From Bit to It, From the Observer's Information to Space Theory

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It, the Cosmos, is a physical system evolving by its own mechanisms, producing hierarchically organized levels of complexity. It produced us; we are It become self-conscious. To understand It and ourselves we must theorize about its fundamental substance(s) and processes. Instead, Relativity and Quantum Mechanics limit us to the mathematical modeling of our observations and measurements. They replace It with bit, with the observers' information. The facts require us to relate all fundamental phenomena to Cosmic space. Space is a substance: the source of electromagnetism, gravity, inertia and all particles. Space is must be quantized, composed of physical "bits", explaining the efficacy of our mathematics. Space is the missing link between mathematics and physics, consciousness and Cosmos, information and causality, bit and It.

1. Observer-Information Modeling vs. Cosmic Theory

To understand the Cosmos, we must seek answers to basic questions such as these:

What is light? Relative to what does it actually move at *c*?
What prevents electrons and hadrons from moving at *c*?
What resists the acceleration of matter, but not its uniform velocity?
What causes gravity? Why does it appear to be an acceleration and velocity field?
What causes the redshift ("time dilation") of the spectra of moving atoms?

Relativity and Quantum Mechanics include accurate mathematical descriptions of these phenomena, but only as they are experienced and measured by the observer. An objectivistic theoretical physics will instead model the Cosmos itself and theorize about the causes of all its phenomena. To answer these questions requires us to attribute physical qualities to space—to treat it as a substance. Its substantiality has never disproved by any evidence or argument, but has been ignored by choice of epistemology—of observer-information modeling over Cosmic theory—of bit over It. Let us use our minds to reach beyond the phenomena and theorize about what exists and causes the phenomena. Let us reach beyond bit to It.

2. The Ideological Roots of Relativity and Quantum Mechanics

With his 1905 papers on Special Relativity and the lightquantum, and later with General Relativity, Albert Einstein imposed an observer-based program upon physics. To understand why he did so, and why his program was accepted, one must appreciate the historic conflict between natural philosophy and all forms of spiritualism, including Platonism, Eastern mysticism, and the Abrahamic religions.[a] In the Dark Ages Aristotle's works on logic were incorporated into Christian thought and education, but with the discovery of his works on

[a] For a detailed treatment of the philosophical issues, see the author's paper in Physics Essays, 15, 113 (2002).

natural philosophy the union was strained. Churchmen viewed his idea of a self-existing Cosmos (Cosmism) as a threat to their religion. Thomas Aquinas tried to reconcile Aristotle and Christianity but could not prevent the inevitable divorce. In 1277 the Bishop of Paris issued a condemnation of many Aristolelian-Thomist theses. William of Ockham then tried to free theology from Cosmic theory by stressing the omnipotence of God and the radical dependence of all created things upon God. He insisted that man should only describe his experiences using the fewest propositions necessary and not posit any God-independent causes or mechanisms.[1]

René Descartes also sought to confine knowledge to what was given to us by God and about which we could be certain—the "clear and distinct ideas presented to the senses". His *Cogito*, "I think, therefore I am", tacitly assumed that consciousness existed prior to and independent of the human body. The Cosmos could be a hallucination produced in his mind by a demon.[2] Descartes concluded that we must shun all theorizing about physical entities and causes and confine ourselves to mathematical descriptions of our sensations—to a universal mathematics. He invented the three-axis coordinate system to convert the Cosmos into information; It into bit. John Locke also claimed that we could only know the ideas presented to us by our senses and could never pass beyond them to any knowledge of the nature or hidden causes of things.[3]

Descartes and Locke were dualists, believing in two realities: spiritual and physical. Bishop Berkeley realized that dualism was unstable. After Copernicus and Newton, he feared that as more phenomena were explained by natural causes, faith in Christianity would decline. He saw natural philosophy as a slippery slope to atheistic materialism. His solution was radical: since we know only our own conscious experiences and have no direct knowledge of any material Cosmos, we must not assume that it exists.[4] Our experiences are not caused by a physical Cosmos but are a virtual reality simulation provided directly to our spirits by God. Humans will not worship the Sun once they realize that it is a God-given apparition. The laws of optics are God's rules for creating the illusion of distance, coordinated with illusions of our own motion within virtual space.[5] Berkeley's subjective idealism was illustrated in the film, *The Matrix.*[6] Humans believe that they are experiencing life in the real world when in reality their bodies are lying in vats, their brains are hardwired to a master computer, and their minds are interacting with each others' within a computer-generated virtual reality. Theirs was a world of bits, not It.

