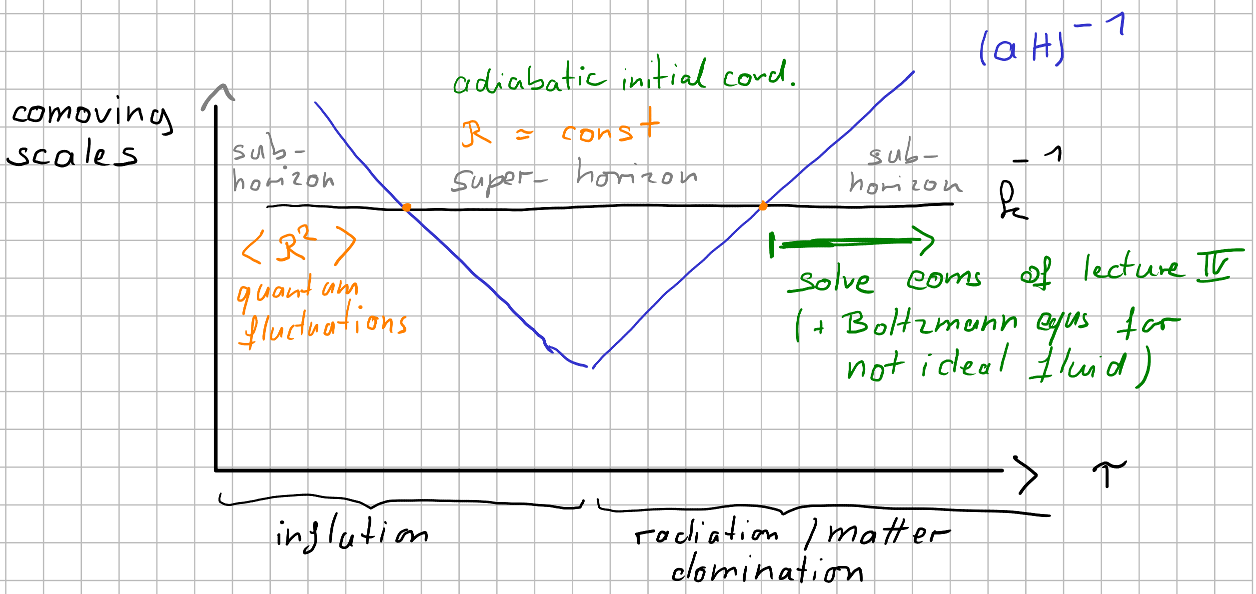
$\partial_i T^i{}_0 = (\bar{\rho} + \bar{p})\, \partial_i v^i$

Lecture V Tests of inflation

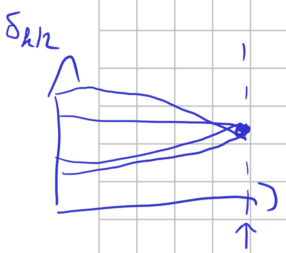
Recap:



1) phase coherence

density perturbation inside horizon

$$\ddot{\delta} - c_s^2 \nabla^2 \delta = F_g[\mathcal{R}]$$

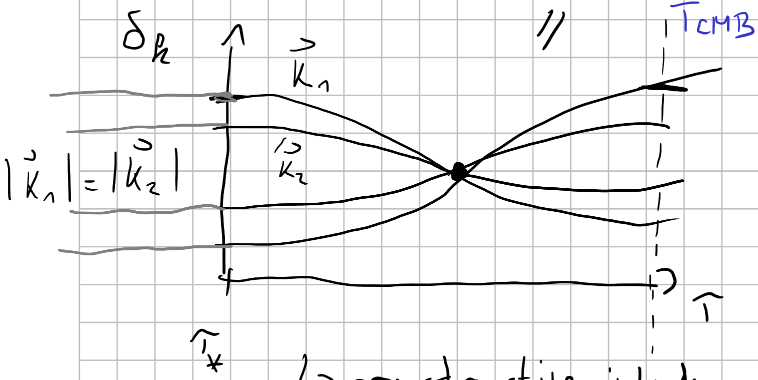


→ Fourier expansion: $\delta_{\vec{k}} = A \cos(\vec{k}\vec{x} - \omega t) + B \sin(\vec{k}\vec{x} - \omega t)$

