Scales — Experiments

Inflationary
e-foldings

60   50   40   30   20   10

wave
frequency
(Hz)

10^{-18} 10^{-16} 10^{-14} 10^{-12} 10^{-10} 10^{-8} 10^{-6} 10^{-4} 10^{-2} 1 10^{2}

**CMB
anisotropies**

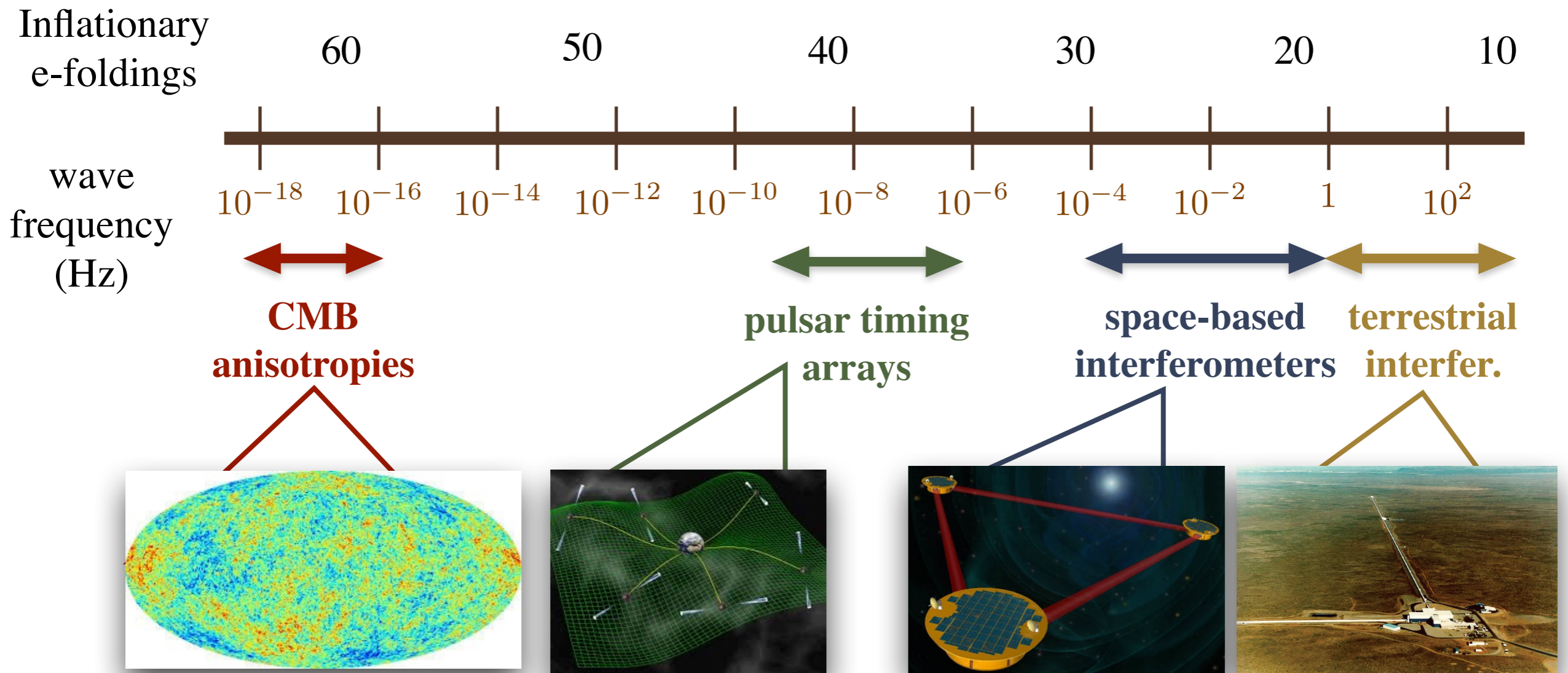**pulsar timing
arrays**

**space-based
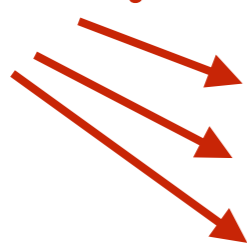interferometers**

**terrestrial
interfer.**

We're lucky to be living during a great time for inflationary cosmology:
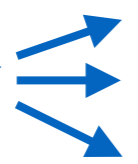
— we still got so much to discover about inflation, theorists can go wild

