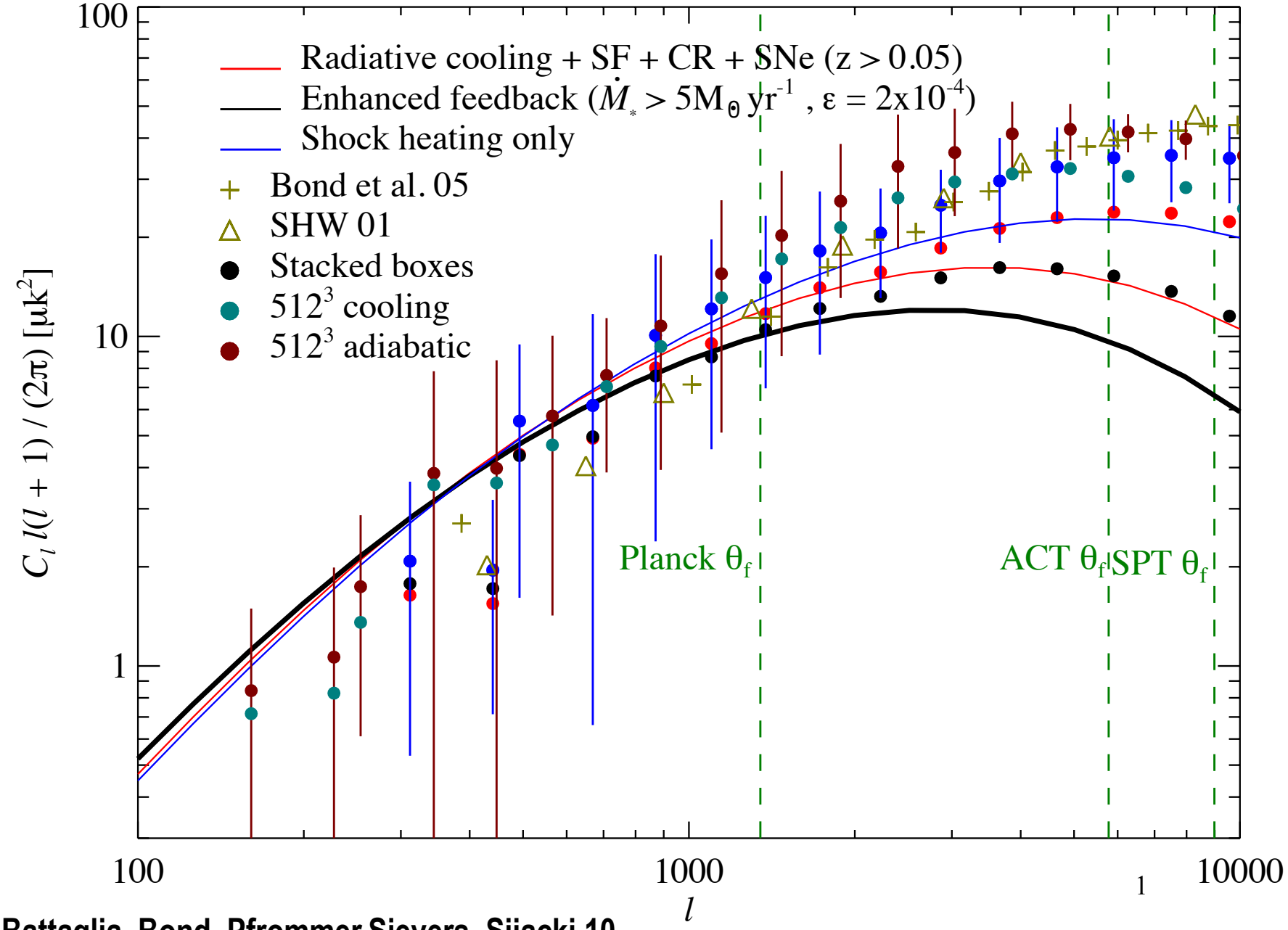
# $C_L^{SZ}$ systematic uncertainties, via large computer simulations

