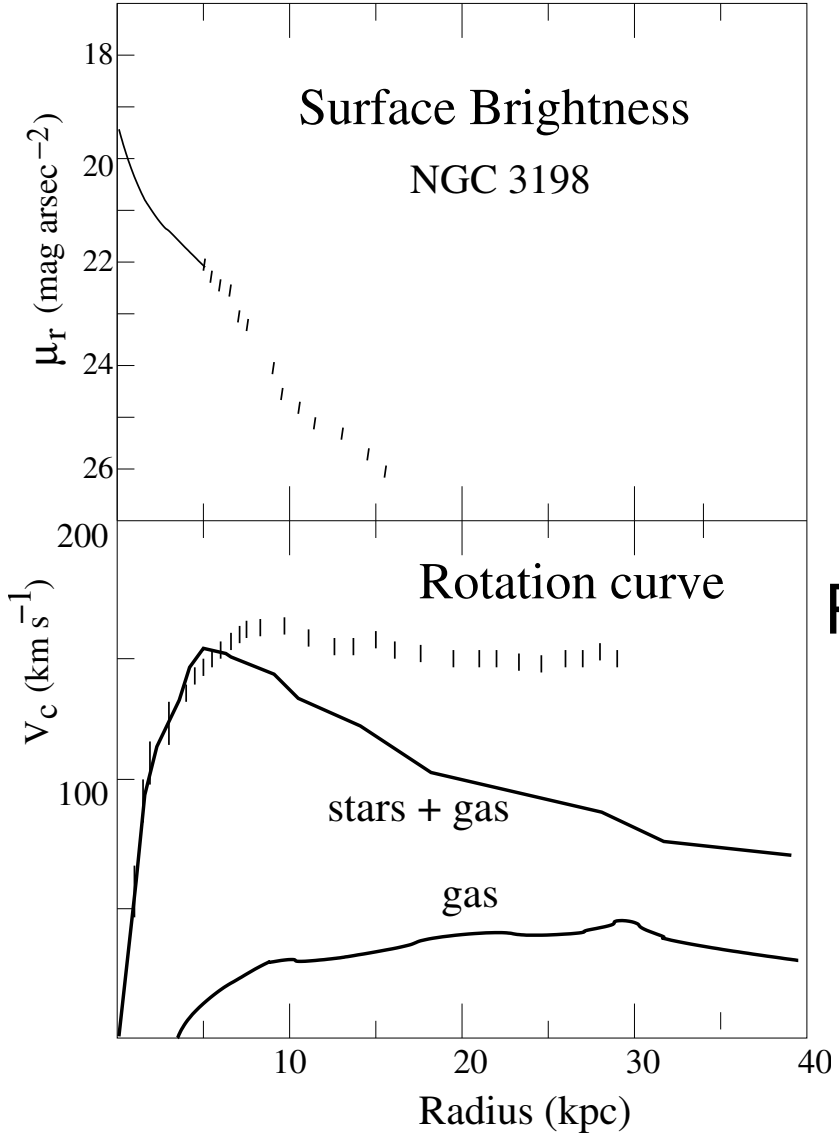
CR Moriond-Cosmo et DM2006

- Le fin du MOND ?
- WMAP : $n_s \neq 1$, etc
- w : SNLS, SDSS.....SKA
- Dark Matter.

Rotation Curves $\Rightarrow$ Dark Matter ?



