

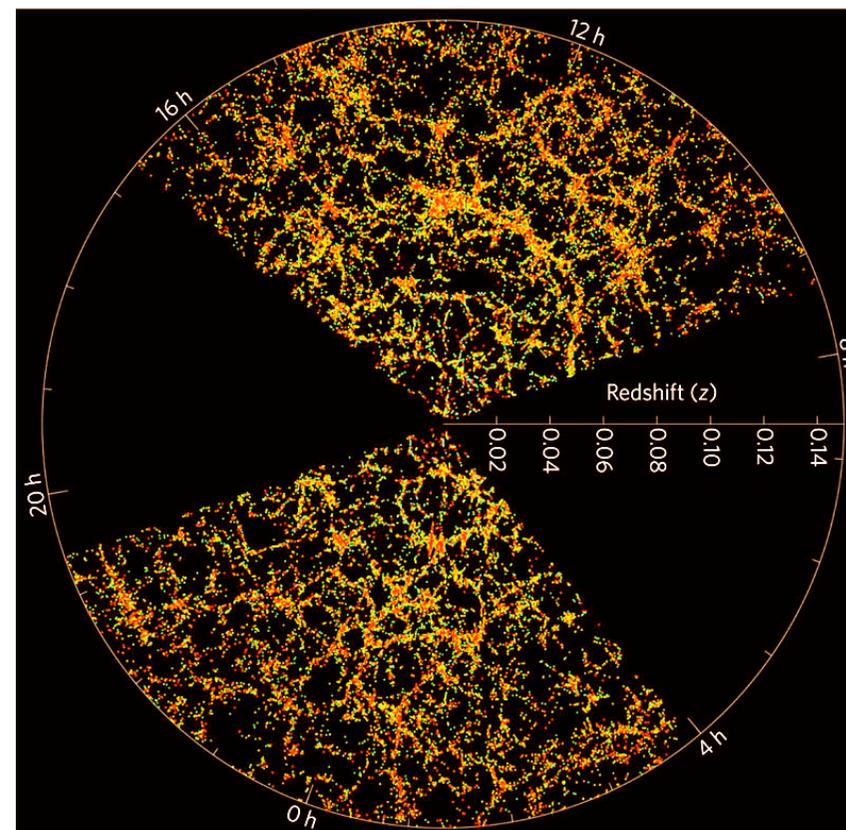
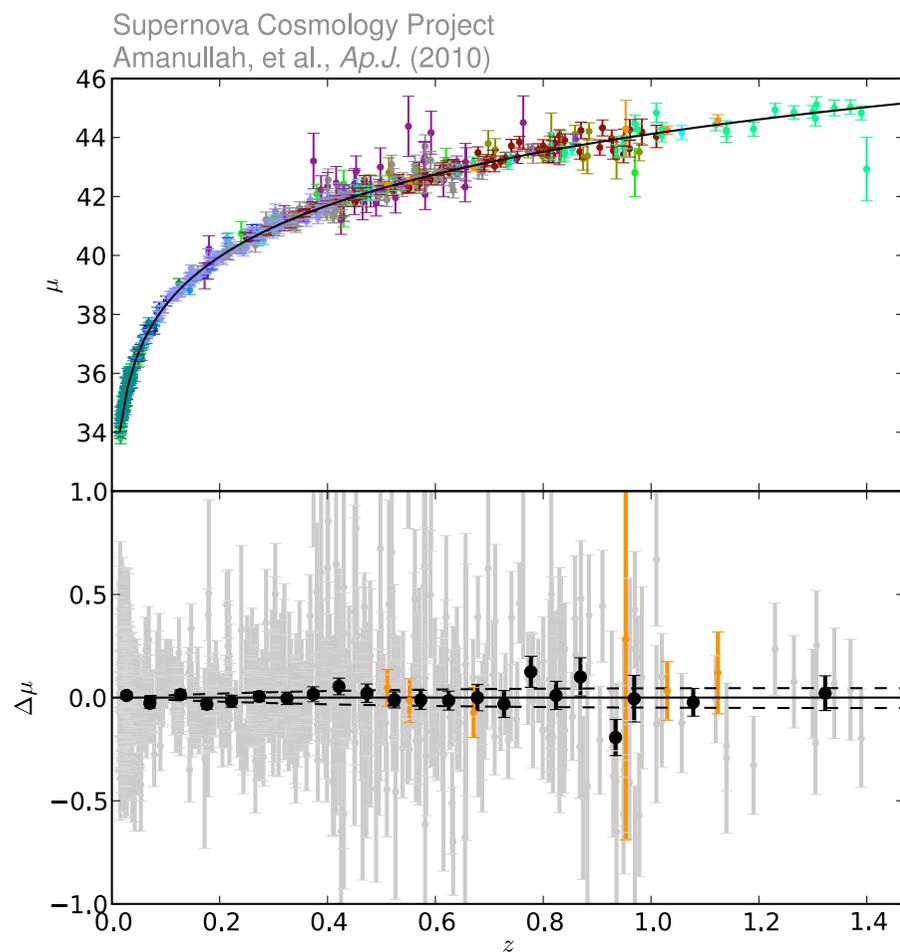
Science from overlapping
lensing / spec-z surveys