Berkeley accused Newton of atheism because his absolute space, absolute time, and matter existed "without the mind" and thus without God. Since God alone makes one experience follow another, philosophy should merely note the regularities and not pretend to explain things by corporeal causes. Against Newton he argued that we should treat motion not as absolute or Cosmic but as merely relative to ourselves and to other objects in our sensoria, and treat time as the succession of events in our consciousness. (We should manipulate God-given bits, not theorize about It.) David Hume also denied that we could know any Cosmic causes, saying that our belief that an effect will follow from a cause is merely a custom we have acquired through repetitive experience.[7] Immanuel Kant also defaulted to idealism-spiritualism,

arguing that we could know only the phenomena (bits) presented to our senses and could never pass beyond them to knowledge of the noumena (It), of things in themselves.[8]

Ernst Mach had a significant influence on thinkers in the late 19th and early 20th centuries. He admitted his debt to Berkeley and Hume.[9] He stated, "The world consists only of our sensations".[10] He asserted that the aim of Science was to describe our sensations and that its laws stated general relationships among our sensations. Anything not directly perceived did not exist; inapparent entities posited to cause our sensations were mere "metaphysical speculations"—convenient fictions. Famously, Mach denied the existence of atoms because they could not be seen, even though they were useful for modeling our experiences. He redefined physical theories as quantitative instruments—mathematical models for facilitating the modeling and prediction of observed facts. He followed Berkeley in branding Newton's theory of absolute space and motion as "devoid of content", saying that "we have knowledge only of relative spaces and motions."[11] He called those who shared this view "relativists". Mach reduced philosophy to Science[b], physics to mathematics, It to bit.

Albert Einstein had a lifelong interest in philosophy—he had read Berkeley and Kant; he admitted that Hume and Mach influenced his development.[12] So we can understand why he stated: "The only justification for our concepts and system of concepts is that they serve to represent the complex of experiences; beyond this they have no legitimacy."[13] His view of Science changed with time: "in my younger years, however, Mach's epistemological position also influenced me very greatly, a position which today appears to me to be essentially untenable. For he did not place in correct light the essentially constructive and speculative nature of thought and more especially of scientific thought;…"[14] Unlike Mach, Einstein came to believe in an "external world independent of the perceiving subject", but it was not the physical Cosmos that we know today. He defined the "real external world" subjectivistically, as the sum total of all experienced events about which subjects can agree.[15] He believed that atoms, photons, absolute *c*, space-time, and Cosmos existed, but only as ideas that proved useful for organizing our sensations and making our shared experiences intelligible:

> *Physics is an attempt conceptually to grasp reality as it is thought, independently of its being observed. In this sense, one speaks of "physical reality."*[16]

Without realizing it, Einstein had chosen Berkeley's Science over Mach's. His reality remained subjectivistic in that it was based upon the contents of consciousness and attempted only to grasp reality "as it is thought". His "freely-created ideas" were mental constructs that helped model the regularities in our experiences; they were not objective physical hypotheses in a physical theory. They were epistemologically equivalent to the epicycles, deferents, and equants of the Ptolemaic Cosmology; ideas that helped to organize and predict the observer's

[b] I capitalize "Science" when referring to the specific ideology invented to replace natural philosophy.

information. Einstein was a mathematical idealist and a theist; he believed that "nature is the realization of the simplest conceivable mathematical ideas",[17] and that God is "a superior mind that reveals itself in the world of experience".[18] He sought the rules of the Matrix, the fewest mathematical "laws of Nature" which could account for our experiences.

