Thursday, November 5, 2009

Astronomy in the News? October 28, NASA launched test rocket for new lift capacity - Ares.

Wheeler - successful meeting with Lori Garver, second in command at NASA, to make the case for support of astrophysics by NASA.



Pic of the Day - Halloween Moon



Homer Simpson episode, conceptual problems.

What are they?



Basic properties of a (non-rotating) black hole



Tidal Forces



2D embedding diagram of 3D curved space around a black hole

Black holes and Time (Section 5.2)

If a clock moves away from an observer it ticks more slowly.

If a clock is deep in a gravity well it ticks more slowly according to an observer at large distance where gravity is absent.

Get both effects if you drop a "clock" into a black hole and watch it fall in from a safe distance where gravity is weak (flat 3D space).

What does it mean to fall? Rather deep and strange phenomenon! Drop things, fall at same rate...

Falling According to Einstein

According to Einstein - curved space around gravitating objects "flows" inward - *inward escalator*.

If an object floats with *no force* in space (free fall), it will move toward the center of gravitation

⇒ falling - all objects respond to the same curvature, have the same acceleration

Like water down a drain - sit still in the water, but go down the drain.

Must exert a force to resist, to avoid free fall, to avoid the flow of space inward toward the center of the gravitating object.



Volunteer finds herself rapidly falling through event horizon, noodleized, dies

Distant observer sees Doppler and gravitational redshifts Received photons get longer, longer wavelength Time between photons gets longer and longer *Infinite time* for last photon emitted just as volunteer reaches the event

horizon; space is moving inward at the speed of light compared to distant observer

⇒Distant observer never sees volunteer cross the horizon ⇒Photons get undetectable, very long wavelength, most of the time is between photons - absolutely black - why black holes are black. One Minute Exam

From the point of view of a distant observer, a volunteer who falls into a black hole



Will be noodleized and die

• Will turn black before arriving at the event horizon

Will age more rapidly

Will shrink to a point



Singularity - all the mass is in a zero volume point in Einstein's theory.

Violates the Uncertainty Principle of Quantum Theory: cannot specify the position of anything exactly.

Need theory of *Quantum Gravity* to rectify, to understand what the "singularity" really is. **Deepest issue in modern physics**.