

Title: Cosmology from CFHTLS-Wide Weak Lensing on Large Scales

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URL: <http://pirsa.org/08060160>

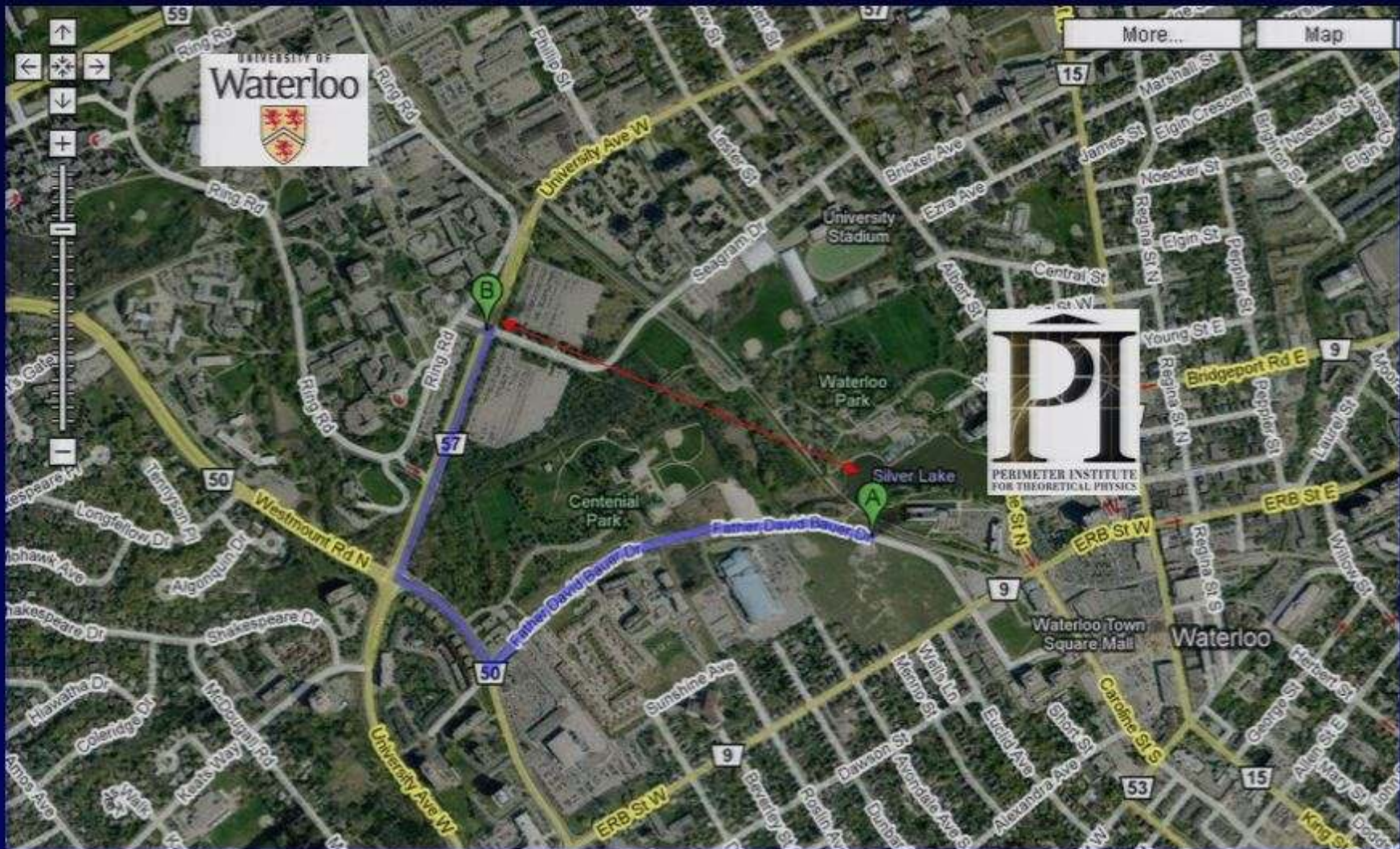
Abstract: I will discuss recent results from the Cosmic Shear component of the CFHT Legacy Survey. These results reach very large scales, allowing a measurement of power spectrum of matter fluctuations in the linear regime, and of cosmological parameters.

Cosmic Shear from the CFHTLS



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Testing Cosmological Models

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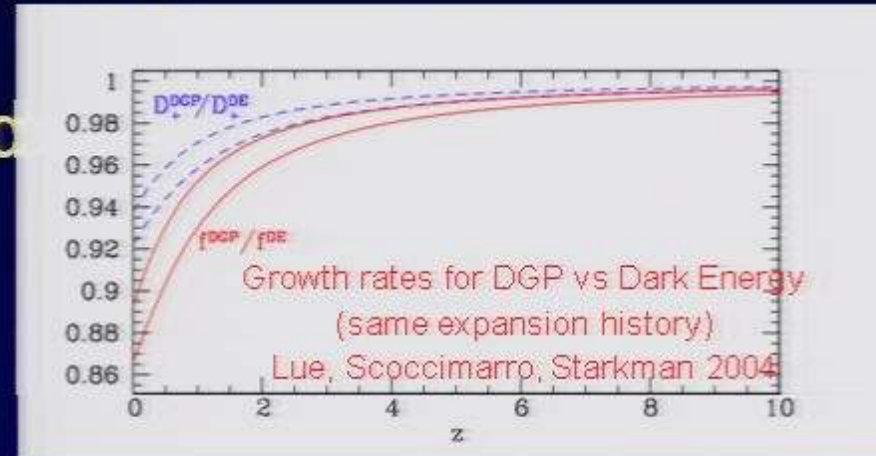
- Global Geometry and Expansion Rate
 - SNe, CMB, BAO

Testing Cosmological Models

- Global Geometry and Expansion Rate
 - SNe, CMB, BAO
- ***Growth of Fluctuations*** as a function of z
 - CMB $z \sim 1100$
 - Ly-alpha $2-3$
 - Cluster Abundance $0-0.8$
 - Weak Lensing $0.2-0.8$
 - Peculiar Velocities ~ 0

