Calibrating Multiplicative Bias In CFHTLenS Using Cross-Correlation

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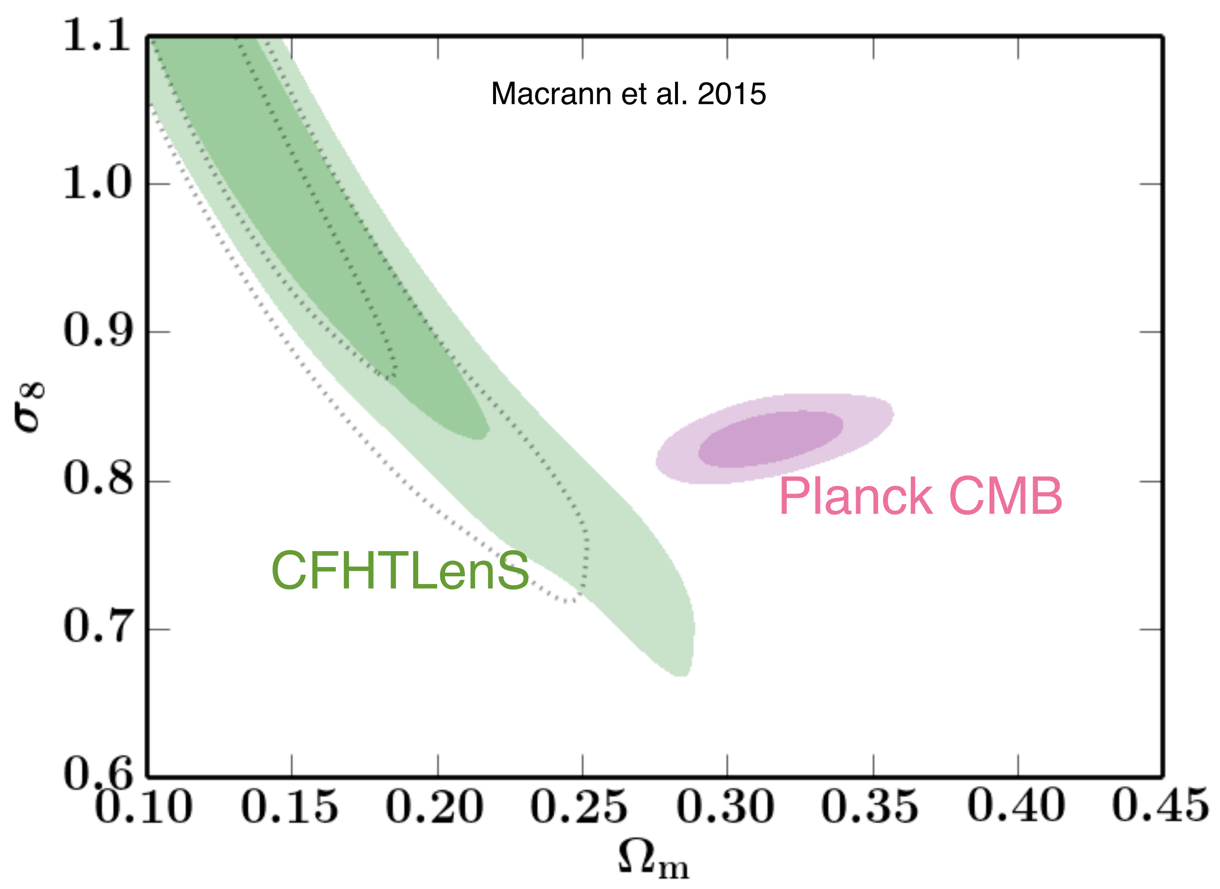
1. Background:

Weak lensing surveys can help us understand the the nature of dark energy. However, lensing surveys can be subject to systematic errors due to uncertainties in galaxy shapes, atmospheric effects, galaxy distances and redshift.

