Cosmic Magnification Detection in COSMOS30

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Motivation

We aim to study Dark Matter halos, as a cosmological probe of structure formation and evolution. Weak Lensing is a powerful tool for mapping halos, but so far only to modest redshift (z~1). Magnification (in contrast to shear) can extend the regime of WL analysis to much higher redshift, as difficult shape measurements are not required. This new method merely relies on distant source detection (objects need not even be resolved!), cross-correlated with stacked foreground massive lenses, as well as accurate photometry.

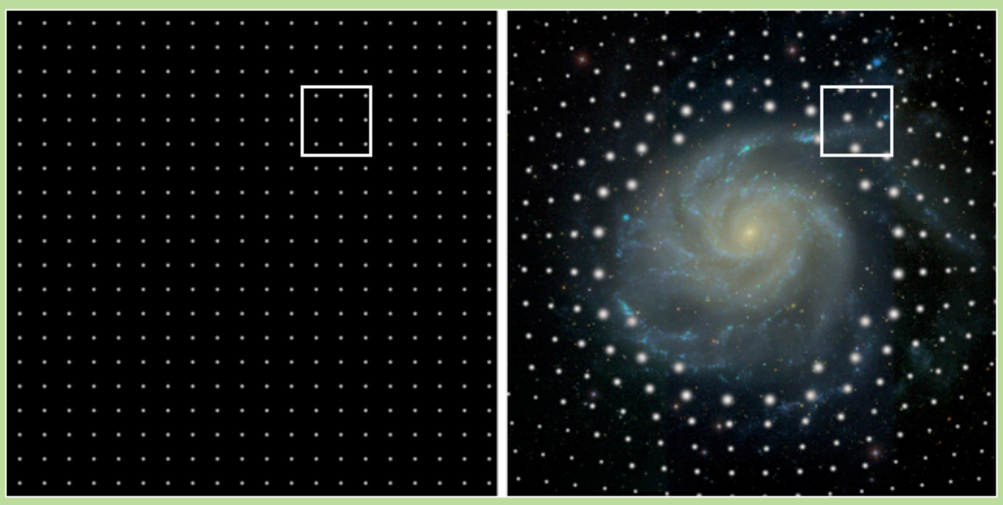
Dilution vs Amplification

The two COMPETING effects of Magnification:

- ★ **Sources get brighter (flux amplification)**
- ★ **The sky solid angle is stretched (dilution)**

$$N(>f) = \mu^{-1} N_o(>\mu^{-1} f)$$

(N= observed source counts; N_o= unlensed counts)



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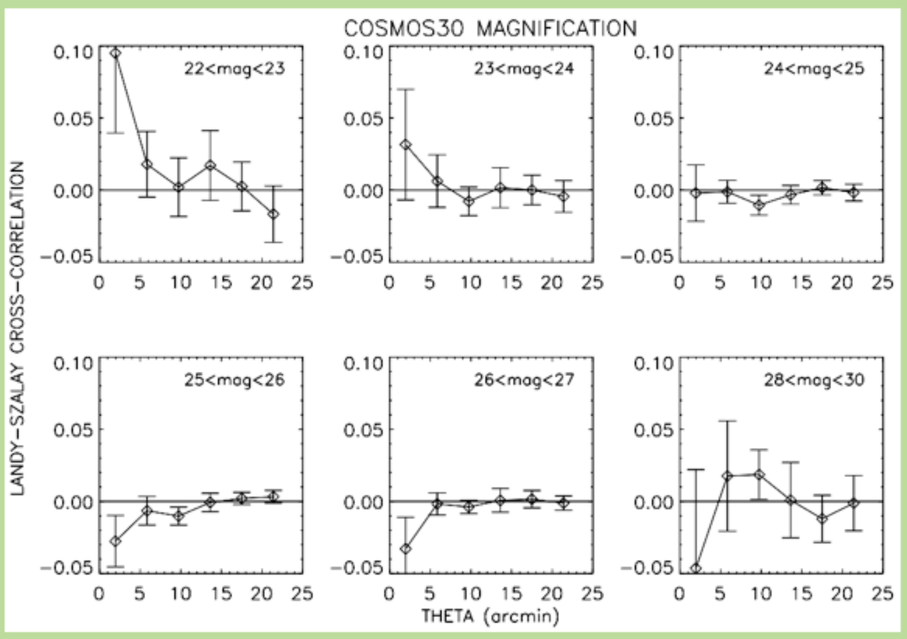
Who wins? Do we expect MORE sources because of brightening? Or LESS sources from dilution?

$$N(m,\theta)dm = \mu^{\alpha-1} N_o(m)dm$$

$$\alpha - 1 = 2.5\frac{d\log n(m)}{dm} - 1 \begin{cases} > 0 : \text{amplification wins} \\ < 0 : \text{dilution wins} \\ = 0 : \text{effects cancel} \end{cases}$$

Data & Results

- ★ **SOURCES: ~1/2 million high redshift galaxies in COSMOS30 ($1.2 < z < 6$)**
- ★ **LENSES: 61 most massive ($>10^{13.6}\,M_\odot$) Xray selected groups in the COSMOS field**



As expected…

- ★ **Bright source galaxies (α-1 > 0) are correlated with the lens sky positions**
- ★ **Intermediate galaxies show no correlation**
- ★ **Faint galaxies appear anti-correlated**

Note: this anti-correlation is an important indicator that there is no physical overlap between lens and source populations

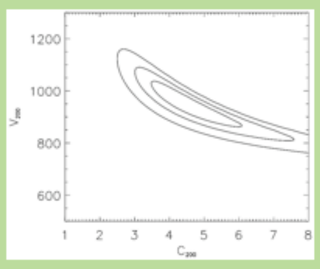
Prospects & Future Work

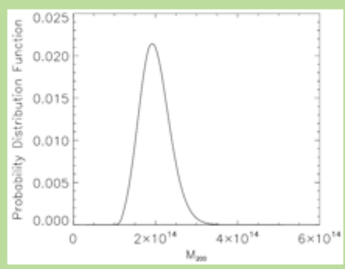
This is a work in progress!… Whats next?

- ★ **Optimize selection of sources according to redshift of each lens, to use more galaxies**
- ★ **Measure (α-1) on a complete galaxy sample & combine magnitude bins to measure μ**
- ★ **Weigh high-z dark matter halos!**

Below - prediction of magnification constraints possible on NFW parameters with a 200 deg² survey:†

V_{200} vs. C_{200}





M_{200}

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References

† **Van Waerbeke L., Hildebrandt H., Ford J., Milkeraitis M., 2010, submitted to ApJ Letters, arXiv:1004.3793v1**
Hildebrandt H., Van Waerbeke L., Erben T., 2009b, A&A, 507, 683
* **Image credit: Colberg, Scranton, Lupton, SDSS**