Einstein was misinterpreted as a physical theorist, for which he was partly responsible. He believed that in the field of epistemology a scientist could be an "unscrupulous opportunist", resorting to realism, idealism, positivism, and Platonism as the situation seemed to require.[19] However, in philosophy inconsistency is error; as the Cosmos is a coherent, hierarchically-organized whole, so must be our linguistic representation of it. His conflict with Bohr and Heisenberg was over the choice of Berkeley's or Mach's versions of Science. Following Mach, the Copenhagen school sought no reality or cause beyond the probabilistic laws that predicted the observer's measurements. Einstein rejected their approach as solipsism, and refused to believe that God played dice when producing reality. He believed that God's Matrix ran on rules that determined what we experienced, and that physics should not stop short of finding them. In the end, Einstein left us with a confused physics: contaminated by Platonism, Machian positivism and Berkeleyan idealism and incapable of theorizing effectively about the Cosmos.

3. The Immateriality of Relativity and Quantum Mechanics

Consider the ideas of Special Relativity (SR), General Relativity, and Quantum Mechanics. SR was based upon Galileo's principle of relativity. Einstein chose this ballistic phenomenon to be the foundation of his program to relate all laws of physics to observers and arbitrary frames rather than to Cosmic space. He stated his restricted principle of relativity:

> *All laws of Nature are the same in all coordinate systems (CSs) moving uniformly, relative to each other.*[20]

Notice that there is no mention of the Cosmos or of any coordinate system that represents the space or matter of the Cosmos. "Relativity" literally means that everything is only relative to any observer or arbitrary frame; that there is "no such thing as an independently existing trajectory, but only a trajectory relative to a particular body of reference".[21] Relativity contains only observers, their CSs, and the laws that determine their experiences and measurements. Motion is not physical, so it has no physical effects; everything is just observer-kinematics. Space is a number of the observers' measuring rods; time a number of ticks of the observers' clocks; mass a measured or calculated quantity. The foundations of Einstein's reality, mass-energy and space-time, are just measurements, made by the observer, in his frame. The laws of Nature are just mathematical correlations among the observers' measurements. They are rules of the Matrix; they have no possible physical explanation.

Einstein realized that SR still included an "absolute" inertial frame for acceleration-rotation. To complete his Relativity program he needed to eliminate this last vestige of Cosmic space and

its effects from physics. No reference bodies or CSs, including the celestial bodies of the Cosmos, should have priority over any observers' or arbitrary CSs. He tried to generalize the principle of relativity by also relating acceleration and gravity to arbitrary frames. The non-Euclidean geometries of Gauss and Riemann were suitable to this purpose:

> *All Gaussian co-ordinate systems are essentially equivalent for the formulation of the general laws of Nature.*[22]

What does this observer-CS scheme have to do with understanding the Cosmos? Imagine the physical nonsensicality and mathematical complexity of relating the laws of Nature to his accelerating-rotating, Gaussian, writhing "reference-mollusc". A tumbling observer cannot grasp the nature of any Cosmic phenomenon, even one so simple as our solar system. Indeed, Relativity nullified the Copernican Revolution; GR made the historic struggle between the views of Ptolemy and Copernicus "meaningless" since it was only a matter of one's choice of coordinate system.[23] However, acceleration, rotation, and gravity are physical effects that are related to the local and distant distribution of matter. They are not merely relative, they have nothing to do with observers or arbitrary frames; they are physical. In truth, SR and GR don't work at all; what works is the application of certain equations in the correct, causal spatial frame. SR and GR do not specify the frame; we do based upon our knowledge and experience (e.g., we use the non-rotating Earth-centered frame for the global positioning system).

