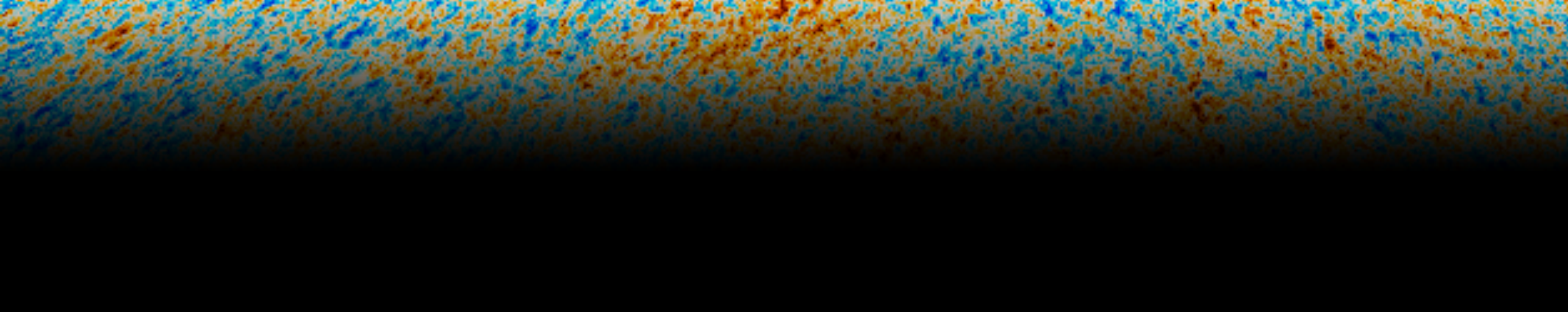

Inflation in the Science Book (v1)

Raphael Flauger

CMB-S4 Collaboration Meeting, SLAC, August 1, 2023

CMB-S4 Science Book

2 Inflation **9**

2.1 Introduction 9

2.2 Basics of cosmological inflation 12

2.2.1 Inflation basics I: A heuristic picture 12

2.2.2 Inflation basics II: Quantifying the predictions 14

2.3 Sensitivity forecasts for r 17

2.4 Implications of a detection of primordial gravitational waves 21

2.4.1 The energy scale of inflation 22

2.4.2 Planckian field ranges and symmetries 22

2.5 Implications of an improved upper limit on r 25

2.6 Tensor-mode science beyond r 29

2.6.1 The shape of the tensor power spectrum 29

2.6.2 Probing matter and gravitational interactions at the inflationary scale 30

2.6.3 Distinguishing vacuum fluctuations from other particle physics sources of B modes 31

2.6.4 Constraining alternatives to inflation 32

2.6.5 Constraints on the graviton mass 33

2.7 Improved constraints on primordial density perturbations 34

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2 Inflation **9**

2.1 Introduction 9

high level introduction summarizing science, motivation, and implication of measurements

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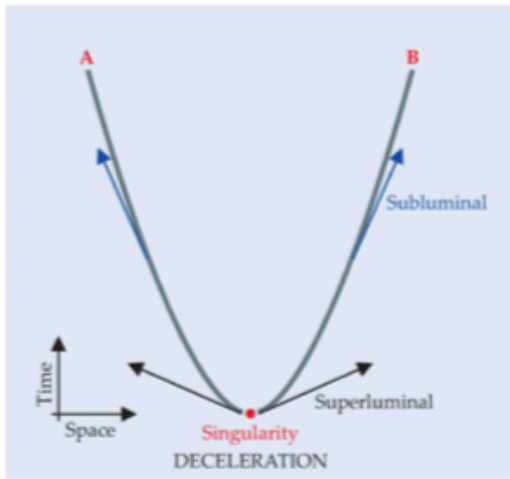
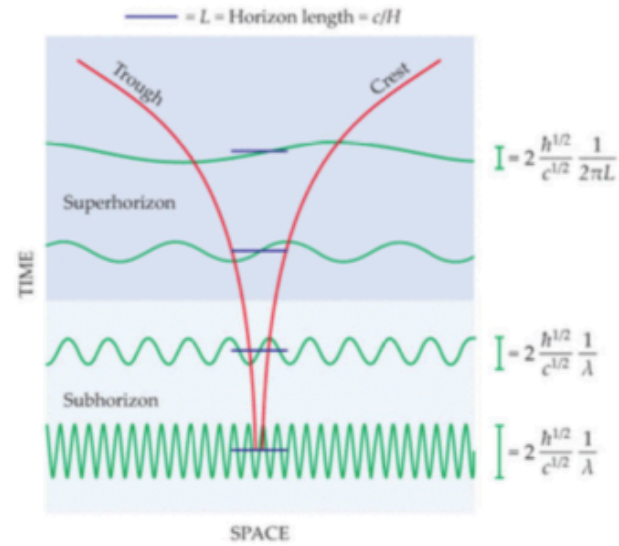
2.2 Basics of cosmological inflation 12

