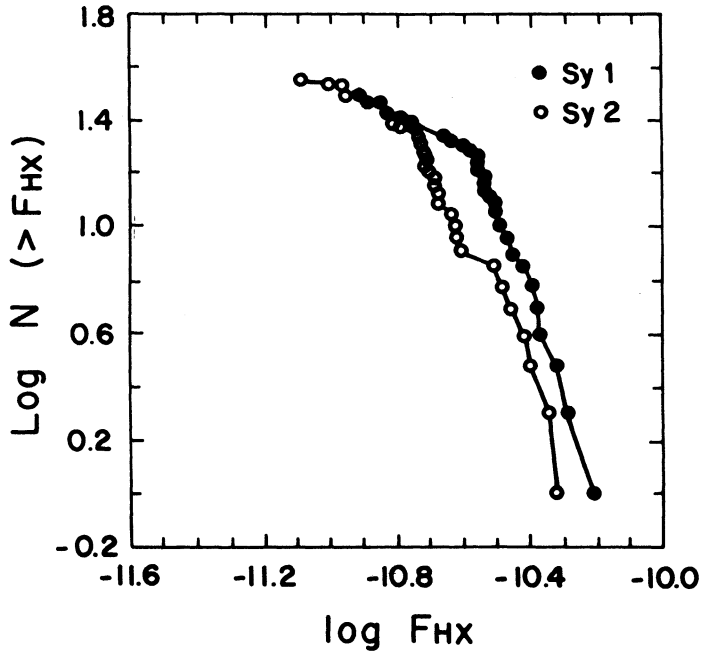

Fig. 3. The same as in figure 2, with the newly identified AGN included.

III. CONCLUSION

The majority of the newly identified AGN are of type 2. There are three possible explanations:

a) previous surveys have recognized more Sy 1 than Sy 2, because their broad emission lines are easy to identify, as is the strong ultraviolet excess.

b) the probability of obscuration is higher in galaxies with lots of dust and the chance for them to appear as Sy 2 is also larger.

c) our criteria do not select the luminous Sy 1 galaxies at large distances, appearing as stellar objects.

X-ray emitting narrow line AGN are a commom class of objects. We interpret these galaxies as being obscured Seyfert 1, as suggested by others (Mushotzky 1982, Lawrence and Elvis 1982, Stephens 1989). The fact that the newly identified AGN tend to be seen as edge-on might imply that the obscuring material is aligned with the disk of the parent galaxy.

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