Wednesday, October 23, 2013

Third exam, Friday.

Third sky watch. Clear skies for a couple of days.

Review sheet posted.

Review Session Thursday, 5 – 6 PM, ***Room WEL 2.256***: ***Note different room***

Reading: Chapter 6, Section 6.7, Chapter 7, Superluminous Supernovae not in book, Chapter 8 - Sections 8.1, 8.2, 8.5, 8.6, 8.10

Astronomy in the news?

New Topic: Black Holes

Chapter 9

Reading, Chapter 9: all except 9.6.3, 9.6.4

Goal:

To understand the historical roots and basic theoretical concepts behind black holes and the huge conceptual differences between Newton's and Einstein's view of gravity.

Black Holes

Mitchell, Laplace, late 18th Century: with Newton's Gravity
could have bodies with **escape velocity** greater than the speed of light
=> light could not get out, completely dark, *corps obscurs*.

Now know Newton was wrong.

Excellent approximation for weak gravity - "true" in that case

Conceptual problems $F = \frac{G M_1 M_2}{r^2}$

infinite force for zero separation (in physics infinity ⇒ problem)
instantaneous reaction => infinite speed of gravity

Experiment – Newton's theory predicts the wrong deflection of light.

Need Einstein and more!

Great conceptual differences between Newton and Einstein on the Nature of Gravity

Newton - Force between two objects

Einstein - Mass curves space, objects move *with no force* in curved space

Need to explore curved space - use geometry in multiple dimensions

Goals:

To understand how Einstein taught us to think about space, time, and gravity.

To understand what we mean by space.

To understand how space can be curved.

SPACE - *The Final Frontier*

Dimensions - defined by the number of mutually perpendicular directions

0 D - point

1 D - line

2 D - area

3 D - volume (secret hand sign)

4 D - ?

Hyperspace - space with more dimensions than the one under consideration

Gravity

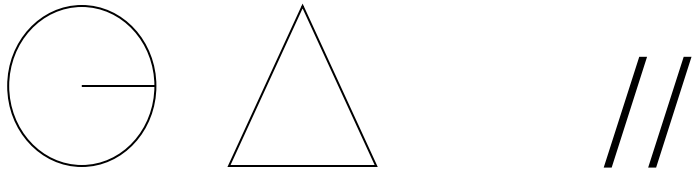
Still a deep mystery. Objects of different mass fall with the same acceleration.

Explore how Einstein taught us to think about gravity: no f*orce of gravity*, but the effect of ***curved space***.

Explore the geometry of space with straight lines.

Straight line on a curved surface, possible or an oxymoron?

Euclidian - Flat Space Geometry



$C=2\pi r$ $\sum=180°$ never cross

Answers only good in ***flat space***: operational definition of flat space
NOT necessarily two-dimensional!

Non-Euclidian geometry - curved space

Both flat space and curved space use concept of “straight line”

Curved Space - explore with straight lines

Definition of straight line

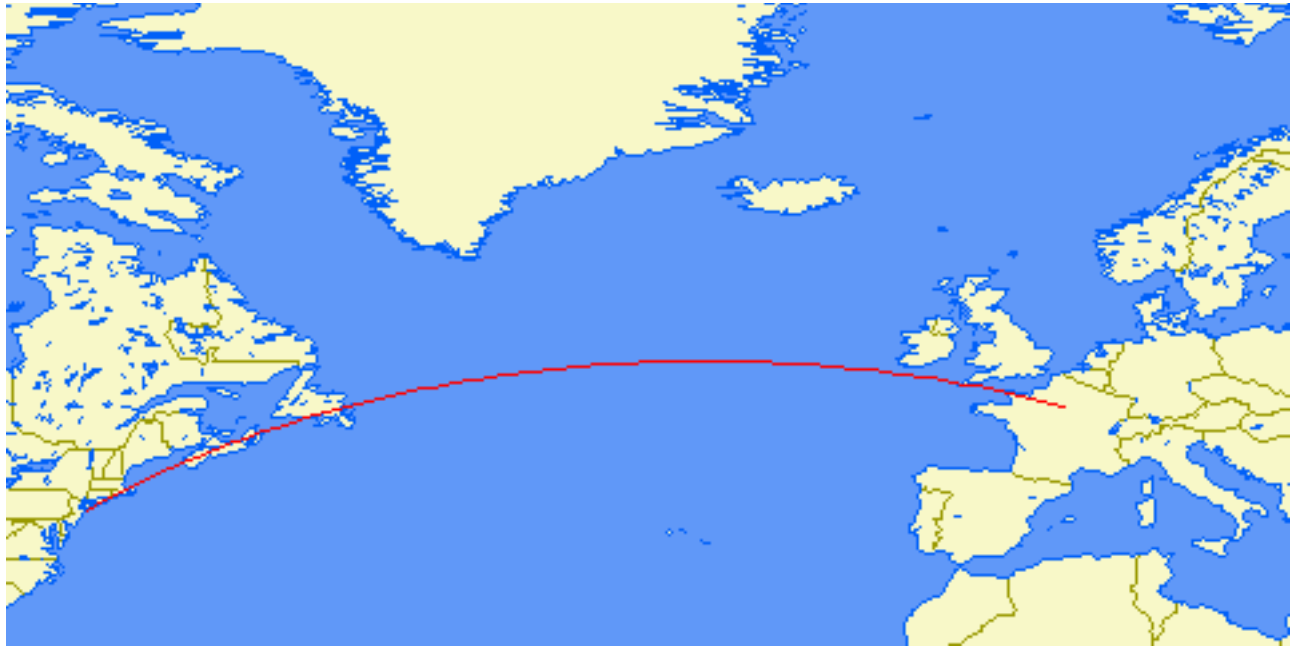
Shortest distance between 2 points - rubber band

Draw a free hand straight line

Parallel propagation - rulers

Parallel propagation will give the shortest distance between two points without necessarily knowing where the two points are in advance.

Parallel propagation works easily, even when the space is *curved*.



Route from JFK airport to Paris Orly.

Is this a straight line?