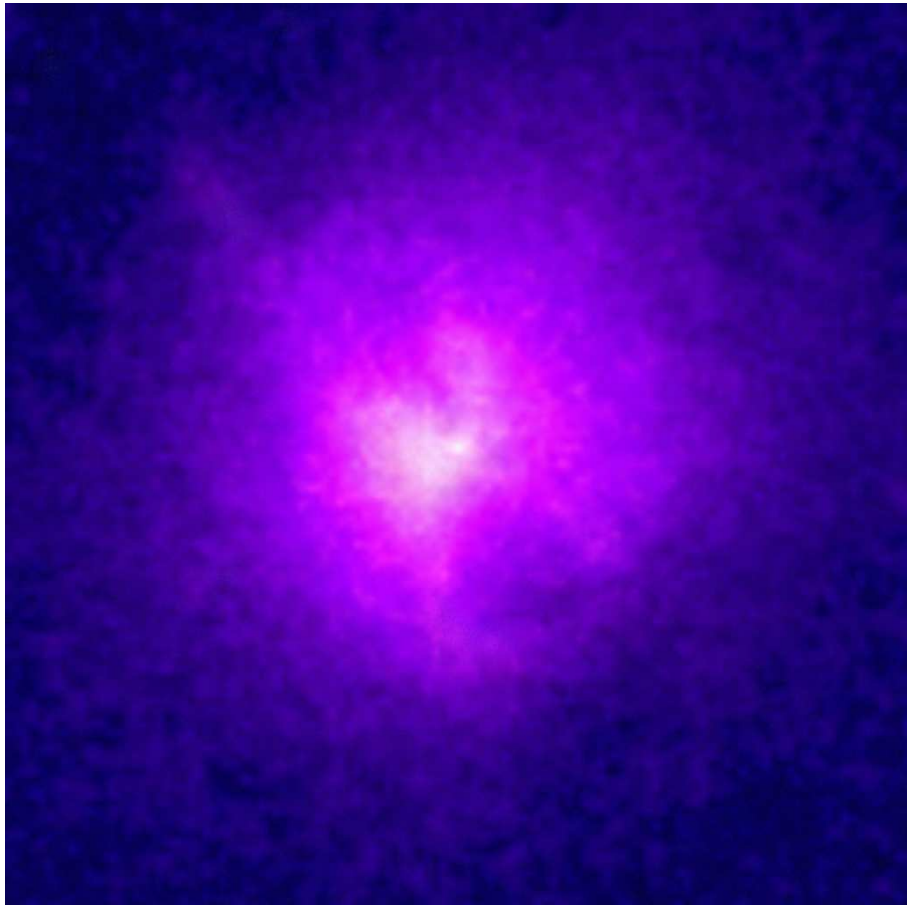
Rotation Curves $\Rightarrow$

Dark Matter

OR

MOdified Newtonian Dynamics

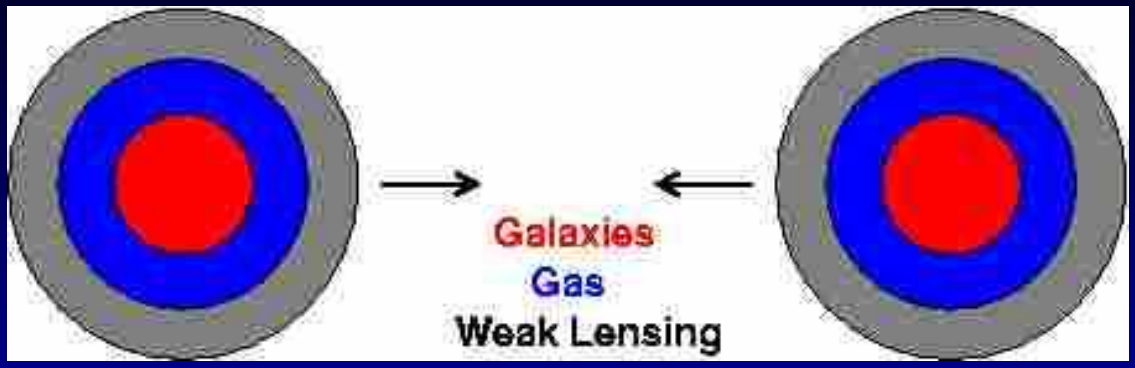
Galaxy Cluster=Hot Gas + WIMPS



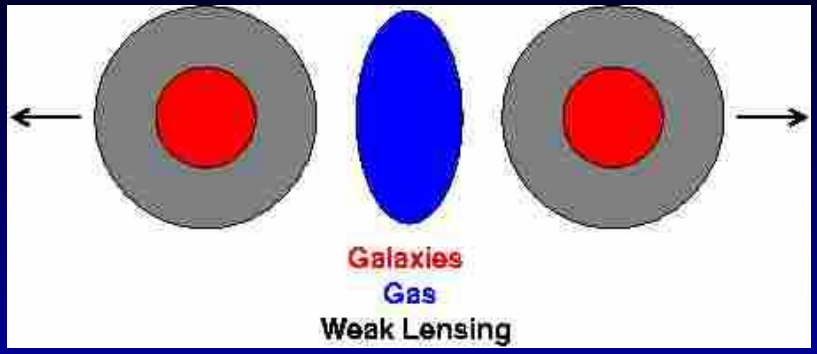
x-ray image of Hydra A

Collision between 2 Galaxy Clusters

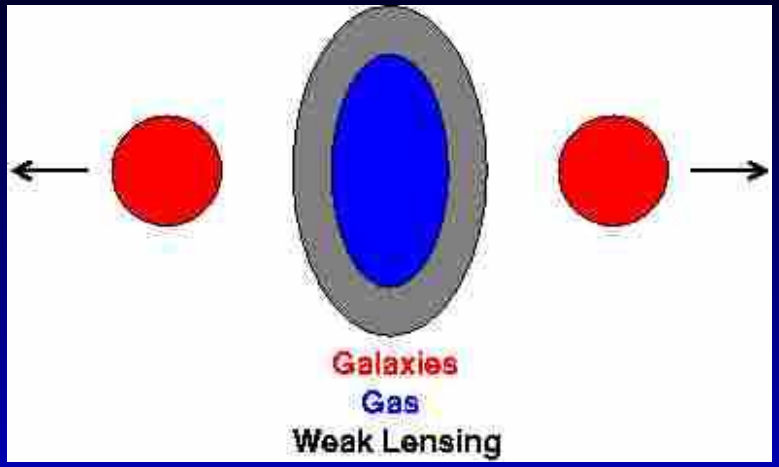
System before impact



System after impact with dark matter



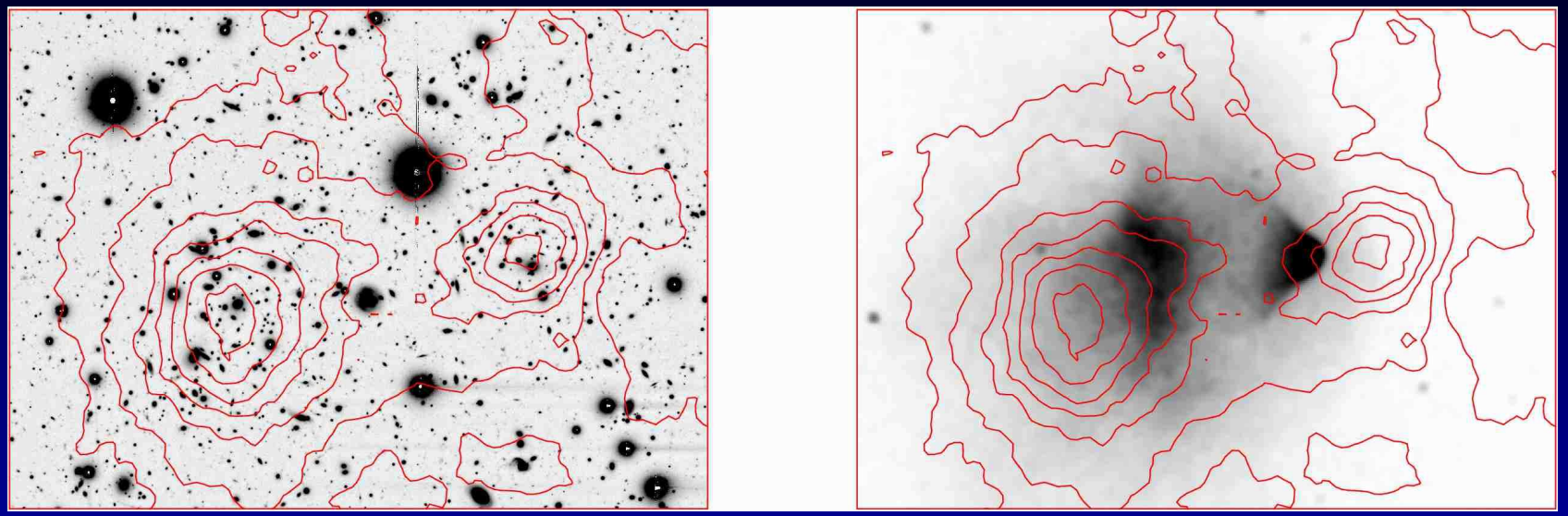
System after impact with alternative gravity