→ initial conditions: $\delta \sim \mathcal{R}$ = const. at horizon re-entry ($\dot{\delta} = 0$)

↳ only cosine mode ($B = 0$)

↳ phase coherence



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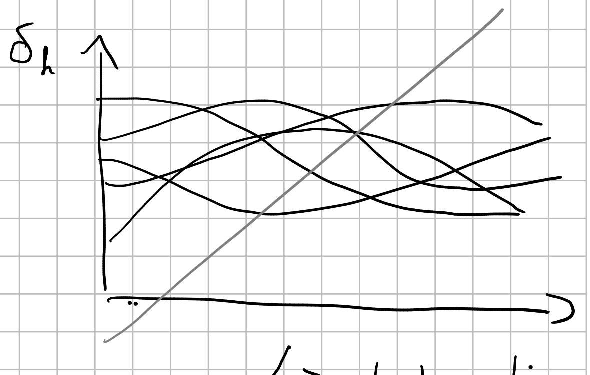

↳ constructive interference

↳ peaks in CMB T spectrum

↳ destructive interference

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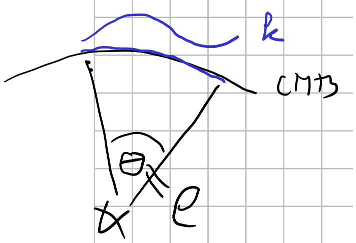
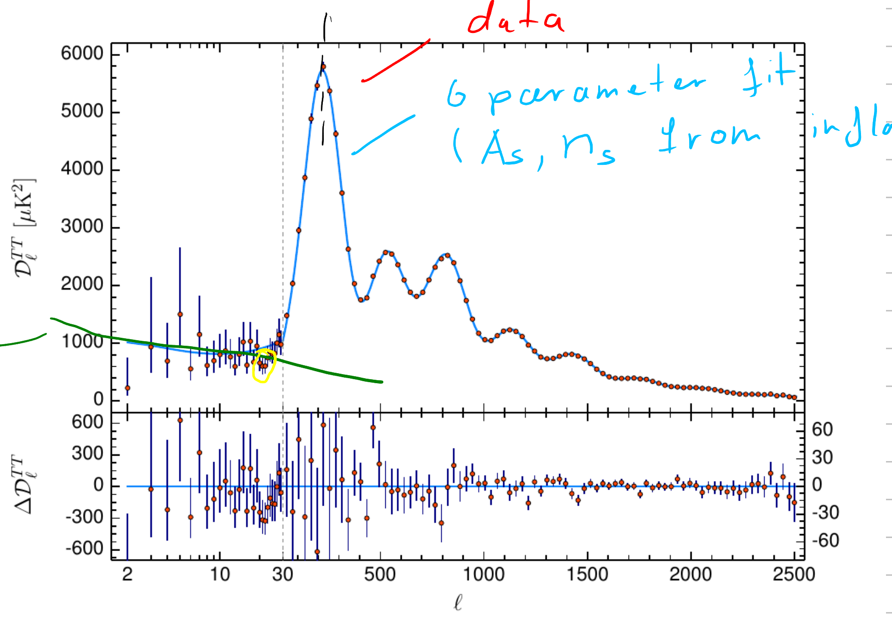
2) CMB

