Mock galaxy catalogues and their applications for Pan-STARRS

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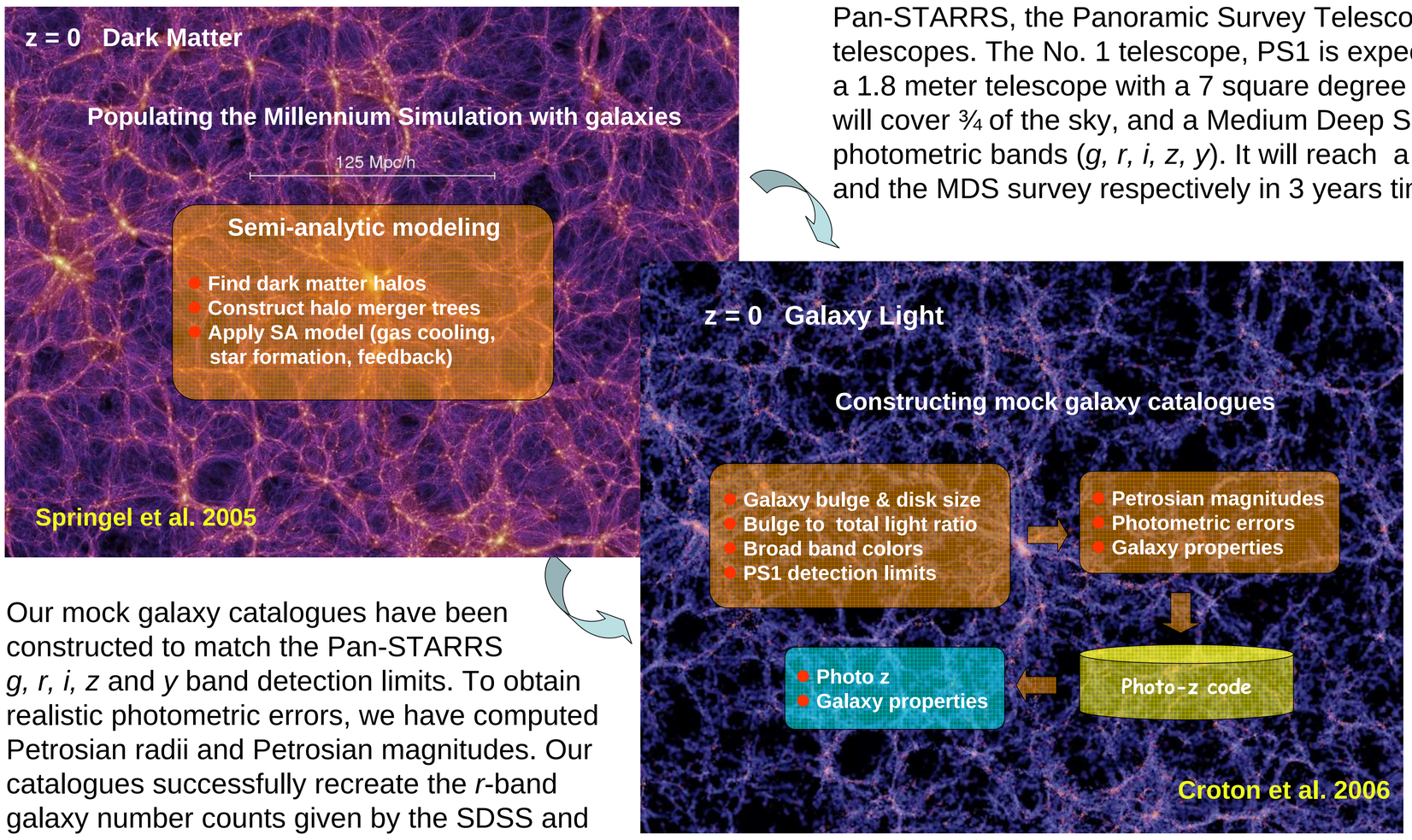
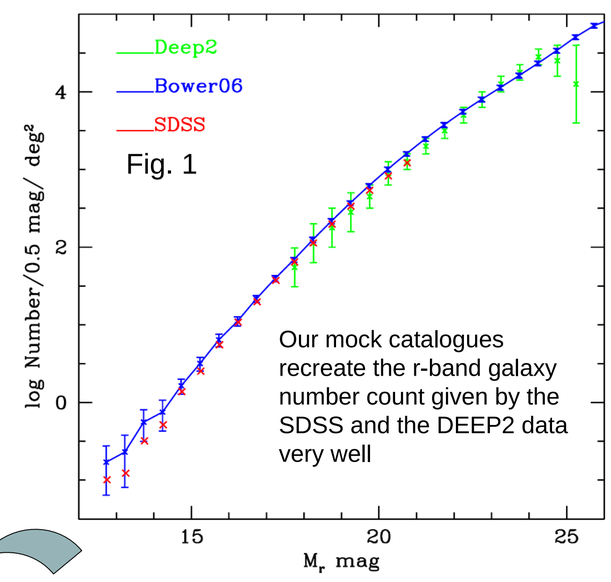


