

The Collapse of Objective Reality: Nonlocality is Quantum Emptiness

When we try to pick out anything by itself we find
it hitched to everything else in the universe.

—John Muir

The physics of the 20th century produced four great physical theories, all of them interdependently related: 1) Einstein's 1905 Special Relativity Theory (SRT); 2) Einstein's 1915 General Relativity Theory (GRT); 3) the 1928 "old quantum theory" (QT) of Planck, Einstein, Bohr and Heisenberg with its "spooky" quantum uncertainty, which begat 4) Dirac's 1929 4-D Relativistic Quantum Field Theory (QFT), and Feynman's much improved QED (Nobel Prize 1965), which begat the Standard Model of Particle Physics, later to be known as the lambda Λ -CDM (cold dark matter) Standard Model. The prodigious unification of hitherto mathematically incommensurate QED and GRT in a much desired Quantum Gravity Theory (QGT) wherein GRT is quantized, awaits us still.

Einstein's GRT is a geometric generalization of SRT; QFT is derived from and unifies quantum mechanical QED and SRT. However, QFT and GRT are mathematically incommensurate; each of them is incomplete and contains the seeds of its own demise. For QT and QFT it's the monumental observer "measurement problem", as we shall see. For QFT and its electromagnetic offspring QED it's the problem of infinities and its "hocus-pocus...mathematically illegitimate" (Feynman) antidotes, namely, "renormalization" (and later "regularization").

Before these concerns of Feynman, Dirac also objected to renormalization: "It's just not sensible mathematics". Yet it has bestowed upon us the computer, the laser, and the bomb. Renormalization, though no real improvement on inherent quantum uncertainty, adds a qbit of very pragmatic predictability to QED.

GRT has its intractable problem of singularities—the physically impossible Big Bang and black hole events thicken the physical plot with inconceivably minute Planck scale action where mathematical and conceptual theory utterly breaks down; to wit, GRT at the macro scale of galactic large scale structure, and QFT/QED at the micro scale of quarks and leptons. "Infinite singularities do not exist in nature" (Max Tegmark). You can see the problem. We require a theory that can handle both scales—the really big stuff, and the really small stuff. Progress in such post-Standard Model physics—supersymmetry/superstring/M Theory, Loop Quantum Gravity, Quintessence—has been painfully slow, due in no small part to physics' ideological bias against tweaking Einstein's sacrosanct GRT, as we shall soon see (Chap. 11, "Gravity Behaving Badly").

So let's briefly explore the interdependent relationship of these four great theories in the hope that it may ultimately lead us, not to a logically impossible physicalist Theory of Everything (TOE), as we have seen in Ch. 3), but to the possibility of a propitious 21st century unified Quantum Gravity Theory (QGT)—the great physics desideratum that is the final unification of QFT/QED with GRT, which for now are utterly incommensurable. A holistic TOE that ventures

beyond mere logical consistency must include not only the spooky nonlocality of the Quantum Theory's random acausal proto-subjectivity, but consciousness studies and philosophy of mind as well (Ch. 12, 13).

We shall see below that the inherent dimensional limit of finite mathematics precludes penetration of the theory wrecking infinite dimensional darkness and uncertainty at the quiescent heart of both GRT and QED, presenting a capacious logical problem for any conceptual QGT unification.

First the Quantum.

Whence the Quantum? The 20th century was the century of the Quantum. Early in the century Quantum Theory pioneer Max Planck (1858-1947) mentored his dear friend Albert Einstein who was doing his own foundational work on the new theory, now known as “the old quantum theory” or QT. Einstein’s 1905 paper on the photoelectric effect (for which he was awarded the Nobel Prize in Physics in 1921) built upon Planck’s earlier work, and was itself a major contribution to emerging Quantum Theory. Einstein was a pioneer of the Quantum Theory, though he later became its most famous detractor, as we shall see.

It was 1905, Einstein’s “miracle year” that he also published “On the Electrodynamics of Moving Bodies”—his breakthrough then very controversial Special Relativity Theory (SRT)—for which he won no prizes, but, with the aid of Bohr's and Planck's Quantum of Action, freed science from 400 years of the Modern European Enlightenment's grail quest for absolute objective certainty in physics, which has now hypertrophied into a hyper-objective, observer-independent Newtonian classical physics dogma. Thank you Herr Professor Doctor Einstein!

Here, SRT, a classical (non-quantum) theory itself, reflexively critiques the limits of classical theory. Just so, the contradiction tolerant quantum logic of Bohr's complementarity reflexively critiques the bivalent deductive logic of Aristotle’s Three Laws of Thought, most importantly, his second axiom that is the Law of Excluded Middle: either a proposition is true; or its negation is true. There is no third possibility, thus the "excluded middle".

