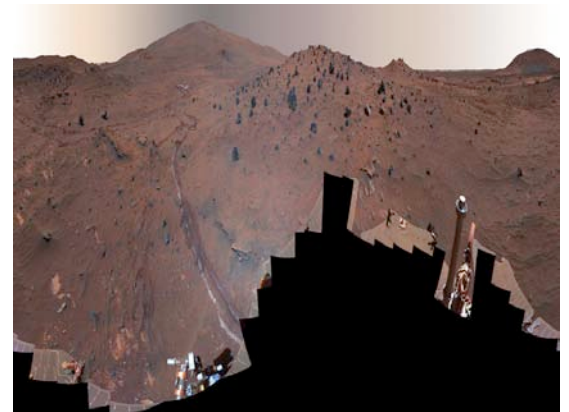11/1/06

Reading- Chapter 9 sections 1 - 5

News? Hubble Lives!

Pic of the day - view from Mars rover Spirit

Invert balloon - 2 D embedding diagram of curved 3 D space around
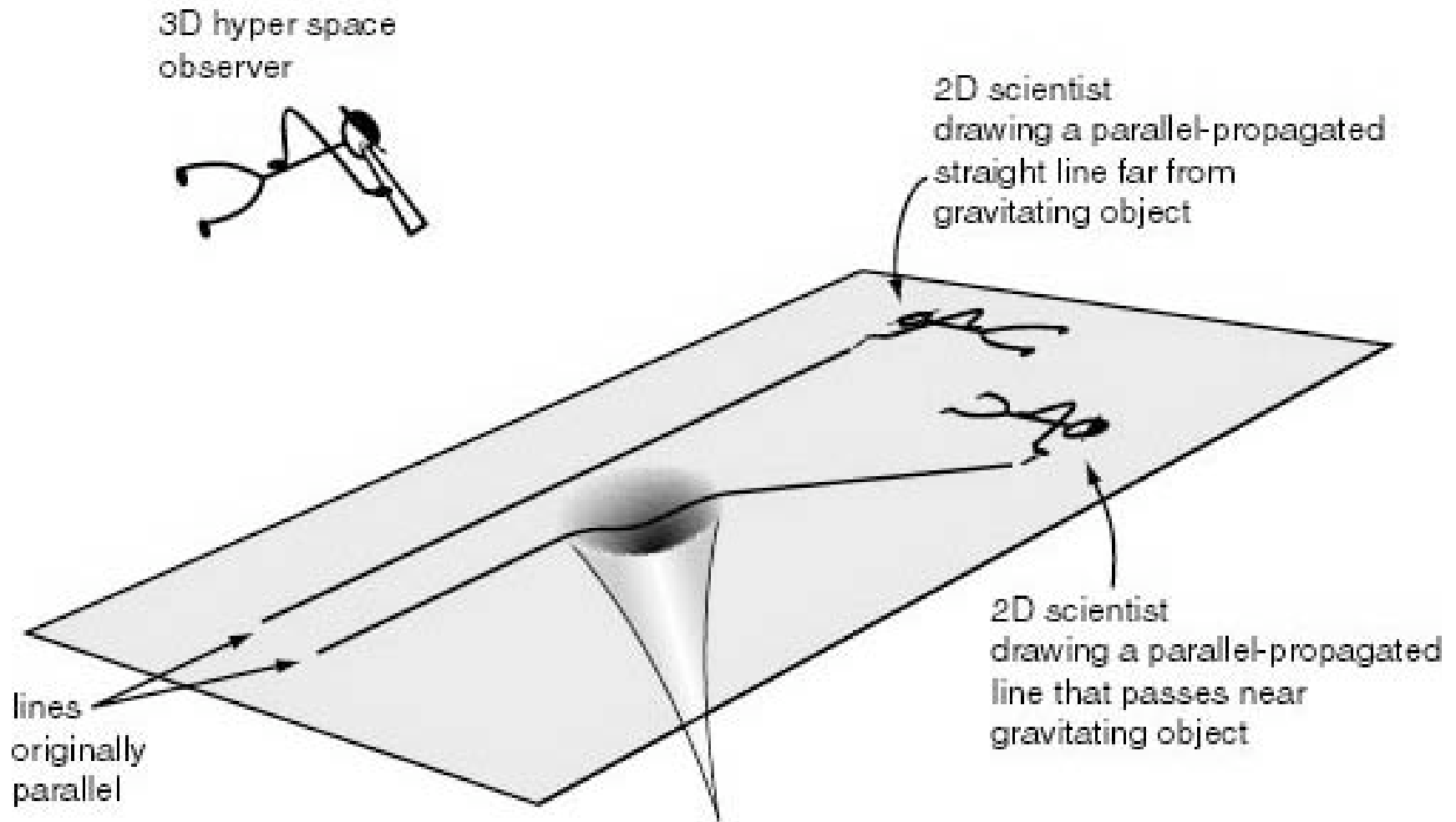   gravitating object

