Cosmic Magnification as a probe of Cosmology

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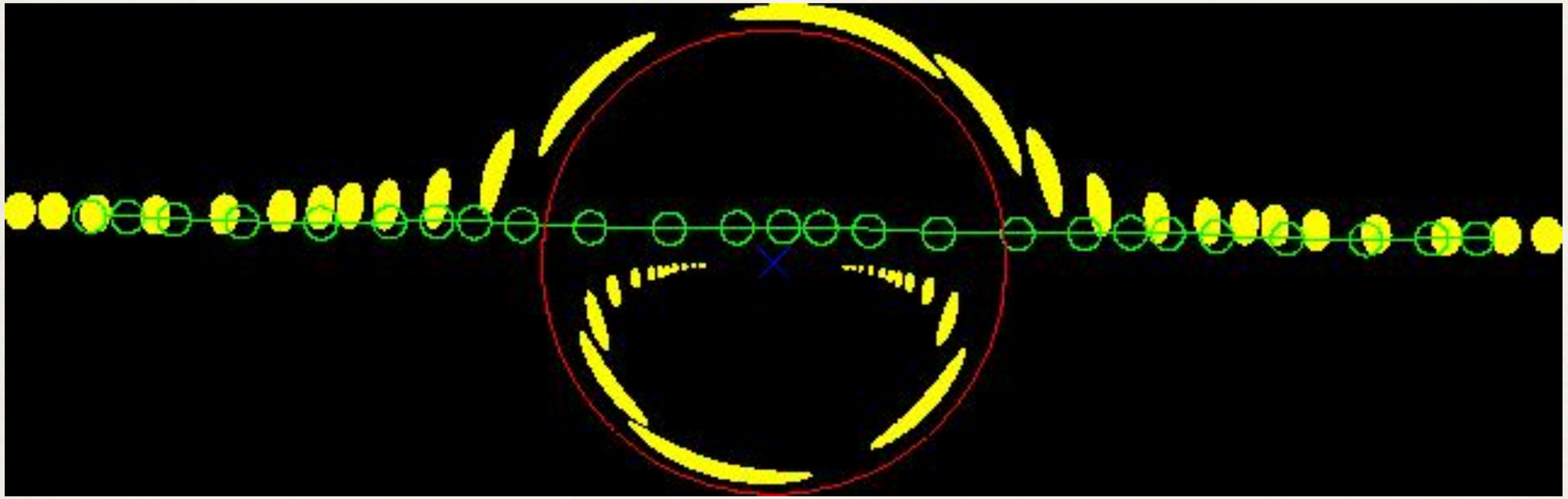
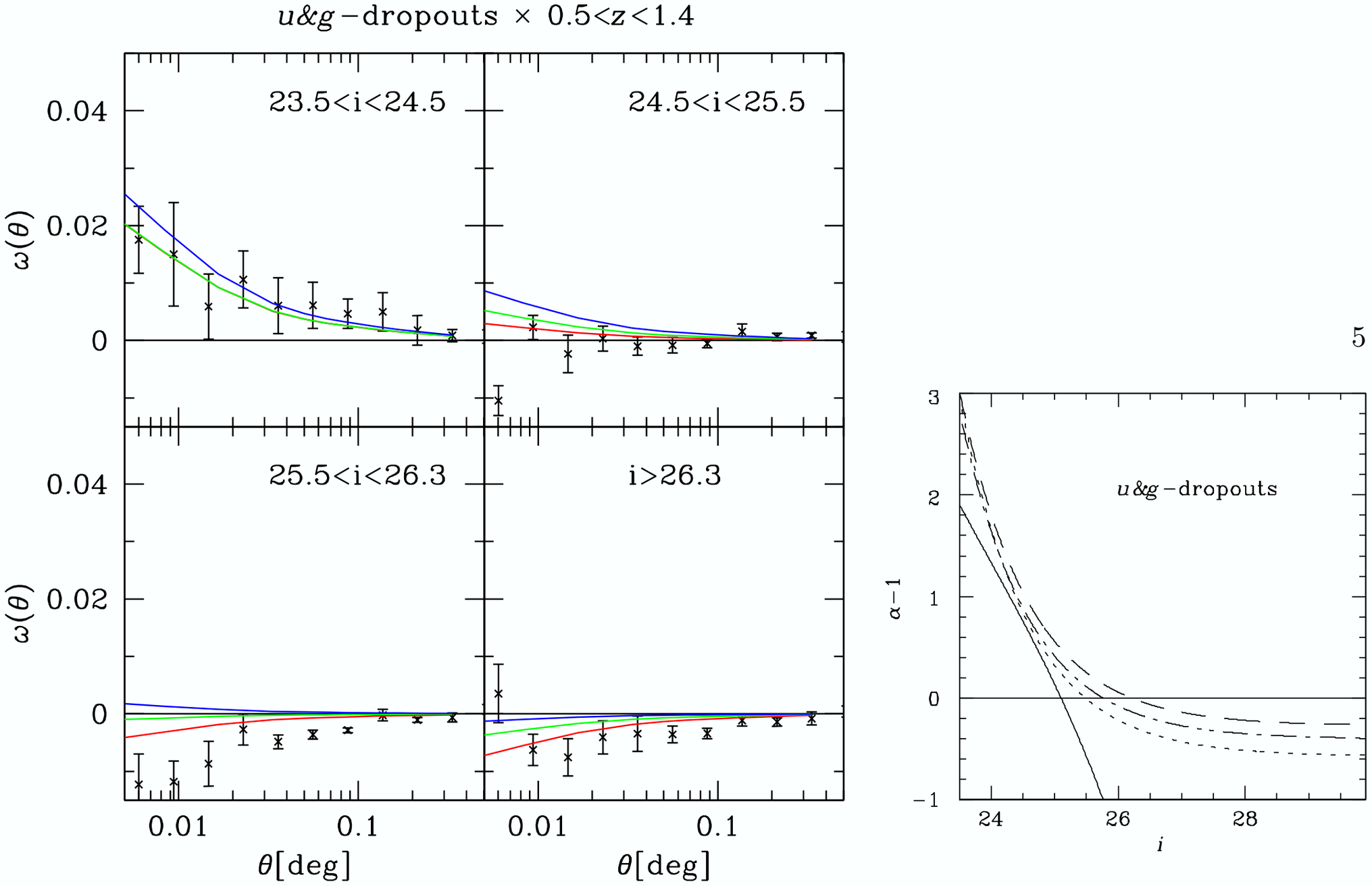
Credit: ESA/Hubble

