

# Space: Its Light , Its Shape.

## Hawking Part II: Theories of the Universe

### Assignment: For Monday, March 7

- Read Hawking's *A Brief History of Time* pages 20-46. (If you like, read pages 47-51 for general interest.) It is available on eReserves.
- Please feel free to bring up other issues you find interesting or puzzling. If at all possible send an email before seminar to me. I will present this topic as my assignment or open it up to discussion by the whole seminar.
- Some of these require additional reading for the presenting team. If I don't explicitly give the reference then the additional information is easy to find on the internet.
- Though everyone is responsible for reading all of the material and for working out all of the exercises, teams have been specific material and exercises for which they are responsible in class presentations. You may want to come to class early to firm up and smooth out the exercises with your teammates.

**Team 2:** State the two postulates of Special Relativity. (We could spend a whole course on this fascinating subject. Sadly, in this seminar we can give it only a glance.) Remind us what the speed of light is. How does it compare to the galaxy recession speeds you found in lab?

**Team 3:** Tell us what a space-time diagram is. Sketch an example on the board.

**Seth:** Review finding distance in a 2D spacetime. Show how the measurement shown in Figure 2-1 is modified for a moving observer.

**Team 4:** What is a light cone? For an event, show how a light cone separates space-time into three regions.

**Team 1:** Remind us how Jeff Weeks describes a geodesic.

**Team 2:** If the sun's mass modifies the local geometry, explain how light following a geodesic might appear to be deflected.

**Team 3:** Bring a balloon to class and demonstrate how the local geometry on the surface might change in time.

**Team 4:** In the first few pages of chapter 3 Hawking reviews Hubble's discovery. On page 39 he suggests an analogy between the expanding universe and a rocket (or any object tossed in the air). Discuss this. If you are able, flesh this out by discussing the velocity, acceleration and energy for such a model.

In the last part of the reading, Hawking briefly mentions cosmological models and the cosmic microwave background radiation. We will spend much of the remainder of the semester learning more about these. So this is only a first look!

**Team 1:** What is the cosmological constant?

**Team 2:** What are the assumptions behind the Friedmann-Robertson-Walker (FRW) universe?

**Team 3:** What did Wilson and Penzias accidentally discover?

**Team 4:** Discuss the three FRW cosmologies shown on page 43.

**Seth:** These days we talk about three types of stuff that determine the fate of the universe. Briefly tells us about each.