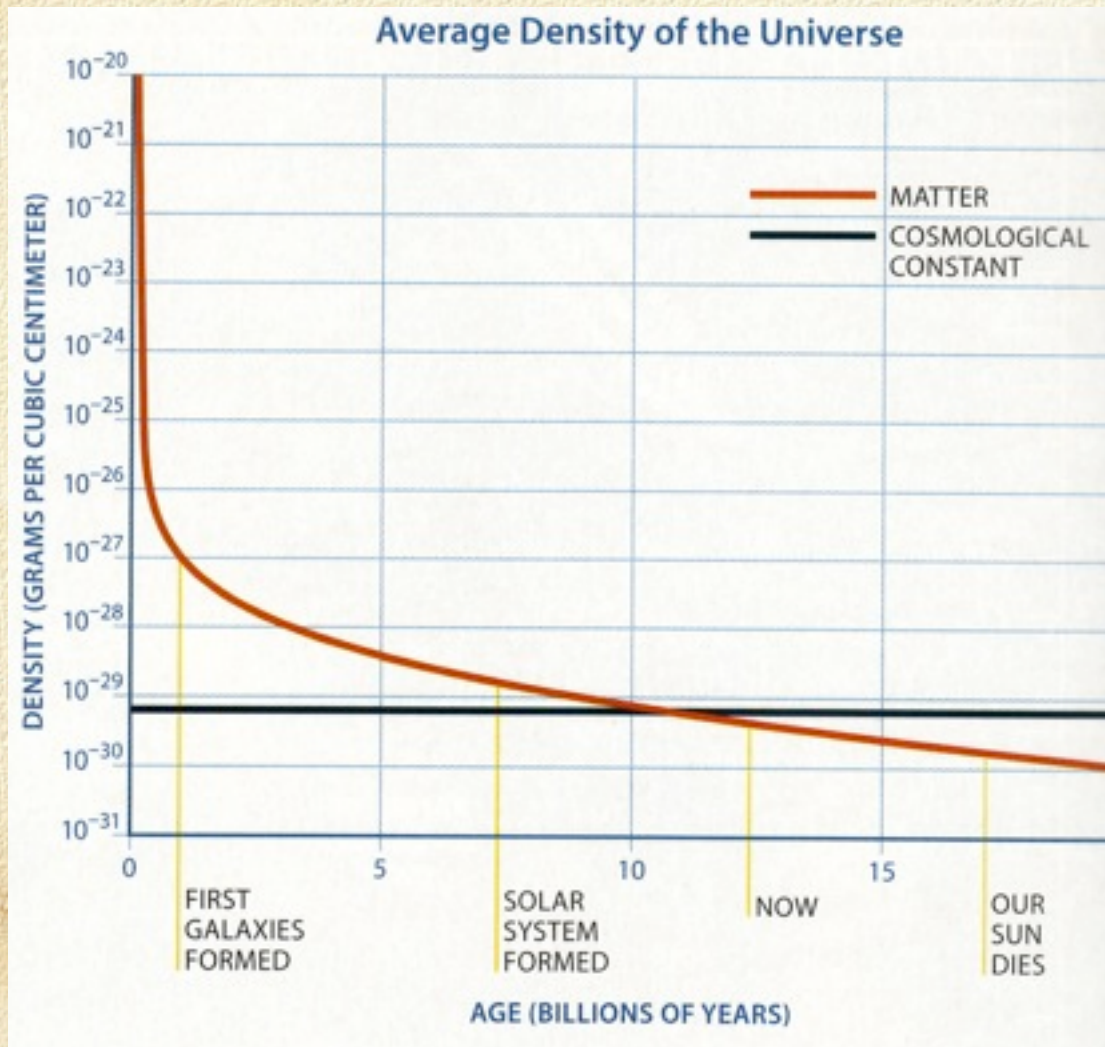

The Undiscovered Country...

