Wednesday, Nov. 28

Part III
Beginning of Movie

Agenda

• Announce:
  – Finish book next week
  – Projects in two weeks…any special needs?
• “We leave that to you”
• Vacuum Energy
• Anthropic Principle

We leave that to you

• Dilemma:
  – World is very complicated, can’t master it all
  – Many purported experts with different opinions
• Whom to believe/accept?

Example: Global Warming

• Should the USA adopt potentially costly policies to address global warming?
  – Is Earth heating up?
  – Is it caused by humankind?
  – Is it worth doing something?
  – What can be done and at what cost?

Other issues you can’t leave to others?

• Should schools teach Creationism/ID in science class?
• Is an antimissile system feasible and should it continue receiving funding?
• Should NASA’s unmanned science program be shortchanged to fund manned exploration?
• Is genetically modified food safe?
• Etc (UFOs, astrology/tarot)
Problems w/ the Cosmological Constant

Picturing Vacuum Energy

- In a region of space take everything out of it…vacuum
- Probe for magnetic fields:
  - A big, slow probe will find no (average) field
  - A fast, small probe finds large, random fields
- On average, energy doesn’t average out…energy of vacuum *is* the cosmological constant

Predictions for Cosmological Constant

- Continue at smaller and smaller length/time scales, random fields get bigger
- Keeps increasing till one gets to the Planck length
- Expected cosmological constant huge: ~10^120

The Problem

- Theory predicts a huge constant
- Experiment/observation shows a small one
- Difference of about 10^120% error!!!!!!
- Perhaps a symmetry causes cancellation
  - But then would expect a zero constant not small!

Introducing the Anthropic Principle

- What kind of universe do you expect
  - Specific values of fundamental constants as “predicted” by physics theories?
  - Arbitrary values that happen to have formed the Universe as we find it today?
  - “Designed” values (e.g. God, higher beings, etc)?
  - Multitude of universes…and we, by necessity, find ourselves in one suitable for intelligent life?
The Argument

• If fundamental values were changed, intelligent life would be impossible
• Example: change mass of neutron
  – Smaller and proton would decay resulting in a neutron universe
  – Larger and only hydrogen found in Universe
• Example from Weinberg: different values of cosm. Constant
  – Negative: collapse of universe
  – Large positive: no galaxy formation

Is it Science?

• Can it be tested?
• Is it giving up?