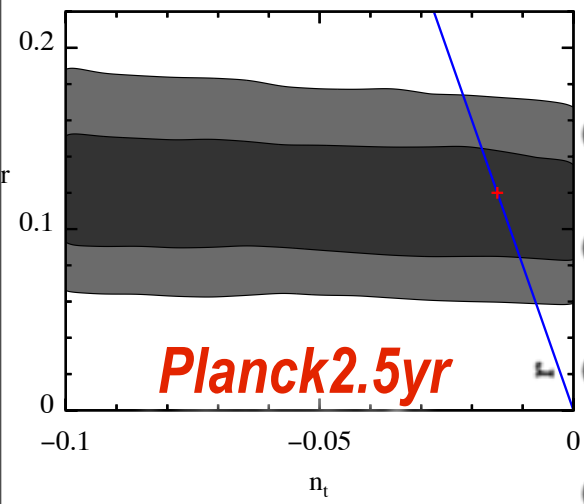


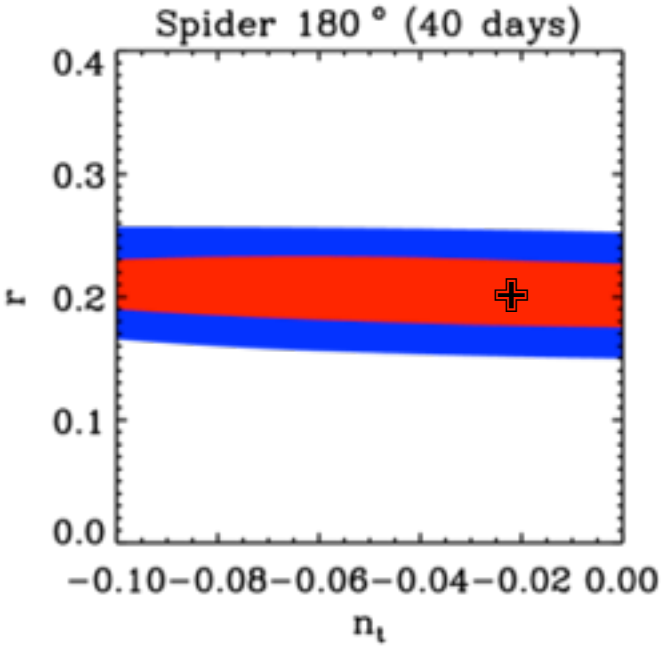

**Battaglia, Bond, Pfrommer,Sievers, Sijacki 10**

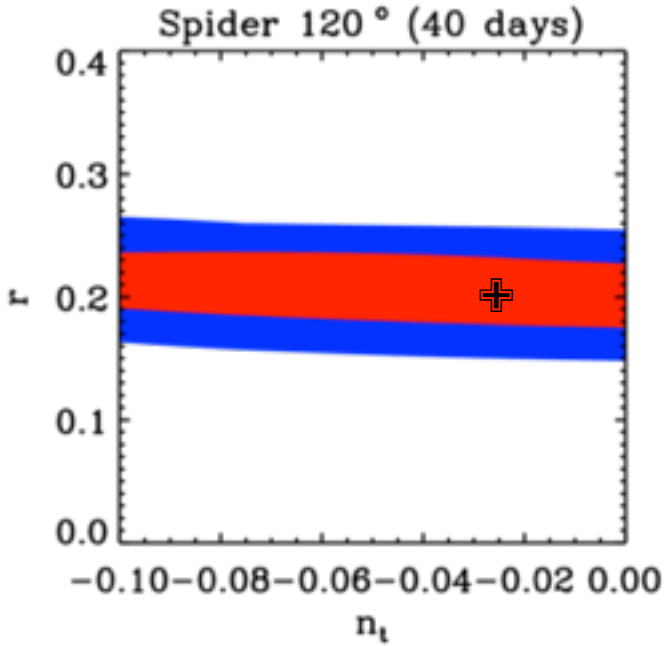
# $r \approx -8n_t$

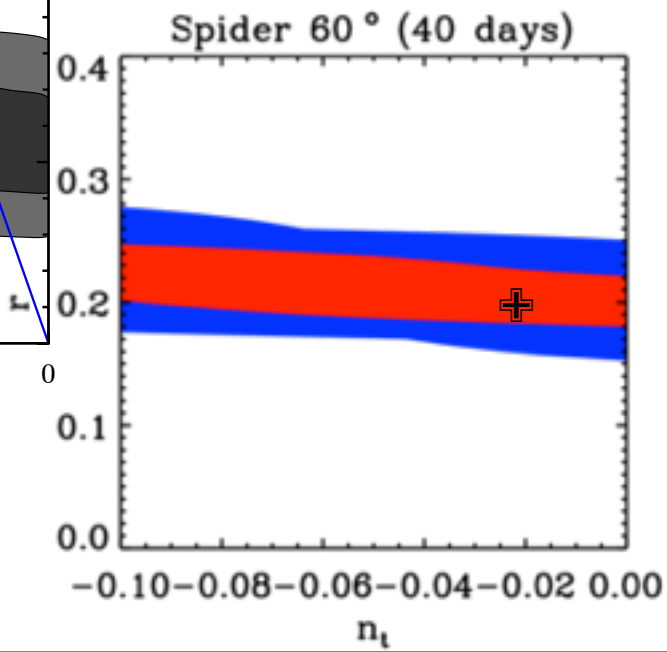
**poor $n_t \Rightarrow$**

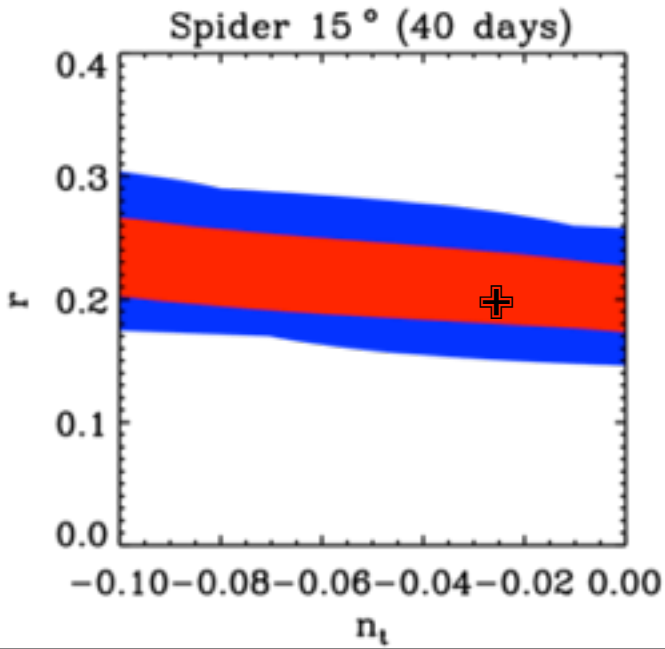
***inflation consistency*** *cannot be checked with Spider or Planck2.5yr*



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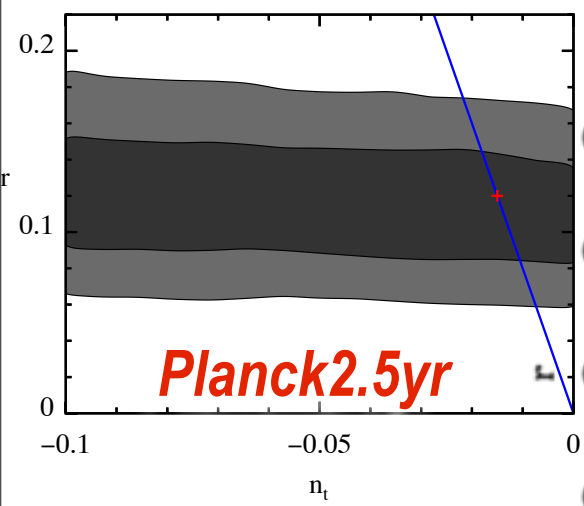