Graduation Address (anonymous)

“Things are going to get unimaginably worse, and they are never, ever, going to get better again!”

Coincidence or Design?



Return to the Center of the Universe..

Galaxies
Never
Form?



Maybe this is telling us something?

Anthropic Mania

IF there are many different universes, and the energy of empty space can vary in each one, then only those in which it is not much greater than what we measure will galaxies form... and only then will stars and planets form, and only then astronomers....

The Landscape of Nothingness

IS THIS SCIENCE?

IT ISN'T RELIGION!!!

COSMIC NATURAL
SELECTION!

Compare to Einstein:

“What really interests me is whether God [sic] had any choice in the creation of the universe”

The End of Science?

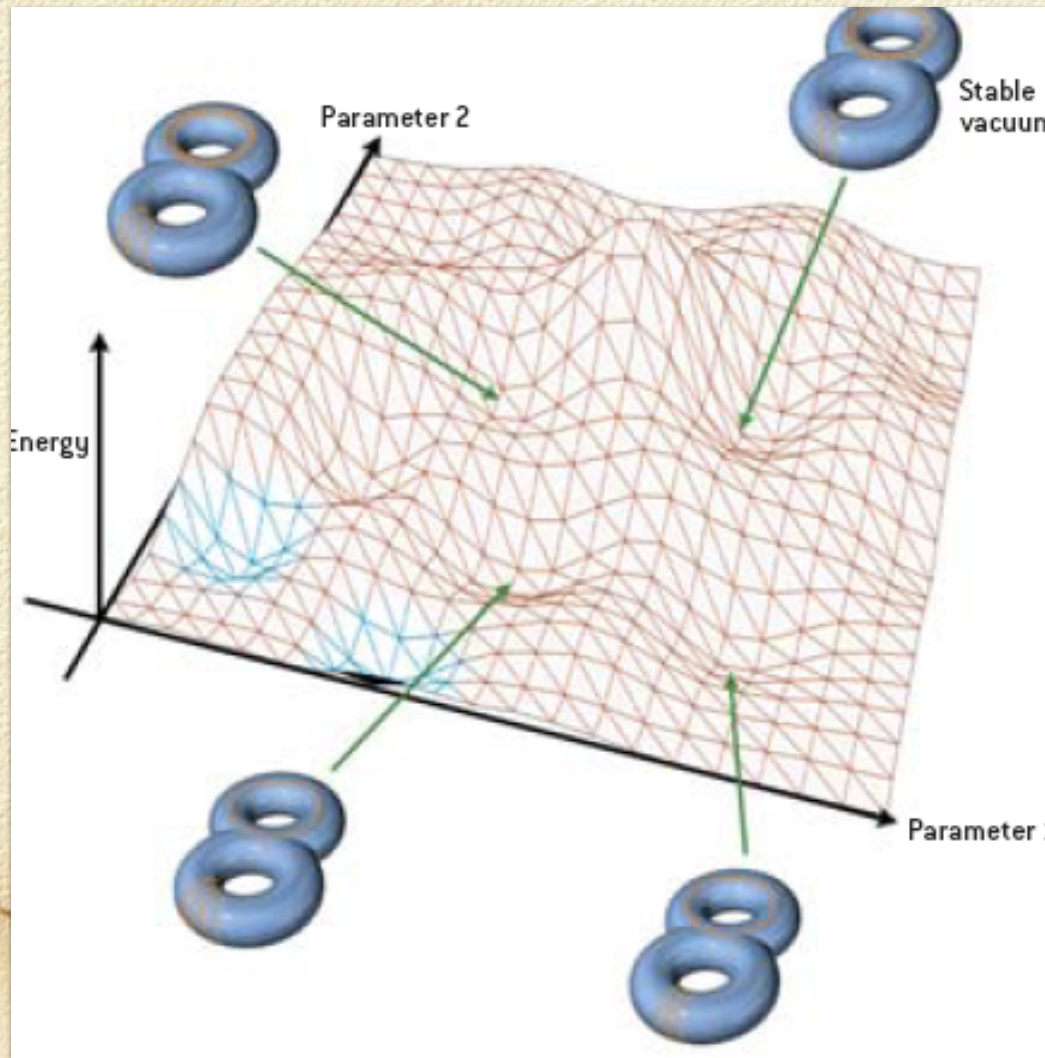
The Constants of Nature and the Puzzles of Modern Physics

