PRIMARY END @ 2012?

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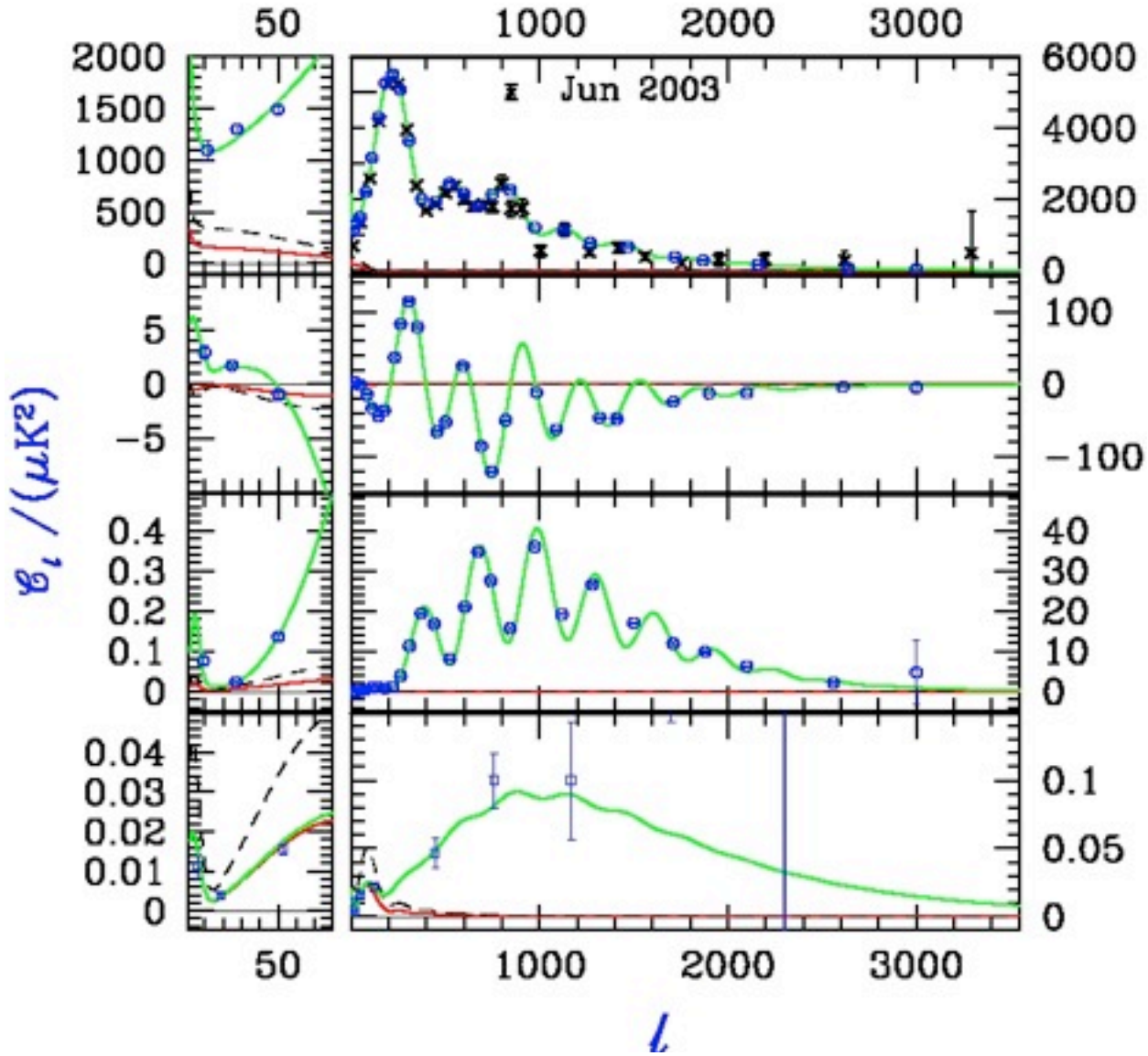
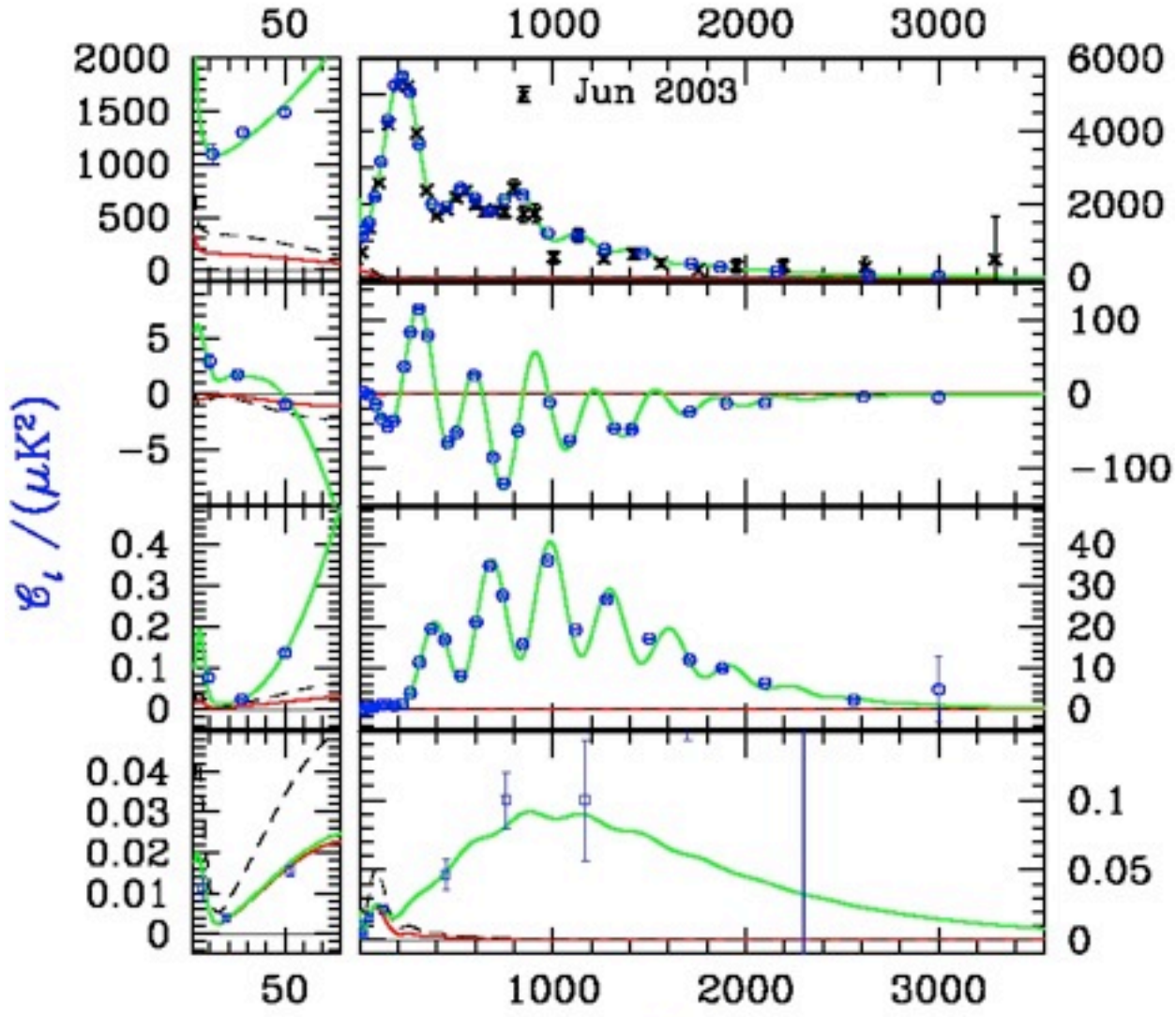


PRIMARY END @ 2012?



CMB ~2009+ Planck1+WMAP8+SPT/ACT/Quiet+Bicep/QuAD/Quiet +Spider+Clover

inflation = accelerating driven "vacuum", then *differentially* & now *differentially?*

$r(k) \approx 16\varepsilon(k)$

$\varepsilon = -\, d\ln H / d\ln a$; Hamilton-Jacobi $V(\psi) \approx 3M_P^2H^2(1-\varepsilon/3)$; $d\psi/d\ln a = \pm\sqrt{\varepsilon}$

resolution k ~ dynamics Ha

trajectory probabilities for early-inflatons & late-inflatons
(partially) blind cf. informed "theory" priors.

compress info onto a variety of modes
make trajectories, then recompress onto new modes

over the years: mode expansion of **H**, *ln***H**, $\mathcal{E}$, $d\ln\mathcal{E}/d\ln k$, $\mathbf{n_s}$, $\ln\mathbf{P_s}$
measure-dependent, priors from only allowed trajectories, V-expansion not great
prior dependence without B info - even for r

