3/19/08

Class this Friday unless the University formally cancels classes.

Current Reading: Chapter 9 (omit 9.6.3, 9.6.4)

Astronomy in the News -

Pic of the day - new shot of Mercury

Embedding diagram - 2 D "shadow" of 3 D curved space, preserves basic aspects of geometry, whether curved or not, and, if curved, how.

Meaning of ***flat space*** in 3 (or higher) dimensions

If 3 D space is flat: $C=2\pi r$; sum of angles of triangle $=180°$; parallel beams of light never cross ***in 3D***.

The embedding diagram of 3D flat space is a flat 2D plane

In curved 3D space, the flat space answers will be wrong: 2D embedding diagram will help to illustrate that.

One Minute Exam

In a curved space

A) Straight lines always connect to themselves

B) Straight lines are the shortest distance between two points

C) There are no straight lines

D) The sum of the interior angles of a triangle is 180 degrees

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^o (can be > or <)

Parallel lines diverge or cross

Embedding diagram:

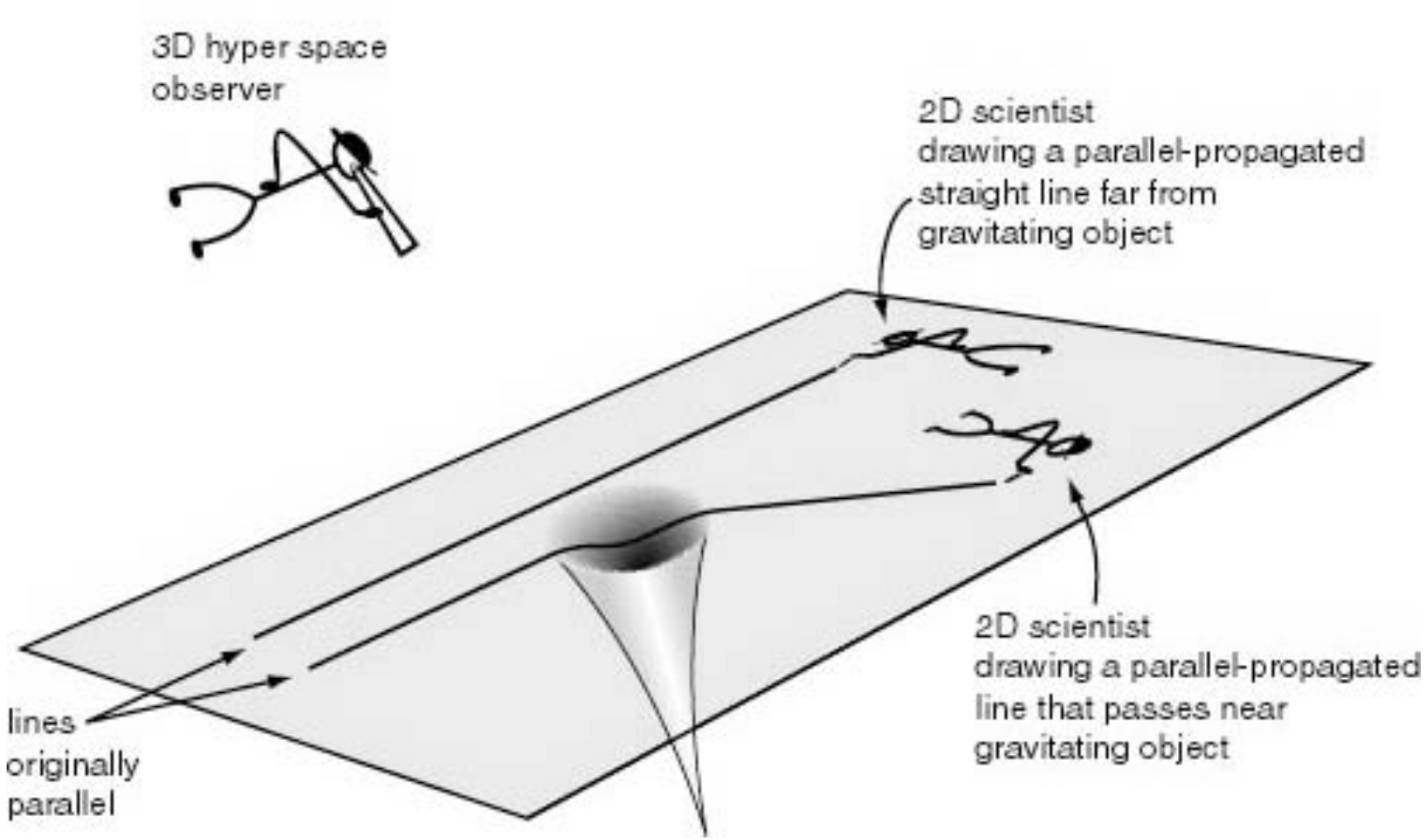
Real Space -> Embedding Diagram Space

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

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

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

Figure 9.4



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

Orbit - circle around “cone”