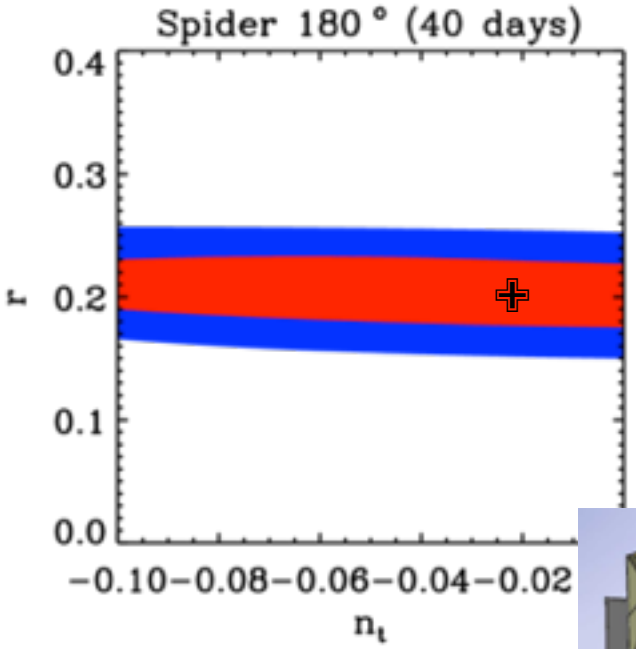


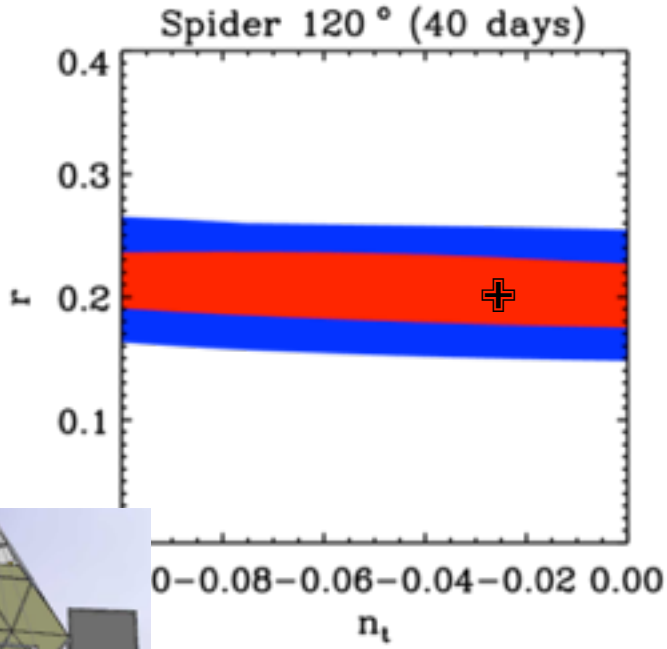


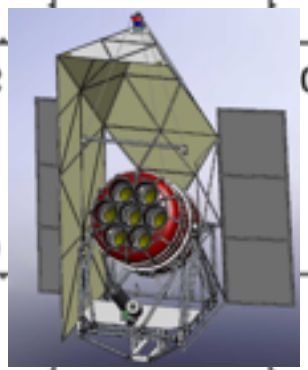

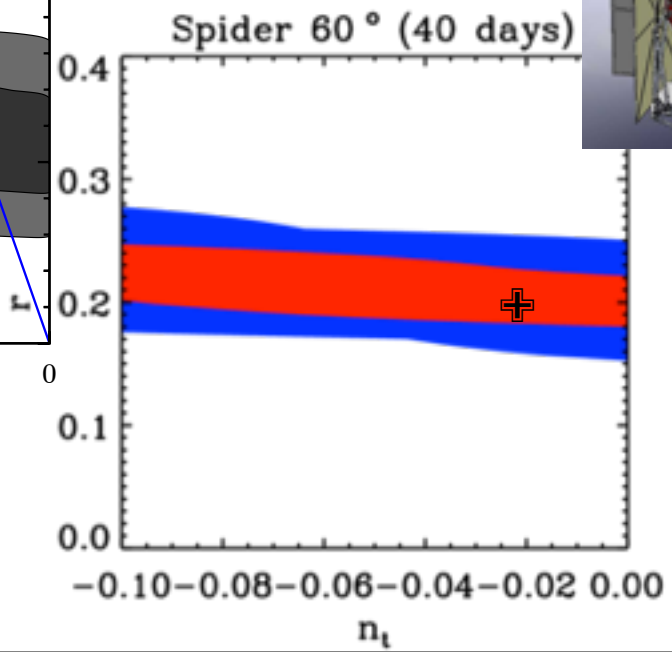


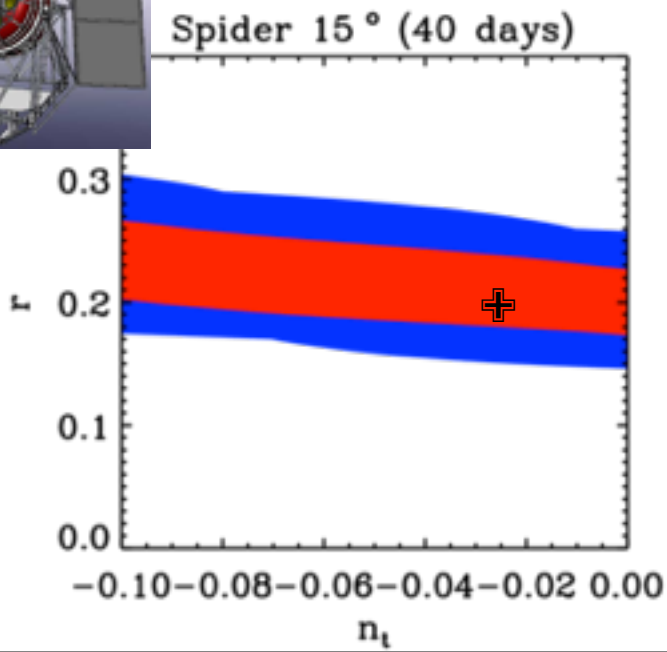

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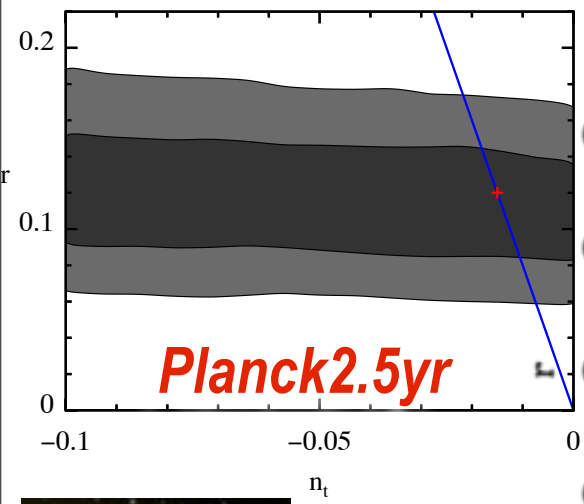
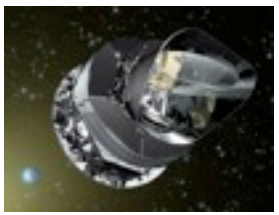
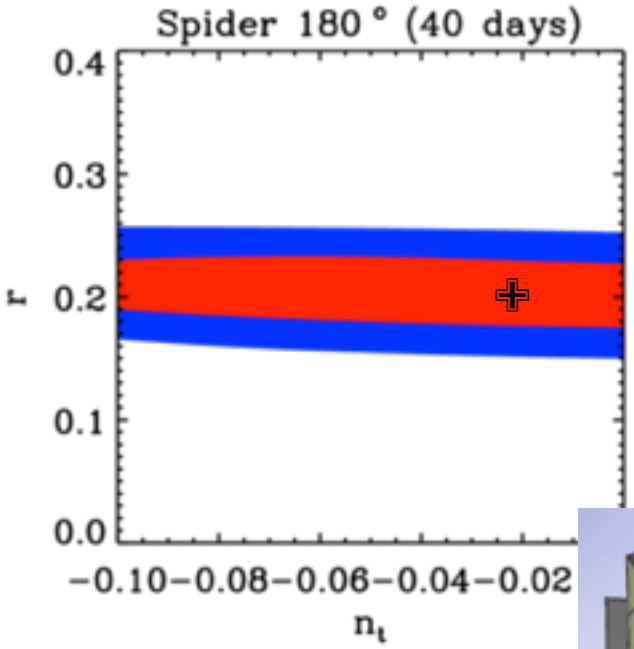
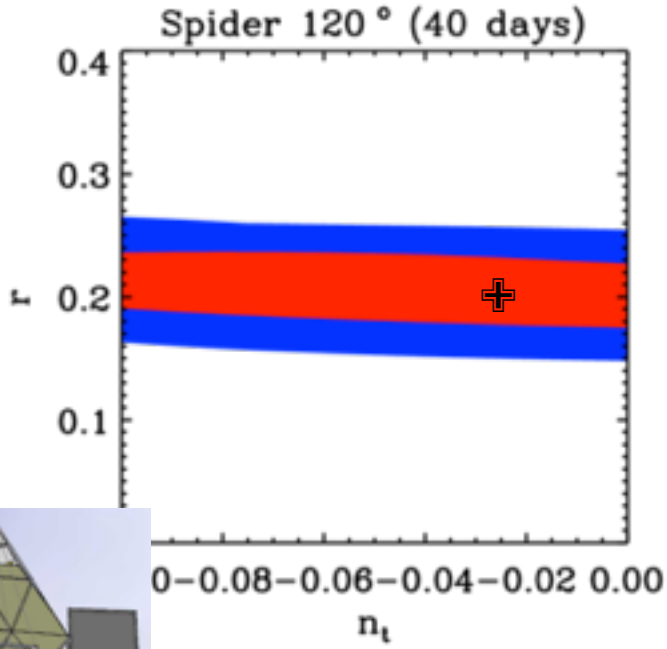
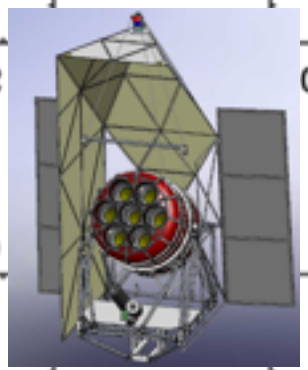
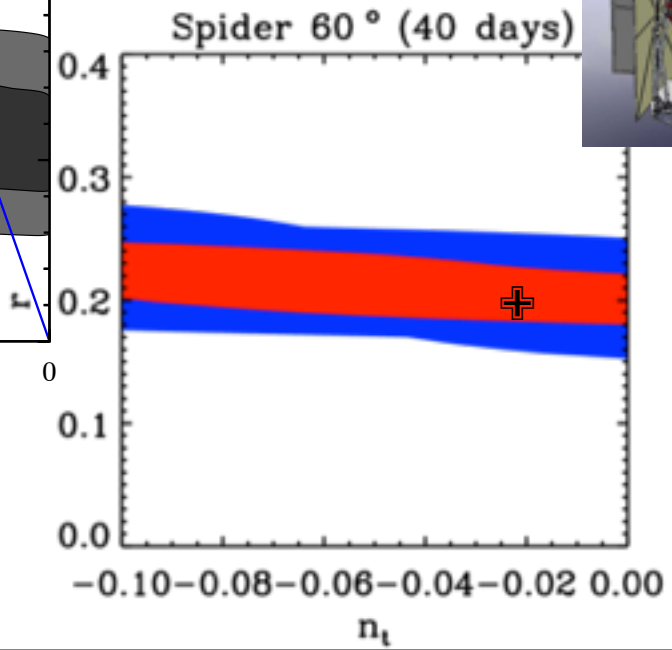