2.2.1 Inflation basics I: A heuristic picture 12

basic "intuitive" explanation of inflation





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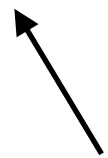

"pedagogical" introduction of perturbed FLRW (not limited to inflation) establishing key quantities and notation used throughout the science book (such as primordial power spectra, tensor-to-scalar ratio, angular power spectra,…)

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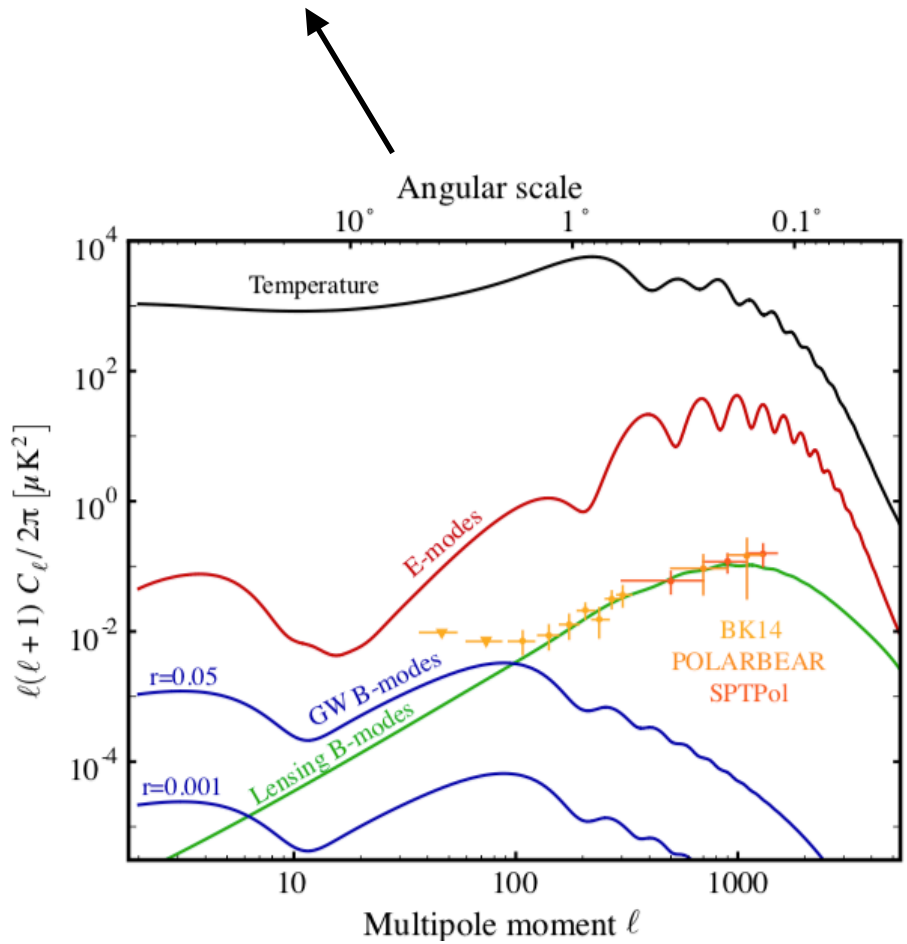

