Friday, November 1, 2013

Grades, Key posted. Check all is okay.

Reading: Chapter 9: all except 9.6.3, 9.6.4

Wheeler at meeting in Washington D. C. on Monday. 2008 film from History Channel, Supernovas. Brief appearances by JCW and Robert Quimby.

Astronomy in the news?

Results from new experiment to detect “dark matter” in Homestake Gold Mine in Lead, S. D. to shield from cosmic rays. Large Underground Xenon (LUX) experiment saw nothing, but that already rules out classes of low mass WIMPS (weakly interacting massive particles; like neutrinos, but more massive). Cannot have mass of proton, might still have mass of hundreds times that of protons.

Goal:

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:

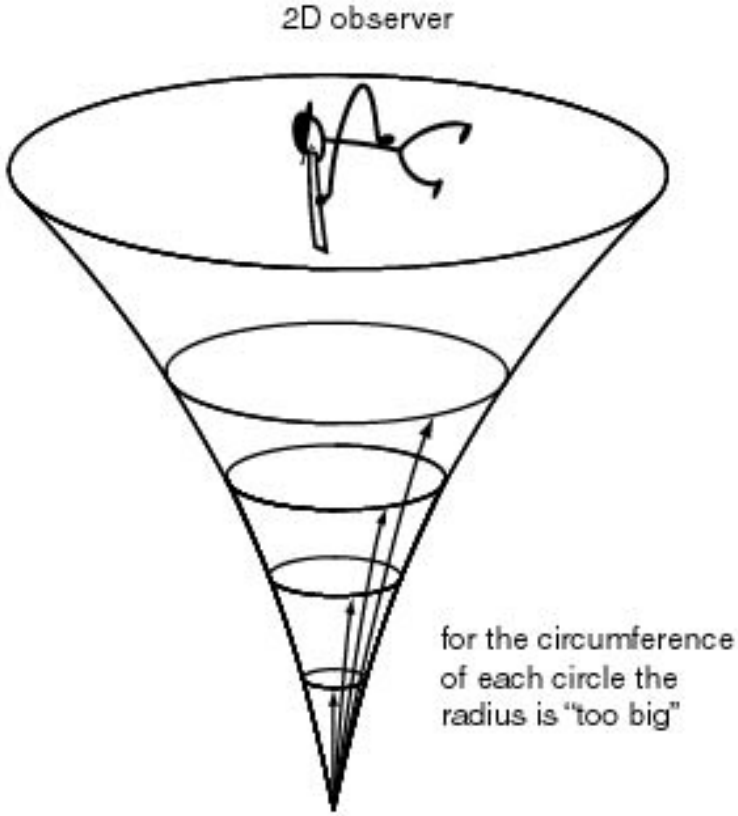
$C < 2\pi R$

Δ not equal 180^{o}

// lines cross or diverge

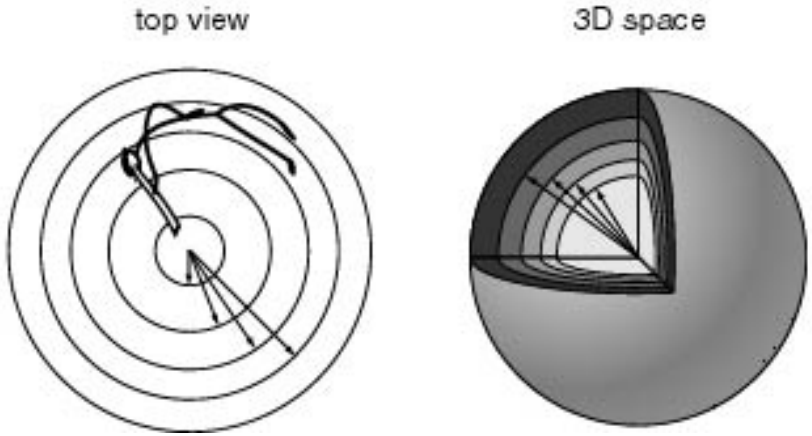
light is deflected (this one has been experimentally verified)