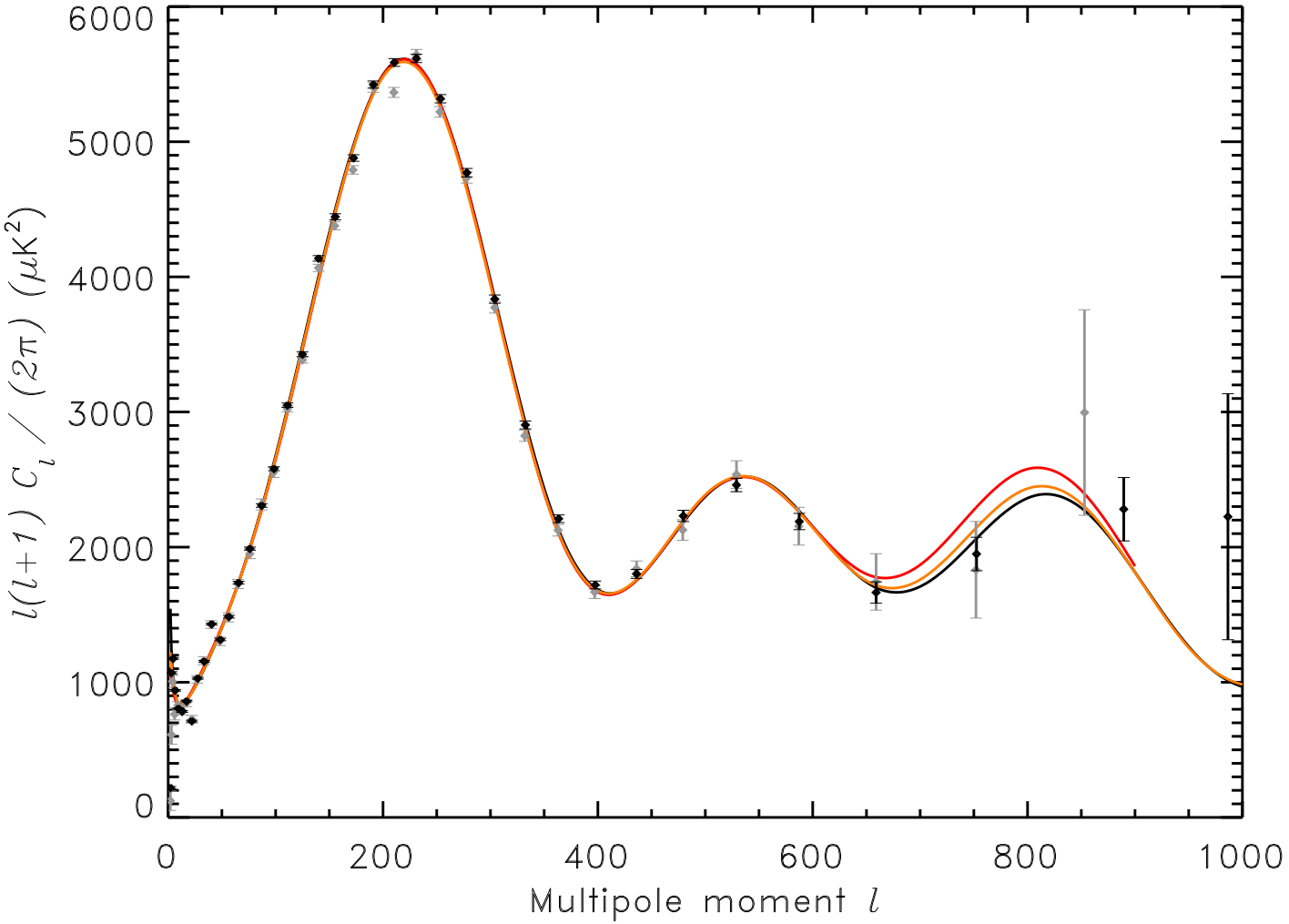
Collision between 2 Galaxy Clusters

D. Clowe et al. (DM2006)

Weak lensing reconstruction

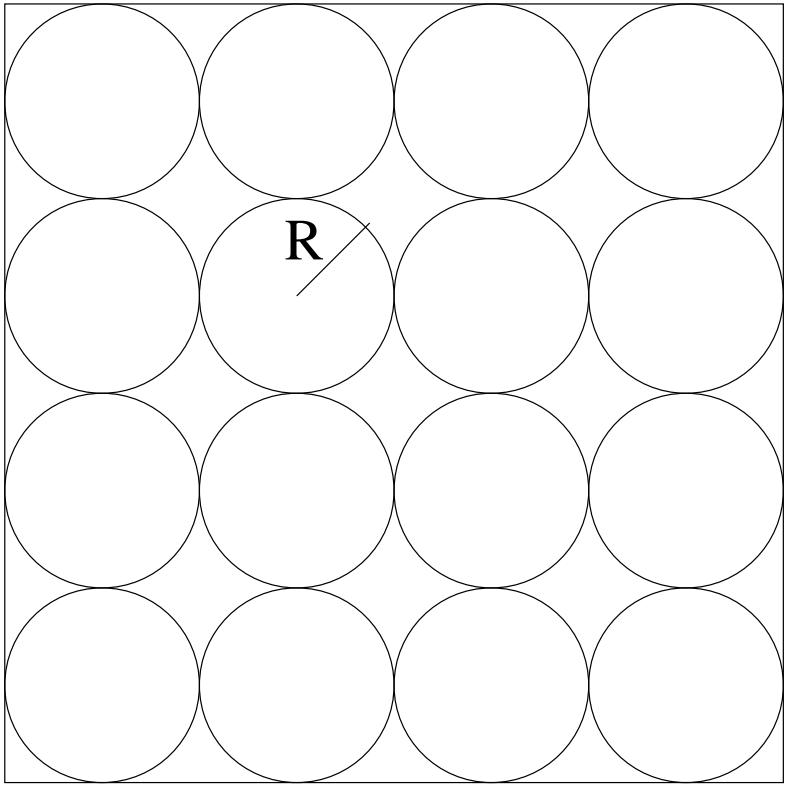


WMAP 3-year temperature anisotropy



$$\Rightarrow (\Omega_m h^2, \Omega_b h^2, h, n_s, \tau, \sigma_8) =$$
$$(0.127^{+0.007}_{-0.013}, 0.0223^{+0.0007}_{-0.0009}, 0.73^{+0.03}_{-0.03}, 0.951^{+0.015}_{-0.019}, 0.09^{+0.03}_{-0.03}, 0.74^{+0.05}_{-0.06})$$

Density Fluctuations



$$\rho(\vec{r}) = \bar{\rho} + \sum \delta_{\vec{k}} \exp(i\vec{k} \cdot \vec{r})$$

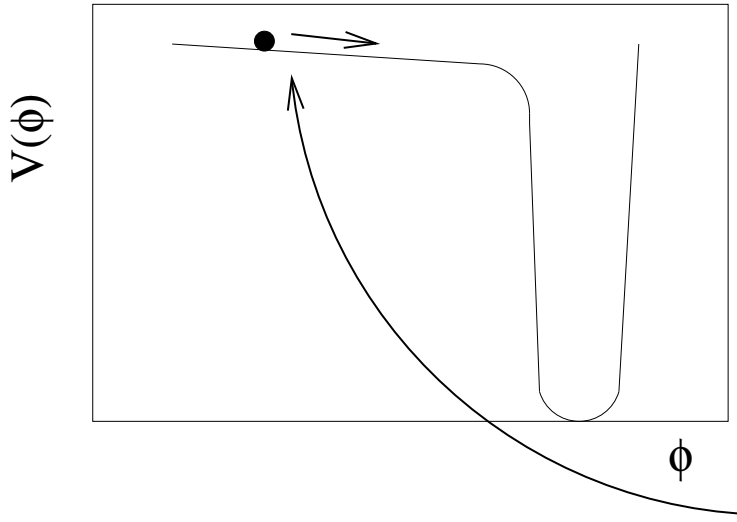
$$|\delta_{\vec{k}}|^2 \propto k^n \quad n \sim 1$$

$$\Rightarrow \left\langle \left(\frac{\Delta\rho}{\rho}\right)^2 \right\rangle_R \sim \left(\frac{1}{R}\right)^{3+n}$$

$$\Rightarrow \Delta\phi_R \sim \frac{G\Delta\rho R^3}{R} \sim \left(\frac{1}{R}\right)^{(n-1)/2}$$

$\Rightarrow (n = 1) \Rightarrow$ scale invariant potential fluctuations

Density Fluctuations from Inflation



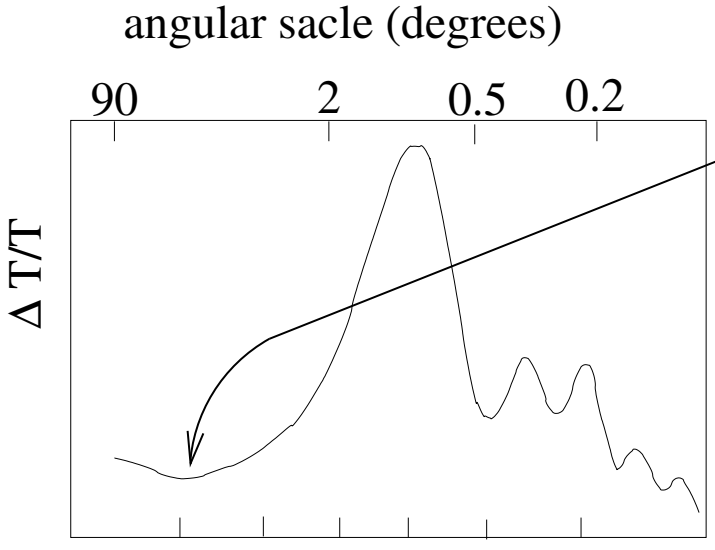
During inflation

ρ= V(ϕ)

