

10/15/04

Exam - histogram - come see me if you want help

Reminder - extra credit for observing project

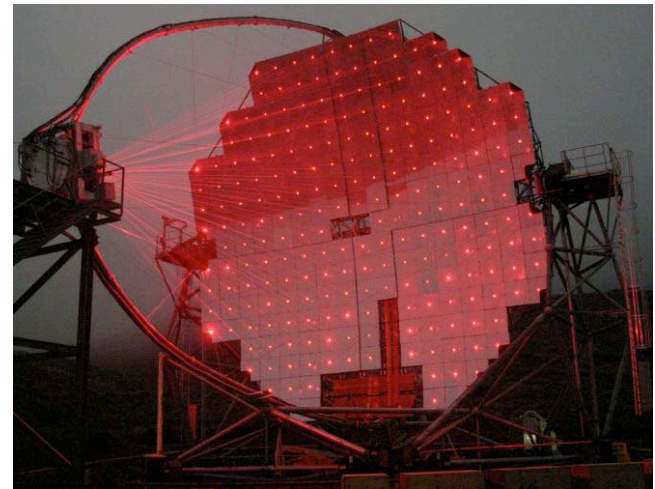
News?

Astronomical significance of today?

Beginning of Ramadan  
9th month of Muslim  
calendar -new crescent  
moon

Pic of the day

Gamma-ray telescope



# New Topic: Black Holes

Chapters 9, 10

What do you know about them -- What did you learn?

Black Hole Comic

Film - The Krone Experiment:

Comments, Questions?

What was the premise?

# Black Holes

Mitchell, Laplace, late 18th Century: with Newton's Gravity  
could have 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 - wrong deflection of light

Need Einstein and more!

## *Great conceptual differences between Newton and Einstein*

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

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

4 D - ?