

The Inflationary Universe, Reading Questions

1. The Ultimate Free Lunch

- What is the conservation of energy?
- How can the creation of the universe from "nothing" avoid violating the conservation of energy?

2. The Cosmic Vista from Ithaca, New York

- What is the flatness problem?
- What do GUTs have to say about magnetic monopoles?
- How might we explore this prediction?

3. The Birth of Modern Cosmology

- What does general relativity have to say about a static universe?
- What three "geometries" for the universe are consistent with general relativity?
- What is Hubble's Law, and how did he arrive at it?
- Does Hubble's Law suggest that we occupy a special place in the cosmos?

4. Echoes of a Scorching Past

- According to the big bang theory, what would the early universe have been like?
- What is a blackbody?
- What does the radiation from the "dark" parts of the sky tell us?
- What is this radiation called?

5. Condensation of the Primordial Soup

- What is nucleosynthesis?
- How does the current distribution of elements bolster the big bang theory?

6. Matters of Matter and Antimatter

- What is a baryon, an antibaryon?
- About how many baryons are there in the observable universe?
- Is this a problem if baryon number is conserved?
- How do GUTs help us out here?
- What two primary conditions are necessary to explain baryogenesis?

7. The Particle Physics Revolution of the 1970s

- What are the four fundamental interactions (forces)?
- What is the standard model of particle physics?
- What three reasons does Guth list for why the standard model made such an impact with the physics community?

8. Grand Unified Theories

- What is the goal of all GUTs?
- Why are in Guth's words Guts "considered highly attractive."
- What is the significance of the data presented in figure 8.1?
- What is the hierarchy problem?
- What is spontaneous symmetry breaking?
- What is a Higgs field?
- What is the significance of the data presented in figure 8.3?
- What is a phase transition?

9. Combatting the Magnetic Monopole Menace

- Has anyone ever seen a magnetic monopole?
- What is the magnetic monopole problem?
- How is the number of monopoles produced in the early universe related to the chaos in the Higgs field?
- What is the horizon distance?
- What is supercooling, and how does it help with the magnetic monopole problem?

10. The Inflationary Universe

- What is the significance of the data presented in figure 10.1?
- What is a false vacuum?
- What is tunneling?
- What startling fact about the false vacuum does figure 10.2 illustrate?
- What gravitational effect does the false vacuum exhibit?
- Why is Guth talking about a vizier and a chess board?
- How does inflation help resolve the flatness problem?
- What is the horizon problem?
- How does Inflation help resolve the horizon problem?
- What is the significance of the data presented in figure 10.6?

11. The Aftermath of Discovery

- What is the significance of the data presented in figure 11.1?
- What is the graceful exit problem, and what does it have to do with making coffee?

12. The New Inflationary Universe

- What did new inflation have to say about the observable universe and the bubbles of normal vacuum created during inflation?
- How did new inflation differ from "old" inflation?
- How did Linde help solve the graceful exit problem?
- What is the significance of the data presented in figure 12.2?

13. Wrinkles on a Smooth Background

- What is problematic about inflation's solution to the horizon problem?
- How was this resolved and what did it have to do with quantum processes?

14. Observational Clues from Deep Below and Far Beyond

- What was the source of Guth's "uneasiness" at the Nuffield workshop?
- What was the significance of placing the proton's half life beyond 2×10^{32} years?
- What is the significance of the data presented in figure 14.1?

15. The Eternally Existing, Self-Reproducing Inflationary Universe

- Once inflation starts how long does it last?
- What is a "pocket" universe?
- What can cosmologists say about what existed before inflation? Be honest.
- What connection does Guth make between cosmological theories and cell division?

16. Wormhole and the Creation of Universes in the Laboratory

- In the *Cosmic Cookbook*, what ingredient(s) are needed to create a universe according to the standard big bang theory?
- In the *Cosmic Cookbook*, what ingredient(s) are needed to create a universe according to inflationary theory?
- What did Roger Penrose prove in 1965?
- What is a white hole?
- What two ways could we get around Penrose's theorem?

17. A Universe Ex Nihilo

- If one day cosmologists are able to explain the creation of the universe, what question remains?