A K_s-band selected, multi-λ survey for quasars in the XMM-LSS field

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(Nakos et al. 2008, A&A accepted)

Outline

1 Scientific motivation
2 The data sets
3 Selection process
4 Quasar identification
5 Method evaluation

Scientific motivation

Understand how KX works

- Perform the quasar candidate selection
- Investigate on the nature of the QSO candidates (reject/confirm)
- Evaluate KX method (efficiency, contamination issues)

Identify non-quasar AGN in survey

- Using color-color plots (thanks to multi-λ information)

Study physical properties of sample

- Estimate redshift
- Separate type-1 from type-2 population
- Fit a torus model - Unification Scheme

Implementing the KX–method

XMM-LSS field (RA $\approx 2^h$, Dec ≈ -7 deg)
(Pierre et al. 2004 JCAP)

Step 1: Perform quasar selection

Select quasar candidates using IR colors & morphology

- R, z'–band data, 4 m tel., CTIO
- K_s–band data, 2.5 m tel., Las Campanas

Step 2:Multi-λ properties of QSO candidates

- 2dF, VIMOS spectra
- $u^* g' r' i' z'$ data, CFHTLS
- XMM–Newton: X–ray data ([0.5–2] & [2–10] keV)
- Spitzer – SWIRE survey (IRAC 3.6, 4.5, 5.8, 8 μm and MPIS 24 μm)

The K_s–band observations

Configuration

- Las Campanas Observatory (LCO)
  5 nights, Oct 2002
- 2.5 m Du Pont Telescope
- WIRC camera, K_s–band only

