Variability-selected AGNs in the VST Survey of the COSMOS and CDFS Fields

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AIMS AND METHOD

This work is aimed at detecting AGNs in the COSMOS and CDFS fields on the basis of their optical variability, using data from the COSMOS and CDFS extension of the SUDARE supernova survey (P.I. G. Pignata, E. Cappellaro).

We explore the effectiveness of the method against other traditional photometric approaches, taking advantage of the wide field of view of the VLT Survey Telescope (VST).

COSMOS (Fig. 1): 1 sq. deg. area; 27 epochs over a 5 month baseline; 83 AGN candidates; extensive multi-wavelength coverage provided by other COSMOS surveys.

CDFS 1+2 (Fig. 1): 2 sq. deg. area; 27+21 epochs, 5 and 4 month baseline, respectively.

RESULTS

COSMOS: the multi-wavelength dataset allowed to constrain the accuracy of the method based on spectroscopic and photometric diagnostics.

Validated sources: 95%; confirmed AGNs: 67; SNe: 12. 66% of the sources in the sample are validated by means of spectroscopic/SED classification, X/O and color-color diagrams as well (**Figs. 4** and **5**). In the subsample of AGNs with some spectroscopic classification, Type 1 are prevalent (89%) compared to Type 2 AGNs (11%).

94% purity; **15% completeness** (rising to >40% using a >2 yr baseline) with respect to all AGNs in the field identified by means of spectroscopic or X-ray classification (see **Fig. 7**), strongly depending on source type and apparent magnitude.

CDFS: the validation is based on the comparison with optical and IR diagnostics.

Validated sources: 73%; confirmed AGNs: 104; SNe: 9.

65% purity; **22% completeness** with respect to IR selection by Donley et al. (2012), again limited only by the short (5 month) baseline.

Fig. 1: COSMOS and CDFS fields

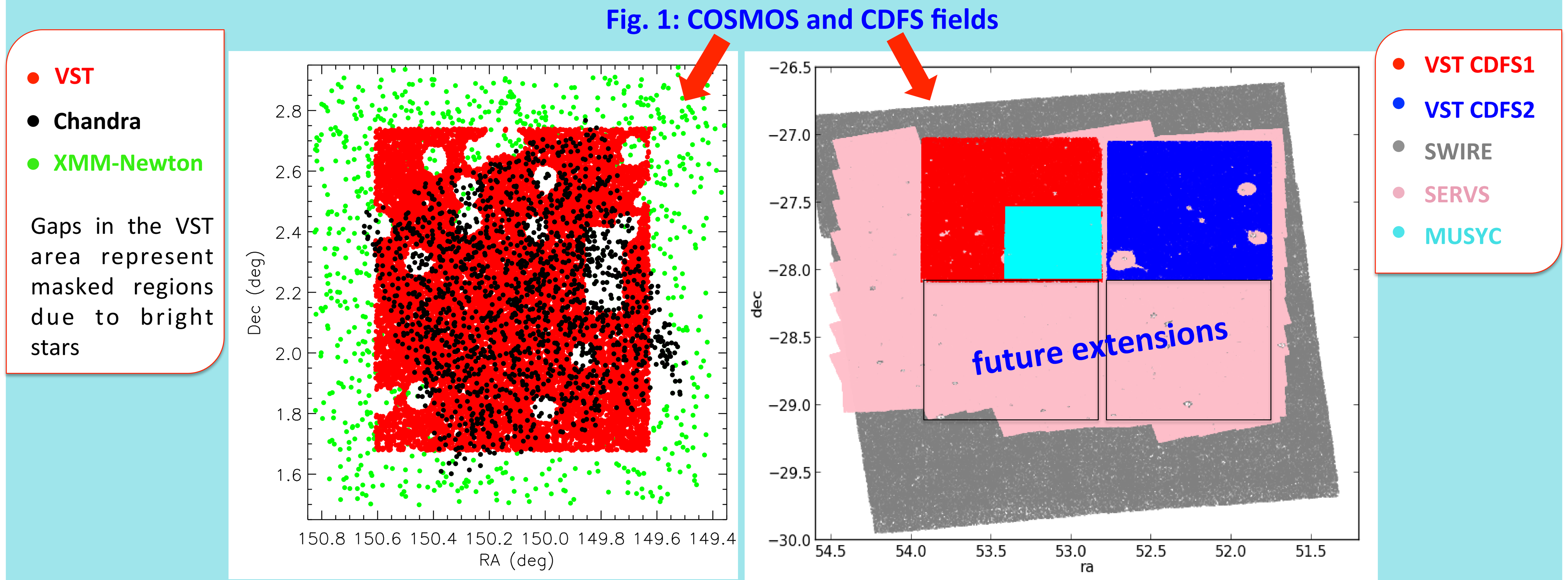


Fig. 2 – variability threshold

From the light-curve of each source we define an average magnitude and the corresponding r.m.s. deviation; the variability threshold is defined as the running average of the r.m.s. deviation plus 3σ.

