# Physics 100 - April 16, 2007

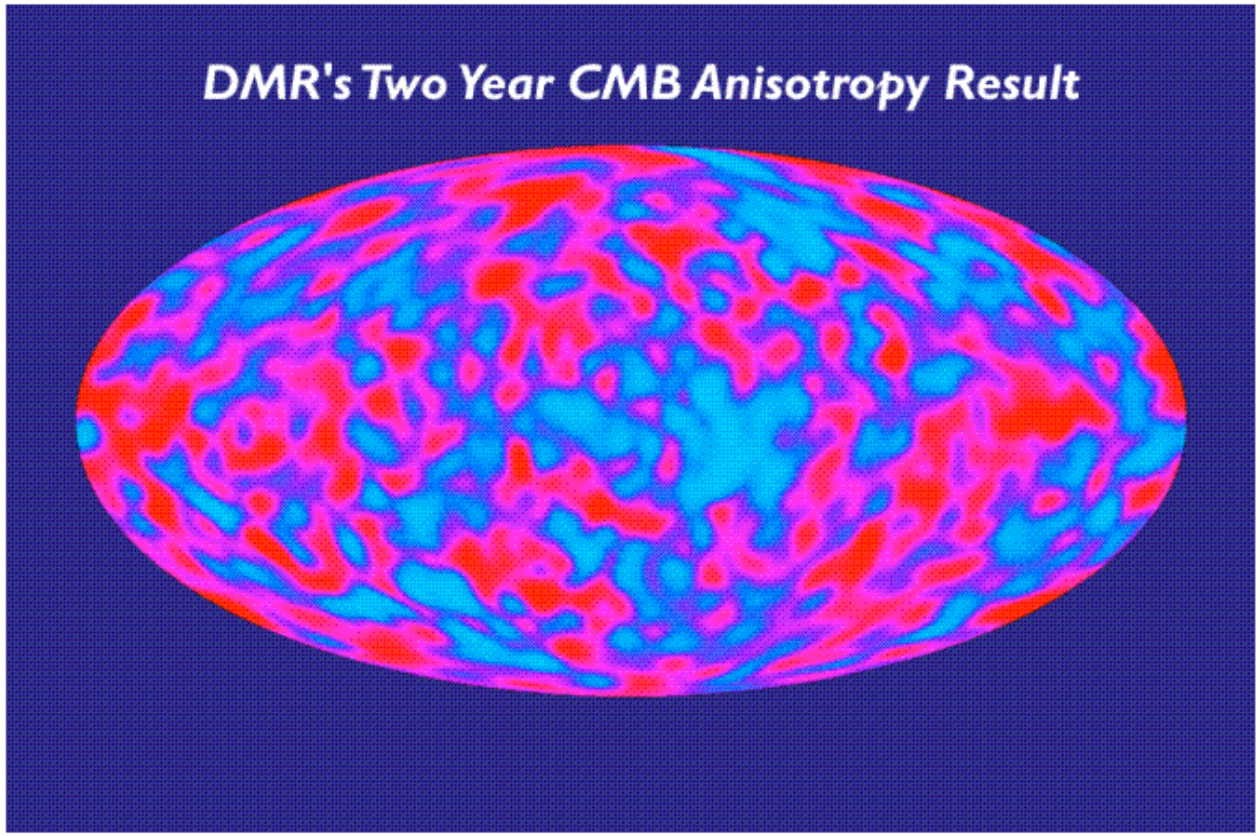
Presentations

April 16: 17-solar system formation
April 18: ~~2-nuclear bombs~~, 6-GPS, 27-football
April 23: 24A-Feynman, 21-nuclear terrorism
April 25: 18-SETI, 26-music
April 30: 25-comets/mass extinctions, 24-Galileo
May 2: 14 String Theory, 2-nuclear bombs
~~If one of the April 18 groups wants to switch to May 2, let me know ASAP.~~

Let me know if issues/problems

Exam 2 - Aiming for Monday — didn't quite happen today

But ... Big Bang CMB cannot be completely uniform because we have galaxies, galactic clusters, etc.



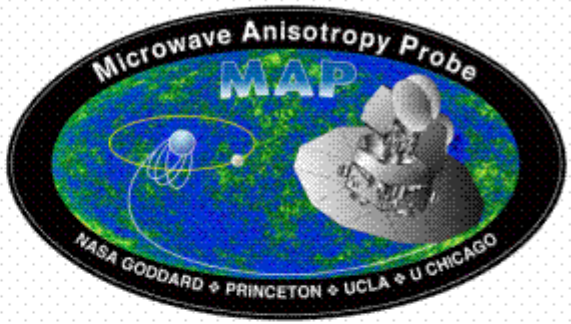

CMB "color" or Temperature seen to vary by 1 part in 100,000

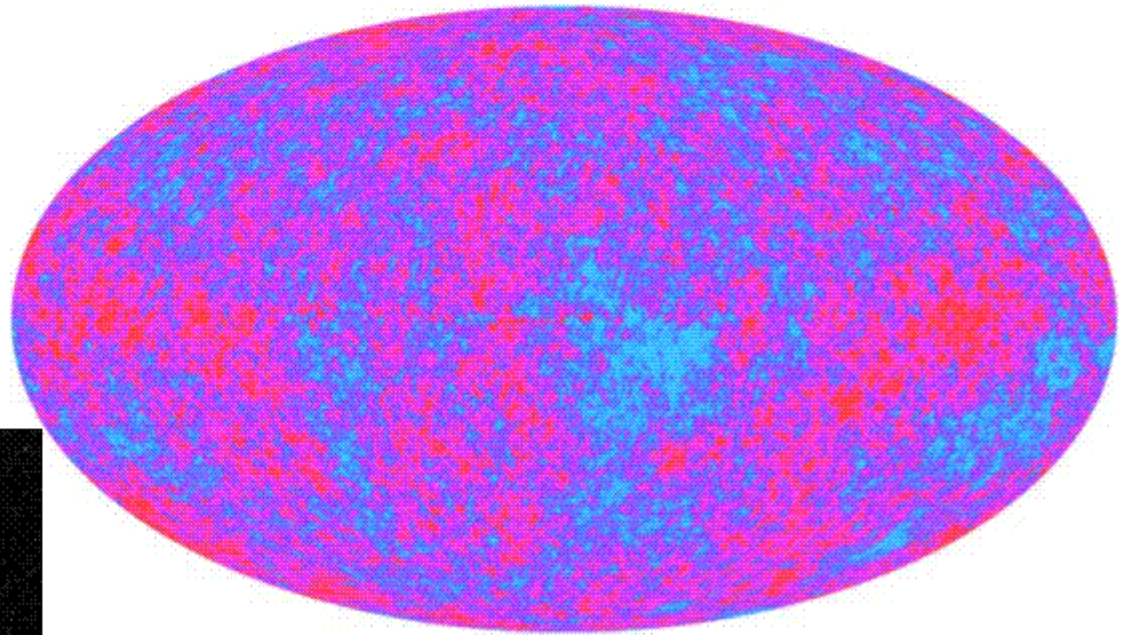
1992 COBE Satellite observation of CMB over all Sky