— we can test our models with more, much better, data in the coming years/decade

(I) GW from binary mergers

(II) GW produced during inflation

	$k \; [\mathrm{Mpc}^{-1}]$	$N_{\mathrm{estim.}}$
CMB / LSS	$10^{-4} - 10^{-1}$	$56 - 63$
$y-$ & $\mu-$distortions	$10^{-1} - 10^{4}$	$45 - 56$
$P_\zeta \to \mathrm{PBH} \to \mathrm{GW}$ @ PTA	$10^{4} - 10^{5}$	$41 - 44$
$P_\zeta \to \mathrm{PBH} \to \mathrm{GW}$ @ LISA	$10^{5} - 10^{7}$	$38 - 41$
$P_\zeta \to \mathrm{PBH} \to \mathrm{GW}$ @ AdvLIGO	$10^{7} - 10^{8}$	$35 - 37$
$P_{\delta g} \to \mathrm{GW}$ @ PTA	$10^{6} - 10^{8}$	$36 - 40$
$P_{\delta g} \to \mathrm{GW}$ @ LISA	$10^{11} - 10^{14}$	$22 - 28$
$P_{\delta g} \to \mathrm{GW}$ @ AdvLIGO	$10^{16} - 10^{17}$	$15 - 17$

Table 1. First column: list of observational windows on inflation. Second column: order of magnitude of the wavenumber of the primordial modes in the corresponding window. Third column: estimated number of efolds before the end of inflation at which those modes exited the horizon. The third, fourth, and fifth row refer to GW produced by the collision of black hole binaries originated by PBH due to enhanced scalar perturbations produced during inflation. For brevity, we denote by AdvLIGO the regime probed by terrestrial GW interferometers. The last three rows denote a stochastic GW signal produced directly during inflation.

Garcia-Bellido, Peloso, Unal - 2016

(III) GW produced at second order from scalar perturbations after inflation (David)