temperature power spectrum





$A_s \simeq 2 \times 10^{-9}$

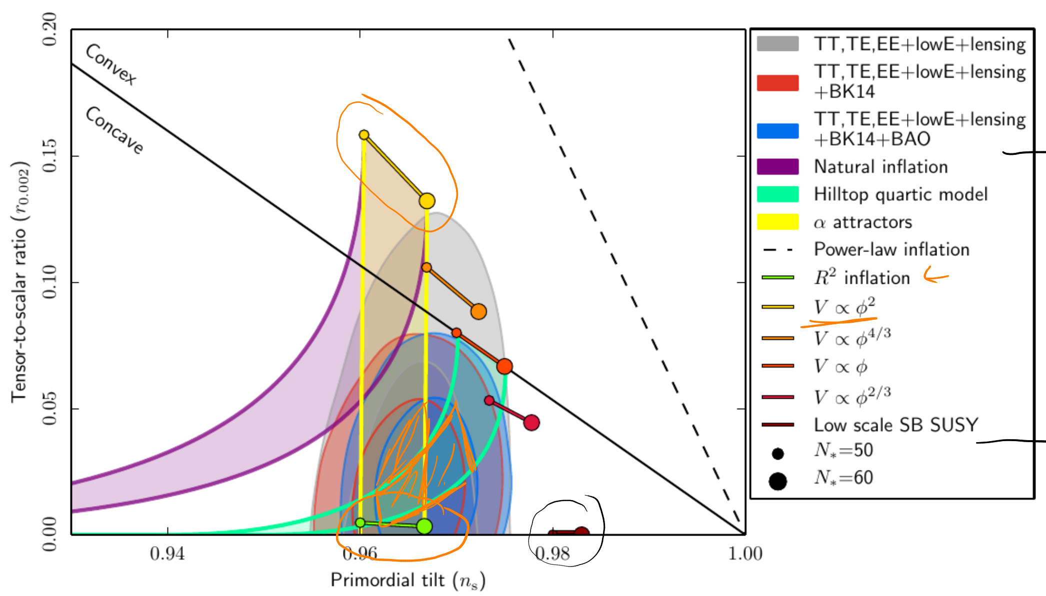
$n_s \simeq 0.97$

$\Delta_R^2 \sim \frac{H^4}{\dot{\phi}^2}$

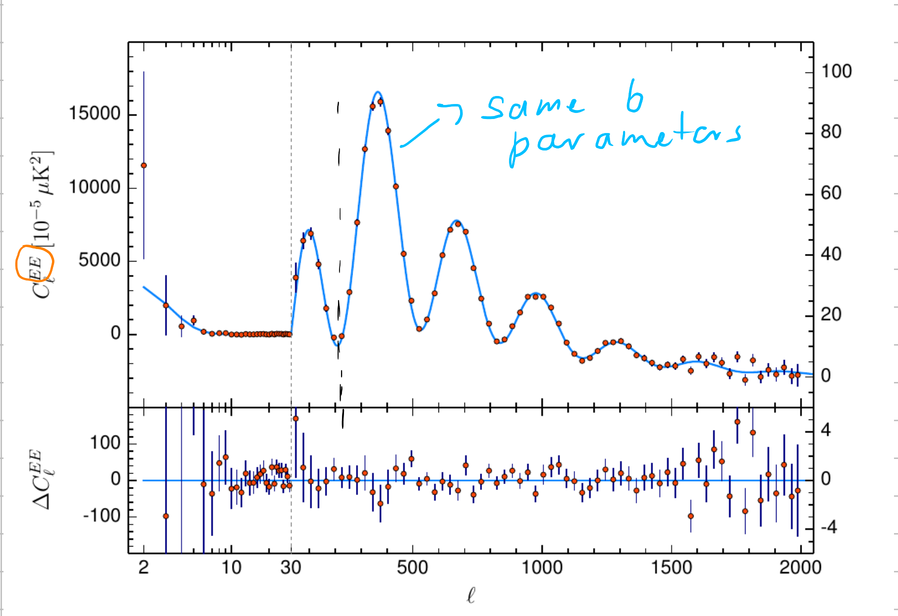
$\Delta_R^2 = A_s \left(\frac{k}{k_{ref}}\right)^{1-n_s+\dots}$ (α_s)

