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AGN optical variability in the VST surveys of the COSMOS and CDFS areas

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Authors
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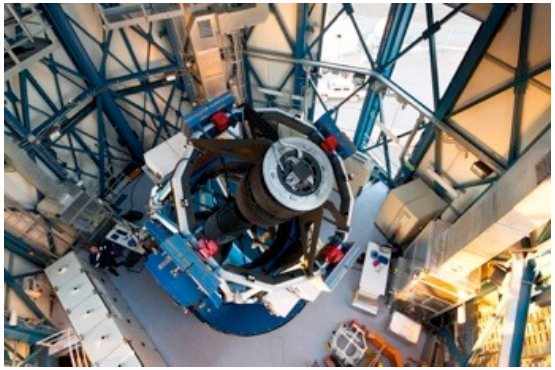
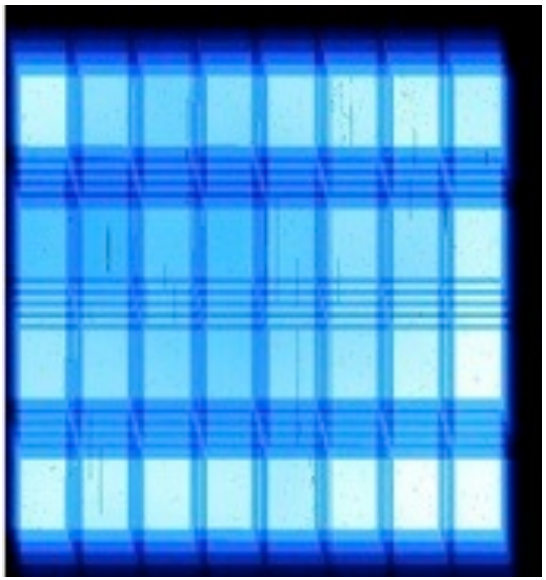
Variability of AGN

All AGN vary in different wavebands: this adds an excellent selection criterium, useful to:

- include highly variable sources in the current AGN census
- extend the demography of faint objects (e.g. Trevese+2008)
- if the sampling time is long enough (years), it is possible to reach a good completeness and low contamination (e.g. Sesar+2007)
- distinguish AGN from other astrophysical sources of similar colors

VST telescope





- VLT Survey Telescope (VST): 2.6 mt, 1 sq deg f.o.v. optical telescope equipped with 32 CCD OmegaCAM detector
- with one pointing it allows to cover entire fields such as COSMOS ($1 deg^2$)
- The dataset is part of: VST SUDARE: SUpernova Diversity And Rate Evolution (SUDARE, PI: E. Cappellaro) survey; VST Optical Imaging of the CDFS and ES1 (VOICE, PI: G. Covone) and the COSMOS extension (PI G. Pignata)
- *r* band every 3 days, *g* and *i* every 10 days for a total of $\sim$30 epochs per field

COSMOS coverage (De Cicco et al. 2014 subm.)