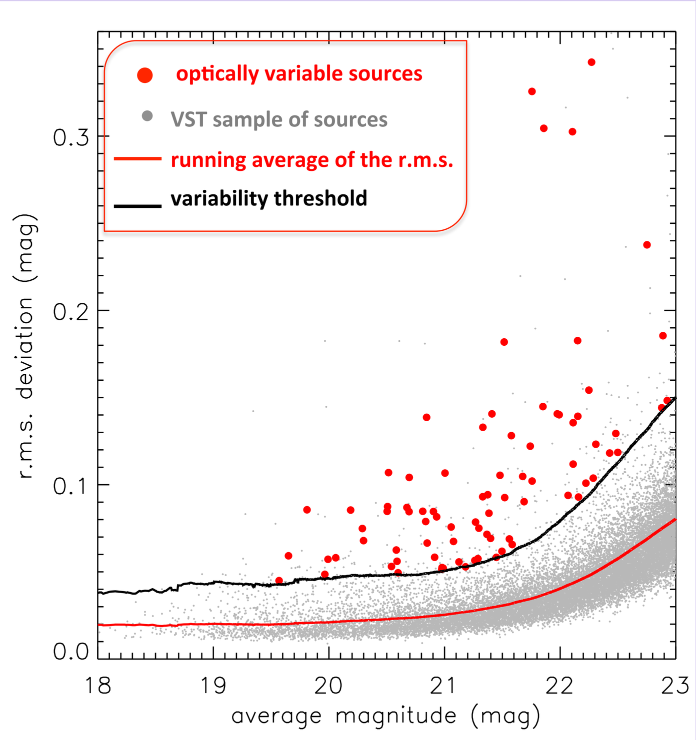


Fig. 3 – examples of light-curves

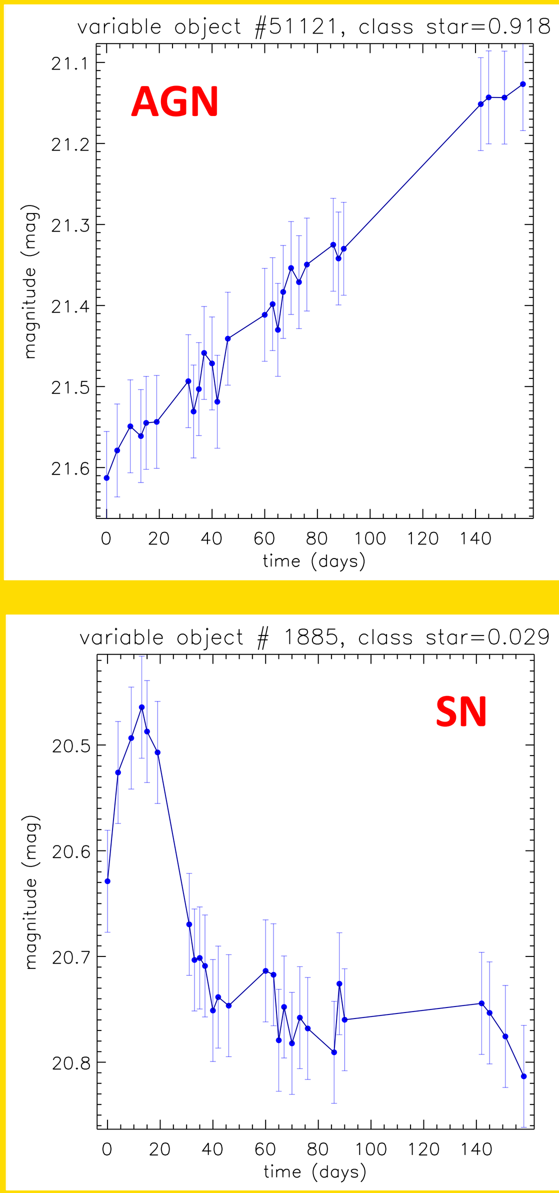


Fig. 4 – X-ray properties

63 out of the 83 COSMOS AGN candidates have an X-ray counterpart. All of them also have an X-ray luinosity $L_X > 10^{42}$ erg/s and an X-ray to optical flux ratio (shown below) -1≤ X/O ≤1: both are typical features of AGNs. 62 out of the 63 sources are spectroscopically classified as Type 1 or Type 2 AGNs.