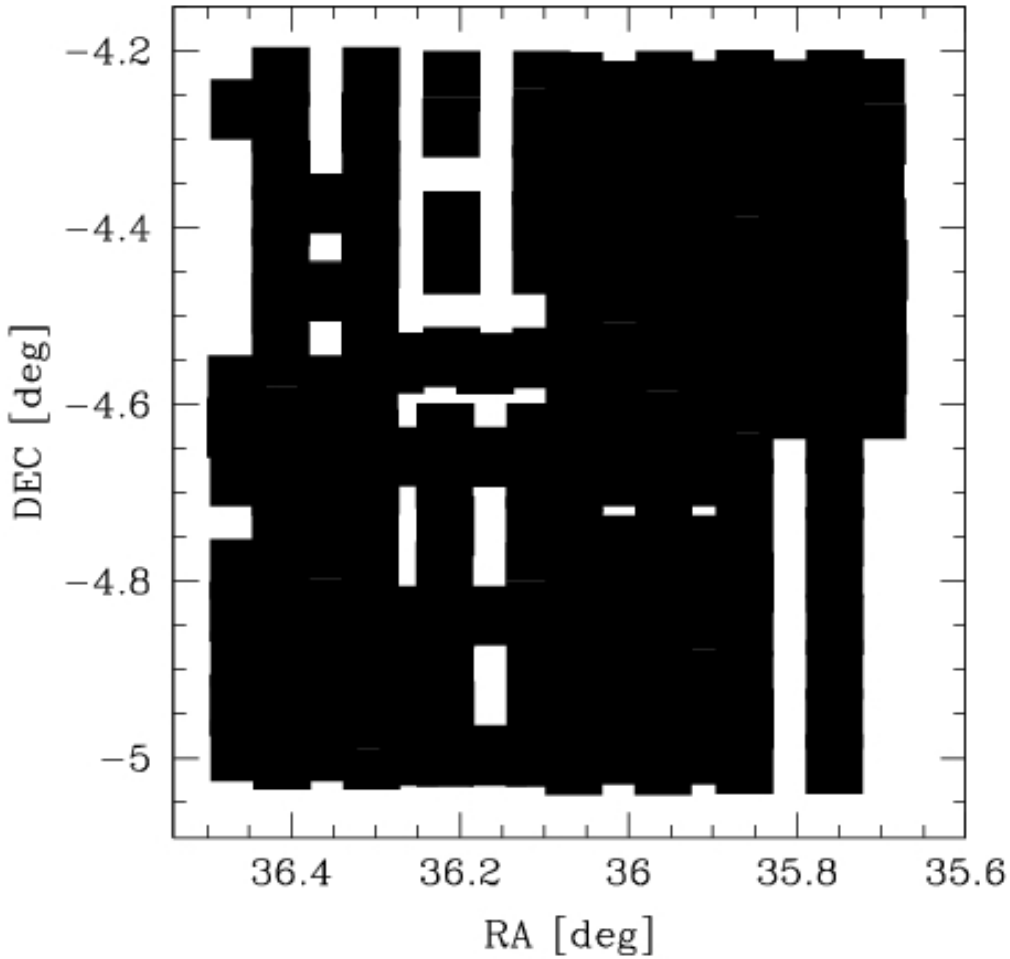
Observing conditions

- 1 night completely lost
- 2 photometric nights
- 2 non–photometric nights
- Seeing $\sim 1.5''$ FWHM

Data reduction

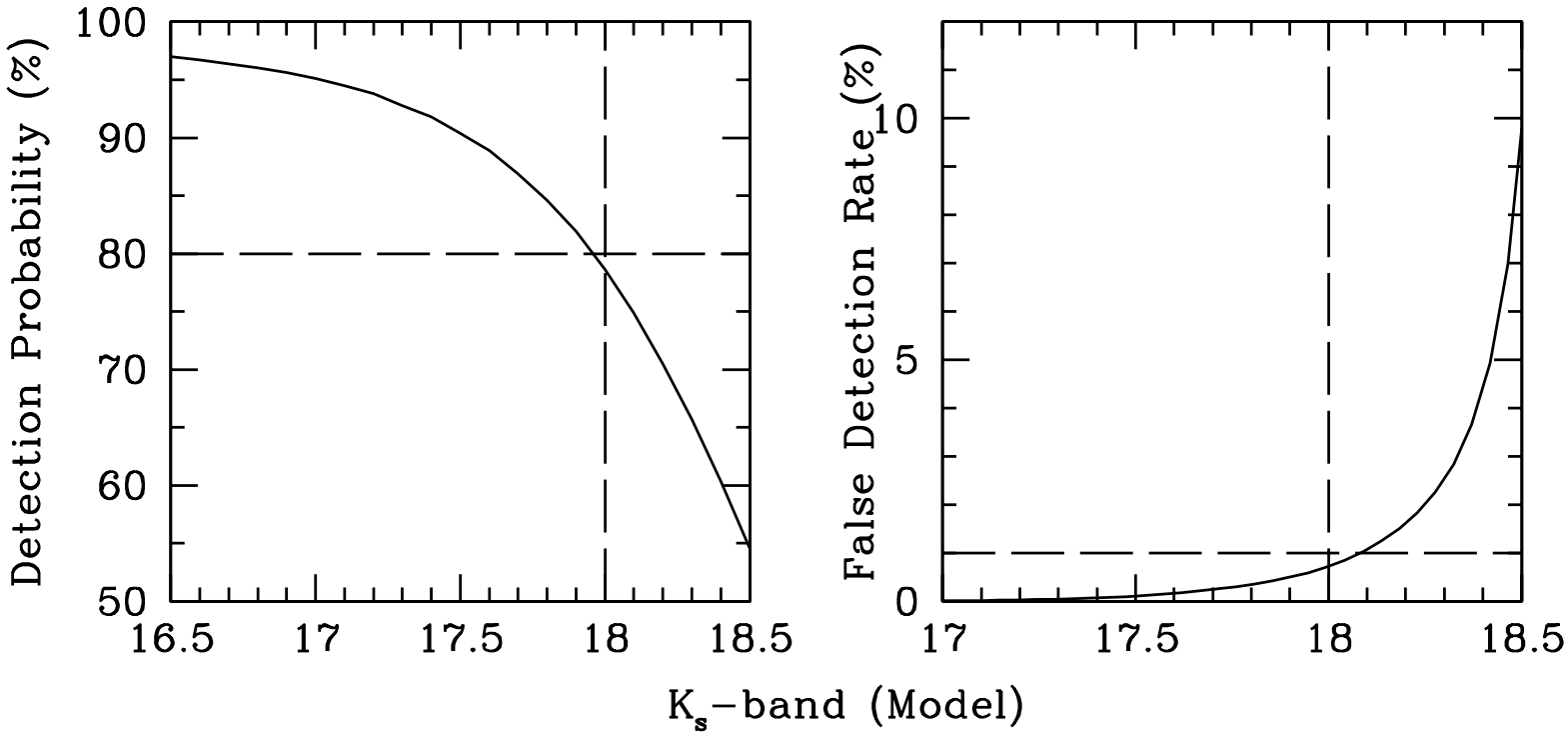
- Pipeline
  - Sky background
  - Patterns due to detector's electronics
  - Patterns due to saturated stars
- Calibrations
  - Photometric
  - Astrometric
- Mosaicking
- Simulations
  - Detection Probability (Completeness)
  - False Detections