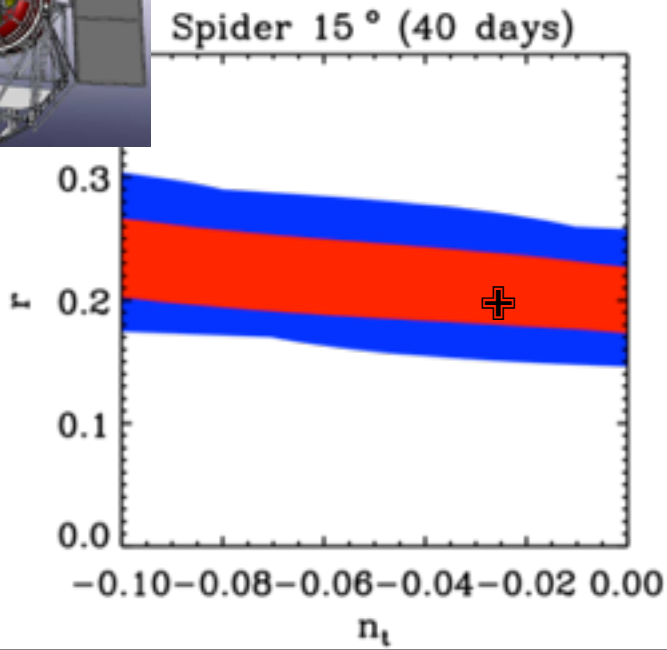





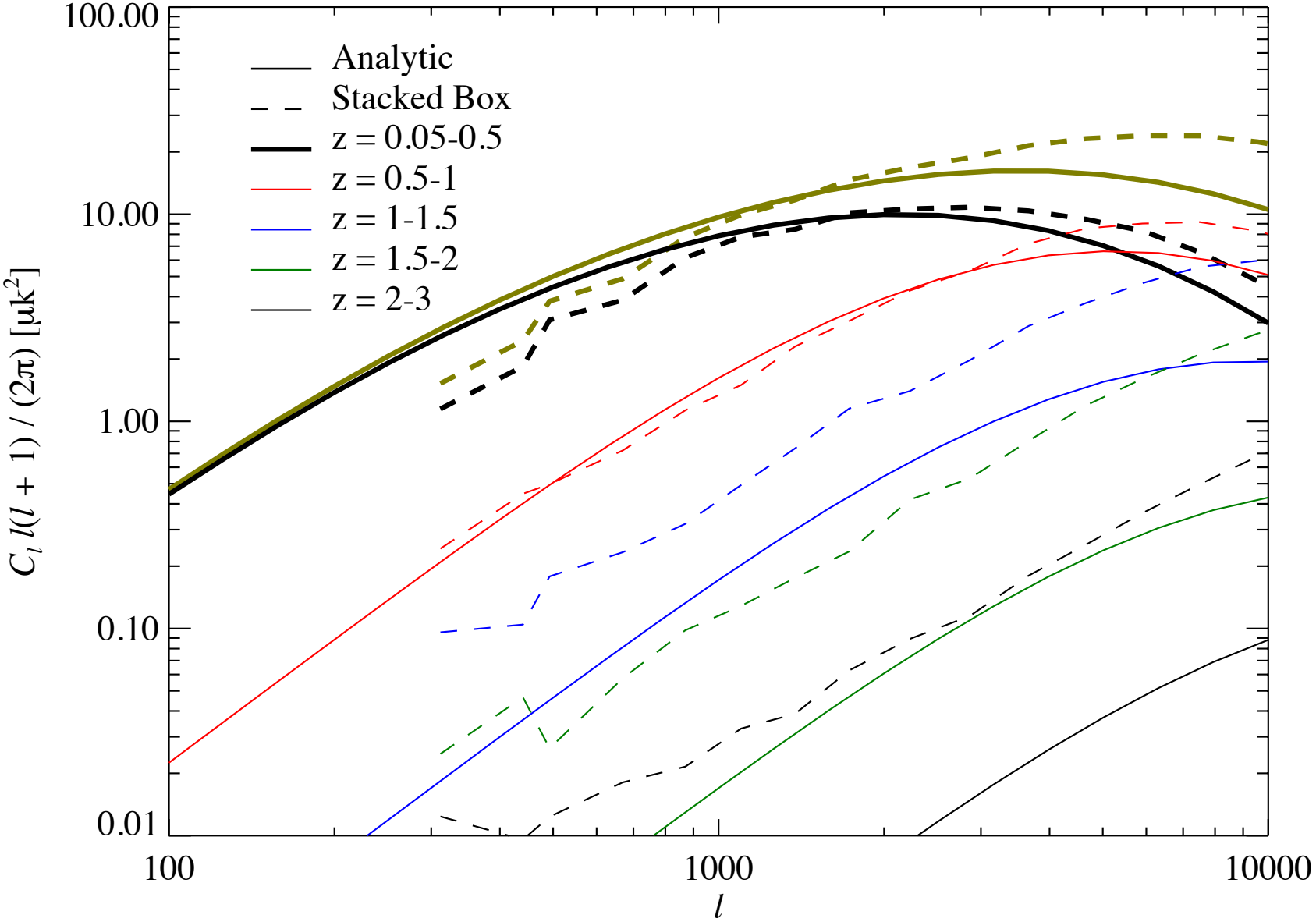





# end

# $C_L^{SZ}$ systematic uncertainties, stacked clusters cf stacked boxes





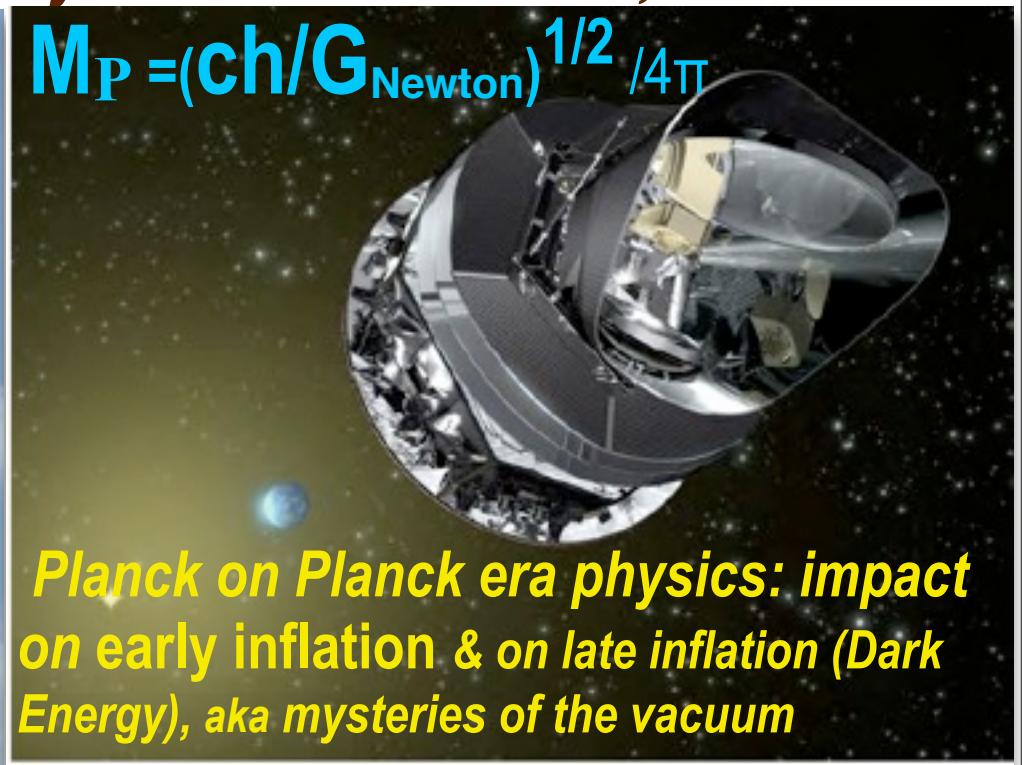

**Battaglia, Bond, Pfrommer,Sievers, Sijacki 10**

# Entering the Planck Era > May 14, 2009

***status A-OK, first all sky survey finishes Feb 2010; 5 in all***

**Launch May 14, 2009**
**FrenchGuiana, @L2 early July,**
**Survey Began Aug 09**

$M_P = (ch/G_{Newton})^{1/2}/4\pi$



***Planck on Planck era physics: impact on early inflation & on late inflation (Dark Energy), aka mysteries of the vacuum***

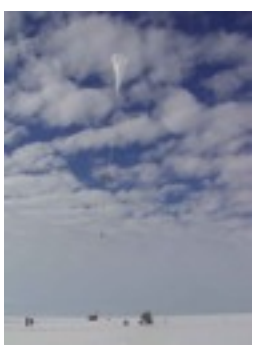
**$n_s(k)$, GW: Tensor(k)**

**subdominant isocurvature, cosmic strings, textures,**

***nonGaussian* $F_{NL}(\chi)$**

ESA /NASA /CSA Toronto HFI QLA/KST, TA, … *Barth & Dick, Marc-Antoine Miville-Deschenes, Carrie MacTavish, Brendan Crill, Olivier Dore, Carlo Contaldi, Mike Nolta, Peter Martin, Francine Marleau,* UBC LFI

