

if 1% further, runaway glaciation about 2 billion yrs ago (some think this avoidable)

RIGHT UNIVERSE

Basic physical forces & approx relative strengths:

Strong nuclear	1	
Electro-magnetic	10^{-2}	(1/100)
Weak nuclear	10^{-5}	(1/100,000)
Gravity	10^{-39}	(1/"1 with 39 zeroes")

Balance of gravity and cosmic expansion
to 1 part in 10^{60} to have universe last so long

Strength of strong nuclear force
important in formation & stability of elements above helium
if 50% weaker, not even iron & carbon stable
5% weaker, deuterium unstable, stars wouldn't work
5% stronger, diproton stable, stars explode

Strength of weak nuclear force
important in causing dispersion of heavy elements from star in supernova explosion
if much weaker, neutrinos pass thru outer shell of star without exploding it to release elements
if much stronger, neutrinos remain trapped in core of star, no explosion

Balance of positive and negative charges
to cancel out electro-magnetic force so gravity dominates on astronomical scale of sizes
must balance to better than 1 part in 10^{37}

protons form much earlier in history of universe than electrons; why same number?

ATTEMPTS TO AVOID DESIGNER

As seen above, universe looks very designed; as this has become apparent, some strenuous attempts to avoid

Weak Anthropic Principle - Brandon Carter
if these not balanced, we wouldn't be here
just accident of observation: no observers if not right

but trivial, not explanation:
if my parents hadn't met...