GW and inflation
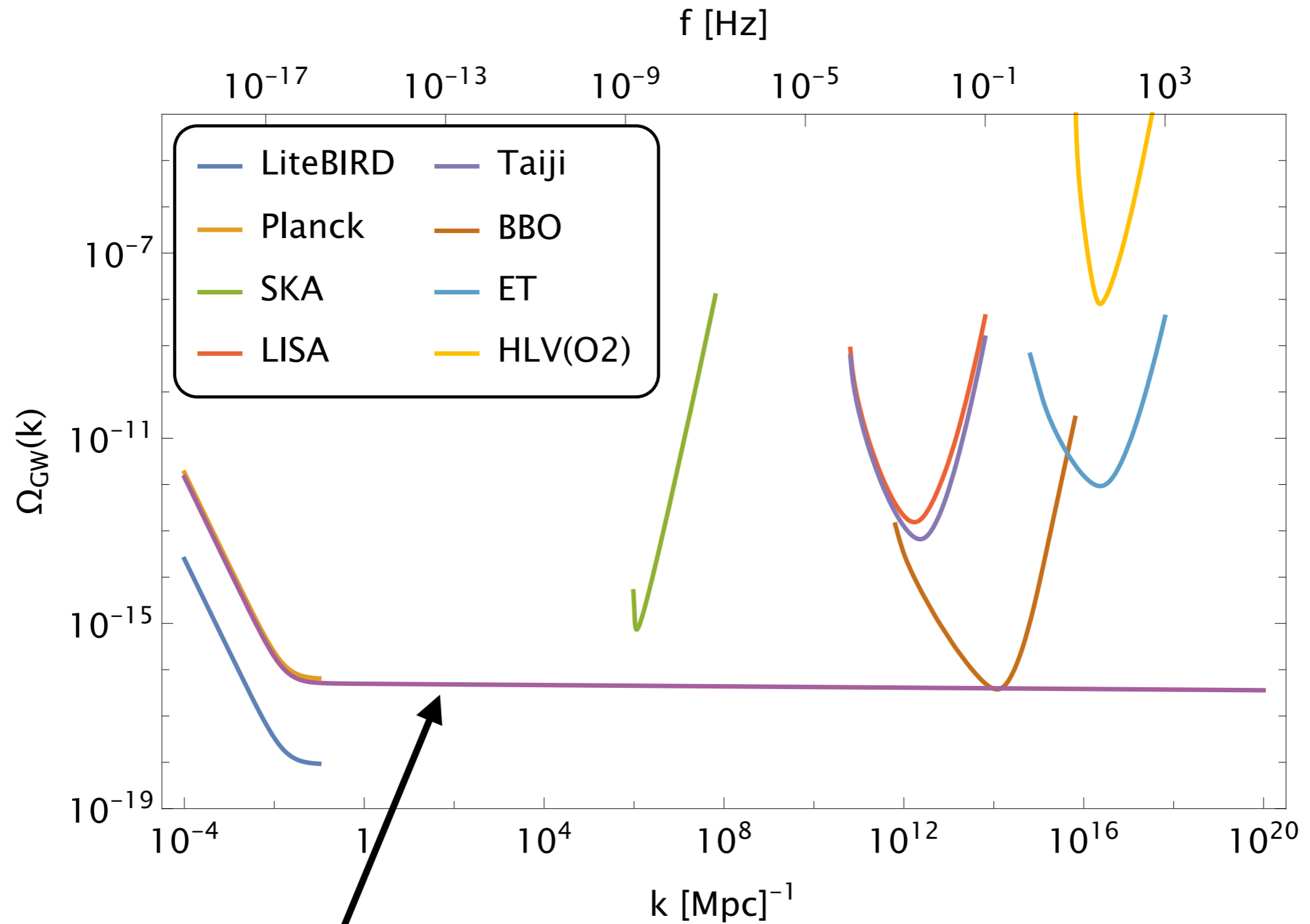
Not the end of the story! So much may have happened that is not represented by this line

GW and inflation: some questions we're asking as theorists

Model building:

what should we expect for the SGWB from inflation? How likely is it that it will be visible at small scales?

Preparing for observations:

how do we exploit [and/or make the case for] upcoming experiments?

GW and inflation: some questions we're asking as theorists

Model building:
what should we expect for the SGWB from inflation? How likely is it that it will be visible at small scales?

- Relaxing vanilla hypotheses [single field/straight trajectory, BD initial states, space diff invariance,..]
- Complementary approaches: EFT and model-specific

Preparing for observations:

- Multiple d.o.f. well motivated from particle physics and string theory

- Excited initial states may have been left over from pre-inflation phase

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Some challenges ahead :

- Building models and computing observables when multiple fields (especially beyond spin-0,1) are involved is hard
- Interesting predictions for tensors without messing up the scalar sector

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how do we exploit [and/or make the case for] upcoming experiments?

GW and inflation: some questions we're asking as theorists

Model building

what s...
from i...
    wi...

Re...
[single field...
initial states...

Complemen...
EFT and m...

- Cosmological n-point correlators (scalar, tensor, mixed)
- Second-order GW production from scalars and consequences for PBH

- Frequency profile/features
- Chirality
- Non-Gaussianity
- SGWB Anisotropies

Preparing for observations:
how do we exploit [and/or make the case for] upcoming experiments?

- Produce accurate predictions
- Identify crucial/new observables
- Figure out the best use of data

- Investigating the capability of new experiments, asking what we would need from experiments and influence their design when possible
- Multi-messenger approach and cross-correlations
- Develop data analysis techniques

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- We may be facing a tiny signal and a lot of noise
- Disentangling the SGWB from inflation from other cosmological/astrophysical backgrounds