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

Figure 9.4

3D hyper space observer

2D scientist drawing a parallel-propagated straight line far from gravitating object

lines originally parallel

2D scientist drawing a parallel-propagated line that passes near gravitating object

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.
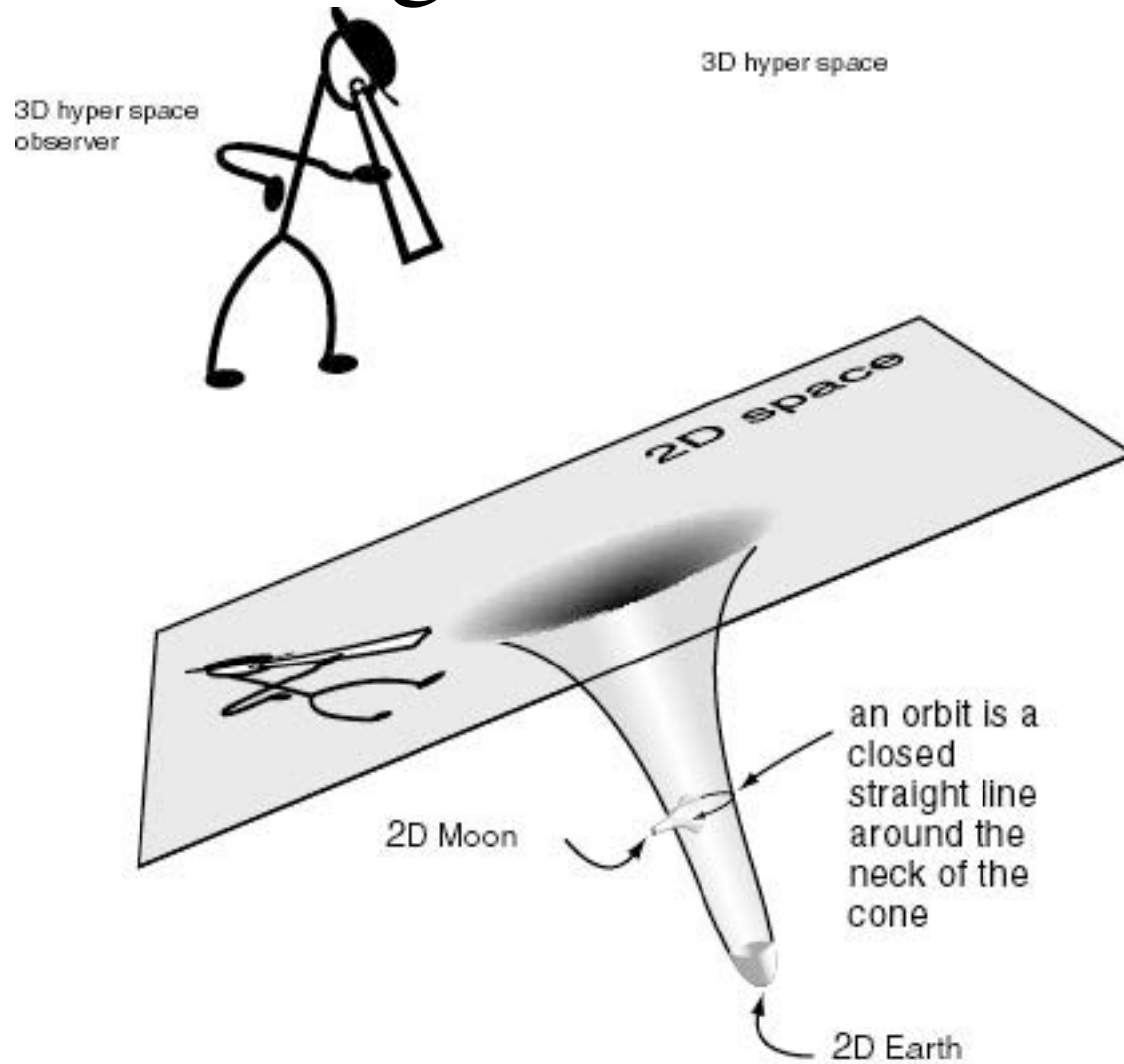
Embedding diagram:

Real Space   -> Embedding Diagram Space

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

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

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

Figure 9.5

Orbits in curved 2D embedding diagram of gravitating space

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

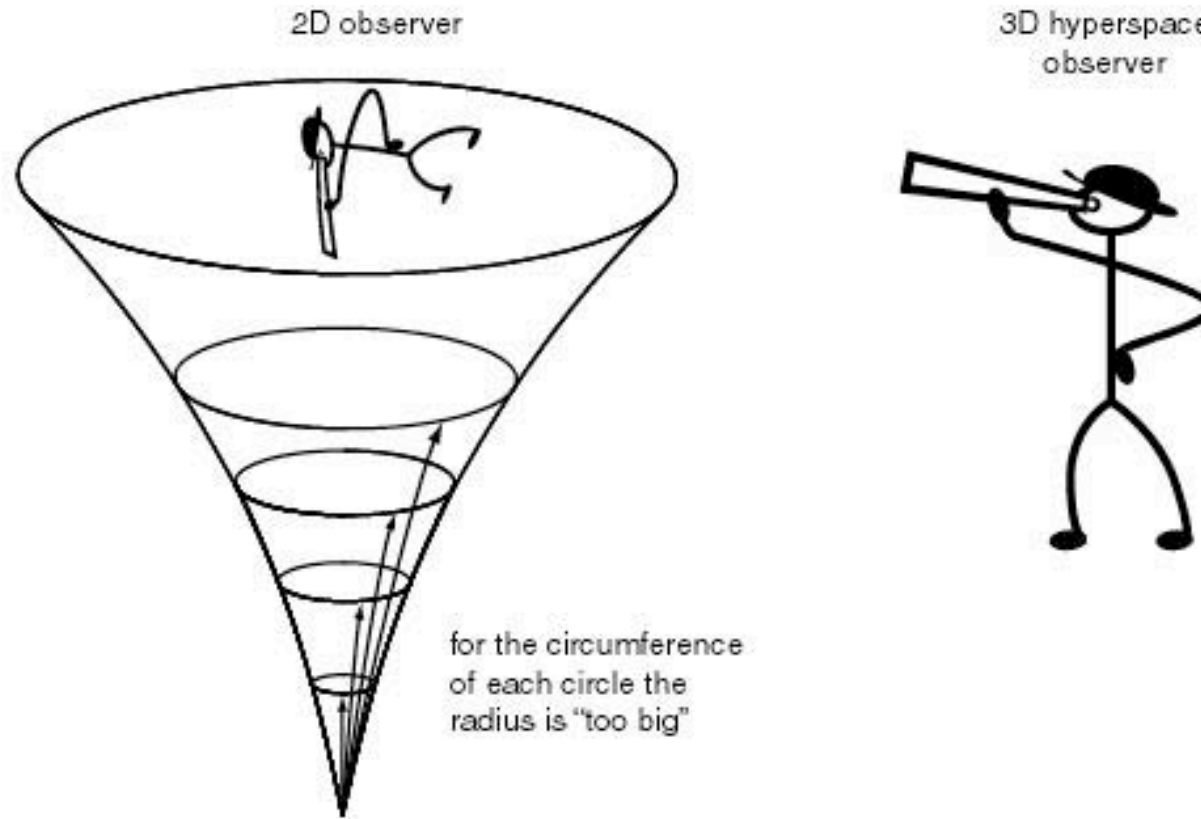Real 3 D space around gravitating objects has the properties:

$C < 2\pi R$

Δ not equal 180º

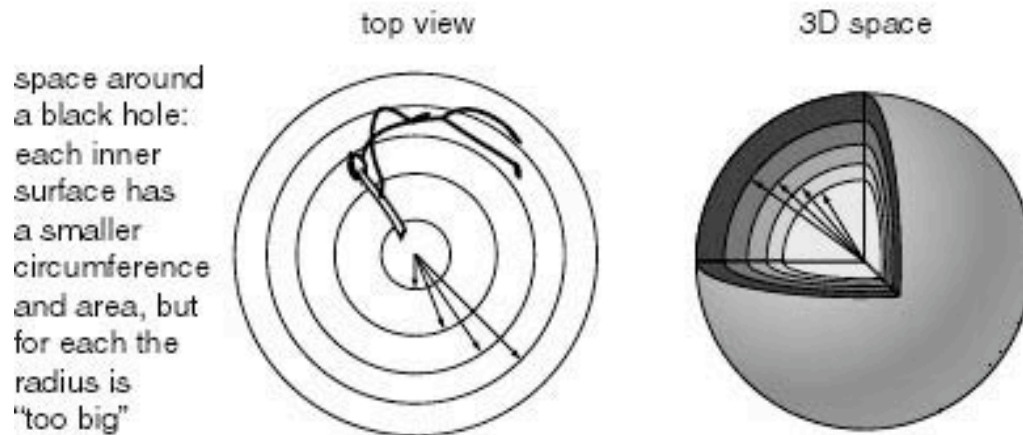// lines cross

light is deflected (this one has been experimentally verified)

Fig 9.6

Curved 3D space

2D observer

3D hyperspace observer

for the circumference of each circle the radius is "too big"

top view

3D space

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

One Minute Exam

Compared to the two-dimensional surface of a balloon, the
   inside is:

A) A two-dimensional hyperspace

B) A three-dimensional hyperspace

C) A four-dimensional hyperspace

D) Accessible to a two-dimensional creature