The obvious, but rarely considered problem with such either-or, binary, true-false, two-valued, truth functional logic is that *there’s a lot of reality in the middle between true and false*. The really bad news: the logical syntax of language—our *objective* voice, our human conceptual cognition—is vacuously binary. The human mind is functionally dualistic!

Well, is there a centrist middle way that offers up a contradiction tolerant yet consistent multi-valued, or at least a three valued (3VL) alternative logic with an "included middle" (cf. "Quantum Logic" below)?

Fortunately, language syntax also includes its semiotic siblings, namely, semantics (meaning) and pragmatics (context, usage, style); not to mention our cognitive subtextual *subjective* emotional, intuitional, trans-conceptual, even nondual contemplative—*yikes!* "spiritual"—modes of cognition; to wit, the mindfulness meditation (*shamatha-vapashyana, sati, bhavana, kenosis*)

that has so profoundly modeled our wisdom traditions, both East and West. Isn't there a lot more to human cognition than mere objective conceptual theoretical thinking?

Centrist middle way views that strike a balance between objective information and subjective wisdom have been present in both our Modern and Premodern wisdom traditions for centuries.

Quantum pioneer Niels Bohr, student of Taoism with its philosophy of the ultimate unity of nature's complementary opposites in primordial Tao—unity of unbounded whole itself—chose the Taoist *Tai Chi* (yin/yang) symbol as his Danish coat of arms posting it auspiciously and conspicuously upon the front gate of his estate in Copenhagen.

This premodern wisdom inspired his Modern 20th century middle way quantum Principle of Complementarity, a centrist, dialectical higher synthetic unity of nature's relative opposites—wave/particle; position/momentum; objective/subjective; existence/non-existence. More on this to come.

And long before Bohr, Nagarjuna, with his premodern 2nd century *Madhyamaka* (Middle Way) explication of 5th century BCE Gautama Buddha's Middle Way, have all pointed the way to a cognitive posture that is open and comfortable with seeming relative-conventional contradictions.

How is this so? In such subtle minds there is cognitive confidence, based in contemplative experience, that the antinomies of *relative* mind are always diametrically resolved—transcended and included—in a more inclusive, even nondual synthesis that is *ultimately* the basal implicate order of the all embracing whole itself, primordial ground and "supreme source" of the explicate order that is all this arising appearing spacetime stuff. We may call it trans-theistic nondual godhead, but for Niels Bohr it is only Tao. We shall see below that for David Bohm it is the "implicate order of the unbounded whole".

The salient metaphysical point: human beings have a subjective cognitive capacity to envisage one's participation and inseparability from the boundless, infinite, perfectly subjective interdependent whole, which is augmented by both objective conceptual knowledge, and contemplative, trans-conceptual wisdom.

The vexing philosophical conundrums of past and present history? Relatively, conventionally, big problems. Ultimately, no problem at all ("Consciousness: Our Perennial Mind-Body Problem" below). Mereologically (the study of part-whole relations), the unbounded whole (logos, *mahabindu*) subsumes and embraces its arising particular parts, as if the parts were not separate at all. The open in-dwelling Wisdom Mind Presence (*vidya, rigpa, Christos*) of That (*tat, sat*) whole is our always present experiential connection.

We have now seen that the Quantum has given us the potential for an understanding of nondual ultimate reality itself that includes the false dichotomy of *either* objective *or* subjective knowing of this limitless reality whole that transcends yet embraces them both.

Thus does this centrist middle way principle—quantum or Buddhist—guide the wild horse of our relative dualistic mind to a semblance of the inherently complementary atavistic wisdom of

the primordial whole. It is the syncretic post-empirical, trans-conceptual subject-object unity that is grasped by our innate Wisdom Mind. Such nondual subjective noetic cognition bestows the intuitive capacity for the nonlinear knowing understanding of this vast interdependent process of linear explicate objective reality arising in the whole.

Hence, this newfound noetic intellectual freedom has opened a way to the observer-dependent subjectivity of the inchoate new Quantum Paradigm. And the Quantum century has prepared us for that next more inclusive paradigm shift; what I have called the emerging Noetic Revolution in matter, mind and spirit of this 21st century (Boaz 2020). It is here that we shall begin the real work; the knowing of the prior ontic and epistemic present *unity* of matter, mind and spirit.

The discovery of the nonlocal, intrinsically interdependent (Buddha's *pratitya samutpada*) quantum nature of reality has revealed this truth of *ontological relativity*—that what really exists is observer-dependently relative to the unified objective/subjective, often trans-conceptual cognition of the mind of the beholder (“Human Happiness” above). *We construct our realities via our deep cultural background preconscious "global web of belief"* (Quine 1969). Does this mean that we *literally* construct physical stuff via our consciousness? Read on.

