# Future LSS Survey and Inflation Models

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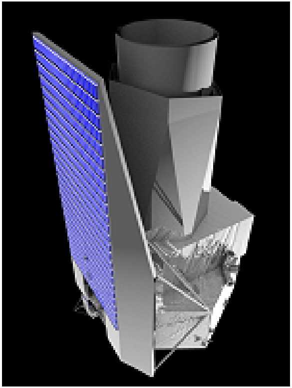
# Why this is a right decision



EUCLID mission:

- Dark Energy
- Galaxies
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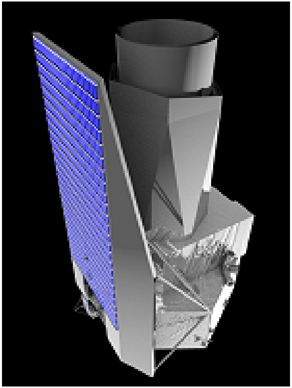

EUCLID mission:

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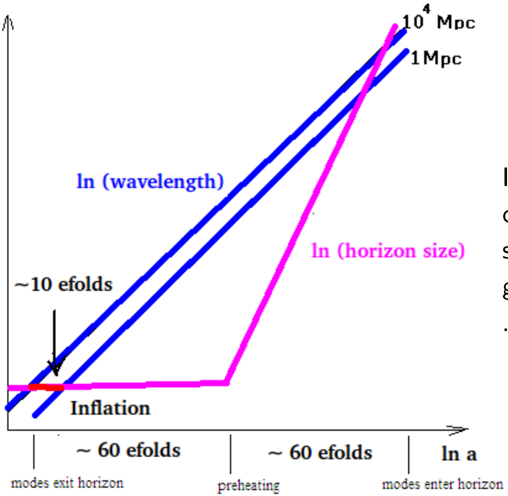
# Only about 10 efolds of inflations are observable




Inflation seeds the cosmological-scale structures (CMB, galaxy clustering, ...).

# Can we learn something?

Two classes of models (natureness v.s. falsifiability).

- Simple models: scalae-invariant power spectrum, adiabatic perturbations, ...
  natural; featureless; difficult to distinguish; general paradigm without concrete physics
- Complicated models: Starobinsky potential (Starobinsky 1992), double inflation (Polarski & Starobinsky 1992), particle production during inflation (Barnaby, Huang, Kofman, Pogosyan 2009, Barnaby & Huang 2009), modulated preheating (Bond, Frolov, Huang, Kofman 2009), extra dimensions (Bean et al 2008, McAllister et al 2010, Flauger et al 2010).
  crazy; falsifiable; most are related to concrete physics above TeV or in extra dimensions

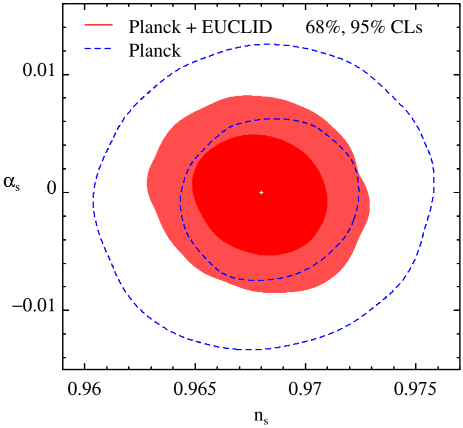
# The bench-mark experiments

- CMB
  Planck (3 channels 70GHz, 100GHz, 143GHz, 2.5yr integration);
- LSS
  A EUCLID-like LSS forecast model.
  The galaxy power spectrum:

$$P_g(k, z, \mu) = \left(b + \frac{d \ln D}{d \ln a}\mu^2\right)^2 D^2(z) P_m(k, z = 0) e^{-k^2\mu^2\sigma^2} .$$

  8 redshift bins $\times$ 30 $k$ bins $\times$ 20 $\mu$ bins
  marginalize over 16 nuisance parameters: $b_1$, $b_2$, ..., $b_8$; $\sigma_1$, $\sigma_2$, ..., $\sigma_8$.
  cut-off at quasi nonlinear scales ($k \sim 0.2\,\mathrm{Mpc}^{-1}$).

# EUCLID and $n_s$, $\alpha_s$

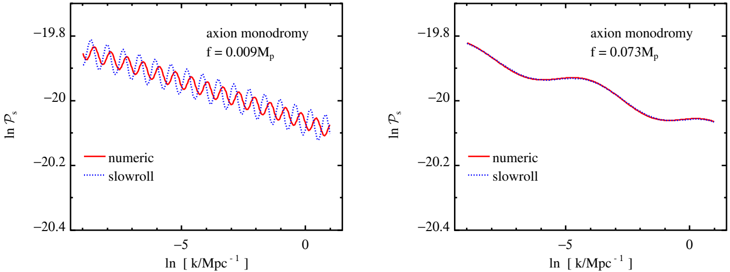



Planck will measure $n_s$ and $\alpha_s$ very accurately. EUCLID can only mildly improve it.

