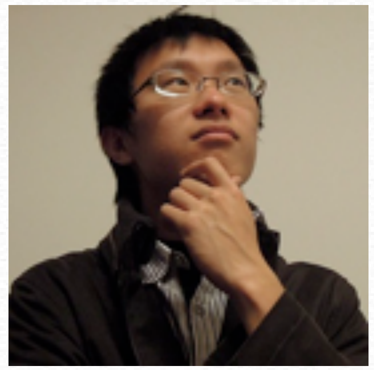
Euclid weak lensing

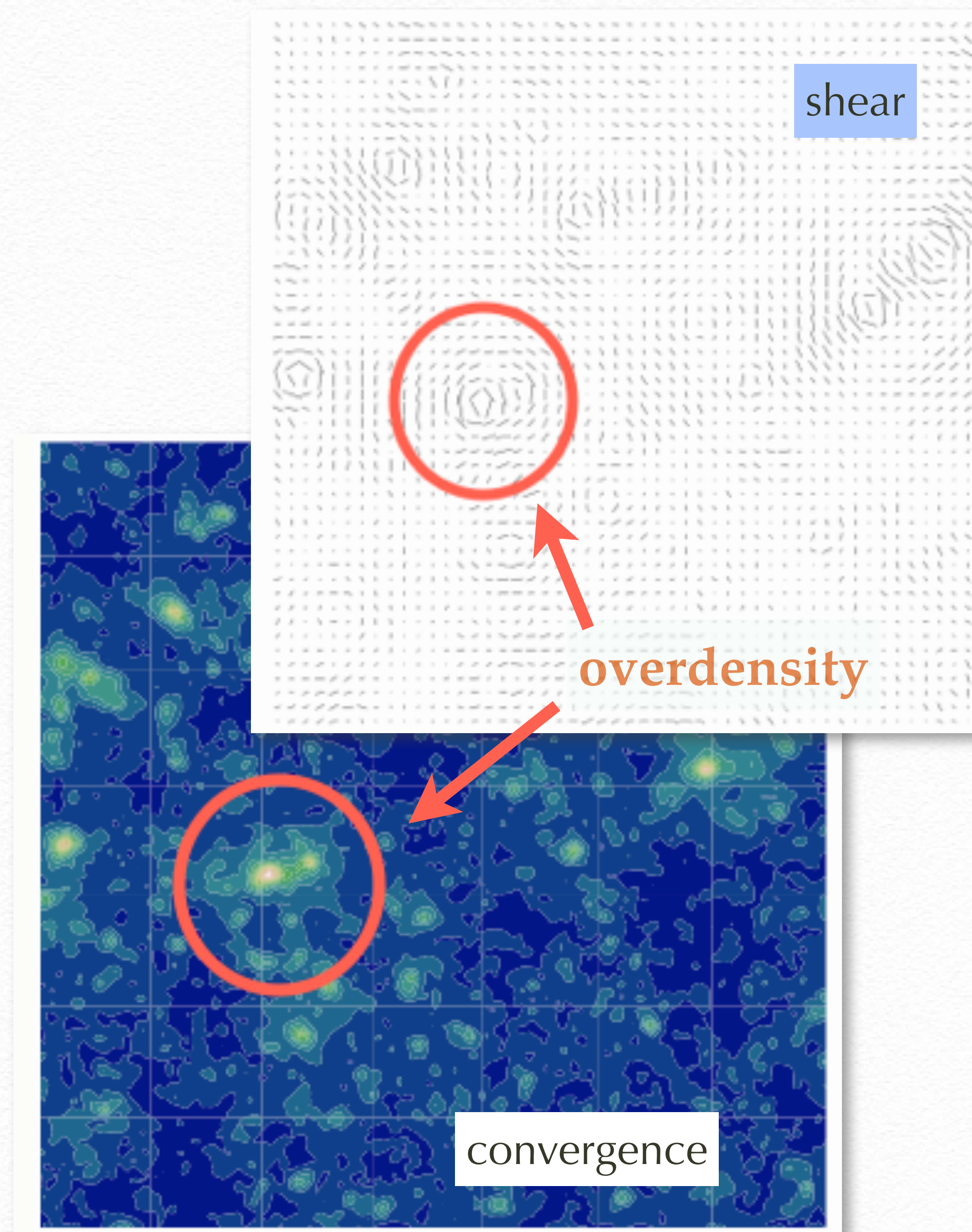
OU-Shear
OU-Level3
Weak lensing working group

