

April 2, 2009

## Agenda

- Announce:
  - Observation 8pm on Tuesday, April 21
  - Project Part IIs Due This Tuesday (4/7)
  - Solar Altitude Writeup Due April 14
  - Read Essay 3 for Tuesday
- Krauss' article: *The End of Cosmology?*
- Review astroparticle/cosmological physics
- Dark Matter Lab

## The End of Cosmology?

- Krauss, author of "The Physics of Star Trek"
- What will future cosmologists see?
  - Important to consider limitations in time as well as space
  - Erroneous conclusions could come from forgetting that (such as that we are at the center of the universe)

## Expanding Universe

- Expansion is speeding up
  - Dark energy overpowers gravity
  - Density of regular matter decreases
  - Density of dark energy remains constant!
- In 100 billion years:
  - CMBR redshifted to radio with little intensity...probably not observable
  - Big Bang Nucleosynthesis obscured by stellar production of heavy elements
  - Local galaxies merge, rest disappear beyond cosmic horizon
- Conclusions:
  - Future cosmologists won't be able to deduce Big Bang
  - Present cosmologists may be seriously handicapped by some similar type of obscuration

## Alternative to Inflation: Ekpyrotic Universe

- Two "branes" collide
- Branes are 3D and move in another dimension
- Flatness: branes would settle in low energy state which would be flat
- Baryogenesis: brane's kinetic energy would create particles ala the Big Bang
- Structure formation: branes collide at slightly different times in different places

## Status of these ideas

- Idea
  - Fairly general and often wild idea
  - Yet to be "molded" to fit existing observations
  - Offers possible explanation of some mystery or explains something possibly better than existing theories
- Proposed theory
  - Fits with current observations
  - Working out predictions
- Competing Model
  - Explains current data, has proposed future tests
  - Often has features that aren't "liked"
  - Not definitive
- Well accepted theory
  - Explains current, has made predictions and passed
  - Generally accepted, though often limited in scope
- Standard Model
  - Fits current and passes predictions
  - Typical research looks at the limits where it may fail
  - Atypical research looks to overthrow completely but very difficult

## Role of Detectors

- Limited in energy, but repeatable
- Tests possible GUT theories
- Search for unknown particles...wide-range of implications:
  - Evidence for extra dimensions
  - Dark matter particles
  - Antimatter generated by dark matter self-interactions
- Neutrino great example

## Fundamental Physics

- Conflict of gravity and quantum mechanics
- Both pass every test we've constructed
- But, they disagree for very dense small regions (which we can't reproduce in lab!)
- Hopes of resolving:
  - String theory
  - LQG

## Ideas...

- Big Bang Theory
- Steady State Theory
- Inflationary Universe
- Ekpyrotic Universe
- Multiple Universes
- String Theory Landscape
- Holographic Universe