While SR and GR deal with observer's experience of macrocosmic motion and its effects, Quantum Mechanics (QM) deals with the observer's experience of microcosmic events. With his lightquantum theory, Einstein again restricted physics to what the observer experiences and measures—the quantized interactions of light and matter. Electromagnetic waves cannot be seen, but clicks in a photomultiplier can be counted. In contrast to Relativity, the subjectivism of QM has been recognized and debated.[24] One textbook explained:

> *Quantum mechanics…rejects as meaningless and useless the notion that behind the universe of our perception there lies a hidden objective world ruled by causality; instead, it confines itself to the description of the relations among perceptions.*[25]

QM is Mach's Science. It begins and ends with consciousness; all that exists or can be known is the observer's information and the rules that govern changes in that information. QM has had to remain probabilistic because the observer can never know or account for all the unseen radiation, particles, etc. affecting his apparatus. Since QM produces only probabilities, what causes one probability to become reality? Lacking any determinative Matrix-rules, it must be the observer's decision to observe that creates reality: subjectivism in, subjectivism out.

Richard Feynman provided a clear description of Quantum Electrodynamics (QED) in his book of that title.[26] Echoing Mach, he asserts that the only criterion of a good "theory" is whether its predictions agree with experimental observations. He describes how QED was

modified *ad hoc* over many decades in order to incorporate and predict the observed facts (as was the Ptolemaic Cosmology). In QED light sources produce neither physical particles nor waves, but "probability amplitudes" that propagate throughout space at *c* as waves do, by "shrinks and turns". Adding up (superpositioning) all the resultant arrows for all the possible paths to a point renders a final amplitude arrow. Squaring this arrow yields the probability that the observer will detect a light-matter interaction at the given place and time. QED is thus an empirical statistical model for predicting detection events, not a physical theory. Feynman realizes that the photon makes no sense as a physical hypothesis; one must do the wave-math and not think about which way the "photon" goes, yet he still insists that "light is made of particles". He concludes that "Nature is absurd", so physics has given up on trying to find physical models to explain the phenomena. Yet he claims that QED is a description of "what Nature is really doing underneath nearly all the phenomena we see in the world". Feynman was caught in the contradiction between Mach's Science and his own common-sense realism.

4. Idealism and Atomism

Unable to theorize about space and its role in all physical phenomena, physicists resort to idealism and atomism. In idealism the observers' ideas, information and rules become real objects existing in some other plane of reality; Platonic ideals that magically produce our reality. The observer's uncertainty about a particle's velocity and location becomes a law of Nature and the cause of zero-point vacuum energy. Mathematical constructs and fixes are reified as Cosmic entities and causes: information, virtual particles, symmetries, singularities, wormholes, strings, membranes, extra dimensions, holograms, multiple universes, etc.

Idealism transforms time from ticks on the observer's clock into a quasi-magical entity that has a beginning, slows down, speeds up, and reverses. An "arrow of time" replaces Cosmic causality. Energy is transformed from the observer's measurement of total motion into a quasi-magical substance that flows from here to there like caloric, produces particles and generally makes everything happen. Space-time is transformed from the observers' rod-and-clock measurements of intervals between events, $ds^2 = (dx^2 + dy^2 + dz^2) - c^2dt^2$, into a Cosmic object and cause—the "fabric of the Cosmos"[27] whose "curvature" causes gravity. Because space-time contains the word "space", physicists assume that it describes Cosmic space and its physical effects. They confuse space-time with space, often in the same sentence (e.g. "expansion of space"). They say that light travels at *c* in space or in space-time, not relative to every CS. They speak of motion in space-time, even though there is no such thing. They want and need to talk about Cosmic space and motion as objective realities, but Relativity stands in their way. Space-time is preventing them from understanding space and time.