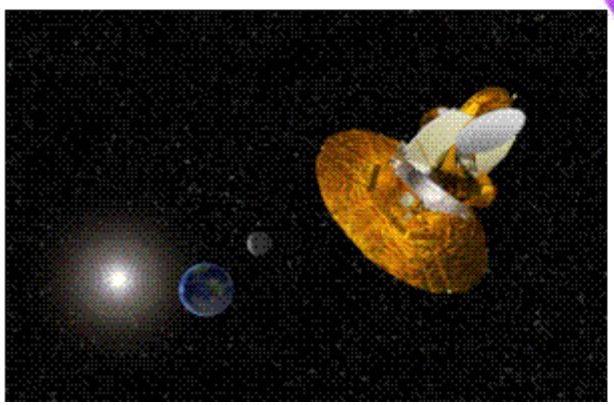
Cosmic Background Explorer

# WMAP - Wilkinson Microwave Anisotropy Probe

(2003 High Resolution Study of CMB



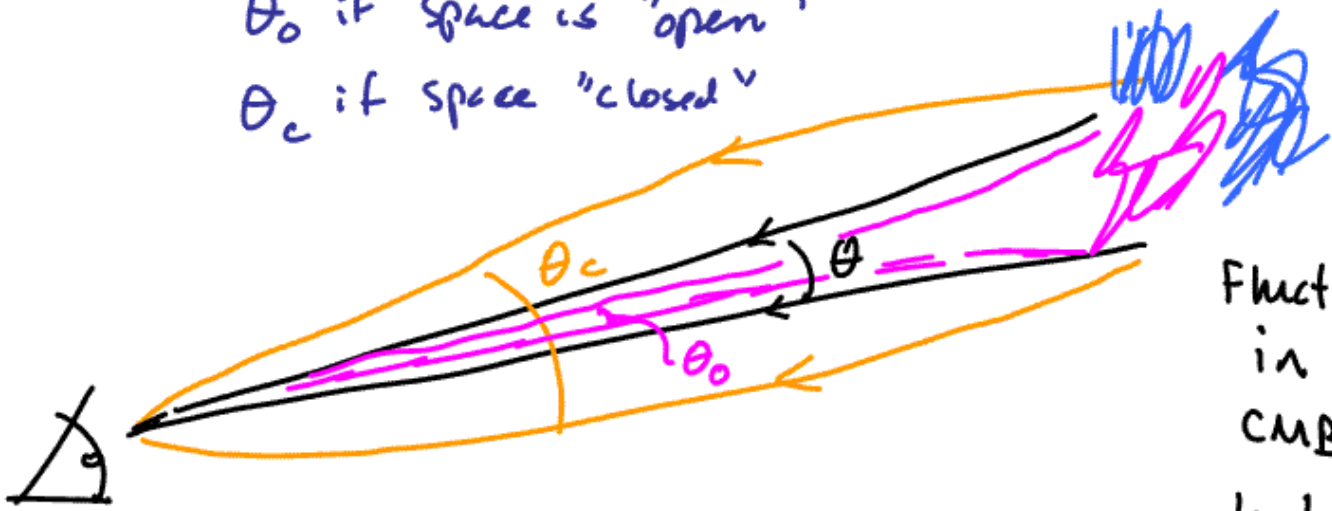





Measure $\theta_f$ if space is flat

$\theta_o$ if space is "open"

$\theta_c$ if space "closed"



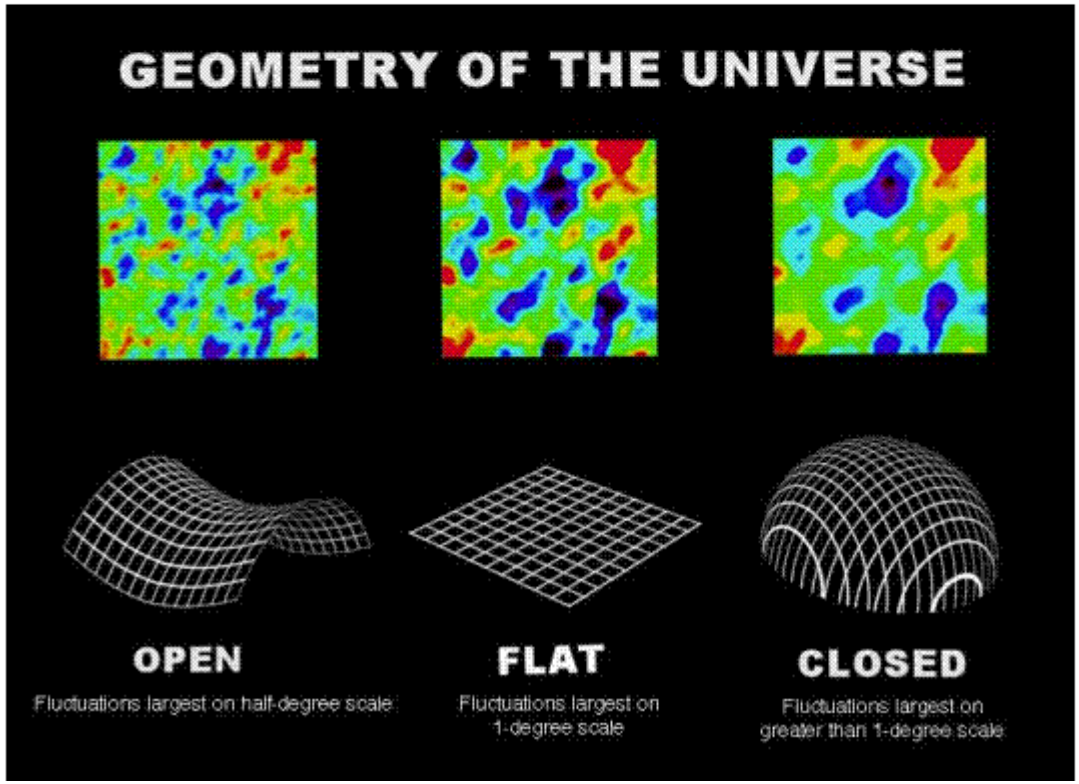

Fluctuations in CMB - light comes to us from DISTANCE of (Age of universe - 100,000) light years

