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

Vladimir S. Lerner 1○ and Malcolm Dean 2, *

1 UCLA (Ret.), Los Angeles, CA 90095, USA; lernervs@gmail.com
2 Higher Cognitive Affinity Group, UCLA, Los Angeles, CA 90095, USA
* Correspondence: malcolmdean@gmail.com
† Presented at the Conference on Theoretical and Foundational Problems in Information Studies, IS4SI Summit 2021, online, 12–19 September 2021.

Abstract: 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 self-aware Information Observer.

Keywords: information theory; it from bit; macrodynamics; observer-participator; information path functional; probability; hidden information; free information; Maxwell’s demon; Markov diffusion; triplet; Jarzynski; causality

1. Introduction

“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 [1]

Like many great teachers, John Archibald Wheeler had a talent for expressing the most potent ideas in a few words. However, 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.

2. Wheeler’s Cosmogony

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 familiar laws of physics are themselves emergents.

At the beginning of this process, there are no facts about reality. The beginning is hidden in uncertainty [2]. 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” [3].

3. The IMD Formalism

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 ln2 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 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 integrates multiple interactive dynamics into finite bits, which observe and measure reality.

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

Independent Confirmation of the IMD Formalism
A theory of every thing makes universal claims about phenomena. Independent confirmation is a reasonable demand. Confirmation must be found at all levels and in all domains. In our ongoing investigation, hundreds of papers from many independent fields of investigation have been shown to reflect IMD processes at work.

Vladimir Lerner’s working papers are freely available at arXiv [4].

**Funding:** This research received no external funding.

**Institutional Review Board Statement:** Not applicable.

**Informed Consent Statement:** Not applicable.

**Data Availability Statement:** Not applicable.

**Conflicts of Interest:** The authors declare no conflict of interest.

**References**