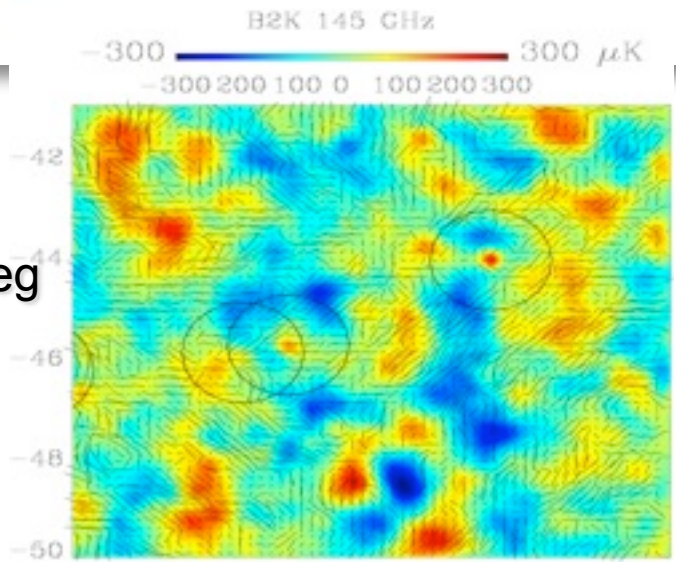
Planck “First Light” Survey Aug 2009



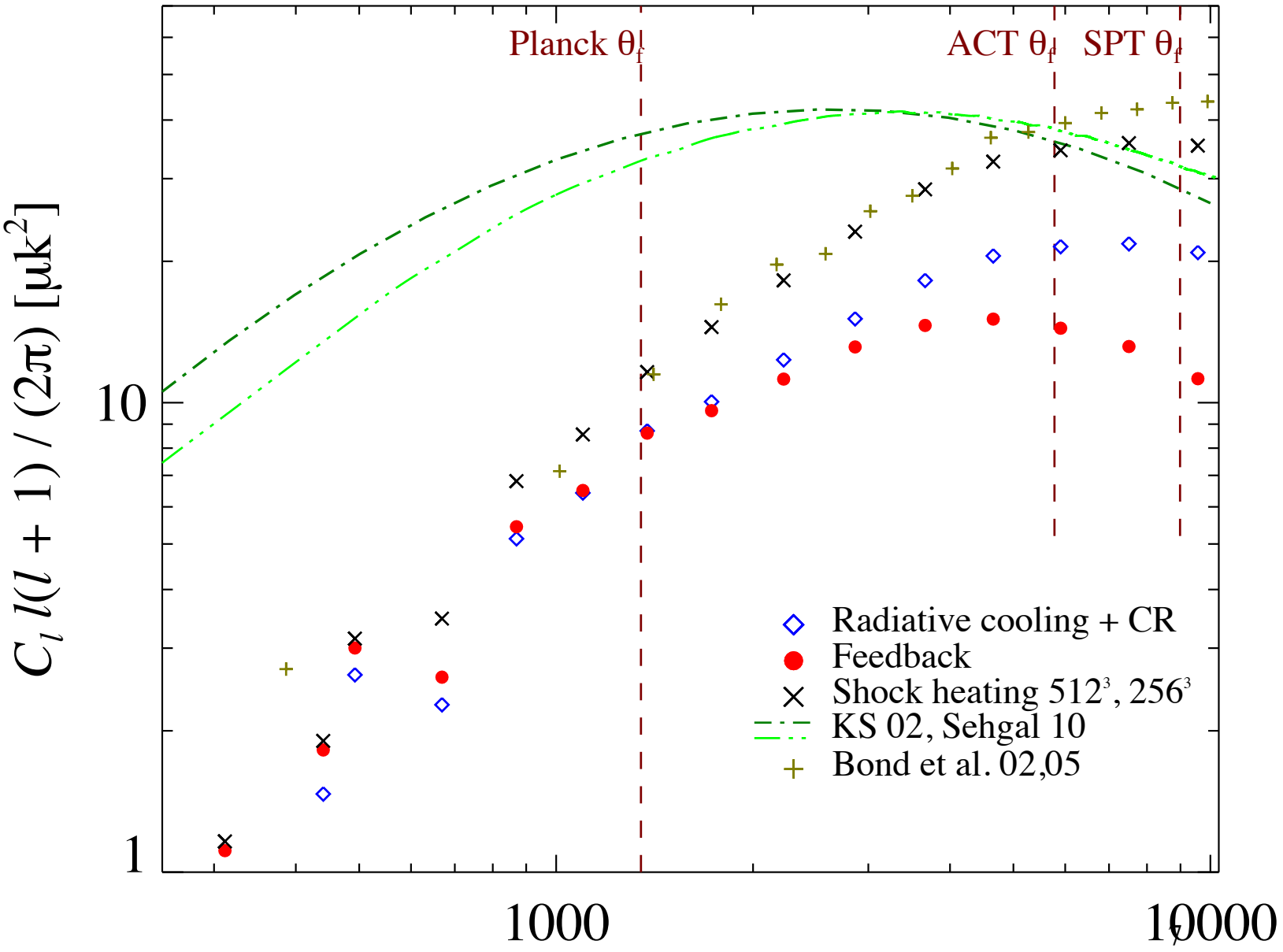
## BoomPol deep
**2003.1, Jul05, Dec09**

125 hours, $f_{sky}$=**0.28%** 115sq deg

**Planck is ~ as deep, but all sky, with similar bolometers (but more) and better resolution**

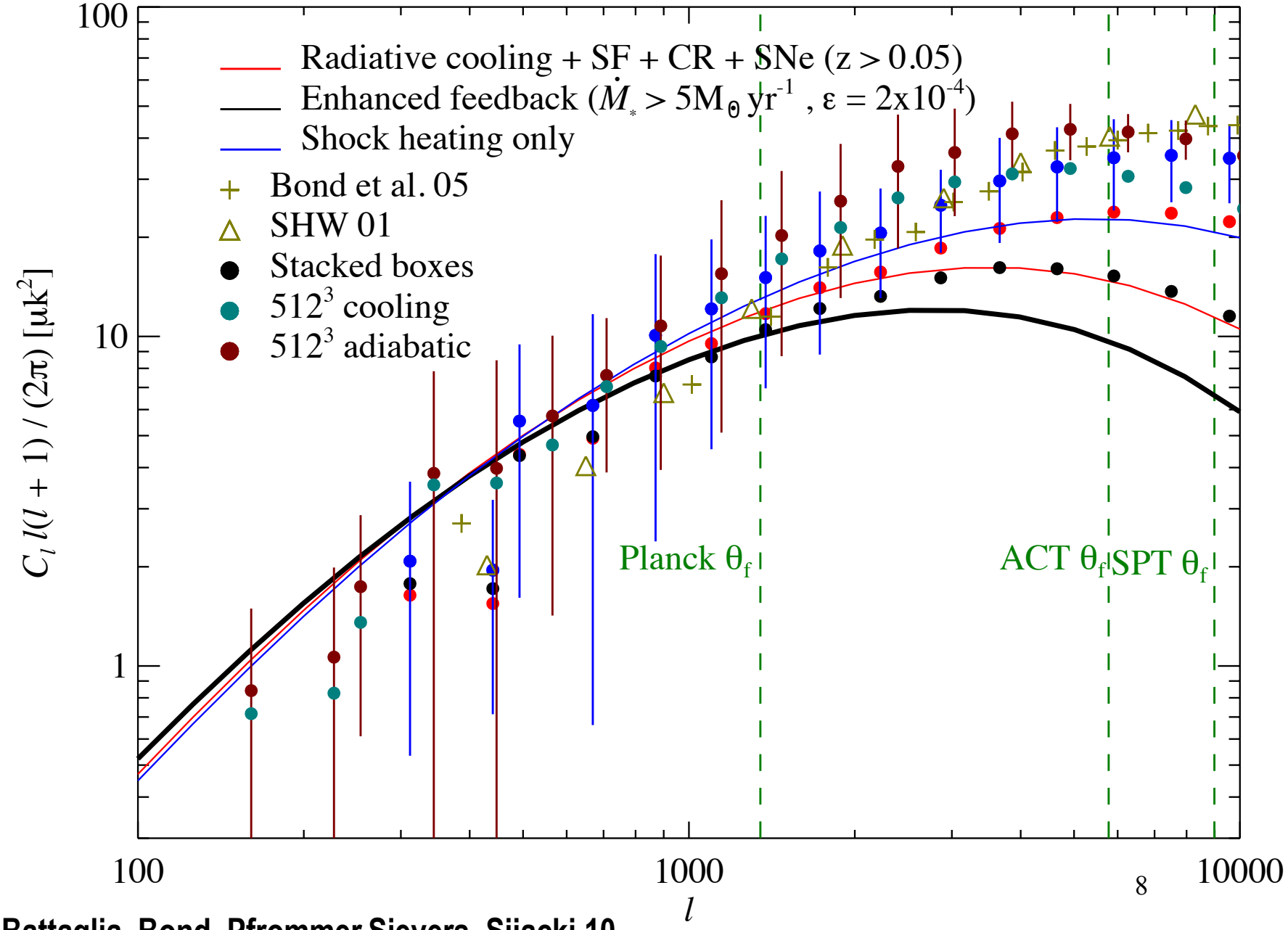


# $C_L^{SZ}$ & $\sigma 8^{SZ}$ theoretical uncertainties & impact on ACT




**Battaglia, Bond, Pfrommer,Sievers, Sijacki 10**

# $C_L^{SZ}$ & $\sigma_8^{SZ}$ theoretical uncertainties & impact on ACT




**Battaglia, Bond, Pfrommer,Sievers, Sijacki 10**

# November 2009 data

**Cosmic Microwave Background (CMB):** WMAP5yr (09), Acbar (09), QUAD (09), BICEP (09), CBI (08), Boomerang (06), DASI (05), VSA (04), MAXIMA (00)

