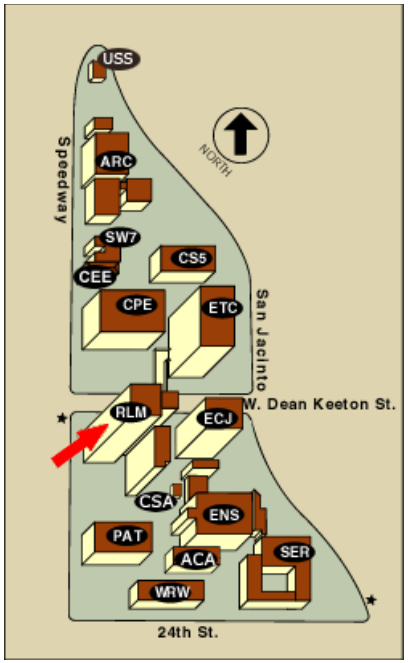
Wednesday, October 19, 2011

Exam 3 Friday. Review sheet posted.

Review tomorrow, 5 – 6 PM, RLM 4.102

Reading: Section 6.7, Chapter 7, Chapter 8 - Sections 8.1, 8.2, 8.5, 8.6, 8.10, Chapter 9 - Section 9.1 and parts of 9.5.1

Astronomy in the news? Conference in Florida supported by DARPA, NASA, 100-Year Starship Symposium



Pic of the day: Draconid meteors over Spain

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.

Can 3-dimensional space be “flat?”

Yes, it can be flat or curved, just as 2-dimensional space can.

3-dimensional space is regarded as flat if the result of doing geometry is the same as ordinary flat two dimensional space, the sum of interior angles of triangles is 180 degrees, parallel lines remain parallel.

If flat space geometry does not apply, the space is curved, or non-Euclidian.

Can 4-dimensional space be flat?

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 - 2 D "shadow" of 3 D curved space, preserves basic aspects of geometry, whether curved or not, and, if curved, how.

Meaning of ***flat space*** in 3 (or higher) dimensions

If 3 D space is flat: $C=2\pi r$; sum of angles of triangle $=180°$; parallel beams of light never cross ***in 3D***.

The embedding diagram of 3D flat space is a flat 2D plane

In curved 3D space, the flat space answers will be wrong: 2D embedding diagram will help to illustrate that.

Embedding diagram:

Real Space -> Embedding Diagram Space

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

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

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

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:

$C < 2\pi r$

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

Parallel lines diverge or cross

Orbits around “cone”