Mosaicking



- $\sim$ 200 images
- astrometric precision: 0.5″
- $\sim$ 0.7 square degrees

Completeness - False detections



Survey $\approx$ 80% complete down to $K_s = 18$

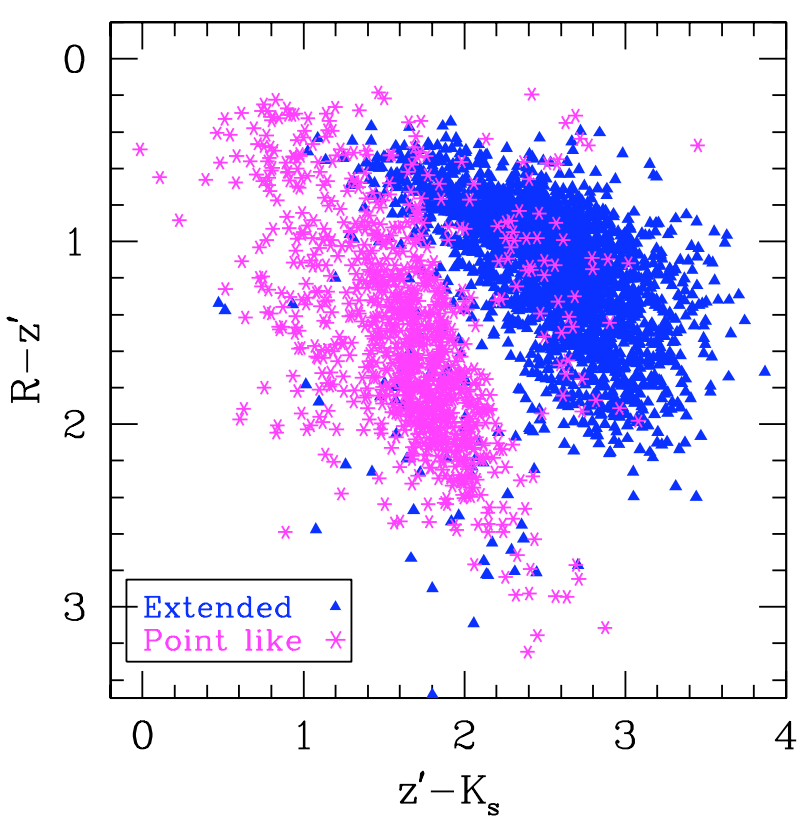
Properties of the $Rz'K_s$ matched catalog