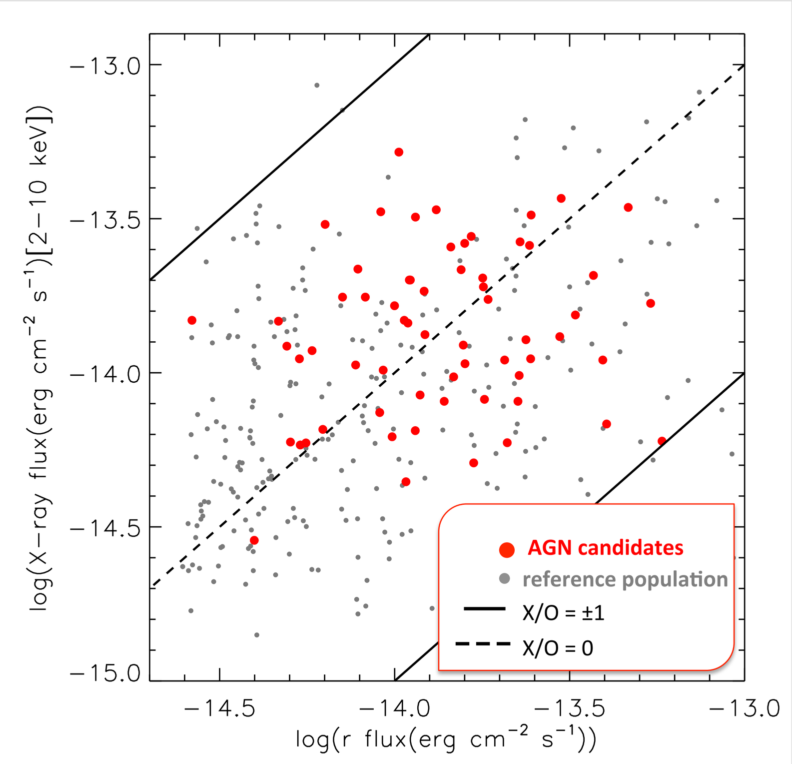


Fig. 5 – optical/IR diagnostic (COSMOS sample)

65% of the optically variable sources are compact but show non-stellar colors, hence they can be classified as QSO's on the basis of their variability, colors and stellarity.