Multiplicative bias in the shear signal can result in deviations in cosmological parameter estimation. In this project we calibrate this multiplicative bias by cross correlating the signal from the CFHTLenS (may be biased) with the Planck CMB convergence maps (not biased).

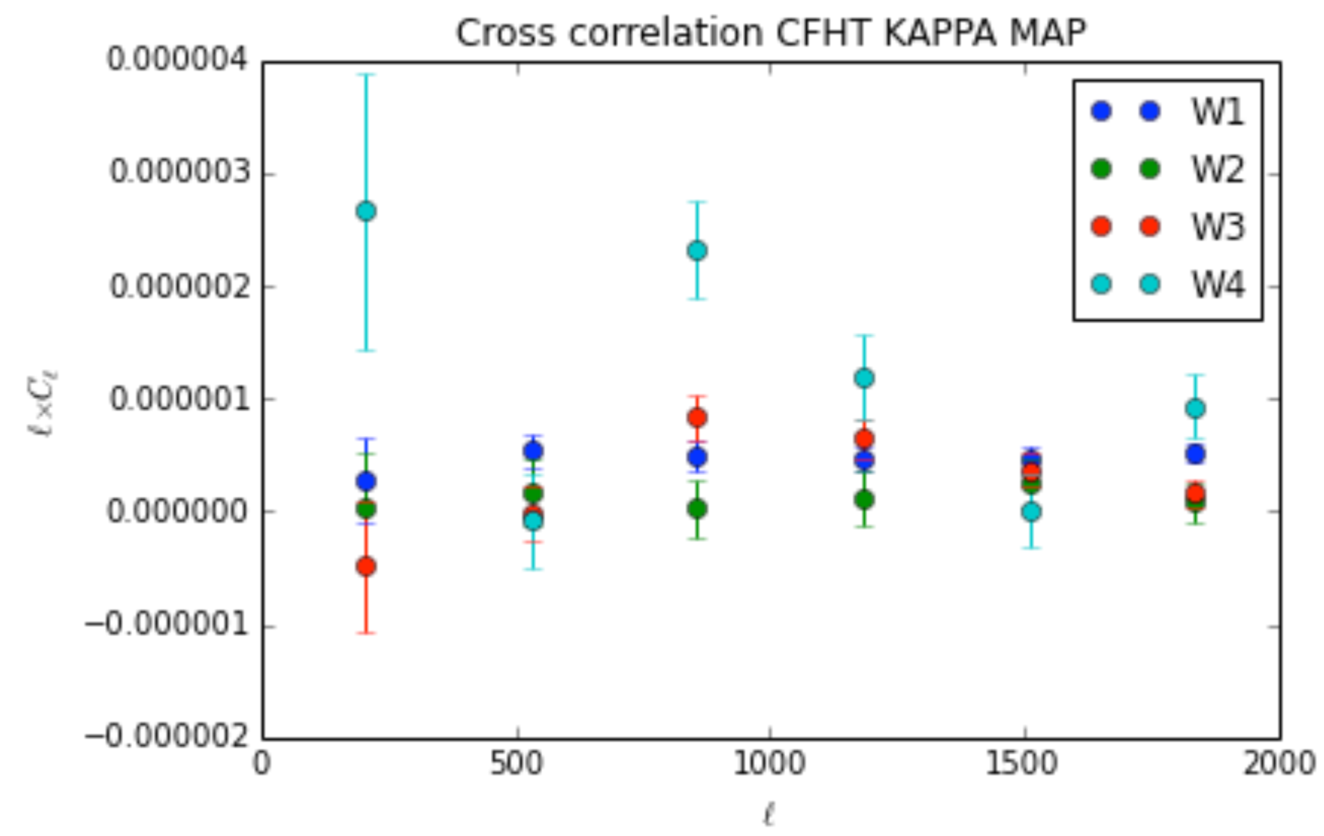


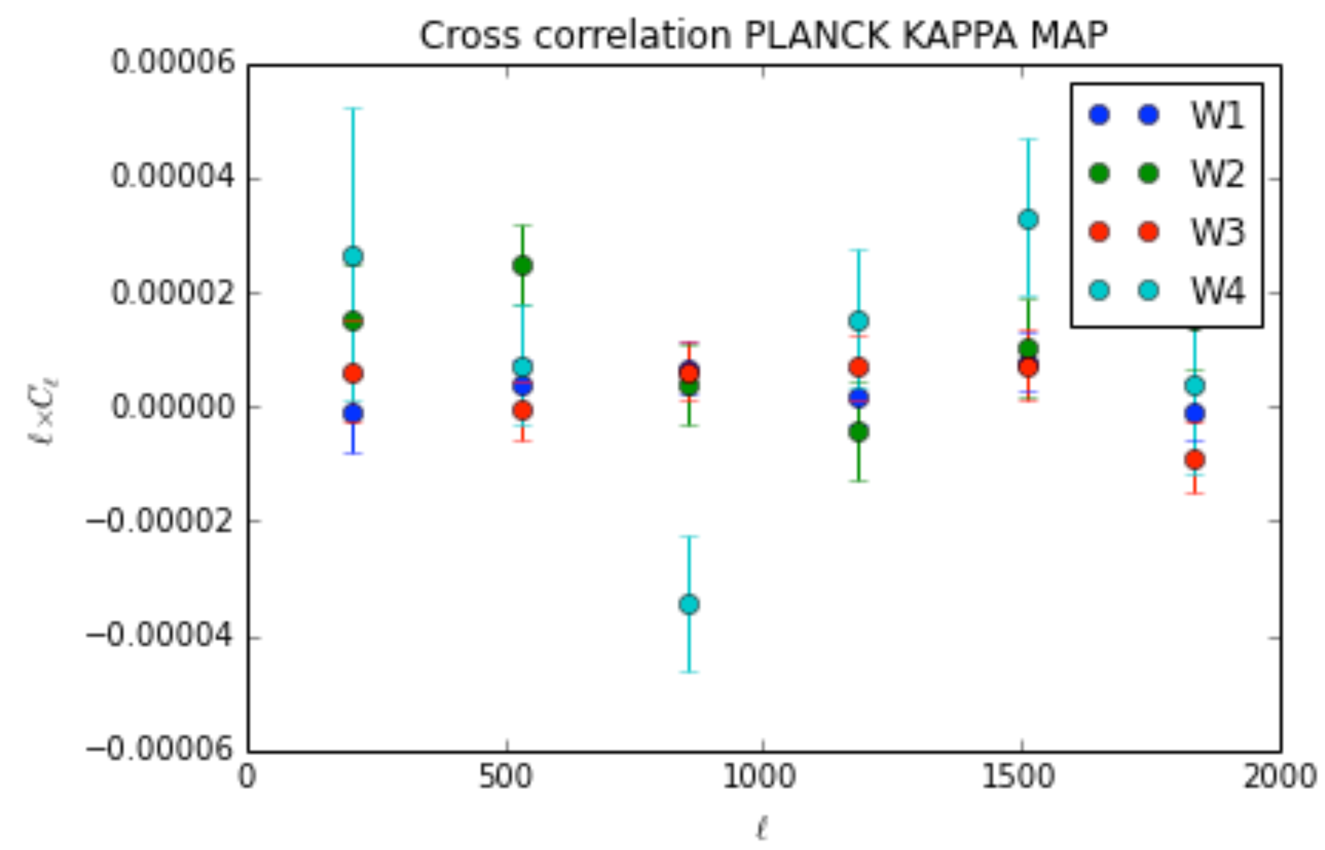
3. Motivation:

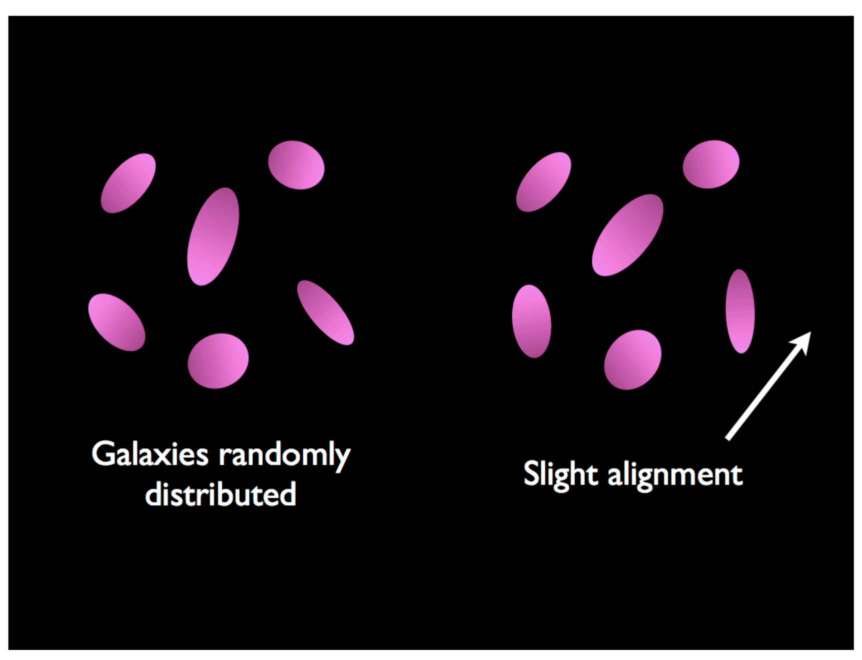
The clustering amplitude (σ_8) and dark matter density (Ω_m) predicted by the CFHTLenS survey (Green) and the Planck CMB Survey (Purple) show 2σ discrepancy. This can be due to our incomplete understanding of cosmology, or systematics such as the multiplicative bias. We test the latter in this work.

5.Results:

The figures below show the cross correlation between our galaxy density maps, with redshift cuts $18 < i < 22$ to reduce discrepancies in the exposure times and depth of the observation.







