



Variability-selected AGNs in the 3 yr Survey of the COSMOS Field by the VST



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AIMS AND METHOD

This work is aimed at detecting AGNs in the COSMOS field on the basis of their optical variability, using data from the SUDARE supernova survey (P.I. G. Pignata, E. Cappellaro) by the VLT Survey Telescope (VST).

The effectiveness of the method against other traditional photometric approaches was already explored in De Cicco+ 2015. Here we take advantage of the long (> 3yr) observing baseline to achieve great improvement in the completeness of our sample and to make use of the structure function of our confirmed AGNs to characterize the sample.

RESULTS

The multiwavelength dataset allowed to constrain the accuracy of the method based on spectroscopic and photometric diagnostics.

Validated sources: 83%; 53% of the sources in the sample are validated by means of spectroscopic/SED classification, X/O, and color-color diagrams as well (Figs. 2 to 4). In the subsample of AGNs with some spectroscopic classification, Type 1 are prevalent (83%) compared to Type 2 AGNs (11%).

>83% purity (some sources still under investigation); **48% completeness** with respect to all AGNs in the field identified by means of spectroscopic or X-ray classification (see Fig. 5); completeness is three times larger than the 15% completeness obtained with a 5 month baseline (De Cicco+ 2015), and is strongly dependent on source type and apparent magnitude.

Fig. 1 – variability threshold

All the sources detected in 20% of the epochs and with < 23 mag constitute our sample.

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 :

$$\sigma - \langle \sigma \rangle \geq 3 \times \text{rms}_{\langle \sigma \rangle}$$