Chris Blake (Swinburne)

Probes of the cosmological model

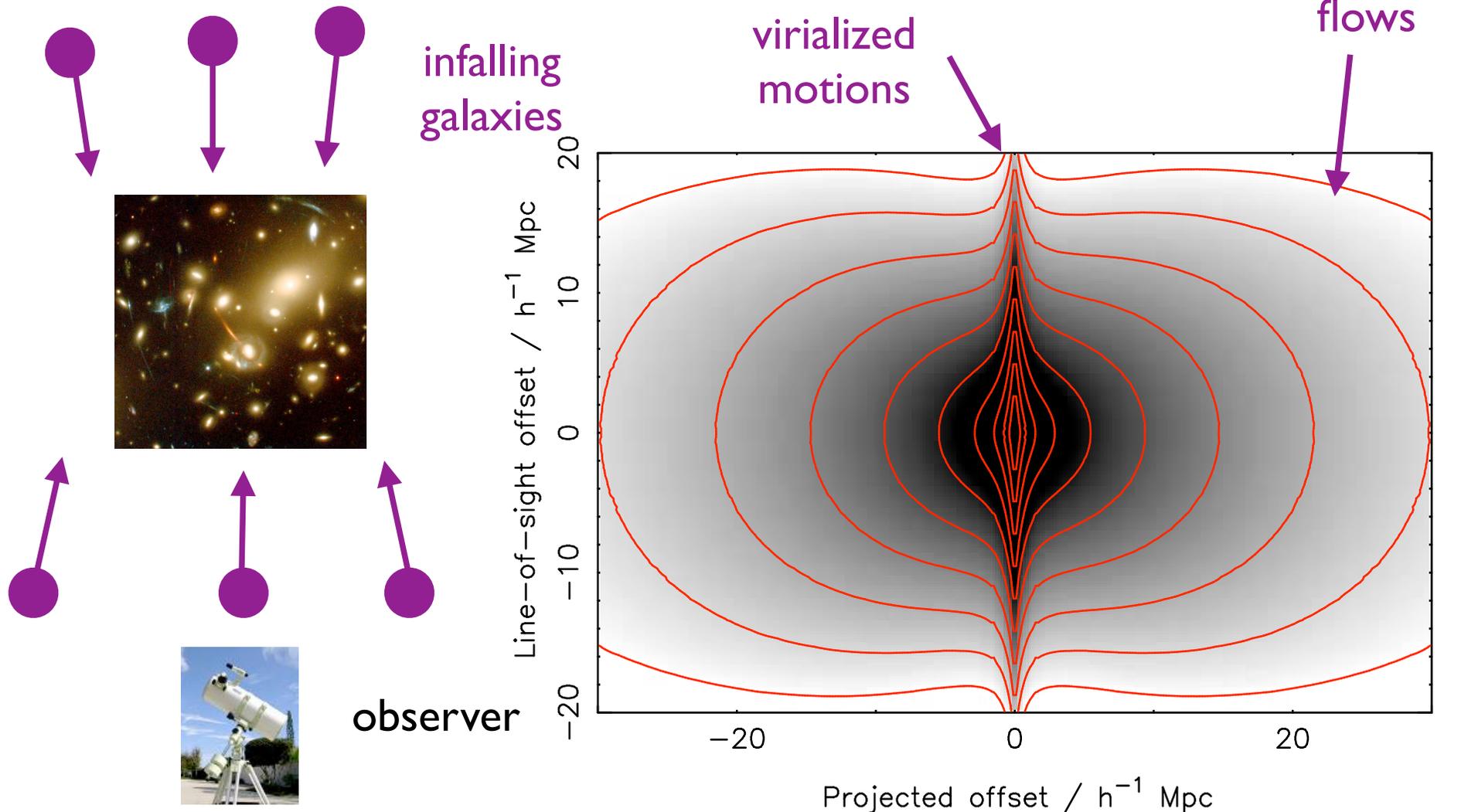
How fast is the Universe expanding with time?

