Reheating the universe after inflation

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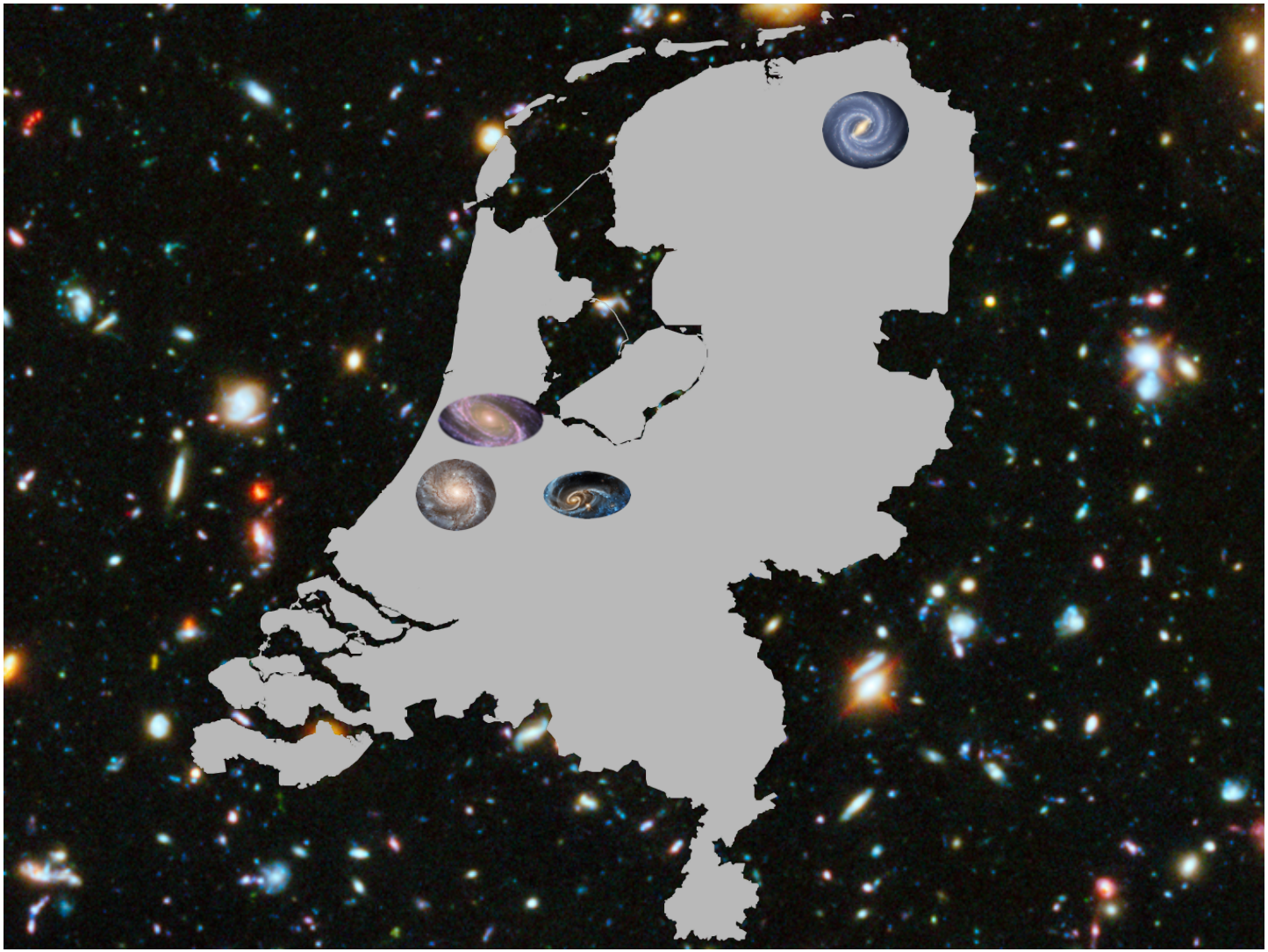
Jamboree
December 18, 2018

Cosmology in the Nikhef Theory group

Theoretical Cosmology in the Netherlands



Visit to UMass

AMHERST CENTER FOR FUNDAMENTAL INTERACTIONS
Physics at the interface: Energy, Intensity, and Cosmic frontiers
University of Massachusetts Amherst