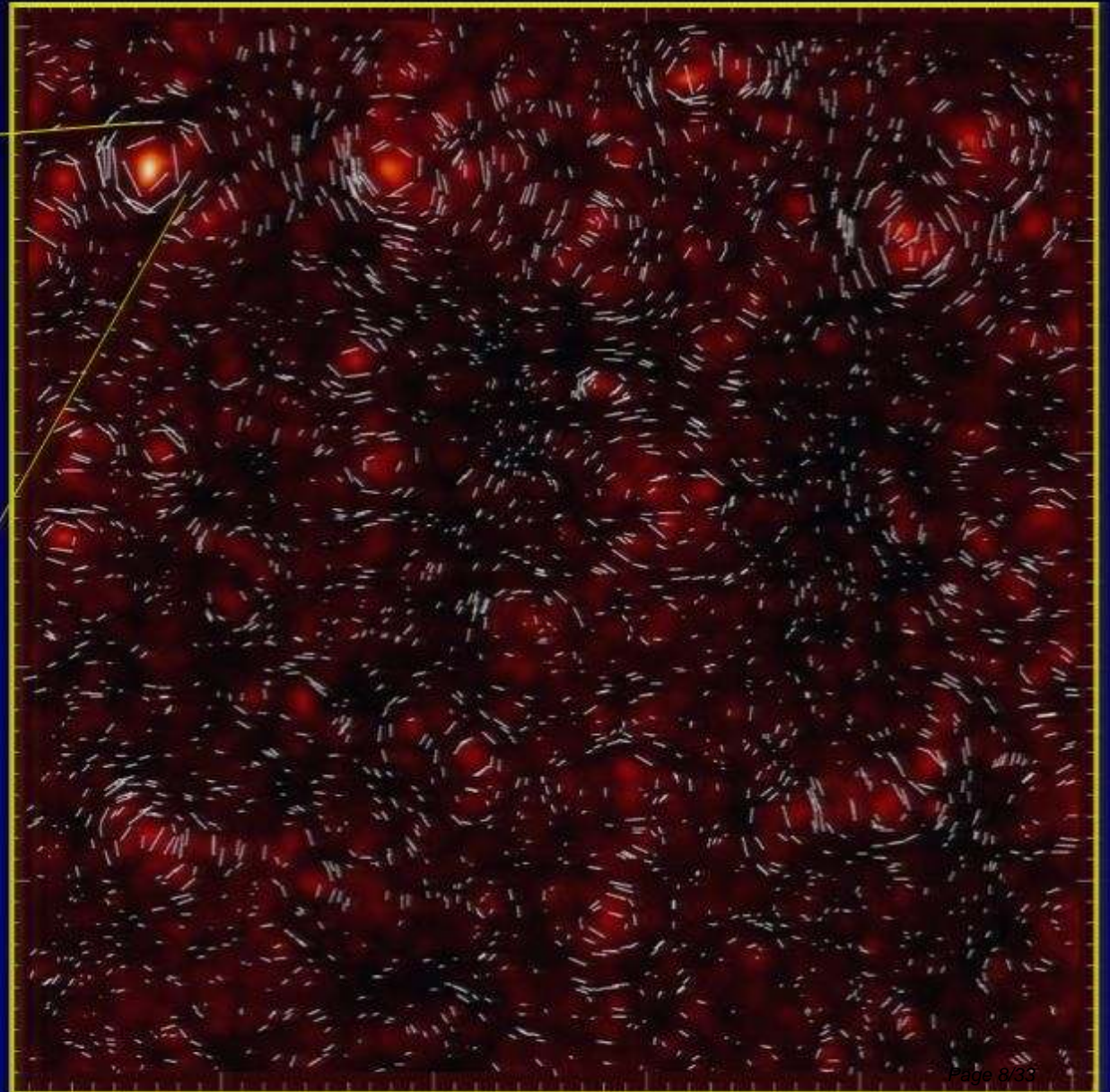
Testing Cosmological Models

- Global Geometry and
• SNe, CMB, BAO



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Dark matter and cosmic shear



Cosmic shear amplitude and coherence is closely related to that of the dark matter

Using (non-round) galaxies to measure weak lensing

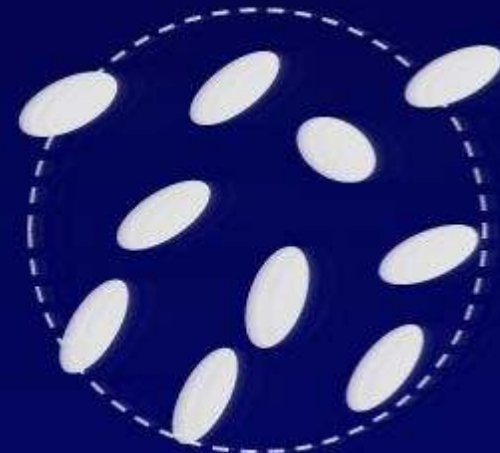
The underlying assumption is that the position angles are random in the absence of lensing.

no lensing



$$\langle e \rangle = 0$$

lensing



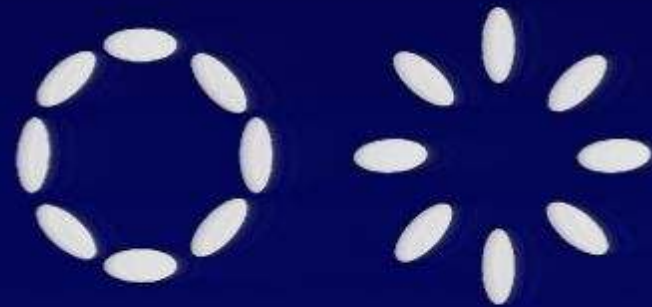
$$\langle e \rangle \approx \gamma$$

Averaged shape:

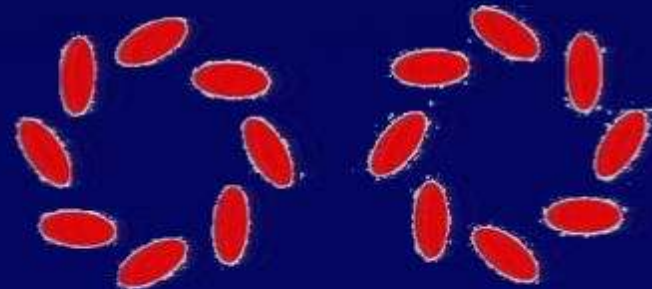
Tests of systematics

The lensing signal is caused by a gravitational potential and therefore should be curl-free (to first order). We can project the correlation functions into one that measures the divergence and one that measures the curl: **E-B mode decomposition**.