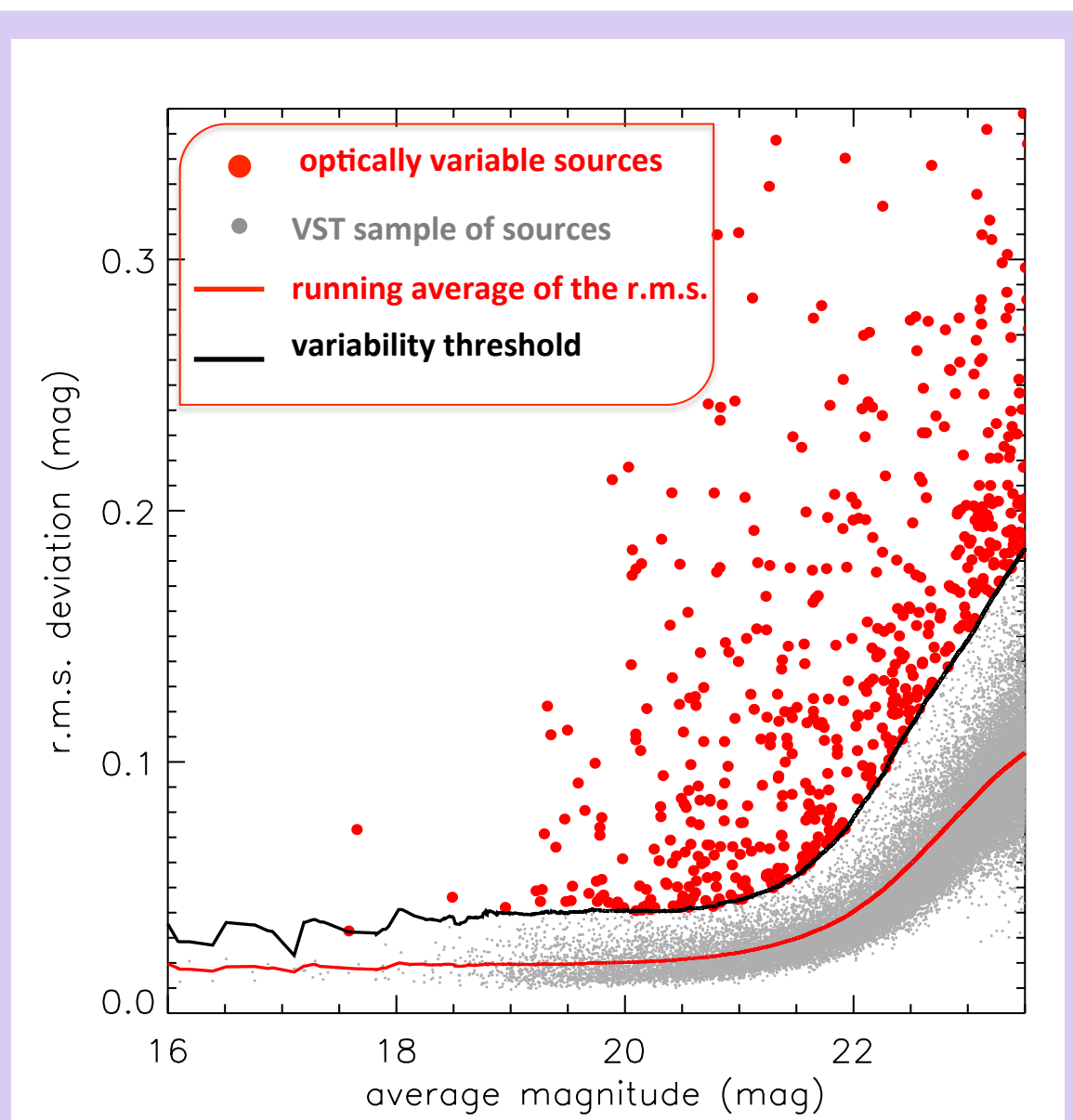


Fig. 2 – X-ray properties

75% of the AGN candidates have an X-ray counterpart. All of them also have an X-ray luminosity $L_X > 10^{42} \text{ erg s}^{-1}$ and all but three have an X-ray to optical flux ratio $-1 \leq X/O \leq 1$: both are typical features of AGNs.

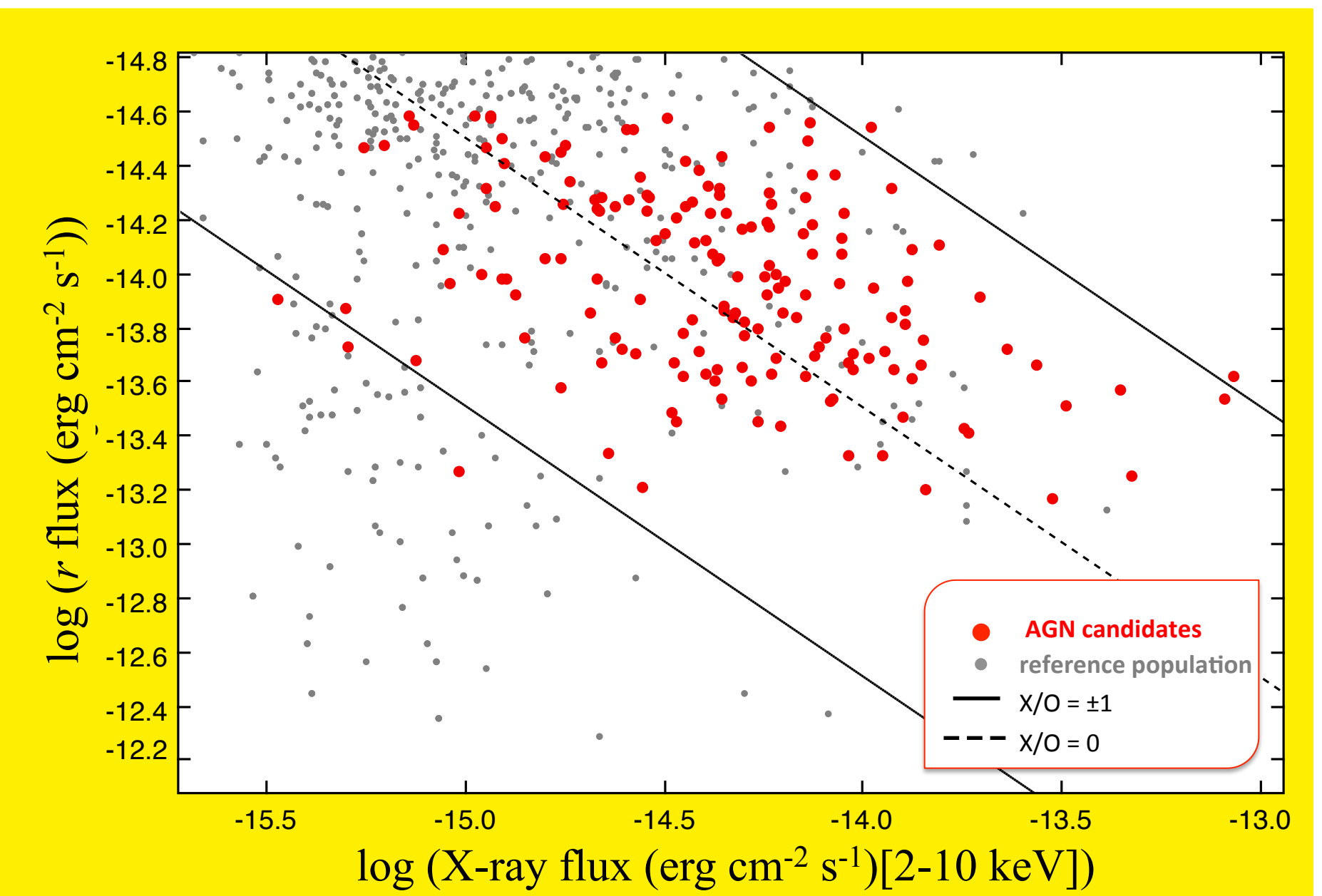


Fig. 3 – optical/IR diagnostic

66% 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.

