ATLAS Galaxy Photo-z

"A prime science driver is to determine the dark energy equation of state by detection of baryon wiggles in the power spectrum of ~450000 z~0.7 RLGs"

Munich can help, because of

- Participation in several large (imaging) surveys: PanSTARRS1, DES, KIDS, EUCLID
- Participation in spectroscopic surveys: BOSS, HETDEX
- PhotoZ code optimized for RLGs embedded in the PCS framework --> large datasets easily manageable

Roberto Saglia - MPE/USM

ATLAS Meeting, 5th December 2011

PCS:
the Photometric Classification Server

Goals:

- Separation of Stars/Galaxies/Quasars (PanDISCS, MPIA)
- Estimation of PhotoZ for galaxies (PanZ, MPE)
- Automatic processing and publishing of data
- Serve the Science Projects

Algorithms:

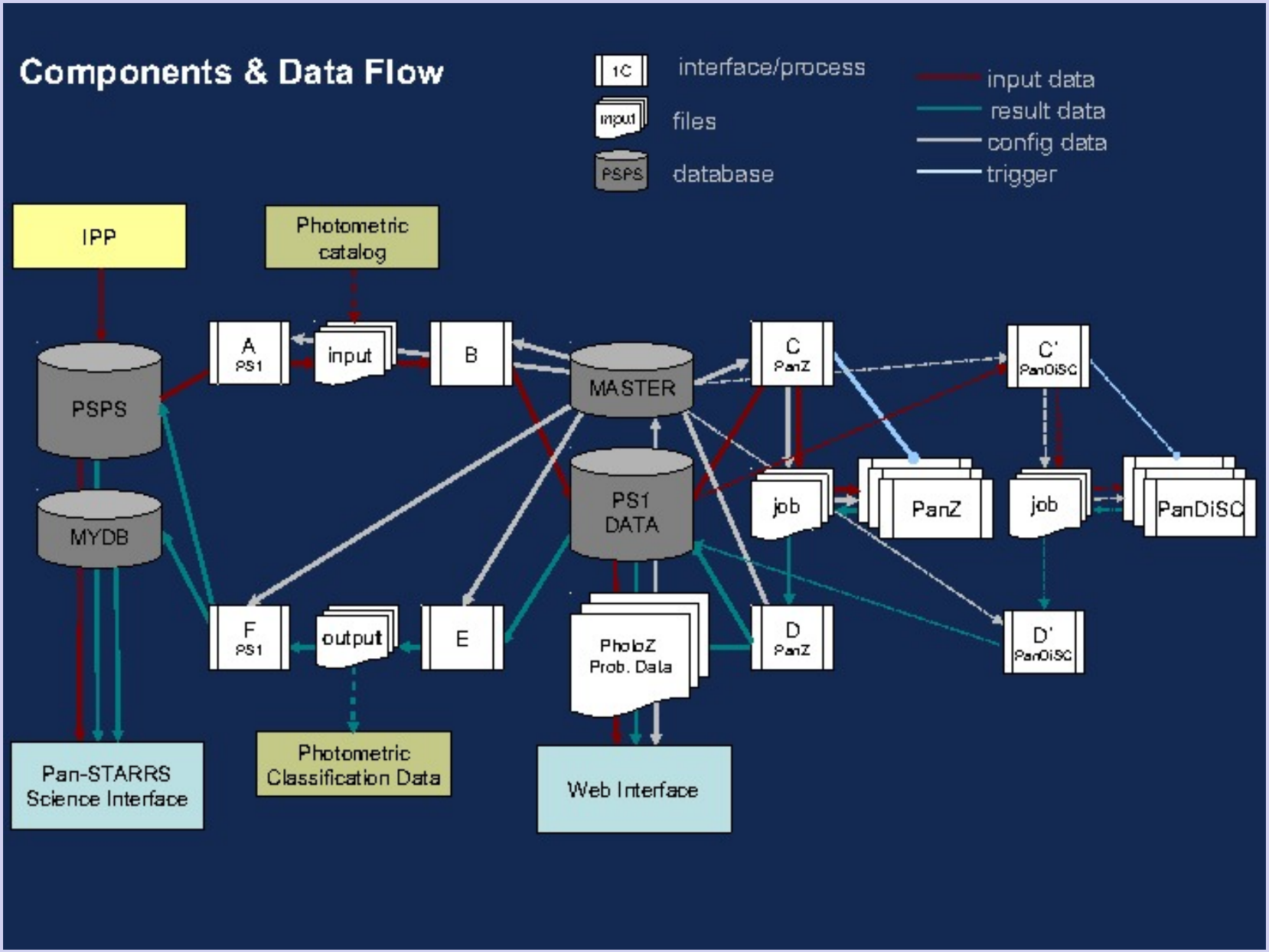
- Support Vector Machine Classifier (PanDISCS)
- Bayesian PhotoZ estimation based on SED fitting (PanZ)
- Further algorithms possible