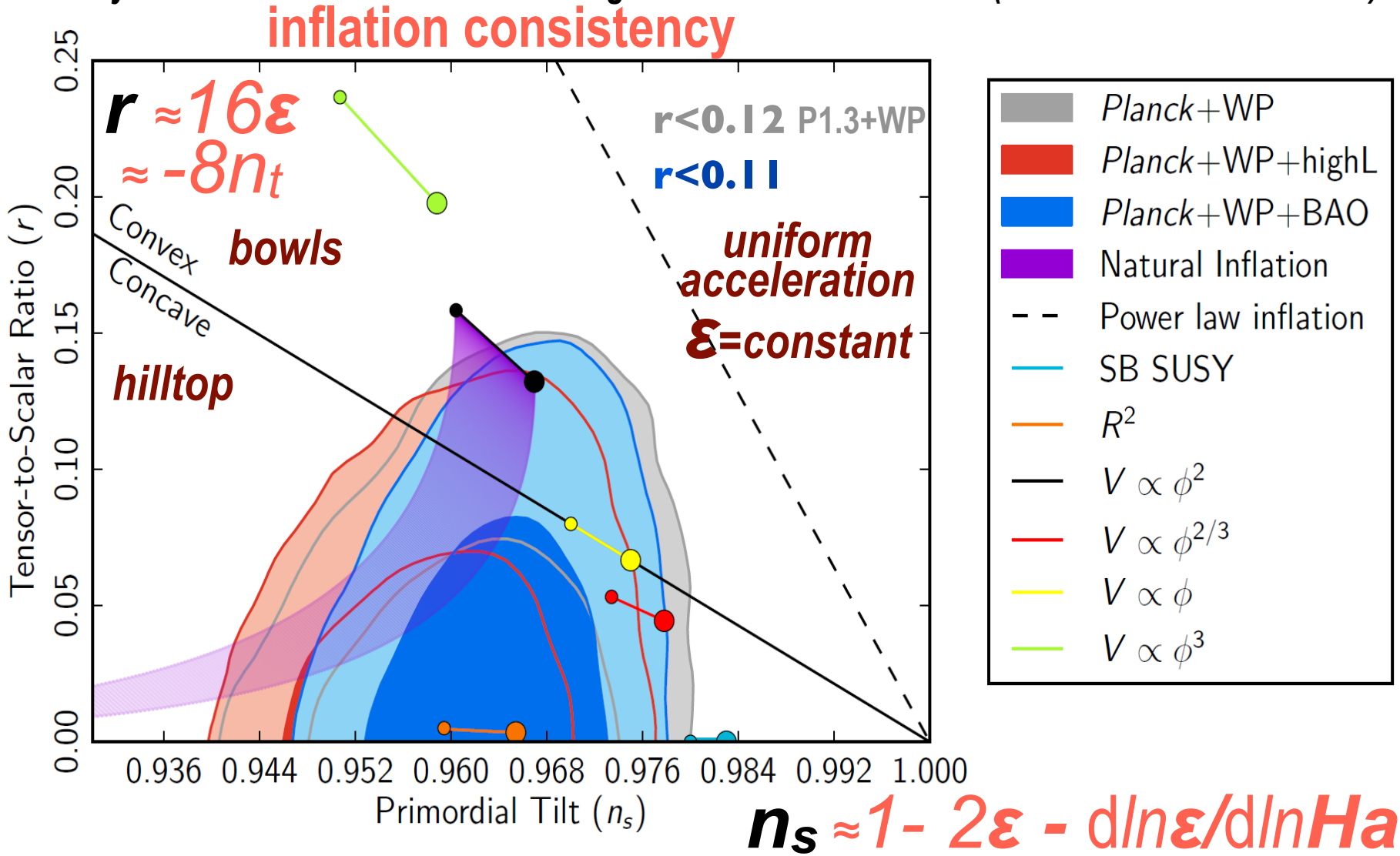
modes in power, effectively quadratic (amplitudeXamplitude) space filtering very similar to Wiener filtering on amplitudes

in praise of the oldest way to do parameter estimation, direct (amplitudeXamplitude) space with large matrices. spider feasible. we will also plan to use Xfaster as well.

Consistent with single field slow roll, standard kinetic term & vacuum (with f_{NL} upper limits)

uniform acceleration *line* ***ε ≡3KE /(KE+PE)*** *= constant is* ***strongly ruled out***

=> early universe acceleration must change over observable scales (as well as to end inflation)



$n_s \approx 1 - 2\varepsilon - d\ln\varepsilon/d\ln Ha$

r without B-mode pol is delicate **rule out: exponential potential models(power-law inf)**, the simplest hybrid inflationary models (Spontaneously Broken SUSY) & **Φ^n, n >2 monomial potentials of chaotic inflation** ***some*** **popular** ***inflation survivors:*** ***Natural = pNGB, monodromy =driven pNGB, Roulette (shrinking holes in extra-dim), brane (separation), Higgs, flattened potentials*** *= non-monomial,* ***...***

inflation = accelerating driven "vacuum", then *differentially* & now *differentially?*

ε = - d*ln*H / d*ln*a ; Hamilton-Jacobi $V(\psi)\approx 3M_P^2H^2(1-\varepsilon/3)$; $d\psi/d\ln a = \pm\sqrt{\varepsilon}$

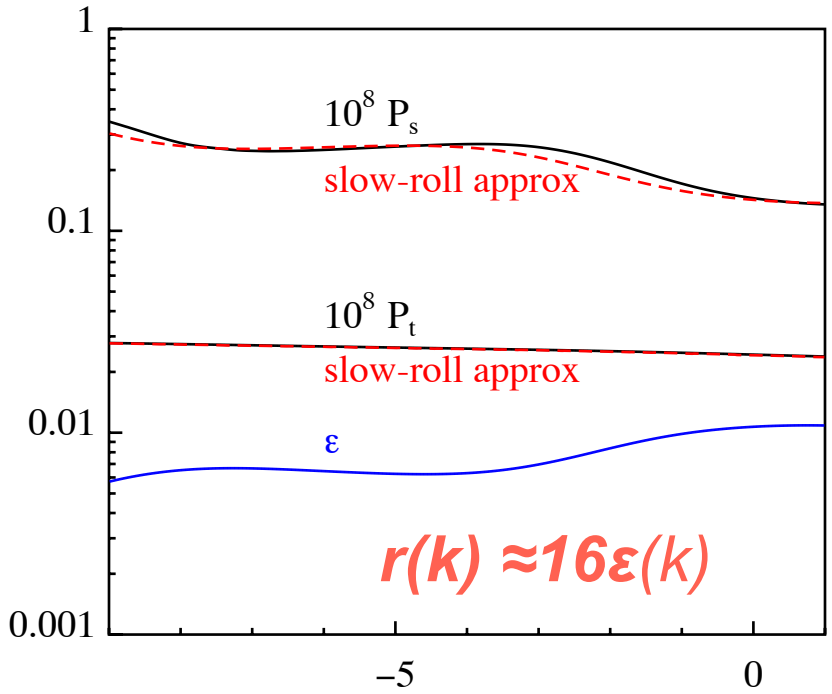
inflation consistency

$-n_t \approx r/8 \approx 2\varepsilon(k)$ $\quad 1-n_s \approx 2\varepsilon + d\ln\varepsilon/d\ln Ha$

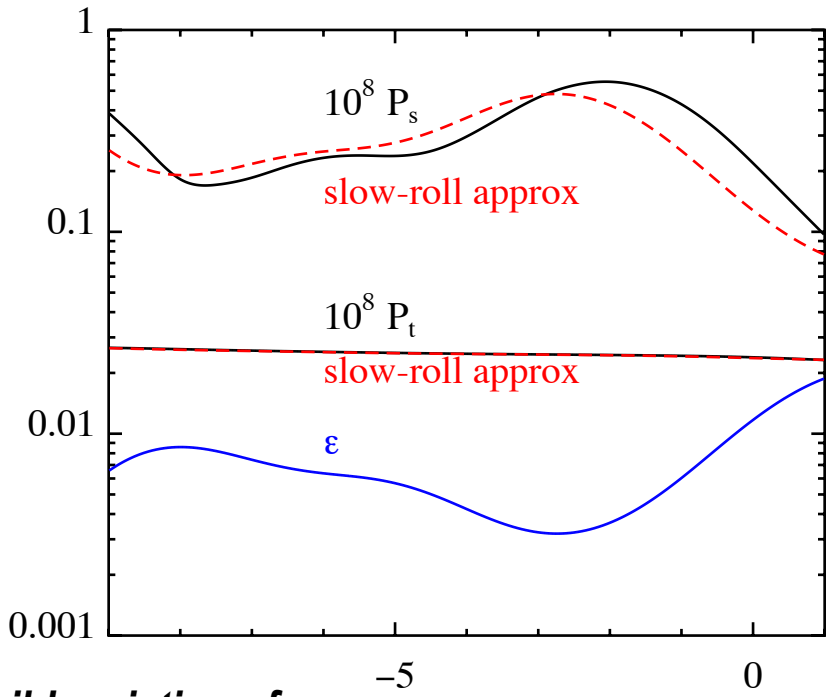
if relax prior of c_s=1, need that trajectory

a path approach to inflation: ε trajectories drive scalar power, indirectly tensor power, V and ψ. use full k-mode integration *but Langevin equation*

stochastic inflation framework - usually very accurate, very for tensor, but full built into MCMC