+ quantum fluctuations

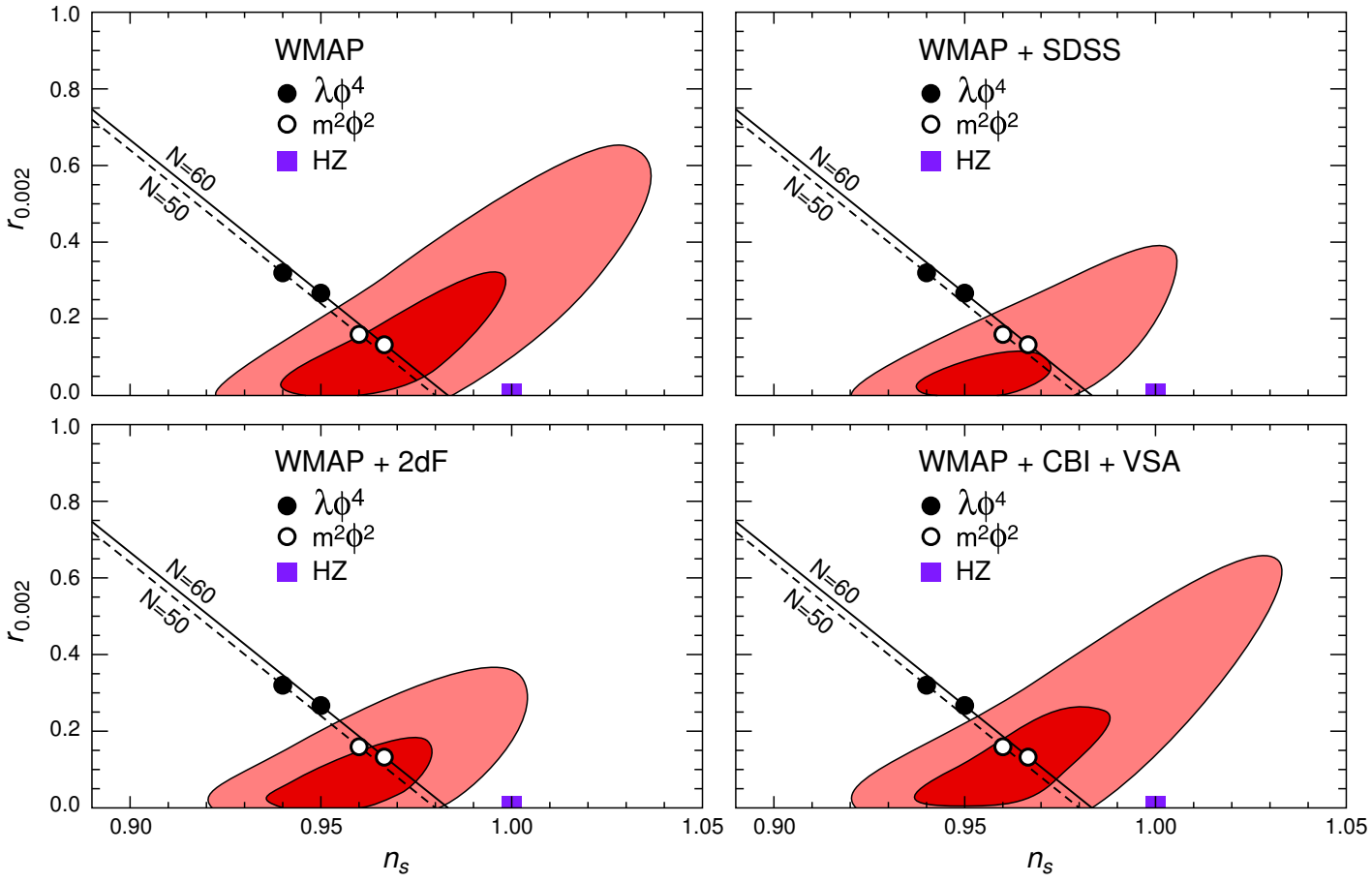
inflationary potential flat here

=> scale independence here



$$n_s - 1 \;=\; -3m_{pl}^2 \left[\left(\frac{2V'}{3V} \right)^2 \;-\; \frac{V''}{V} \right]$$

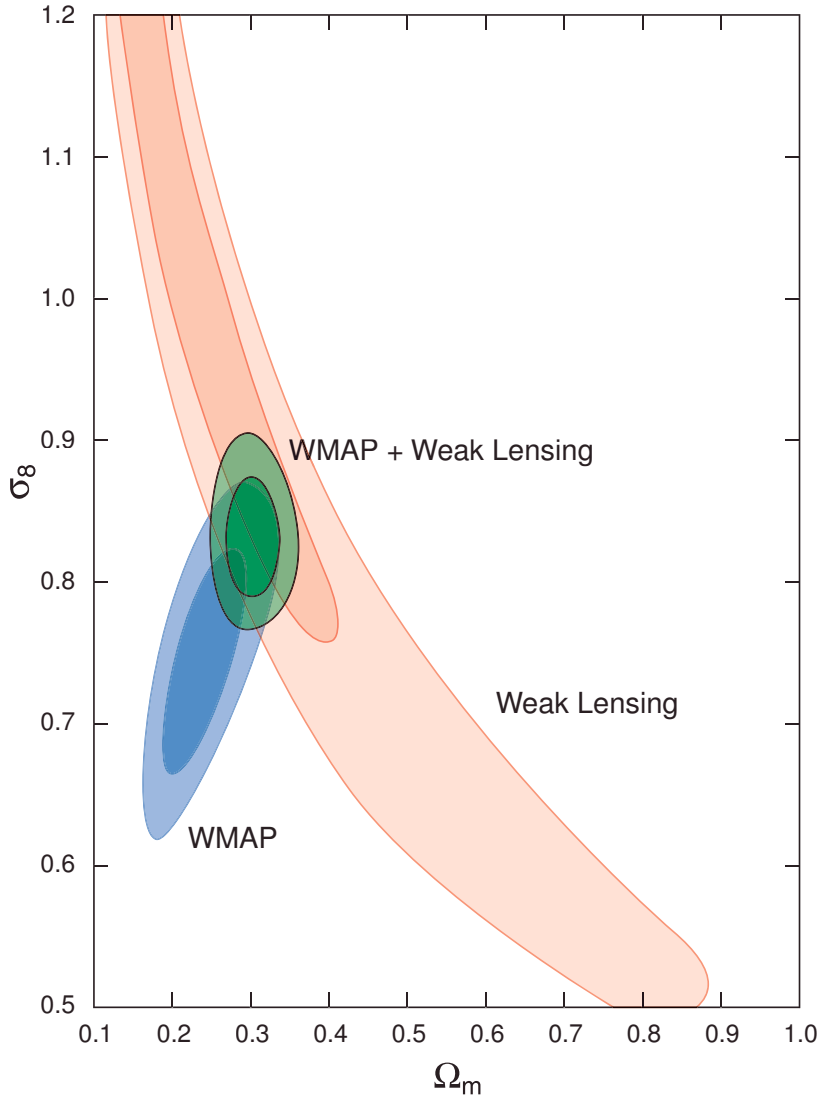
WMAP constraints on (n_s, r)



