Synthetic Galaxy Catalogues From A Galaxy Formation Model

Alex Merson

& Carlton Baugh, John Helly, Shaun Cole

5th December 2011

Durham University

Synthetic Galaxy Catalogues From A Galaxy Formation Model

- Lightcone synthetic "mock" catalogues

- VST ATLAS lightcone

Lightcone "mock" catalogues

- Multi-wavelength synthetic galaxy catalogues → "lightcone mocks"

- Halo merger trees from Millennium Simulation

- Galaxy properties from GALFORM

- Broad range of applications:

Calibration of statistical estimators

Training sets

Removal of systematics

Relate observations to galaxy formation theory

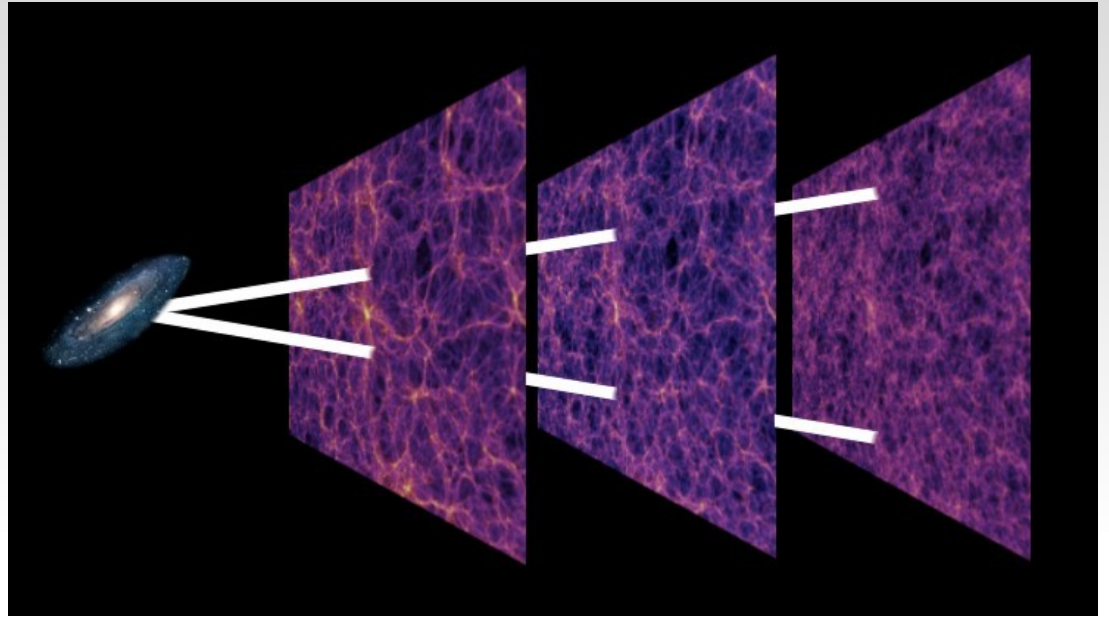Predictive power

Millennium Lightcones

Cosmology:

$$\Omega_M = 0.25 \quad \Omega_\Lambda = 0.75$$
$$\Omega_b = 0.045 \quad h = 0.73$$
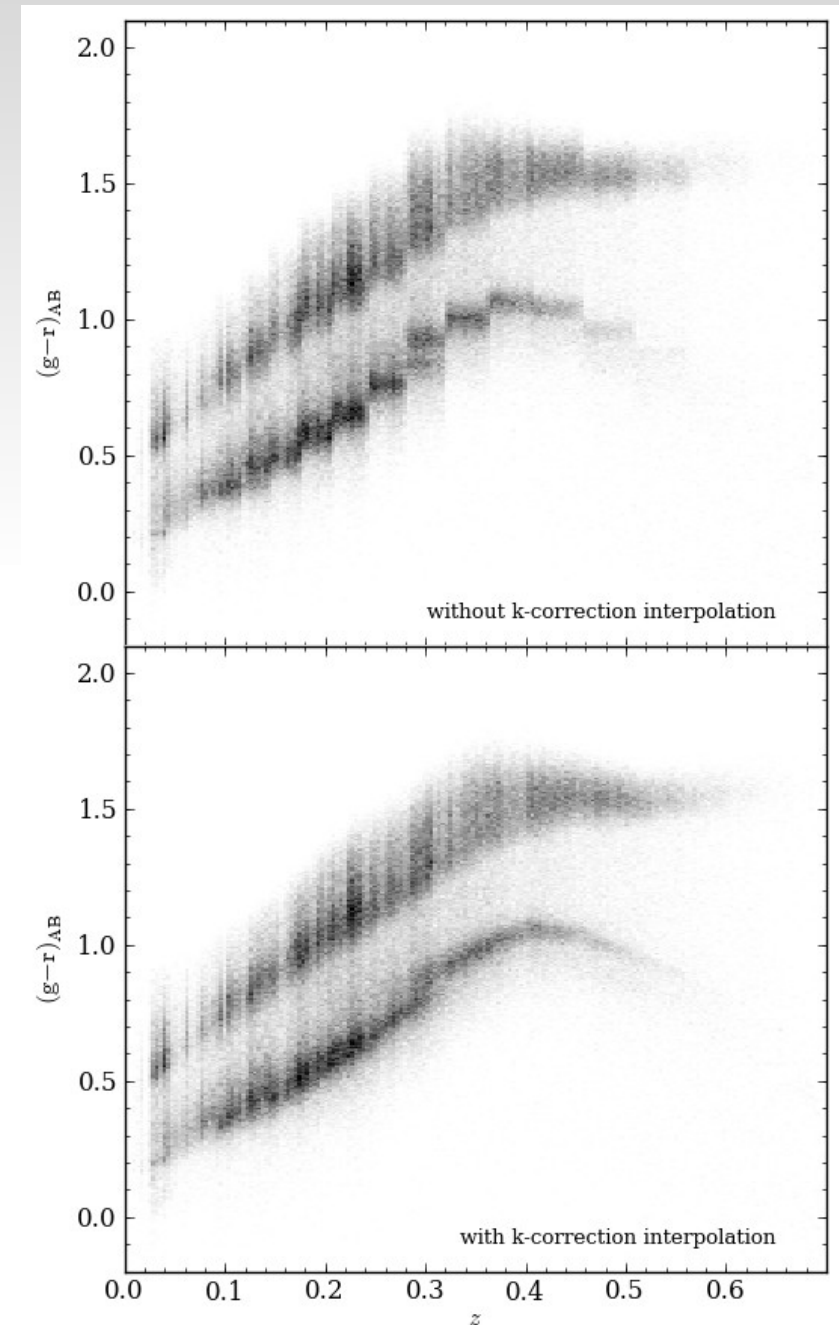
$$L_{box} = 500\mathrm{h}^{-1} Mpc$$
$$\Rightarrow \ z \ \sim \ 0.17$$

i. Run GALFORM model on simulation snapshots

ii. Place observer & replicate copies of simulation box

 → generate sufficient volume to contain survey

iii. Determine where galaxies enter observer's light cone

 → interpolate positions between simulation snapshots

Millennium Lightcones (II)

iv. Apply angular mask

→ match solid angle of survey

v. Assign galaxy properties

→ smooth k-correction:

interpolate between magnitudes

vi. Apply radial selection

→ select galaxies according to

multiple bands simultaneously

vii. Post-processing

→ completeness mask, photo-zs,

images …
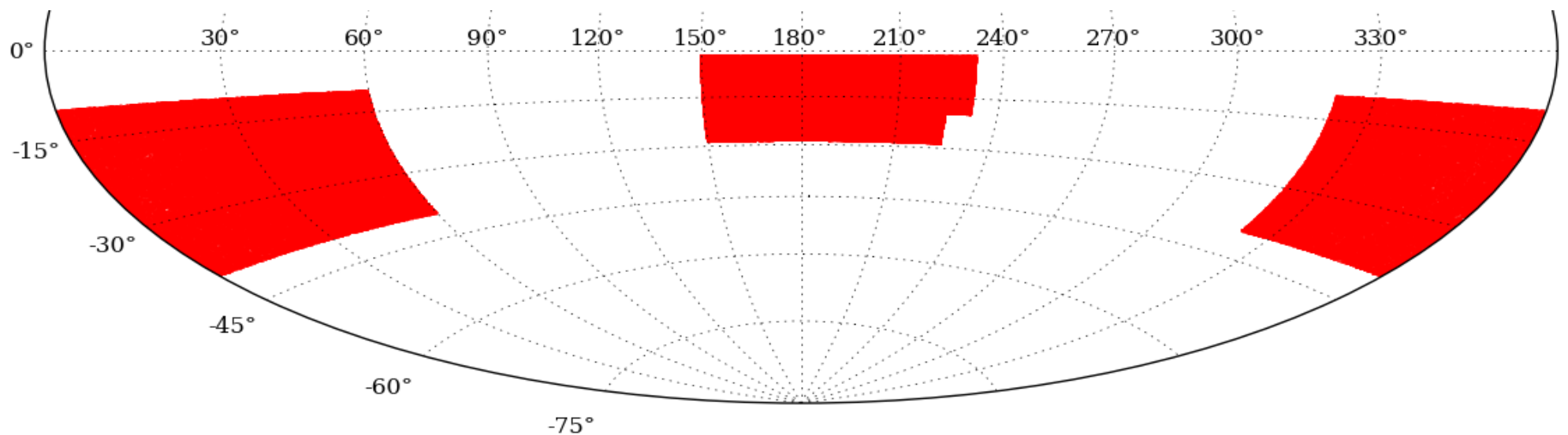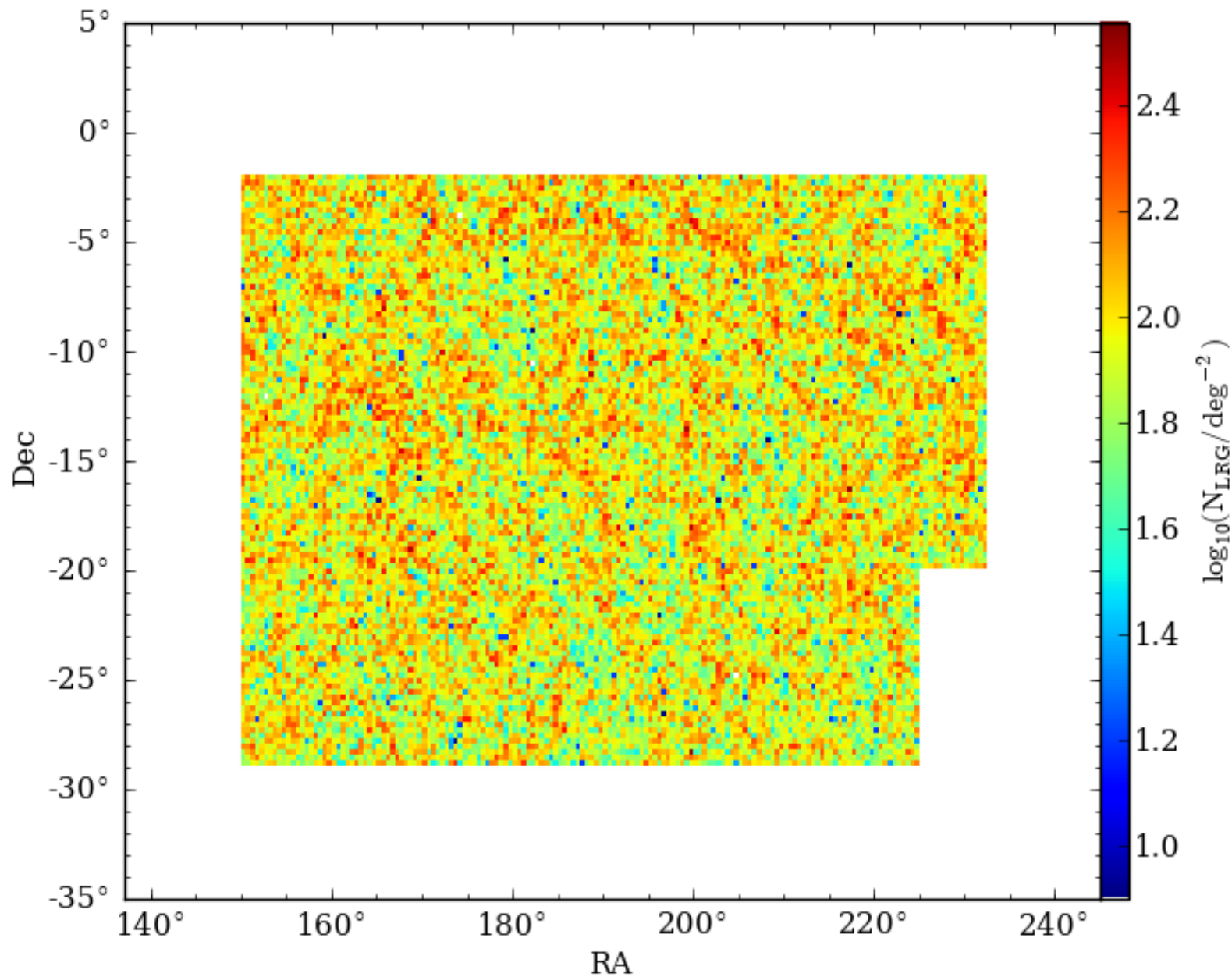
Mock Images

