Thursday, October 29, 2009

Wheeler away next Tuesday - meeting with NASA officials, Nova movie on black holes. Extract from Simpson's episode. Very cute, but some conceptual problems. What are they?

Astronomy in the News? Sunyaev's talk on Tuesday: Cosmic background radiation from the Big Bang was discovered in 1965, Sunyaev and colleagues had worked out all the implications for which it took technology 30 years to catch up.

Pic of the Day - Zodiacal light, dust in plane of solar system, and Milky way, stars in plane of our Galaxy.



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° (can be > or <)

Parallel lines diverge or cross

Orbits around "cone"

Figure 9.4



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

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.

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



Orbits in curved 2D embedding diagram of gravitating space

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:

- one of the beams entered the black hole
- 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

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



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

light is deflected (this one has been experimentally verified)





Basic properties of a (non-rotating) black hole