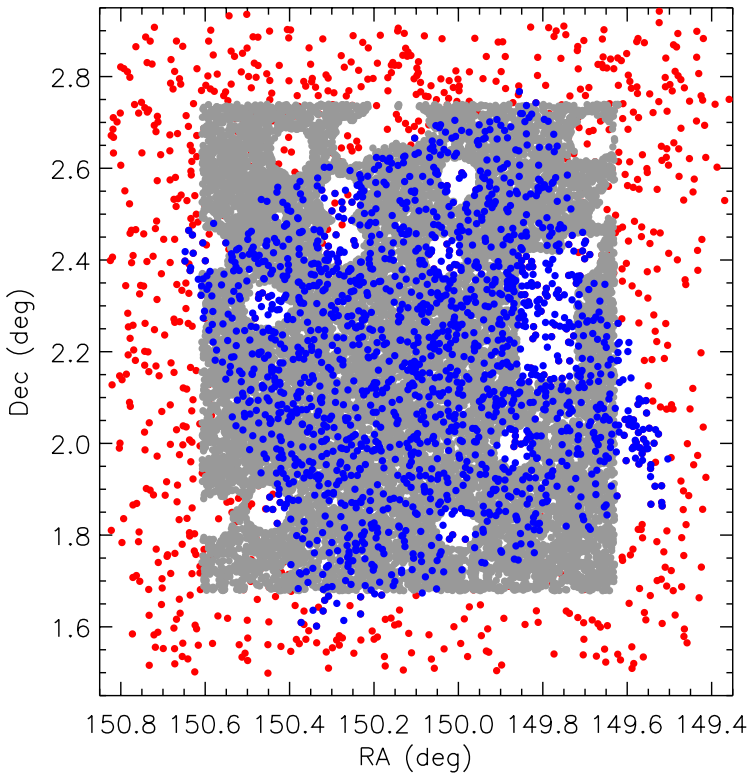


Figure : Complete multi-band coverage. VST (one pointing) Chandra (Civano2012), XMM-Newton (Brusa+2010)

CDFS coverage (Falocco et al. 2014, close to subm.)

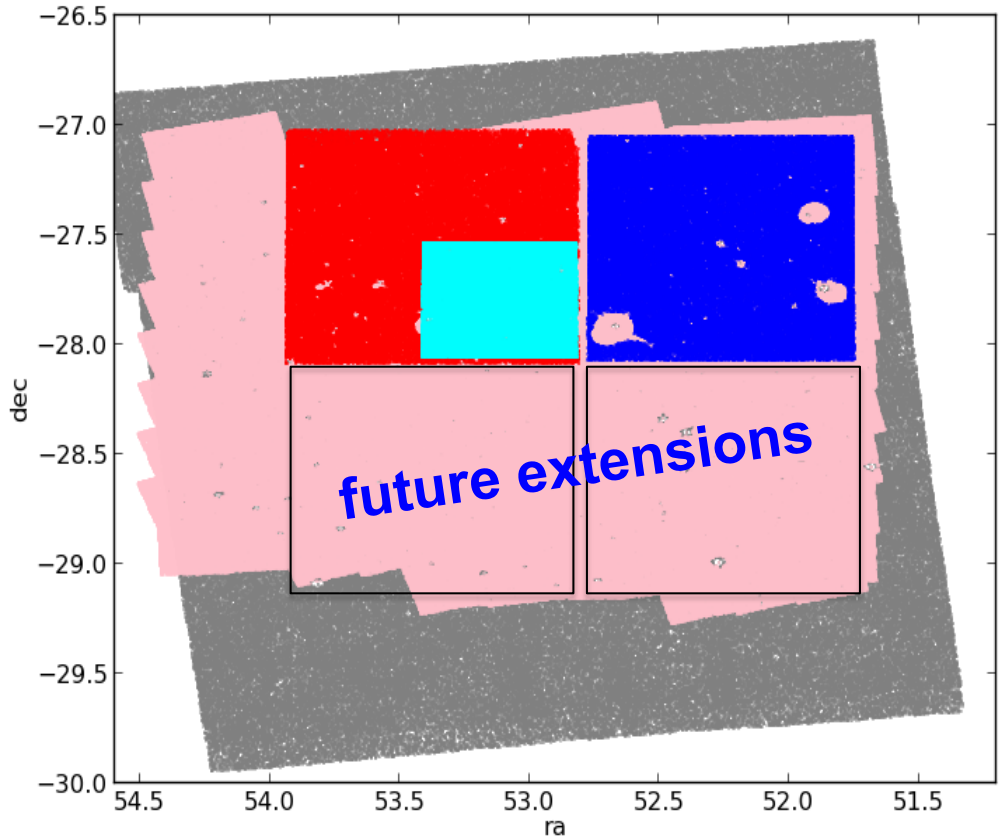
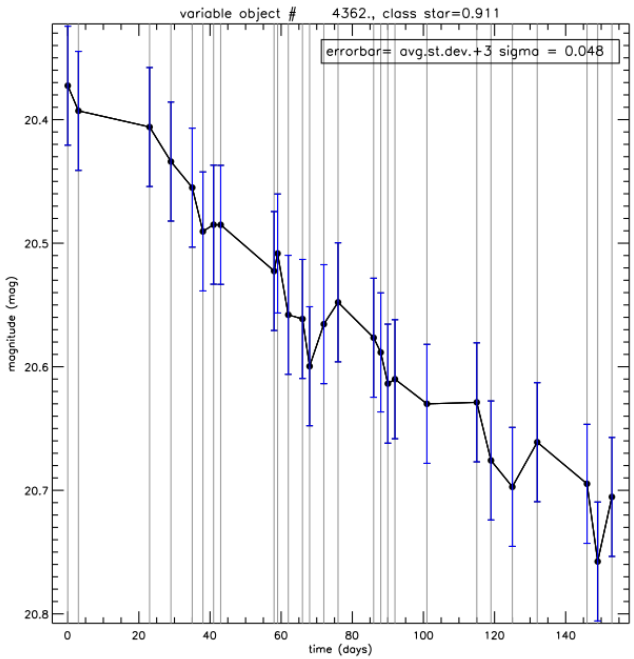