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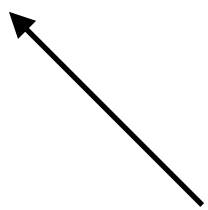

short section of forecasts for r describing (in words)
what went into figures (additional discussion in 8.10)

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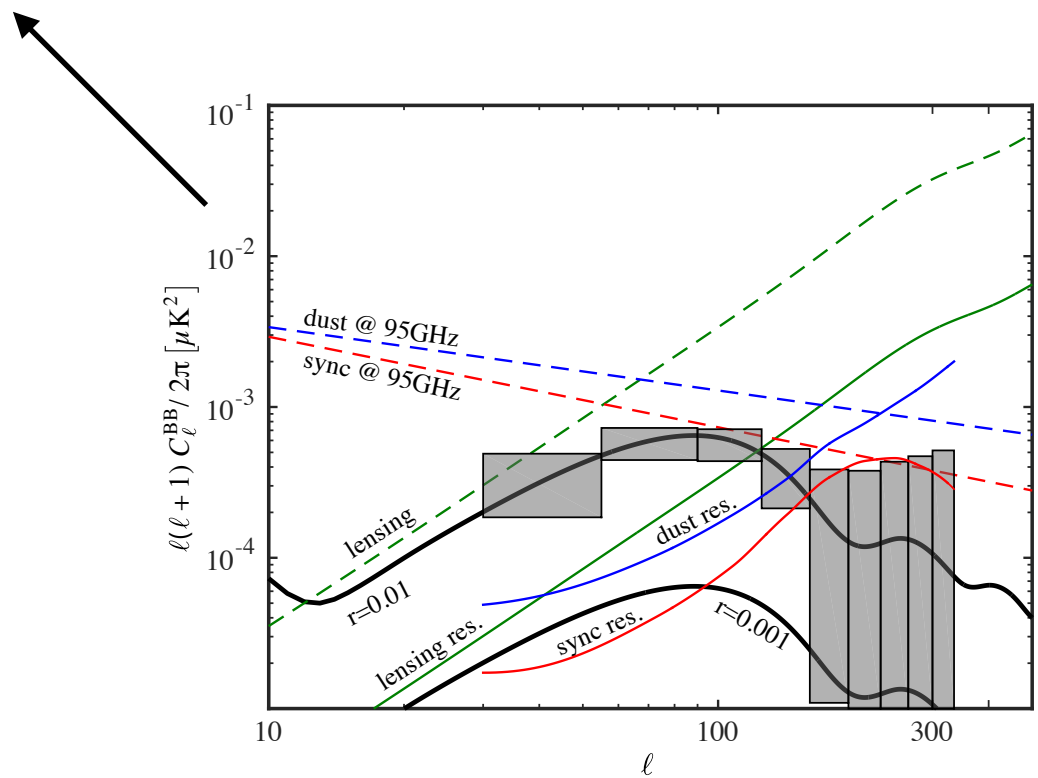