In 1900 Max Planck (Nobel Prize in Physics 1918) demonstrated through his quantum resolution of the infamous “ultraviolet catastrophe”—the black body radiation problem—that light is absorbed and emitted, not in a continuous wavelike flow, Aristotle’s smooth continuity, but rather in discrete, clumpy, particle-like bits or packets or “energy elements” which Planck named “quanta”. Planck proved that reality constituting light-energy is quantized! But is the spacetime gravity of GRT quantized? Aye, that is the rub.

This counter intuitive quantization did not occur to Aristotle whose realist objectivist materialist philosophical cognitive bias we have, not altogether consciously, inherited as our Western deep cognitive background hyper-objectivist/materialist “web of belief”.

For Planck, light is not a wave spread out in space as Thomas Young had “proven” in 1801 with his early double slit diffraction experiments. Planck discovered, to his dismay, that light is rather, a spaceless, empty point-like particle! This amazing discovery of the complementary dual wave-particle quantum nature of light is known as Planck’s “quantum of action”, to wit, Planck’s constant h (where energy $E = h\nu$). These dynamic particle information qbits soon became known as *photons*—our beloved particles of light, just like Newton’s wondrous “corpuscle” points of light. Greek atomists Leucippus and his heart-son Democritus would have agreed.

Einstein named these tiny points of light *lichtquanta* (light quanta)—spacetime located, quasi “real” discrete point-like light-energy packets. *Photons are particles or particle emissions of wave motion. Light is emitted and absorbed as photons, but light travels as waves.* Thus the paradoxical, ironic *wave-particle duality* of the nature of light. Both particle and wave properties must be factored for any given quantum system. Einstein told it well: “We have two contradictory pictures of reality; separately neither of them explains the phenomena of light, but together they do.”

Einstein's “light quanta” is mathematically equivalent to Planck’s “energy elements” yielding the syncretic Planck-Einstein Relation $E = hf$.

Einstein's contribution as a founding father of early quantum theory is often underestimated. We shall see however, that Einstein, an inveterate acolyte of *observer-independent* Platonic Metaphysical Local Realism/Scientific Realism could not abide the philosophical subjectivity of the *observer-dependent* antirealist and acausal consequences of quantum randomness, and thus engaged quantum polemical quarrels with Niels Bohr, and later with others, until his death in 1955 at the age of 76.

Einstein worked upon his deathbed toward a unified field theory that would include a refutation of quantum entanglement/nonlocality. It has yet to be accomplished. A primary thesis of our investigation here is that it cannot. We shall soon see that quantum entanglement/nonlocality is fundamental to spacetime reality as we know it in the 21st century.

Disquieting Quantum Weirdness. In 1935 the EPR Paradox (Einstein, Podolsky, Rosen) was debated by Einstein and his intellectual nemesis Niels Bohr over the completeness of Bohr's and Heisenberg's nominalist instrumentalist Copenhagen Interpretation of the epistemology of the nonlocal anti-realist quantum theory demonstrated by Heisenberg's Principle of Uncertainty. The debate, which labored on for years, was one of the greatest polemical contests, engaging two of the most subtle minds—one realist, one antirealist—in the history of science.

The EPR Paradox is this: the counter intuitive antirealist, non-objectivist nonlocality inherent in the randomness of the quantum theory presents the possibility that a measurement result of one particle in an entangled two part quantum system can have a superluminal, instantaneous effect on the other particle in the system, even when they are "spacelike separated" by many light years.

Such "nonlocal behavior" violates Einstein's sacrosanct second Special Relativity principle, namely, the finite speed of light in the vacuum of space. For Einstein such absurd non-objective anti-realist "spooky action at a distance" meant that the Quantum Theory was not dead wrong, but woefully incomplete—and to be sure, not objectively "scientific". It needed a "hidden parameter" or "hidden variable" to *objectively* explain such uncaused behavior. After all, the very foundational principle of all of Science, not to mention common sense, is causality; causes precede their effects! The negation of the causal principle could be bad for the economy!

Most physicists today construe the EPR Paradox as not so much revealing a weakness in the Quantum Theory, but as a vivid out-picturing of the radical difference between classical objectivist relativistic physics and intrinsically non-objectivist quantum physics; and of the uncertainty of the nature of observer measurement itself, and thus of an observer-dependent objectively "real world out there" (RWOT). The very existence of our beloved spacetime world depends upon the wondrous principle of cause and effect; does it not? This quantum conundrum is a really big deal! Stay tuned. The not entirely orthodox resolution is revealed below.

Therefore, ontologically speaking, the debate concerns nothing less than the ultimate nature of objective physical spacetime reality itself. Einstein acutely understood the ontic and epistemic stakes. His view was this: There exists one objective *observer-independent* physical reality perceived by many different relative reference frames. Bohr's view was that objective physical reality is *observer-dependent* and ontologically relative, created by the observations and

measurements of an observer-experimenter. There is no absolutely existing real world out there, independent of the consciousness of an observer. So forget metaphysics already, and just calculate!