Figure : VST-CDFS1, VST-CDFS2, SWIRE (Londsdale+2004),SERVS (Maduit+2012), ECDFS (Hsu+2014)

Variability selection



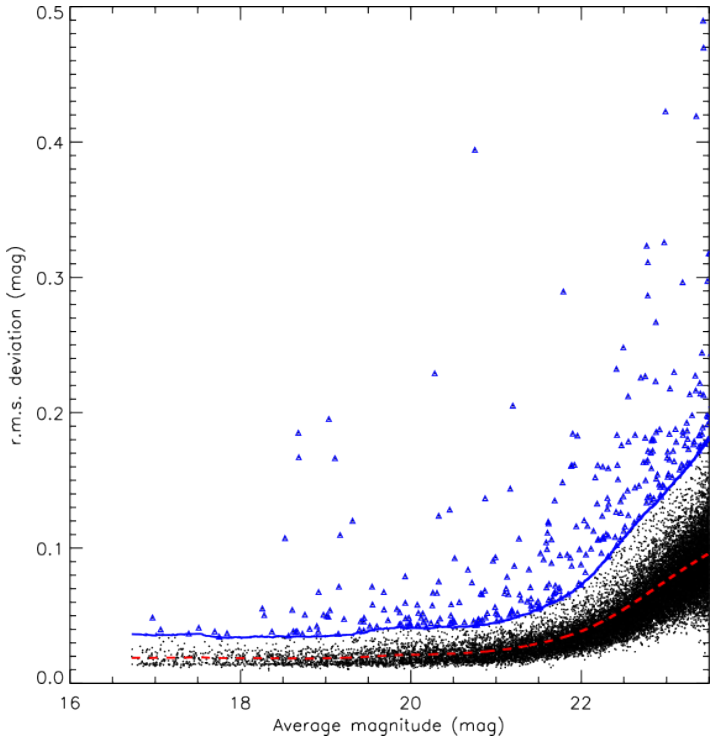


Figure : CDFS2 selection. Faint end: statistical uncertaintes; bright end: systematics

Results

X/O (for COSMOS, De Cicco+2014)