Pan-STARRS, the Panoramic Survey Telescope and Rapid Response System, consists of 4 telescopes. The No. 1 telescope, PS1 is expected to be surveying the sky early in 2009. PS1 is a 1.8 meter telescope with a 7 square degree field of view. PS1 will carry out a '3pi' survey, which will cover ¾ of the sky, and a Medium Deep Survey (MDS) survey over 84 sq. deg. PS1 has 5 photometric bands (*g, r, i, z, y*). It will reach a depth of about *r* =24.5 and 27 for the '3pi' survey and the MDS survey respectively in 3 years time.

Semi-analytic galaxy formation models enable us to populate the Millennium simulation with galaxies. The model of Bower et al. (2006) is able reconstruct galaxy luminosity functions from z=0 up to z=1.5. We have used this model to construct mock galaxy catalogues for Pan-STARRS PS1. With these catalogues, we have tested the accuracy of photometric redshifts and made predictions for the detectability of large-scale-structure, such as baryon acoustic oscillations. Our mock catalogues are available at http://star-www.dur.ac.uk/~cai/.

Our mock galaxy catalogues have been constructed to match the Pan-STARRS *g, r, i, z* and *y* band detection limits. To obtain realistic photometric errors, we have computed Petrosian radii and Petrosian magnitudes. Our catalogues successfully recreate the *r*-band galaxy number counts given by the SDSS and the DEEP2 data (Fig. 1).