E-mode (curl-free)



B-mode (curl)



Scaling of the Cosmic Shear Signal

Simple case, assuming a single lens plane and $P(k) \sim \sigma_8 k^n$

$$\langle \kappa^2(\theta) \rangle = \langle \gamma^2(\theta) \rangle$$

Gravitational convergence
(surface mass density)

Gravitational shear =
ellipticity induced by
gravitational lensing on
galaxies

Cosmological parameters

$$\langle \kappa^2(\theta) \rangle^{1/2} \approx 0.01 \sigma_8 \Omega_m^{0.8} \left(\frac{\theta}{1 \text{ deg.}} \right)^{-\frac{n+2}{2}} z_s^{0.75}$$

Redshifts of background galaxies



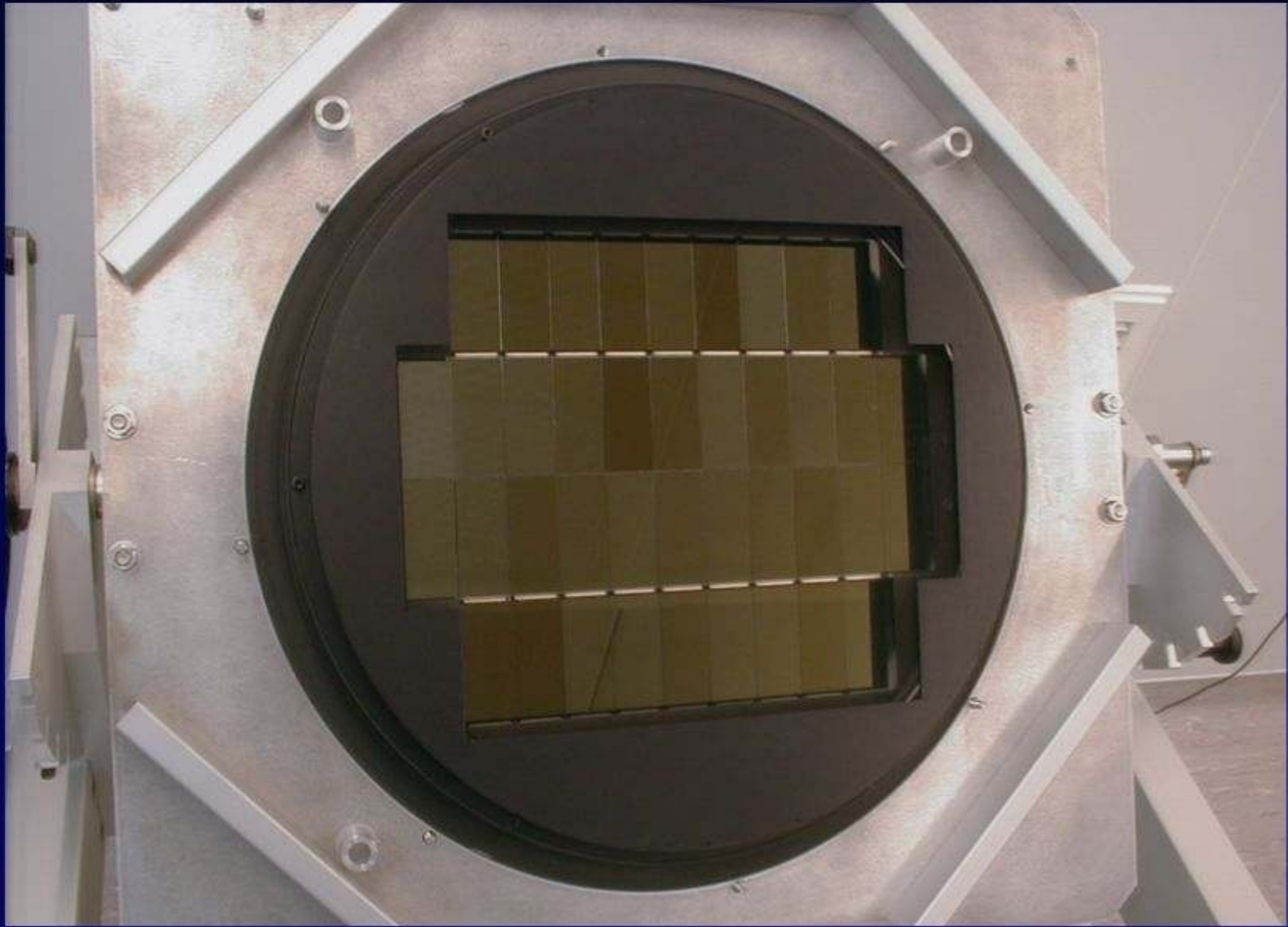
CFHT Legacy Survey

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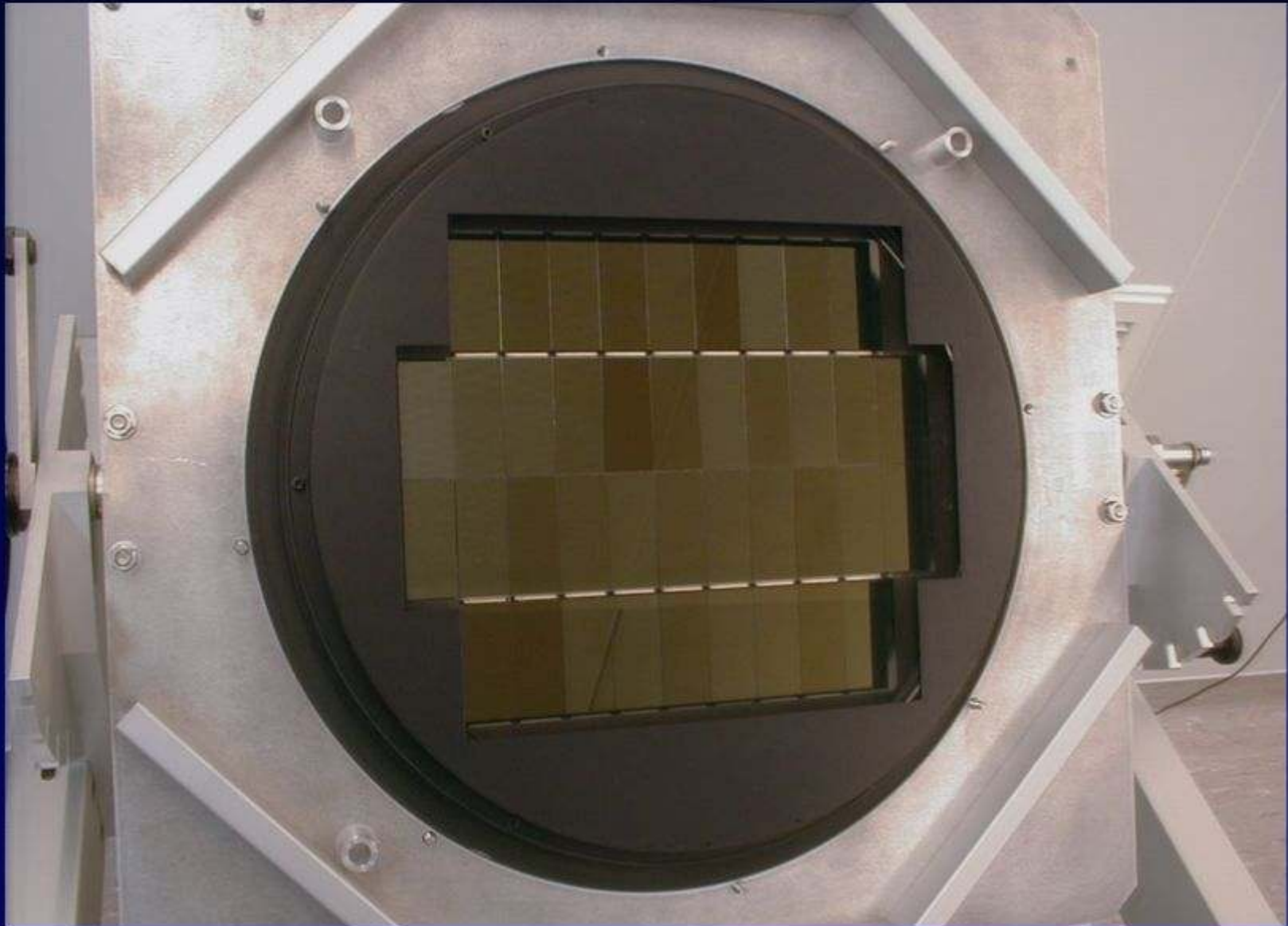