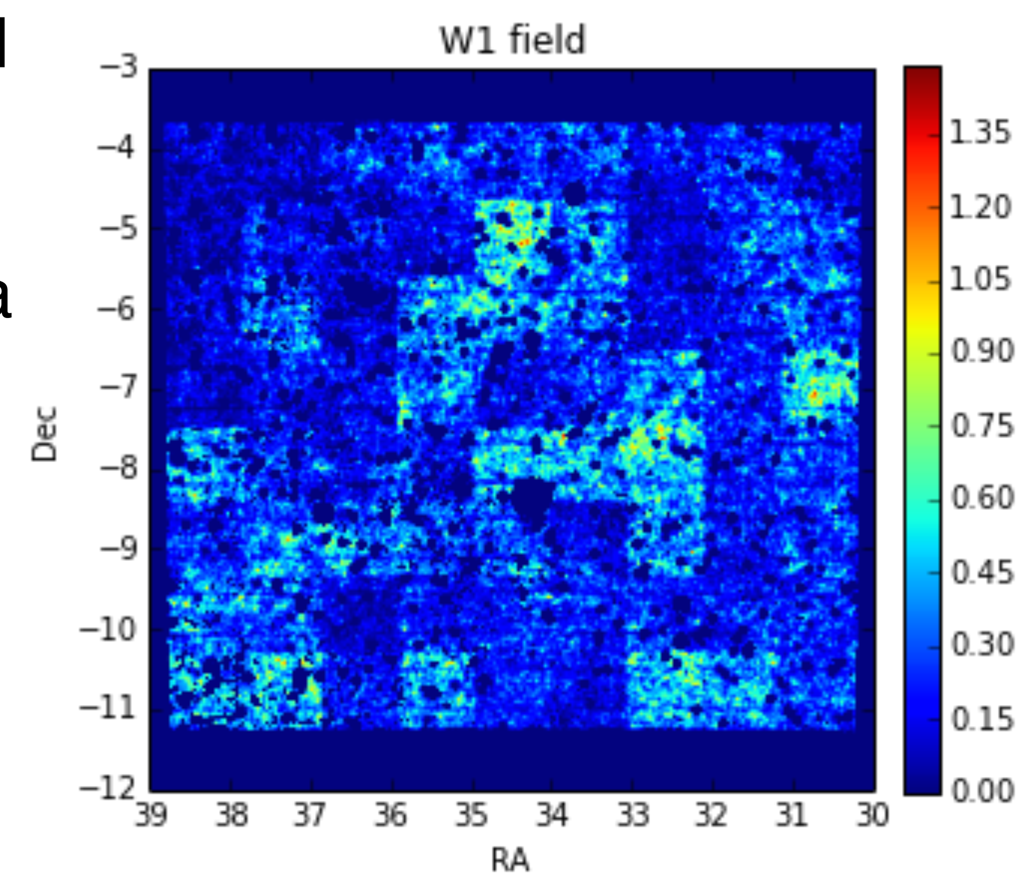
Source: E Grocutt, IfA, Edinburgh

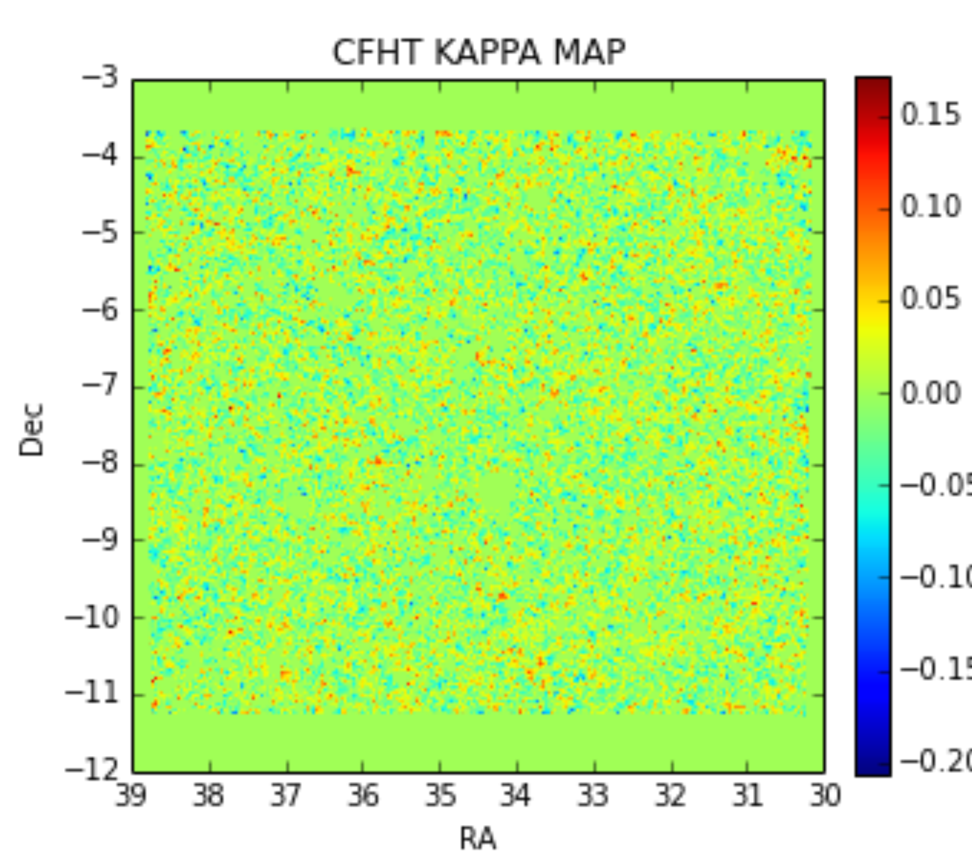
2. Weak Lensing:

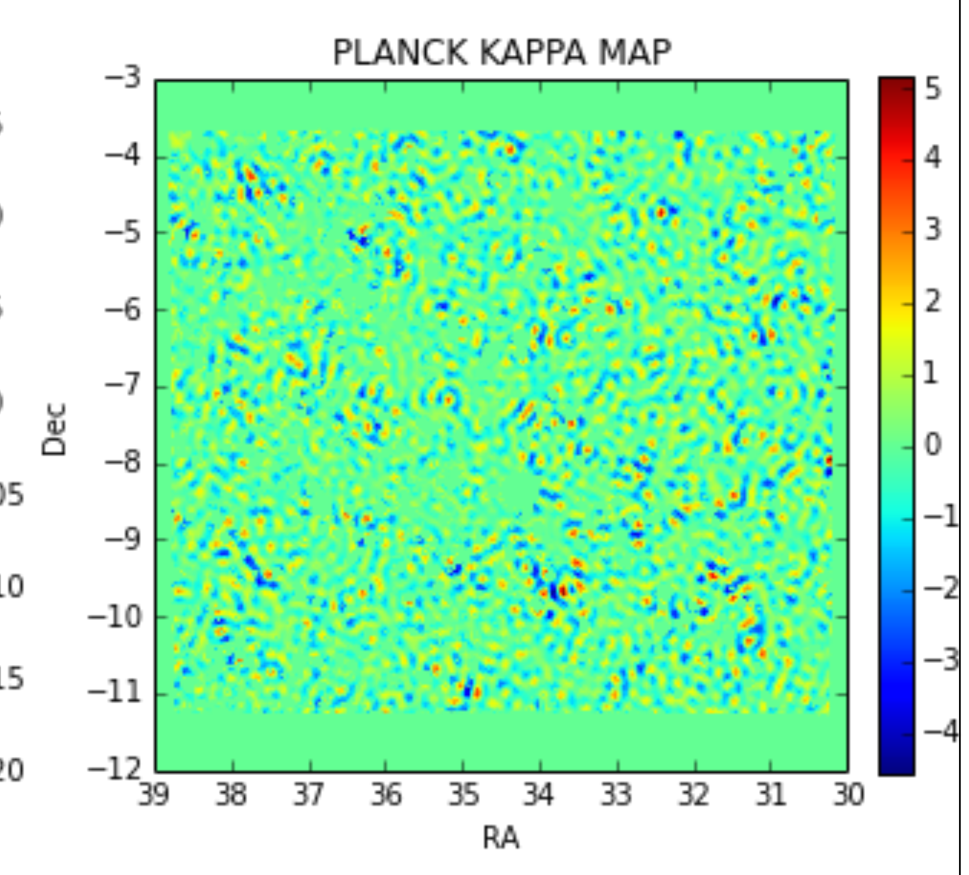
Weak lensing occurs all over the universe due to the presence of dark matter between astronomers and background galaxies. As the intrinsic shape of galaxies is unknown, we average over a large set of galaxies to infer the underlying mass, with the assumption that galaxies are randomly oriented.

4.Survey:

For this analysis we looked at CFHTLenS wide fields and generated galaxy density maps from the data (right). We then compared them to the CFHTLenS (bottom left) and Planck CMB (bottom right) convergence maps.







6. Further work:

Using the cross-correlation results, we will calculate the multiplicative bias factor *m* (Das et al. 2013):

$$\frac{C_\ell^{\kappa_{\rm opt}\Sigma}}{C_\ell^{\kappa_{\rm CMB}\Sigma}} = m\frac{g_{\rm opt}(\eta)}{g_{\rm CMB}(\eta)}$$

Future surveys with more objects will allow for more accurate prediction of cosmological parameters. This research will be important to remove the systematic errors in lensing surveys.