Other physicists eschew idealism; they believe in matter and mechanism. Since they cannot theorize about the causal role of space, all that's left is atomism. They try to explain all phenomena as due to various particles interacting in a void. QM's Standard Model posits twelve

self-existent matter particles (leptons and quarks) interacting via four forces, each associated with a boson particle. The forces are caused by the exchange of "virtual particles" between real particles. This is merely an accounting scheme; it makes no sense as a physical theory. Theorists are forced to endow space with physical qualities, surreptitiously. They incorporate the wave qualities of light as "wave-particle duality", and the spatial-field qualities of electromagnetism, inertia and gravity as "field-particle duality". However, particles are localized objects by definition and have nothing in common with waves and fields. Many of the Standard Model's particles violate QM's Machian epistemology as they have never been *directly* observed (i.e. quarks, W and Z bosons, Higgs boson, virtual particles, photons, neutrinos, gluons, gravitons, etc.). The Standard Model's particles and concepts are just more deferents, equants, and epicycles: devices humans invented to get their predictions right.

5. Cosmism and Philosophy

Bishop Berkeley had to eliminate physical space from physics in order to eliminate physical causality and leave but one reality and one cause: God-spirit-magic. He replaced natural philosophy with Science, It with bit. Now, more than a century since the Darwinian revolution, we are becoming comfortable with the fact that our species is the result of a natural process of hierarchical Cosmic evolution: subatomic, atomic, chemical, biological, neuropsychological and linguistic-philosophical. We are beginning to understand the evolution of language and of our unique linguistic consciousness.[28,29,30,31] Language alone separates us from other animals, not a divine spirit. With our computers we have learned enough about information processing to understand that our individual consciousnesses are virtual reality simulations of ourselves, the Cosmos and our interactions with it. These simulations are created and maintained by our individual brains; they are not a separate spiritual reality. There is no longer any reason that we should refrain from theorizing about the Cosmos as a physical system.

The ancient Greeks turned language into the most powerful information-processing tool of all—philosophy—the ability to reach beyond our sensations and measurements by creating and criticizing theories about what exists and causes the phenomena we experience. Logic and mathematics are tools of philosophy; linguistic software that we invented for the purpose of better representing the Cosmos and its processes. Logic consists of rules that assure that our linguistic representations represent Cosmic entities and causality. Mathematics is our quantitative representation of Cosmic entities and processes. It adds precision to our observations, predictions, and theories. Logic and mathematics work because the Cosmos is a stable, interacting system that evolves through cause and effect.

6. Space Theory: A Program for a New Physics

For fundamental Cosmic phenomena to have a physical cause, space must be a substance. If space is nothing, everything is magic. Physicists Robert Laughlin[32] and Frank Wilczek have

concluded that space is a substance. Wilczek calls space "the grid", "the primary ingredient of physical reality, from which all else is formed".[33] It is logical: the Cosmos is a coherent system precisely because all its phenomena arise from motions and distortions in and of a single substance. We will never understand space, however, until we abandon anti-spatial Relativity and QM. How do we characterize this unknown substance? We must ascribe to it whatever qualities are needed to explain the phenomena. In order to produce the uniformity that we observe, space must have smallest parts of some determinate size, the ultimate quanta. It may be composed of "cells" at the Planck scale (10^{-33}cm). The spatial cell is the ultimate integer, the monad, the physical bit, the reason that Cosmic phenomena can be described by mathematics. These cells must be sufficiently complex to produce all the fundamental phenomena that we observe. Because space is quantized so too are length, time and action. Length is not just a measurement or dimension but a number of spatial cells. Time is Cosmic evolution itself—the unending procession of causes and effects. We standardize and measure evolution using a clock—some regular physical cause-effect process. Every clock's mechanism is altered by physical circumstances (temperature, acceleration, velocity, etc.). Space does not have mass or charge, these result from certain motions or distortions in and of space. Energy is not a self-existent vital force; it is just motion, as Francis Bacon concluded long ago.[34] Matter and energy are different kinds of motion in and of quantum space. Matter is persistent organized motion(s), energy is less organized motion(s); from this identity follows their interconvertibility and mutual conservation. Electrons, hadrons, muons, neutrinos, etc. are not self-existent particles in a void but various persistent patterns of motion(s) in and of space. Electromagnetic and gravitational fields are different distortions and motions in and of regions of space.