mild variation of acceleration history



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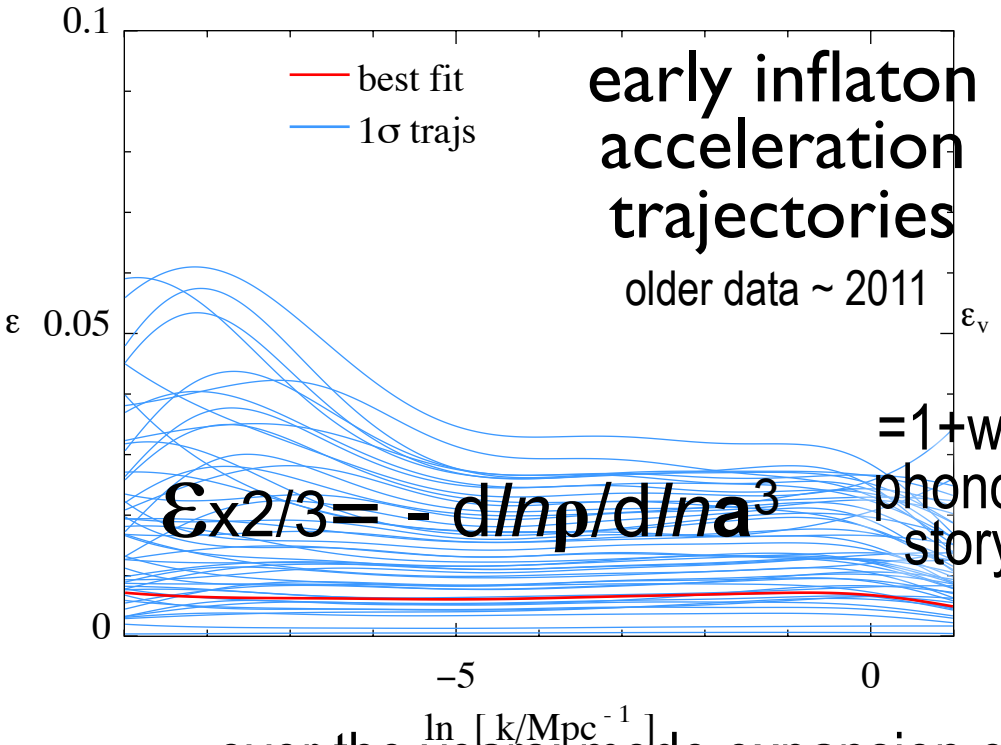

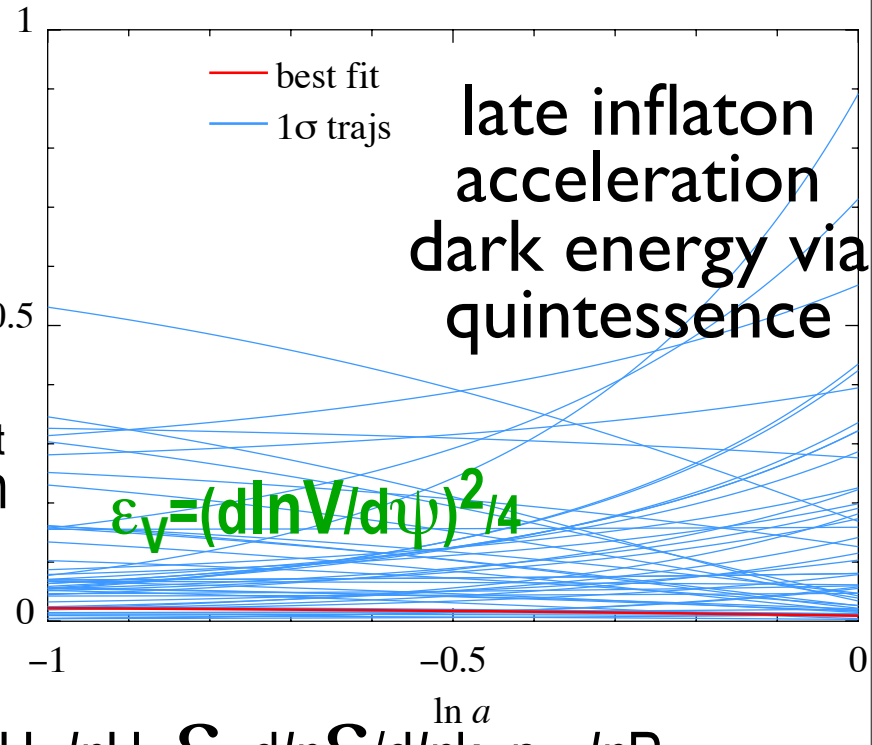

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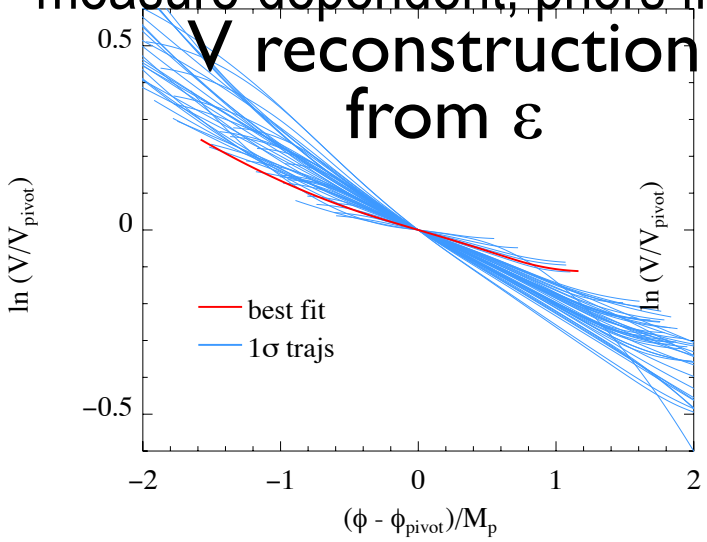
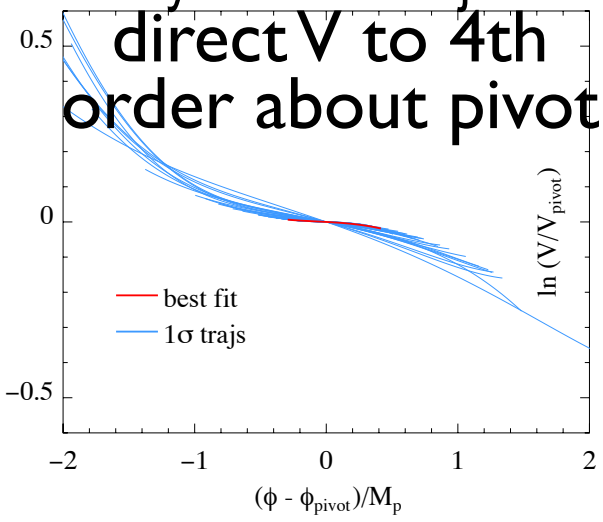
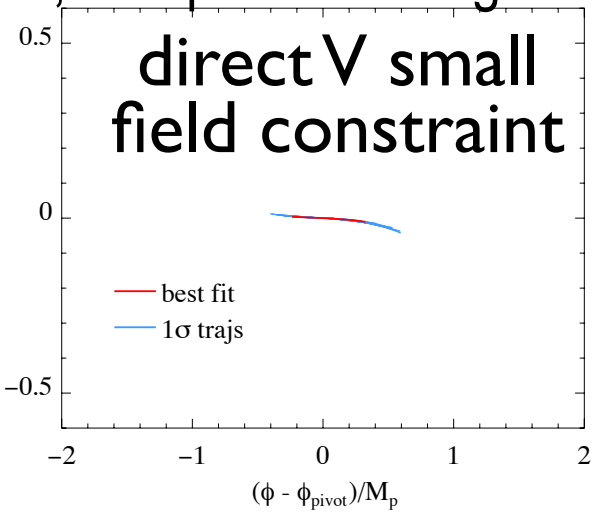
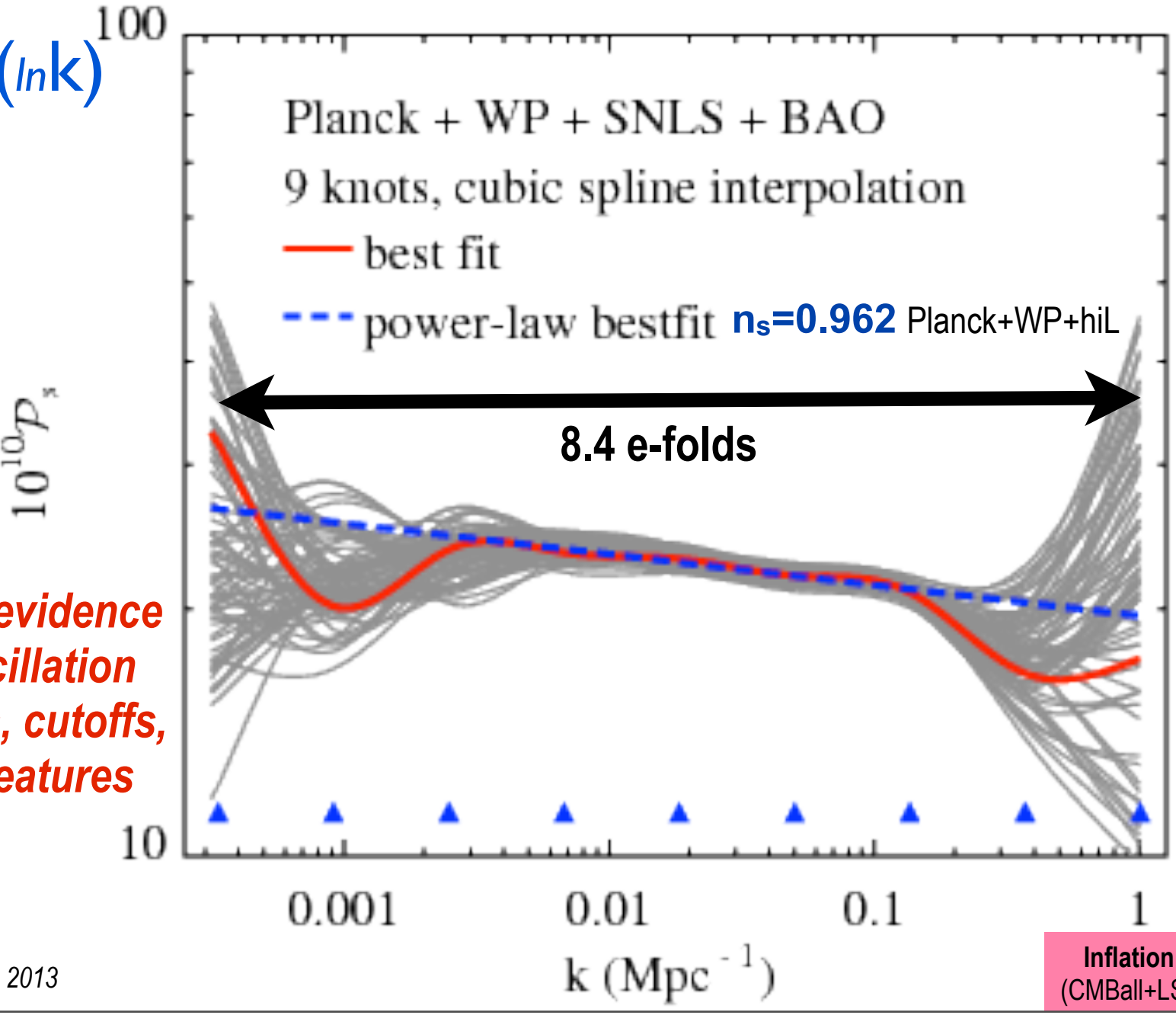