Megacam: 1 square degree field of view
 ~350 megapixels

CFHT Legacy Survey



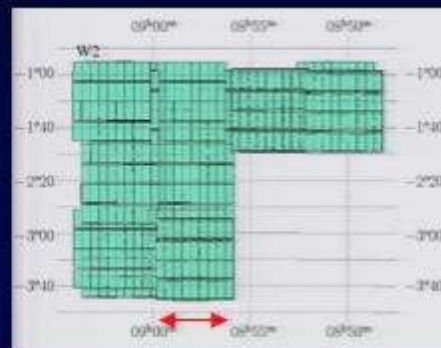
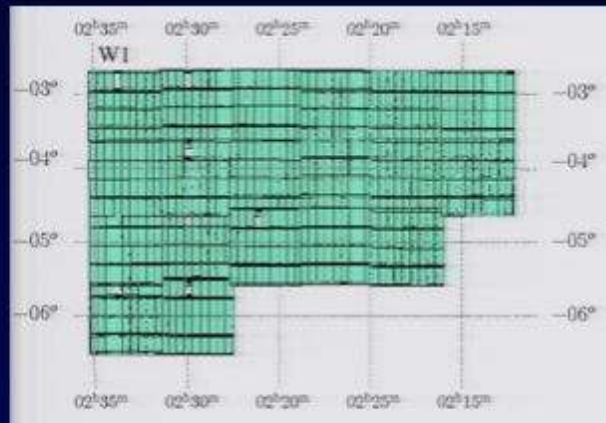


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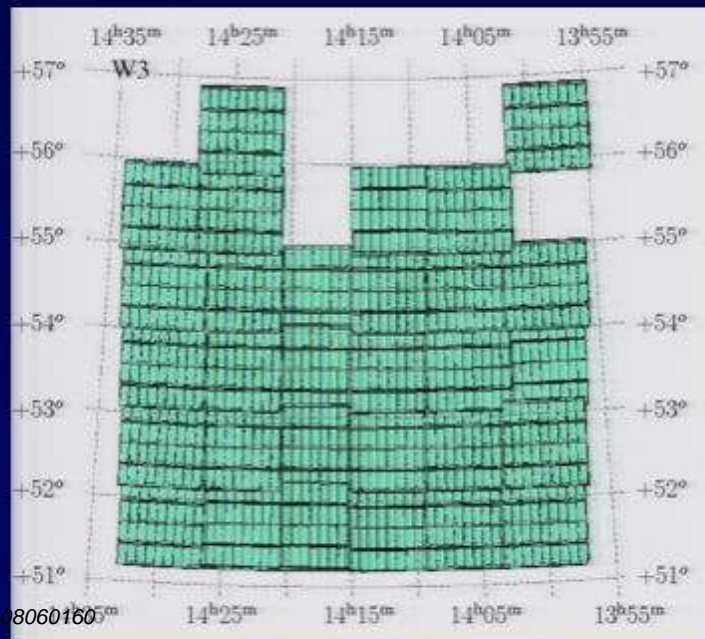
**Very weak lensing in the CFHTLS wide:
cosmology from cosmic shear in the linear regime^{*,**}**

L. Fu^{1,2}, E. Semboloni^{1,3}, H. Hoekstra^{4,***}, M. Kilbinger^{1,3}, L. van Waerbeke⁵, I. Tereno^{1,3}, Y. Mellier¹,
C. Heymans^{1,5}, J. Coupon¹, K. Benabed¹, J. Benjamin⁵, E. Bertin¹, O. Doré⁶, M. J. Hudson⁷, O. Ilbert^{8,9}, R. Maoli^{1,10},
C. Marmo¹, H. J. McCracken¹, and B. Ménard⁶

Current CFHTLS Data Set

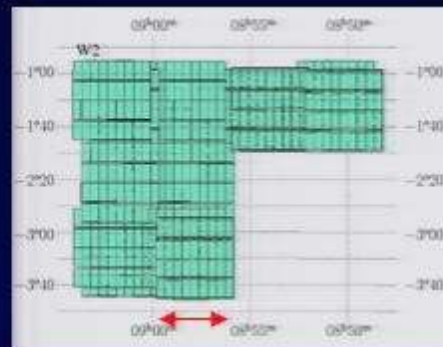
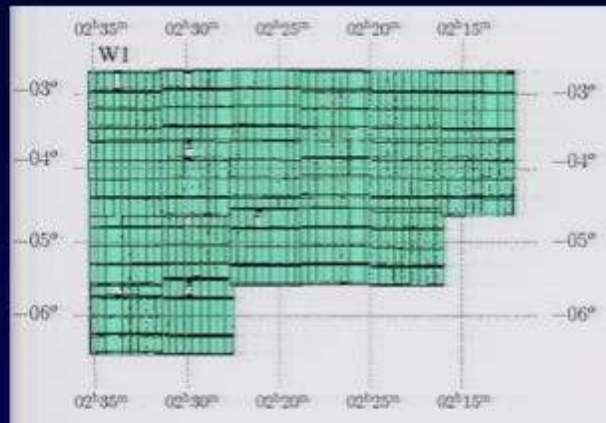