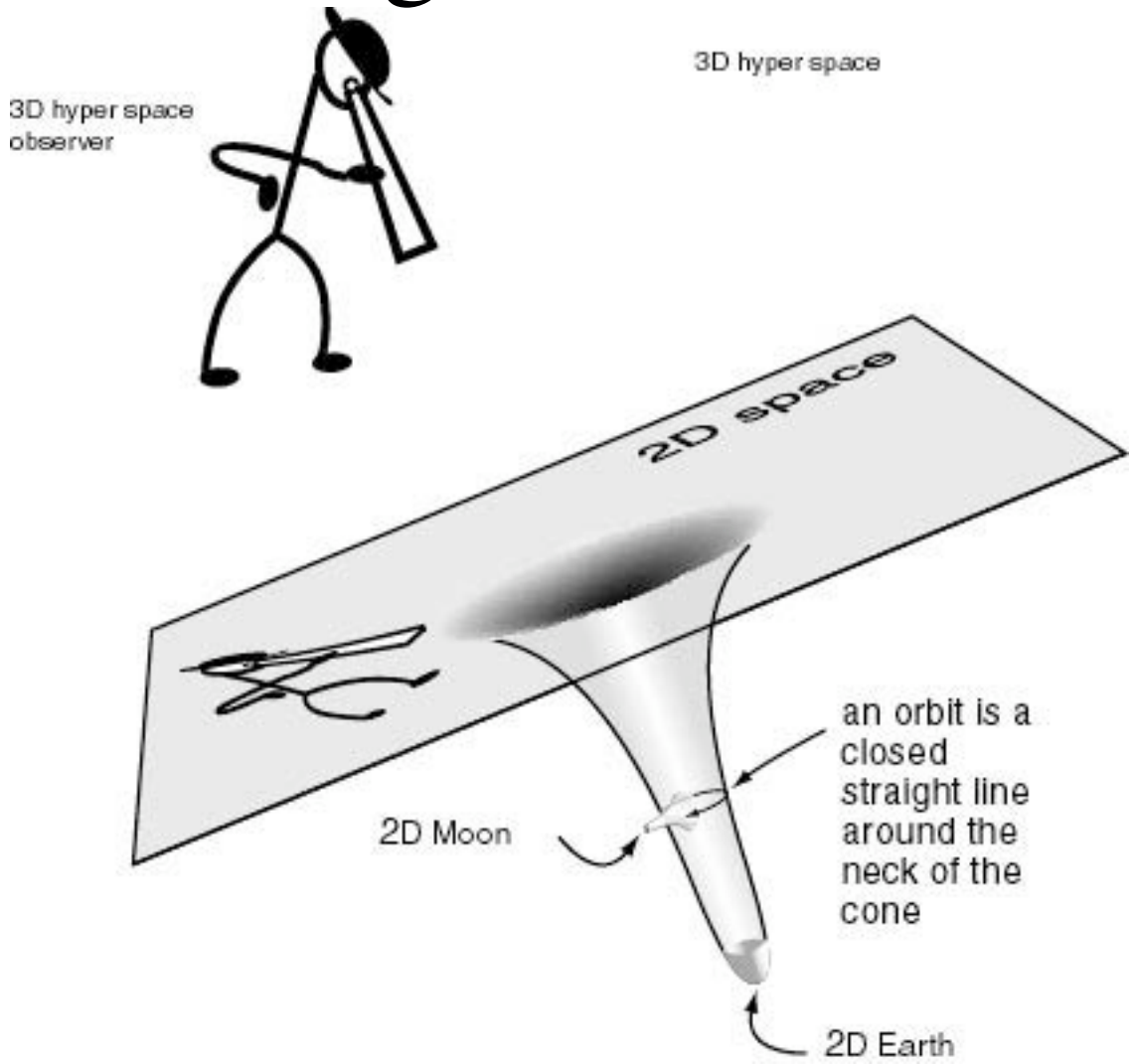
Moon is going as straight as it can in curved space around the Earth

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.

Figure 9.5



Orbits in curved 2D embedding diagram of gravitating space

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