Martin Kilbinger, CEA Saclay

WL peak counts



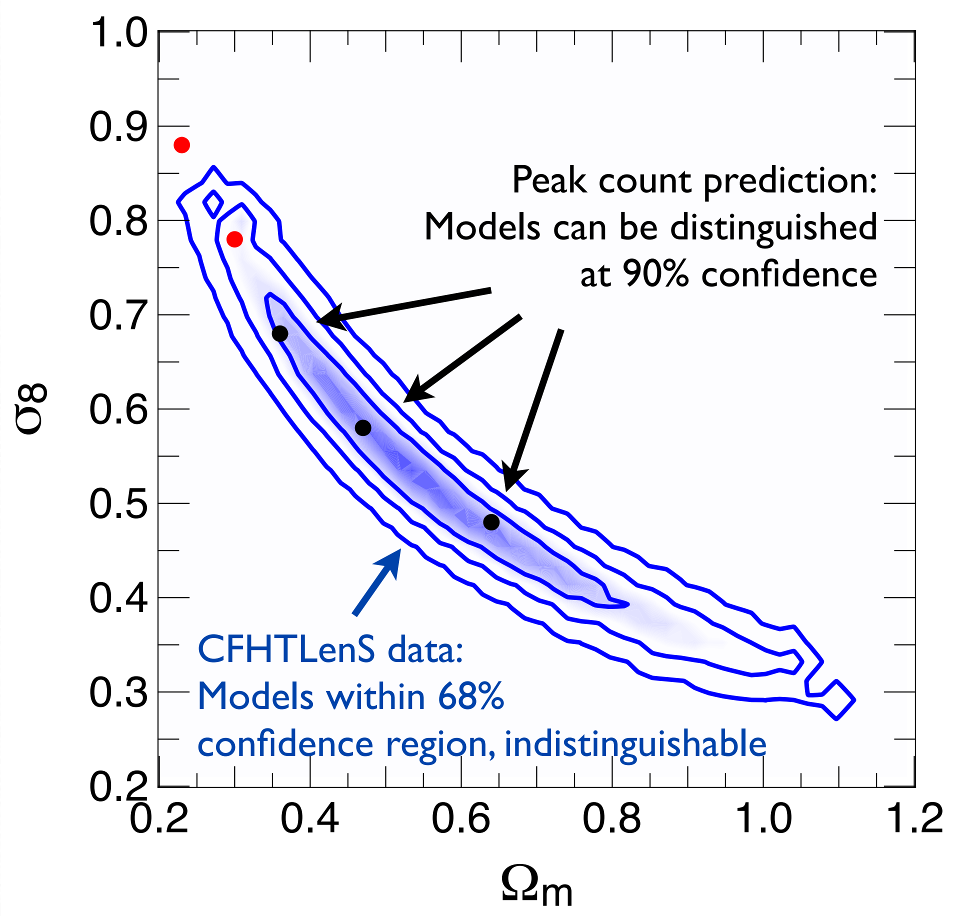
Chien-An Lin's PhD thesis



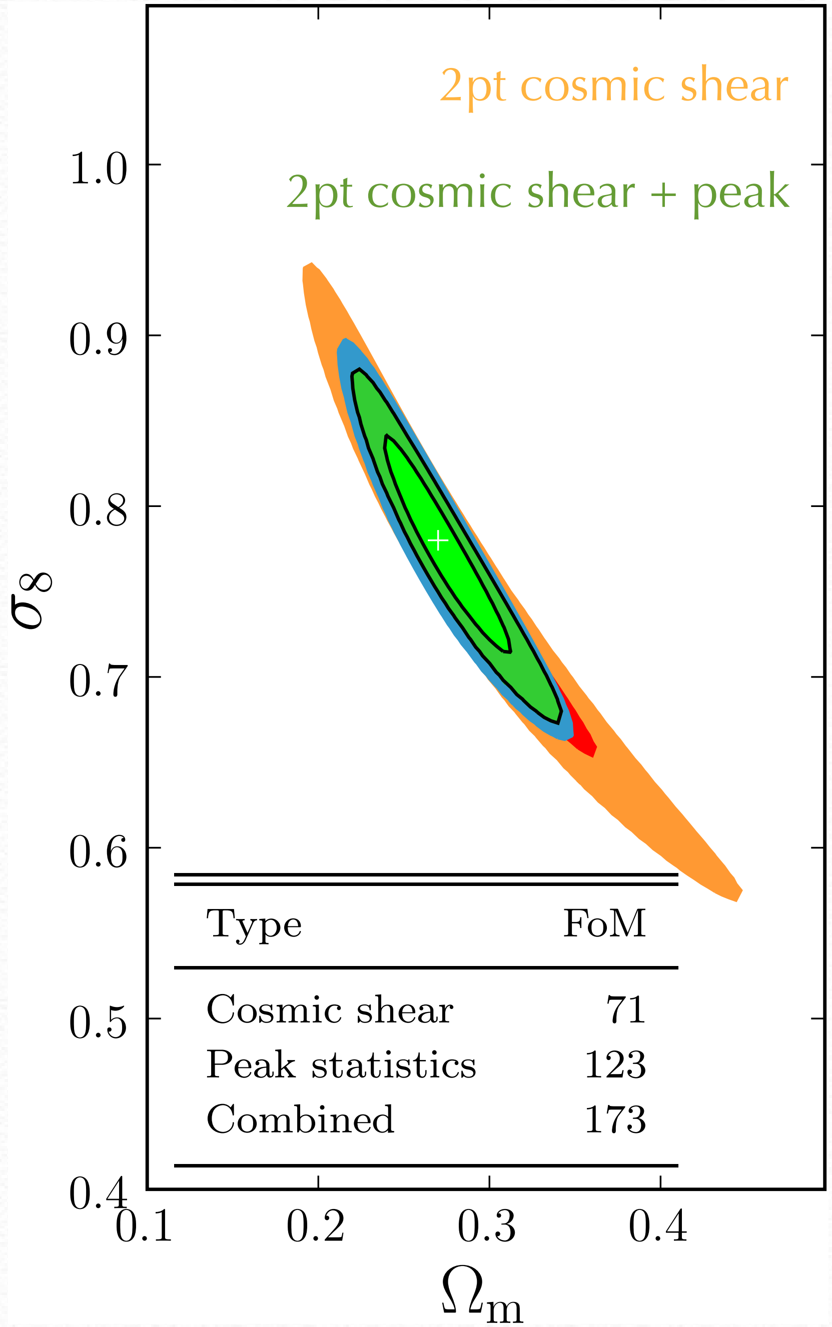
- Number of peaks in weak-lensing maps, as function of S/N, z
- High-density regions → measure of non-Gaussianity of LSS
- First-order in ellipticity
- Not (yet?) a Euclid requirement, but increasingly active

WL peak counts

- Complementary to power spectrum (2pt cosmic shear), new information on cosmology



Data (blue): Kilbinger et al. 2012
Prediction (black): adopted from Pires, Leonard & Starck 2012



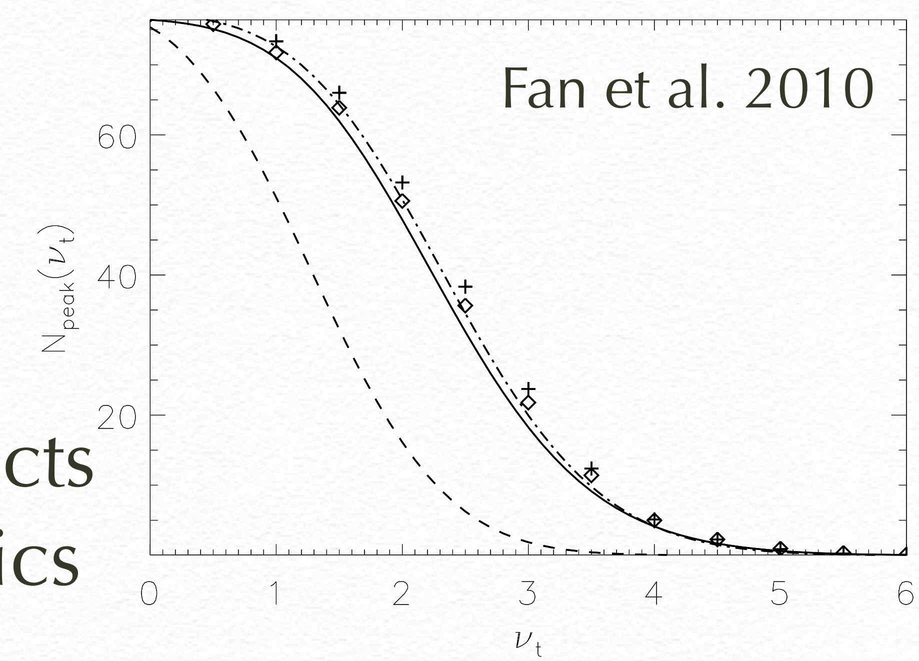
Type	FoM
Cosmic shear	71
Peak statistics	123
Combined	173

Dietrich & Hartlap 2007

WL peak counts

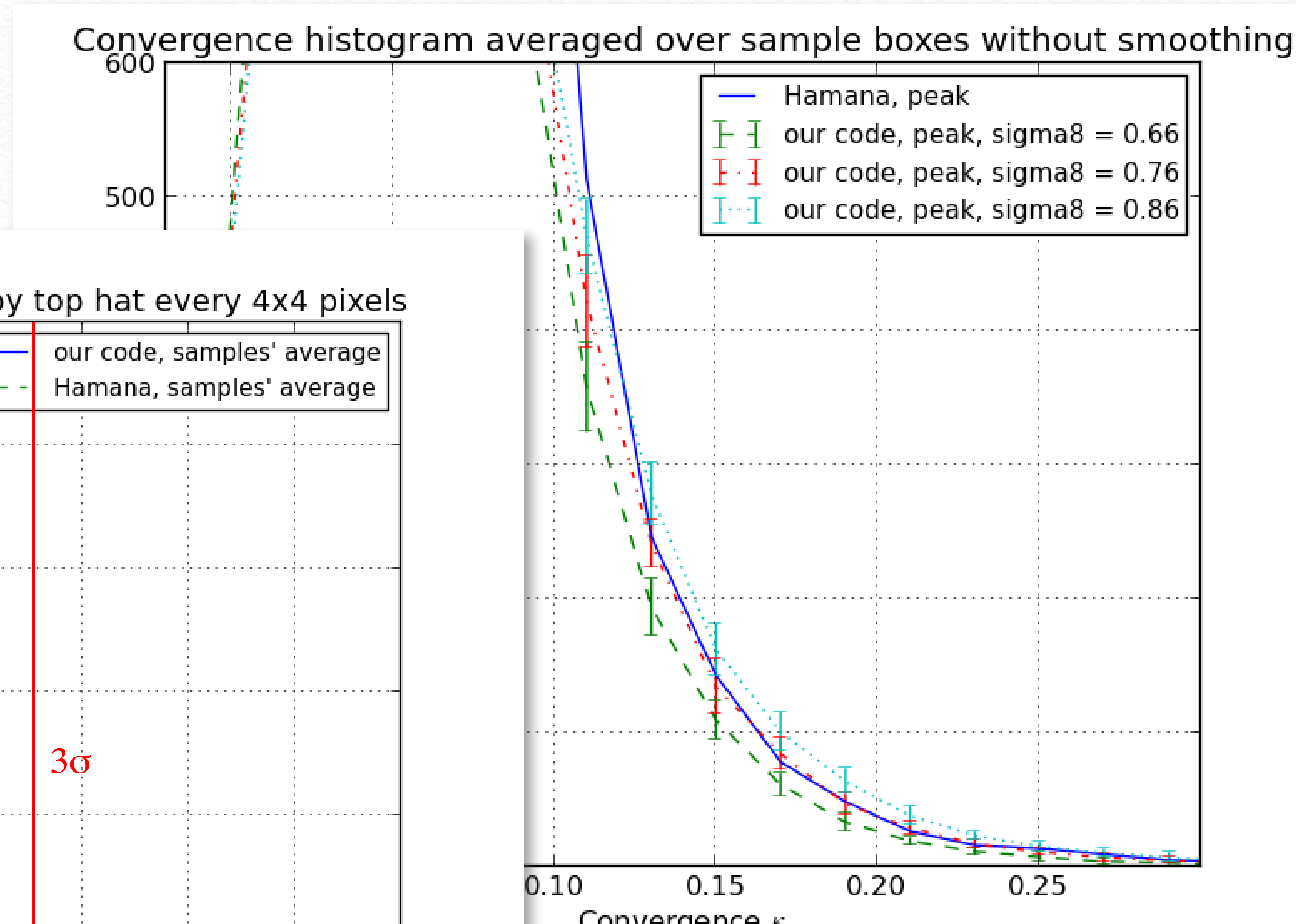
- Difficult to build theoretical model:
  - WL peaks strongly contaminated by noise (up-scatter to higher S/N)
  - LSS projections along line of sight

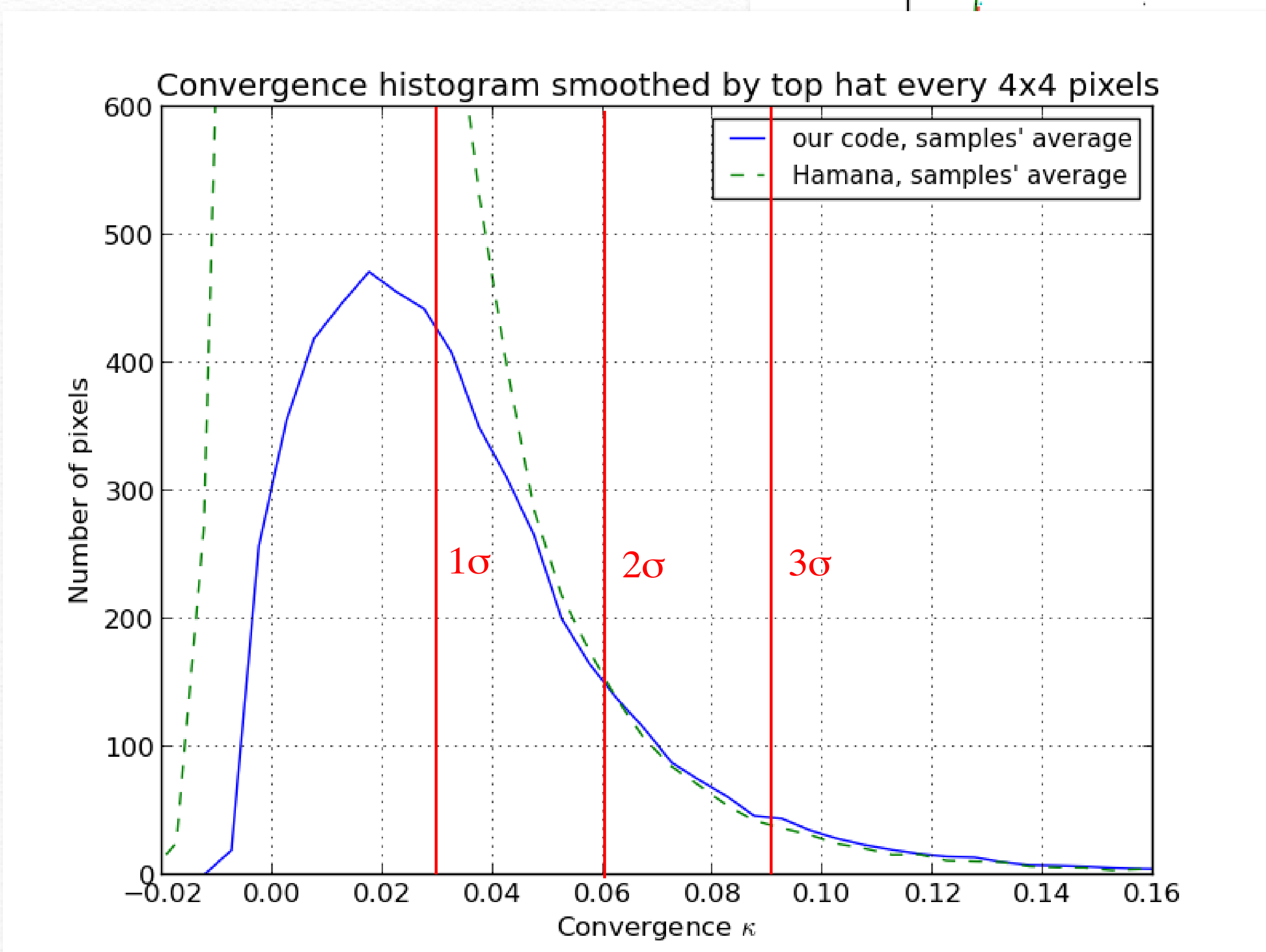
- Existing models based on Gaussian random fields (Maturi et al. 2009, 2011; Fan et al. 2010)
  - Good enough for large S/N?
  - Work for non-linearly re-constructed κ maps?
  - Inclusion of observational effects (PSF, masks, ...) and astrophysics (intrinsic alignment)?



WL peak counts

- Idea: Fast LEnsing Simulations of Halos (FLESH), contains peaks but no (or low-order) clustering.
- Compare to full *N*-body sims.

