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X-ray and Optical Identification and Characterization of AGN Candidates in Low-Stellar-Mass Galaxies Selected by Variability

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The origins of supermassive black holes (SMBHs) at the centers of massive galaxies are a topic of intense investigation. One way to address this subject is to identify the seeds of SMBH as intermediate-mass black holes (IMBHs; $100 M_{\odot} < M_{BH} < 10^6 M_{\odot}$). Given the observed relationship between the mass of a black hole and the mass of its host galaxy, IMBHs are expected to be found at the centers of low-stellar-mass galaxies. To this end, we used a random forest algorithms to classify all objects in a large portion of the sky, using optical light curves obtained or built from images provided by the Zwicky Transient Facility (ZTF). The AGN candidates selected through this method were cross-matched with objects in the NASA-Sloan Atlas (NSA) of local galaxies, selecting those with $M_* < 2 \times 10^{10} M_{\odot}$ and z< 0.15. We obtained a sample of 506 candidates AGN candidates in low mass galaxies.

From these candidates, we found 415 good archival optical spectra from the SDSS. We performed spectral fitting to verify the AGN nature and characterize the candidates, using the broad Hα and Hβ emission lines as probes of AGN activity. As a result, we identified 357 candidates exhibiting significant broad emission lines, and were able to estimate the mass of 355 objects. We found a median mass of $1.1 \times 10^7 M_{\odot}$, with 2% of the objects having a mass lower than $10^6 M_{\odot}$.

We further established the fraction of candidates with detection in the eROSITA Data Release 1 catalog of X-ray sources and studied some of their properties. From the sample of 415 candidates with archival spectra, 195 are in the eROSITA-DE sky, and 130 (67%) have an X-ray counterpart within 10" in the eRASSv1.1 catalog. For these objects, we found that the X-ray luminosity at 0.2-2.3 keV and Hα luminosity follows the same relation previously found with the 2-10 keV band for more massive galaxies (e.g., Ho et al, 2001, ApJ, 549, L51; Panesa et al, 2006, A and A, 455, 173).

We conclude that the applied methodology is significantly more successful selecting low-stellar mass galaxies with X-ray counterpart when comparing with previous works that use similar data (see Arcodia et al, 2004, A and A, 681, A97). This shows that AGN discoverable by optical variability in low mass galaxies are in fact not significantly X-ray weaker than more massive objects.

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