The debate continues today. Indeed, this question as to the *ultimate nature* of appearing *physical* reality is the primary subject of our present investigation.

Einstein's standard defensive retort on intrinsic non-causal quantum randomness: "God does not play dice with the world." On one occasion an exasperated Bohr is said to have replied, "Oh Einstein, stop telling God what to do".

Hence, at the very heart of matter—cause, change, motion, mechanics—matter-energy is *created* in purely random, thus uncaused, thus epistemologically uncertain proto-physical zero-point energy eruptions—quantum fluctuations—from its primordial "zero point energy" vacuum ground state into $E = mc^2$ light-form material reality.

This ZPE arising is Wheeler's "quantum foam", something real (physical) arising from nothingness; the primordial quantum emptiness ground potential. That something can arise ex nihilo, from nothing; something that is not *caused* by something prior, violates science's sacrosanct law of cause and effect—the Principle of Local Causality—basis of Scientific Realism, epistemic foundation of modern physics; and indeed of our Western idol of "Common Sense Realism", Bertrand Russell's "metaphysics of the stone age".

Moreover, the "creation" of energy ostensibly violates physics inviolable law of the conservation of energy. For 400 years of philosophy and physics, notwithstanding Alan Guth's eternal inflation, something cannot arise from nothing. The universe is "no free lunch". The Causal Vehicle of Mahayana Buddhism would very much agree (Ch. 3).

Well, in purely physical time and space everything has a cause. That at least is objectively certain. Or is it? For the Quantum Theory of Bohr and Heisenberg it is not so. The determinism of classical physics and the indeterminacy (Heisenberg's Principle of Uncertainty) of quantum physics: strange bedfellows indeed. ("Quantum Nonlocality" below.)

This inherent quantum uncertainty at the heart of nature means that quantum theory is founded in a "built in", non-classical (non-distributive) probability theory (Fuchs, Caves, Qbism in Boaz 2020). The theory is probabilistic and indeterminate, which is, for Bohr and Heisenberg, the logically necessary incompleteness of any physical system (Gödel's Incompleteness below). This is of course a far cry from the uncomfortable comfort zone of absolute objective certainty demanded by classical empirical physics, for which Einstein was the ideological guru. Thus turncoat quantum pioneer Einstein hated it.

Heisenberg's quantum indeterminacy is interpreted by the faithful as a probability distribution of measurement outcomes of a "real", physical "observable". This is the objectivist-physicalist orthodox interpretation. Such complementary "observables" include particle position and particle momentum—the cognitive infernal machine of quantum wave-particle duality—the energy and duration of a given physical state.

Unlike classical quantities, quantum observables are “non-commutative”, that is, they cannot be observed or measured simultaneously ($AB - BA \neq 0$). It's not that we don't have enough *information* or data to measure both at once. It's a lot worse than that. Their quantities are *inherently* uncertain. Now that's spooky! The lovely absolute objectivity and causality of four hundred years of noble European Enlightenment physics is now kaput! Einstein's inner local realist hated it: "God does not play dice with the world".

Surely, Einstein reasoned, the world of physical nature is conceptually understandable. That is after all the essential assumption upon which the entire four century scientific "Enlightenment Project" endeavor is grounded; is it not? The diabolical acausal Quantum Theory has just derailed the greatest human intellectual achievement in the history of our species! And Einstein himself was the official guide. Little wonder he was a bit defensive.

Therefore, for the heretical Quantum Theory it is not possible to observe or to measure the full range of properties of the wave and particle at the same time. For example, we can measure the position of the particle absolutely, but not its momentum. We can measure the momentum of a particle absolutely, but not its position. The more accurate the measurement of position, the less accurate the measurement of momentum. And vice versa.

Probability theory to the rescue. QFT logically implies Metaphysical Antirealism; that we cannot assume that objects possess any properties at all, not even the property of spacetime existence, prior to a measurement by the subjective *consciousness* of an observer! Spooky subjective "consciousness" in objectivist physics? Einstein hated it.

It's beginning to look like the appearing objects of physical reality are dependent for their very existence, or at least for their observation, upon the *consciousness* of a sentient observer/measurer, whatever that might be. In other words, reality is essentially objective, physical and observer-dependent, in contradistinction to the view of both Newton's and Einstein's classical physics, and even of the "Core Theory" of Standard Model physics, that reality is observer-independent, intrinsically existing, whether observed or not; in short, a really RWOT. A mighty tree falling in the forest makes a real sound, whether or not there is an observer about to perceive it.

So, for Bohr, *if* subatomic particles come to exist in spacetime only through the medium of observation and measurement by way of an observer's consciousness—observer-dependently—*then* it makes no sense to ponder a particle's sovereign properties as ontologically existent prior to observation by the consciousness of an observer. This view, often called a nominalist, or instrumentalist, or operationalist ontologically and logically entails that particles—photons, electrons—are somehow interconnected, or entangled nonlocally, without local particle light signal contact. This view is ontologically antirealist. Einstein's innermost local realist hated it.