14 Mpc/h @ $z \sim 0.4$

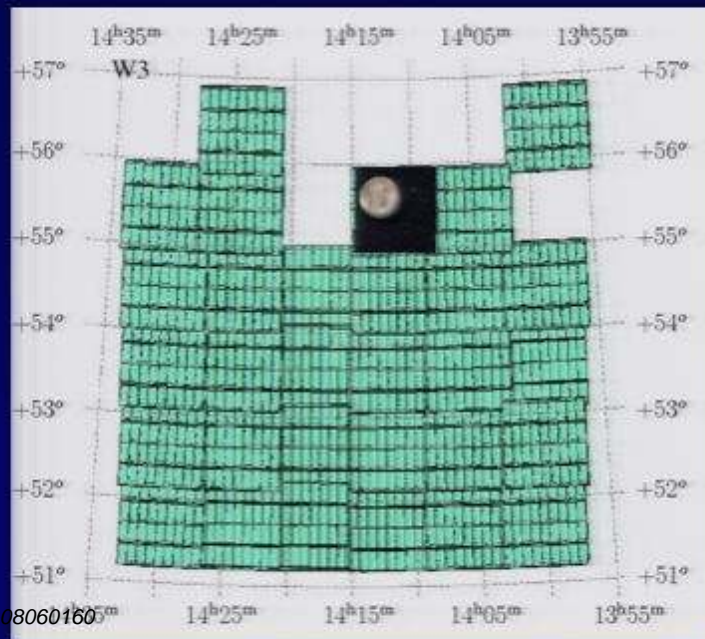


- Span 57 sq. degrees: linear regime
- (34.2 sq deg effective)
- 1.7 million galaxies

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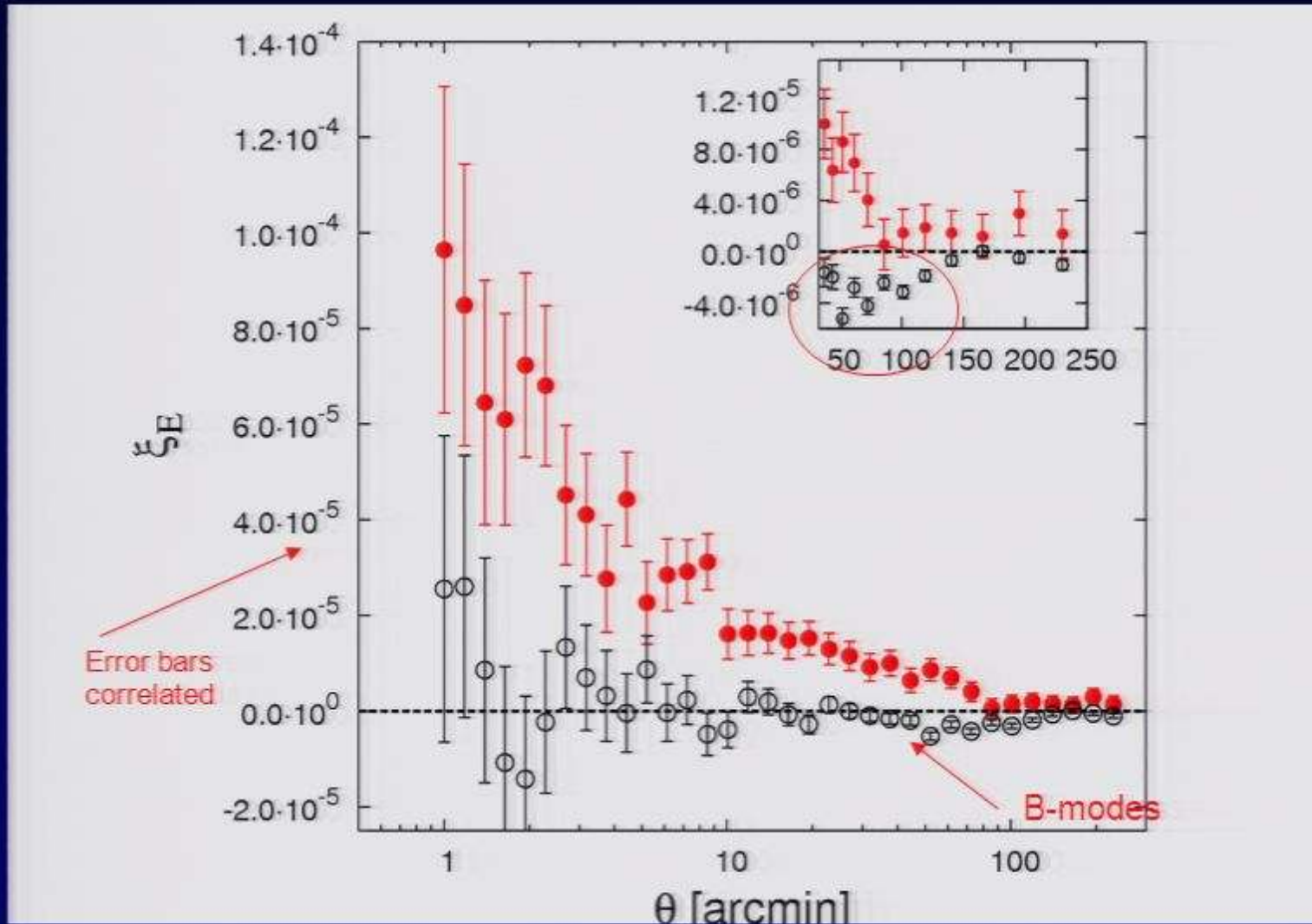