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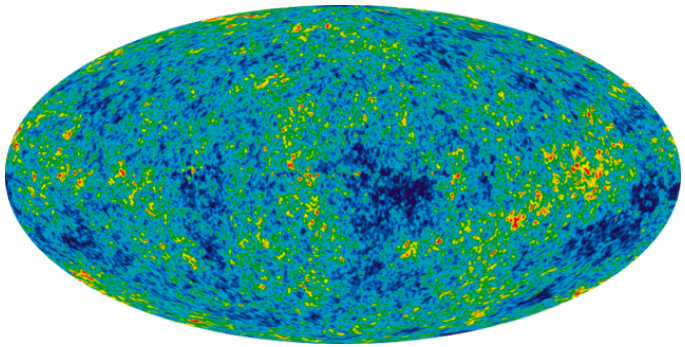
Tom
Giblin
Rachel
Nguyen

What is reheating?

What is inflation?

- Phase of accelerated expansion in the early universe
- Solves horizon problem (and more)



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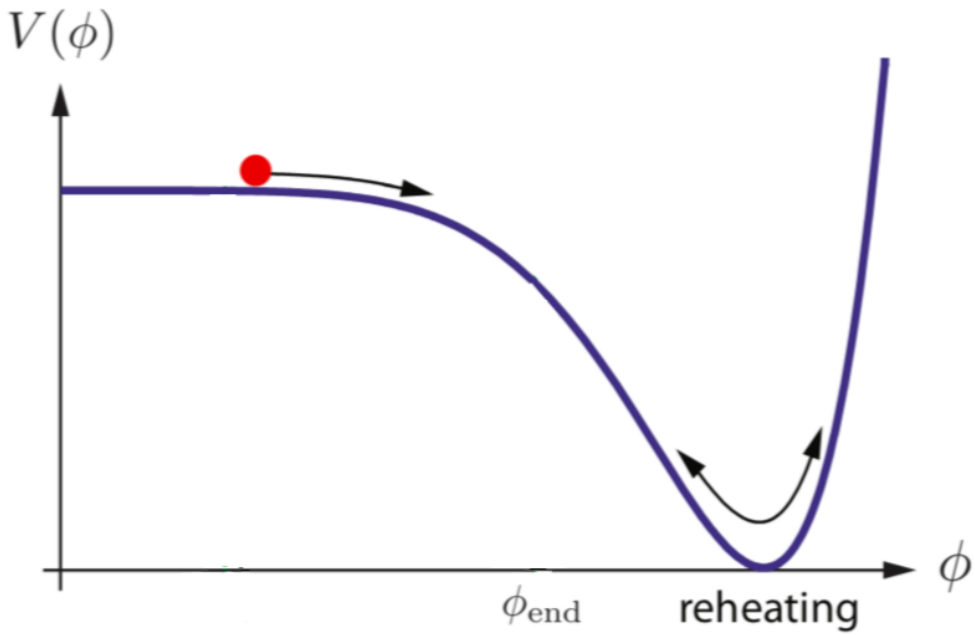
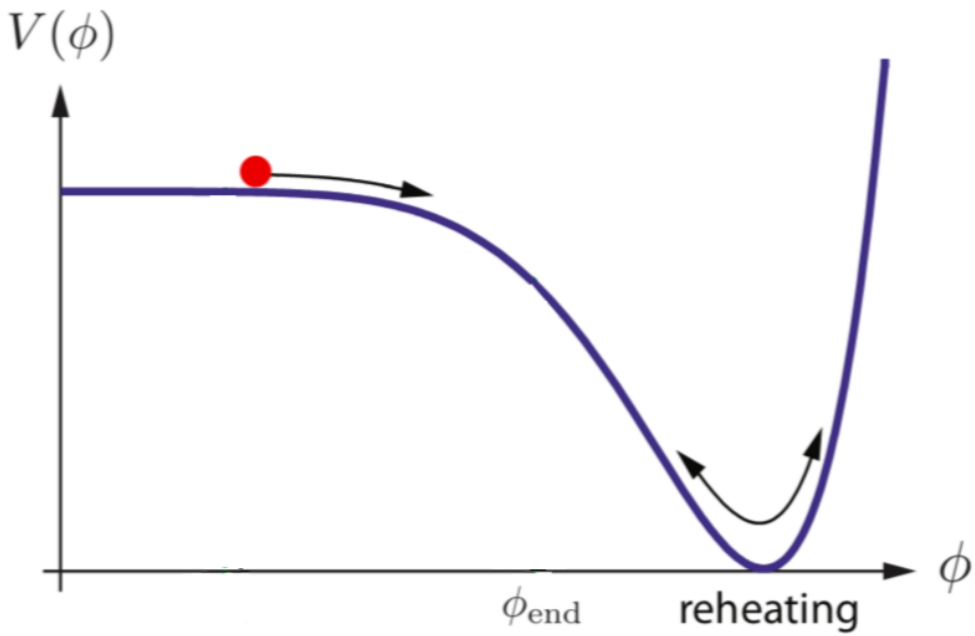
Inflation