7. Gravity is a Flow of Space; Light is a Wave in Space

Newton argued that space was the seat of inertia (recall his spinning bucket argument). His absolute space was an abstract, pan-Cosmic, Euclidian body that resisted the acceleration of matter but not its uniform velocity; all matter had some definite velocity in absolute space, even if it could not be determined.[35] Lorentz ether theory[36] (LET), further developed by Poincaré,[37] considered Newton's space to also be the electromagnetic medium in which light moved at *c*, in which moving electrons and therefore matter were shortened in the direction of motion, and in which moving atoms' electronic spectra were redshifted. SR was just an observer-based reinterpretation of LET, treating physical space as just another coordinate system. LET is mathematically equivalent to SR for most predictions,[38] but is philosophically superior as it replaces the observer and magic with Cosmic reality and mechanism. It eliminates SR's paradoxes and allows us to theorize about the cause of "relativistic" effects.[39]

It has been known for many decades that gravity can be modeled and many predictions of GR reproduced with greater simplicity by treating gravity as an acceleration and velocity field.[40,41 42,43,44,45,46] Einstein's principle of equivalence of inertial and gravitational acceleration

implies that Earth is causing its surrounding space to accelerate towards its center. Test masses are accelerated Earthward with the surrounding space (free fall). Objects on Earth's surface are prevented from accelerating centripetally with space, so have weight. This implies that Newtonian-Lorentzian space is not a Euclidean solid but a massless, frictionless fluid flowing radially into all matter as into a sink. Space's centripetal acceleration outside a mass is GM/r^2 and its velocity is $\sqrt{2GM/r}$. Thus Newton's escape velocity is also the spatial inflow velocity that explains gravity's electromagnetic ("relativistic") effects including the confinement of light by black holes and the gravitational redshift.[c] This theory has resurfaced as the waterfall or river model of black holes[47,48,49] Interestingly, spatial sources produce the same acceleration and velocity gradients—they would also produce gravity, but with one major difference.

The flowing space theory offers tantalizing solutions to many problems in physics and Cosmology.[d] It implies that every celestial body creates a vast co-moving field of radial sink-flow that determines the local inertial and luminal frame to a great distance. This entrainment of space by matter is sufficient to explain Mach's Principle. Spatial entrainment by orbiting stars would cause the space, the "inertial frame", within galaxies and clusters to also orbit and accelerate centripetally to various degrees, explaining the anomalous stellar accelerations and velocities without the need for "dark matter". The galaxial recession anomaly ("dark energy") implies that stars are spatial sources, that their nuclear reactions create or release so much space so as to overwhelm the spatial consumption of their inert matter and flow outwards. All bright galaxies would be spatial sources. The space they produce, having no route of exit, would accumulate in the voids between clusters, pushing them apart and producing the accelerating Cosmic expansion. The Inflation of the Big Bang is then explicable as space-producing nuclear reaction involving the destruction of most or all of the hadrons in the preceding Big Crunch.

To supersede QM and the Standard Model, we need only to relate the phenomena to space. The photon and point-particle electron are myths; light and electrons always behave as waves.[50] QED's probability amplitudes represent, to some extent, real waves in electromagnetic (EM) space. Electrons are extended EM wave-structures that absorb and emit light waves in quanta determined by their structure. Once emitted, a wave-quantum spreads diffractively in space like all waves, more or less according to its frequency. The probabilistic method of QED is required due to our ignorance of the number and direction of emitted wave-quanta, their spread, and their superpositioning with background EM radiation from all sources.[e]

We can produce a physics of causality—without observers, information, paradoxes or schisms—a physics that makes sense. A working theory of space will revive natural philosophy and will inform and enrich all our sciences. We just need to reach beyond bit to It.

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[c] See the author's presentation of the flowing space theory in Physics Essays, 25, 500 (2012).
[d] Unpublished paper by the author
[e] See the author's wave-interpretation of QED in Proceedings of SPIE, Vol. 8121, 81210X-1 (2011).

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