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SELF-REPLICATING PROBES ARE A RELIABLE STRATEGY FOR ETI

Abstract

The Sagan-Tipler debate regarding the existence or non-existence of ETI revolved around their deployment of self-replicating probes to permeate the Galaxy within astronomically short timescales. Tipler proposed that such self-replicating probes are the most economical and robust means for Galactic exploration. Hence, if ETI existed, their self-replicating probes would have arrived in our solar system within My. Sagan suggested that self-replicating probes are subject to evolutionary divergence imposing unacceptable risks to altruistic ETI who would only communicate with other ETI through signals. Such altruism must apply to all ETI. This argument assumes that self-replicating machines are essentially uncontrollable because they must evolve. This is not so. Evolutionary mutation can be prevented to any arbitrary degree through the introduction of channel coding which provides a means for ensuring the fidelity of information through a communications channel – in this case, a vertical evolutionary channel. Biological genetic fidelity is limited by the energy cost of physical repair mechanisms but memory-encoded binary information repair involves only bit flipping. Channel coding is implemented as error detection and correction codes (EDAC) which offer efficient encoding mechanisms to reduce replication errors to an arbitrary degree. EDAC is used in spacecraft memory to enhance robustness to data corruption due to radiation effects of space. We review the main approaches to EDAC. There are two major types of EDAC and variations thereof - block coding and convolutional coding – which add redundant information. Interleaved Reed-Solomon block coding with convolutional coding is commonly implemented for reliable interplanetary data transmission, e.g. Voyager. Turbo coding approaches the maximum encoding efficiency dictated by Shannon's theorem. EDAC provides a mechanism for reliable vertical transmission of genetic information through multiple generations. For a self-replicating probe to spread through the Galaxy requires copying fidelity over only 23 vertical generations. We might employ deeper encoding depth at critical genetic instructions such as number of offspring. In this way, we can prevent mutations generated by copying errors in the genetic code. EDAC is the key to preventing the self-replicating probe from evolving. This suggests that Sagan's argument is unsound and that self-replicating probes are the most economical and robust strategy for ETI to search for other ETI. The Fermi paradox dictates that either ETI do not exist or that evidence has not yet been found. Suitable technosignatures may be located in the asteroid belt to search for extensive clay deposits as residue of in-situ manufacturing.