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Artificial Cosmogenesis: A New Kind of Cosmology

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This paper introduces foundations for a new kind of cosmology. We advocate that computer simulations are needed to address two key cosmological issues. First, the robustness of the emergence of complexity, which boils down to ask: "what would remain the same if the tape of the universe were replayed?" Second, the much debated fine-tuning issue, which requires to answer the question: "are complex universes rare or common in the space of possible universes?" We argue that computer simulations are indispensable tools to address those two issues scientifically. We first discuss definitions of possible universes and of possible cosmic outcomes - such as atoms, stars, life or intelligence. This leads us to introduce a generalized Drake-like equation, the Cosmic Evolution Equation. It is a modular and conceptual framework to define research agendas in computational cosmology. We outline some studies of alternative complex universes. However, such studies are still in their infancy, and they can be fruitfully developed within a new kind of cosmology, heavily supported by computer simulations, Artificial Cosmogenesis. The Appendix [section 9] provides argumentative maps of the paper's main thesis.

KEYWORDS: artificial cosmogenesis, cosmic evolution, computational cosmology, digital physics, Drake equation, Cosmic Evolution Equation, robustness, fine-tuning, multiverse.

Which authors of this paper are endorsers?