Comments on Dark Energy Experiments

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Outline:

- General comments on techniques
- Some scary lensing details
- Comments on survey depths

Measurements of dark energy

Basic approaches:

- Cluster counting
  - X-ray selection: Flux limited
  - SZ surveys: redshift independence
  - Lensing surveys: clean mass selection?
  - Optical surveys (!)
- Structure Formation
  - Galaxy LSS from spectroscopic surveys
  - Weak lensing power spectrum
- Angular diameter distance
  - Strong lensing statistics
- Luminosity distance
  - Type Ia SNe

What to worry about…

Age of statistical astronomy, large samples are not a problem

Systematics will limit all these experiments: Predictions must include estimates of these

Cluster counting:

Mass thresholds, cluster evolution…

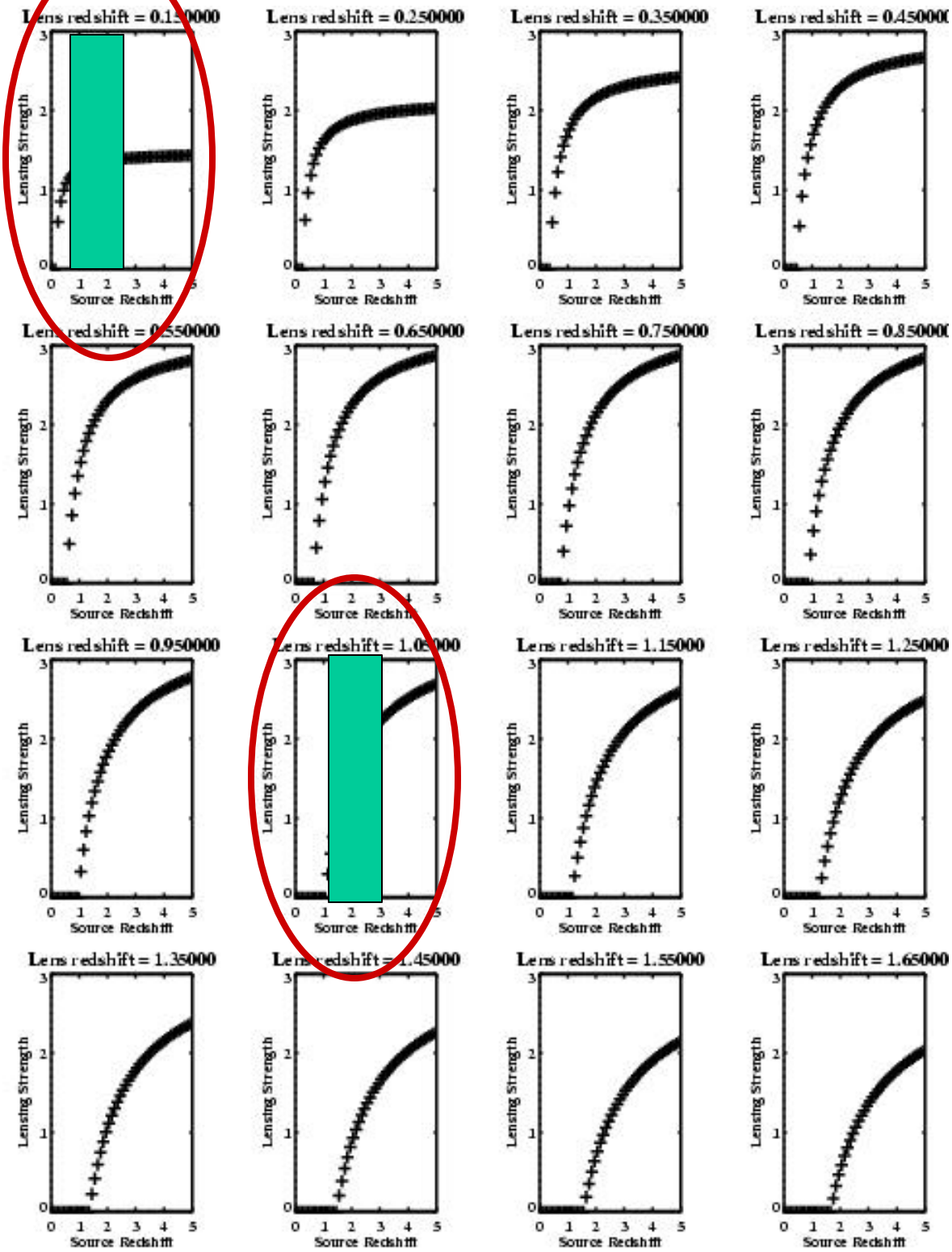
Structure formation:

Bias, selection function….

Strong lens surveys:

Selection effects, halo profiles….