Look at Angular Size of fluctuations in CMB

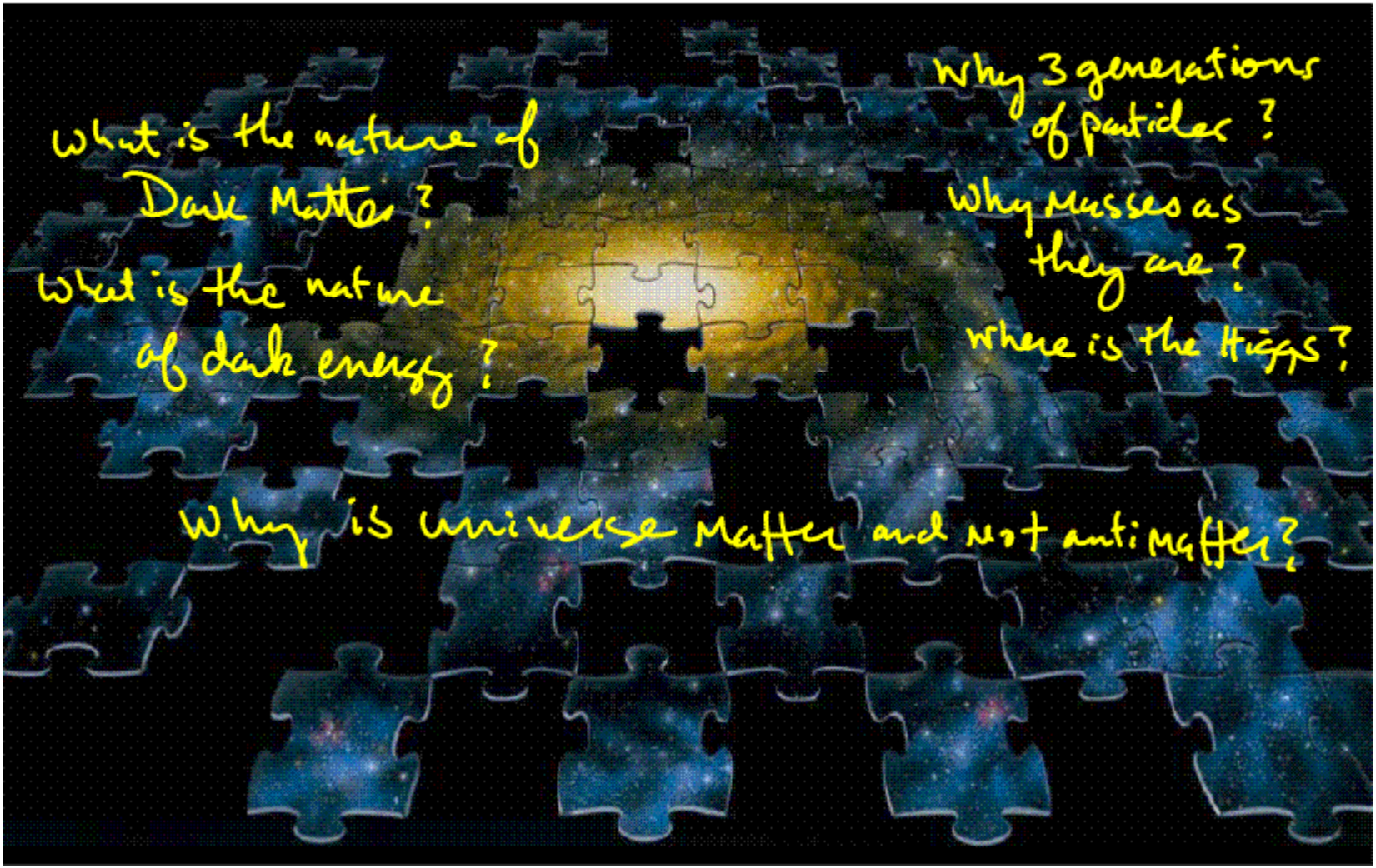
PATH light takes depends on geometry of universe. We measure different Angular Sizes depending on geometry of space between