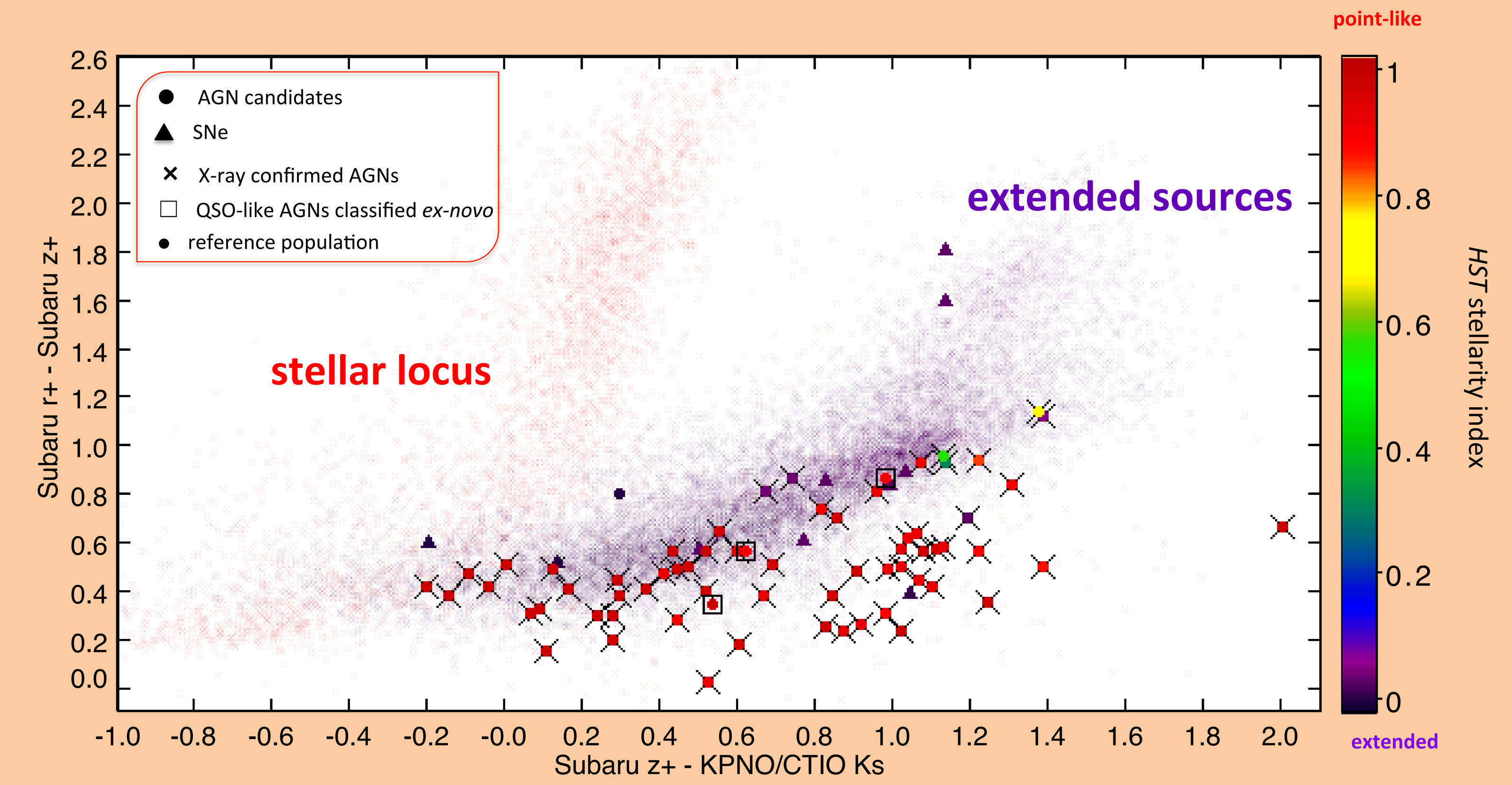


Fig. 6 – IR diagnostic (CDFS sample)

90% of the optically variable sources with a measure of IRAC fluxes match the IR selection criteria (Lacy+ 2004, 2007) and overlap with X-ray-selected subsamples (Donley+, 2012).