Fig 9.6



Curved 3D space

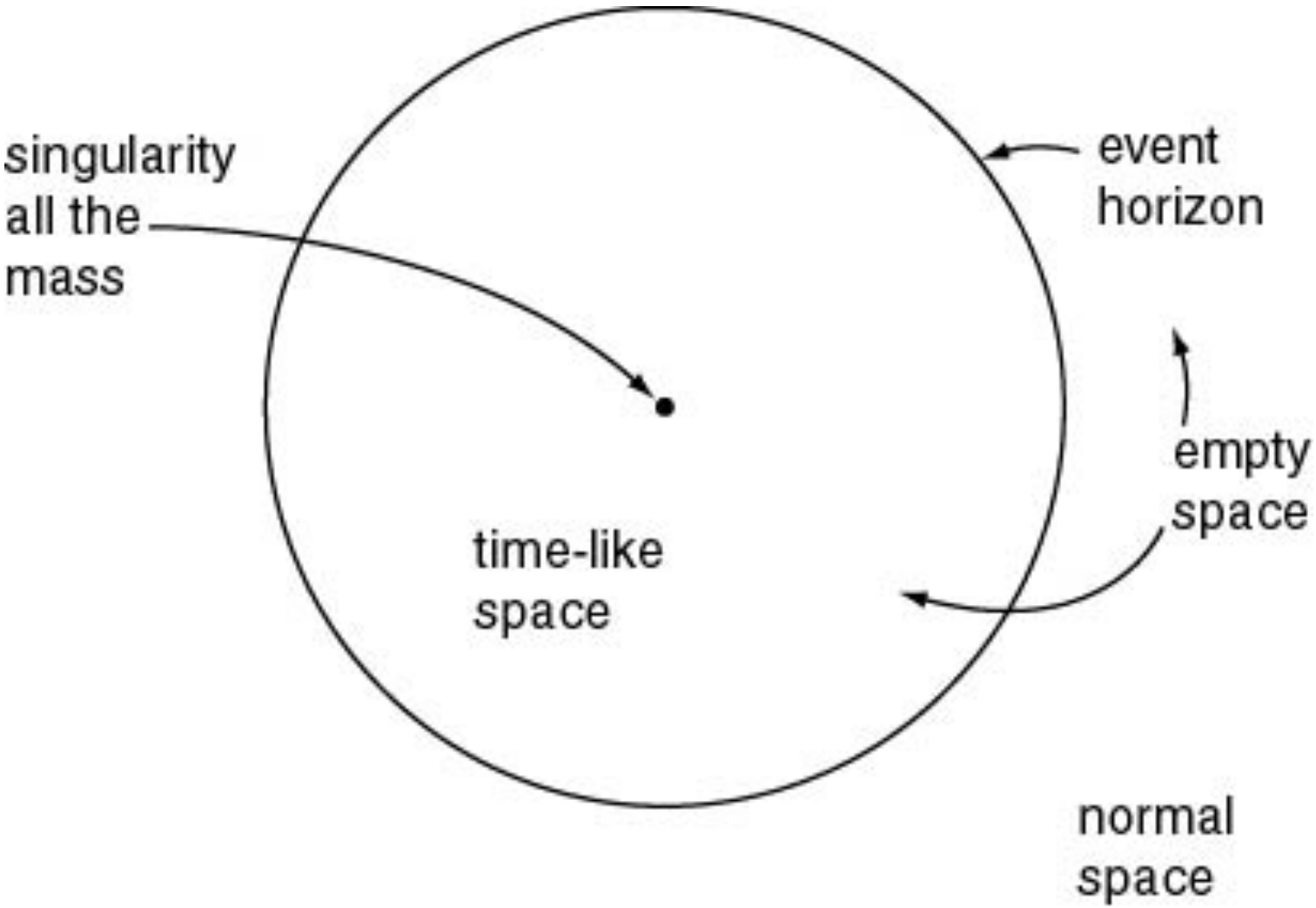
space around a black hole: each inner surface has a smaller circumference and area, but for each the radius is "too big"



Goal:

To understand the basic features of a black hole

Figure 9.1



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

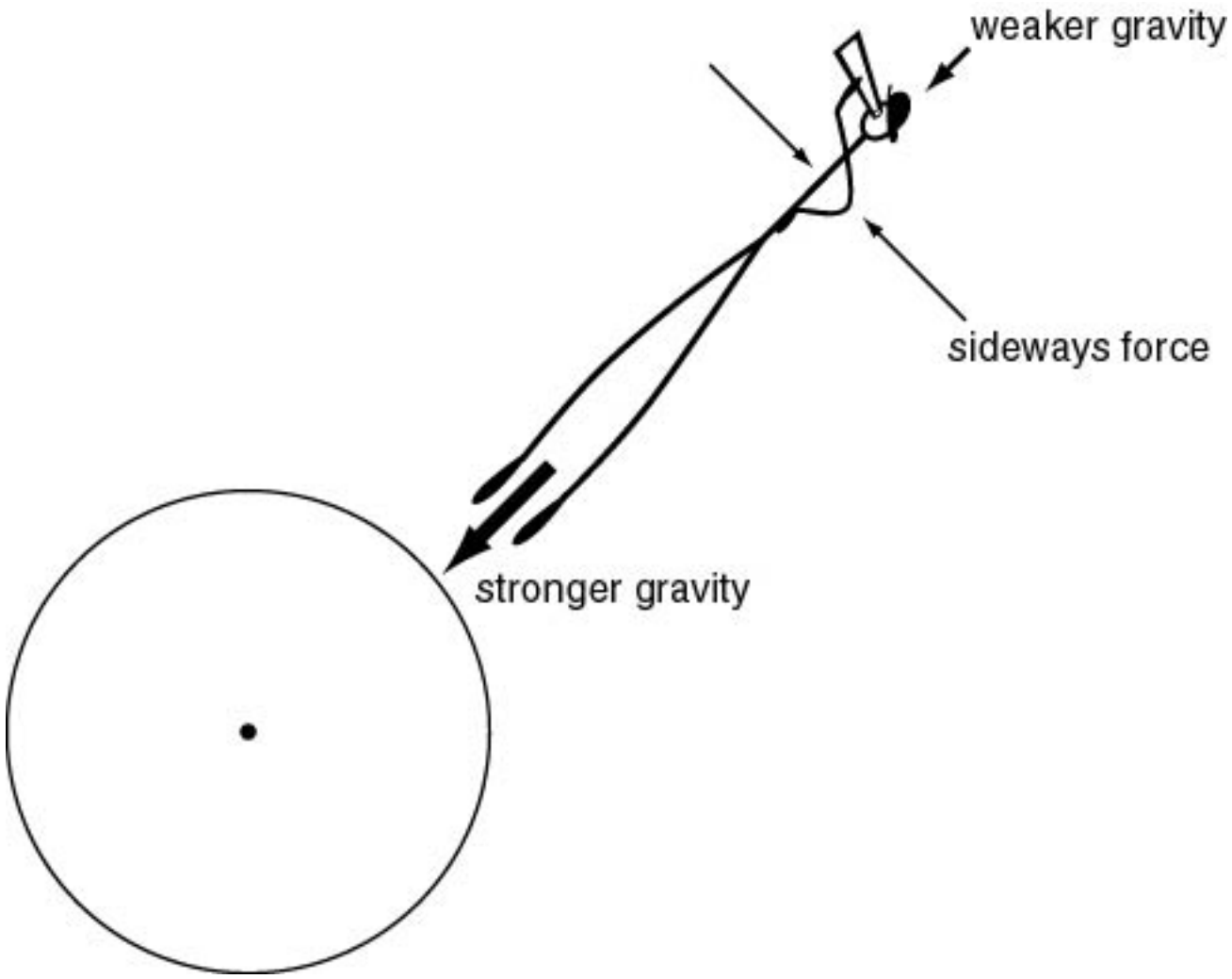
Singularity: Finite mass, zero radius, zero volume

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

Goal:

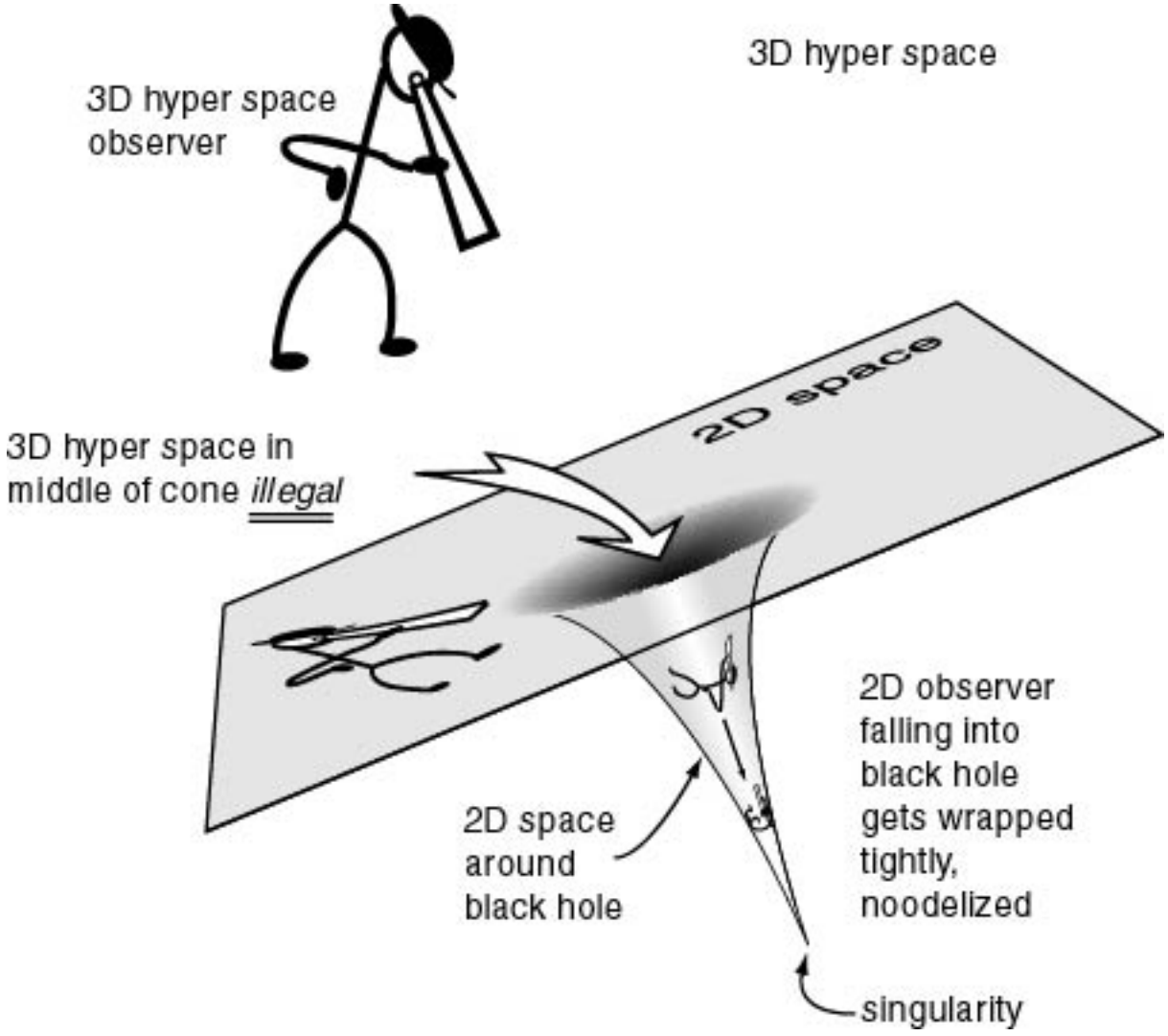
To understand what it is like to die falling into a black hole.

Figure 9.2



Tidal Forces

Figure 9.3



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

Goal:

To understand how time works in curved space and near black holes.

Black holes and Time (Section 9.5.2)

What does it mean to fall? Rather deep and strange phenomenon!

Drop things, fall at same rate…

Falling involves the passage through time as well as space.

Falling According to Einstein

According to Einstein - curved space around gravitating objects "flows" inward - ***inward escalator.*** Necessary to truly understand orbits.

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

$\Rightarrow$ 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.

Freely falling object has no force on it. You, sitting there, do.