Cosmic Magnification



$$n(>S,z) = \frac{1}{\mu(\vec{\theta},z)}\, n_0\left(> \frac{S}{\mu(\vec{\theta},z)}, z\right) \xrightarrow{n_0(>S)\propto S^{-\alpha}} n(>S,\vec{\theta}) = \mu^{\alpha-1}(\vec{\theta})\, n_0(>S)\ .$$

$$\delta n_m(>S,\bar{\theta}) = 2(\alpha-1)\kappa(\bar{\theta})$$



Data from CFTHLS Deep
Source z ~ 3
Foreground 0.5 <z< 1.4

Credit: Hildebrandt et. al 2009; CARS: The CFHTLS-Archive-Research Survey III. First detection of cosmic magnification in samples of normal high-z galaxies

Theory

- Three separate contributions to observed number density of galaxies on sky

$$n = \delta n_m + \bar{n}(1 + \delta_g)$$

$$\propto \kappa(\Omega_m, \delta_m, r) \qquad = b(k, r)\delta_m$$

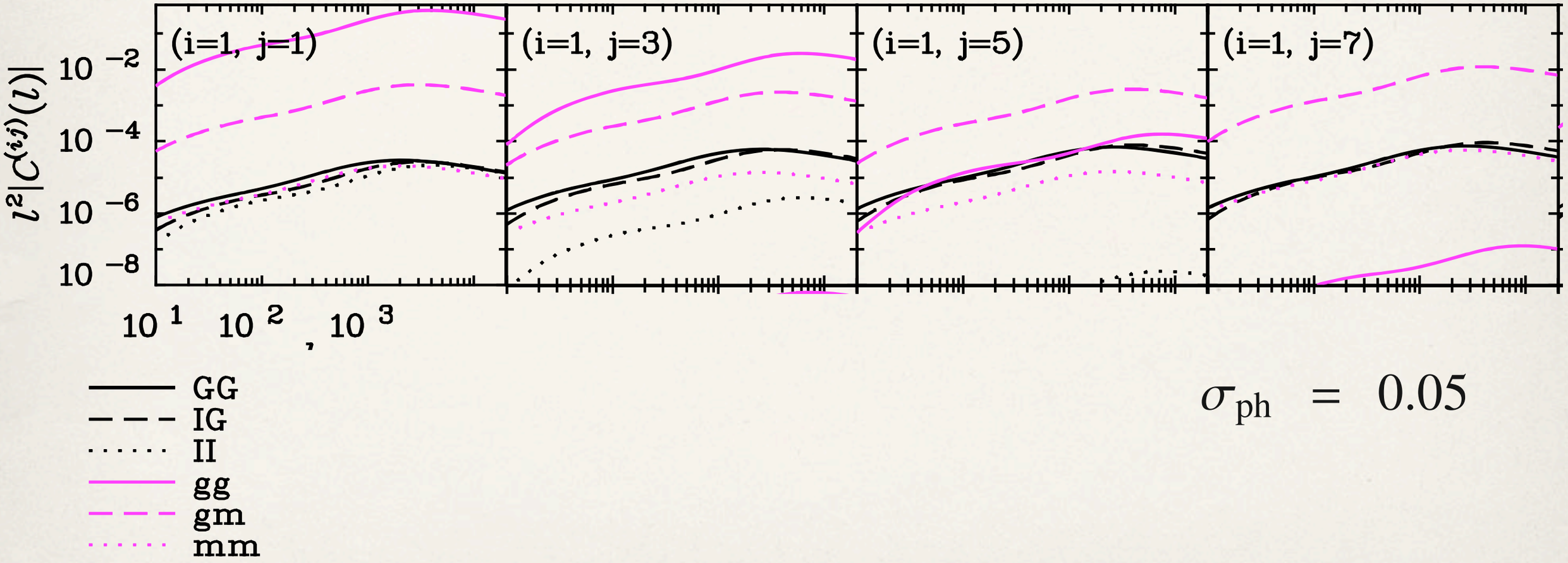
- Leads to four terms in the number (over)density power spectrum:

$$P^{ij}_{\delta n} = P^{ij}_{mm} + P^{ij}_{gm} + P^{ij}_{mg} + P^{ij}_{gg}$$

- Dependence on matter density and distribution, independent of type of matter.

- Dependence on evolution history of Universe - handle on Dark Energy.