Modified from Tasi Lectures on Inflation, Baumann

Reheating

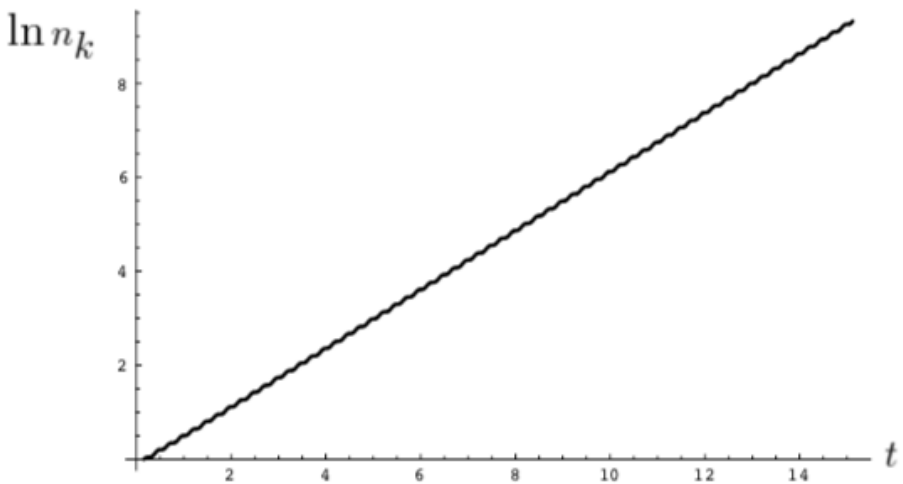


Modified from Tasi Lectures on Inflation, Baumann

Transition from a universe filled with inflaton to a universe filled with SM (and DM?) particles

Initial stage: **P**reheating

- Oscillating inflaton field leads to resonant particle production
- Exponential growth of particle number



Kofman, Linde, Starobinsky 1997

End of (p)reheating

Inflaton decays completely during preheating

Decay products thermalize

Inflation ends

Preheating does not complete

Inflaton decays perturbatively

Decay products thermalize

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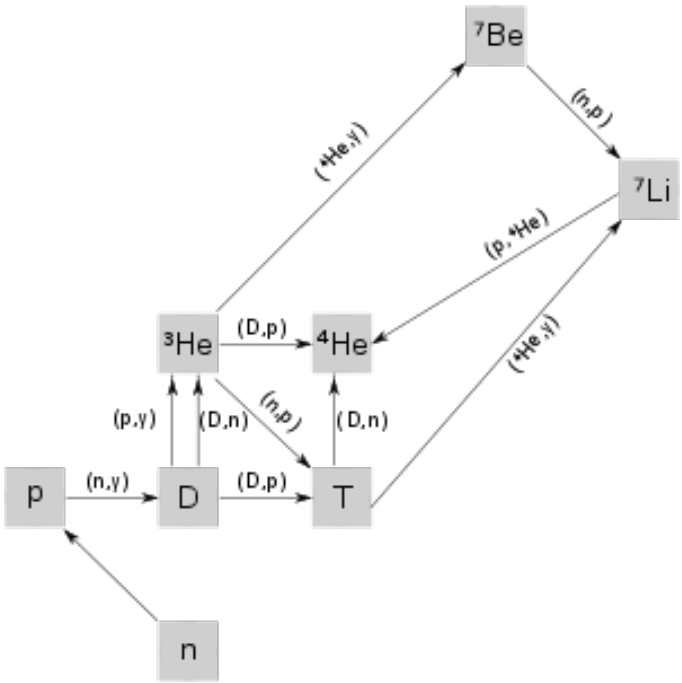
Why is reheating interesting?

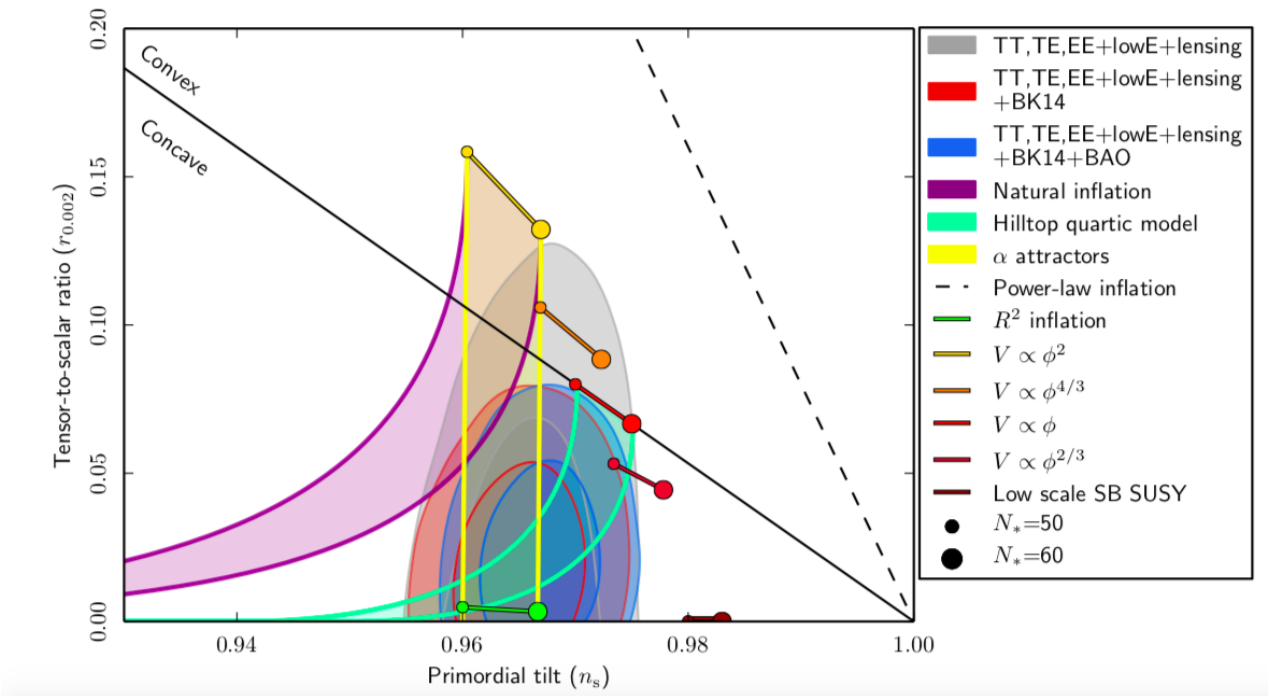
- Does reheating complete before Big Bang Nucleosynthesis?



- Dark matter production

Why is reheating interesting?

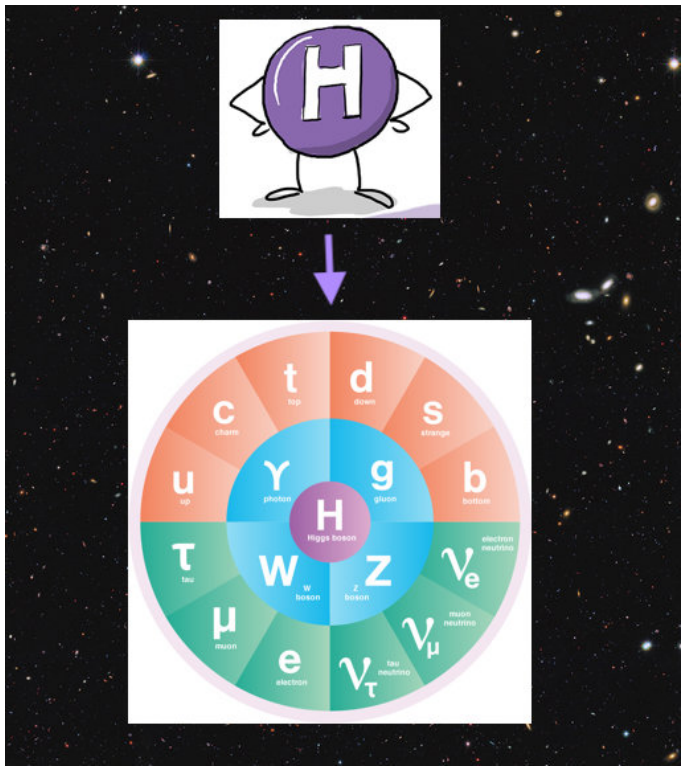
- Duration of reheating affects the comparison of inflationary models to CMB observables



Planck 2018

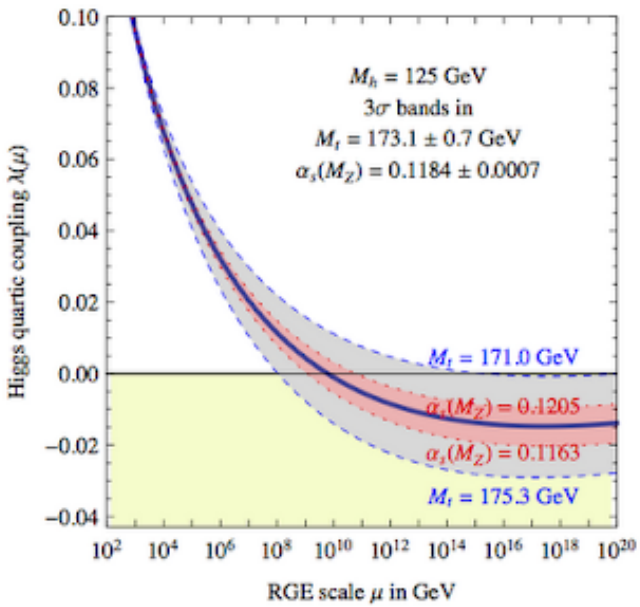
Preheating after Higgs inflation E Sfakianakis, JvdV 2018

- Higgs responsible for inflation?
- Couplings to SM are known
- Strong coupling: very fast reheating through gauge bosons
- Intermediate coupling: reheating through Higgs bosons



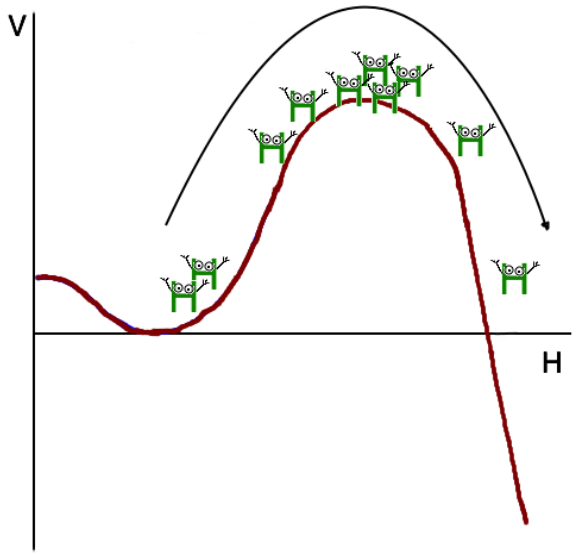
Higgs vacuum decay during preheating? M Postma, JvdV 2017

- Electroweak vacuum metastable?



Degrassi et al. 2012

- Efficient preheating of Higgs modes might lead to vacuum decay



Summary

- Transition from a universe dominated by inflaton to universe with SM particles
  - Does reheating finish before BBN?
  - Dark matter production
  - CMB constraints
- Reheating after Higgs inflation
- Stability of the electroweak vacuum