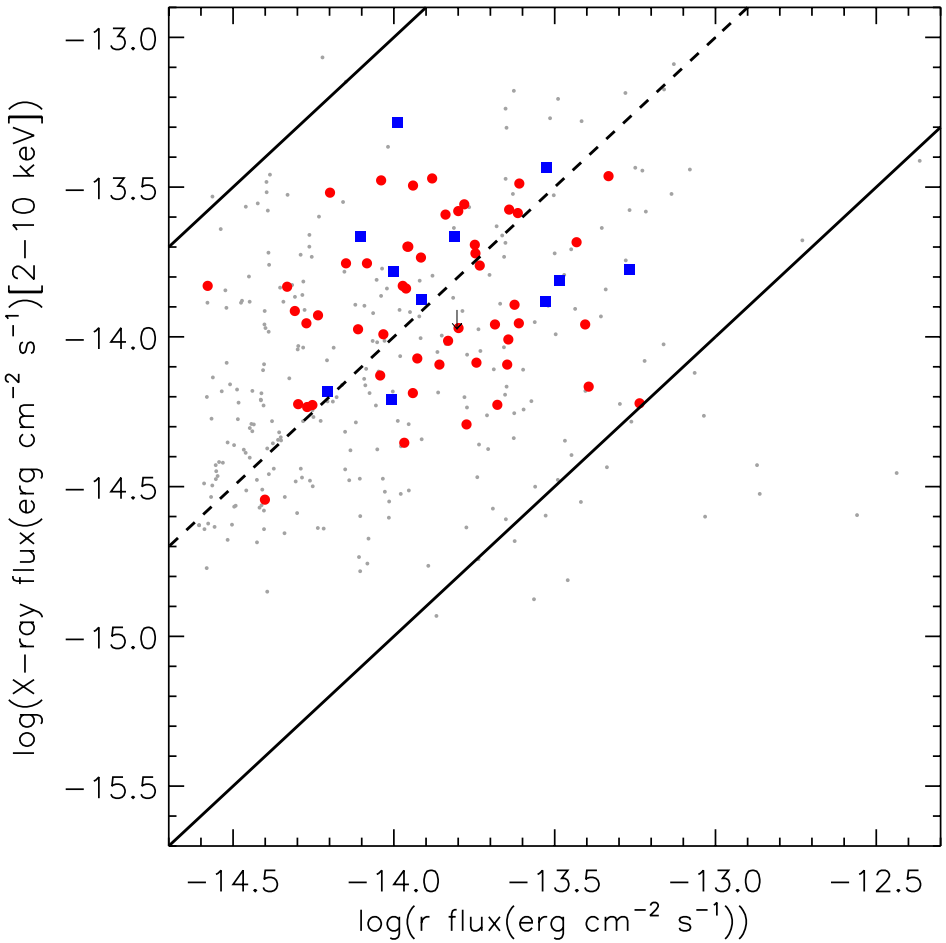


Figure : X/Op. diagnostic (e.g. Mainieri+2002) XMM-Newton, Chandra.

Diagnostic z - k versus r - z (COSMOS, De Cicco+2014)

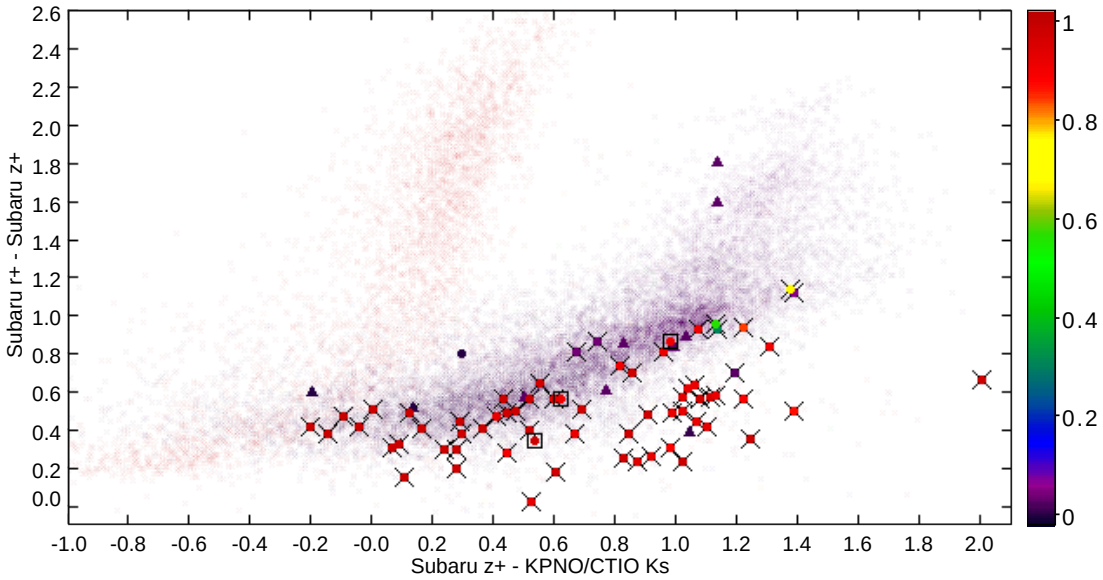


Figure : Cross: AGN; triangles: SN, boxes: new QSOs.

- extended sources; pointlike sources
- small points: VST master catalogue (background population)
- Background population: stars, galaxies and QSOs are visually segregated
- VST variable population: in the QSO region

r.-3.6 versus r-i diagnostic (for the CDFS, Falocco+2014)