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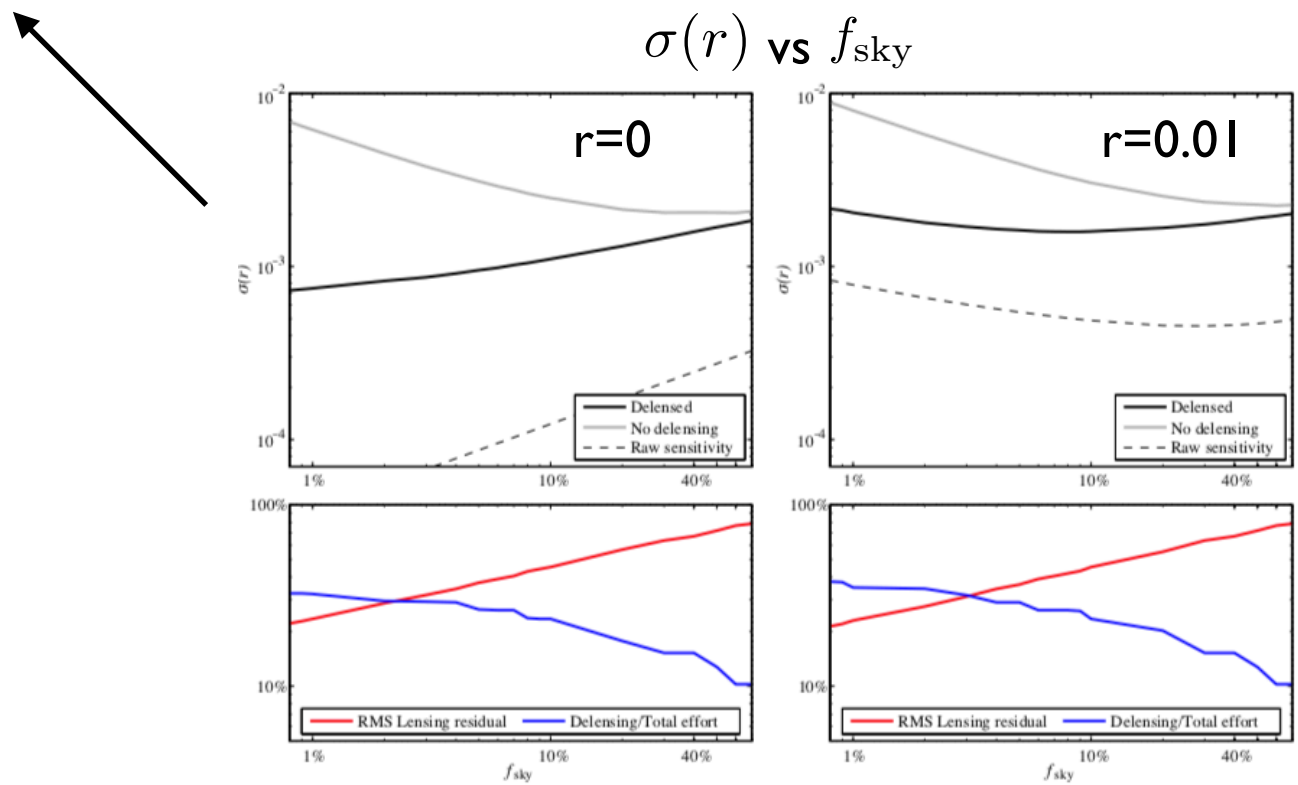

