The *Planckian Information Theory* as a Unified Theory of Organizations in Physics, Genomics, and Glottometrics

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Abstract. During the past 6 years at Rutgers [1, 2], a mathematical equation called the *Planckian distribution* (PD), i.e., y = (a/(Ax + B)^5)/(Exp (b/(Ax + B)) – 1), has been discovered that fits data measured from a wide range of natural and human sciences, including (i) blackbody radiation, (ii) polarized cosmological microwave background radiation, (iii) protein folding. (iv) single-molecule enzyme catalysis, (v) protein-length frequency distributions in living cells, (vi) whole-cell mRNA metabolism in yeast, (vii) whole-cell mRNA metabolism in human breast tissues, (viii) T-cell receptor variable region gene diversity, (ix) fMRI (functional magnetic resonance imaging) signals from a human brain before and after infusing the hallucinogen, psilocybin, (x) word-length frequency distributions in a speech delivered by Kerry in 2004, (xi) word-length frequency distributions in prose, private letters and comments, and (xii) decision-making time histograms in experimental animals and humans.
PD is related to (and can be derived from) the Planck radiation equation discovered in 1900, which consists of two components – (i) the power function related to the number of standing waves per volume per frequency, and (ii) the exponential function specifying the average energy per mode of the standing waves [3]. PD is also related to the Menzerath-Altmann law discovered in glottometrics in 1928-80 [4] and recently found to be derivable from a statistical mechanical perspective [5].

In all the cases examined so far, the rising phase of the PD function (and that of the Menzerath-Altmann law) has been found to overlap with the associated Gaussian function, suggesting that the PD implicates thermally excited random processes. Thus there may exist a universal mechanism underlying all Planckian processes (i.e., those physicochemical and biological processes that generate data fitting PD) called the SID-TEM-TOF mechanism, the acronym standing for Signal-Induced De-excitation of Thermally Excited Metastable states leading TO Function. The universality of PD may be attributed to the universal role of standing waves (and hence the principle of the *wave-particle duality*) in dynamical physical systems and the universality of thermal or Brownian motions as a prerequisite to free energy-driven organizations of matter leading to functions [2]. The SID-TEM-TOF mechanism includes the mechanism of enzyme catalysis based on the concept of *the conformon* (i.e., chemical reaction-derived *conformational wave packets* in biopolymers postulated to drive all goal-directed molecular motions in the cell) proposed in 1974 [6]. The degree of the thermally excited, free energy-selected organization of matter in space and time can be quantified using what has been referred to as the *Planckian information*, I_P, i.e., the binary logarithm of the ratio of the area under the curve (AUC) of the Planckian distribution over the AUC of the associated Gaussian distribution, $I_P = \log_2(\int P(x)dx/\int G(x)dx)$, expressed in the unit of bits per selective action.

References

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