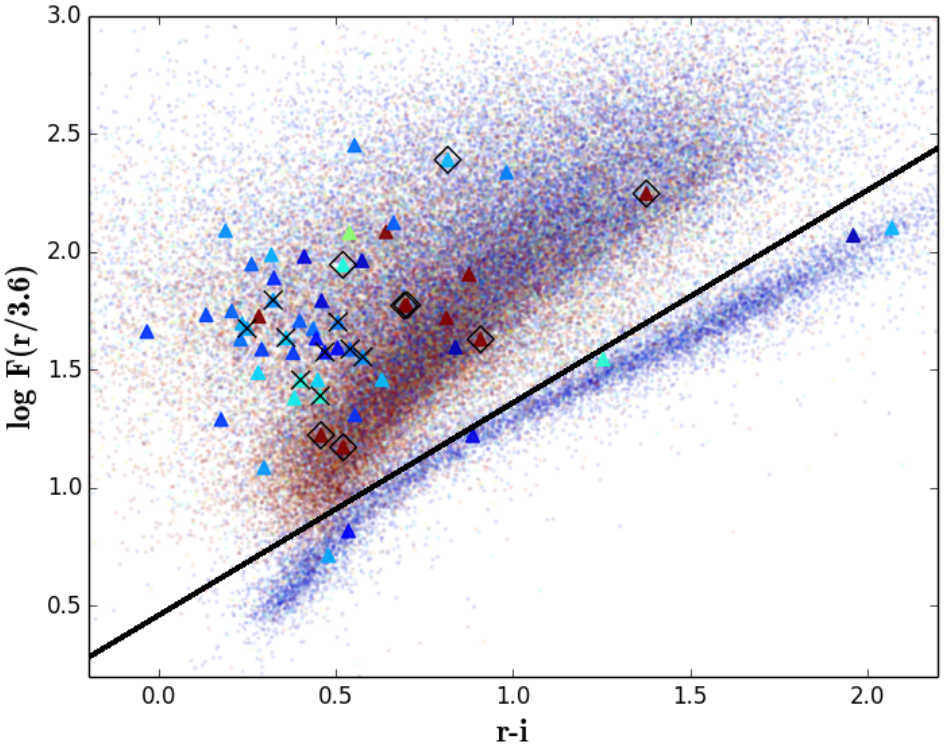


Figure : Diamonds: SN, Crosses: X-ray detected sources (following slides)

- pointlike sources; extended sources
- small points: SERVS+SWIRE. Bigger symbols: VST variable objects
- Background population: stars, galaxies and QSOs are visually separated
- The majority of the variable sources are in the QSO area
- The power of this plot is to identify stars

IRAC diagnostic (for the CDFS, Falocco+2014)