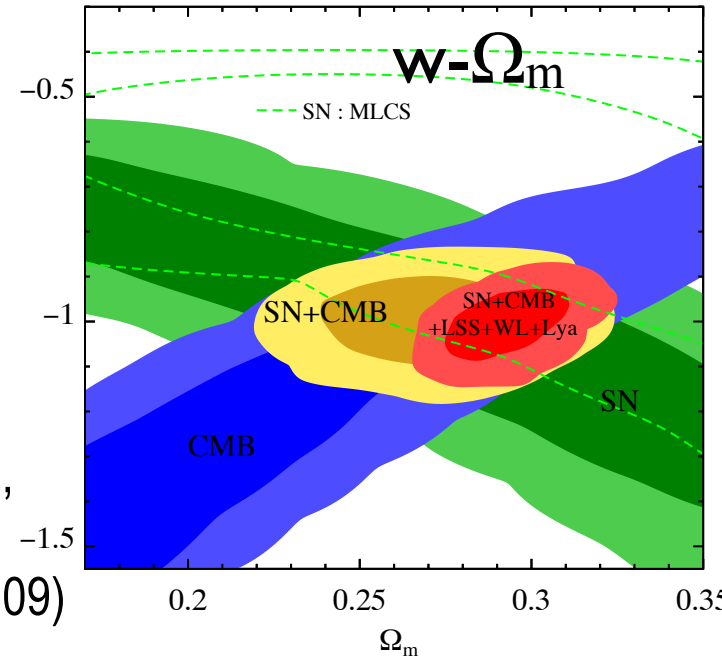
**Type Ia Supernova (SN)**: LOWZ + SDSS + ESSENCE + SNLS1yr + HST (Kessler et al 09) **(soon will + SNLS3yr)**

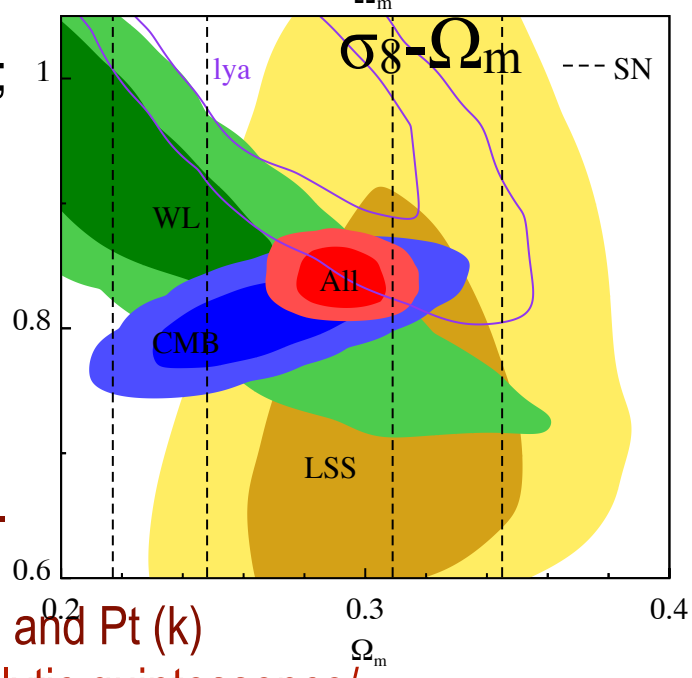
**Weak Lensing (WL)**: COSMOS + CFHTLS-wide + RCS + VIRMOS + GaBoDS (Massey et al 07, Lesgourgues et al 07, Benjamin et al 07)

**Large Scale Structure (LSS)**: SDSS-DR7 LRG (Reid et al 09)

**Lya Forest (Lya)**: SDSS Lya(McDonald et al 05, 06)

**Others**: HST constraint on Hubble parameter (Riess et al 09); Cluster x-ray gas mass fraction (Allen et al 08)




## *COSMOMC plug-ins* (Zhiqi Huang)

Decaying dark matter

CMB, WL, SN, BAO mock data simulator

arbitrary Primordial Power spectra functions Ps (k) and Pt (k).

full Ps (k) & Pt (k) integrator for arbitrary single-field inflation

automatic adjust L, k interpolations for more oscillatory Ps (k) and Pt (k)

Dark energy equation of state: arbitrary w(z), with built-in analytic quintessence/ phantom parametrization.

# trajectory probabilities for early-inflatons & late-inflatons

**very early U** early to middle to now U **very late U**

**inflation** *string theory/landscape/higher dimensions* **dark energy**

$V_{eff}(\psi_{inf})$ ? $K_{eff}(\psi_{inf})$ ? partial shape reconstruction

reconstruct gradient $1+w_0 = -0.0 \pm 0.06$

$V_{eff}(\psi_{inf})$ ? $K_{eff}(\psi_{inf})$ ?