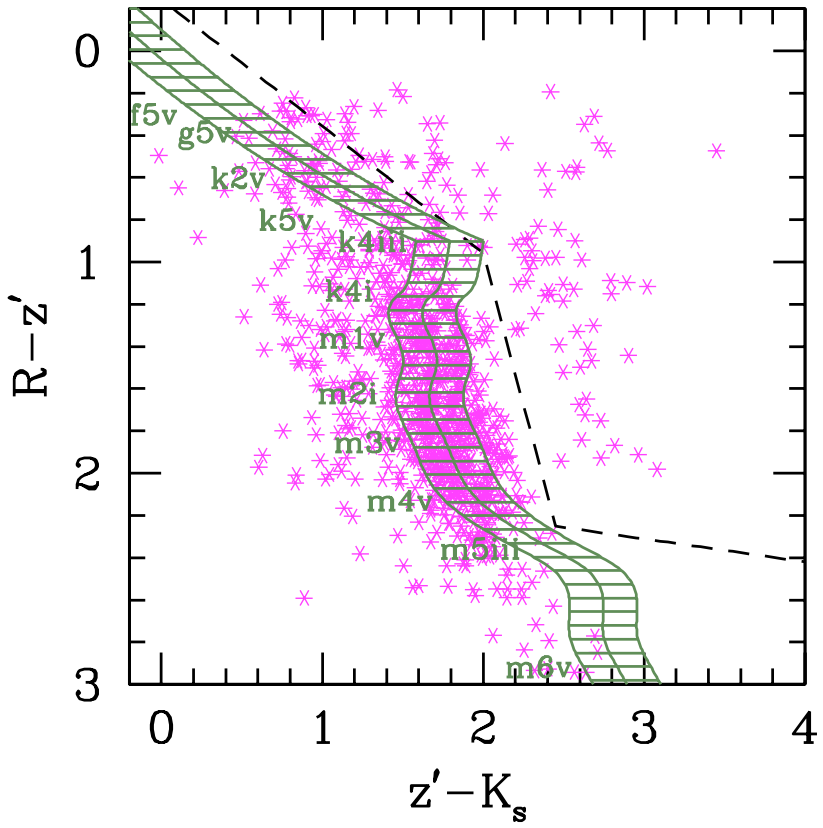
Catalog matching:

- Independent reduction of Rz' & K_s data
- Catalogs extracted (SExtractor, Bertin 1996), correlated using K_s `as a reference`

Filter	Frames	Astr. pres.	Phot. pres.	Mag limit
R	190	$0.3''$	0.02	23.5
z'	190	$0.3''$	0.02	22.0
K_s	200	$0.5''$	0.07	18.0

