Tester la gravitation à grande échelle

Tester la gravitation à grande échelle

Standard Cosmological model: concordance cosmology

Cosmological parameters

Cosmological parameters

...pretty well known

Cosmological parameters

...pretty well known : SNIa, CMB, P(k)

Cosmological parameters

...pretty well known : SNIa, CMB, P(k)

Parameter	Vanilla	Vanilla + Ω_k	Vanilla + w	Vanilla + Ω_k + w
$\Omega_b h^2$	0.0227 ± 0.0005	0.0227 ± 0.0006	0.0228 ± 0.0006	0.0227 ± 0.0005
$\Omega_c h^2$	0.112 ± 0.003	0.109 ± 0.005	0.109 ± 0.005	0.109 ± 0.005
θ	1.042 ± 0.003	1.042 ± 0.003	1.042 ± 0.003	1.042 ± 0.003
τ	0.085 ± 0.017	0.088 ± 0.017	0.087 ± 0.017	0.088 ± 0.017
n_s	0.963 ± 0.012	0.964 ± 0.013	0.967 ± 0.014	0.964 ± 0.014
$log(10^{10} A_s)$	3.07 ± 0.04	3.06 ± 0.04	3.06 ± 0.04	3.06 ± 0.04
Ω_k	0	-0.005 ± 0.007	0	-0.005 ± 0.0121
w	-1	-1	-0.965 ± 0.056	-1.003 ± 0.102
Ω_Λ	0.738 ± 0.015	0.735 ± 0.016	0.739 ± 0.014	0.733 ± 0.020
Age	13.7 ± 0.1	13.9 ± 0.4	13.7 ± 0.1	13.9 ± 0.6
Ω_m	0.262 ± 0.015	0.270 ± 0.019	0.261 ± 0.020	0.272 ± 0.029
σ_8	0.806 ± 0.023	0.791 ± 0.030	0.816 ± 0.014	0.788 ± 0.042
z_{re}	10.9 ± 1.4	11.0 ± 1.5	11.0 ± 1.5	11.0 ± 1.4
h	0.716 ± 0.014	0.699 ± 0.028	0.713 ± 0.015	0.698 ± 0.037

(Ferramacho, Blanchard & Zolnirowski, 2009)

Not much progresses...

Not much progresses...

Table 10. Basic and Derived Cosmological Parameters: Running Spectral Index Model[a]

	Mean and 68% Confidence Errors
Amplitude of fluctuations	$A = 0.83^{+0.09}_{-0.08}$
Spectral Index at $k = 0.05$ Mpc^{-1}	$n_s = 0.93 \pm 0.03$
Derivative of Spectral Index	$dn_s/d\ln k = -0.031^{+0.016}_{-0.018}$
Hubble Constant	$h = 0.71^{+0.04}_{-0.03}$
Baryon Density	$\Omega_b h^2 = 0.0224 \pm 0.0009$
Matter Density	$\Omega_m h^2 = 0.135^{+0.008}_{-0.009}$
Optical Depth	$\tau = 0.17 \pm 0.06$
Matter Power Spectrum Normalization	$\sigma_8 = 0.84 \pm 0.04$
Characteristic Amplitude of Velocity Fluctuations	$\sigma_8 \Omega_m^{0.6} = 0.38^{+0.04}_{-0.05}$
Baryon Density/Critical Density	$\Omega_b = 0.044 \pm 0.004$
Matter Density/Critical Density	$\Omega_m = 0.27 \pm 0.04$
Age of the Universe	$t_0 = 13.7 \pm 0.2$ Gyr

(WMAP, 2003)

Cosmological parameters

Cosmological parameters

SNIa, CMB, P(k)

Cosmological parameters

SNIa, CMB, P(k) which can be derived from

geometrical quantities:

Cosmological parameters

SNIa, CMB, P(k) which can be derived from

geometrical quantities:

$$\int_0^{1+z} \frac{dz}{H(z)}$$

Growth rate of perturbations

Growth rate of perturbations

Equations for linear perturbations:

Growth rate of perturbations

Equations for linear perturbations:

$$\ddot{\delta} + 2H\dot{\delta} = 4\pi G\rho\delta = \frac{3}{2}\Omega H^2$$

But...

But...

if acceleration is due to some break of GR (DGP, ...)

