

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

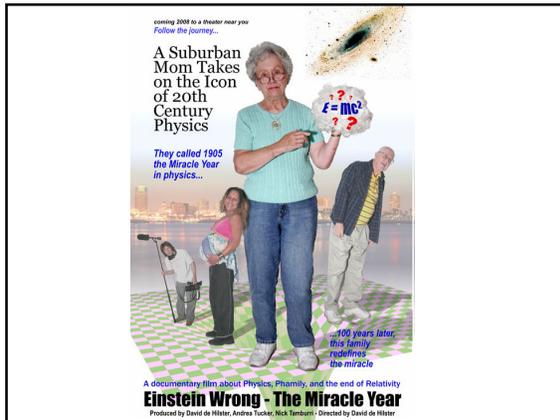
- Should the USA adopt potentially costly policies to address global warming?

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: $\sim 10^{120}$

- ### 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?