- Gravity: The weakest force in nature...
- Proton 2000 times heavier than the electron
- Three generations of elementary particles...
who ordered them...
-
- A theory of anything?

STRING THEORY SUMMARIZED:



The Landscape of Nothingness



The Fundamental Anthropic Problems?

- An idea based on ignorance
- One never knows what variables are anthropically selected (or not).
- One never knows what the set of possibilities is.
- It is never compelling, only suggestive.
- It has been wrong before!

Can Anthropic Principle “Explain” Lambda?

As often currently framed: just
demonstrates correlations..

typicality is **EVERYTHING!**

Which is the best Anthropic Measure?

VASTLY DIFFERENT RESULTS
DEPENDING UPON CHOICE!

$$P = \delta (x - \text{img})$$



“The Future ain’t what it used to be!”

Yogi Berra

2. A Miserable Future?

“To see what is in front of one’s nose requires a constant struggle”

G. Orwell

$$\rho \rightarrow \rho_{\Lambda} \equiv \frac{\Lambda}{8\pi G}$$
$$a \rightarrow a_0 \exp(\sqrt{\Lambda/3}t)$$
$$\Rightarrow \dot{d} = \sqrt{\Lambda/3}d$$

Objects at distances greater than some distance D are receding faster than the speed of light.

$$\text{if } \rho_{\Lambda} \approx 6 \times 10^{-30} \text{ g/cm}^3 \Rightarrow R_H \approx 1.7 \times 10^{26} \text{ m} \approx 18 \text{ Glyr}$$

effects soon “visible!”

A Miserable Future?

Redshift effect:

$$R./R_{\text{Supercluster}} = 5000 \approx \exp(t/t_0)$$

- In 150 Gyr, redshift > 5000 for all objects outside our supercluster!
- In 2000 Gyr, redshift of all objects outside our local supercluster will exceed 10^{53} ! Even highest energy gamma rays will be invisible.
- the future of objects at a redshift \geq a few today will never be observed!
- if $Q_{\text{vac}}/Q_{\text{tot}} > 0.7$ today, the “in principle” observable future of high redshift objects has been shrinking since $t < 1/2$ the present time.

FUND COSMOLOGY NOW!

An Uncertain Future

We will never know if we live in the worst of all possible universes!

NEW RULES = NO RULES!

GEOMETRY ≠ DESTINY

LMK and MST, 1999

Krauss vs Dyson:

**LIFE (=Consciousness) CANNOT
PERSIST FOREVER IN ANY
ETERNALLY EXPANDING
UNIVERSE!**

Falsifiable Science?

- Recall Cosmology CIRCA 1900: Static and Eternal
- Cosmology circa 1916: *STATIC* de Sitter:

What will the future bring?:

Our Island Universe....



1. Hubble Expansion Disappears: 100 billion years
most things invisible, 1 trillion years, rest of
universe disappears. NO OBSERVED
HUBBLE EXPANSION OF GALAXIES

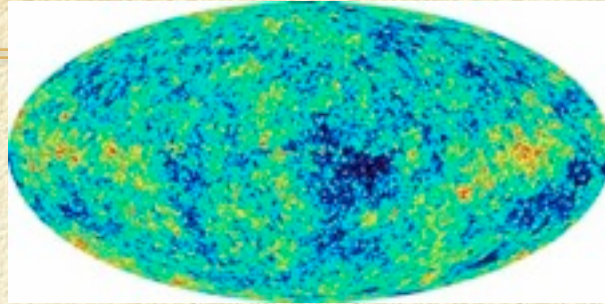
2. Dark Energy disappears?:

$$\rho_M / \rho_\Lambda \sim 10^{-12}$$

 Dark energy invisible when

$$\rho_\Lambda \ll \rho_M, \text{ but also when } \rho_\Lambda \gg \rho_M.$$

Cosmology will End (LMK RS 07)