In 1928 this quantum weirdness would be finally formalized by Niels Bohr (Nobel Prize 1922) and his student-collaborator Werner Heisenberg (Nobel Prize 1932), the luminous founders of the instrumentalist, antirealist Copenhagen Interpretation of the quantum theory.

Most ideologically orthodox Local Realist particle physicists still assent to this antinomian antirealist metaphysical/ontic position—which means that they haven't a clue as to the philosophical implications of their discomfiting contradictory "local" belief system. I say, let

physicists read a qbit a philosophy of physics; even show up at their metaphysical "Mysterion" (thinking mind has a conceptual limit that points beyond the two valued logic of language) conventions.

It was Heisenberg's 1927 Uncertainty Principle (Principle of Indeterminacy) that described the matrix mechanical mathematics, precursor to Schrödinger's quantum wave function Ψ , of the strange measurement behavior of "non-commuting observables". We've seen that Heisenberg's quantum uncertainty explicates this *fantasque* non-commuting epistemic complementarity of such quantum observables, which exist only in subjectively connected "conjugate pairs"—"conjugant quantities", as in the wave and particle duality.

In other words, quantum wave function collapse at the instant of a measurement or observation by a sentient consciousness usually results in precise data; but not so for "non-commuting observables" such as particle position and momentum. Quite strangely, to objective super-logical concept mind anyway, they do not commute. Heisenberg's quantum uncertainty fundamentally limits the measurement precision of Bohr's "complementary variables" or conjugate variable properties/quantities such as particle position and momentum. The more precise the position, the less precise the momentum, and vice versa. When position is entirely determined by a measurement, momentum becomes entirely indeterminate. More cosmic irony. "What hath God wrought?"

Moreover, whether an electron is observed at position x, or position y is entirely random, that is, uncaused. Once again, quantum mechanics has demolished four centuries of scientific causality. The inviolable principal of scientific and commonsense cause and effect is empirically violated! Quantum weirdness indeed.

Great gravitational physicist John Wheeler opined: "Bohr's principal of complementarity is the most revolutionary concept of this century..." It is indeed the only holistic attempt to transcend the inherent conceptual dualism at the heart of obsessively objective Western Science, based as it is in the formidable two valued logical syntax of human language.

Remember that at the pinnacle of our Primordial Wisdom Tradition formless *ultimate* nondual reality—primordial awareness-consciousness being itself—arises and appears as form, a *relative* duality of participating objective and subjective dimensions of insubstantial, impermanent, physical objectively "real" existence. This spacetime existence is grounded in the numinous ineffable ultimate reality that is the formless emptiness base in which, or in whom it arises—be it empty ZPE quantum vacuum foam, or Buddhist boundless *shunyata* emptiness, or nameless Tao, or bright *kham brahm* that is Parabrahman/Nirguna Brahman, or God the Primordial Father (Jesus' *Abba*).

Any of these may serve as a *relative* conventional metaphor representing *ultimate* nondual primordial basal ground of all arising appearance—ultimate essence and nature of boundless whole itself that is "supreme source" of all this emerging stuff (Ch. 13 "Primordial Consciousness: Dzogchen Panpsychism").

Let's note in this regard that the domain of physics is not to establish or describe the ultimate *nature* or ground of matter. That remains the task of metaphysical ontology—philosophy of physics and cosmology. The task of physics is to describe the *behavior* of matter in the vast

causal matrix of physical space and time (if there is any causal spacetime). Physics cannot, and must not presume to tell us what matter is, but what matter does.

Unfortunately, conflating these two—*relative* empirical science and *ultimate* metaphysical reality conjecture and assumptions—has resulted in an abundance of discomfiting errors for objectivist physics, and for finite mathematics. Not the least of these errors is the failed paradigmatic "scientific" ontology that is the dogma of Western Metaphysical Scientific Local Realism and Scientific Materialism/Physicalism, as we have seen just seen above; and in Chapter 3 and 4.

The End of Objective Certainty? *Four 20th century mathematical discoveries have utterly demolished any "scientific" hope of absolute objective certainty: 1) consistent alternative geometries to Euclid's foundation; which one describes the real world?; 2) Kurt Gödel's two recursive 1931 Incompleteness Theorems; 3) the non-objectivist acausal nonlocal uncertainty of the quantum theory; and 4) the complete breakdown of finite mathematics at a black hole singularity, and at the Big Bang singularity origin of cosmos. Infinite singularities do not permit mathematical penetration. Infinity precludes finite conceptual ingress, pointing beyond to more subtle, more inclusive holistic theories. These discoveries continue to belie our hope of a scientific logical mathematical absolute objective certainty.*

Going beyond the limits of conceptual cognition I have here and elsewhere described as the *wisdom of uncertainty*. Such wisdom represents a post-objective cognitive aperture into that which is cloaked to human cognitive concept and belief, but not to human trans-conceptual, contemplative cognition. Cases in point: nondual Buddhist *Dzogchen* (Ch. 13), and *Advaita* Vedanta view and praxis.