Selection of the quasar candidates - I





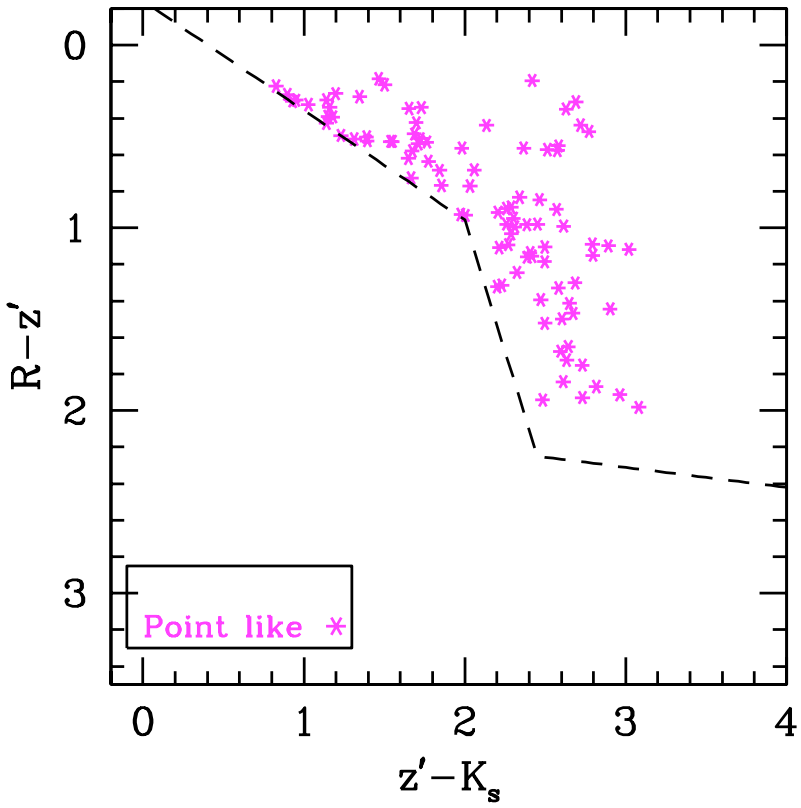
Stellar spectra: Pickles 1998

Selection of the quasar candidates - II

QSO candidates:

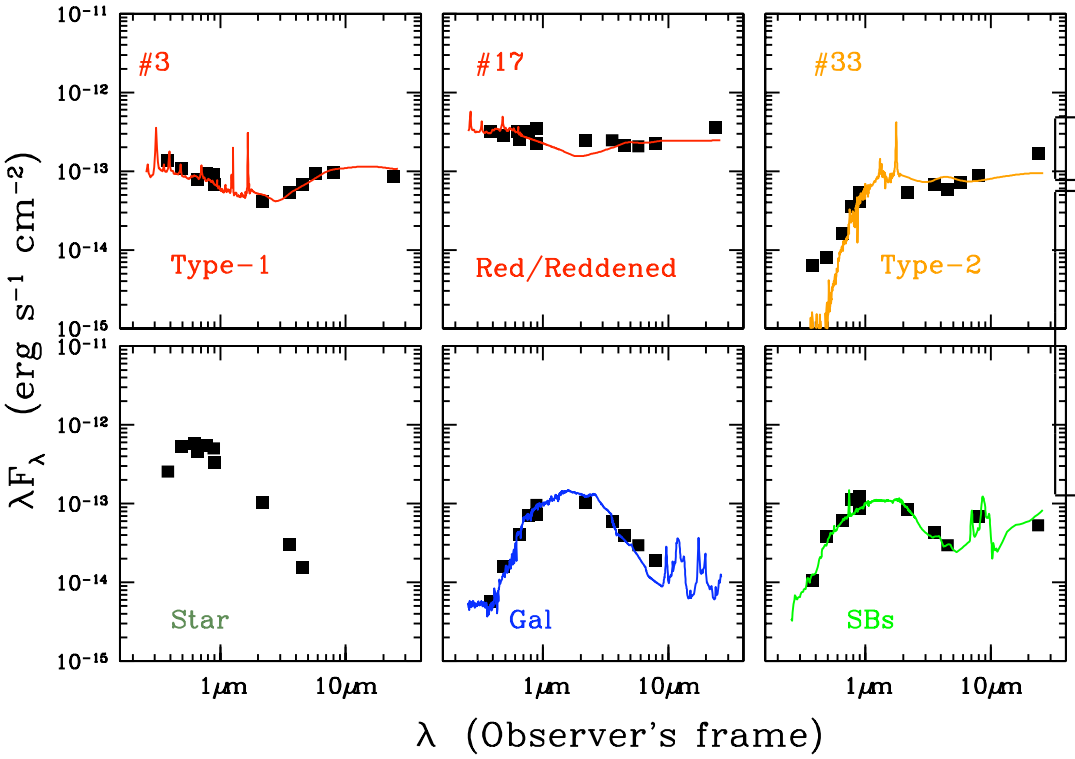
point–like morphology
galaxy–like colors

93 sources



Quasar identification - I

Due to lack of spectra, SED visualization allowed to probe nature of QSO candidates.