***trajectory probability***

$-d\ln\rho_{tot}/d\ln a\ /2$

$=\varepsilon(k)=1+q,\ k\sim Ha$

$\Rightarrow \mathbb{P}_s, \mathbb{P}_t$

$\mathbb{V}_{eff}(k)$, $\psi_{inf}(k)$

*trajectory probability*

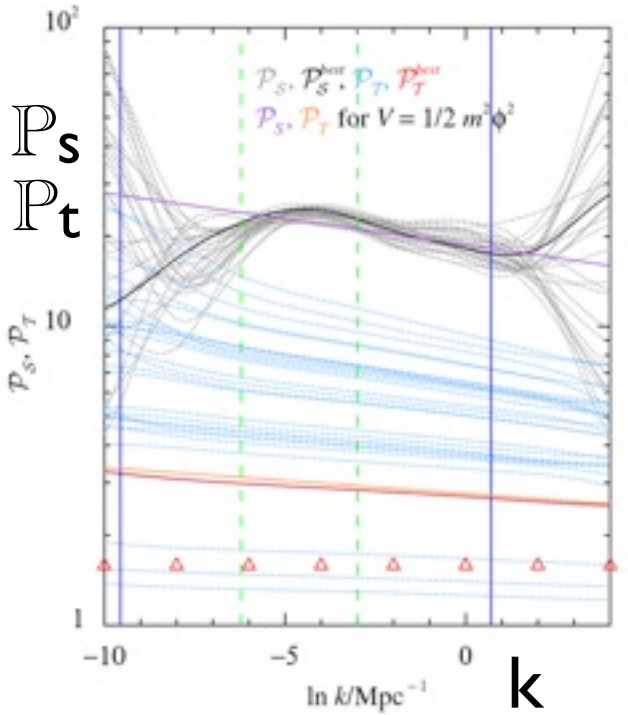
$-d\ln\rho_\psi/d\ln a\ /2$

$=\varepsilon_\psi(a)=(1+w)2/3$ $\Rightarrow$

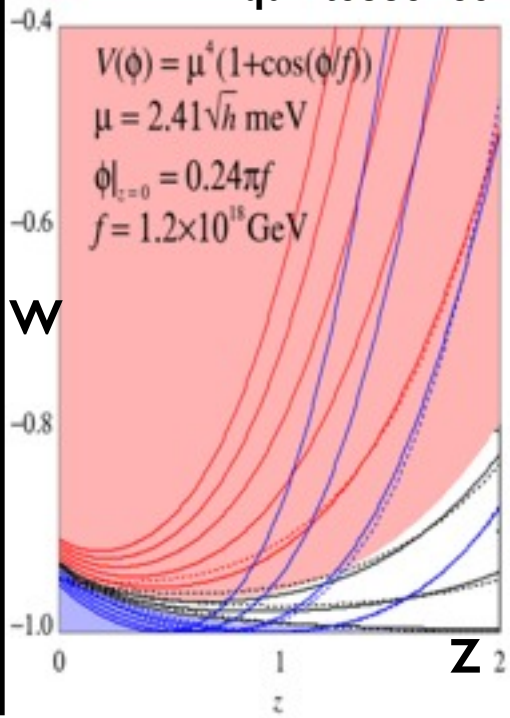
$\varepsilon_V=(d\ln V/d\psi)^2/4$

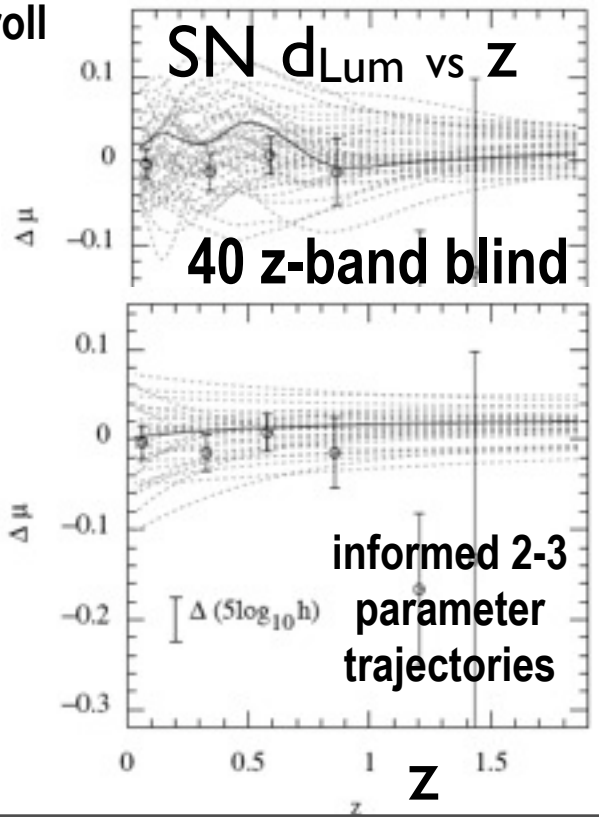
@pivot $a_{eq}$ $\varepsilon_s$ yes

$d^2\ln V/d\psi^2\ /4$ no




**slow-to-moderate roll quintessence**



*Bond, Contaldi, Huang, Kofman, Vaudrevange 2005-2010*

**Semi-blind phenomenology**: mode function expansions of $\ln P_s$ ($\ln k$) & $P_t$ ($\ln k$): generalized running via Chebyshev; nodal-point Cheb, splines, physical shapes @ knots

**Inflation** functional **Consistency** built in: solve $P_s$ ($\ln k$) & $P_t$ ($\ln k$)

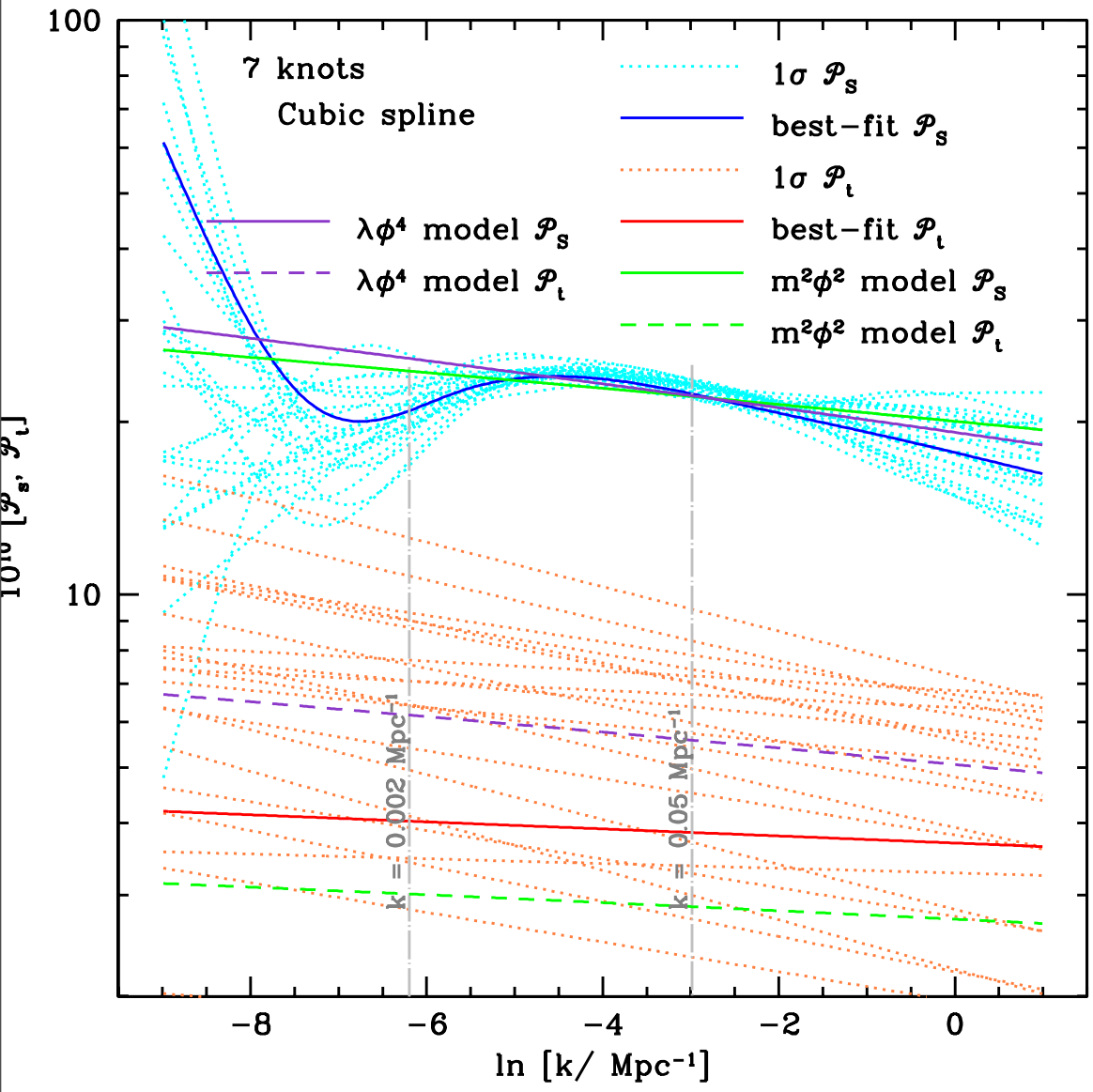
exactly for mode function expansions of possible acceleration histories $\varepsilon(\ln Ha)$

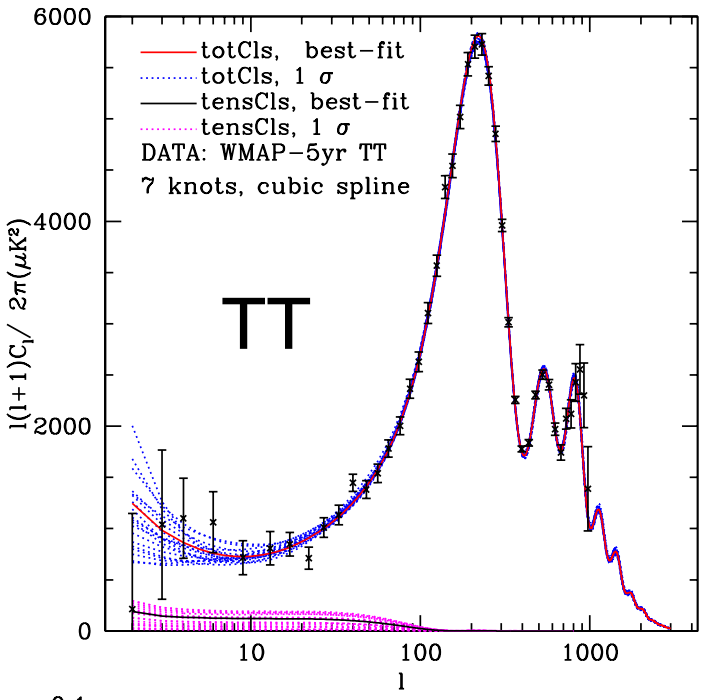
*results depend on prior measure for expansion coefficients for current data, less so with CMB experiments targeting the B-mode of polarization*

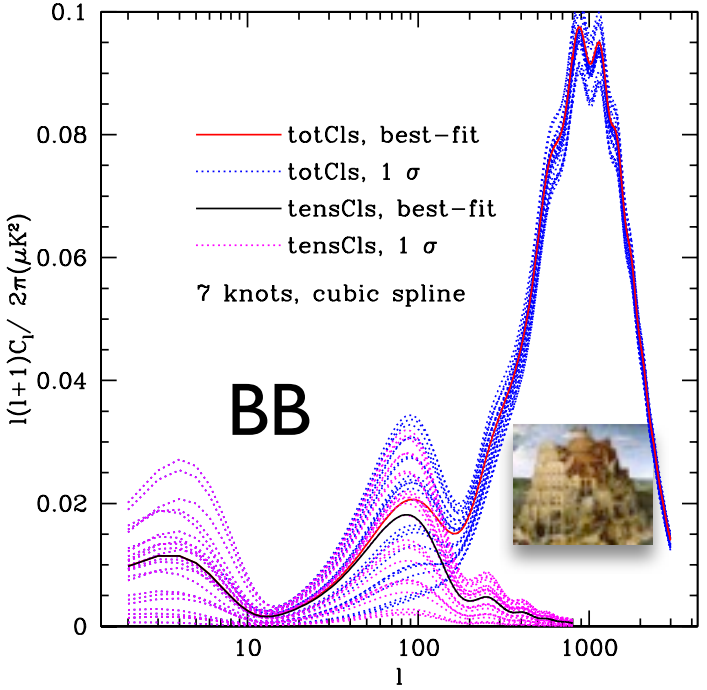
***Reconstruction has been much explored over the years, since the 90s. recent examples:***