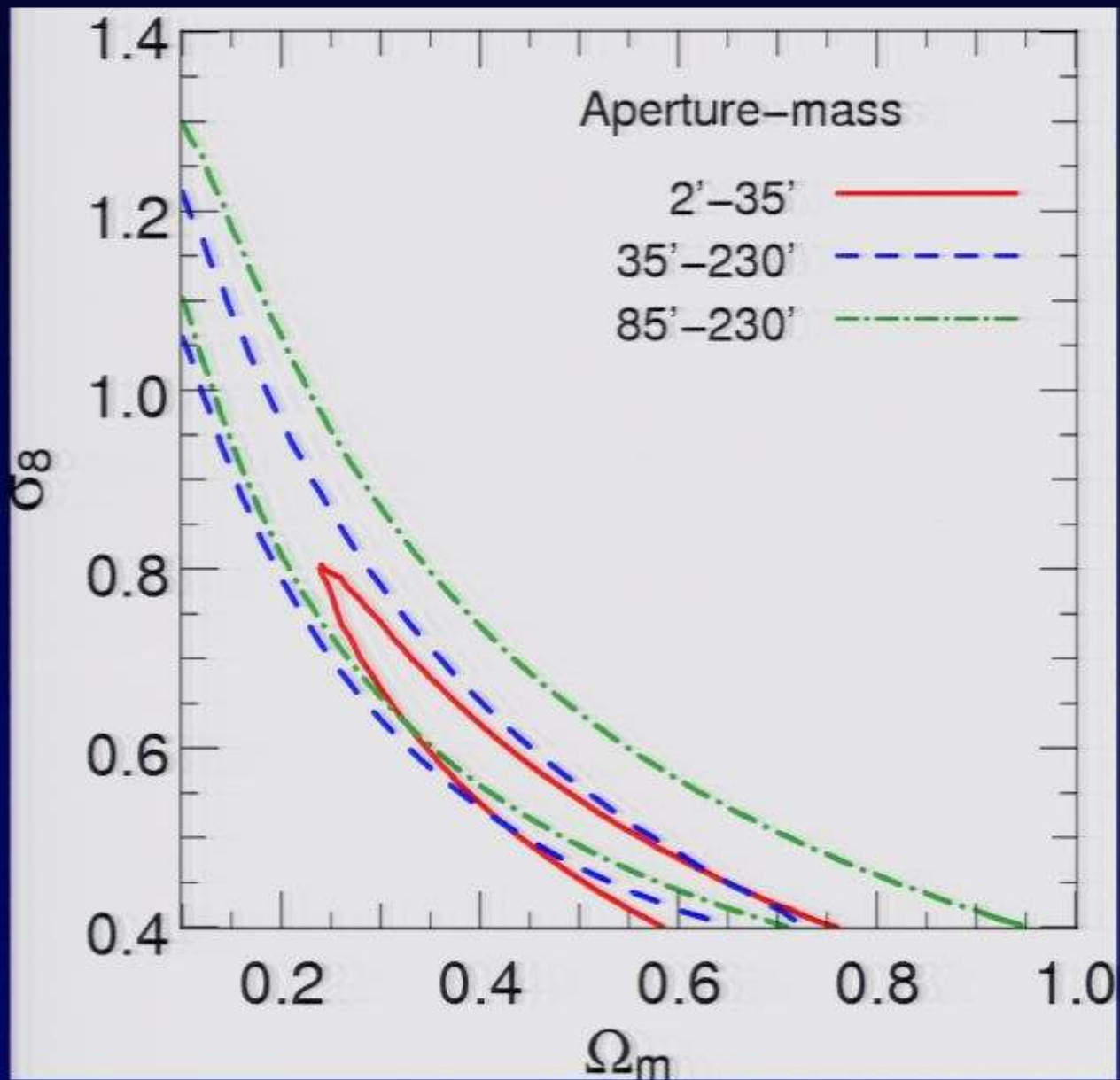
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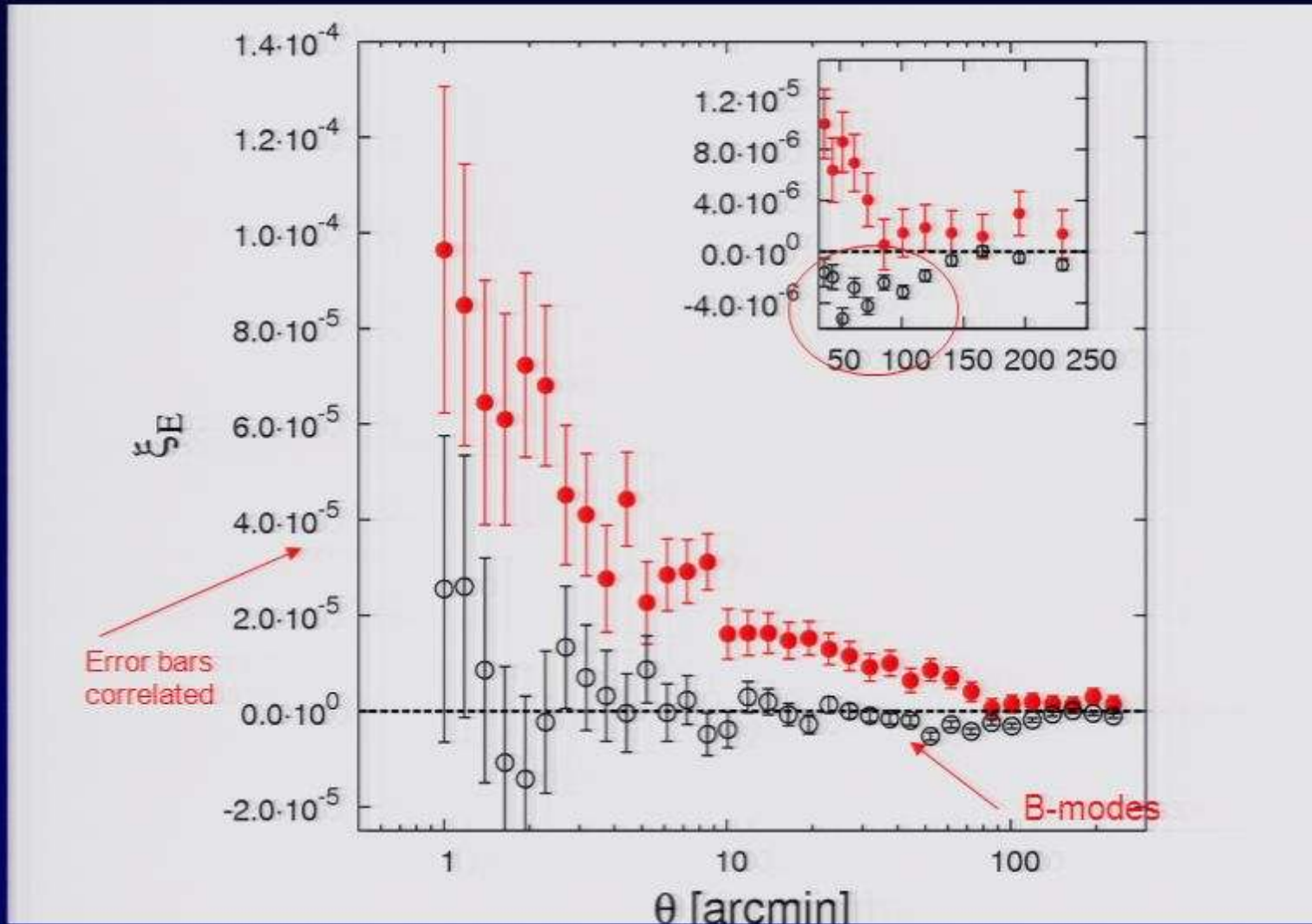