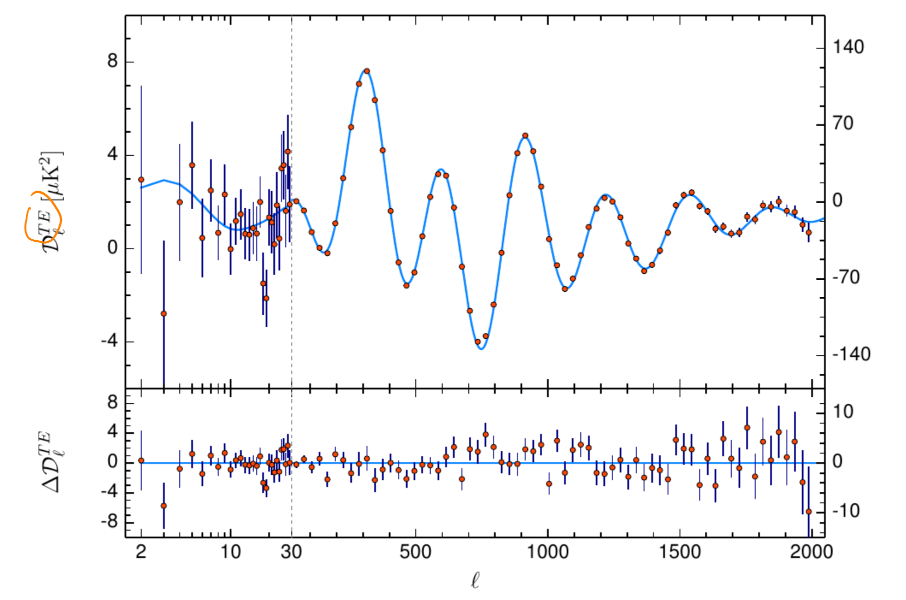
discriminate between inflation models:

$r = \frac{\Delta_t^2}{\Delta_R^2}$



beyond TT spectrum:





3) (non-) Gaussianity

non-gaussianity:

$$\langle \mathcal{R}_{\vec{k}} \mathcal{R}_{\vec{k}'} \mathcal{R}_{\vec{k}''} \rangle = \delta(\vec{k}+\vec{k}'+\vec{k}'')\, B(\vec{k},\vec{k}',\vec{k}'')$$

↳ non-zero iff different $\vec{k}$-modes are correlated

↳ very small in single field slow-roll inflation

↳ data consistent with single-field slow-roll

4) gravitational waves

$$\Delta_t^2 = \frac{2}{M_p^2} \frac{H_*^2}{\pi^2}$$

$$r = \frac{\Delta_t^2}{\Delta_\mathcal{R}^2} < 0.1$$

$\Delta_\mathcal{R}^2 \sim 2 \times 10^{-9}$

} $\hat{=}$ upper bound on energy scale of inflation

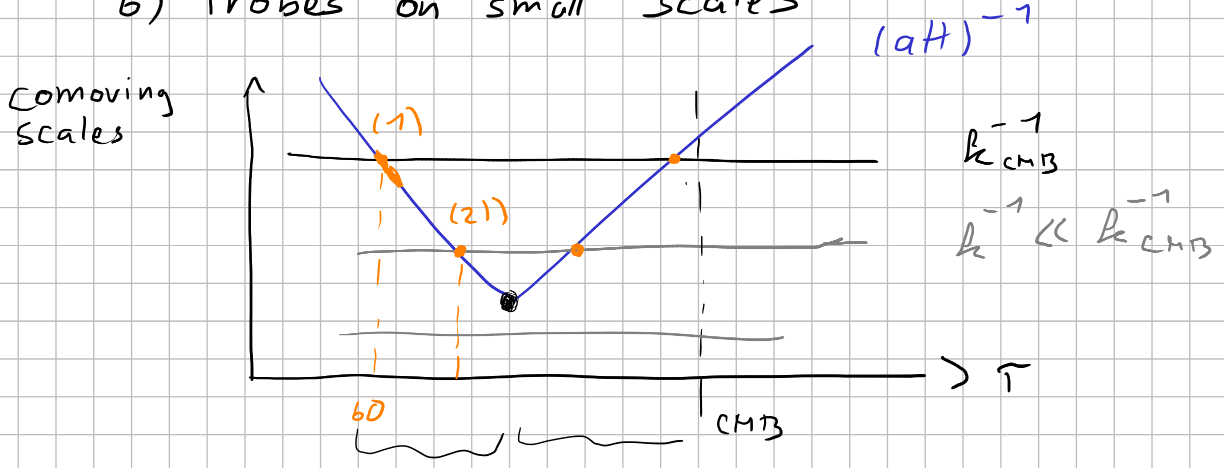
$$n_t = -r/8$$

Consistency relation
↳ to be checked

5) adiabatic initial conditions

↳ see lecture IV

6) Probes on small scales



- scalars
  - distortions of CMB blackbody
  - PBHs
  - LSS

- tensor
  - "
  - GW searches, e.g. PTAs, LISA, LIGO
    ↳ Chiara's lecture