Play WMAP Movies

Size of fluctuations/structure in the CMB is sensitive to the geometry of the universe



# Still ... many missing pieces



# Dark Matter

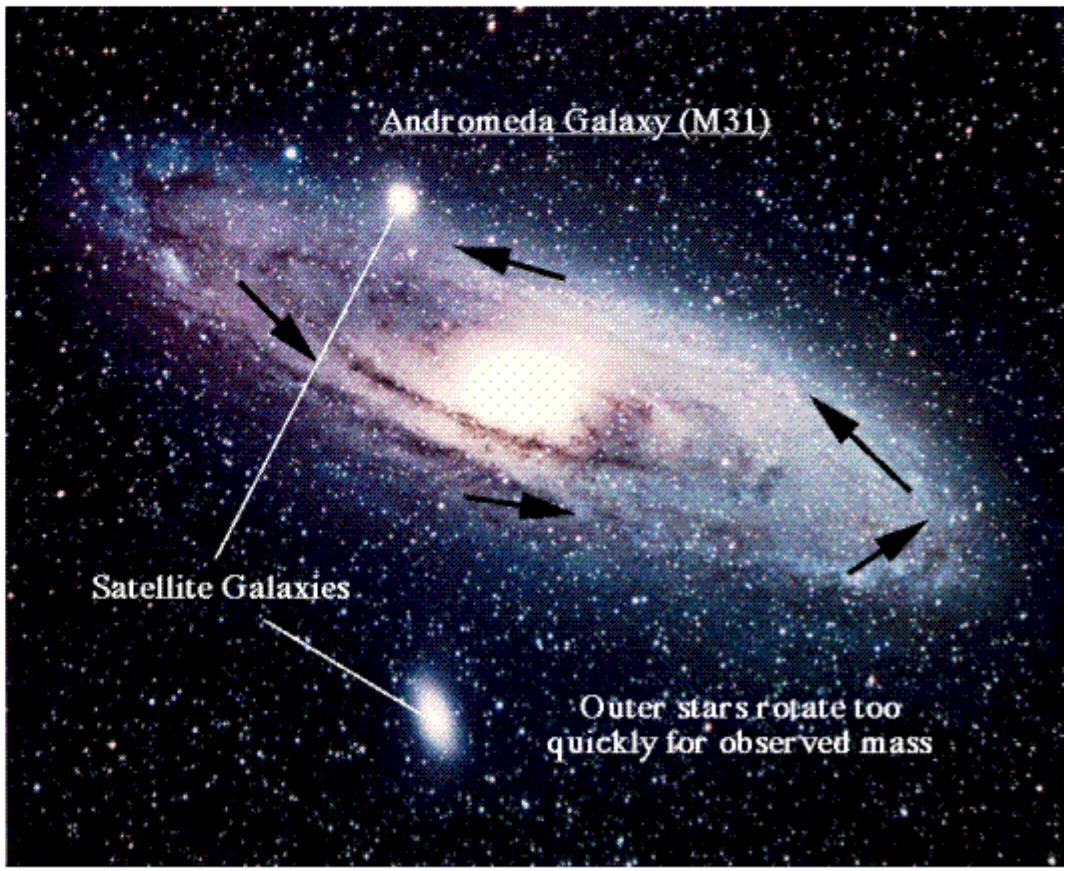
Orbits $F = \frac{mv^2}{r}$ $F = \frac{GMm}{r^2}$

Circular Motion

$\frac{mv^2}{r} = \frac{GMm}{r^2}$

Can relate velocity radius and force in orbits.

Have seen that orbits in stars and galactic clusters require stronger Gravitational force than can be explained by conventional Observable "visible" matter




-P. Cushman

This is evidence for a new form of Matter in the universe that interacts gravitationally but Not via the other forces.

Does Not emit or absorb light, for example.


And we don't know what it is!

May make up 80% of the Mass in the universe!!