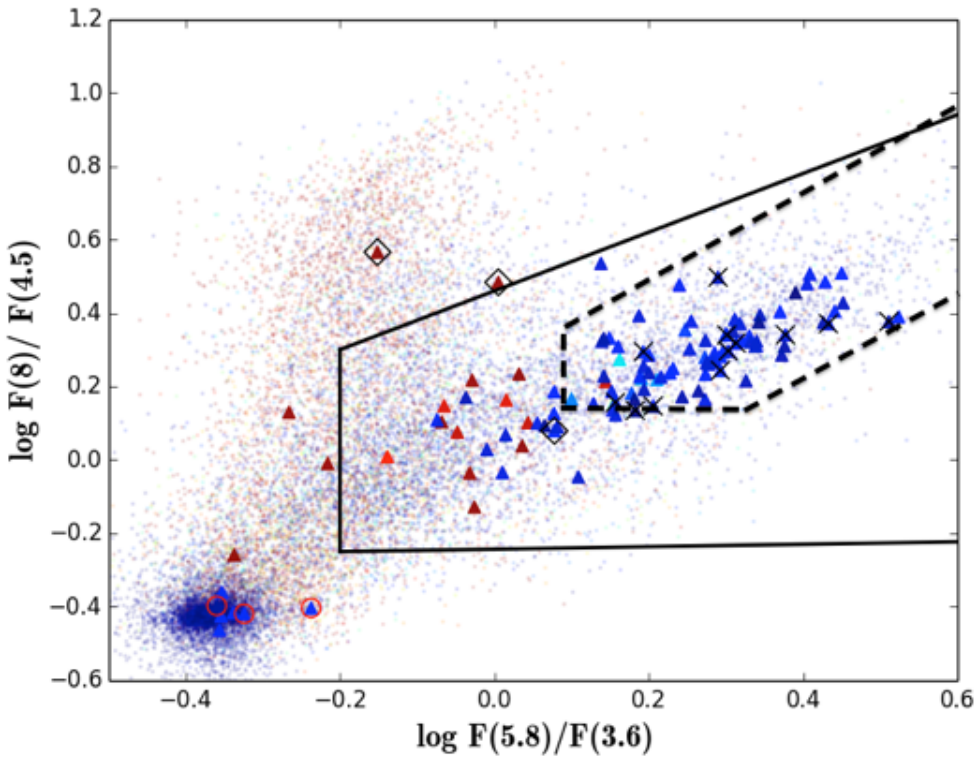
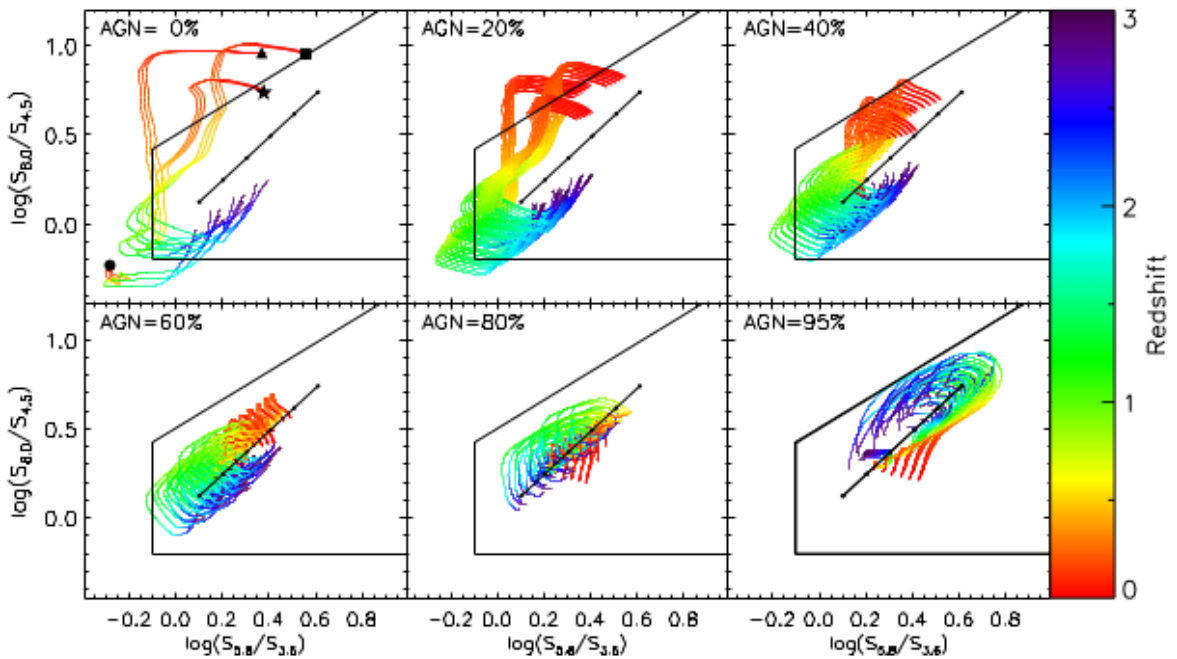


Figure : Diamonds: SN, Crosses: X-ray detected sources (following slides)

- Background population (SERVS+SWIRE): stars, galaxies and QSOs visually separated
- contamination of Starbursts inside the AGN area (solid line)
- X-ray detected sources tipically inside the box of Lacy+2004
- redefined AGN area (dashed line) by Donley+2012:
  - includes most of X-ray sources
  - excludes most of extended sources
- galaxies powered or not by active nuclei (see next slide) are found inside or outside the wedge