Realization:

- MySQL based database system on Linux
- Linux cluster for parallel processing
- External and internal interfaces for data flow control

Saglia et al. 2011, ApJ, in press, astro-ph/1109.5080

PCS: Database implementation



Photometric Redshifts with PanZ

Estimate distances by comparing a set of (discrete) template SEDs to broad band photometry of redshifted galaxies.

$$p(z, T|\{C_i\}, m, \ldots) \qquad p(z) \sim \sum_k p(z, T_k)$$

Using Bayes' theorem:

$$p(z, T|C, m) \;\propto\; p(C|z, T)\; p(z, T|m)$$

Prob. of having $\{z, T\}$ given $\{C, m\}$

Prob. of observing $\{C\}$ given $\{z, T\}$

Prior (z and T distribution at magnitude m)

Redshift and magnitude priors

z prior:

$$P_{z,T} = z^{n} \exp\left[-\ln 2 \frac{(z - z_T)^{b}}{a^{2}} \right]$$

$$n = 0, b = 2 \quad (Gaussian)$$

$$z_T = 0.02, 0.1, 0.2, 0.3, 0.4; a = 0.2$$

Luminosity prior:

$$P_L = \exp\left[-\ln 2 \frac{(M - M_*)^{p}}{\sigma_*^{2}} \right]$$

$$p = 6 \quad (Flat\ top)$$

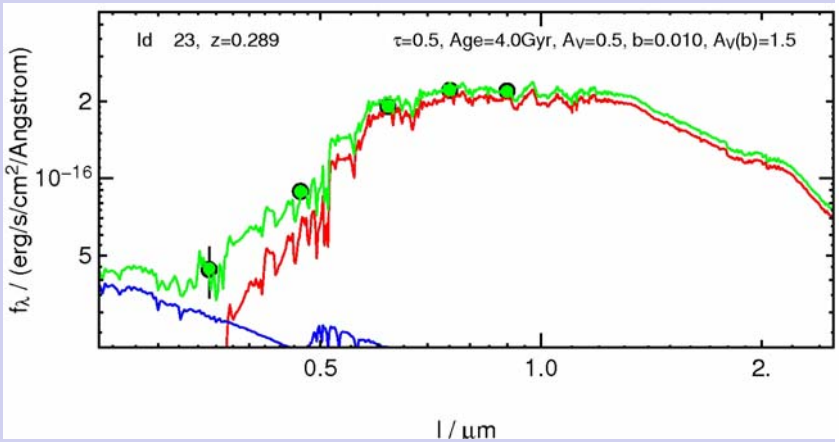
$$M_* = -21, \sigma_* = 3$$

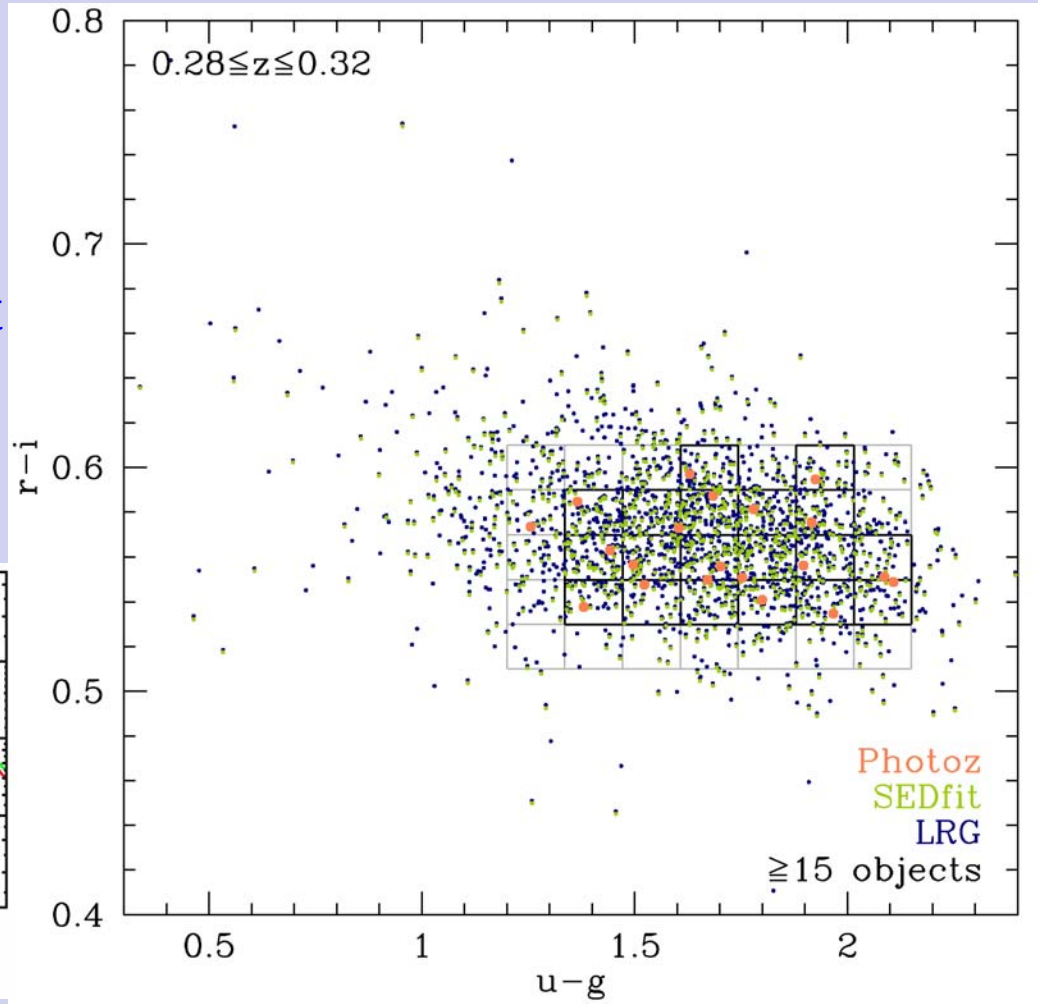
New SEDs to cover color space and z of RLGs

SEDs constructed using the code of Drory et al. (2005) so to sample the color space of RLG as a function of z

SEDs are a composition of model SED (B&C03) and burst spectrum:

$$SED = \alpha\left(SED_{\mathrm{mod}} + \beta SED_{burst}\right)$$

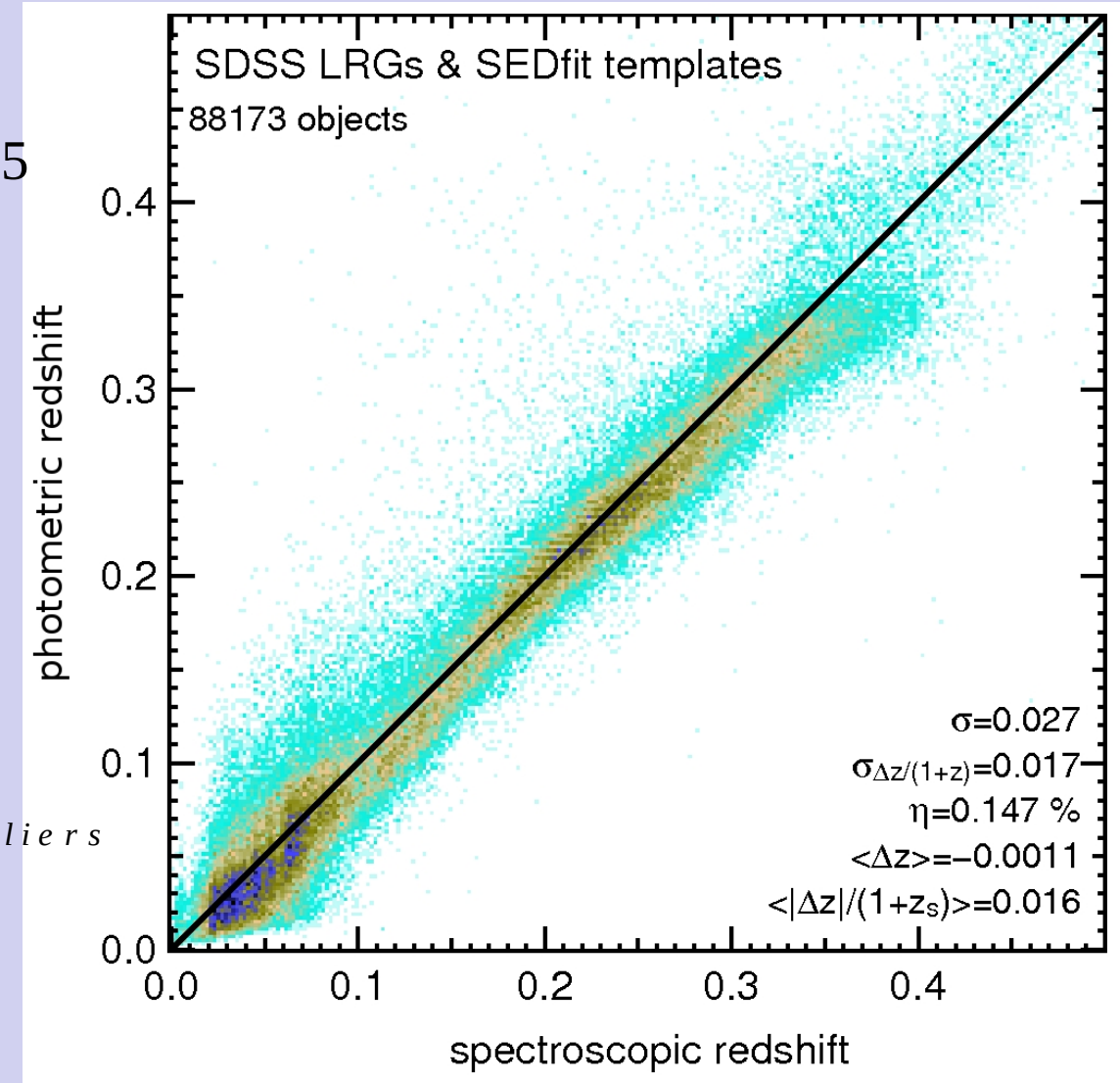