How fast are structures growing within it?



Redshift-space distortions

- RSD allow spectroscopic galaxy surveys to measure the growth rate of structure



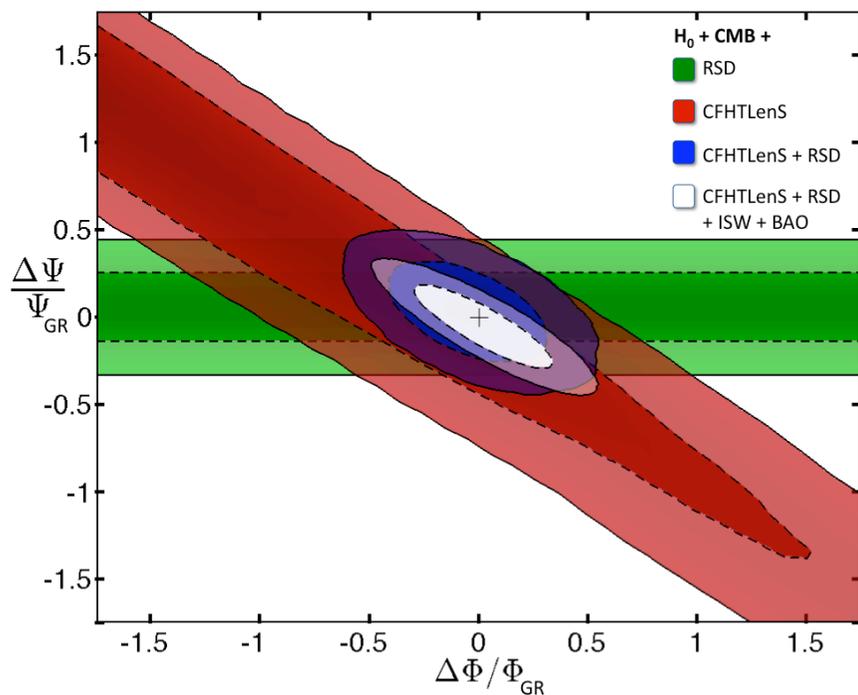
Why combination of lensing and RSD?

- Sensitive to **theories of gravity** in complementary ways
- General perturbations to FRW metric:

$$ds^2 = [1+2\psi(x, t)] dt^2 - a^2(t) [1-2\phi(x, t)] dx^2$$

- (ψ, ϕ) are **metric gravitational potentials**, identical in General Relativity but can differ in general theories
- **Relativistic particles** (e.g. light rays for lensing) collect equal contributions and are sensitive to $(\psi + \phi)$
- **Non-relativistic particles** (e.g. galaxies infalling into clusters) experience the Newtonian potential ψ