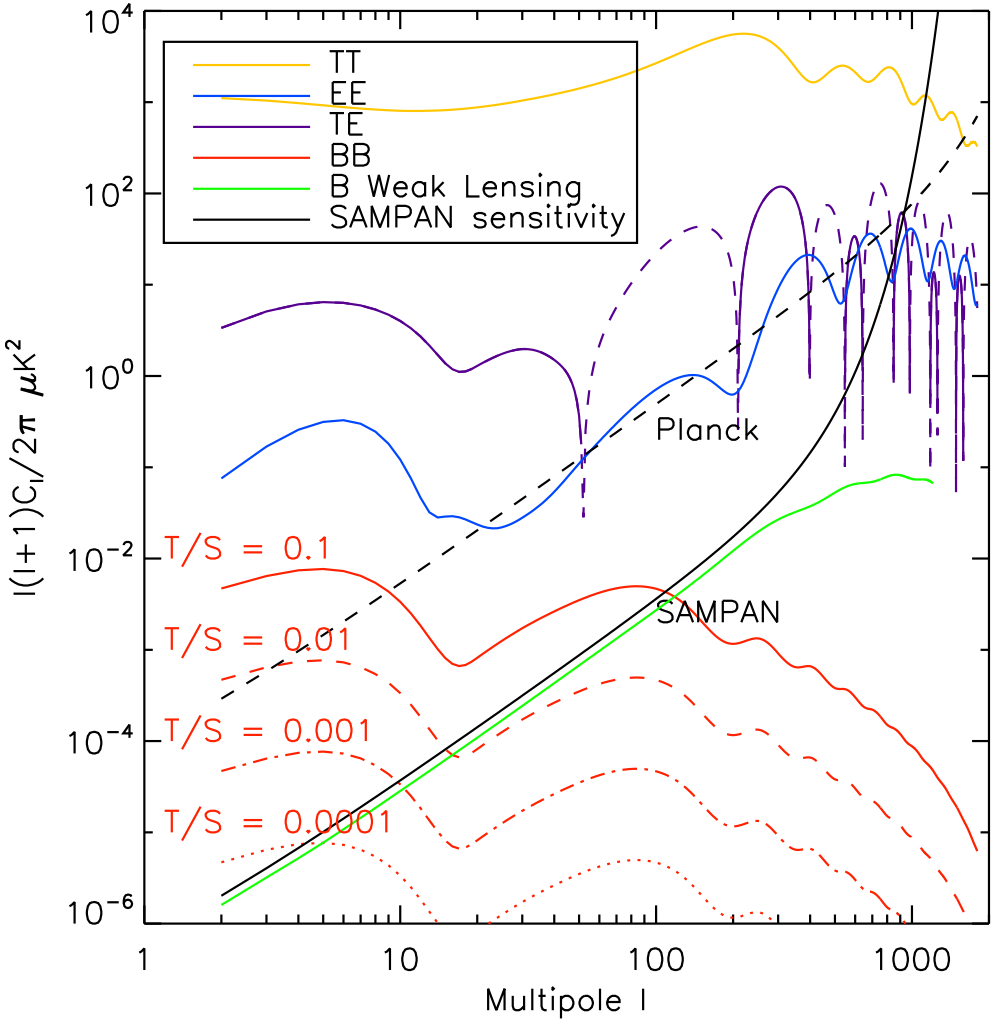
r = tensor/scalar amplitude ratio

WMAP vs weaklensing (CFHTLS)

$$\sigma_8 = \left(\frac{\Delta\rho}{\rho}\right)_{8h^{-1}Mpc}$$



Future CMB polarization measurments



$\Rightarrow$ gravity waves from inflation

$$T/S > 0.001 \Leftarrow$$
$$E_{inf} > 6 \times 10^{15} GeV$$

Time evolution of Dark Energy ?

Time evolution of dark energy density, ρ_{de} determined by w :

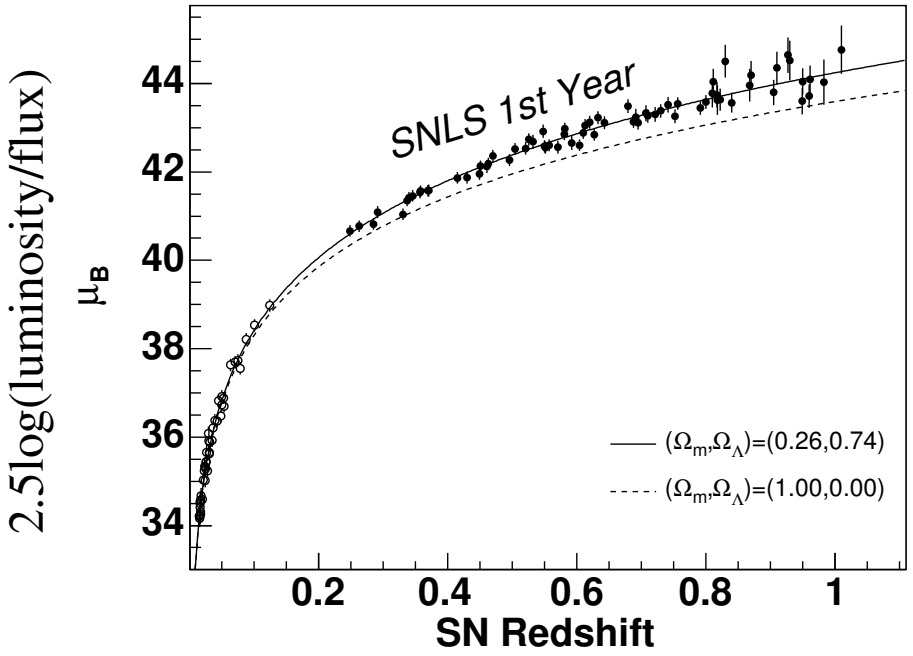
$$w = \frac{p_{de}}{\rho_{de}} \qquad \frac{1}{\rho_{de}}\frac{d\rho_{de}}{dt} = -3H_0(1+w)$$