SLOAN RLGs with optimized SEDs

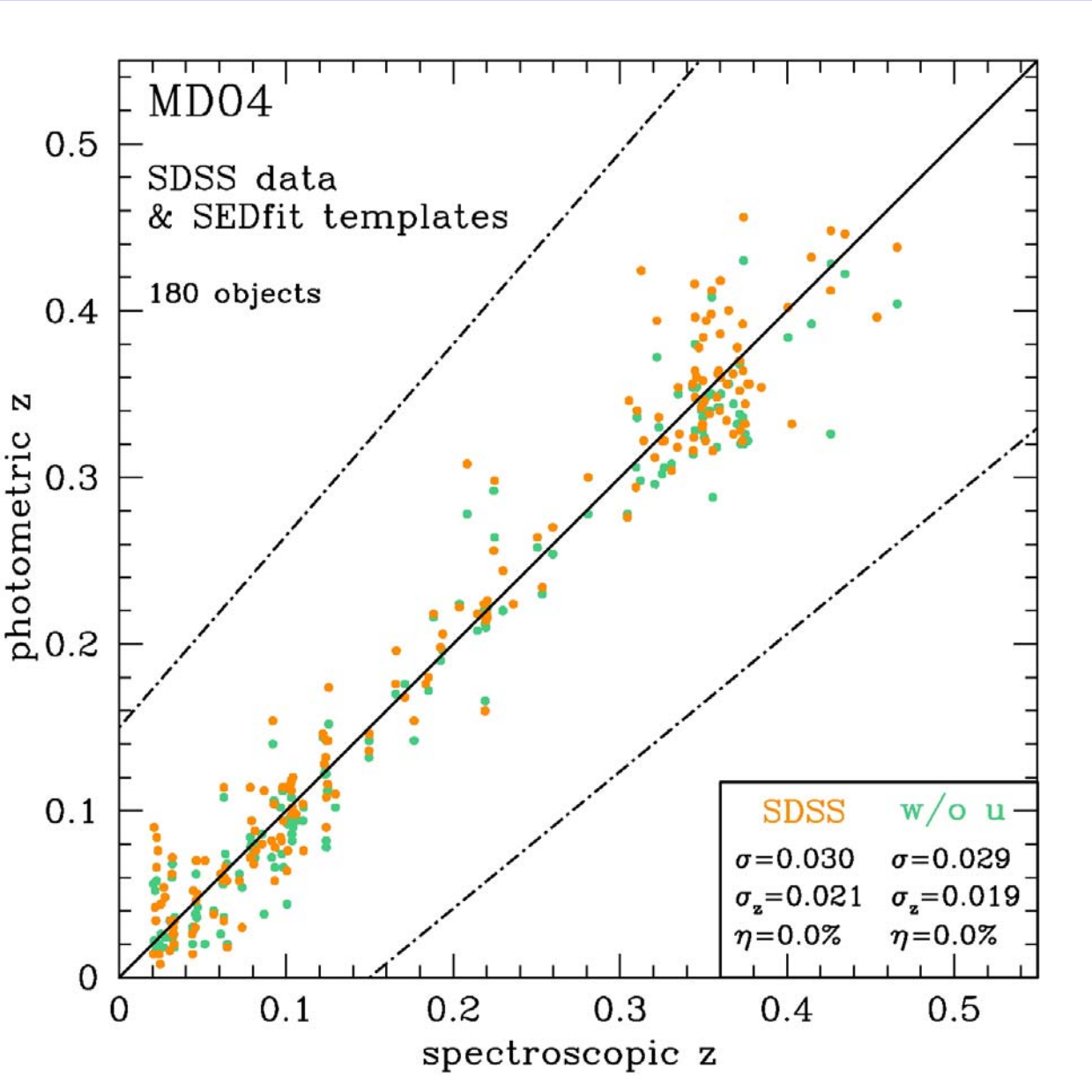
$$\eta : \frac{|\Delta z|}{1 + z_{spec}} > 0.15$$

