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Optically Variable AGNs in the 3 yr VST Survey of the COSMOS Field

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Variability characterizes AGNs at all wavelengths, with timescales from minutes to years depending on the observing window.

Variability measurements can contribute in shedding light on the underlying emission mechanism, providing constraints on the size and structure of the emitting region.

The analysis of AGN variability at different wavelengths and the study of possible correlations among different spectral windows is nowadays a major field of inquiry. Optical variability has been extensively used to identify unobscured AGNs in multi-epoch surveys. The strength of a selection method based on optical variability lies in the chance to analyze data from surveys of large sky areas by ground-based telescopes. Plus, variability allows to retrieve those AGNs characterized by low X-ray emission and hence not classified as AGNs on the basis of their X-ray properties; also, it proves effective in unearthing low-luminosity AGNs because of the anti-correlation between AGN luminosity and variability amplitude.

We tested the use of optical variability as a tool to identify AGNs in the VST multi-epoch survey of the COSMOS field, originally tailored to detect supernova events. We pushed towards deeper magnitudes than in past studies and made wide use of ancillary multi-wavelength catalogs in order to confirm the nature of our AGN candidates and constrain the accuracy of the method based on spectroscopic and photometric diagnostics.

The effectiveness of our selection technique against other traditional photometric approaches was already explored in De Cicco+ 2015. Here we confirm that the method allows the selection of high-purity (>80%) samples, and we take advantage of the long observing baseline to achieve great improvement in the completeness of our sample: the extension of the analysis from a five-month to a three-year baseline led to a significant increase in the completeness of the AGN selection with respect to optical/IR/X-ray confirmed samples of AGNs, rising from 15% up to ~50%, with a strong dependence on the source apparent magnitude.

The reliability of our selection technique is of great relevance in the framework of current and planned multi-epoch wide-field surveys (e.g., LSST), which will use variability as one of the main AGN discovery approaches, combining it with complementary selection methods.

We also present our results from the investigation of the dependence of AGN variability on black hole mass and accretion rate, performed by computing the structure function of the X-ray confirmed AGNs in our sample. Our findings support the existence of an anti-correlation with the accretion rate, while no relation with the black hole mass emerges, consistently with other works from the literature.

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