But it gets worse for the ideologues of a purely physical objective "real world out there" (RWOT). It is beginning to look as if this universe is holographic. The *Holographic Principle* is a mid 20th century physics theory conjecture in which matter and energy within an in finite spacetime boundary region, a black hole, or the Big Bang origin of the universe itself, may be physically fully explained by the physics at the finite surface boundary of that region. Here the entropy of matter is proportional to finite surface area, not the volume of the infinite whole. Mass-energy volume—the "complete description" of the "primary qualities" of physical form, namely; size, shape, volume, motion, number and extension and dimension in space and time—manifest at the surface boundary or event horizon of the region as an illusory stationary hologram of the whole of these qualities and attributes.

Is our universe of space and time naught but a spooky diaphanous holographic illusion? Is a Local Realism interpretation of the Holographic Principle possible? Enter David Bohm.

By the late 1940's physicist David Bohm, colleague and pal of Einstein, had become entirely disillusioned, as was Einstein himself, with Niels Bohr's antirealist, instrumentalist Copenhagen Interpretation of the quantum theory. The 1951 publication of Bohm's textbook *Quantum Theory* became an immediate classic; yet Bohm no longer believed its acausal, antirealist conclusions. How is this so?

On Bohm's account, the "implicate unbroken whole" of this physical universe is a hologram. Not just a stationary hologram but a dynamical interconnected, even interdependent spacetime "holomovement".

Bohm was intellectually uncomfortable, as was Einstein, with Bohr's antirealist insistence that a physical particle with its *permanent* properties of mass, charge and spin, does not physically exist before it is observed by the consciousness of a sentient measuring experimenter. This view logically entails that subatomic particles are nonlocally, non-causally connected. How might an acolyte of Metaphysical Local Realism explain an objective RWOT that is somehow nonlocal? It was in this frame of mind that David Bohm went to work on holism.

Now if the micro particles that comprise the physical fields of spacetime reality don't exist before they are observed, that is to say, if reality is *observer-dependent*, then the stuff of appearing reality—our RWOT—cannot be objectively absolutely "real". Separate, independent "objects" do not, cannot exist outside of a conceptually ineffable subjective grounding relation matrix that Bohm was to call the "implicate order" of the "unbroken whole" itself, primordial ground of everything.

So do we just create our realities by observing, then cognitively reifying them, as the mystical Hindus and *Yogachara* Buddhists believe? Is physical reality but perceptual and conceptual imputation and reification, but nonexistent otherwise? That's way too "spooky" to believe for most of us skeptical closet local realists steeped in 400 years of European Enlightenment objectivist materialist Negative Cognitive Bias.

Moreover, Bohr and his Copenhagen Interpretation disciples believed that the quantum theory was "complete"—a theme variation on the "closure principle" bias of Metaphysical Scientific Materialism/Physicalism (Appendix B: "Idols of the Tribe")—so it is not empirically nor logically possible to penetrate more deeply into the quantum depths; no possibility of a physical or even metaphysical plenum, no substrate or ground beyond mere subatomic particle motion, no spacetime foundation, no hope of a quantum zero point energy field (ZPE) source, no "quantum potential" that pervades the infinite whole of spacetime, no holographic "implicate order of the unbroken whole". Bohr's instrumentalist, antirealist interpretation of the great Quantum Theory did not allow for much objective reality "out there". Both Bohm and Einstein hated it.

Neither of these classically indoctrinated geniuses could buy into such a negative, antirealist, anti-science pretense to knowledge. Therefore, Bohm had an ontological problem, and an epistemological problem. He needed a holistic ontic-metaphysical Local Realism interpretation of the quantum theory that surpassed even Bohr's nonlocal holistic Principal of Complementarity, and included a new paradigmatic opening into an infinite "implicate order" of the whole holomovement, but dodged the epistemic antirealist and instrumentalist anti-metaphysics of the Copenhagen Interpretation. In short, Bohm needed a consistent realist nonlocal theory. No small order.

So David Bohm developed a local-nonlocal hybrid; a holistic nonlocal realist *observer-independent* ontology wherein subatomic reality is really "real" even in the absence of a quantum observer's perceiving consciousness. He desired an ontology that pointed to a subtler, deeper strata of formation, a ground that is the very "unbroken whole" of this continuously arising

physical-mental infinite universe; an "implicate" primordial ground that enfolds all of "explicate", but inherently local sub-light speed spacetime physical reality—that is, a really real reality connected by local information light signals that could explain the apparent nonlocality of the pre-QED Quantum Theory.