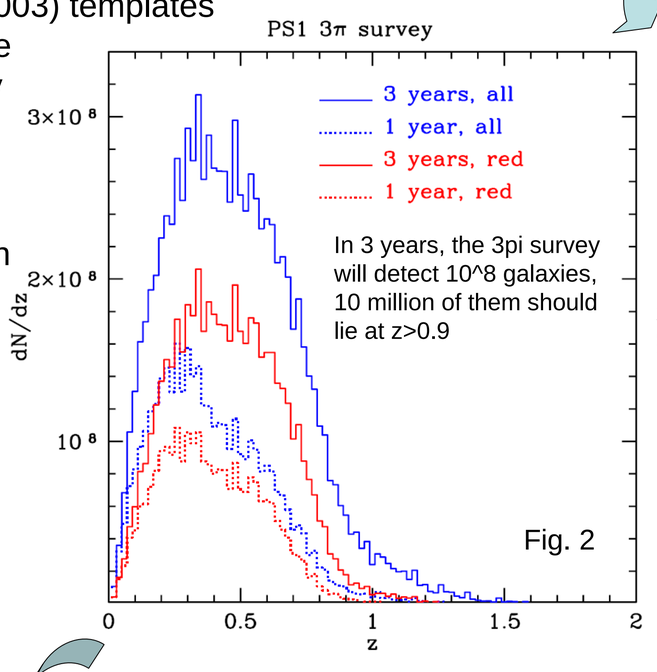


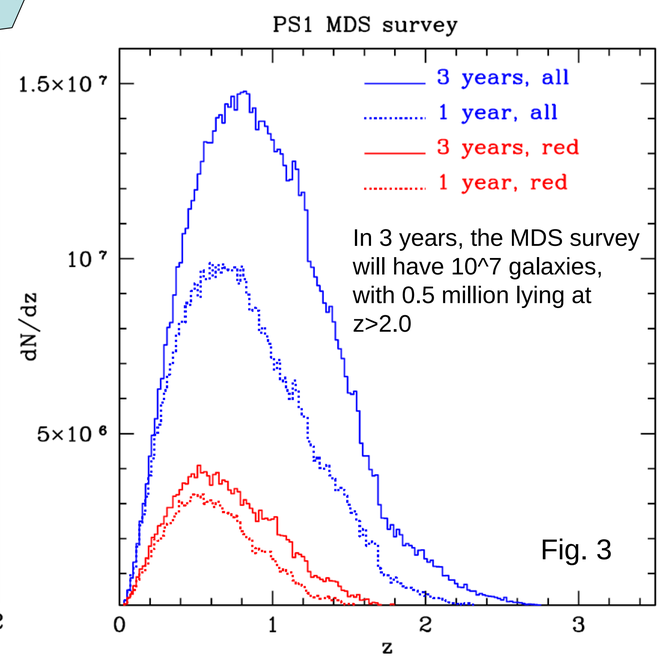
● PS1 galaxy number counts

- 3pi survey ---- 10^8 galaxies in 1 year, more than 1 billion galaxies in 3 years
- MDS survey ---- 10^7 galaxies in 1 year, more than 50 million galaxies in 3 years

● PS1 galaxy redshift distributions for all 5 band detections

- 3pi survey ---- in 1 year, 10^7 galaxies; in 3 years, 10^8 galaxies, 10 million lying at z>0.9, peaks at z~0.5 (Fig. 2)
- MDS survey ---- in 1 year 10^7 galaxies, will double in 3 years, with 0.5 million lying at z>2.0. peaks at z~0.8 (Fig. 3)





● Photo-z test on PS1 mock galaxies

- Hyper-z code (Bolzonella et al. 2000) is used with Bruzual & Charlot (2003) templates
- Δ z/(1+z) ~ 0.6 could be achieved using PS1 g, r, i, z and y bands alone
- 15% error reduction if combined with UKIDDS near infrared photometry
- Δ z/(1+z) ~ 0.02 -0.04 is achievable for red galaxies (Fig. 4, below)

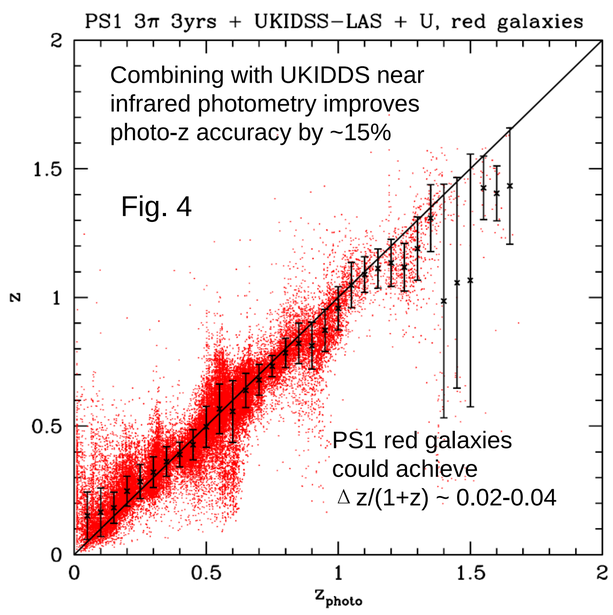
● Detectability of baryon acoustic oscillations with photo-z