An example from lensing, mass scale…



Some predictions…

SNe will play a key role:

- Discovered dark energy
- Local physics….
- Systematics known
  - Evolution
  - Dust
  - Malmquist bias
  - Lensing magnification

Ground or space?

Comparison of ground and space based optical surveys

We have completed detailed comparisons of ground based and space based optical surveys from first principles

Gary Bernstein, 2001, submitted to PASP

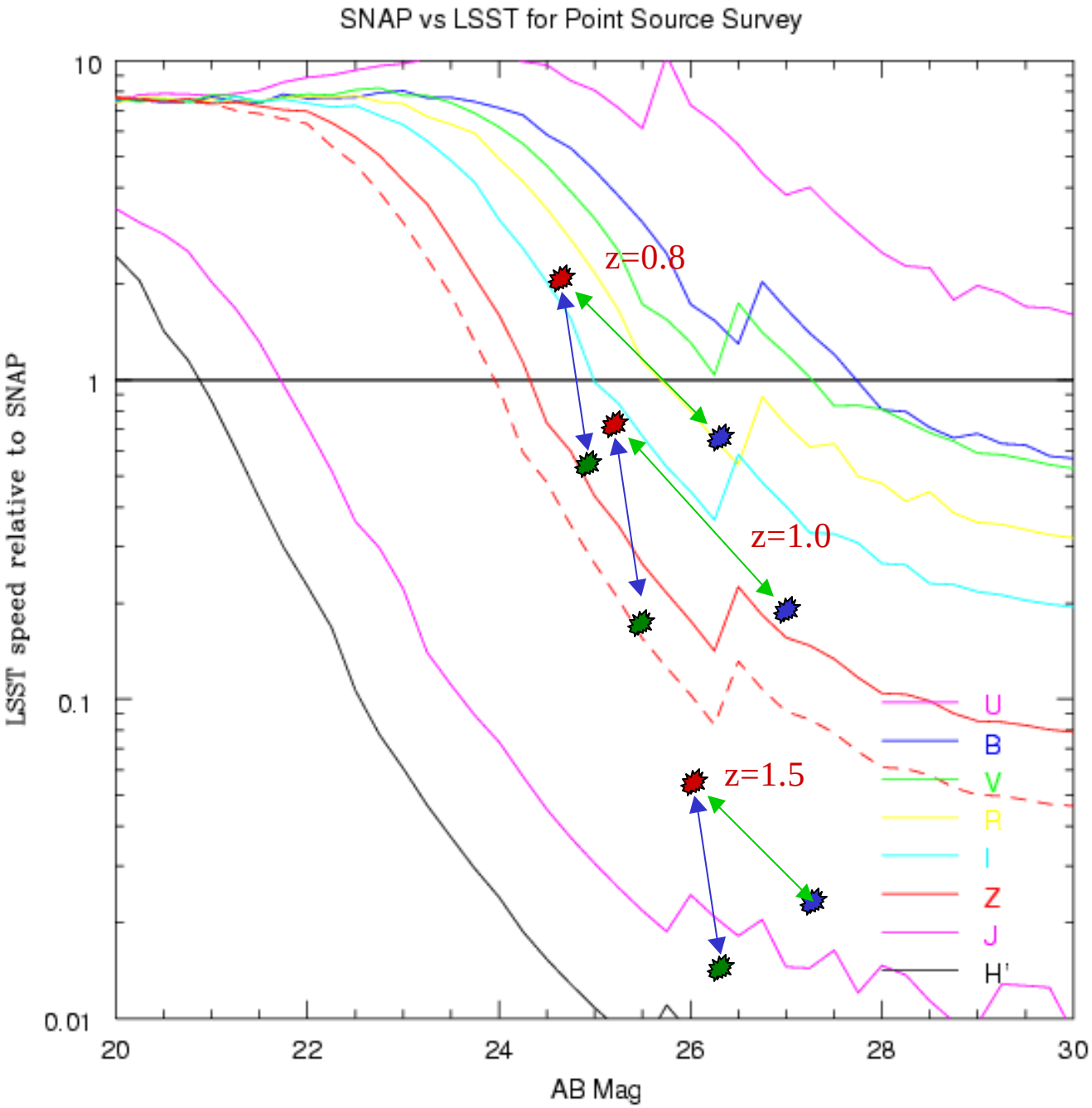
- Calculations for PSF photometry
- Includes undersampled and dithered images
- Includes cosmic ray rates
- Includes intra-pixel sensitivity variations (10% gutters)
- Calculated for point source and galaxy photometry
- Determines astrometric errors
- Determines galaxy shape errors

Allows us to answer some commonly arising questions about imaging strategies:

- What amount of dithering is ideal?
- What pixel size optimizes the productivity of a camera?
- Which is more efficient; space-based or ground-based observing?

