How Information Creates Its Observer: The Emergence of the Information Observer with Regularities

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"No escape is evident from four conclusions: (1) The world cannot be a giant machine, ruled by any pre-established continuum physical law. (2) There is no such thing at the microscopic level as space or time or spacetime continuum. (3) The familiar probability function or functional, and wave equation or functional wave equation, of standard quantum theory provide mere continuum idealizations and by reason of this circumstance conceal the information-theoretic source from which they derive. (4) No element in the description of physics shows itself as closer to primordial than the elementary quantum phenomenon, that is, the elementary device-intermediated act of posing a yes-no physical question and eliciting an answer or, in brief, the elementary act of observer-participancy. Otherwise stated, every physical quantity, every it, derives its ultimate significance from bits, binary yes-or-no indications, a conclusion which we epitomize in the phrase, it from bit." — John Archibald Wheeler

John Archibald Wheeler had a talent for expressing the most potent ideas in a few words. But he was not the first to suggest that binary distinctions are fundamental to nature, an idea that dates back to the 17th century, at least. Nor did he elaborate on the path taken from the primordial to real physical Bits.

Vladimir Lerner's Information Macrodynamic (IMD) formalism is the first full application of John Archibald Wheeler's *It from Bit* approach to physical Information processes. The IMD formalism accounts for the evolution of Information physics from Quantum to Classical regimes, showing how intelligence and Wheeler's Observer-Participator are naturally emergent.

Distinct from "digital physics" or simple coding-decoding schemes, the IMD formalism presents a continuous step-by-step physics of natural Information processes, from the first distinction to the emergence of the Information Observer.

Certainly, there have been many attempts to link Quantum phenomena with life, intelligence, consciousness, and so on. Our aim is more extensive, combining fundamental approaches epitomized by Kolmogorov, Bayes, Shannon, Landauer, and others, into one mathematical framework. For the first time, the internal anatomy of the Bit is revealed, and the connection between Information and macroscopic phenomena such as qualities and intelligence is explained.

Wheeler called *It from Bit* a phrase, but it is really an *aphorism*, a concise description of a universal phenomenon. More than that, it is a *cosmogony+*, an explanation of how the universe happens, along with everything within it. A true theory of every thing.

Wheeler's cosmogony is expressed in another important aphorism: *Law without Law*. Put simply, Wheeler's universe is entirely *emergent*. There are no prior laws that set everything in motion. The laws of Physics are themselves *emergents*.

At the beginning of this process, there are no facts about reality. The beginning is hidden in uncertainty (Lerner 2019:xiii). Now let us imagine a featureless space or field. Of course, this is impossible, because in the act of imagination, we have made an observation—we have created a virtual object. The leap beyond uncertainty requires an Observer.

Virtual or quasiparticles are *emergent*. Tom Lancaster observes: "A system without interactions might support particle excitations, but these will not be detectable as they pass through each other (and everything else). As soon as interactions are added to a system, they change the properties of the particles. … Assuming that no symmetry is broken, the properties of the particles can be shown to evolve continuously from the non-interacting theory upon turning on the interactions. We might characterize this as the emergence of the particle properties" (Routledge Handbook of Emergence, 2019:275).

Quantum Field Theories successfully describe the relativistic realm as well as the multiparticle realm of condensed matter physics, hard matter and soft matter. In this way, interactions in a field have natural statistical regularities, and these regularities lead to the probabilities and features of our Classical world.

First, a distinction emerges. Through interaction, and subsequent interactions, a process begins that leads from binary distinctions to Bits, and finally, something in the real world, an It. By interacting with the environment, yes-no actions begin to model Information Bits. In this way, an Information (IMD) process connects the virtual to reality, Information, and the Observer.

As the Information process approaches probability one, attracting interactions capture energy that memorizes the asymmetrical logic in a certainty, an Information Bit. Such a Bit is naturally extracted at minimal quality energy equivalent *In2* working as Maxwell's Demon.

The memorized impulse Bit and its free Information self-organize multiple Bits into triplets, structuring a macroprocess. Memorized Information binds reversible microprocesses with irreversible Information macroprocesses along multidimensional observing processes. Hierarchical networks now form, whose free Information produces higher level nodes, encoding triplets in multiple levels of hierarchical organization.

The quantity of Quality Energy and Information identifies the anatomy of Information units structures: from qubits, to Bits, Free information, triplets, Information Networks (IN), and a final triplet that binds multiple INs. Physical units arise, ranging from the elementary structure of particles to various macro units: molecules, electro-chemical forms, cells, biological organisms, and humans. Each unit, bound by an invariant triple structure, preserves an invariant Information measure.

The interactive Information dynamics of the Information process steadily assemble geometrical and Information structures. Gradually, these structures become capable of cognition and intelligence, stored in a double spiral rotating code. The Information Path Functional (IPF) integrates multiple interactive dynamics in finite bits that observe and measure reality.

As Wheeler predicted, the time and space of reality exist as units of Information. Cognition and intelligence emerge naturally, leading to the self-aware Observer-Participator.