scan $ln\mathbf{P_s}(ln k)/A_s$, $ln\mathbf{A_s}=ln P_s(k_{pivot,s})$, $\mathbf{r}(k_{pivot,t})$; *consistency => reconstruct* $\boldsymbol{\varepsilon}(ln\mathbf{Ha})$, $\mathbf{V(\psi)}$

$ln P_s(ln k)$

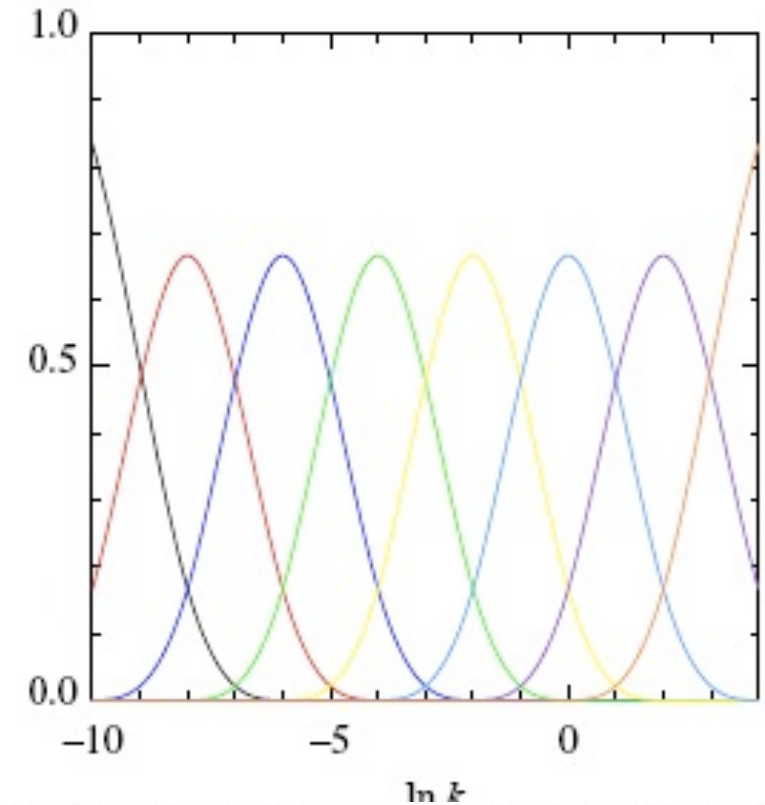


no strong evidence for oscillation patterns, cutoffs, local features

Bond, Huang 2013

Inflation Histories
(CMBall+LSS+SN+WL)

new parameters: trajectory probabilities for early-inflatons & late-inflatons
(partially) blind cf. informed "theory" priors. *compress info onto a variety of modes*



B-spline functions of order 3 at 8 nodal points

sample smaller set of cubic spline modes
L~100 is ln k ~ -5
.002 Mpc^{-1} is ln k ~ -6.2

Power Spectrum Analysis
Filtering in Quadratic pixel-pixel space
any mode functions will do, simple CL bandpowers, single or a few broadband informed CL templates(r, rBB cf rEE)

semi-blind e.g., **B-spline modes**
but also Tchebyshev polynomials (go to Fourier at high order), triangles, **top hats**, etc

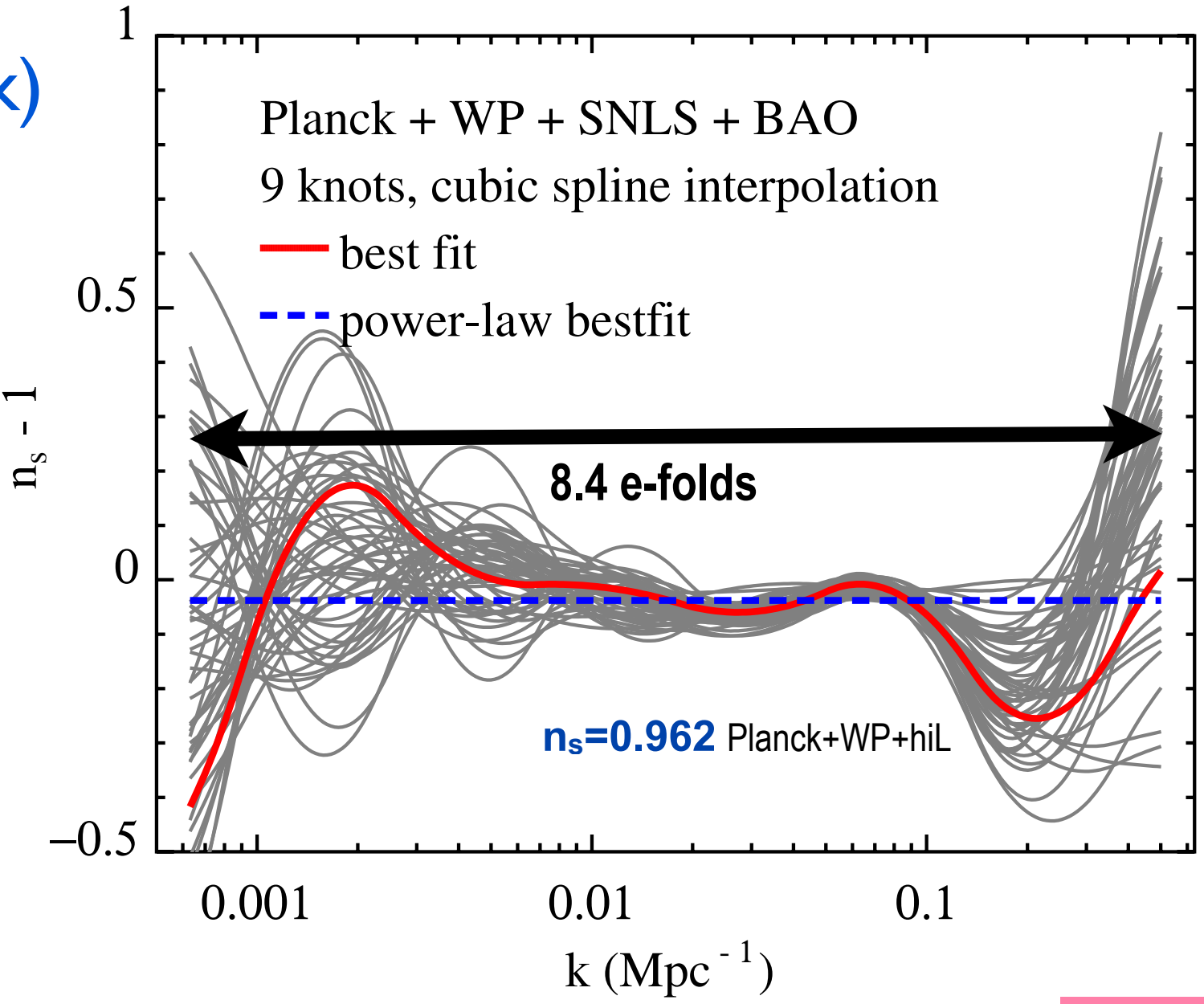
CL shaped CL(shape) inside bands. good for broad bands

inflation modes. informed by consistency, or semi-blind Fisher-eigenmodes, determined with exptal setup and generalized noise, with a criterion for stopping the inclusion. begin with a saturated expansion.