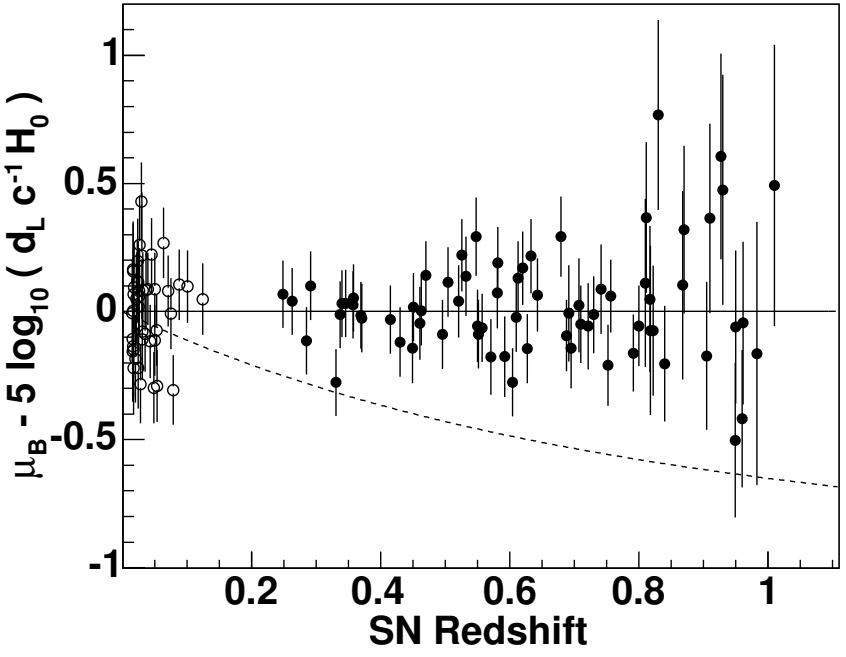
($w = -1$ for vacuum energy/cosmological constant)

Information on w from

- supernova fluz vs. z
- standard ruler size vs. z (acoustic horizon)
- structure formation vs. z (weak lensing ; clusters from SZ surveys)

SNLS year 1 Hubble diagram (71SNIa)





Hubble diagram

Luminosity is an empirical function of

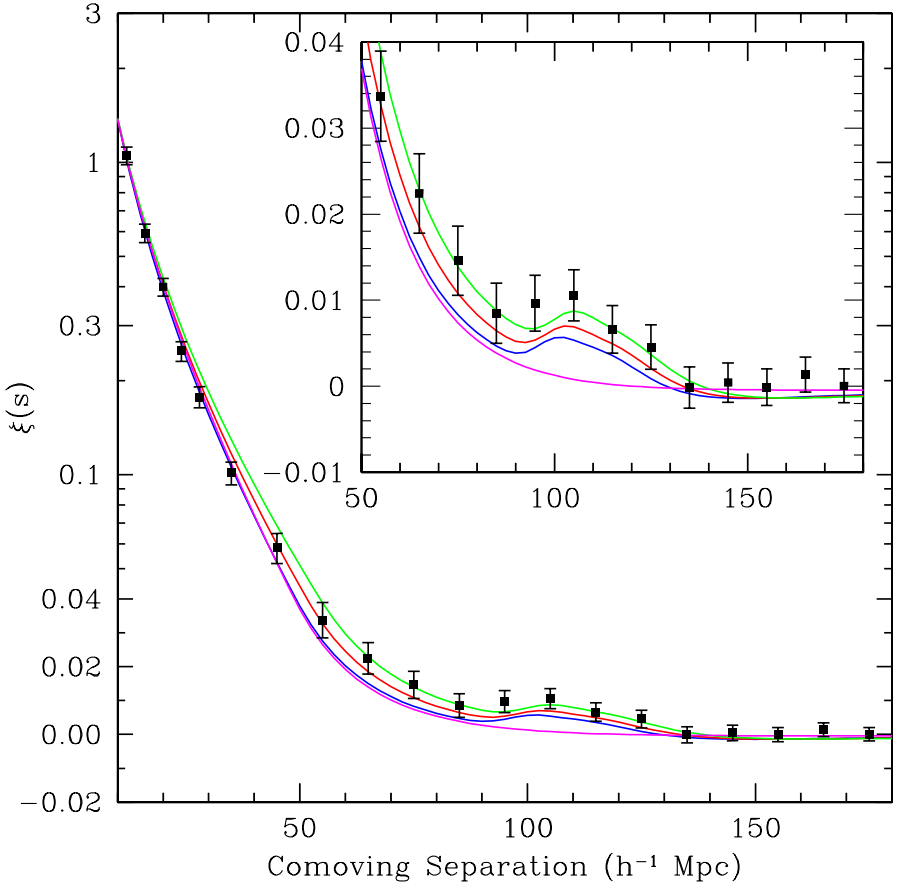
- "stretch" (risetime+falltime) and
- "color" (rest-frame B-V)

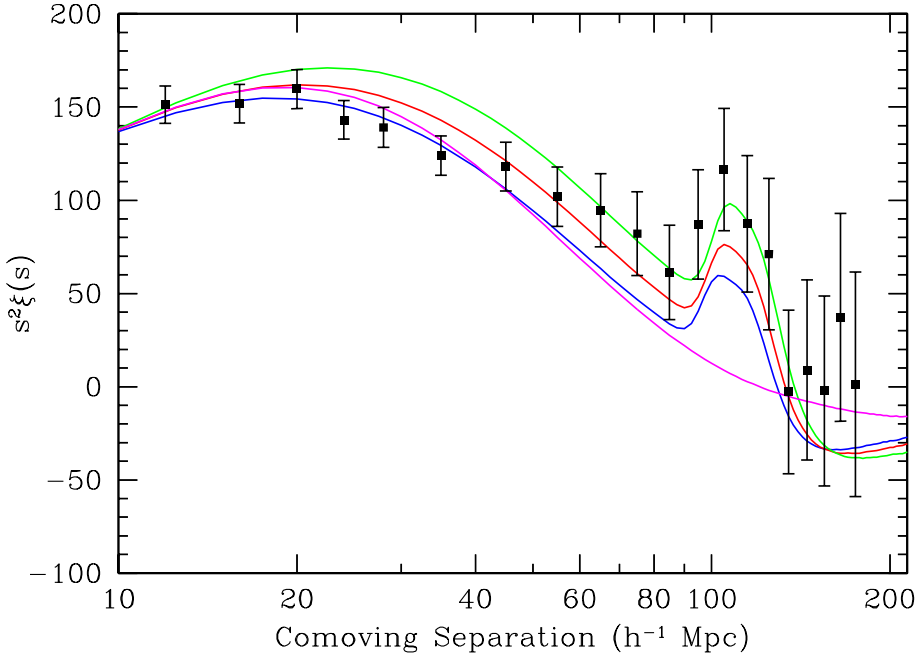
residuals to
$(\Omega_M, \Omega_\Lambda) = (0.26, 0.74)$

SDSS galaxy correllation function

(Eisenstein et al Astrophys.J. 633 (2005) 560-574)