Supernova survey efficiency for SNAP and LSST:

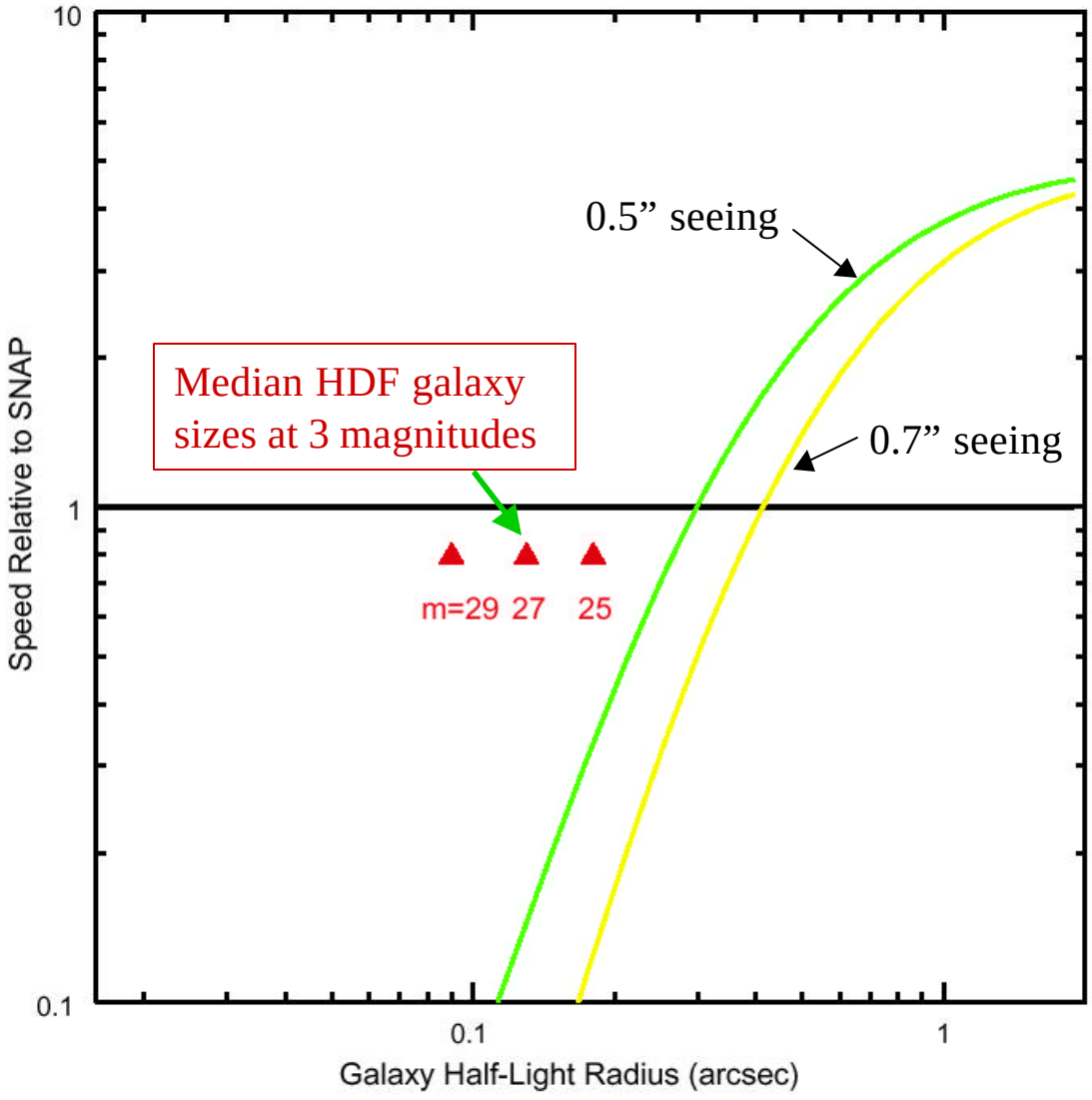
- LSST is better at z<0.7
- SNAP is much faster for high-z objects



- Brightness and B band wavelength of SNe Ia at peak
- Discovery brightness to prevent Malmquist bias
- Brightness and V band wavelength of SNe Ia at peak

Weak Lensing Survey Speed: including effects of galaxy size

Galaxies must be resolved for use in weak lensing analyses. HDF studies (Gardner & Satyapal, 2000) show that galaxies become *much* smaller at faint magnitudes.



Approximately 85% of galaxies with r<30 are between r=27 and 30….

A few conclusions

Many techniques required to constrain dark energy

All will be systematics limited

Sensitivity estimates should include reasonable systematics guesses

Only SNe have detected dark energy and faced systematics:

They will play a key role in the coming decade