FBC, FBCS on Xe-modes for recombination history with entropy criteria for truncation in number,
Dvorkin and Hu used emodes for inflation (as did we, B +Huang + ... over the years)

scan $\ln \mathbf{P_s}(\ln k)/A_s$, $\ln \mathbf{A_s} = \ln P_s(k_{pivot,s})$, $\mathbf{r}(k_{pivot,t})$; *consistency => reconstruct* $\boldsymbol{\varepsilon}(\ln \mathbf{Ha})$, $\mathbf{V}(\boldsymbol{\psi})$

$n_s(\ln k)$



Bond, Huang 2013

Inflation Histories
(CMBall+LSS+SN+WL)

early-inflaton DE acceleration trajectories then

Bond, Huang 2013

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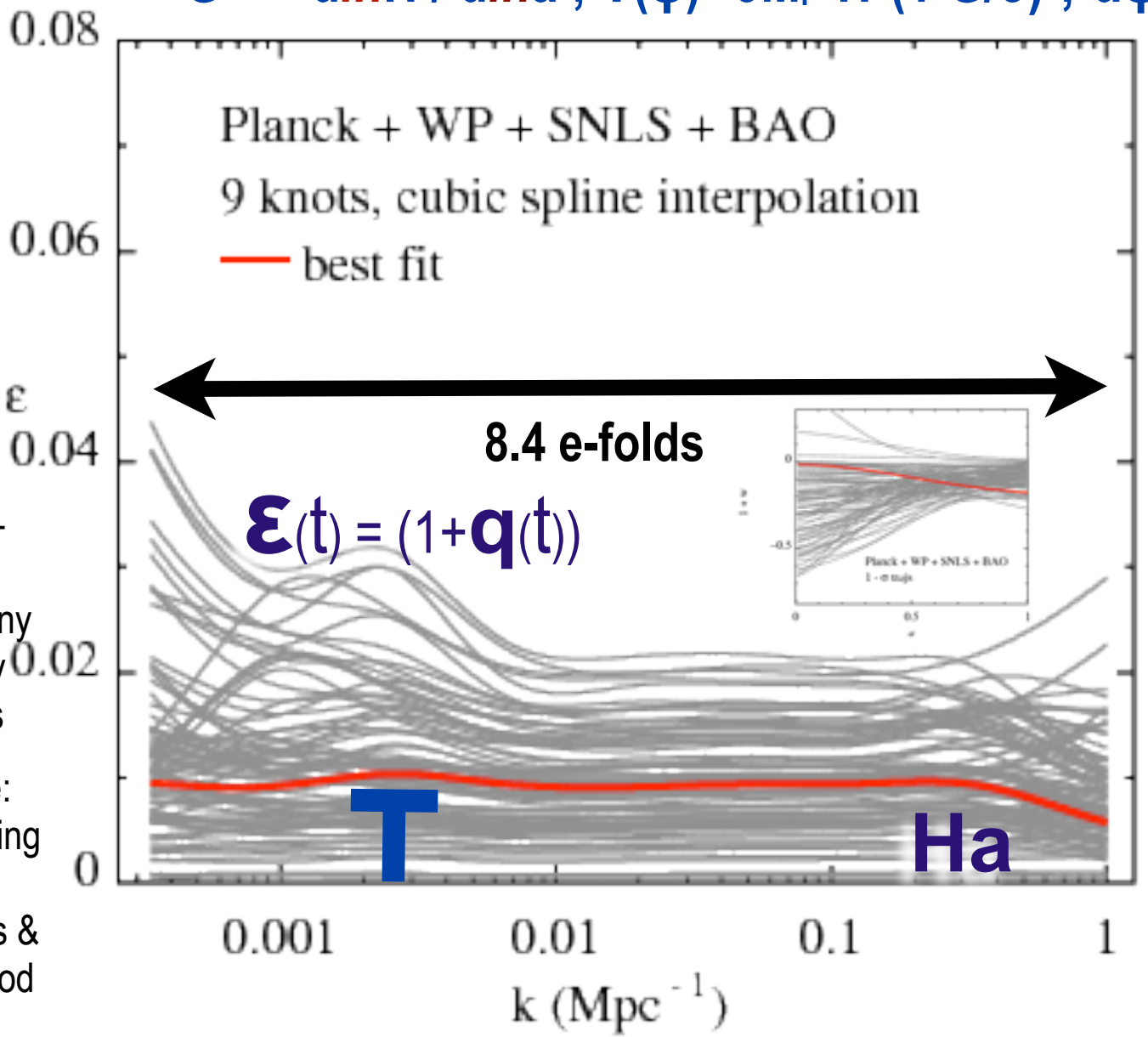


can post-process bands in any trajectory variables

key issue: characterizing the correlations & the likelihood surface

aka

$(1+w_{de})^{3/2}$

then

(hydro)

resolution $\ln k \sim \ln Ha$ ***dynamics***

$\varepsilon \approx r/16$

$\varepsilon \approx V$ / $0.0005\ (10^{16}\text{Gev})^4$

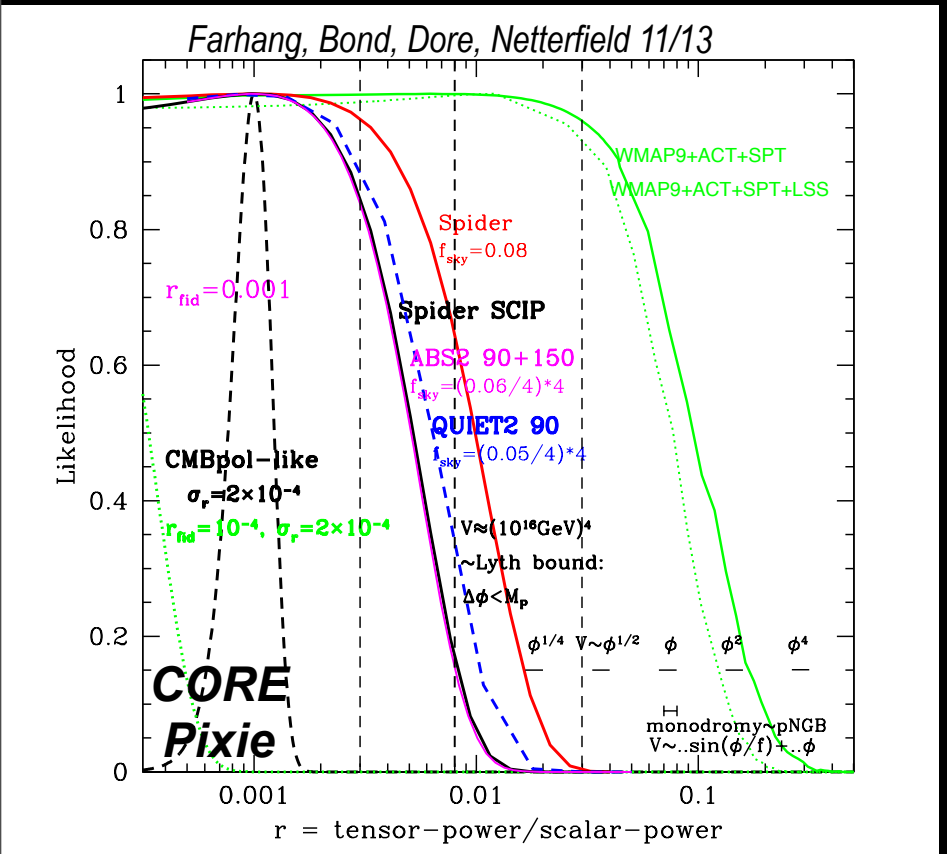
Spider24days+Planck2.5yr: r-n_t *matrix*-forecast for r=0.12 input for $m^2\varphi^2$ ($2\sigma_r$ ~0.02 including fgnds)

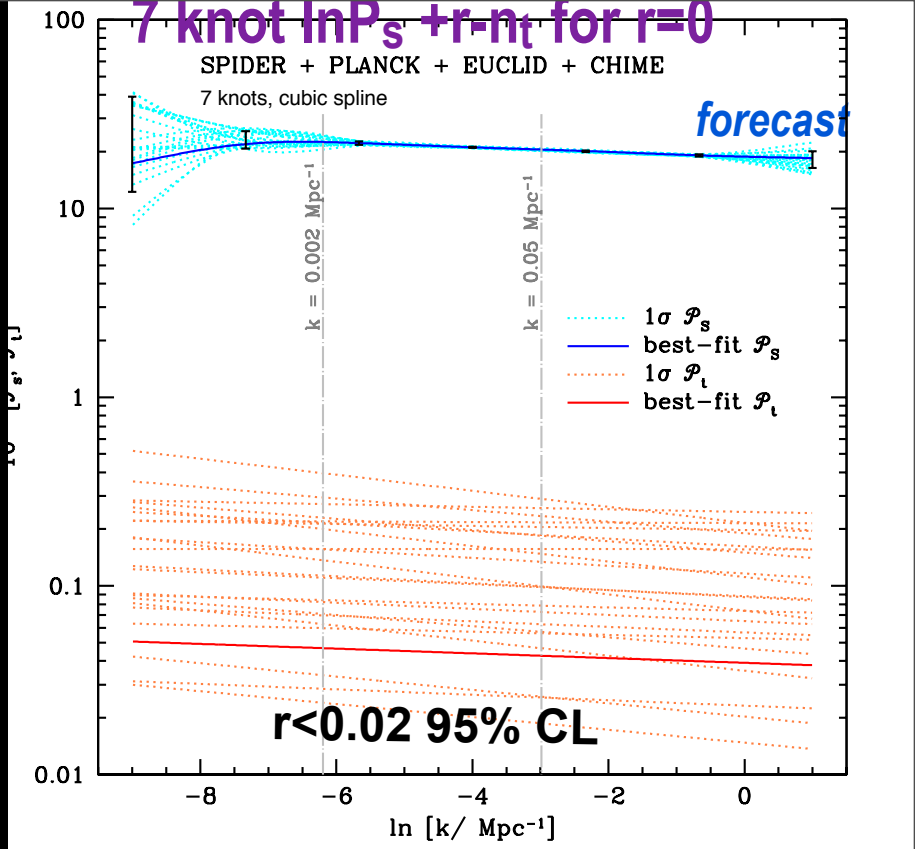
*similar r-forecasts for **ABS+/VIP, Quiet***