SED type	Number
Q-Type-1	22
Q-Type-1 Rd	2
Q-Type-2	1
Galaxy	50
Star	18

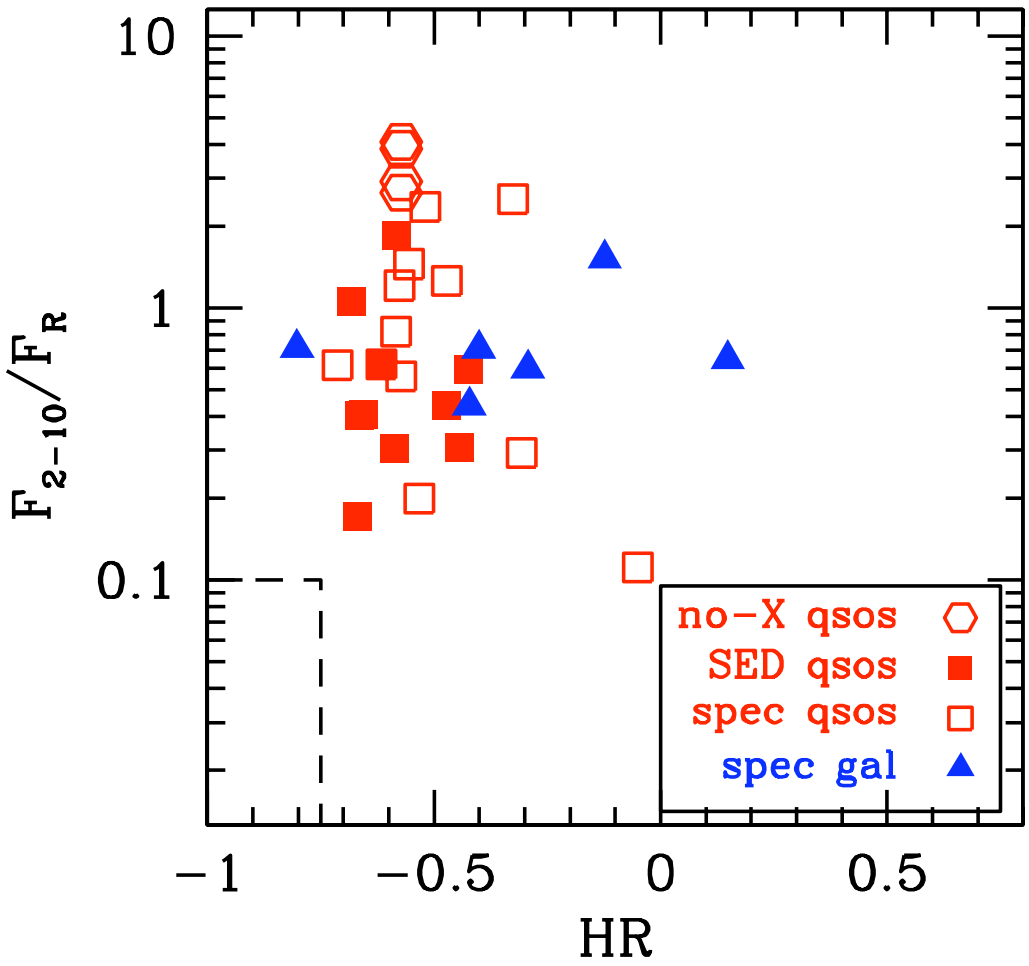
25 / 93 cand. identified as QSOs

Quasar identification - II

How confident the QSO classification?

- for 13/25 SED-classified quasars we dispose spectra
  - 9 2dF spectra *before* selection
  - *after* selection VIMOS spectra for 4 targets revealed 4 quasars.
- 21/25 SED-classified quasars show X-ray emission.
- F_x/F_R vs HR shows AGN signature (Della Ceca et al. 2004).
- None of the false candidates shows X-ray emission.