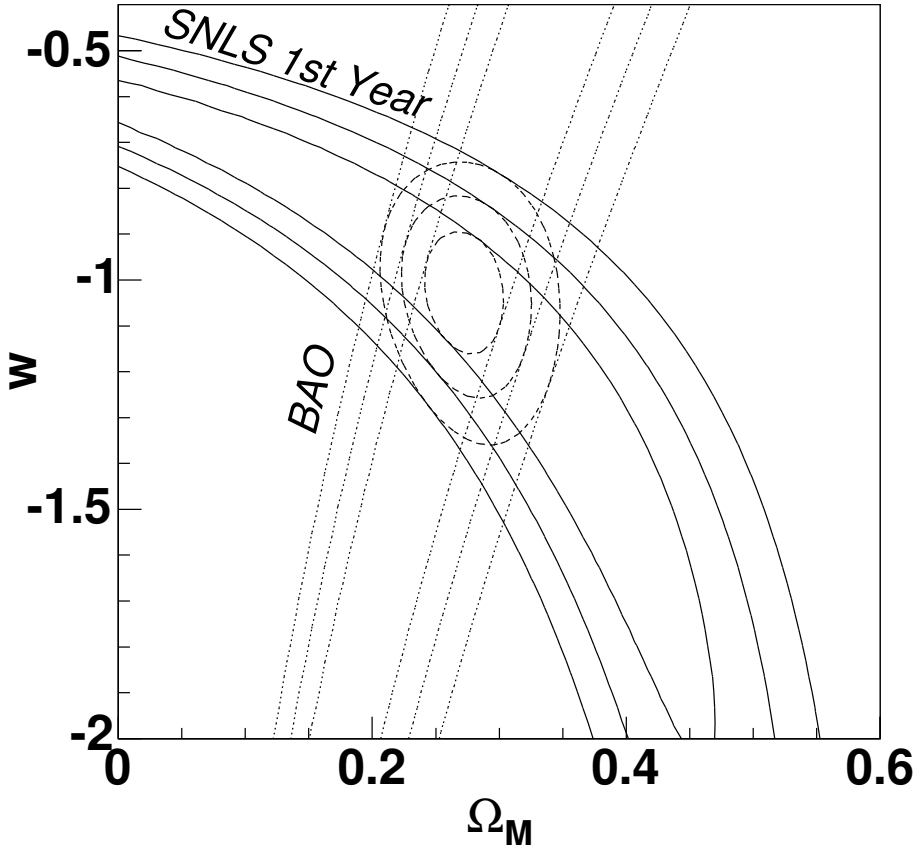
Galaxies like to be separated by $105h^{-1}Mpc = 150Mpc$





SNLS and SDSS constraints on w

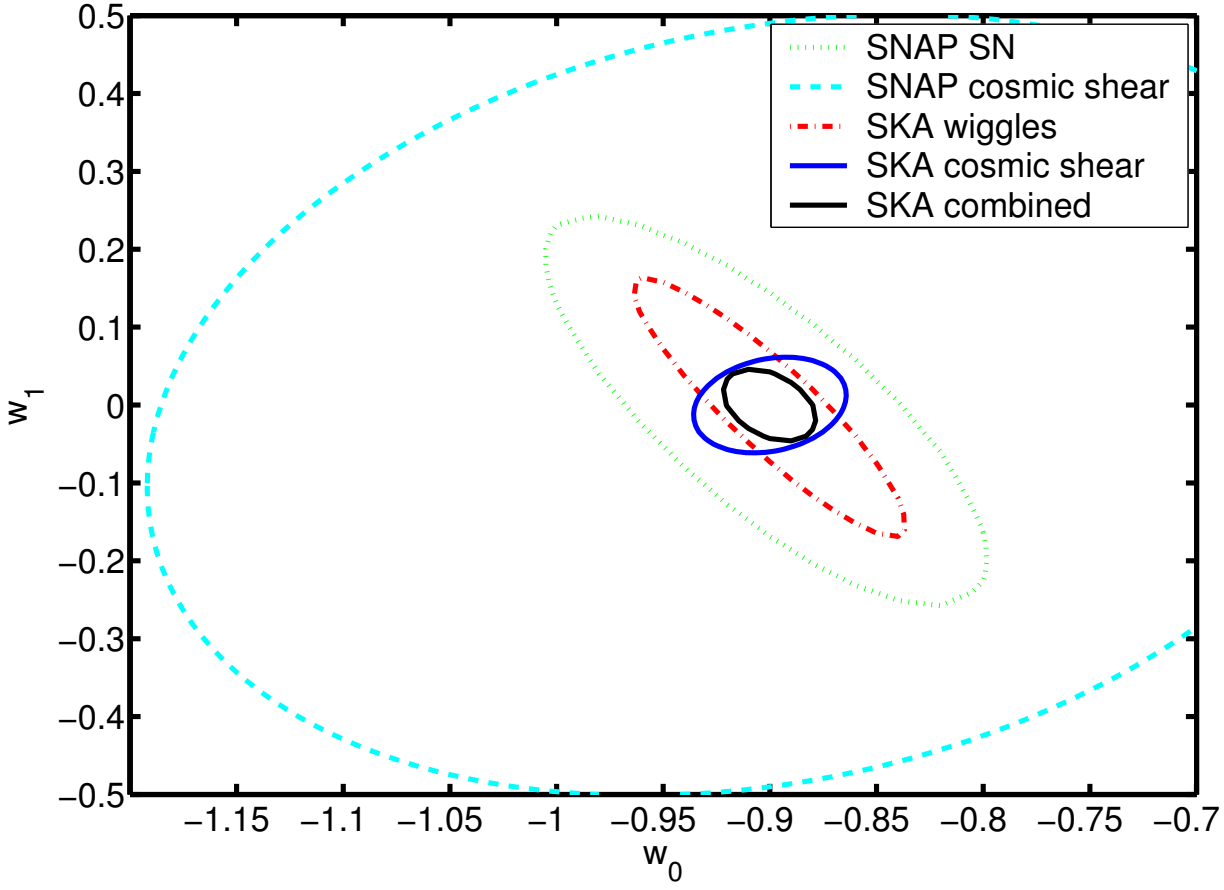
(Astier et al, 2006 A&A, 447, 31A)



$$w = -1.023 \pm 0.090 \pm 0.054$$

(BAO= Baryon Acoustic Oscillations)

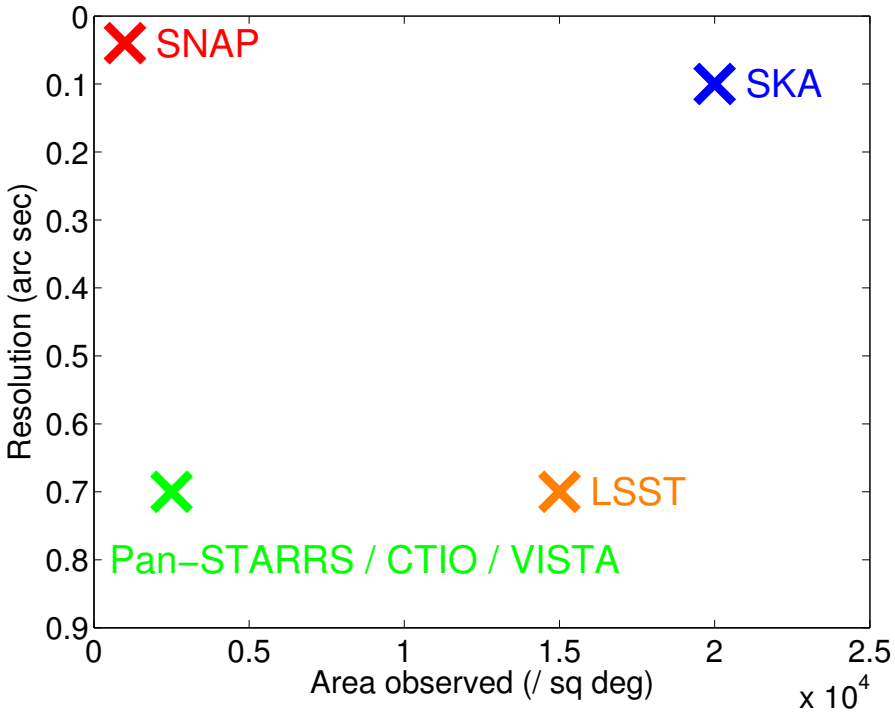
Future limits on (w, w') from SKA



SKA=Square Kilometer Array (2018)