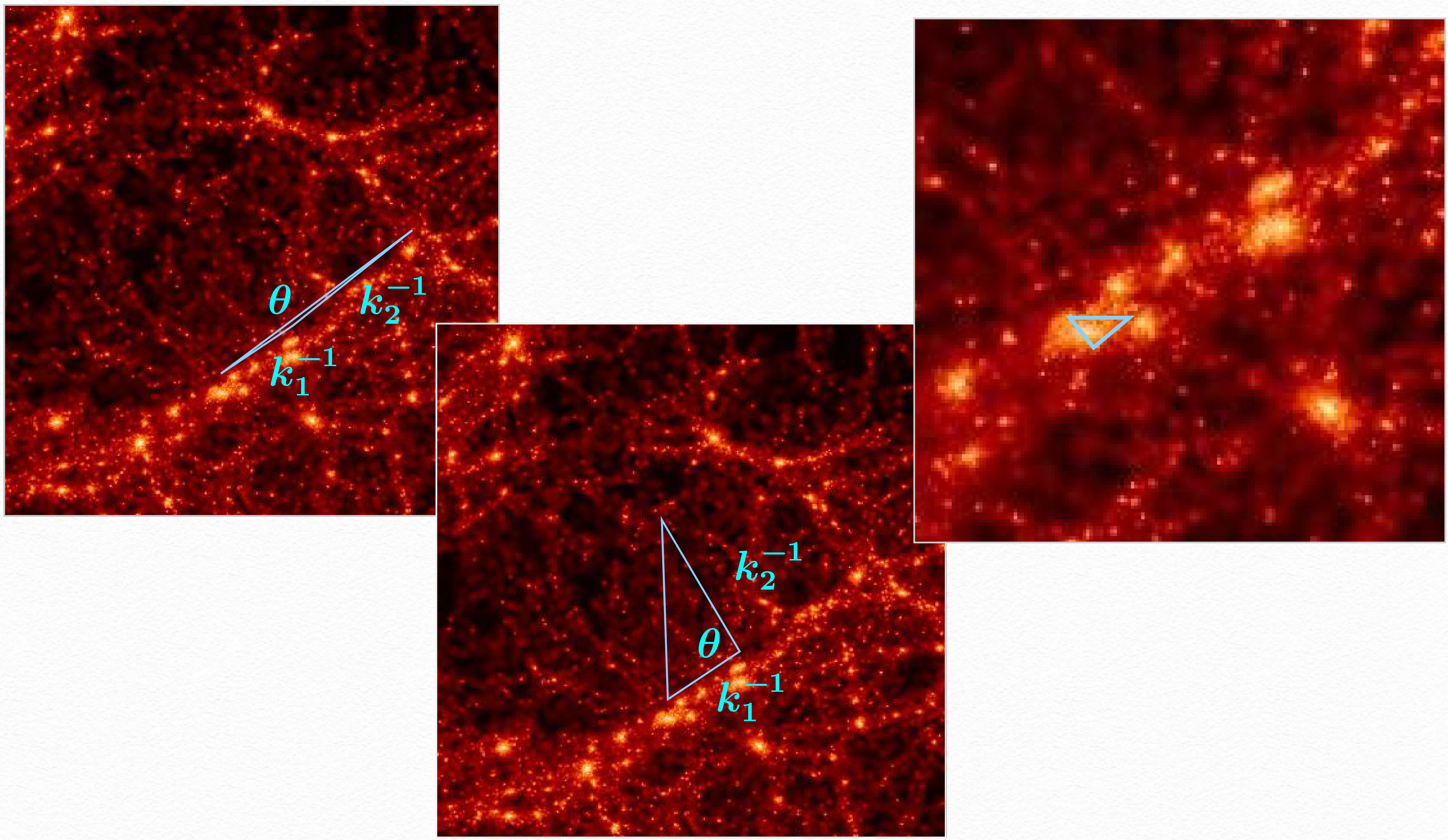




plots from Chieh-An Lin

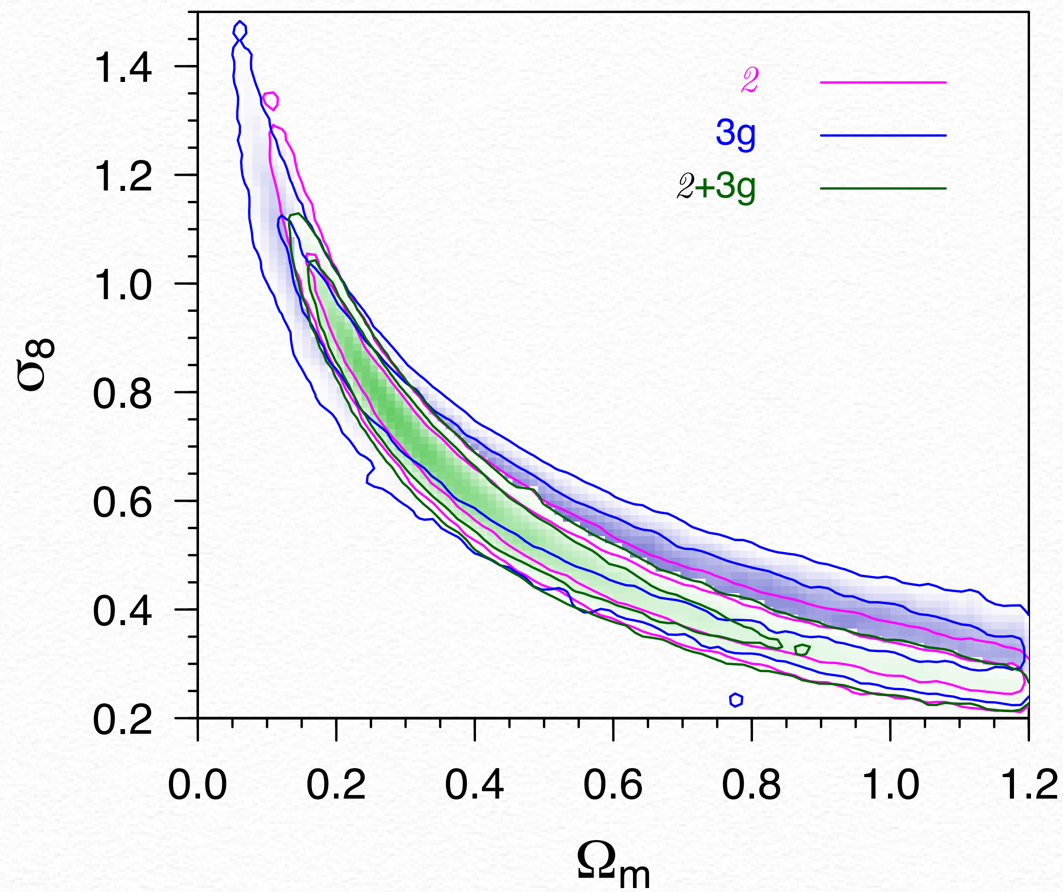
Higher-order stats

- Bispectrum: Sensitive to filamentary structure and halos depending on scale and triangle configuration



Higher-order stats

- Complementary information wrt two-point stats



CFHTLenS
Fu, Kilbinger et al. in prep.

- Ongoing work: estimators, astrophysical contaminations (intrinsic alignment, source-lens clustering)
- Much to do: theoretical predictions, covariance, ...

Two-point stats

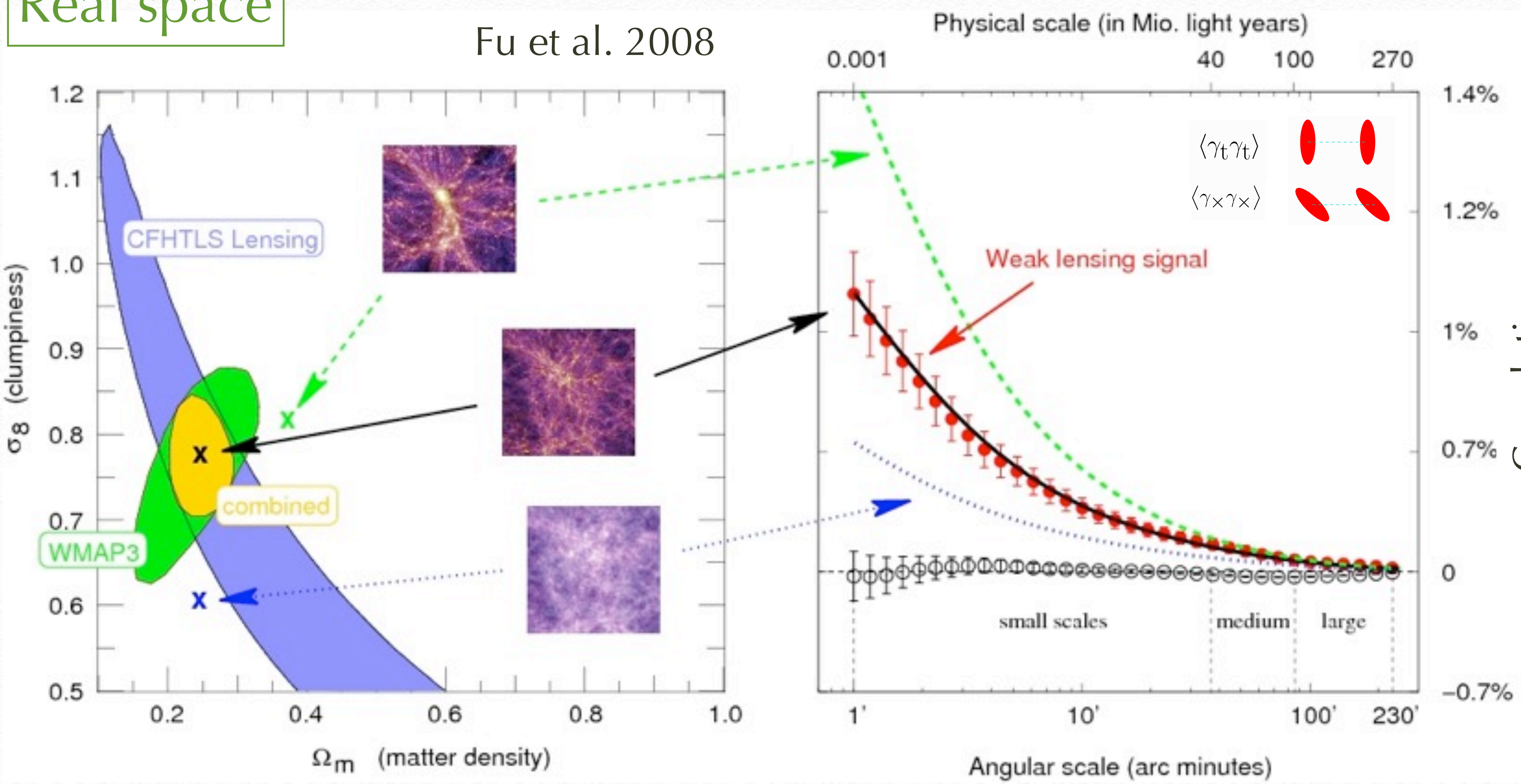
Euclid main WL requirement:

Real space: Tomographic shear two-point correlation function

Fourier space: Tomographic shear power-spectrum

Real space

Fu et al. 2008

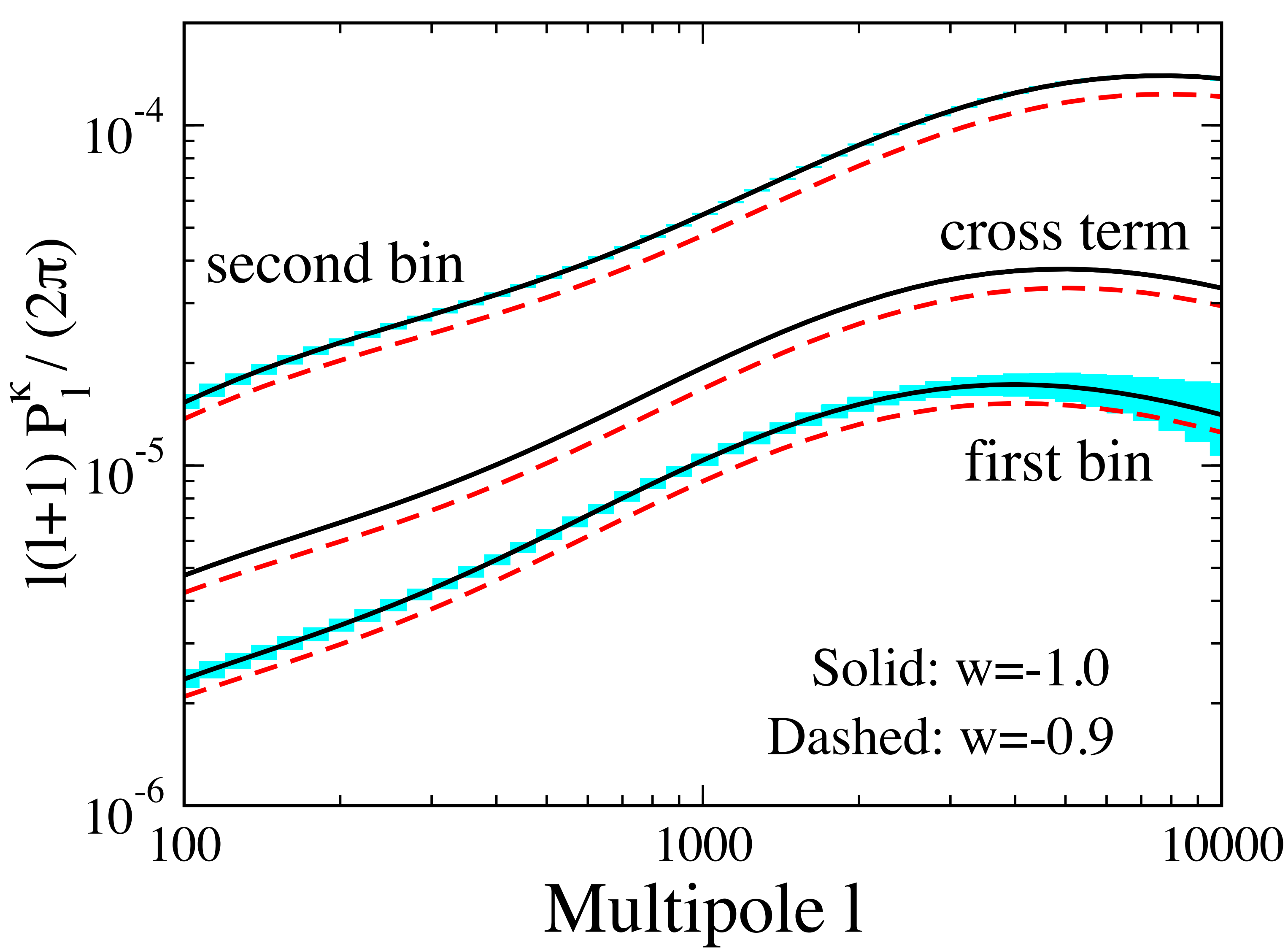


Two-point stats

Euclid main WL requirement:
Real space: Tomographic shear two-point correlation function
Fourier space: Tomographic shear power-spectrum

Frieman, Turner & Huterer 2008

Fourier space

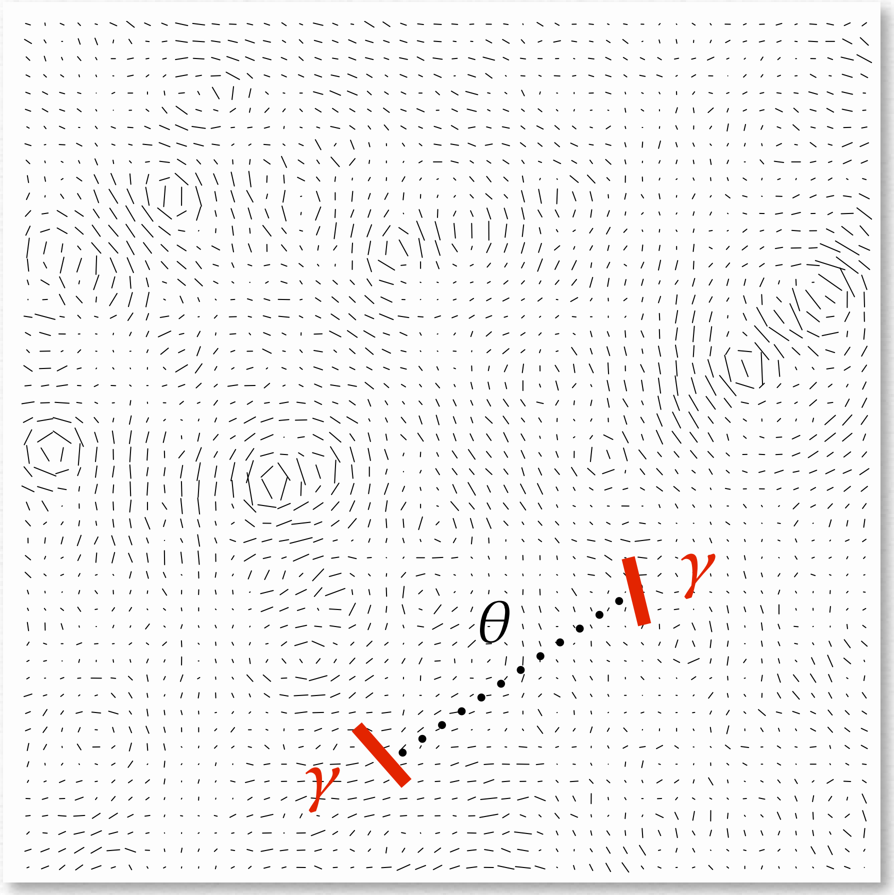


Two-point stats

- Validation of 2pt algorithms
  - First stage: Log-Normal random fields with known input power spectrum (Benjamin Joachimi [UCL], Reiko Nakajima [AIfA Bonn])
  - Results to be discussed at Nice OU-LE3 meeting (December 2013)