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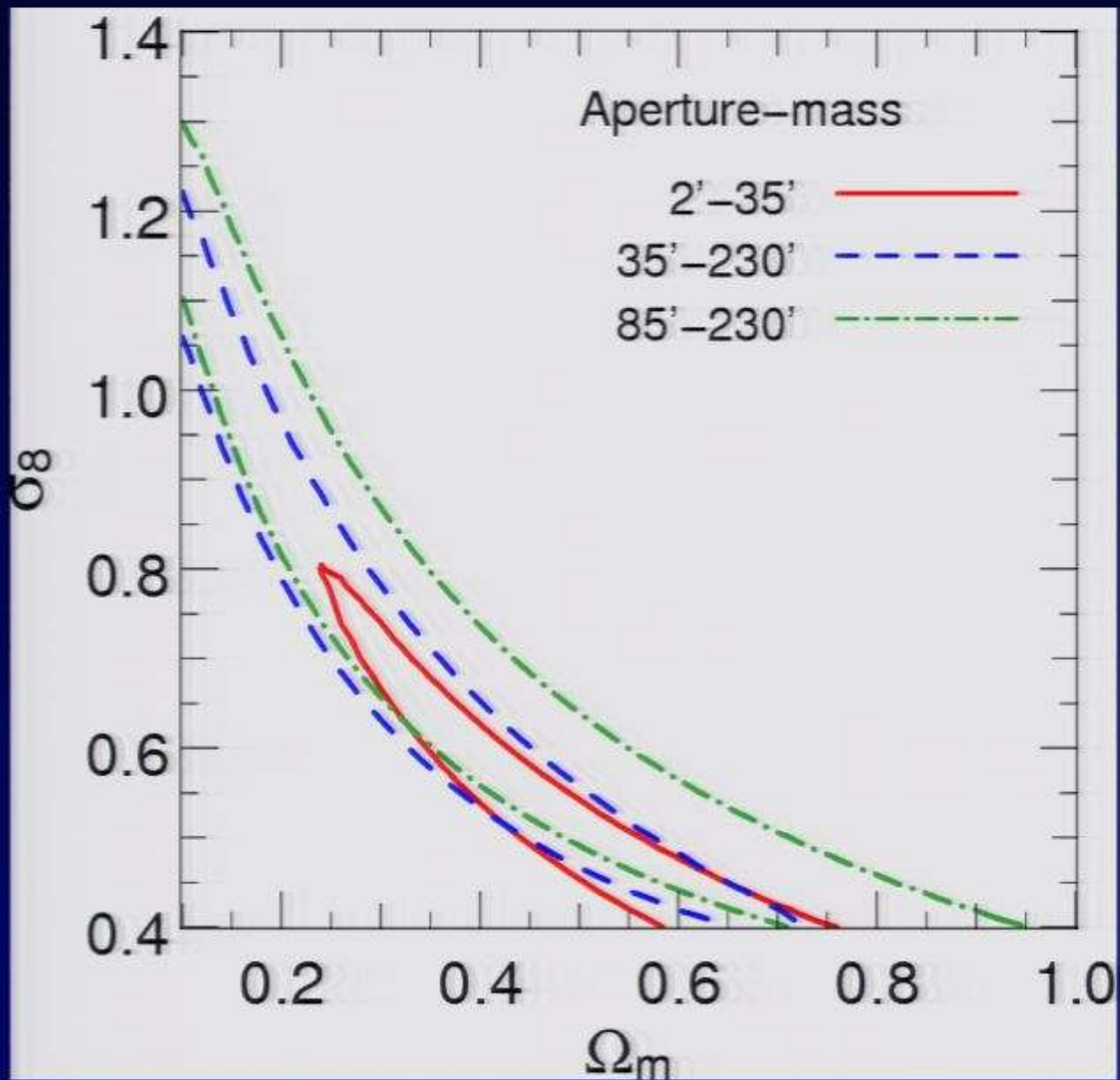
Current Results