Measuring Magnification



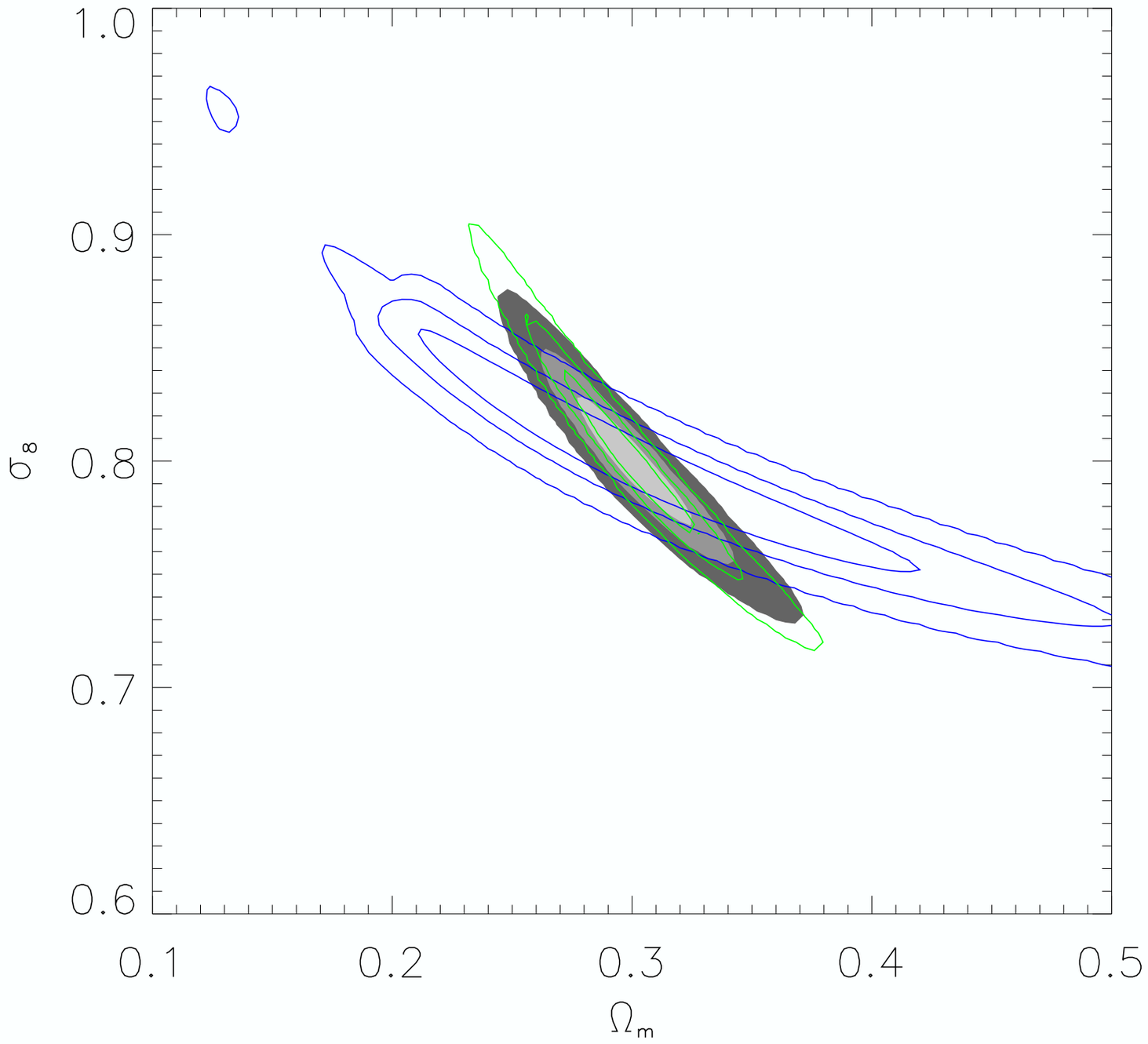
Credit: Joachimi, J., Bridle, S., "Simultaneous measurement of cosmology and intrinsic alignments using joint cosmic shear and galaxy number density correlations."

With b = 1.

Blue - Magnification

Green - Shear

Filled - Joint shear and Mag



Credit: Van Wearbeke - Shear And Magnification: Cosmic Complementarity

Measuring Magnification

- Cosmic shear suffers from measurement systematics, PSF and Intrinsic Alignments.

- With magnification we must be careful about:

  - Contamination from the gg term dominating the magnification signal.

  - Photo-z errors, including catastrophic photo-z's.

  - Spatial variation of the slope of the number counts.

  - Errors in magnitude determination.

Outstanding Work

- Gain a better understanding of systematics inherent in magnification analysis.

- Test impact of photometric redshift errors, and the limitations they impose on magnification.

- Investigate the level of S/N of magnification. Is it competitive to other independent probes of cosmology, such as cosmic shear?

- Detail potential gains in using magnification, either as independent probe or as a complementary technique.