3. CMB Disappears! $t \approx 100$ Gyr, peak at ≈ 1 m, frequency of 300 MHz. Intensity down by 12 orders of magnitude!

4. Plasma freq. in galaxy is

$$\nu_p = \left(\frac{n_e e^2}{\pi m_e} \right)^{1/2}$$

$$\approx 1 \text{ kHz}$$

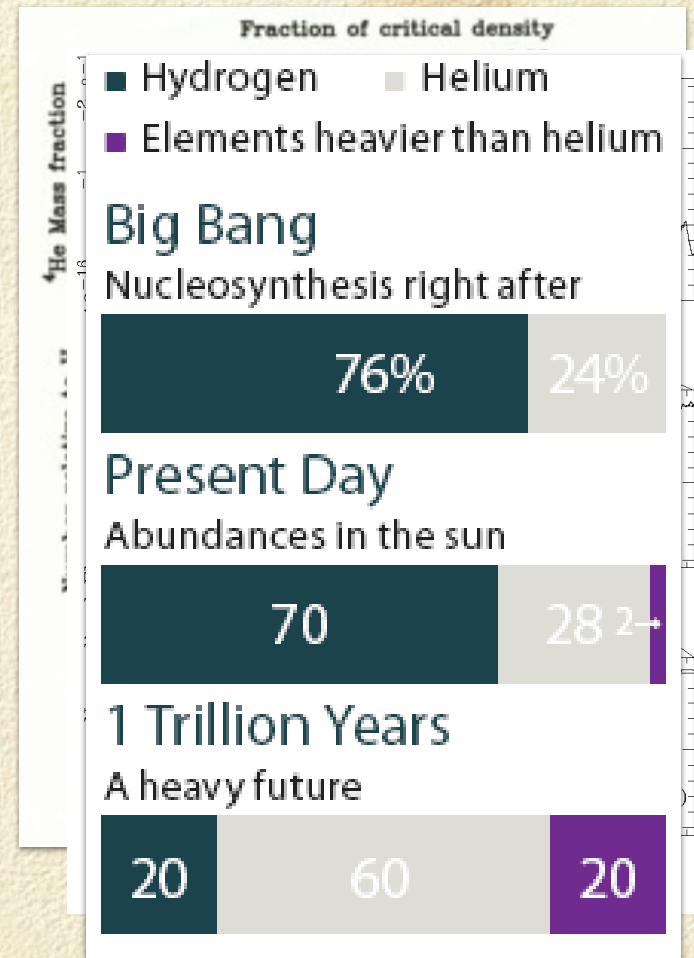
- CMB not permeate the galaxy.
- achieved when universe less than 50 times its present age..

-
5. General Relativity no help! (Recall LeMaitre)
 6. Island universe allowed in background Minkowski space (schwarzschild solution).. temporarily.. hence finite future.
 7. What about finite past?

8. Primordial Abundances Polluted: i.e $Y_{\text{prim}} \approx 0.24$ but $Y \approx .6$ in the future!

9. No primordial deuterium absorption from distant quasar

No evidence of primordial big bang production!



**FALSIFIABLE SCIENCE:
Return of Static Universe!**

The Good News

We live in a very special time: the only time when we can observationally verify that we live at a very special time!

We will be lonely and ignorant,
but dominant.....

Windows on the Future...



Windows on the Future...





“The fairest thing we can experience is the mysterious.. It is the fundamental emotion that stands at the cradle of true art and true science..”

Albert Einstein