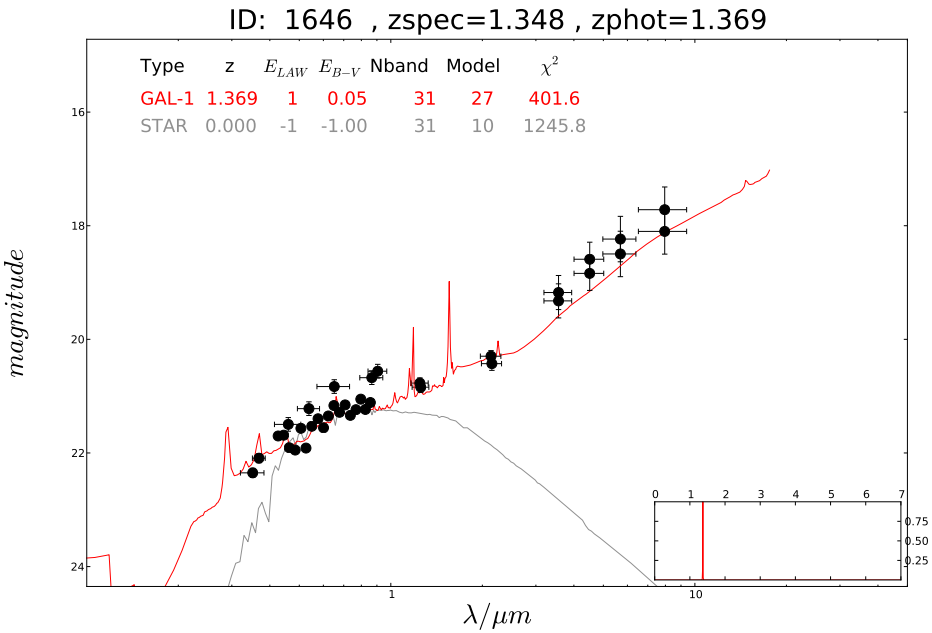
IRAC diagnostic (simulations by Donley+2012)

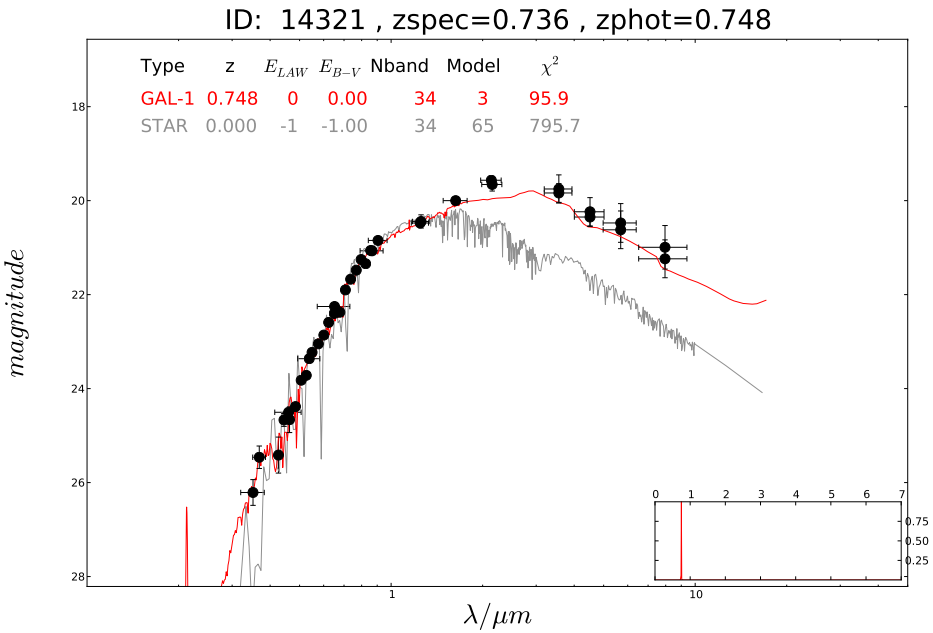


SED and X-ray detections (CDFS, Falocco+2014)

- 15 sources with SED and X-ray information (Hsu et al. 2014)
- 12 have X-ray detections and AGN SED
- 3 not X-ray detected, have galactic SED and SN lightcurves

SED (Hsu, Salvato et al. 2014, subm.)





Confirmation of the variable sources in COSMOS (83) and in CDFS (137)

In COSMOS:

- 80±4% efficiency of detecting AGN
- 14±4% contamination by SN

In CDFS:

- 75±4% efficiency of AGN selection
- 6±2% SN contamination
- 4±2% of contamination by stars

Purity and completeness

- purity: >85% in CDFS, 94% in COSMOS: this value increases with the quantity of information in the region
- completeness: >22% in CDFS, >15% in COSMOS: this value increases with the sampling time

For more details see the poster (by De Cicco et al.)

Future perspectives

- extension of the sampled time to reach higher efficiency and completeness
- application to future datasets (LSST)
- finding rare AGN (jet-powered, highly variable, low luminosity AGN, AGN with strong starbursts, LINERs, etc.)
- this is possible only if the timescale is extended

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