But...

if acceleration is due to some break of GR (DGP, ...)

then:

$$\ddot{\delta} + 2H\dot{\delta} = 4\pi G(k, z)\rho\delta$$

Measuring D(t)

Measuring D(t)

Is a test of gravity <-> GR

Clusters abundance

Theory of the mass function:

Clusters abundance

Theory of the mass function:

$$n(M) = -\frac{\overline{\rho}}{M^2\sigma(M)}\delta_{NL}\frac{d\ln\sigma}{d\ln M}\mathcal{F}(\nu_{NL})$$

Clusters abundance

Theory of the mass function:

$$n(M) = -\frac{\overline{\rho}}{M^2\sigma(M)}\delta_{NL}\frac{d\ln\sigma}{d\ln M}\mathcal{F}(\nu_{NL})$$

with : $\sigma_t(M) = D(t)\sigma_0(M)$ and $\nu_{NL} = \frac{\delta_{NL}}{\sigma(M)}$

Number counts:

Number counts:

$$N(>l,z)=\int dz\frac{dV}{dzd\Omega}\int_{M_{min}(l,z)}n(M)dM$$

or

$$N(z)=\int dz\frac{dV}{dzd\Omega}\int p(M,z)n(M)dM$$

Clusters selection

Clusters selection

- Optical

Clusters selection

- Optical

- Lensing

Clusters selection

- Optical

- Lensing

- X-ray

Clusters selection

- Optical

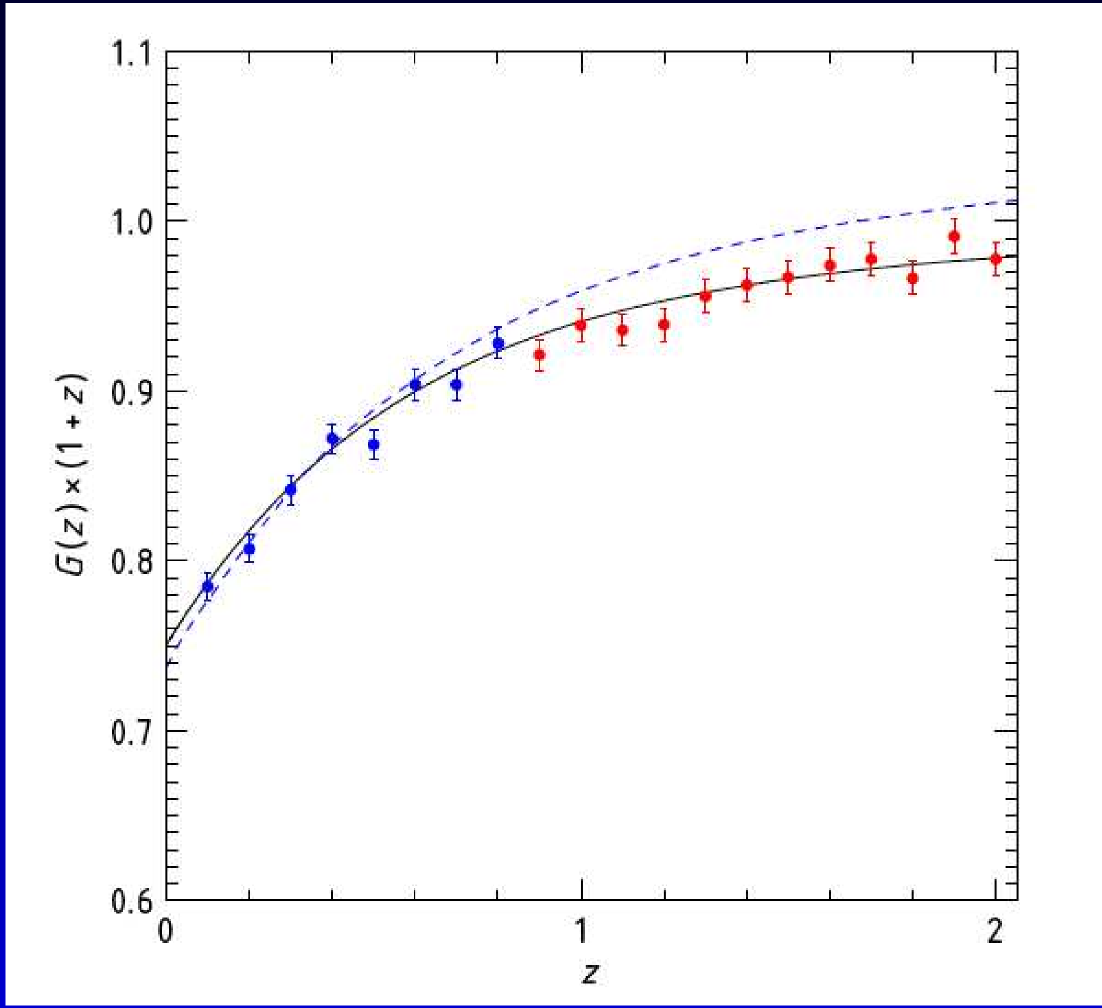
- Lensing

- X-ray

- SZ

An example : WFXT

An example : WFXT



But...

But...

A mass proxy is needed

But...

A mass proxy is needed

Accurate selection function knowledge is needed