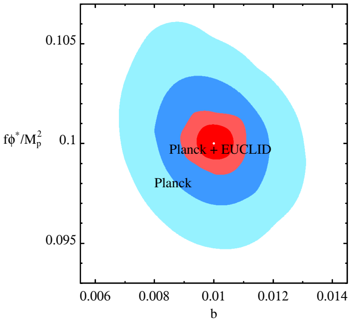
# Models that have features in the potential

Axion monodromy inflation model:

$$V(\phi) = \mu^3 \left[ \phi + bf \cos\left( \frac{\phi}{f} \right) \right] \, .$$



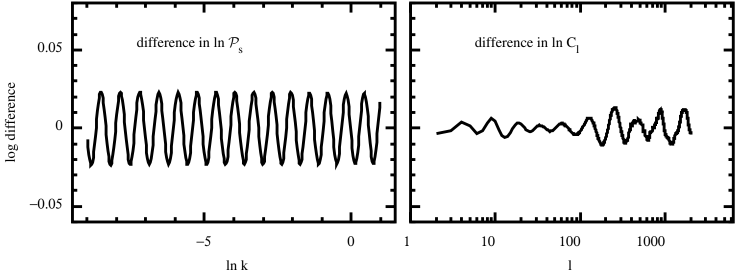
# EUCLID and axion monodromy




For $\delta \ln k \sim 0.1$, EUCLID improves the FOM by a factor of about 10.

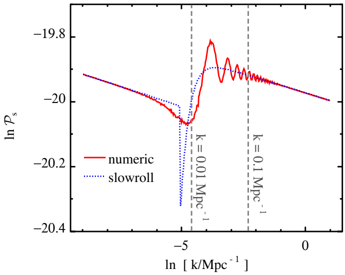
# Why EUCLID can measure sharp features better

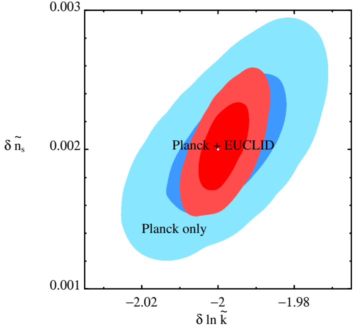
The difference between monodromy and a linear potential with the same $\mu^3$




CMB measures integrated angular correlations. Sharp features are suppressed.

# Another example, ringing feature from Starobinsky potential.



# Take-home Message

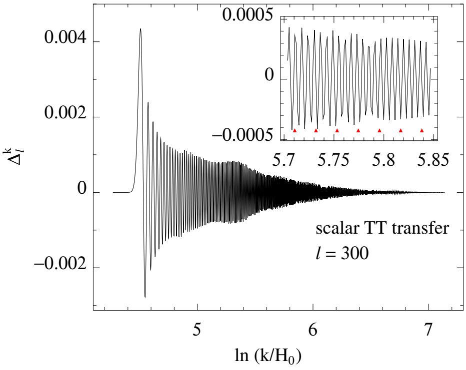
- Interesting physics can manifests itself in the form of glitches in the primordial scalar power spectrum.
- EUCLID is a curcial experiment to measure the glitches.

Some Technical Details (for Julien Lesgourgues)...

# Towards the quick-oscilllation $\delta \ln k \sim 10^{-3}$

$$C_\ell = \int \left(\Delta_\ell^k\right)^2 \mathcal{P}_s(k) d\ln k$$

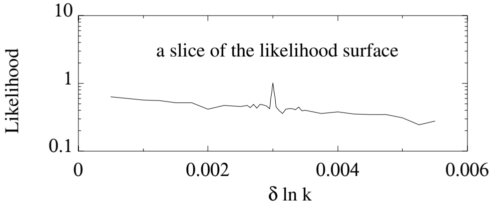
Integration scheme in CAMB, CLASS etc.




- Brute-force increment of $\ell$ and $k$ resolutions $\Rightarrow \sim 10^3$ times slower.
- Better integration scheme using the recurrence relation of $j_\ell(x)$ (implemented in my code).

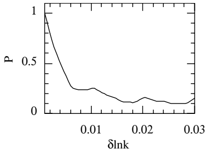
# Monodromy likelihood surface: searching the radio band

CMB only
fiducial $\delta \ln k = 0.003$.




- Quadratic approximation fails (Fisher-matrix does not work).
- MCMC converges much slower than usual.
- "Tuned-in channel" can be easily destroyed by varying other parameters. Marginalization is important.

CMB Only:




LSS + CMB: