

ASTR 425/525 Cosmology

Worksheet #18
Wednesday 11/12/2025

Question 1.

Inflation is characterized by a very short period of exponential expansion in the very early Universe with $a(t) \propto e^{H_I t}$, where H_I is the constant Hubble rate during inflation. Here, we would like to explore how inflation solves the horizon and flatness problems.

- (a) Explain how this short period of inflation can address the horizon problem. Modify the diagram below to show how the causal horizon behaves when an early period of inflation occurs.

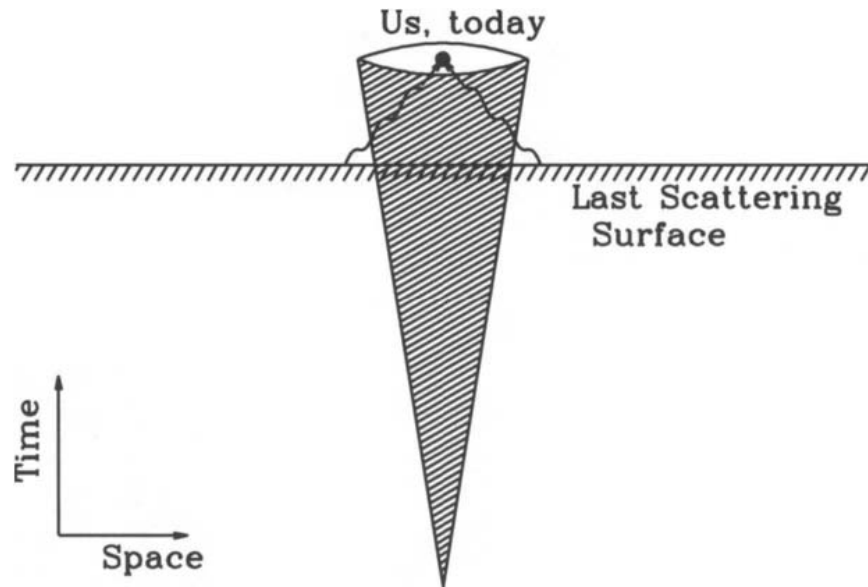


Figure 1: The gray cone represents the causal horizon in the absence of inflation. The CMB photons we observe today started outside of that cone at the last scattering surface. Figure from Dodelson (2003).

- (b) Explain how this short period of inflation can address the flatness problem by removing the fine-tuning issue of having $|\Omega_{\text{tot}}(t) - 1|$ be an extremely small number at early times.

