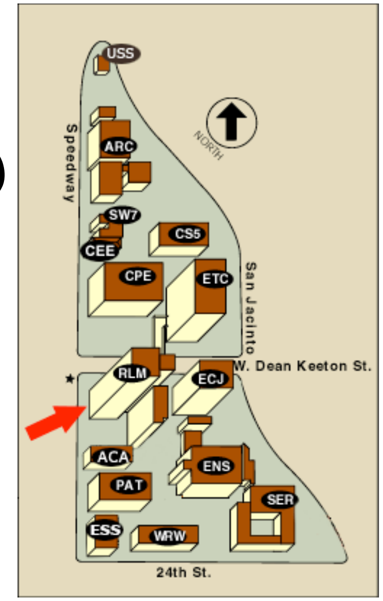
Wednesday, March 30, 2016



Exam 3, Skywatch 3, Friday, April 1 (no jokes on exam!!) Review sheet posted.

Review session Thursday, 4:30 PM, RLM 15.216B (Backup RLM 15.202A)

Wheeler available most afternoons (but best to make appt.)

Reading for Exam 3: Chapter 6, end of Section 6 (**binary evolution of Type Ia supernovae**), Section 6.7 (**light curves and radioactive decay**), Chapter 7 (SN 1987A). Background in Chapters 3, 4: Sections 3.1, 3.2, 3.3, 3.4, 3.5, 3.8, 3.10, 4.1, 4.2, 4.3, 4.4, 5.2, 5.4 (**binary stars and accretion disks**).

Astronomy in the news?

Extra credit on Exam 3 will come from topics that arose during the lectures on Exam 3 material.

Goals:

To understand how Einstein taught us to think about space, time, and gravity.

To understand what we mean by space.

To understand how space can be curved.

One Minute Exam

An intelligent ant crawls around on a surface, drawing triangles as the intersection of 3 straight lines. She finds that the sum of the interior angles is always more than 180 degrees and that triangles of the same size always give the same results. She deduces that the following will be true:

- ➡ If she draws two straight lines that are initially parallel they will begin to diverge.
- ⬅ The surface she is walking on is three-dimensional
- ⬆ If she walks off in a straight line she will never return to her point of origin
- ⬇ If she walks off in a straight line she will return to her point of origin

Goal:

To understand the nature of curved space, and hence of gravity, in the vicinity of a massive object, a planet, star, or black hole.

To understand the role of an “embedding diagram” in helping to explain that curved space.

Embedding diagram: Removes one dimension, but preserves key aspects of the geometry, curved or not, and how curved.

Real Space -> Embedding Diagram Space

Volume (3D) -> Surface (2D)

Surface (2D) -> Line (1D)

Line (1D) -> Point (0D)

Embedding diagrams allow us to visualize some aspects of the curvature of space from a higher dimensional “hyperspace” perspective.

Invert balloon - 2 D embedding diagram of curved 3 D space around gravitating object

Properties of this curved space that are preserved in the embedding diagram and are true in the original 3D space:

$C < 2\pi r$

Sum of angles of triangle not equal 180° (can be > or <)

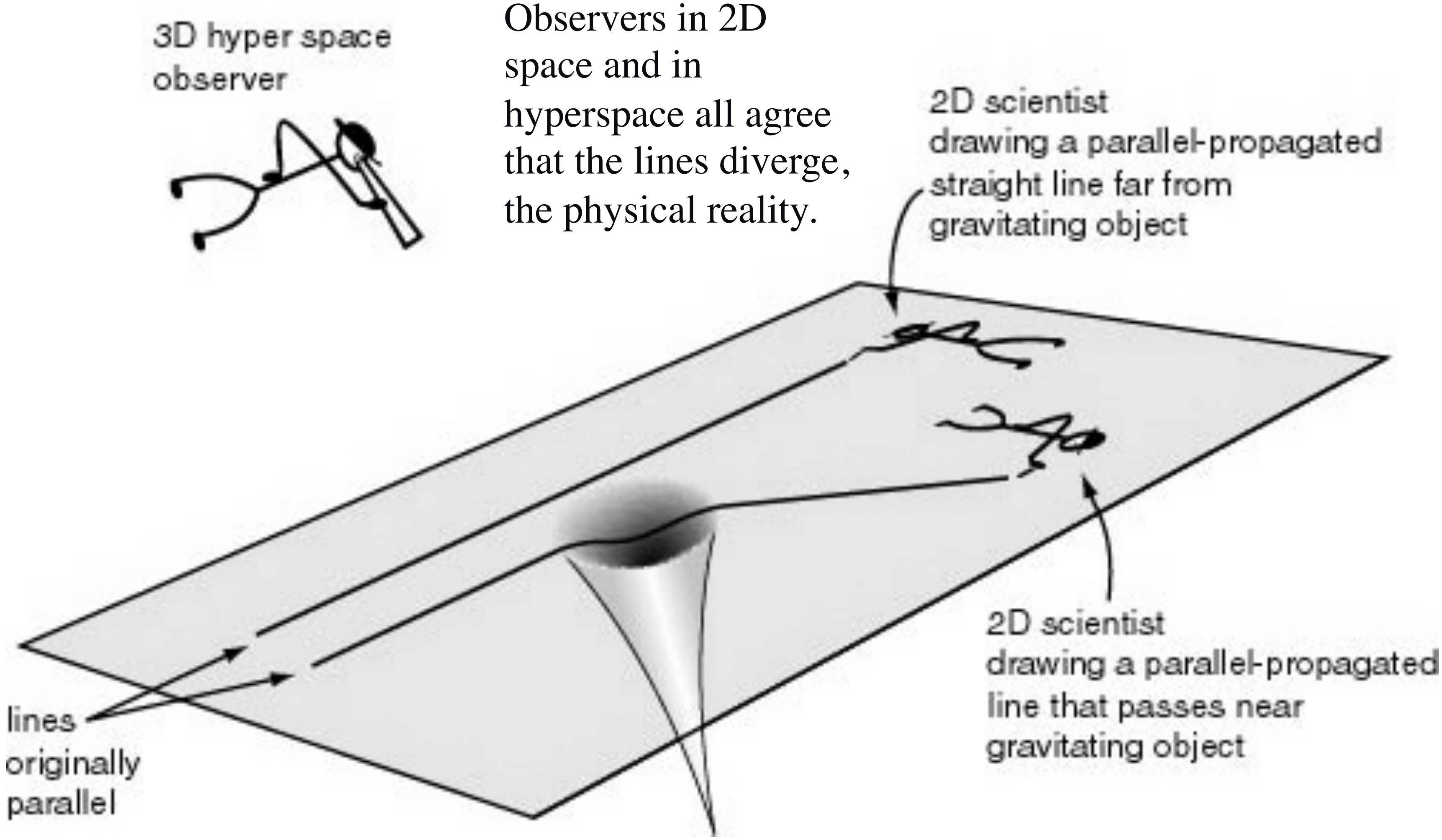
Parallel lines diverge or cross

Orbits around "cone"

Far from a gravitating object, the curvature and hence gravity, gets very weak, 3D space becomes FLAT, and the corresponding embedding diagram is a flat 2D plane (can't show this with the balloon).

Figure 9.4

Observers in 2D space and in hyperspace all agree that the lines diverge, the physical reality.



Straight lines in the 2D embedding diagram of curved, gravitating space.