inflation consistency

$$-n_t \approx r/8 \approx 2\varepsilon(k)$$

$$1-n_s \approx 2\varepsilon + d\ln\varepsilon/d\ln Ha$$



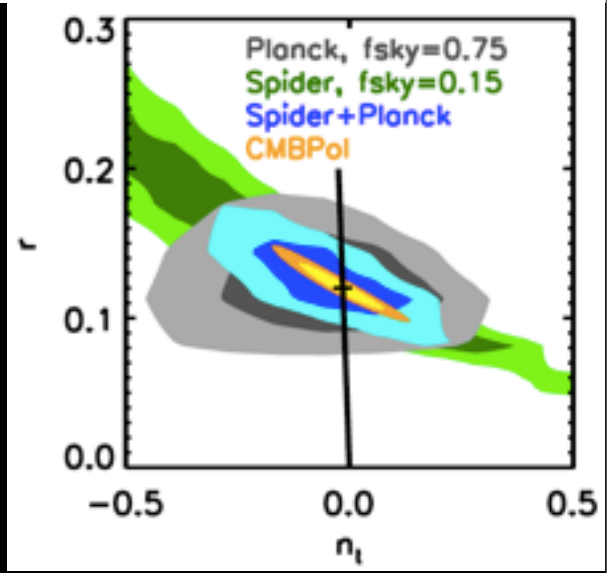


can get B-mode shapes but without the precision needed to check

$$-n_t \approx r/8$$

consistency

COBE-like errors on tilt



quest for B mode similar to first T detections, first E detections => broad-band analyses

Farhang BDN 11/13: use full matrix quadratic matrix analysis of Q/U if possible. ancient COBE history. feasible with modest parameter numbers r and most correlated, rBB, rEE and broadband rband phenomenology
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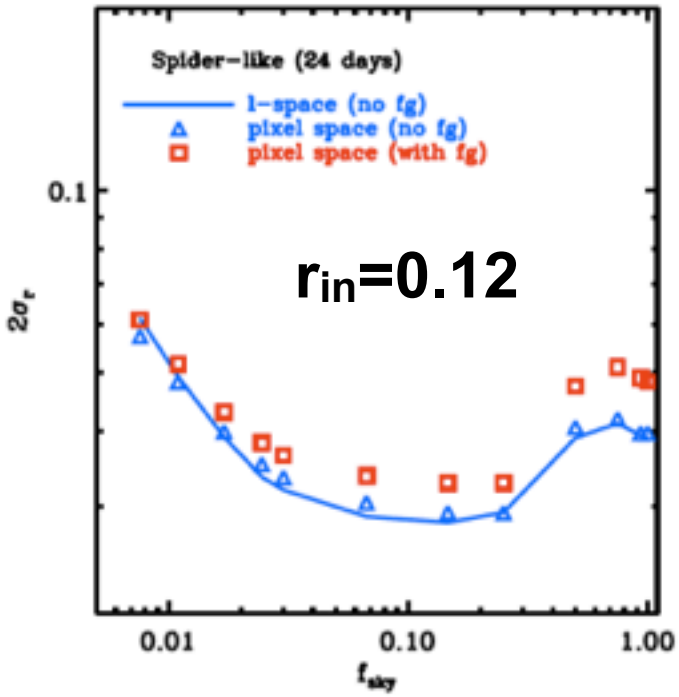
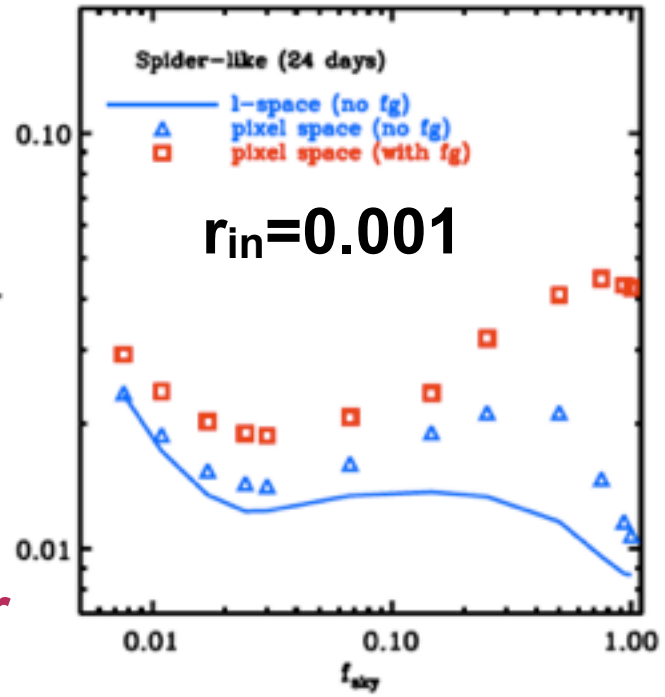
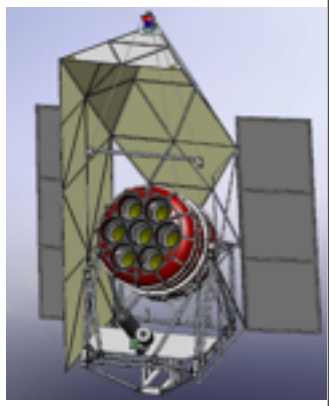


$2\sigma_r$ *VS* f_{sky} *via* ***QU*** ***direct to r***

Spider

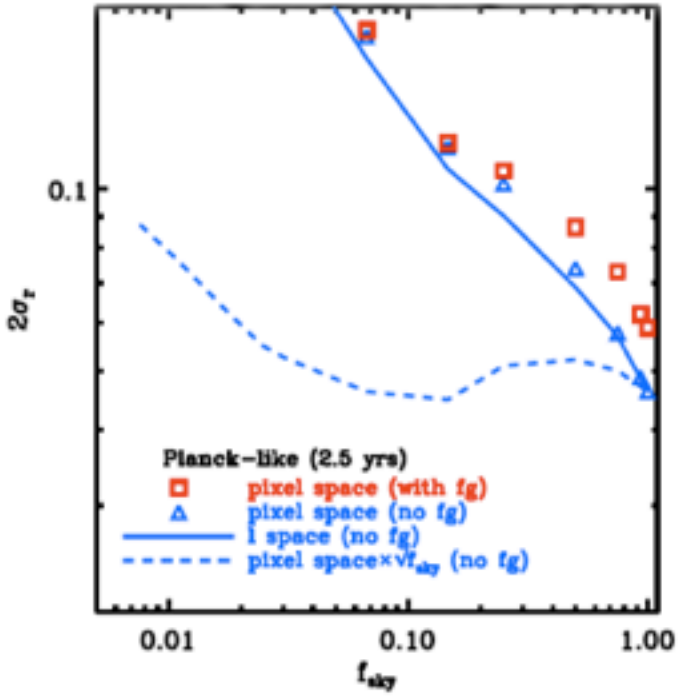




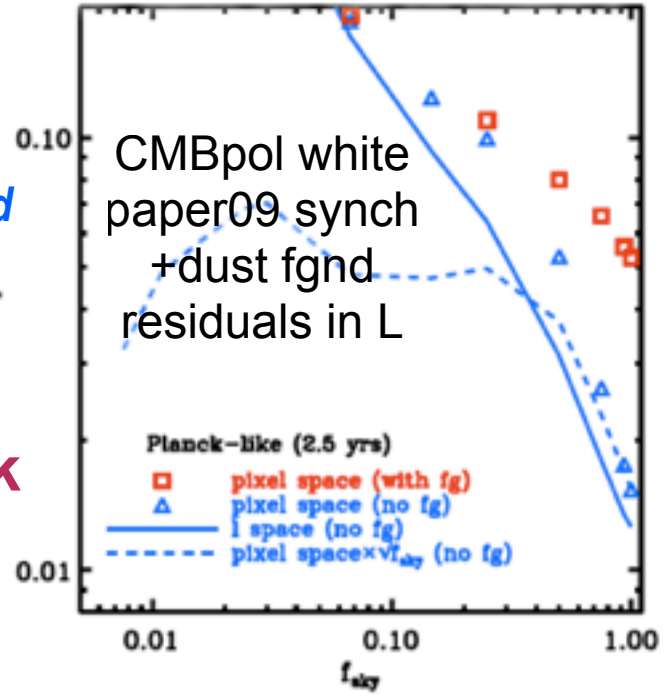
Spider
96+150 GHz
~2000 bolos
24 days LDB