Applications



arXiv:1003.2185

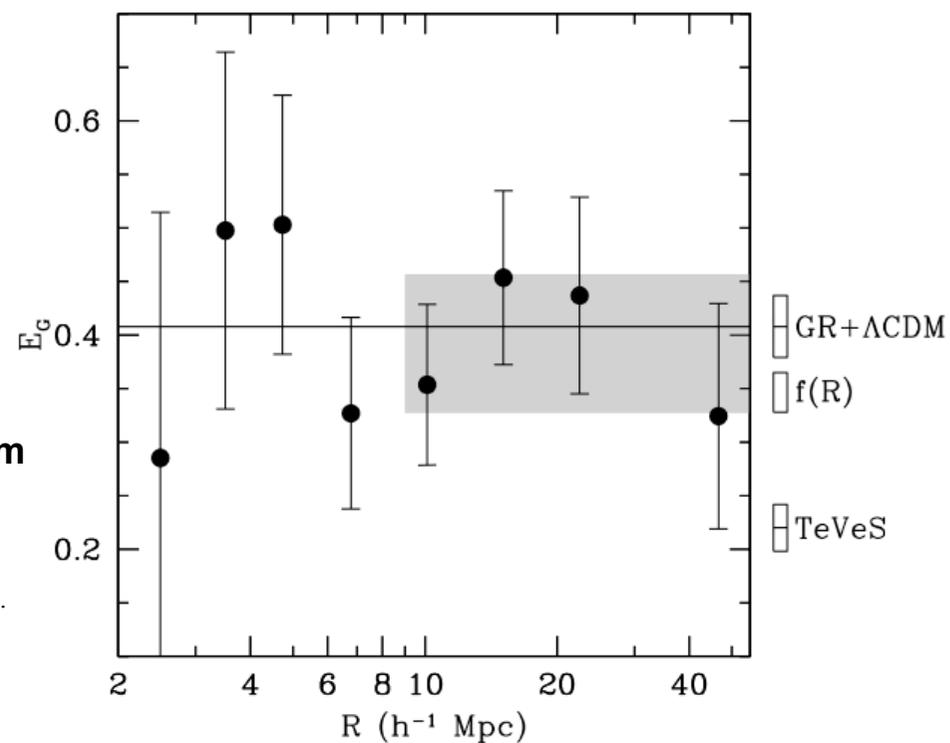
Confirmation of general relativity on large scales from weak lensing and galaxy velocities¹

Reinabelle Reyes¹, Rachel Mandelbaum¹, Uros Seljak²⁻⁴, Tobias Baldauf², James E. Gunn¹, Lucas Lombriser², Robert E. Smith²

arXiv:1212.3339

CFHTLenS: Testing the Laws of Gravity with Tomographic Weak Lensing and Redshift Space Distortions

Fergus Simpson^{1*}, Catherine Heymans¹, David Parkinson², Chris Blake³, Martin Kilbinger^{4,5,6}, Jonathan Benjamin⁷, Thomas Erben⁸, Hendrik Hildebrandt^{7,8}, Henk Hoekstra^{9,10}, Thomas D. Kitching¹, Yannick Mellier¹¹, Lance Miller¹²