**Simple binning techniques:** Bridle etal 03; Hannestad 04; Bridges etal 06, 07; Spergel etal 07;
**Direct inversion:** Shafieloo etal 04,08; Kogo etal 04; Tocchini-Valentini etal 05 06; Nagata etal 08; Nicholson etal 09a,09b;
**Basis function expansion:** Mukherjee 05; Leach 06;
**Cubic spline interpolation:** Sealfon et al 05; Peiris et al 08 09;
**Slow-roll reconstruction (flow equations):** Peiris etal 03,06a,06b; Easther 06; Adshead etal 09;

# *partially-blind scalar power trajecteries & usual r-$n_t$ tensor - no consistency relation. Nov09 data*



# Future Forecasts

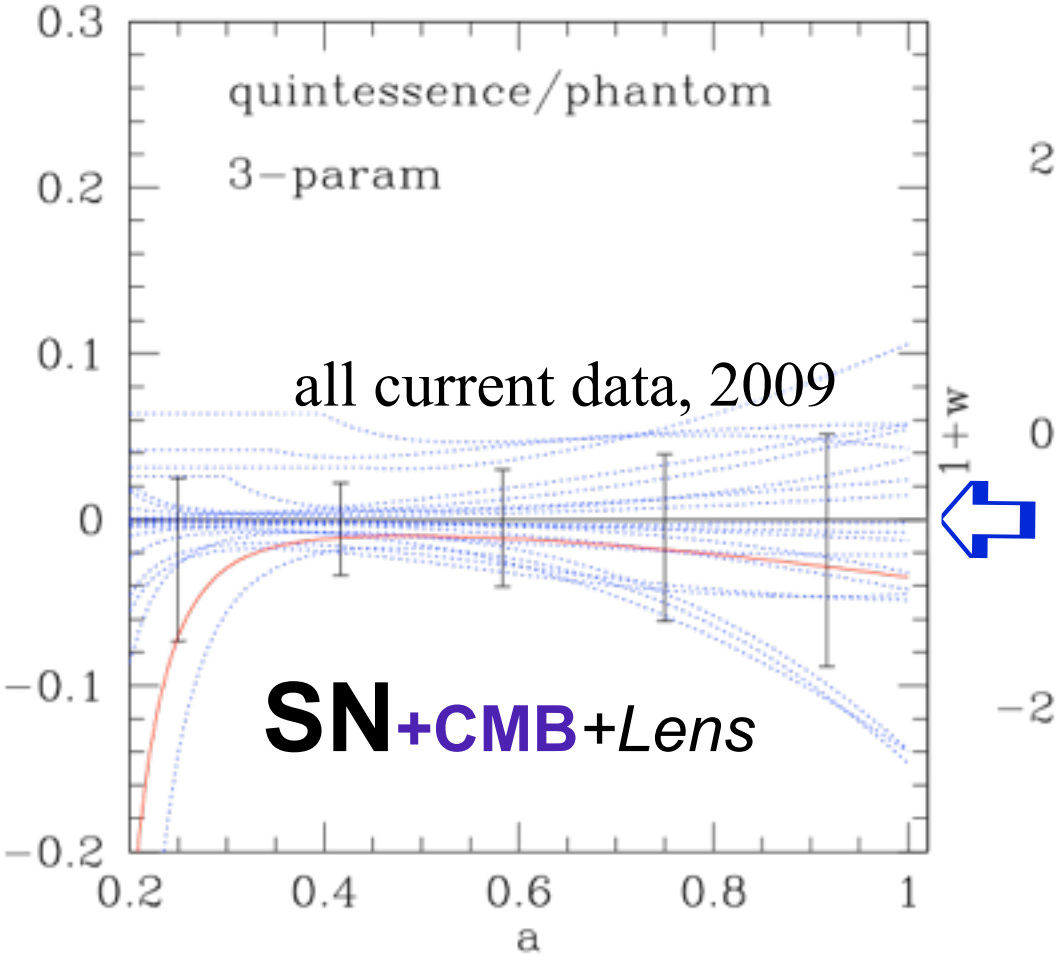
**CMB: Planck2.5yr, using 3 channels (70GHz, 100GHz, 143GHz), *assuming 5% foreground residual (synchrotron + dust)*, fsky = .75, Lmax = 2500.**
**other future polarization experiments: SPIDER, EBEX, QUIET, KECK, ...**
**CMBPol**

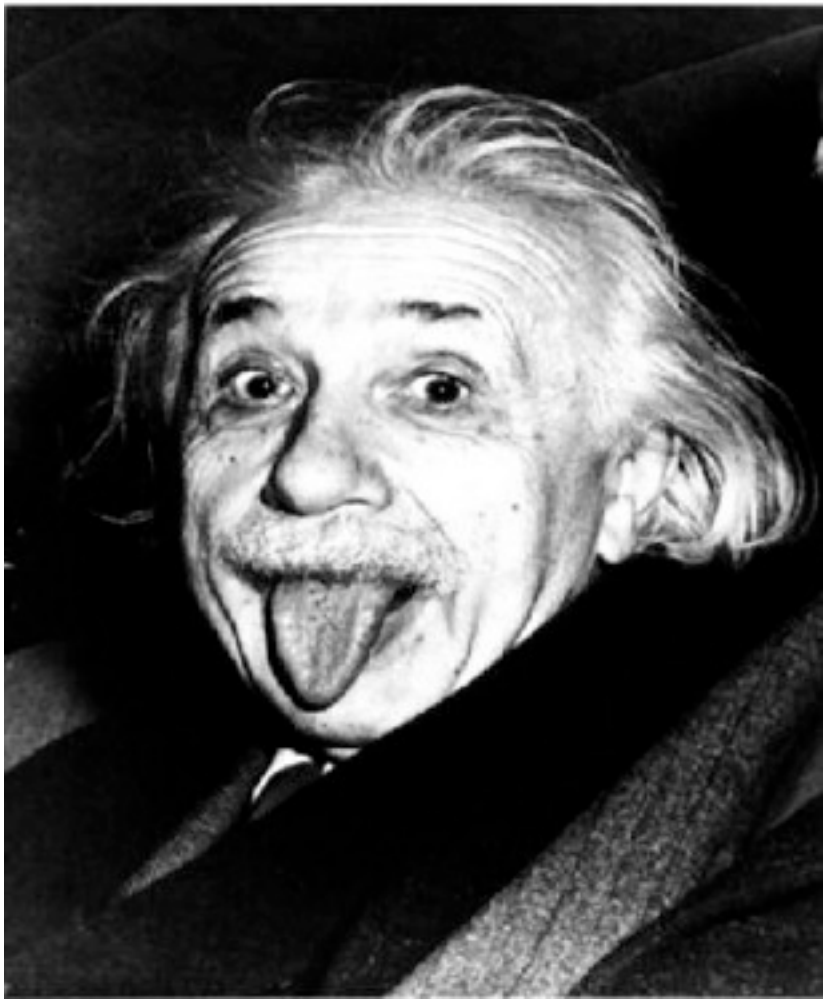
**WL: DUNE-like weak lensing tomography, 20000 sq deg,**
**depth z~1, 35 galaxies/arcmin$^2$, two redshift bins, Lmax = 1500. → Euclid**
**other proposed deep and wide WL surveys: JDEM, PanStarrs, LSST, ...**

**SN: JDEM-like, 500 LOWZ (z < 0:03) + 2500 HIGHZ (0:03 < z < 1:7)**
**other ongoing/future SN surveys: SNLS, SDSS, LSST ...**

**BAO: JDEM, 10000 degree2, 0:5 < z < 2, 10 redshift bins**
**other ongoing/future BAO surveys: WIGGLEZ, CHIME, BOSS, LSST, ...**

# is the dark energy "vacuum potential energy" ?



TEST: within errors, energy-density does not change with expansion ⇨Einstein's cosmological constant is best fit so far