47th IAA SYMPOSIUM ON THE SEARCH FOR EXTRATERRESTRIAL INTELLIGENCE (SETI) –
The Next Steps (A4)
SETI 2: SETI and Society (2)

Author: Dr. Claudio Maccone
International Academy of Astronautics (IAA) and Istituto Nazionale di Astrofisica (INAF), Italy

ENTROPY AND ENERGY OF LIFE AND CIVILIZATIONS MODELLED BY EVO-SETI THEORY

Abstract

Biological evolution over the last 3.5 billion years was an increase in the number of living species from one (RNA) to the current (say) 50 million. Past mass extinctions make this growth become a stochastic process having an exponential mean value, called Geometric Brownian Motion (GBM). We also proved that LIFE is a b-lognormal, i.e. a lognormal starting at instant b (birth). Next our Peak-Locus Theorem showed that the GBM exponential is the geometric locus of all the peaks of the b-lognormals. Since the b-lognormals are probability densities, the area under each of them always equals 1 (normalization condition) and so, going from left to right on the time axis, the b-lognormals become more and more "peaky", and so they last less and less in time. This "level of civilization" is what physicists call ENTROPY.

This author also proved mathematically that, for all GBMs, the (Shannon) Entropy of the b-lognormals in his Peak-Locus Theorem grows LINEARLY in time. The Molecular Clock, well known to geneticists since 1962, shows that the DNA base-substitutions occur LINEARLY in time since they are neutral with respect to Darwinian selection. This is Kimura's neutral theory of molecular evolution. The conclusion is that the Molecular Clock and the LINEAR increase of EvoEntropy in time are just the same thing! In other words, we derived the Molecular Clock mathematically as a part of our Evo-SETI Theory. In addition, our EvoEntropy, i.e. the Shannon Entropy of the b-lognormal (with the minus sign reversed and starting at zero at the time of the origin of Life on Earth) is just the new EvoSETI SCALE to measure the evolution of life on Exoplanets (measured in bits).

Our Evo-SETI Theory also covers the ENERGY used by a living Species or Civilization along its whole lifetime. We were able to add the consideration of ENERGY in addition to ENTROPY by replacing the b-lognormals by a new curve, finite in the time: the LOGPAR. It is made up by an ascending b-lognormal between the birth and the peak followed by a descending parabola between peak and death. The area under the logpar may be any positive number since it represents the ENERGY requested by the organism to live over its entire lifetime. We show that three instants only (birth, peak and death) are sufficient to describe each logpar.

In conclusion, Evo-SETI Theory is a strong mathematical tool to investigate Astrobiology and SETI.