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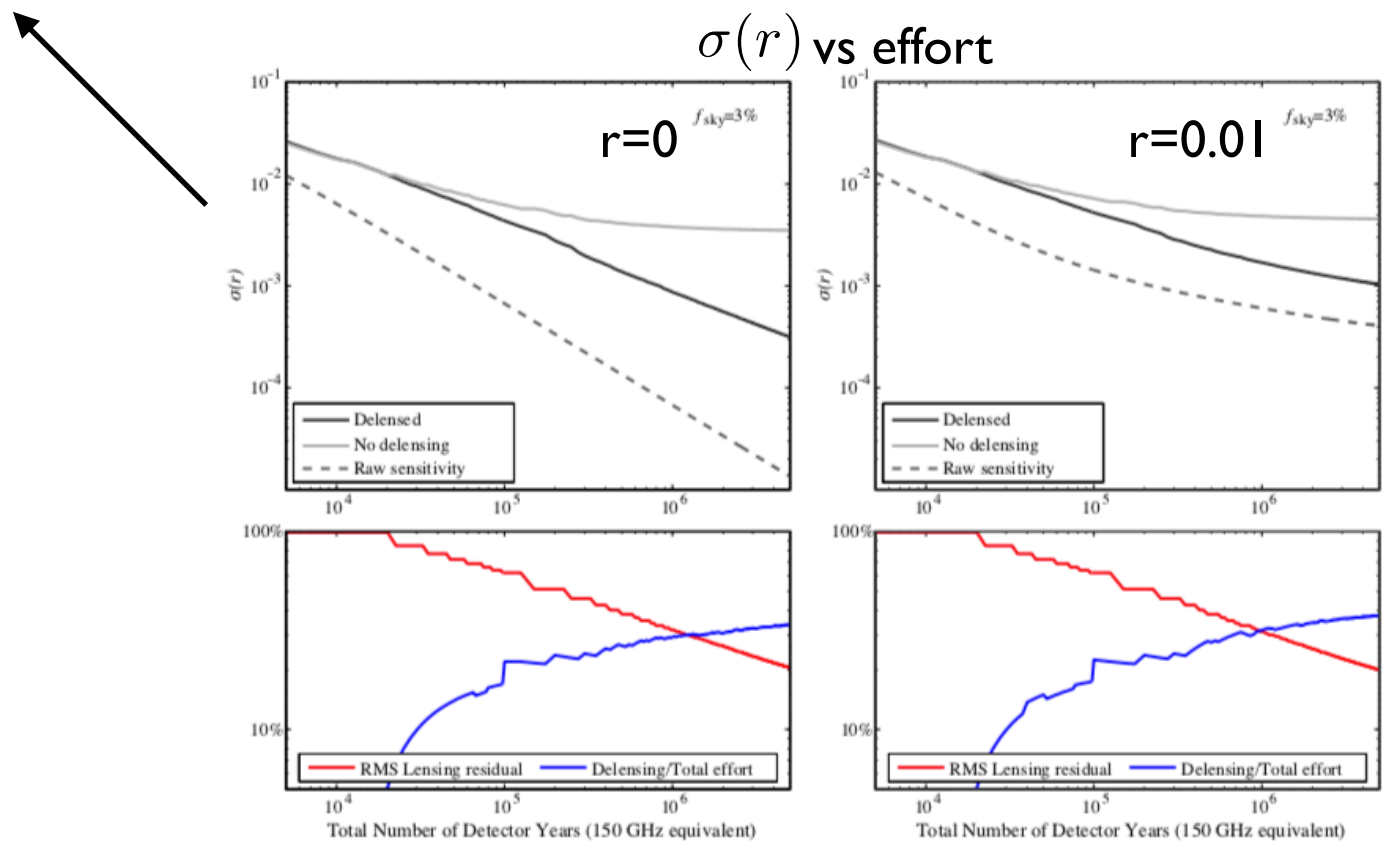

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2.4 Implications of a detection of primordial gravitational waves 21
2.4.1 The energy scale of inflation 22
2.4.2 Planckian field ranges and symmetries 22

discussion of implication of detection in the context of the simplest models of inflation