We are confident that the SED-classification gives trustworthy results



$$HR = \frac{H - S}{H + S}$$

Method Evaluation - I

- N_c number of quasar candidates,
- N_t number of true quasars among candidates
- N_e number of expected quasars (based upon model predictions, Maddox & Hewett 2006)

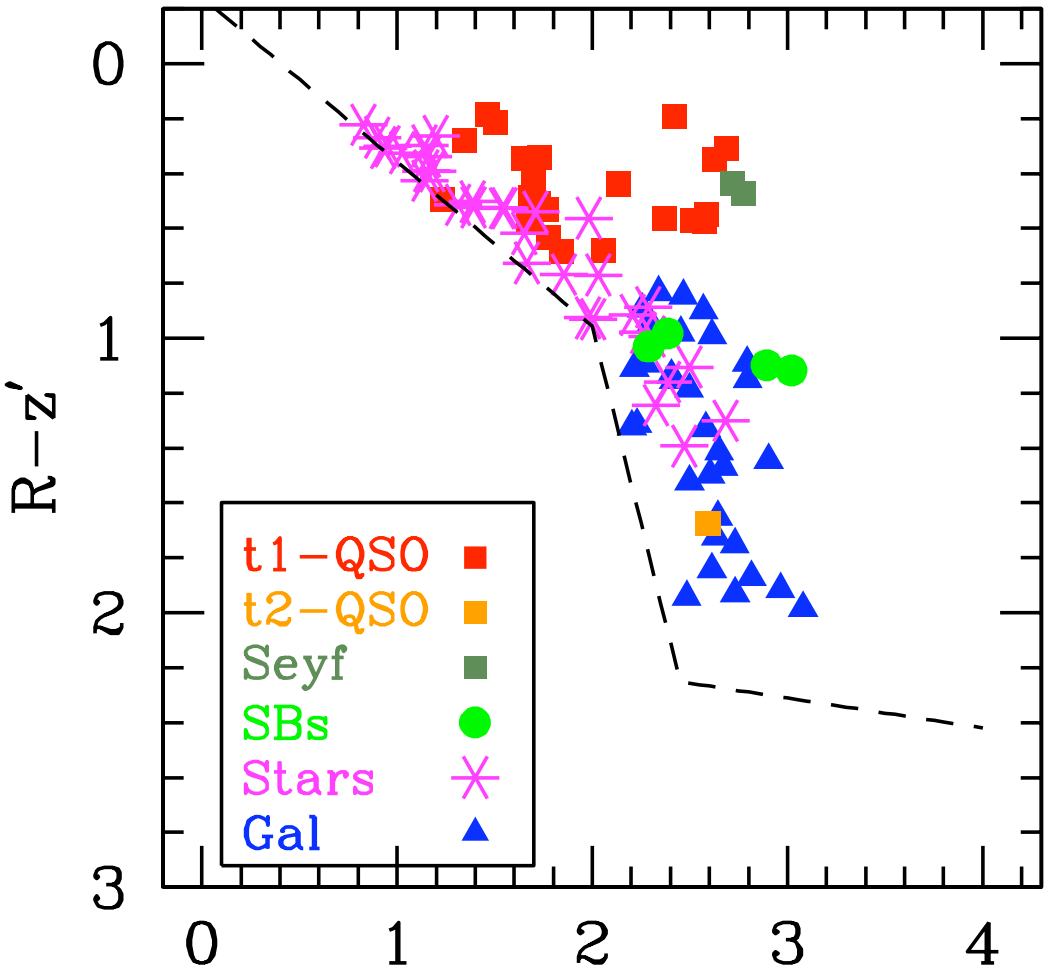
Efficiency defined as:

$$E = \frac{N_t}{N_c} \times \frac{N_t}{N_e} = \frac{25}{93} \times \frac{46}{50} \approx 25\% \quad (1)$$

Conclusions

- Method's efficiency dominated by contamination rate.
- SED-identification can be extremely useful for isolating false quasar candidates, before proceeding with spectroscopic identification.

Method Evaluation - II



Templates from Polletta et al. (2007)
Photo-z based on HyperZ (Bolzonella et al. 2000)