Can Buddhist Philosophy Help? Bohm's centrist view between the two extremes of Bohr's instrumentalist spooky antirealism and Einstein's absolute permanent Local Realism is not at all dissimilar to the Nonlocal Realism of Middle Way *Madhyamaka Prasangika*, the very foundation, according to H.H. The Dalai Lama, of the nondual *Dzogchen* view; the acausal Great Completion (Ch. 13) of the Two Truths duality that is the Buddhist Mahayana Causal Vehicle.

For Bohm, by 1980 with the publication of his seminal *Wholeness and the Implicate Order*, the entire physical universe is seen to be a primordial, all embracing dynamical "holomovement", an enfolded "implicate order" or aboriginal ground of infinitely embedded arising reality in which the "explicate order" of spacetime stuff is a dynamic holographic illusory image outpicturing the "vast implicate order of the unbroken whole" itself. *Prima facie* this illusory vast holographic boundless whole is Metaphysical Idealism—relative spacetime reality is ultimately a nonexistent illusion. But for Bohm the unfolded, seemingly nonlocal explicate order must be locally real, an objective physical RWOT.

This ontic strategy parallels the Two Truths trope of centrist Middle Way *Madhyamaka Prasangika*, namely, the *relative local explicate order* of objectively real spacetime reality; and the *ultimate nonlocal implicate order* of the vast unbounded whole, primordial ground itself. So far, so good.

Just so, from the implicate order of a holographic film arises an encoded permanently embedded explicate holographic image of its more fundamental ground. But this image is static. It cannot represent the infinite dynamical motion of spacetime arising from its implicate ground.

Therefore Bohm has termed the holographic nature of cosmos a "holomovement". As each part of a holographic image enfolds the whole image, each part of the holomovement enfolds the "vast unbroken whole" of reality itself.

Mereologically (the study of part-whole relations), each subatomic particle is transcended yet embraced by its particle, who is included by its atom, included in its molecule, then its cell, organism, culture, planet, always embraced by a greater whole. Macroscopically, our galaxy is transcended yet embraced by the great galaxy clusters, then the whole universe, and that by an infinity of universes—the multiverse, as the case may be. The "three times", past present and future, are always already enfolded in the infinite fullness of the great plenitude that is boundless emptiness of the whole shebang, whether we name it *mahabindu*, *mahashunyata*, *dharmakaya*, Tao, *Nirguna Brahman*, or nondual godhead (Primordial Father). Even post-Standard Model quantum ZPE zero point energy field that sparks the worlds of form arises from its prior formless emptiness ground.

Once again, as Buddha told in his sublime nondual *Heart Sutra*, "Form is empty; emptiness is form. Form is not other than emptiness; emptiness is not other than form". Infinite implicate

empty, formless wholeness manifests as this finite multiplicity of cosmic stuff, the instantiated participating parts, without ever departing the unbounded whole itself—no ultimate separation at all.

For 2nd century Nagarjuna, founder of the Buddhist Mahayana Middle Way, "There is not the slightest difference between samsara and nirvana". *Kahm Brahm*, "Braham and the world are one". For Jesus, "That which you seek...the Kingdom of God...is already present within you...and it is spread upon the face of the world, but you do not see it".

Further, just as every part of a holographic film displays the entire original image, so physical reality is inherently acausal and nonlocal at the fundamental *ultimate* strata of its implicate order, while displaying locally at the explicate *relative* strata of space and time. Mahayana Buddhists will agree.

However, we must always remember that this apparent dichotomy or duality of relative-explicate and ultimate-implicate are already a prior ontic and always present epistemic and phenomenal unity. The implicate order of the whole is *ultimately* unbroken, already embracing all of its relative parts. We separate these Two Truths discursively, conceptually and potentially misleadingly in order to better understand the unity of the whole, which then feeds back to enhance our relative knowledge. *We reflexively, recursively re-cognize the great whole through cognizing the nature and behavior of its parts, while always remembering the prior, complementary ultimate unity. Perhaps this is our relative and ultimate yoga as human beings being here in time.*

But dualistic one dimensional Western Science generally fails to cognitively unify that ontic reality which it has theoretically torn asunder. Then, adding epistemic insult to ontic injury, it reduces (scientific reductionism) the great implicate order of the whole to nothing but subatomic qbits, ignoring, explaining away or denying their original ground in which, or in whom the unfolding parts arise and participate, including all of us cognizers. This alarming process demonstrates a perilous and most destructive ignorance (*avidya, hamartia/sin*) due to the subtle duplicity of human cognitive "confirmation bias". Such ignorance masquerades as objective quantitative science while preaching gross qualitative unconscious metaphysics, namely, materialist-physicalist-objectivist ideological orthodoxy. Ken Wilber's destructive "hidden metaphysics" indeed.

