March 28, 2011

Exam 3 this Friday. Review Sheet posted.

Review session Thursday, 5 PM, Room WRW 102

Reading: Chapter 7, Chapter 8 - Sections 8.1, 8.2, 8.5, 8.6, 8.10, Chapter 9 – Sections 9.1 – 9.5.1

Sky watch, Flatland, due Friday

Astronomy in the news?

Pic of the day: Time-lapse video of Norweigian aurorae, steller winds and magnetic fields in action



To understand what Einstein means by an orbit.

Orbit - circle around "cone"

Moon is going as straight as it can in curved space around the Earth

This is how gravity works for Einstein - no Newtonian Force -

Gravitating objects curve the space around them - nearby objects move in that curved space

The parallel-propagated straight lines of their force-free motion are warped by the curved space.



Orbits in curved 2D embedding diagram of gravitating space

One Minute Exam

In the corresponding two-dimensional embedding diagram, the interior volume of a real, three-dimensional planet would be represented as:

A point



One Minute Exam

In a two-dimensional embedding diagram of the Earth, the surface of the Earth would be represented by:

A volume
A surface
A line
A point

One Minute Exam

An astronomer fires two laser beams so they will pass near a distant black hole. The beams are initially parallel. An astronaut on the far side of the black hole tracks the two beams and finds that they are diverging, but that they never crossed. This means that:



the beams passed on opposite sides of the black hole

the beams passed on the same side of the black hole

one of the beams had more energy than the other

To understand the "real" curved space of a gravitating object in three dimensions

3 D gravitating space is not a "cone;" that is just an artifact of the 2 D embedding diagram.

Real 3 D space around gravitating objects has the properties:

 $C < 2\pi R$

 Δ not equal 180°

// lines cross or diverge

light is deflected (this one has been experimentally verified)



To understand the basic features of a black hole



Basic properties of a (non-rotating) black hole

In Einstein's theory of gravity, black holes are predicted to have an *event horizon* and a *singularity*

Event horizon: the surface within which nothing travelling at or less than the speed of light can get out.

=> No event within the event horizon can be witnessed from outside

Singularity: Finite mass, zero radius, zero volume

=> infinite density, infinite tidal forces, the end of space and time.

To understand what it is like to die falling into a black hole.



Tidal Forces