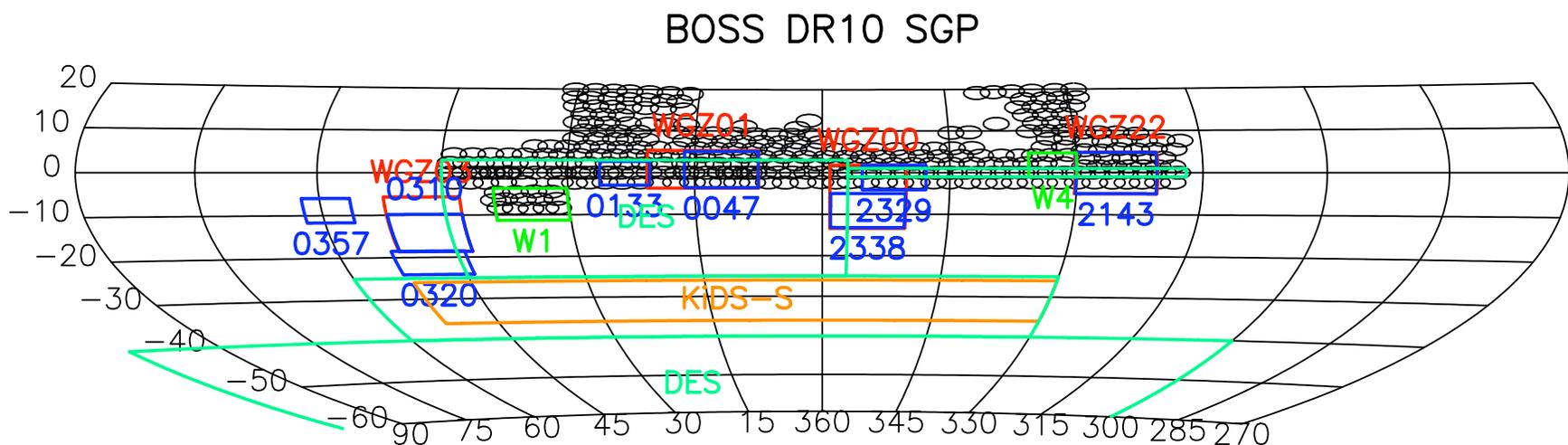
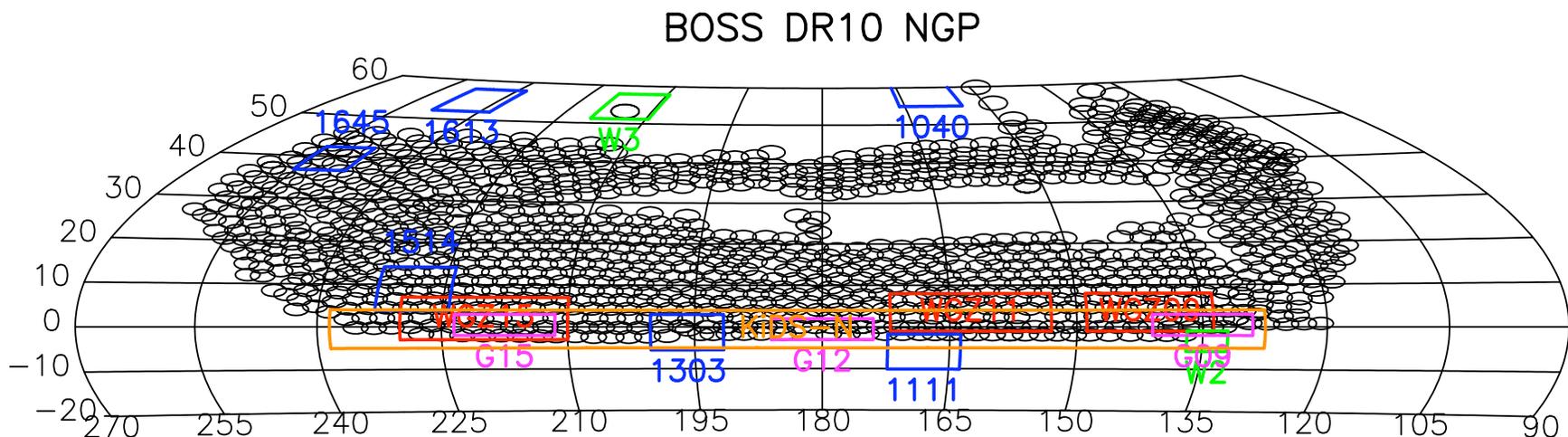


Overlaps of lensing and spec-z surveys

- Improvement of cosmological measurements through addition of **galaxy-galaxy lensing**
- [e.g. determines bias of lens sample which improves RSD measurements of lenses, especially when using multiple-tracer techniques, e.g. Cai & Bernstein (2012)]
- Spec-z survey allows **definition of lens samples** (e.g. groups, galaxy types) enabling a range of studies
- **Understanding, calibration and risk mitigation of systematic errors** (photo-z errors including outliers, intrinsic alignments, cosmic shear)

