Anthropic Principle in Modern Physics

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Content

Questions

What would this world be like, naively speaking, if the following things are changed?

- Planck length
- Fine-structure constant
- Gravitational constant
- Speed of light

  $\Longrightarrow$the permittivity and permeability of the vacuum

Origin of anthropic principle: Cosmology

- The anthropic principle (from Greek anthropos, meaning "human") is the philosophical consideration that observations of the Universe must be compatible with the conscious and sapient life that observes it.

- Brandon Carter first describe it in 1973 as the form of privileged observers. (Sould we give the observers – us privileged position in the vast universe?)

- "The argument can be used to explain why the conditions happen to be just right for the existence of (intelligent) life on the Earth at the present time. For if they were not just right, then we should not have found ourselves to be here now, but somewhere else, at some other appropriate time." – – Roger Penrose

Variants of anthropic principle

- Weak anthropic principle (WAP) (Barrow and Tipler): "The observed values of all physical and cosmological quantities are not equally probable but they take on values restricted by the requirement that there exist sites where carbon-based life can evolve and by the requirements that the universe be old enough for it to have already done so."
- Strong anthropic principle (SAP) (Barrow and Tipler): "The Universe must have those properties which allow life to develop within it at some stage in its history."
- Modified anthropic principle (MAP) (Schmidhuber): The 'problem' of existence is only relevant to a species capable of formulating the question. Prior to Homo sapiens intellectual evolution to the point where the nature of the observed universe – and humans' place within same-spawned deep inquiry into its origins, the 'problem' simply did not exist.
- Strong self-sampling assumption (SSSA) (Bostrom): "Each observer-moment should reason as if it were randomly selected from the class of all observer-moments in its reference class."

Parametrized universe

- The gravitational constant, the mass of the proton, the age of the universe, etc.
- In high energy physics: fine-structure constant, Planck constant (Planck units)
- Elegant theory: QED with only two parameters.

$$\mathcal{L} = \bar{\psi}(i\partial\!\!\!/ - m)\psi - \frac{1}{4}F_{\mu\nu}F^{\mu\nu} - e\bar{\psi}\gamma^{\mu}\psi A_{\mu}$$

- Sometimes we call it rubbish: SUSY with more than 100 parameters.
- Distinguish: Physical parameters apart from parameters in effective theory.
- Fine-tuned universe.

Possible physical interpretation

- Multiverse (apparently the most favored one, by both amateurs and sci-fi writers)

  $\Longrightarrow$Some deep senses in Quantum Mechanics

- String theory (Well-known possible grand unify theory but yet unproven)

  $\Longrightarrow$Some said in additional dimensions there could be a different universe but I don't approve.

  $\Longrightarrow$Huge numbers of possible vacua is another more reasonable explaination.

- The absurd universe/the unique universe/intelligence design/The fake universe/Top-down cosmology (Hawkings)

- Most boring ones:

  The life principle: there is an underlying principle that constrains the Universe to evolve towards life and mind.

  The self-explaining universe: only universes with a capacity for consciousness can exist

Thanks