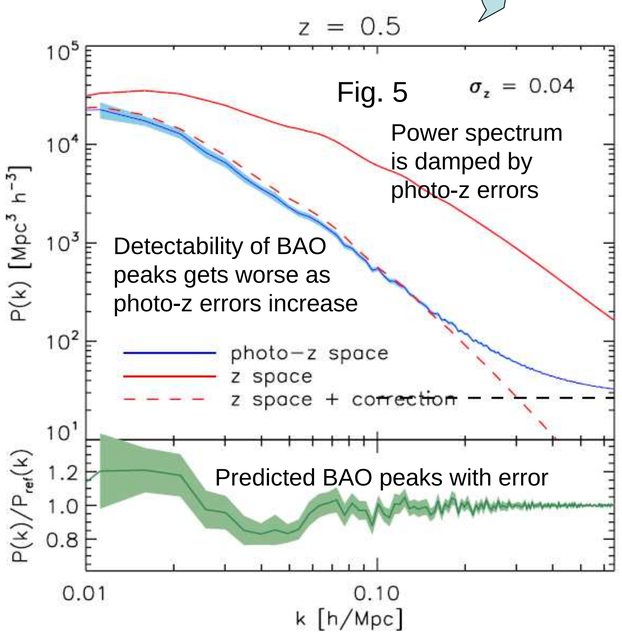
We find that the PDF of photo-z errors is well fitted by a Gaussian function
An increase of photo-z error would lead to:

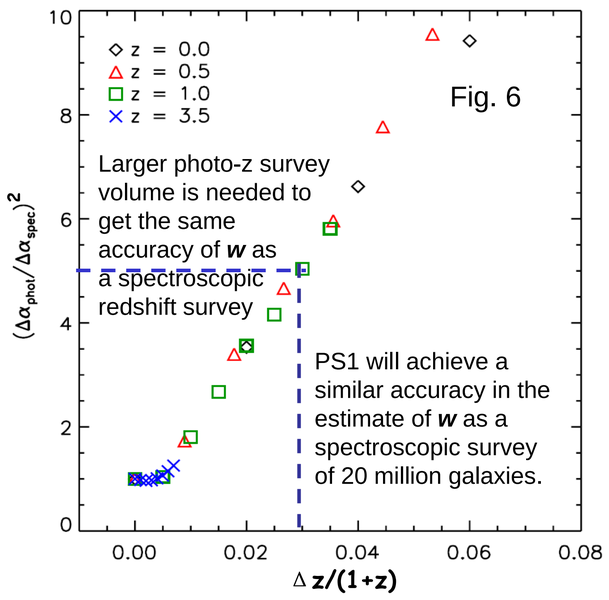
- an increase of damping factor to the power spectrum
- increased noise on BAO measurements
- a decrease of the BAO amplitude at high wave number (Fig. 5, below)

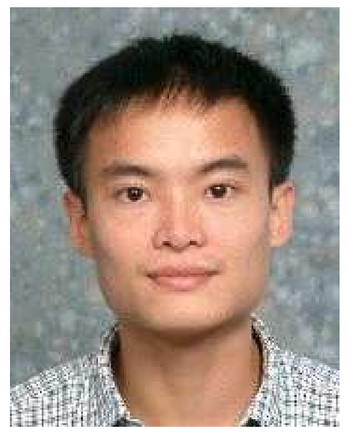
● Constraining the dark energy equation of state, *w*

Using the photo-z method, PS1 will achieve a similar accuracy in this estimate as a spectroscopic survey of 20 million galaxies. The y-axis of Fig. 6 shows the factor by which the volume of a photo-z survey needs to be larger than the volume of a spectroscopic survey to achieve the same accuracy.









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