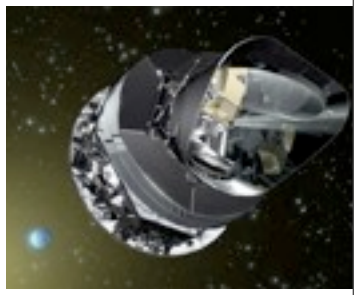
PRIMORDIAL GRAVITATIONAL WAVE DETECTABILITY WITH DEEP SMALL-SKY CMB EXPERIMENTS

Farhang, Bond, Dore & Netterfield 2011/13



Planck



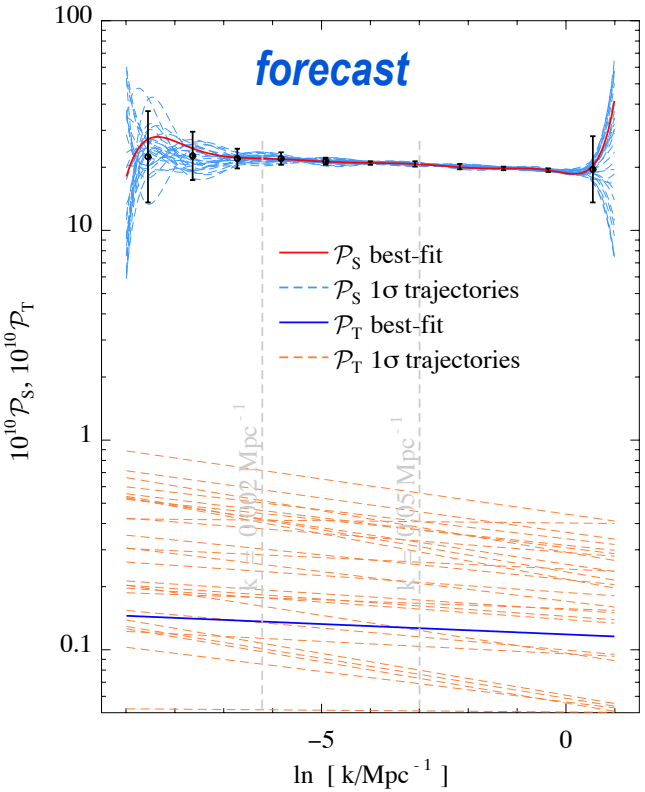


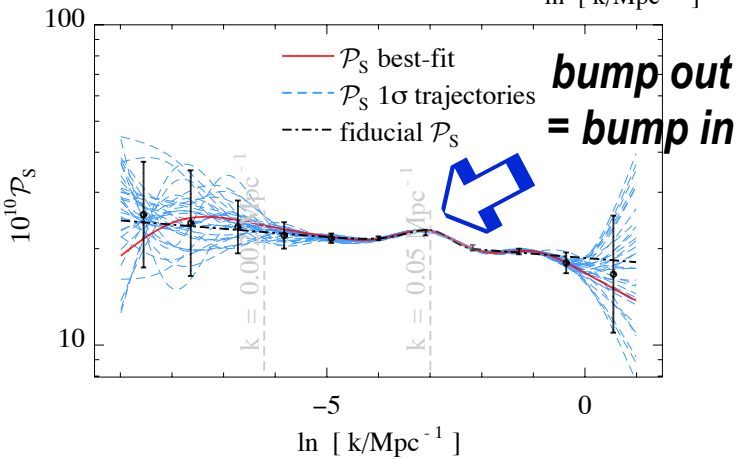
Planck
100+143 GHz
16 PSB+8 SWB
of 32PSB+20SWB
2.5 yrs@L2

s,t power spectra trajectories: compress data onto non-top-hat k-modes

Bond, Contaldi, Huang, Kofman, Vaudrevange 2011

Spider-24days + Planck-2.5yr + ... 11/7 knot $\ln P_S$ +r-n_t forecast for r=0 (+ fgnds)

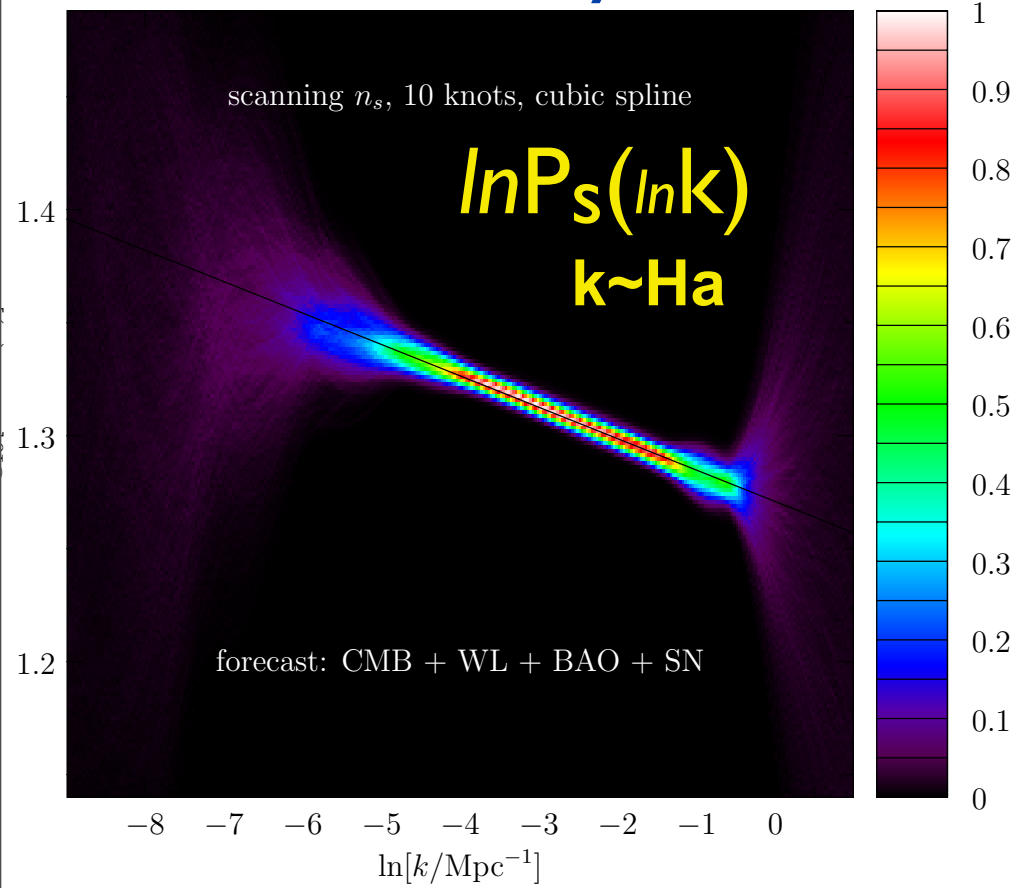


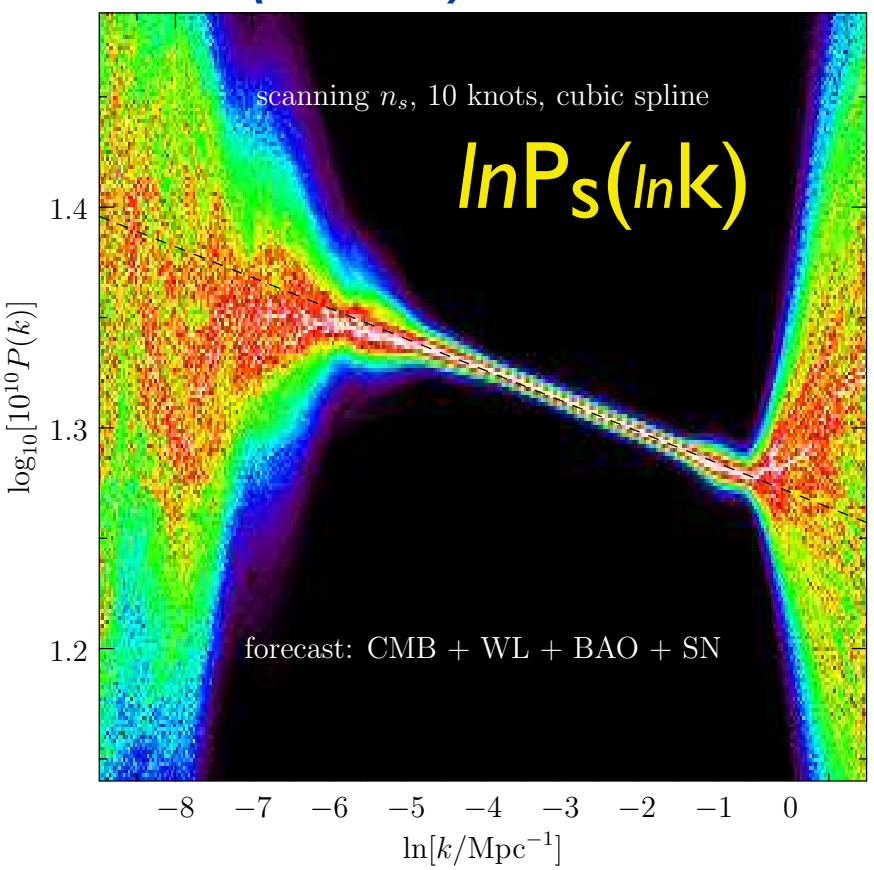


future scalar power spectrum trajectories

scan $\mathbf{n_s}(\ln k)$, $\ln \mathbf{A_s} = \ln P_s(k_{pivot,s})$, $\mathbf{r}(k_{pivot,t})$;

consistency => reconstruct $\boldsymbol{\varepsilon}(\ln \mathbf{Ha}), \mathbf{V}(\psi)$





