Do We Live In An Intelligent Universe?

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ABSTRACT

This essay hypothesizes that the Universe contains a self-reproducing neural network of Black Holes with computational abilities—i.e., the Universe can "think"! It then rephrases the Final Anthropic Principle to state: "Intelligent information-processing must come into existence in each new Universe to assure the birth of intelligent successor universes". Continued research into the theory of Early Universe and Black Hole information storage, processing and retrieval is recommended, as are observational searches for time-correlated electromagnetic and gravitational wave emission patterns from widely separated Black Hole transient events indicative of the existence of a universal inter-Black Hole faster-than-light communications network.

"The Final Anthropic Principle" (FAP) states**:** "Intelligent information-processing must come into existence in the Universe, and, once it comes into existence, it will never die out" (emphasis added)[1]. Applying the FAP broadly today, it is hypothesized that: (a) Our Universe can holistically sense itself in real time[2]; (b) Black Holes are interconnected through a 5th Dimension, wormholes or quantum entanglement to form a real-time neural network (Fig. 1) that has evolved "intelligent information-processing" abilities--i.e., it "thinks"; and (c) our Universe will generate new universes via Super Massive Black Holes (SMBHs).

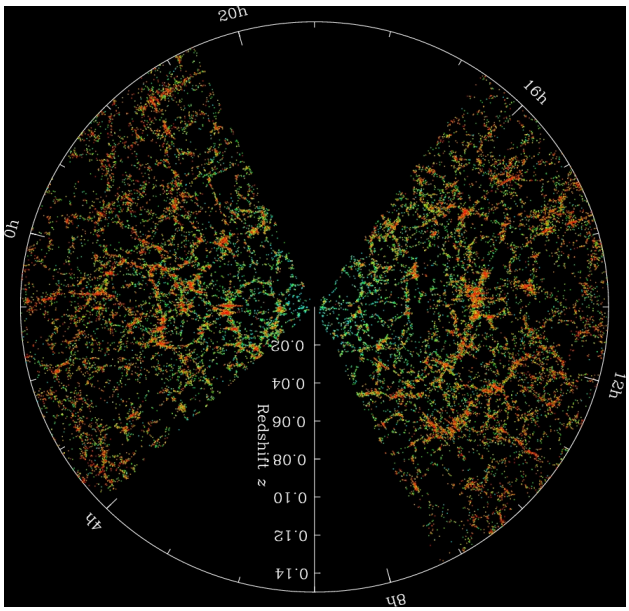

Figure 1. A network-like structure is apparent in the slices through the SDSS 3-dimensional map of the distribution of galaxies (Earth is at the center) where each point represents a galaxy. Galaxies are colored according to the ages of their stars. The circle radius is two billion light years. ***Credit: M. Blanton and the Sloan Digital Sky Survey.***

Coming into existence: The Universe appears to have originated from a vanishingly small speck of space-time containing an extremely high amount of vacuum energy that caused it to dramatically inflate in size, and then convert its remaining energy into particles and heat that gravity arranged into galaxies, stars and planets where intelligent carbon-based life eventually appeared. We have also learned that our Hubble volume contains ~trillion galaxy-centered SMBHs that, like non-sleeping hard drives, have captured and stored radiation and matter coming their way for ~13 billion years.

Stephen Hawking's final paper, with Haco, Perry and Strominger, provided "incremental evidence …. that hidden conformal symmetry explains the leading black hole microstate degeneracy", suggesting that information inside BHs is *not* lost but may be fully determined by measurement of external microstates.[3] This is a significant further step toward establishing a clear quantum link between information on the horizon of Black Holes and information inside them. Others have hypothesized that "black holes are the fastest computers in nature."[4]

Connecting up: The speed of light limit on information transfer in our 4-D spacetime, as embodied in Albert Einstein's classical General Relativity (GR), allows energy to concentrate into structures. It also makes possible the receipt and processing of *chronological* cosmological information. If all communication were instantaneous, there would be no history of distant events in spacetime. Rather than seeing how things *were* the further out one looked, one would see how they *are* now, unless information could be stored and later retrieved.[5] But, could Black Holes have formed a separate neural network that bypasses this limitation and receives, stores, processes and exchanges information in real-time?

Never Dying Out: According to the current paradigm of ΛCDM cosmology, the Universe has a finite lifetime left before its continued exponential expansion, dilution of energy, and evaporation of Black Holes will result in the loss of its ability to support life or any other type of complex structure. Under what conditions might information processing continue?

Conditions at the beginning of the Big Bang and at the centers of Black Holes connect them mathematically. Each contains enormous amounts of energy packed into vanishingly small volumes of spacetime where the laws of physics become hazy and uncertain. This essay postulates that they form a continuum of physical processes, so that SMBHs can seed successor Universes, each with its own separate space-time and subsequent time evolution, allowing information processing to continue.

It appears likely that in some regimes inside SMBHs, the fundamental characteristics of spacetime and energy are entrapped in quantum fluctuations that to an extent may be viewed as simultaneous collections of all potential outcomes. Thus, successor Universes could have a wide range of potential laws of nature that would not take on specific values until joined with incoming specific "information" to forge a viable

union of the many possibilities. Said another way, incoming information collapses the wave function to establish the genetic makeup of the offspring Universe.[6]

What "incoming information" could trigger a SMBH to consolidate the many probabilities and eject a baby Universe with its own spacetime and physical laws? It could be as simple as inputting the right pattern of energy in just the right time and fashion to trigger "natural processes". Absent such input, a SMBH would have missed its window and just evaporate over time without generating a successor. Of course, for a Universe as large as ours and teaming with SMBHs, and perhaps also with carbon-based life that could conceivably have a functional role in this, the probability of successful reproduction could be quite high.