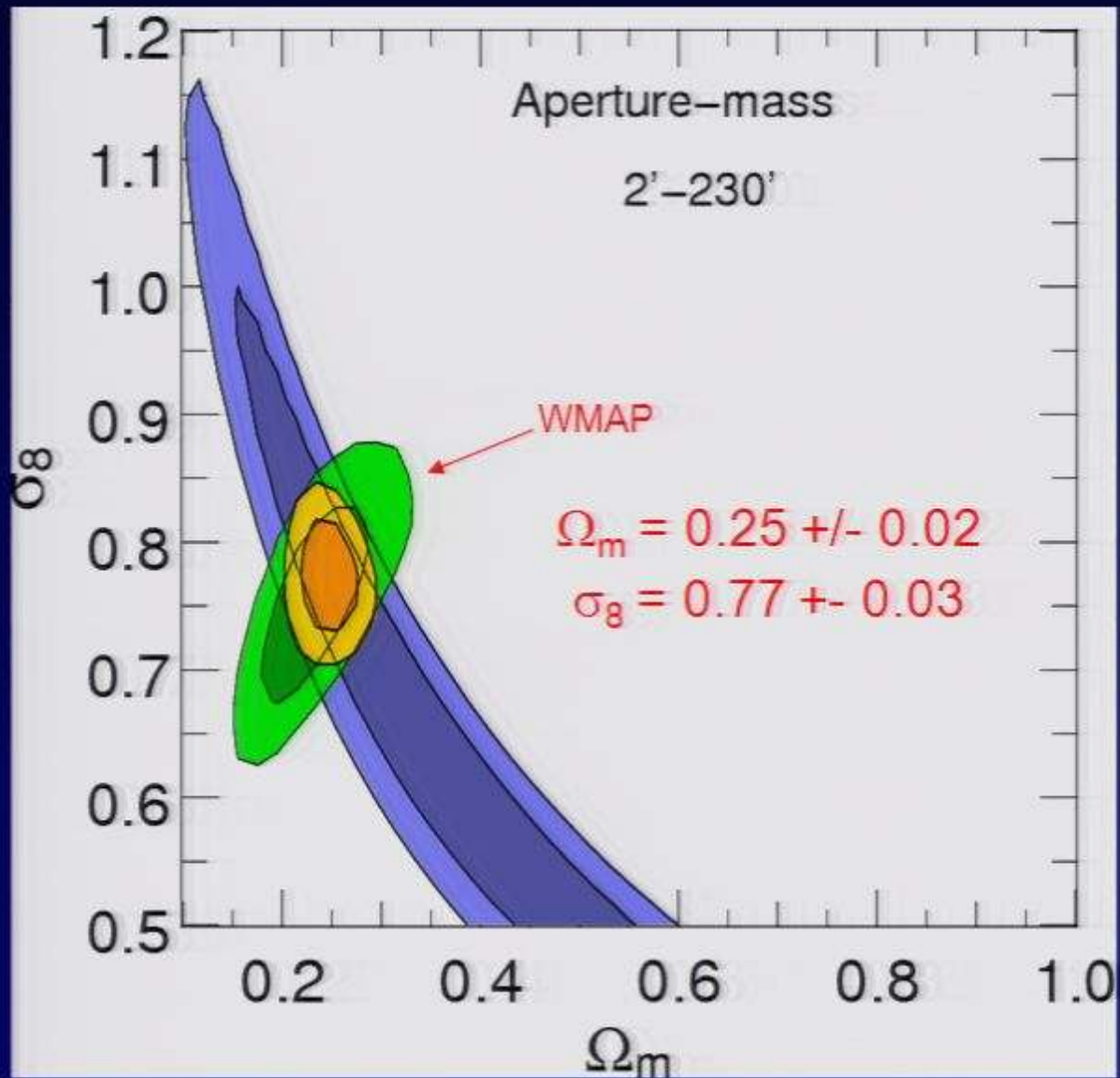




Current Results

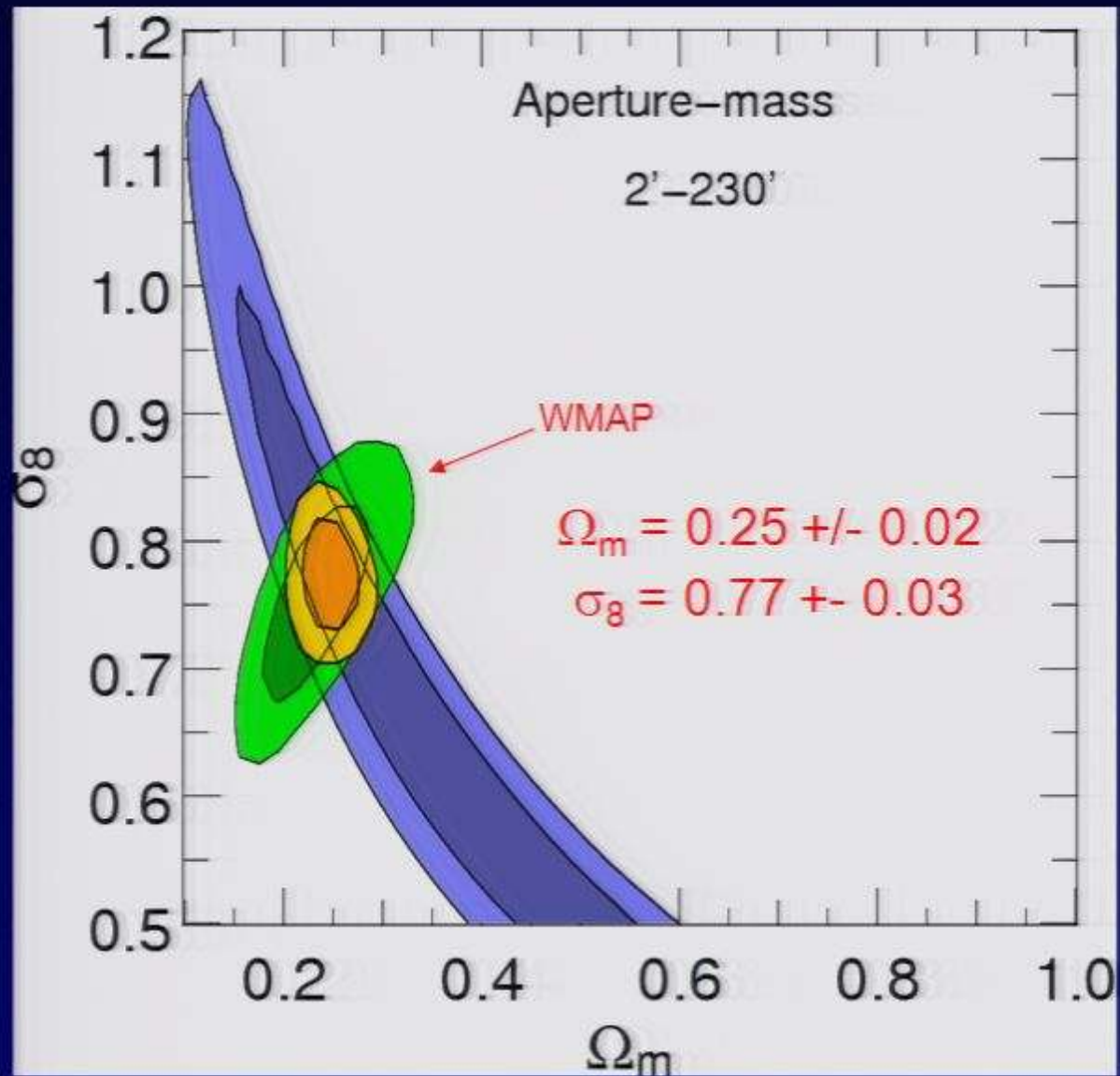






CFHTLS Cosmic Shear: On-going or on the « To Do » List

- Full data set: approx 3 times larger
- Photo-z, ultimately for the full Wide survey
 - Real 3-D « tomography »: evolution σ_8 of as a function of (z)
 - Dark energy
 - $w(z)$
- 3-point correlation functions:
 - breaking the σ_8 - Ω_m degeneracy
- « Gastro » physics:
 - Galaxy-galaxy lensing (Parker et al. 2006)
 - Galaxy (light) - Mass cross-correlation: biasing



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Summary

- First measurement of weak lensing in the linear regime
- Consistent with extrapolation of WMAP (3 & 5) results within LCDM
 - No evidence for unusual growth factors
- Lots of applications *and* better data still to come

Peculiar Velocities

- Measure the derivative of the growth rate
- Probe very large scales
- Bulk flow (Dipole) within a 50 Mpc/h Gaussian
 - All surveys consistent*
 - $V = 403 \pm 80$ km/s

Survey	ML		BC	
	$\Omega_m = 0.258$ χ^2	$\sigma_8 = 0.796$ $P(> \chi^2)$	$\Omega_m = 0.28$ χ^2	$\sigma_8 = 0.86$ $P(> \chi^2)$
SHALLOW	1.95	0.583	1.83	0.608
DEEP	8.75	0.033	8.32	0.040
SFI++	13.60	0.004	12.85	0.005
COMPOSITE	13.77	0.003	13.02	0.005

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