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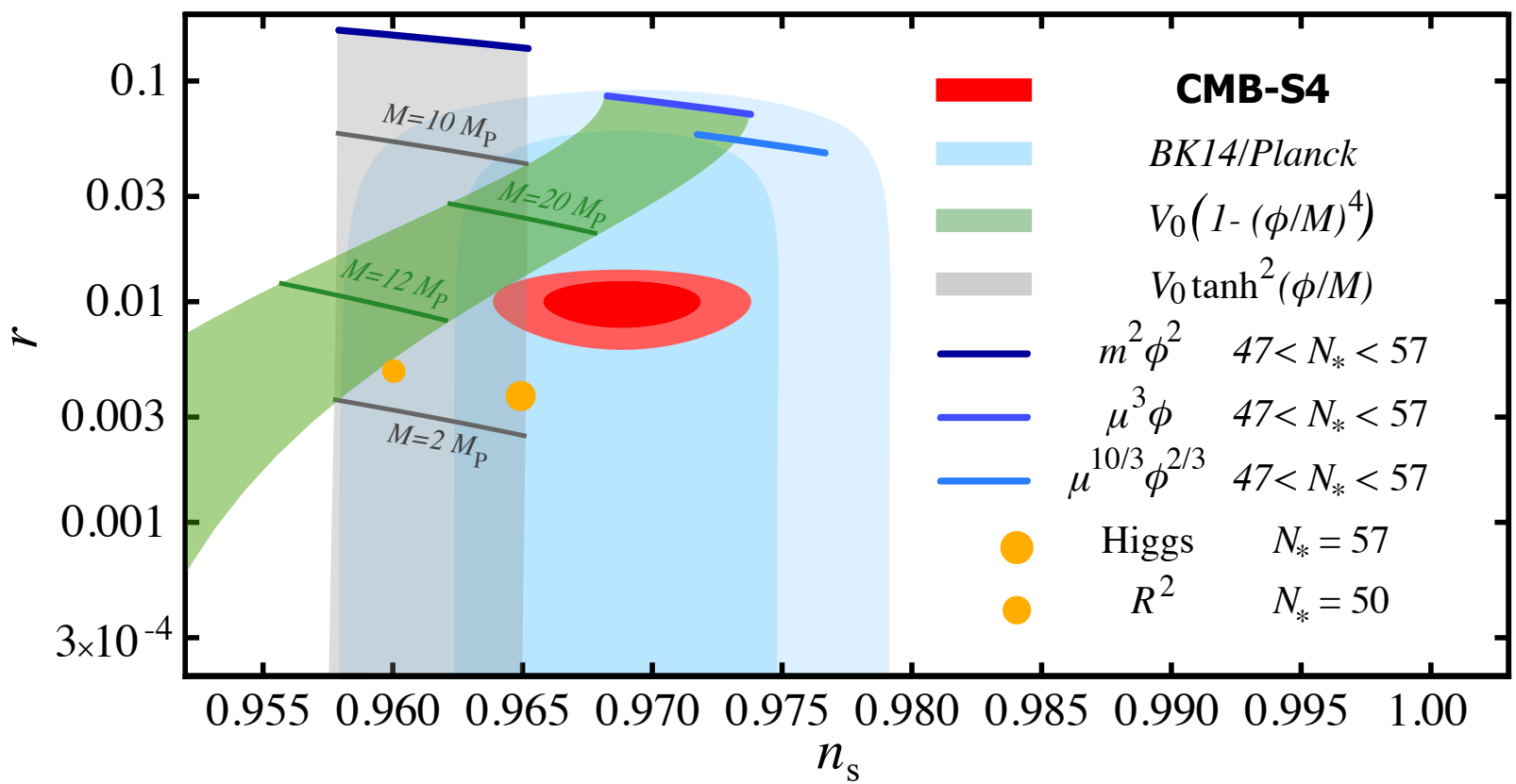

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2.5 Implications of an improved upper limit on r 25

discussion of implication of upper limit, introduction of new concepts, including characteristic scale