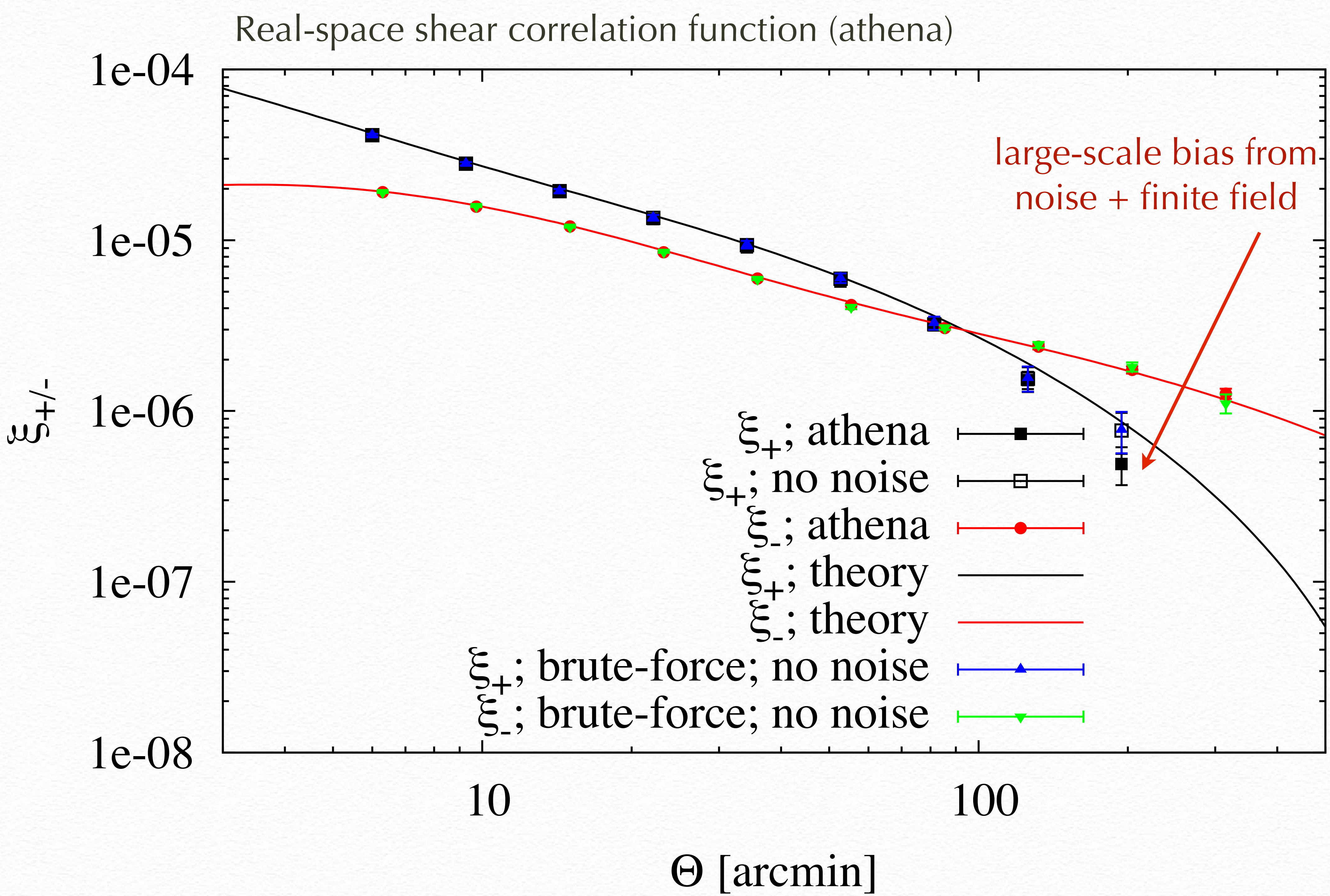
Two-point stats

- Real-space two-point correlation function: Direct, unbiased estimator from data



- Power spectrum:
  - 1D-FT of 2pcf
  - 2D-FT of the γ or κ, e.g. Pseudo-C_l's, maximum-likelihood
  - Many methods for γ → κ (FFT, Kaiser & Squires, Seitz & Schneider, inpainting, Wavelet-Helmholtz, ...)

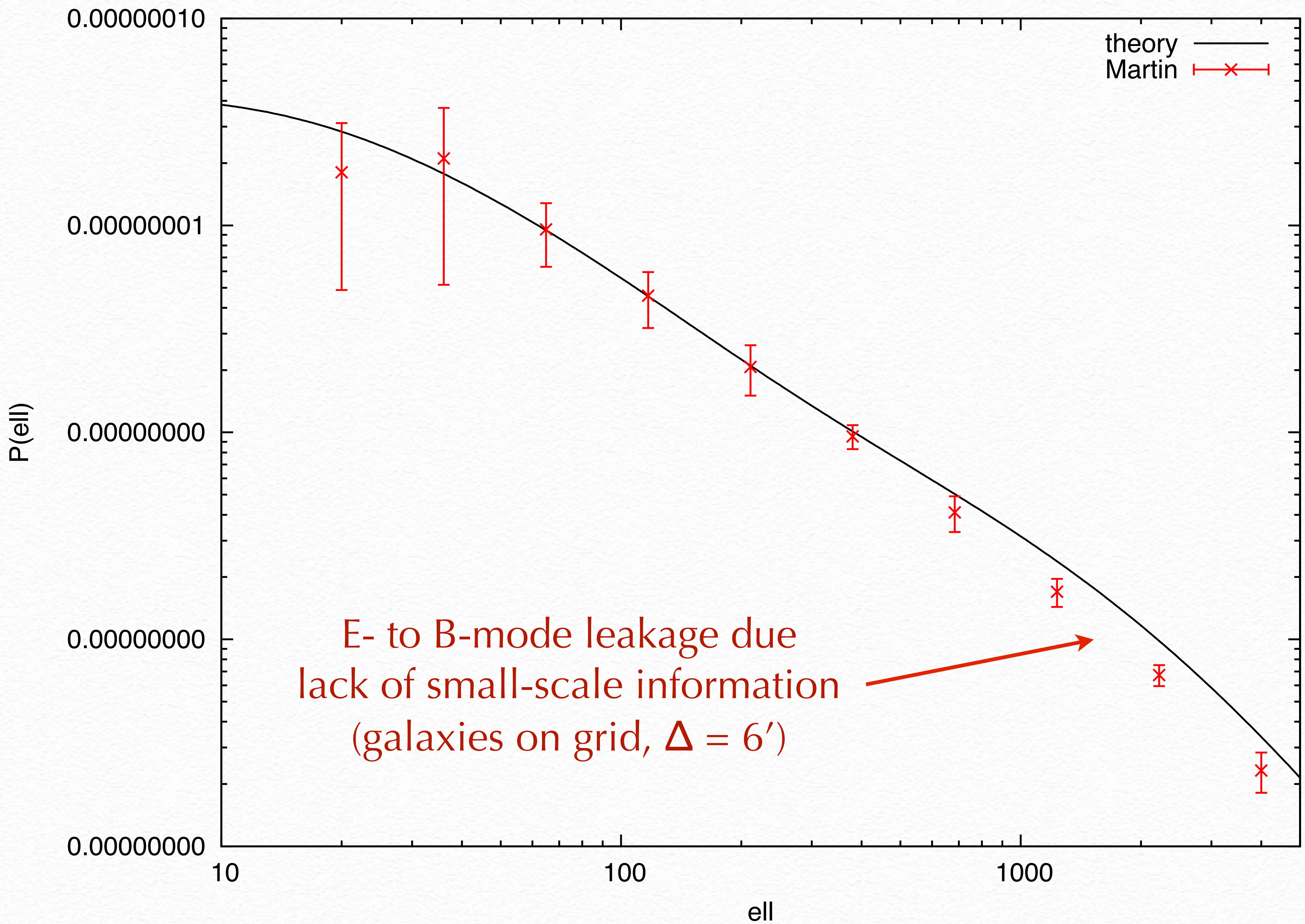
Two-point stats



www.cosmostat.org/athena

Two-point stats

Band-power spectrum (pallas/athena)



