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OPTICAL VARIABILITY OF INFRARED POWER LAW-SELECTED GALAXIES & X-RAY SOURCES IN THE GOODS-SOUTH FIELD

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We investigate the use of optical variability over 6 months to identify AGNs in the GOODS-South field. Photometry was performed on a sample of 24 infrared power law-selected AGN candidates and 104 X-ray sources with optical counterparts. We find that while the majority of variable objects are unobscured AGN, 30% of IR-only selected candidates show evidence of AGN via optical variability.

Galaxies were chosen from two catalogs. The first is a sample of IR-selected AGN candidates from Alonso-Herrero et al. (2006) with optical counterparts in the GOODS-South field, selected using Spitzer/MIPS 24 μm observations and are well-fit with a power law spectral energy distribution (SED) through the Spitzer IRAC bands from 3.6 to 8 μm. The second sample consists of X-ray sources compiled by Alexander et al. (2003) of the Chandra Deep Field South, which overlaps GOODS-South.

To quantify optical variation and pick out the galaxies varying significantly above the photometric error, we calculated the mean magnitude, the standard deviation of the mean, and an error on the standard deviation using the following formula:

$$error_\sigma = \sqrt{\frac{\Sigma(error_{mag})^2}{N}} \quad (1)$$

where error$_\sigma$ is the error bar on the standard deviation, error$_{mag}$ is the individual magnitude measurement error of a galaxy in each epoch, and N is the total number of measurements (in this case N=5, for 5 epochs). We determined the "significance" of each object's variability as simply the standard deviation, σ, divided by error$_\sigma$.

We find that 34% of pre-selected AGN candidates using multiwavelength data are optically variable (significance greater than 3 - see Figure 1). Specifically, 30% of IR-only sources, 26% of X-ray-only sources, and 64% of those in both catalogs are variable. The most variable sources appear to be AGN with little obscuration, most of which have BLAGN-like IR SEDs and are both X-ray and IR-selected sources. Several others are optical variables detected only in X-rays. These are unobscured AGN with negligible amounts of dust near the ionizing source, resulting in very little or no reprocessed light.

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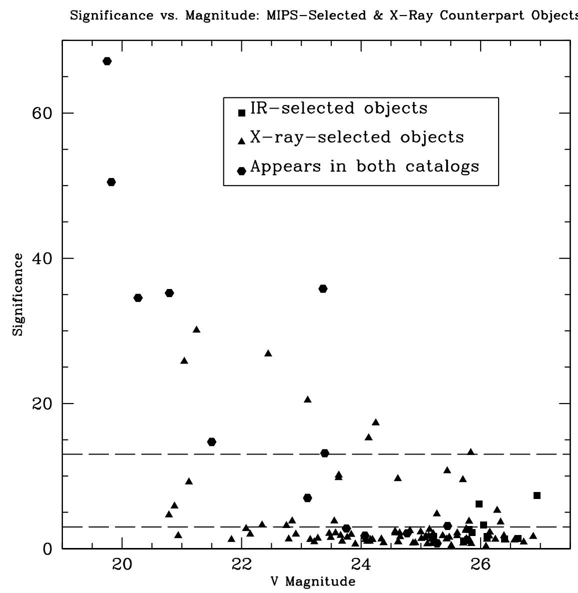

Fig. 1. Optical variability significance vs. nuclear V magnitude for all objects in this study. Triangles are objects detected only in X-rays, squares are objects selected via IR power law behavior, and hexagons are objects that appear in both catalogs. The dashed lines delineate sources that are not varying (significance values 0 to 3), are marginally varying (3 to 13), or are clearly varying in the optical (more than 13).

These findings are consistent with the expectation that optical variability selects primarily Type 1, relatively unobscured AGN. However, three IR-selected objects without X-ray counterparts have been identified with marginal optical variability. Such objects may be heavily obscured AGN, whose X-rays are mainly blocked by dust which re-emits the light at longer wavelengths.

REFERENCES

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