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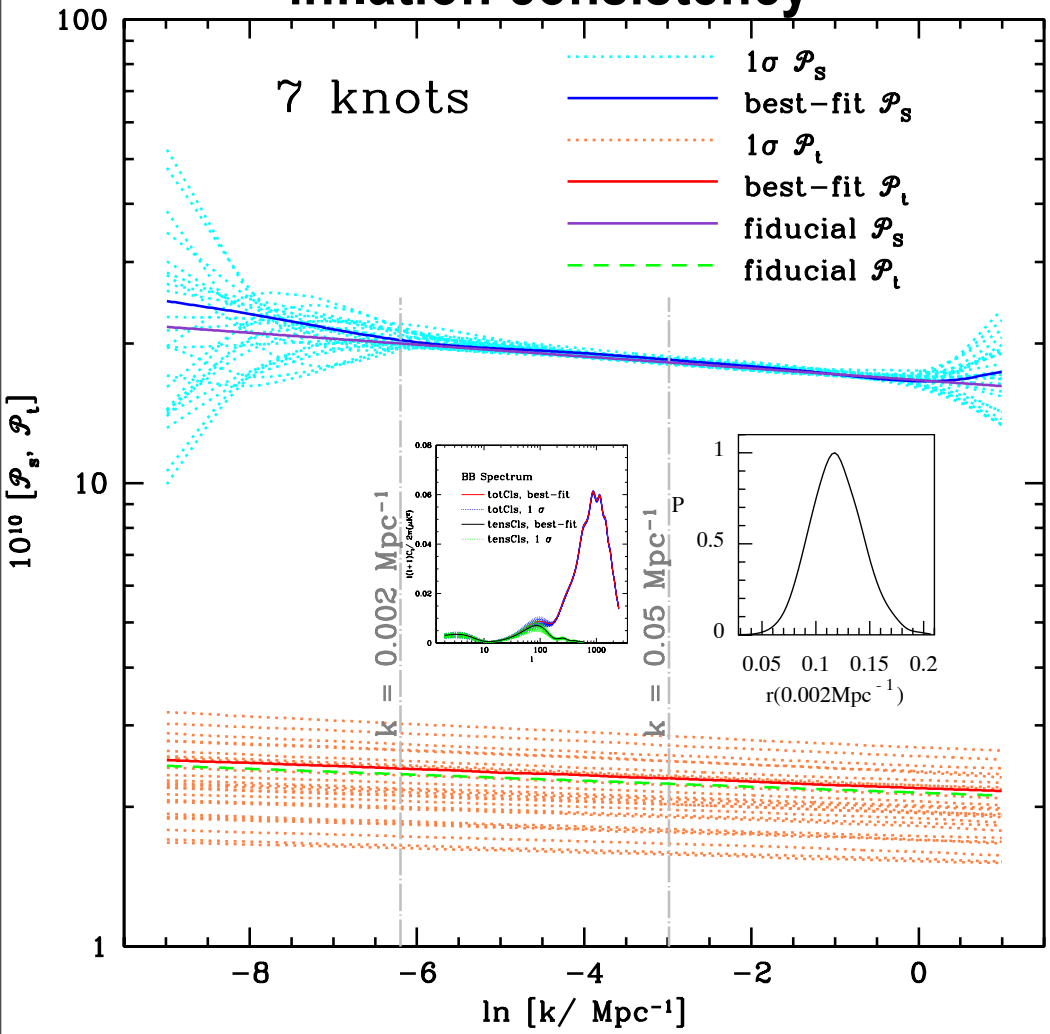
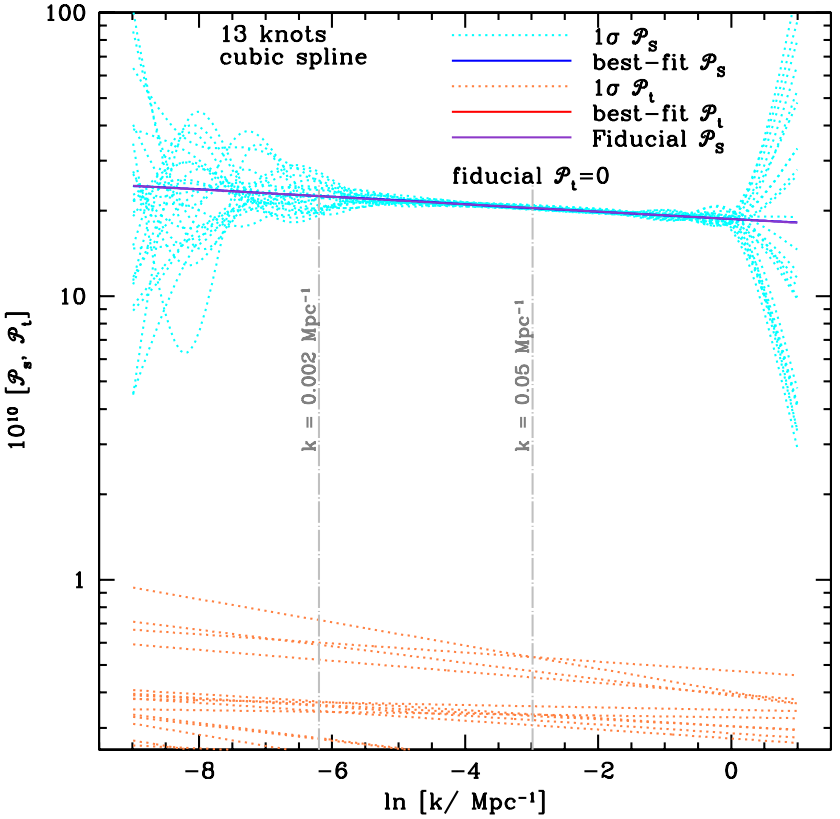
GW/S $\equiv r \approx 16\varepsilon$

Planck2.5 forecast with inflation consistency



Planck2.5 r=0 forecast for 13 knot semi-blind P_s +r-n_t



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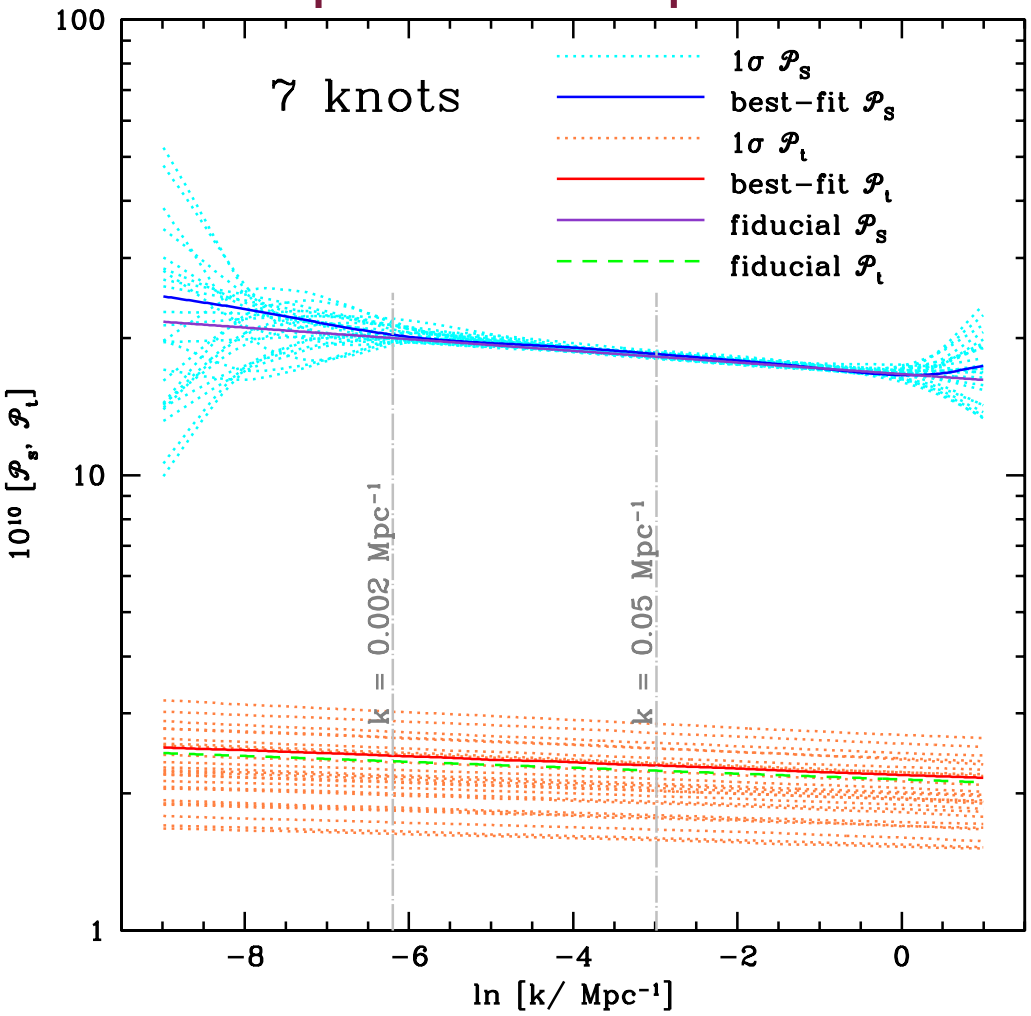
compress data onto non-top-hat k-modes

Farhang, Bond, Dore, Netterfield 2011-13

Bond, Contaldi, Huang, Kofman, Vaudrevange 2011

Planck2.5 7 knot with inflation consistency; input r=0.12 for $m^2\varphi^2$



r to ± 0.02

***ε* expansion only over the observable range, < 10 e-folds, tried extrapolating to *ε* =1, 50-60 efolds downstream - too much freedom, smooth approach, waterfalls, isocurvature onset, etc.**

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end