stellarity: blue = pointlike, red = extended

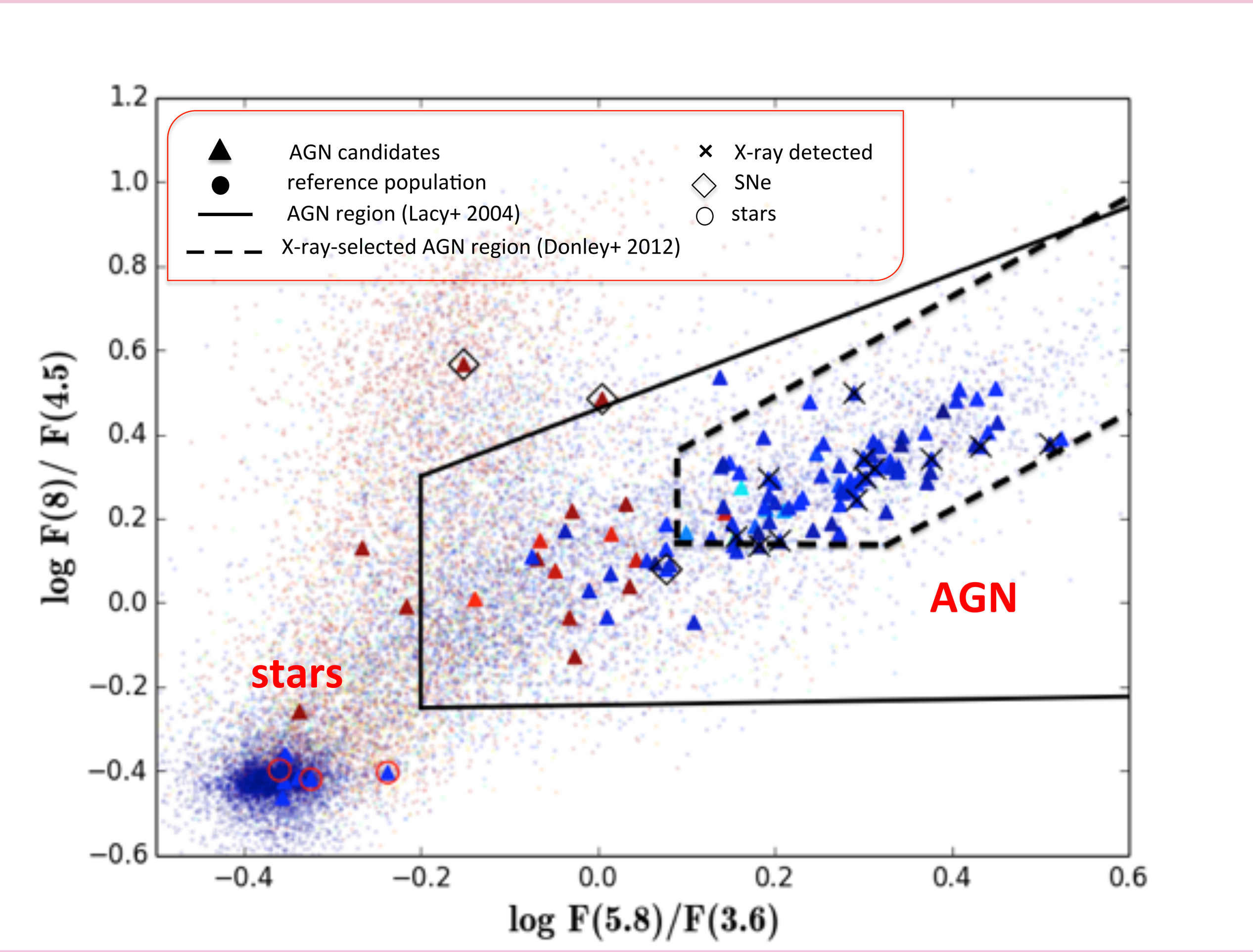
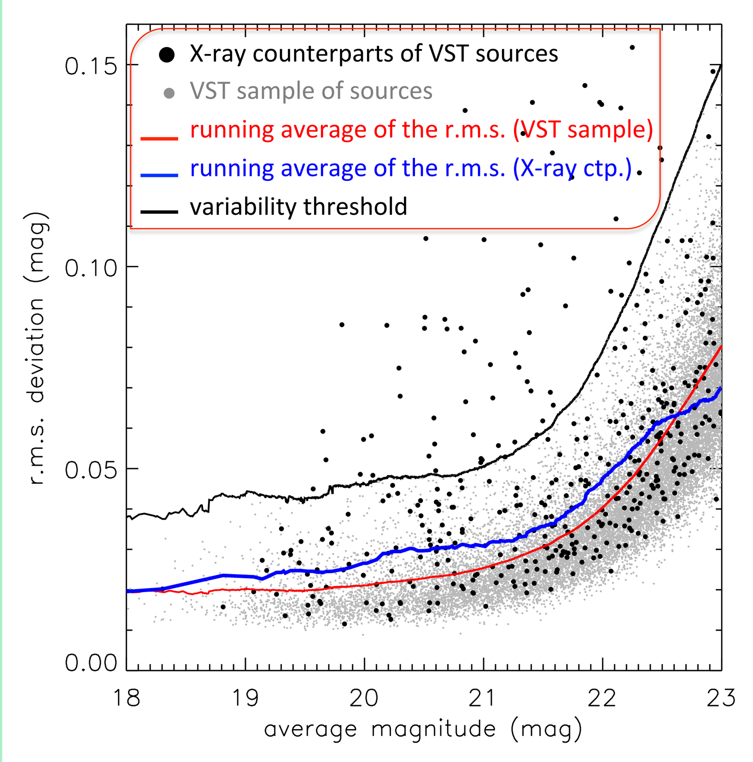


Fig. 7 – optical variability of X-ray counterparts

Same plot as in Fig. 2, for all the X-ray sources with a VST counterpart and that are confirmed AGNs. Although most (85%) of the X-ray sources fall below the variability threshold, they have on average larger r.m.s. than the rest of the population. This indicates that variability detection for most of these objects is prevented only by the photometric accuracy of the data.



CONCLUSIONS

Our results show how the selection of AGN candidates on the basis of their optical variability allows construction of robust AGN samples; this, especially when coupled with a higher photometric accuracy and a longer observing baseline, is encouraging in the framework of current and future wide-field surveys (e.g., DES, LSST), where variability is important both for the discovery and the study of AGNs and other variable sources.

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