$$\sigma_{\Delta z/(1+z)} = 1.48\, Median \left(\frac{|\Delta z|}{1 + z_{spec}} \right)_{non-outliers}$$



Greisel, Seitz et al., 2011 in prep.

With and without u band

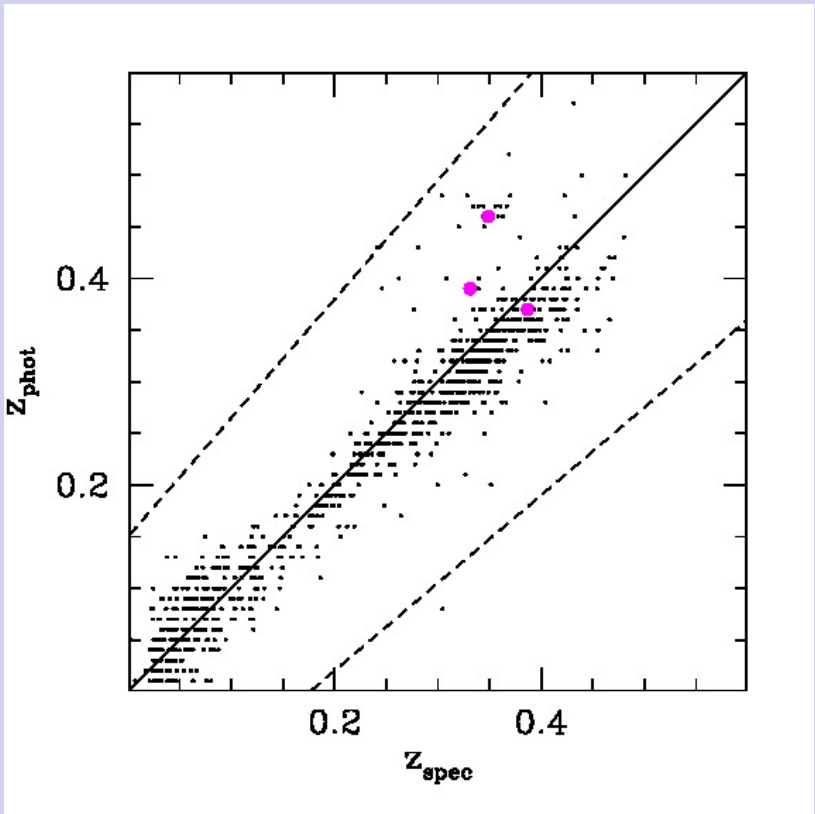


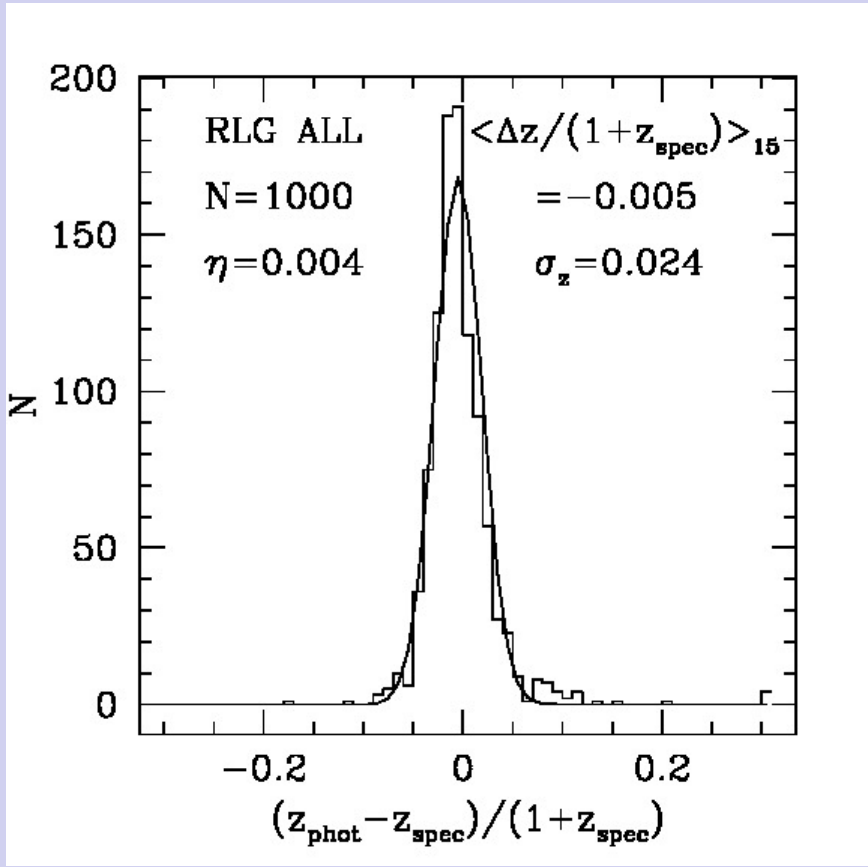
Almost no change...

Not yet tried:

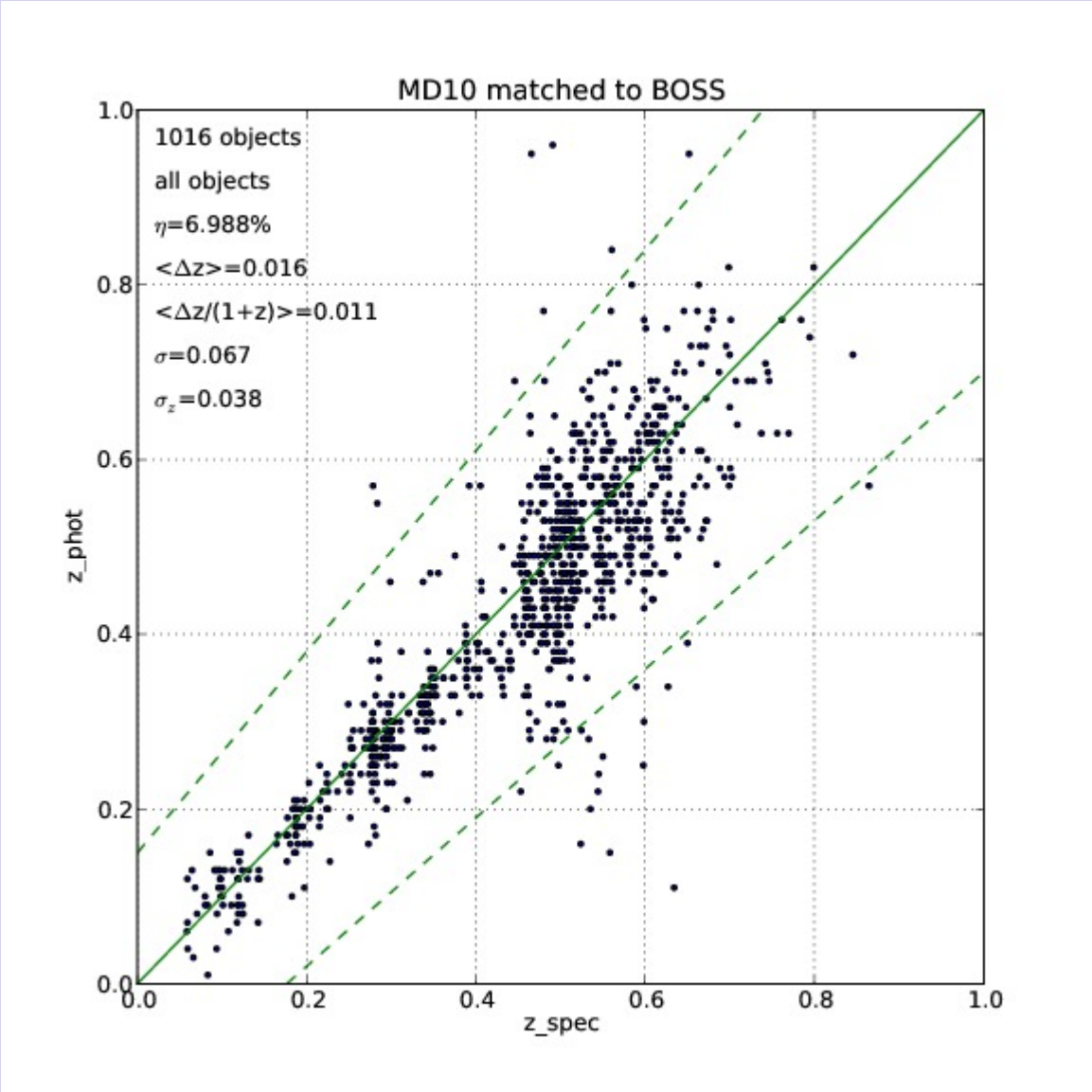
What happens Adding NIR data

RLGs with grizy from PS1

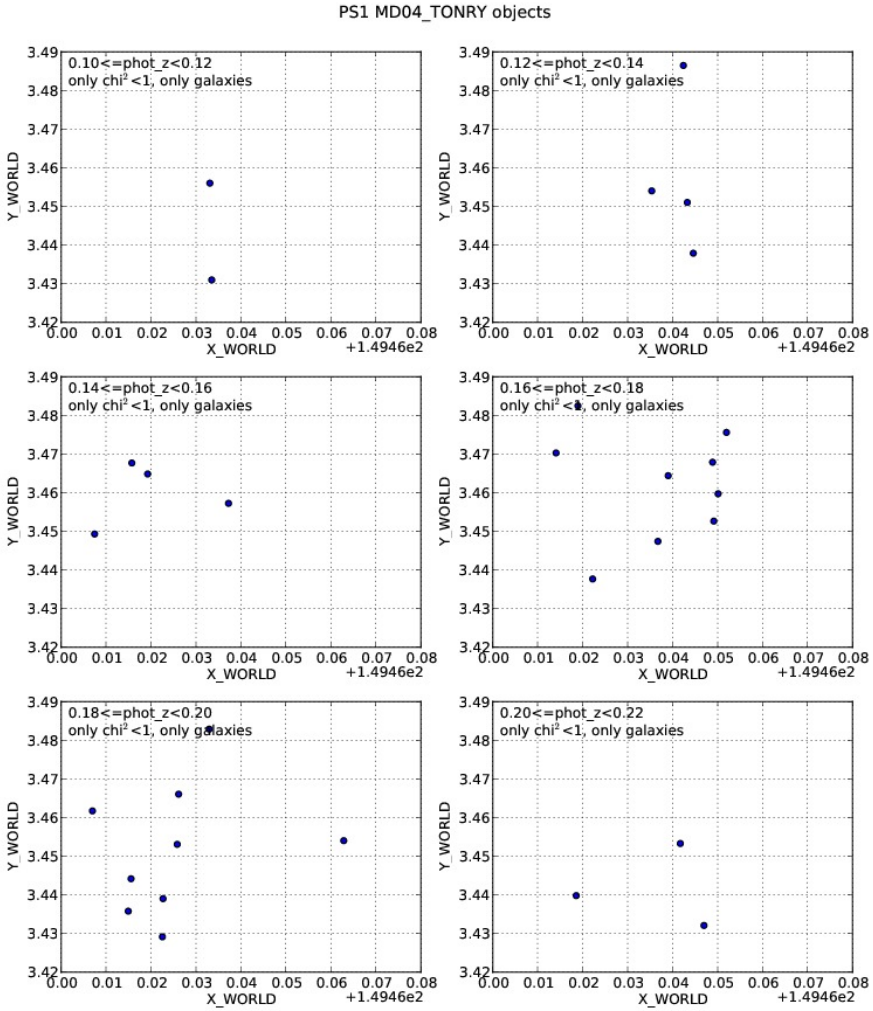


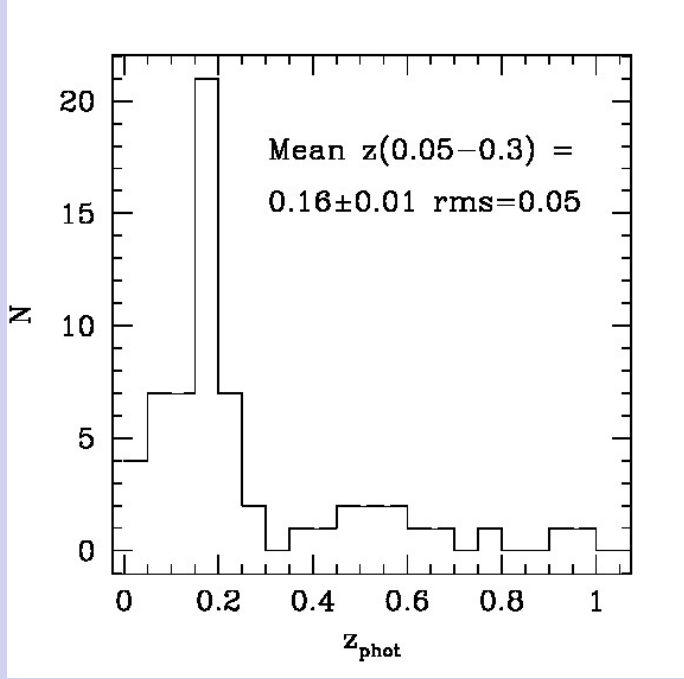


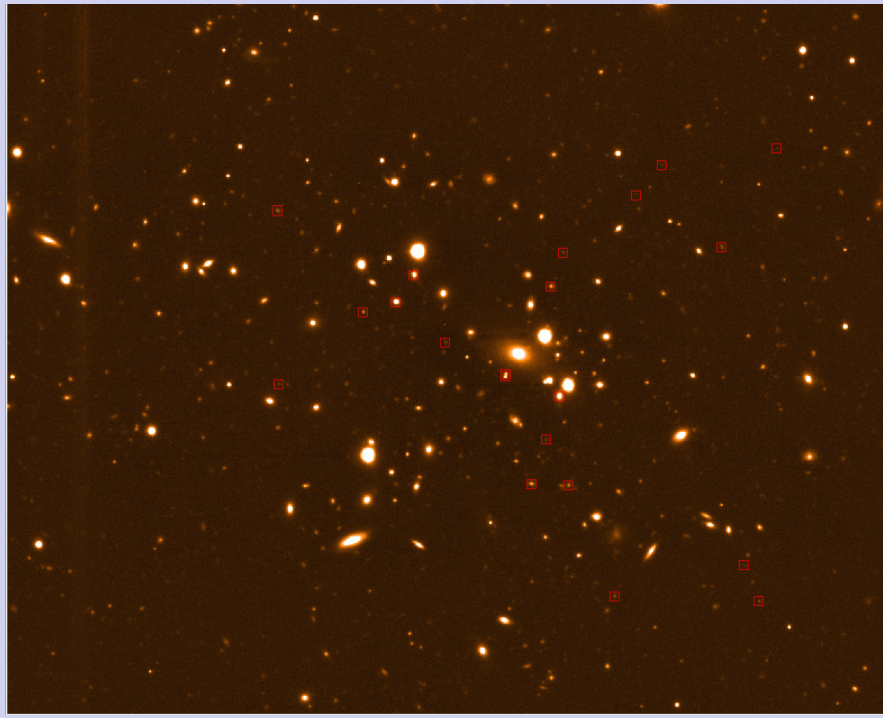
RLGs to z~0.7: BOSS with PS1 grizy



Science application: photoz of (eROSITA clusters)







Conclusions

Experience with SLOAN dataset shows that photo-z for RLGs can be measured to 2% accuracy with low (0.5%) bias and low (0.5%) fraction of failures to z=0.4. Using BOSS spectra we are pushing the limit to z=0.7.

ATLAS should provide a similar dataset for the south

The PanZ component of PCS can easily be adapted to run on ATLAS catalogues, providing an efficient way to measure and test large numbers of photo-z.

Important: measure colors of galaxies after having homogenized the PSFs across bands. Zero-points Accurate to 0.01 mag are needed to get the above quality.