Information transfer requires the generation, relocation and processing of non-random energy arrangements of radiation or particles. Temperatures in the early Universe far exceeded values at which this could successfully occur via "normal" processes. However, if information transfer took place at an even earlier "safe" stage, it might have initiated "processes" leading to the hot Big Bang and subsequent evolution of our Universe. In this scenario, the "safe" information transfer regime existed in a SMBH, generating a successor universe that possessed the 4-D GR we see, the right inflaton field energy to power inflation, and Standard Model quantum fields.

It has been suggested that Dark Matter consists of Primordial Black Holes (PBHs) produced long before the hydrogen/helium plasma was created in the first few minutes.[7] Such PBHs could be extremely numerous, and their mergers over time possibly could have produced our generation of SMBHs. Are PBHs the natural "pollen" produced by a SMBH predecessor from an earlier universe, seeding our Universe and growing into a subsequent "intelligent" neural network of SMBHs?

Would prior universes leave a detectible signal in ours? Hawking radiation from PBHs into our 4-D Universe might carry information on what they collected earlier. Analogous to encryption, our Universe would need an information processing ability to "download" and use this previously stored information. Could dark matter in PBHs automatically transfer key coding each cycle? G. Dvali et al. have suggested that "primordial quantum information" could have been carried through the inflationary era by the "maximal memory storage capacity" of the de Sitter vacuum, and may generate an observable "memory pattern".[8] Then, nature could take its course, reestablishing the laws of physics and the space-time scaffolding in each generation.

L. Smolin long ago speculated that it might be possible for Black Holes to generate baby Universes via a type of natural selection.[9] A question raised here is whether intelligent life might play a role in this process, serving as an "app" in a Universe-wide self-assembling and evolving computer program that discovers, arranges and transmits key information to a potential offspring Universe, via SMBHs, making it also life-friendly and capable of continuing its line. Could carbon-based life be needed to ensure that the same basic laws of nature and key relationships of energy and geometry that we see in our Universe are carried forward?

CONCLUSIONS

If the Universe is not a one-time event and intelligent life (intentional non-random information-processing) has a functional role in its continued survival via reproduction, the FAP should be expanded to encompass the entire process-i.e., "Intelligent information-processing must come into existence in each new Universe to assure the birth of intelligent successor universes".

Astrophysics research should proceed on the following: (a) very early universe information transfer, (b) Black Hole information storage, exchange, processing and retrieval mechanisms, and (c) searches for "smoking-gun" gravitational and electromagnetic wave signatures[10], such as time-correlated emission patterns from widely separated Black Hole transients that might indicate the existence of an inter-Black Hole faster-than-light communications network.[11]

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[1] J. D. Barrow and F.J. Tipler, *The Anthropic Cosmological Principle* (Clarendon Press, Oxford Univ. Press, 1986), p. 23; *See also*, Id. at 658-677.

[2] Classical 4-dimensional General Relatively constrains communication times to the speed of light. In our 93 billion light year diameter Hubble volume, information would need to travel 10^{20} times faster than c to cross it in 1/100 of a second or less.

[3] S. Haco, S.W. Hawking, M.J. Perry, and A. Strominger, "Black Hole Entropy and Soft Hair", arXiv:1810.01847 [hep-th], 13 Dec. 2018.

[4] A. R. Brown, D. A. Roberts, L. Susskind, B. Swingle, and Y. Zhao, "Complexity, Action, and Black Holes", arXiv:1512.04993 [hep-th], 10 May 2016; *See also*, G. Dvali and M. Panchenko, "Black Hole Based Quantum Computing in Labs and in the Sky", arXiv:1601.01329 [hep-th], 6 Jan 2016.

[5] There would no Cosmic Microwave Background or view of the galaxy evolution; instead, one would only see large-scale structure about 13.8 billion years old.

[6] E.g., *See,* J.B. Hartle and S.W. Hawking, "Wave Function of the Universe", Phys. Rev. D 28, 2960, 15 Dec. 1983.

[7] E.g., *See,* B. Carr, "Primordial Black Holes as Dark Matter and Generators of Cosmic Structure", arXiv:1901.07803 [astr-ph.CO], 23 Jan 2019; *See also,* A. Y. Kamenshchik et al., "Non-Canonical Inflation and Primordial Black Holes Production", arXiv:1812.02547 [gr-gc], 27 Feb. 2019.

[8] G. Dvali, L. Eisemann, M. Michel and S. Zell, "Universe's Primordial Quantum Memories", arXiv:1812.08749 [hep-th], 20 Dec. 2018, p.8.

[9] L. Smolin, *The Life of the Cosmos*, Oxford Univ. Press, 1997.

[10] E.g., *See,* L. Z. Kelly and M. Charisi et al., "Astro2020 Science White Paper: Multi-Messenger Astrophysics with Pulsar Timing Arrays", arXiv:1903.07644 [astro-ph.HE], 18 Mar 2019, describing how multi-messenger studies of SMBH binaries will revolutionize our understanding of the co-evolution of SMBHs with their host galaxies and the fundamental physics of accretion.; *See also,* M. Colpi et al., "Astro2020 Science White Paper: The Gravitational Wave View of Massive Black Holes", arXiv:1903.06867 [astro-ph.GA], 16 Mar. 2019.

[11] One would hope that both Einstein and Hawking would have been pleased with the foregoing undertakings, should they occur.