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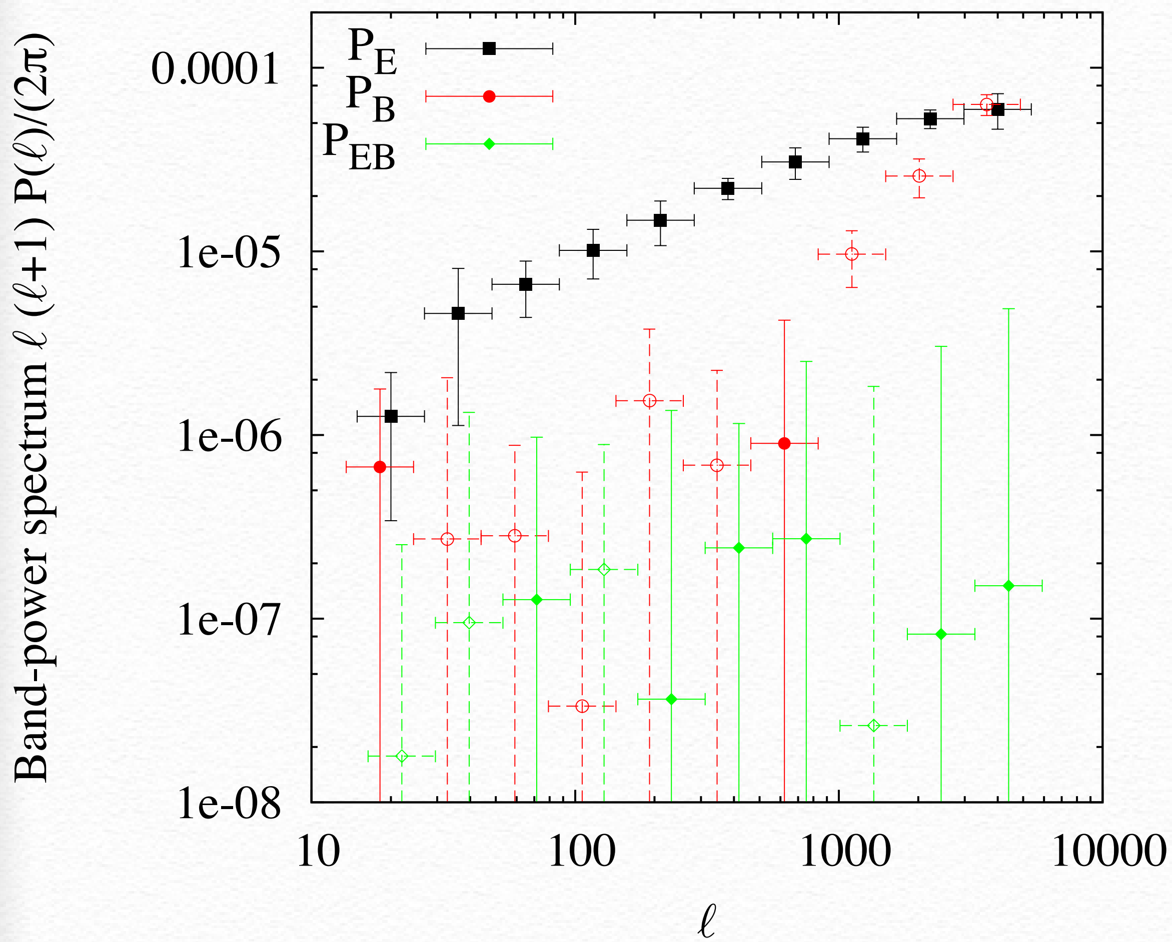
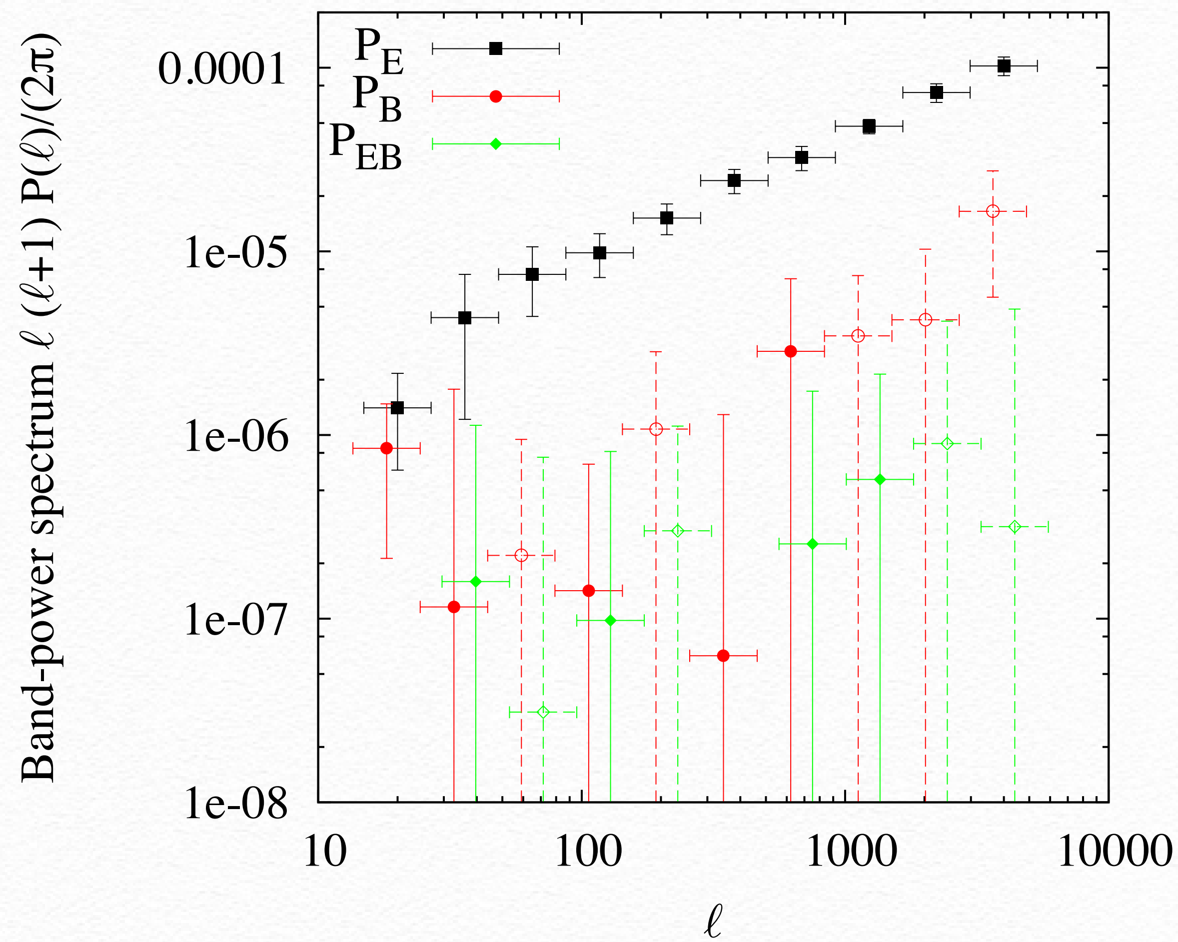
Two-point stat