21cm (atomic hydrogen) survey to $z = 3$ redshifts (acoustic peak) + weak lensing

Future Surveys



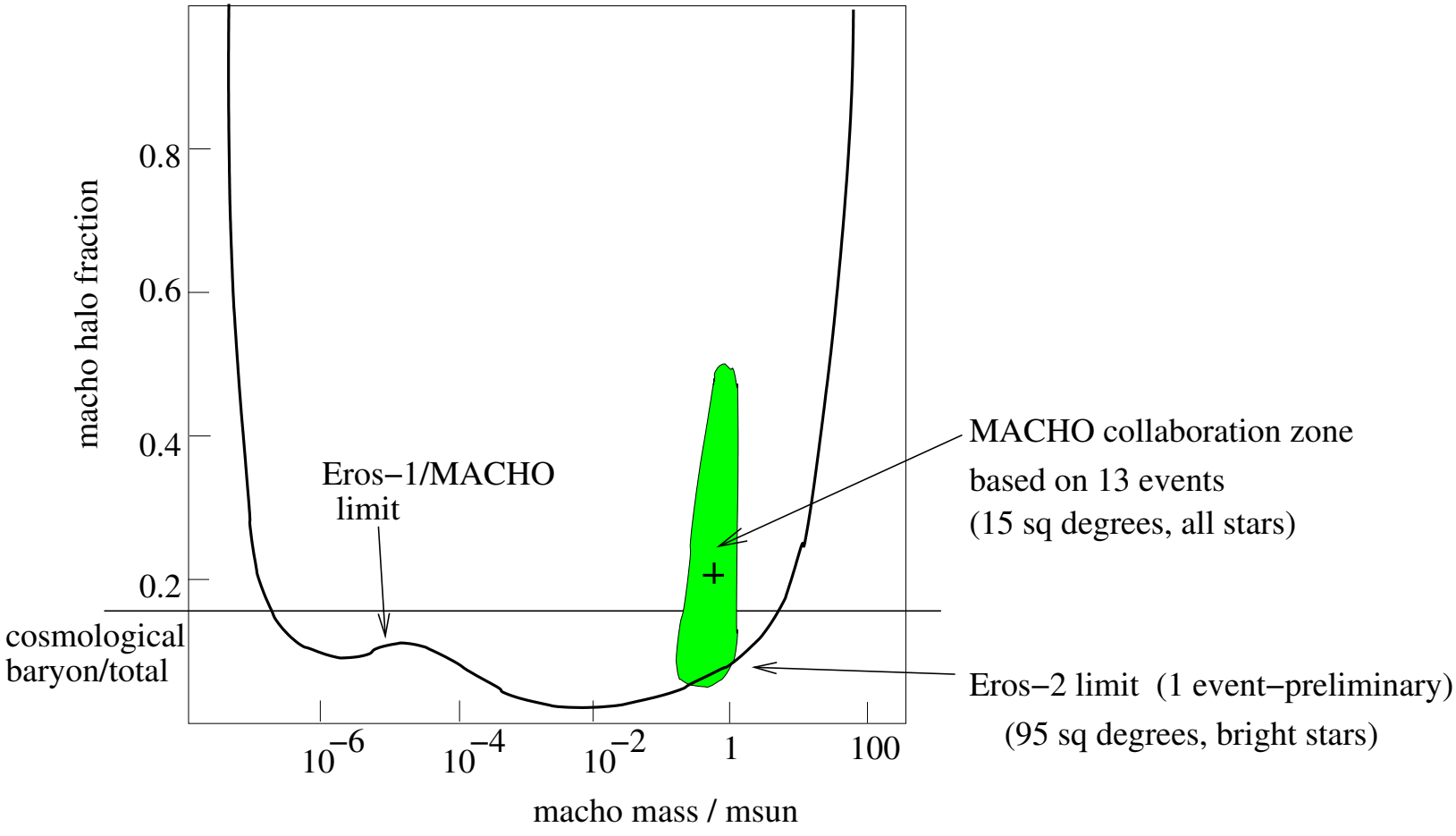
SNAP,DUNE : SN and lensing from space

PanSTARRS....LSST : lensing, SN, clusters from Earth

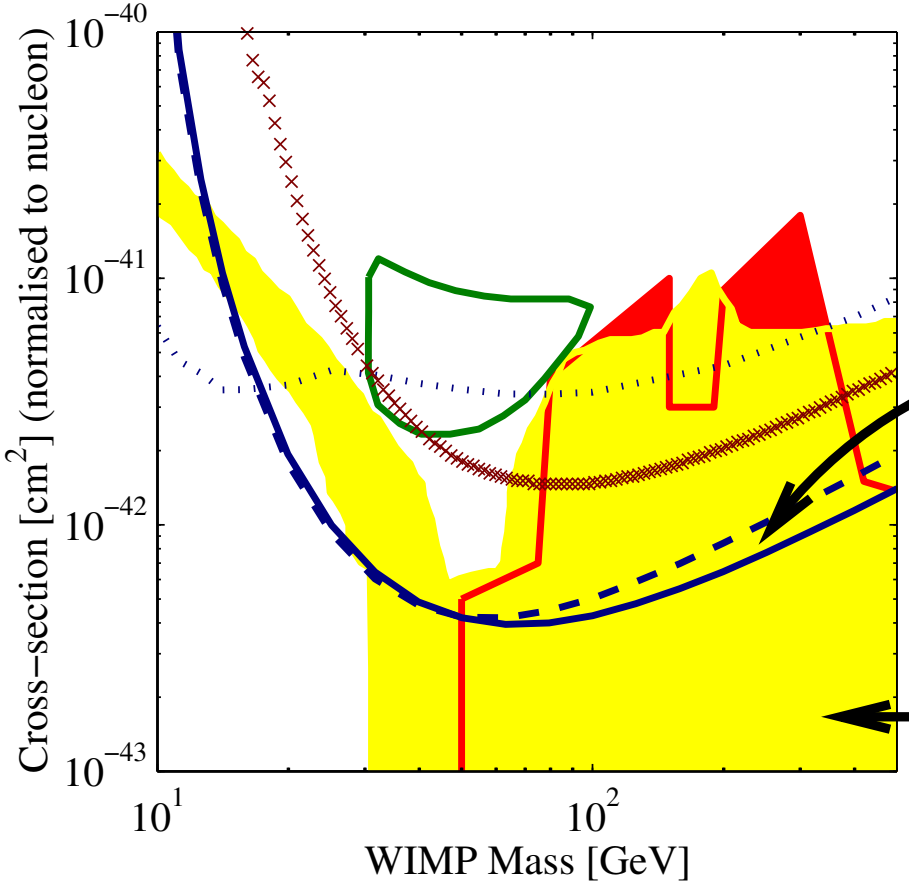
SKA : weaklensing and BAO, 21cm

WFMOS, HETDEX : BAO from Earth

Limits on Macho Halo fraction



Wimp Searches (direct)



CDMS limit on
wimp cross−section/mass

plausible values of
supersymmetric
wimp cross−section/mass

Future : Silicon, Germanium, Xenon, Argon, Neon,
+LHC !