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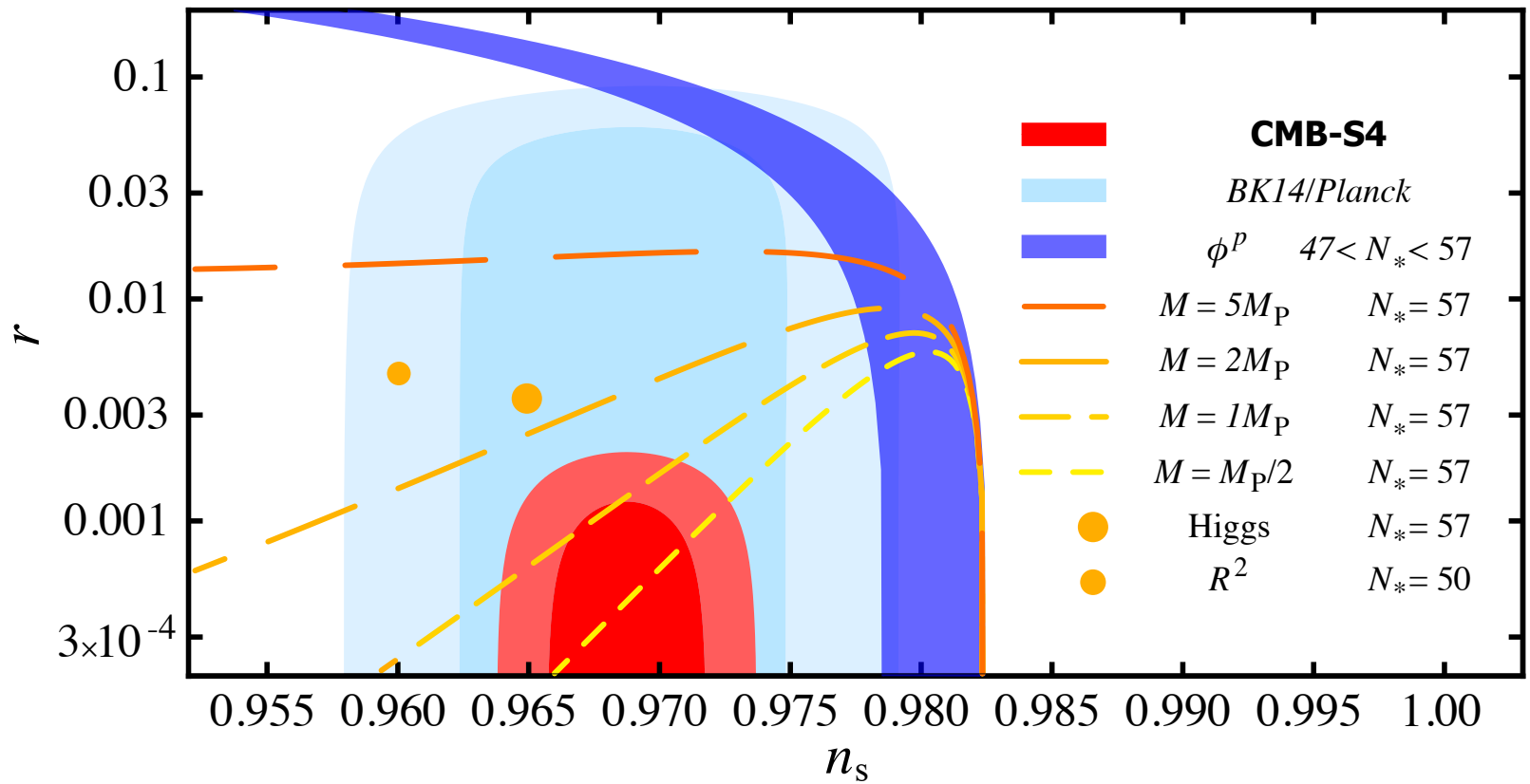

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2.6 Tensor-mode science beyond r 29

constraints on tensor spectral index, tensor non-Gaussianity, sourced gravitational waves, alternatives to inflation, and model-independent bound on graviton mass implied by detection.

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2.7 Improved constraints on primordial density perturbations 34

2.7.1 The scalar power spectrum 35

constraints on spectral index, running, features

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2.7.1 The scalar power spectrum 35
2.7.2 Higher-order correlations of scalar modes 35

constraints on local, equilateral, orthogonal bispectrum

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2.7.1 The scalar power spectrum 35
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2.10 Microwave Background Anomalies 41
2.11 Cosmic Strings 42
2.12 Primordial Magnetic Fields 43
2.13 Summary 44

Conclusions

- At least to me the overall structure still makes sense and could be adopted for v2.
- Several of the sections can be kept with minor only minor updates (assuming v2 is meant to be self-contained) or referenced.
- Other sections should be updated
- In particular those involving forecasts should be updated from the ground up to correctly reflect the current state of the art of forecasts (and perhaps the history?)
- In the spirit of making the science book a self-contained reference, especially feed back from non-specialists willing to try to delve into the different topics might help.

Thank you