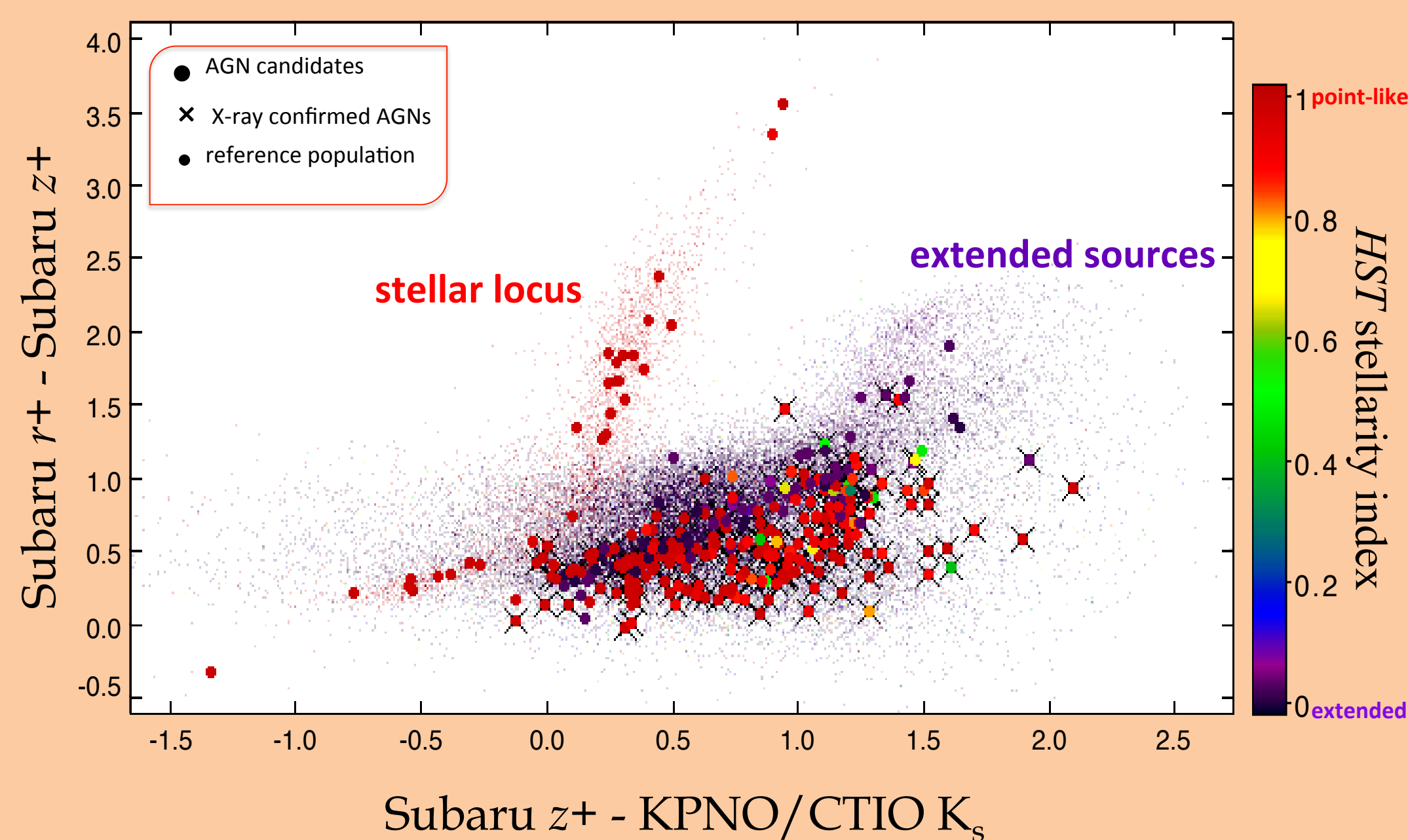


Fig. 4 – IR diagnostic

71% of the optically variable sources with a measure of IRAC fluxes match the IR selection criteria (Lacy+ 2004, 2007) and 34% satisfy the purer selection criteria by Donley+ 2012.