Overlaps of lensing and spec-z surveys

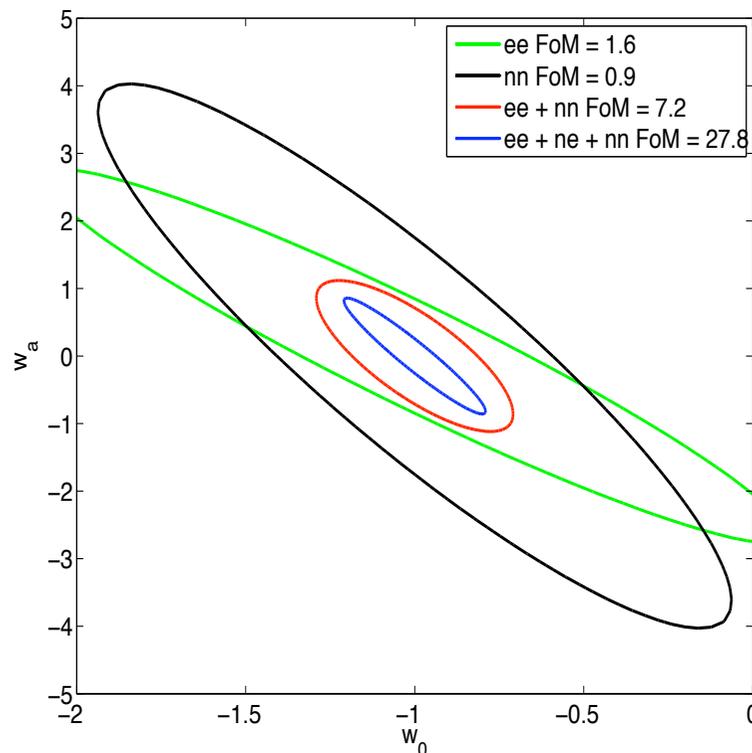
- Mis-match between imaging and spectroscopic surveys!



Overlaps of lensing and spec-z surveys

- Many recent papers considering impact for cosmology of **same-sky vs. different-sky** lensing/spec-z surveys

arXiv:1307.8062



Optimising Spectroscopic and Photometric Galaxy Surveys: Same-sky Benefits for Dark Energy and Modified Gravity

› Donnacha Kirk¹, Ofer Lahav¹, Sarah Bridle², Stephanie Jouvel³,
› Filipe B. Abdalla¹, Joshua A. Frieman⁴

› on the sky, producing a joint data vector and full covariance matrix. We calculate a same-sky improvement factor, from the inclusion of these cross-correlations, relative to non-overlapping surveys. We find nearly a factor of 4 for dark energy and more than a factor of 2 for modified gravity. The exact forecast figures of merit and same-sky benefits can be radically affected by a range of forecasts assumption, which we explore

- For me a key issue is **systematic error control**

Photometric redshift calibration

- **Photometric redshift errors** are one of the leading systematics for weak lensing tomography
- Mean and width of redshift distributions in each photo-z bin must be known to accuracy $\sim 10^{-3}$
- Method (1) : **spectroscopic training set** [issues : sample variance, incompleteness of training set, outliers]
- Method (2) : **photo-z/spec-z cross-correlations** [issues : degeneracies with galaxy bias, cosmic magnification]
- Can OzDES currently help with either method?

Photometric redshift calibration

- **Training set method** : suppressing sample variance systematic for DES weak lensing requires 100 AAOmega pointings or 5 VIPERS surveys !
- **Phot-z/spec-z cross-correlation method** : need $\sim 50,000$ spec-z's per unit redshift -- can use 2dFGRS, SDSS, BOSS at $z < 0.6$ and VIPERS at $z > 0.6$?
- **OzDES is not currently transformational** for this science, but photo-zs are still useful for other large-scale structure topics with less stringent requirements

Future AAT proposals?

- OzDES-wide proposed in March 2013 (150 nights, 3000 deg² coverage) - not approved
- Issue (1) : time now allocated to other projects (SAMI, OzDES-deep) - only 10-15 nights/semester remain?
- Issue (2) : can only observe DES fields in B semesters
- Issue (3) : need to map > 1000 deg² to be competitive (e.g. existing RCS2, future HSC projects)
- **Current status : musing on competitiveness of 2014B proposal targetting KiDS, later widening to DES?**