Band-power spectrum (pallas/athena)

v1.2: galaxies on grid, $\Delta = 6'$



v1.3: random galaxy positions



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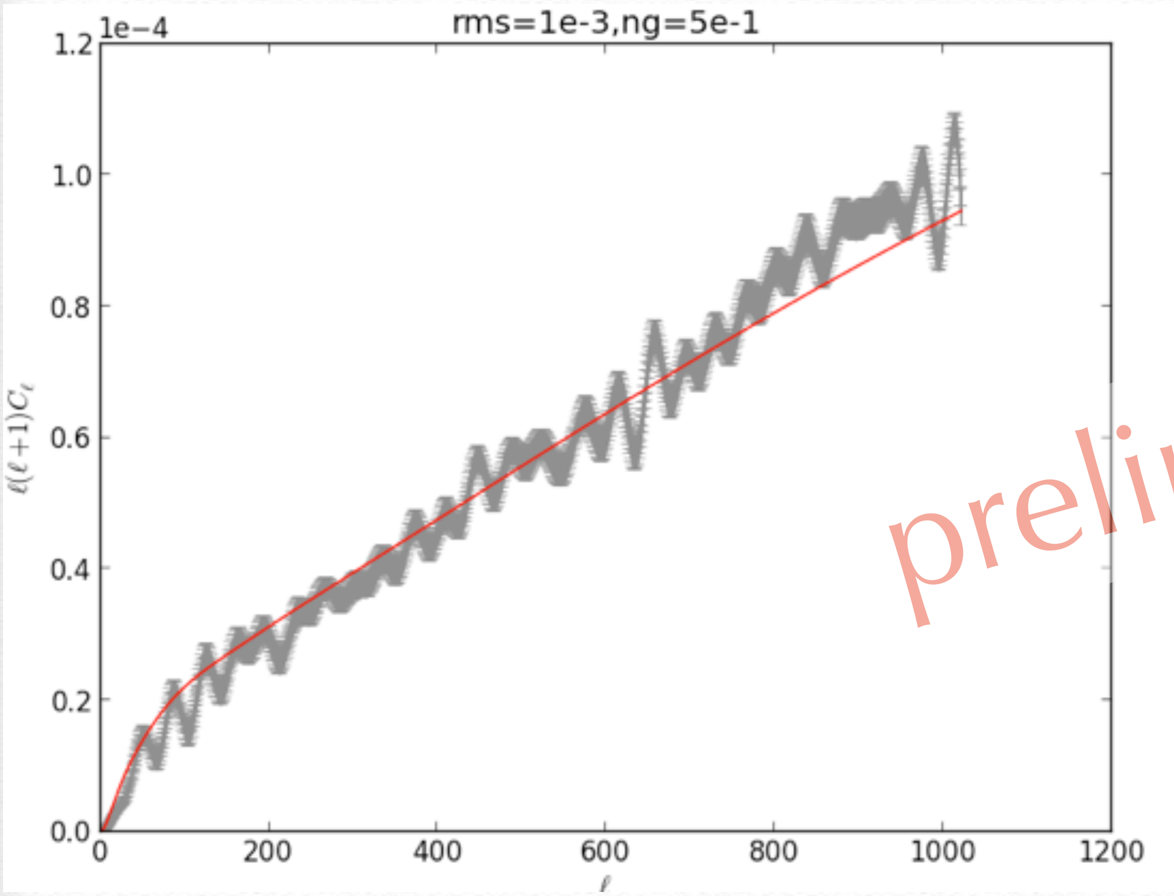
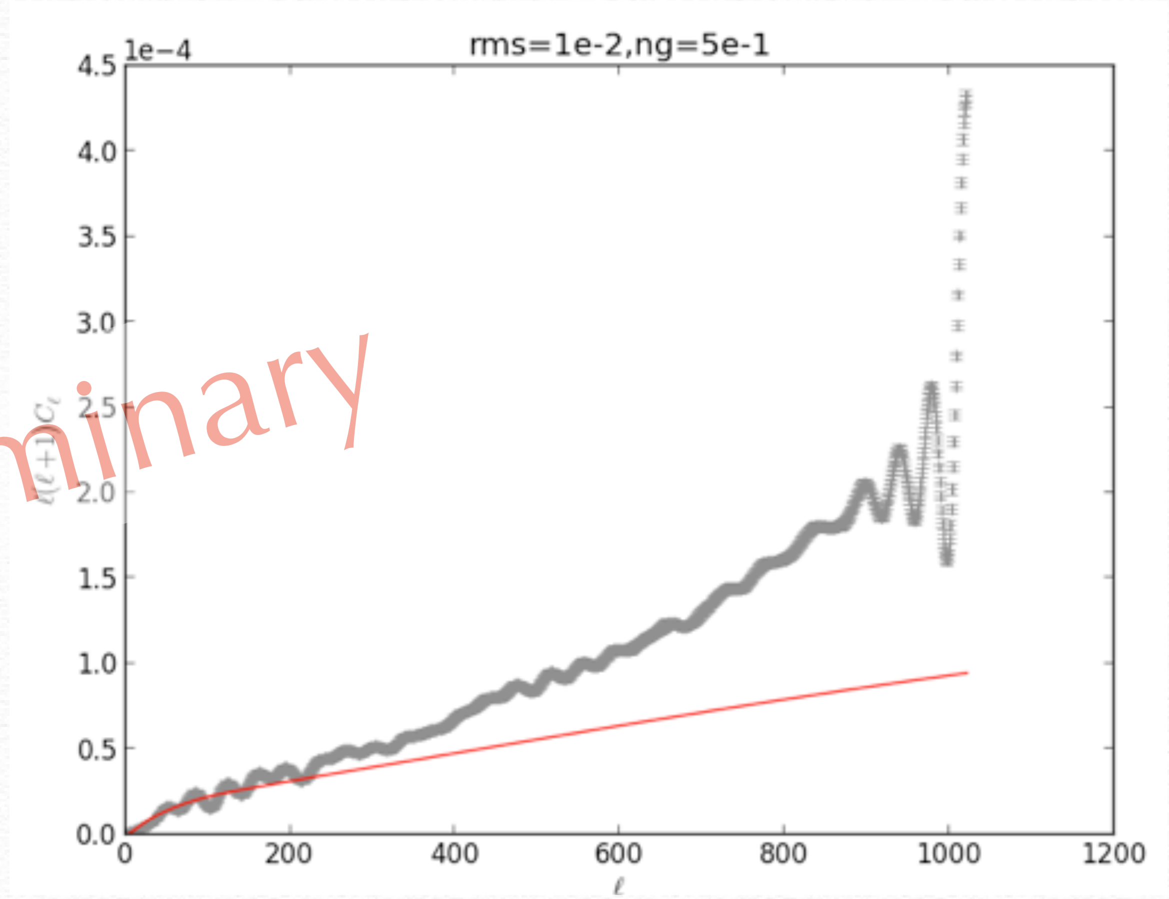
Two-point stats

Log-normal random field

low noise

high noise





Sreekumar Balan (UCL), full-sky power spectrum, Bayesian method. More at the Nice meeting...

Thursday, December 5, 13

Shape measurement

	Model-Fit	Moments
Bayesian	"Shearfit" Lensfit gfit	Armstrong-Bernstein
Frequentist	im3shape MCMC PCA	KSB Deimos FDNT MegaLUT TVNN

from Andy Taylor

Shape measurement

With a sufficiently good calibration set any method can be calibrated to meet Euclid Requirements.

Needs calibration/priors for p(e), p(size), p(galaxy morph), p(PSF), p(colours), p(CTI)...

But will fail if method requires:

- too large a calibration set (large N).
- too accurate a calibration set (high-res, wide range).

from Andy Taylor

Shape measurement

Where does calibration set or priors come from?

Image Simulations.

But what are simulations based on?

Deep HST Calibration images and ultimately Euclid Deep.

Need methods which are sufficiently insensitive to calibration or priors.

Viola, Kitching, Joachimi shown for simple moment-based.

Need analysis + test on simulations for all approaches - SHE Challenge for 2014!

from Andy Taylor