(Daniel Farrow)
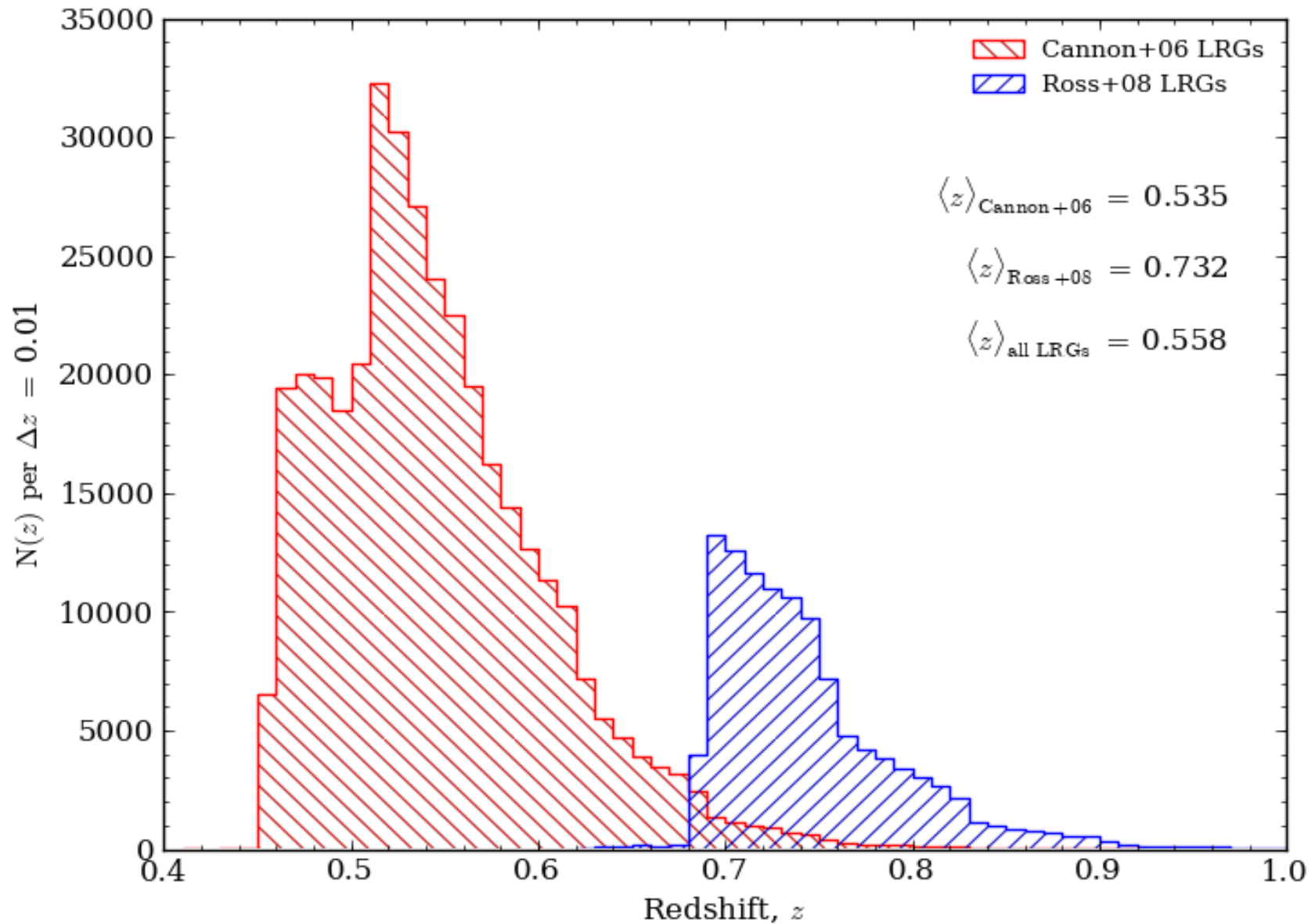
VST ATLAS lightcone

- Bower et al. (2006) GALFORM model
- 4500 deg^2 lightcone in VST ATLAS fields
- Approximately SDSS depth
   u < 22.0   g < 22.2   r < 22.2   i < 21.3   z < 20.5
- LRGs
   → Cannon et al. (2006) and Ross et al. (2008) cuts
   → ~470,000 LRGs with ~105/deg^2
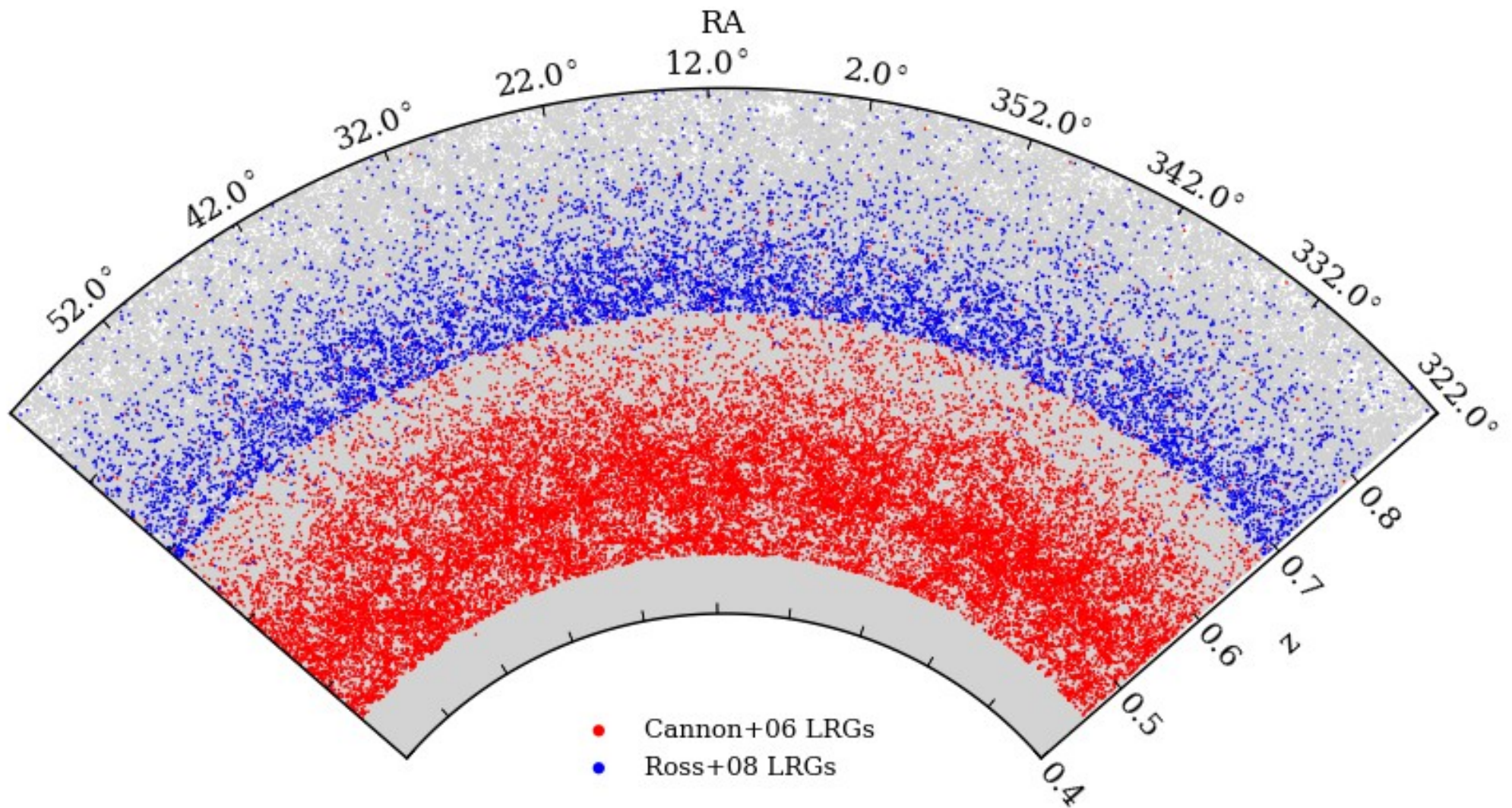
Lightcone: LRG sky density

Lightcone: redshifts

Lightcone: LRG distribution

Summary

- Lightcone synthetic "mock" catalogues
    - → constructed from Millennium Sim. + GALFORM model
    - → periodic replication of simulation box
    - → interpolation of galaxy positions
    - → smoothed k-correction
    - → select galaxies in multiple bands simultaneously
    - → post-processing (images, photo-zs)

- VST ATLAS lightcone
    - → 4500deg^2, ~SDSS depth
    - → ~470,000 LRGs (~105/deg^2, Cannon+06 & Ross+08 cuts)