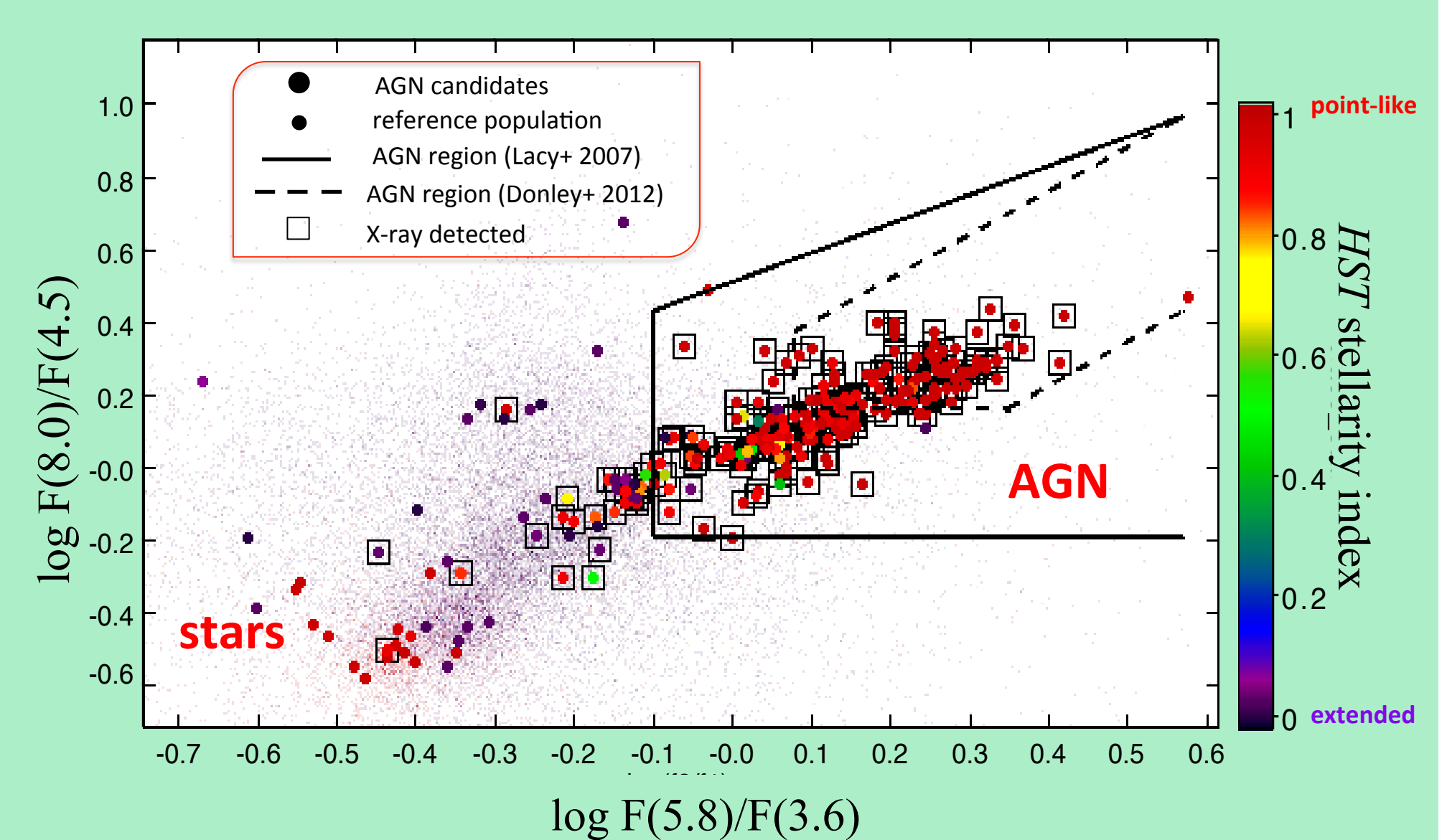


Fig. 5 – optical variability of X-ray counterparts

Same plot as in Fig. 1, for all the X-ray sources with a VST counterpart and that are confirmed AGNs. In De Cicco+ 2015 we showed that (left panel), although 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 the variability detection for most of these objects is prevented only by the photometric accuracy of the data.

A > 3 yr baseline allows to retrieve a three times larger sample of confirmed AGNs, with 48% of them above the variability threshold (right panel).

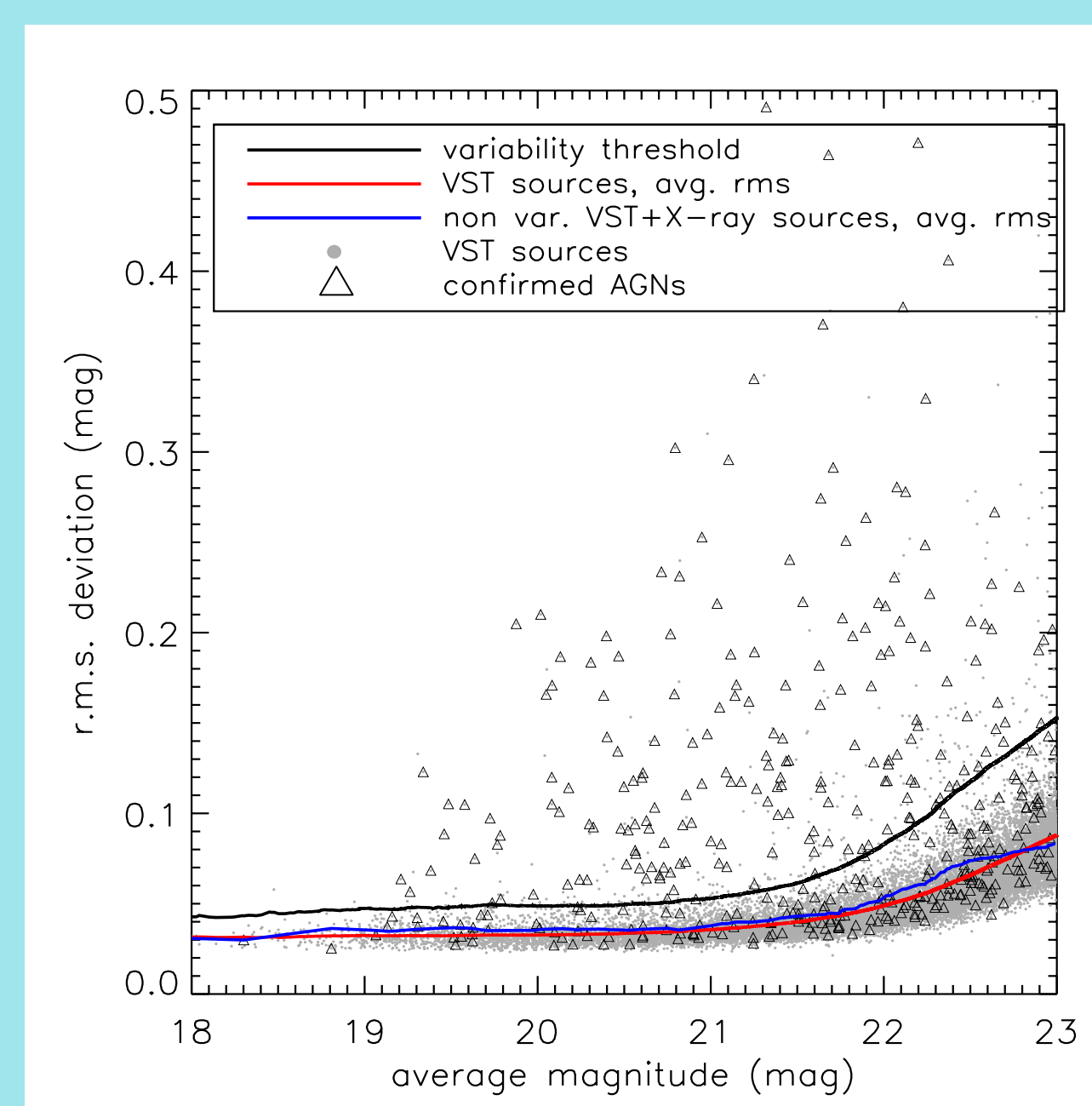
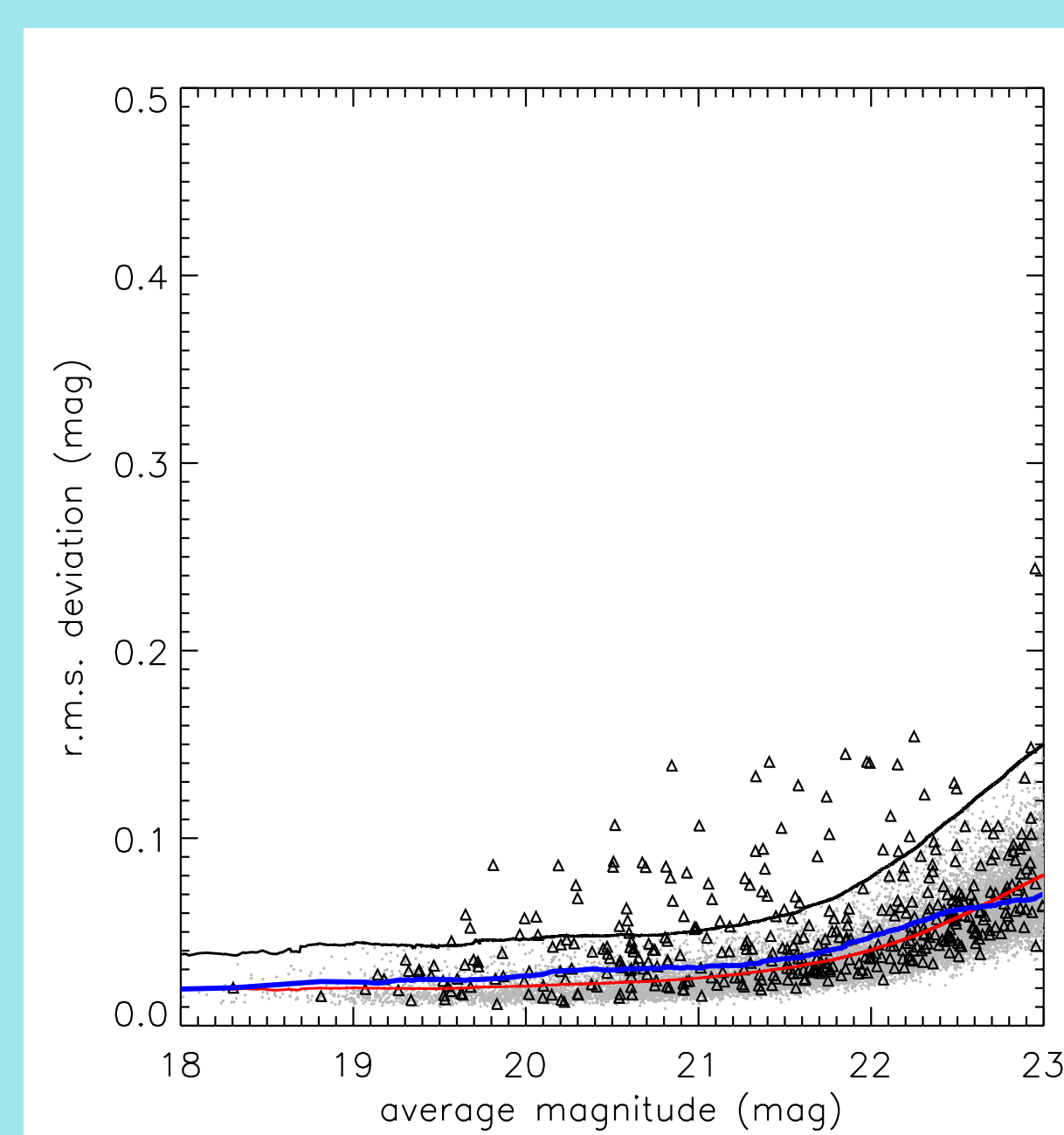
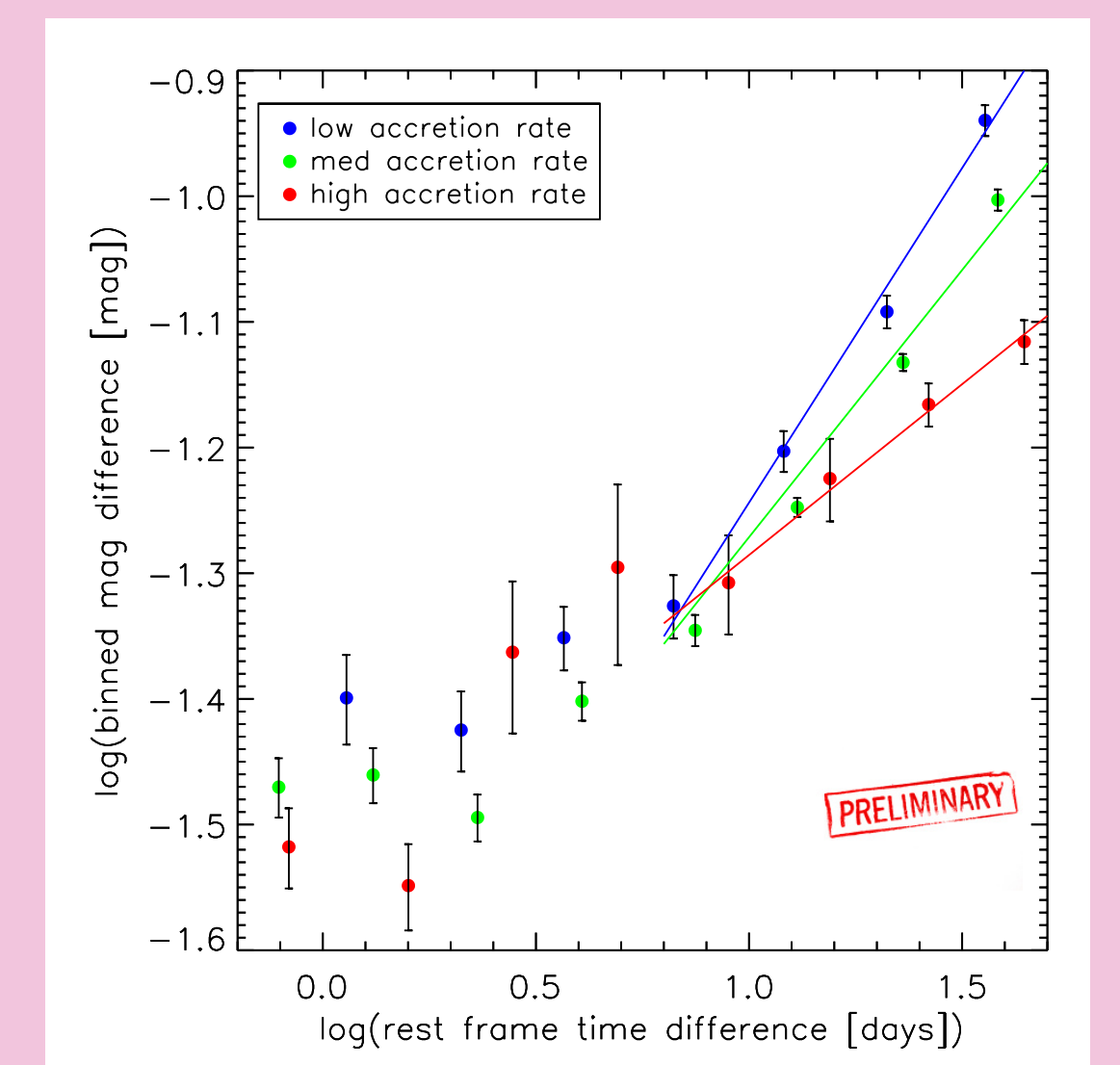
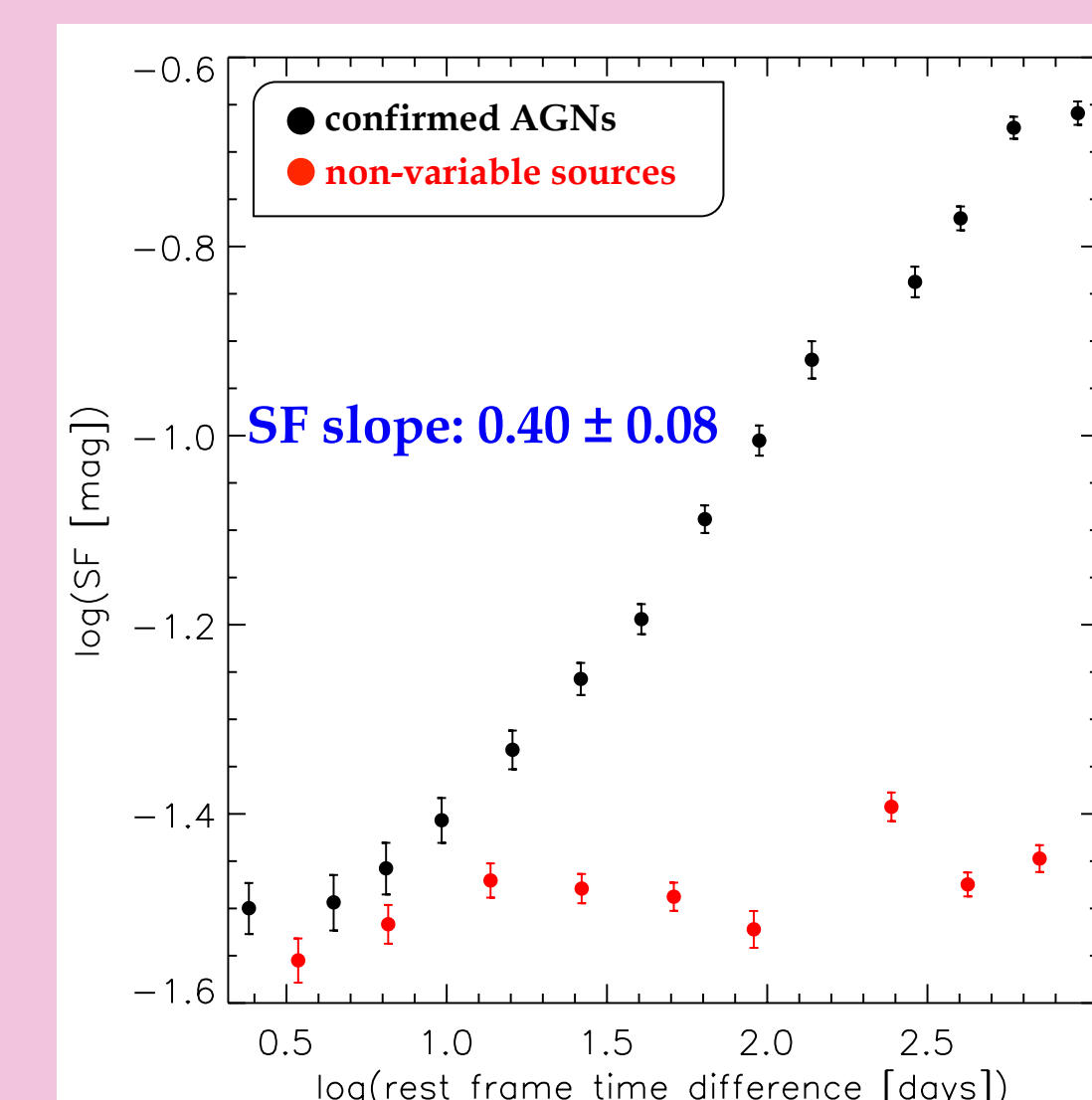


Fig. 6: structure function

The structure function of the confirmed AGNs in different Eddington ratio ranges shows an anti-correlation between variability and accretion rate.



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 high photometric accuracy and a long 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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