The unlikely cure? Radical skepticism as to our own inherited "global web of belief" (Quine 1969)—our personal, well defended concept-belief system biases. The red flag of defensive impatience/anger is the alert to a breach in our ego defenses.

The powerful desire that our biased web of belief be objectively "true", does not make it so. Intellectual and ethical honesty require that we, as imperfect self-ego-I beings remain present to this still small voice of our always already present Primordial Wisdom Mind—bright Presence of That. Not so easy. Mindfulness makes it happen.

Holistic Eastern philosophy, broadly construed, has no such bias. As East meets West the profound, preconscious objectivist-physicalist bias of science, along with its taboo of *a priori* subjective, even contemplative knowledge characteristic of the current "hard" paradigm in

physics and academic philosophy, shall yield to the "soft" cognitive subject-object noetic doublet now emerging in our inchoate 21st century Noetic Revolution in science, culture and spirit.

The Modern European Enlightenment ideal of reducing the perfectly subjective infinite implicate-ultimate reality dimension to the dimension of objective, finite explicate-relative, purely physical spacetime matter-energy subatomic qbits has stalled not only the intellectual evolution of physics and cosmology, but our human psycho-emotional-spiritual evolution as well.

Michael Talbot, in his lucid and most readable book *The Holographic Universe* (1991), has distilled for us the infinite interdependence of these two dimensions—analogue to the Buddhist Two Truths trope—formless implicate Ultimate and explicate Relative spacetime form (Ch. 2).

For example, we know that a subatomic particle may manifest as either a particle or a wave. Both its relative wave and particle identities are *ultimately* enfolded in the primordial implicate order of Bohm's "vast unbroken whole". But the *relative* mathematical dynamics of a particle's finite interaction with the consciousness of an observer-experimenter determines which face—wave or particle—shall be revealed and displayed.

Recall that in the physics of wave-particle duality, light-energy travels as its wave form, but is emitted and absorbed in its particle form. Both are forms or voices always already enfolded in the timeless nondual infinite implicate order of the boundless unbroken whole itself, original ground of all of this explicate arising of being in spacetime form.

Certain finite bounds hold against the utterly uncertain trans-rational chaos of the infinite whole. But for our indwelling *Bodhi*-Wisdom Mind, chaos is after all ultimately an orderly situation. We have a qbit of finite free will to choose the trans-conceptual certainty of our innate infinite Wisdom Mind, knowing open Presence (*vidya*, *rigpa*) of the implicate Ground of being itself; just beyond our relative explicate "global web of belief" (Quine 1969). The requisite contemplative method in the Buddhist tradition is mindful *shamatha* and the penetrating insight of *vipashyana*. Through this skillful method we may, if we choose to do so, establish a practice refuge from this chaos of being in form—a protected space in the mind in which to be happy.

Moreover, as we have seen, this holographic implicate order of the vast whole is *ipso facto* the nonlocal interdependent ground of its not separate yet locally appearing explicate manifested particular instantiations. The ultimate great non-causal nonlocal implicate whole is greater than, and subsumes and embraces the cause and effect manifested relative explicate parts of "common sense Realism", and of parallel Scientific Local Realism. This ultimate mereological relationship of part to whole is, in a word, a relation of *identity*; or nondual unity, when we remember.

Once again, "Who am I?" *Tat Tvam Asi*—That I Am! *That* is our "supreme identity". Such infinite wisdom insight transcends yet embraces our finite intellectual understanding, just as the parent's mind embraces the mind of the child, but not the other way round.

Be that as it may, Bohm tells us that it is misleading to speak of a cosmos that is fabricated of separate parts. Classical (non-quantum) elementary objective, physical point like micro particles and their proto-subjective quantum fields are necessarily the unfolding explicate instances of the infinitely interdependent interconnected implicate "holomovement", nondual boundless unbroken

whole that forever enfolds dualistic broken spacetime reality, and our dualistic binary thinking about it.

Yet, for Buddhism and for Bohm this misleading epistemic abstraction that we insist on imputing and reifying into objectively real only physical objects or "things" is not *ultimately* just a holographic illusion, the *avidya maya* of Indian Metaphysical Idealism. It possesses its own conventional explicate *relatively* really real local reality—a RWOT (real world out there). Had Bohm studied Middle Way Buddhist philosophy he would have enjoyed this prodigious ontic parallel to his work. Indeed, it may well have improved his work. Science, mathematics, philosophy—all relative voices of ultimate Wisdom Mind that we are.

Bohm strived valiantly to accomplish the difficult metaphysic of Local Realism; again similar to Buddhist Nonlocal Realism of the Two Truths Middle Way *Prasangika* philosophy and practice (Ch. 2 and 3 above). One cannot but wonder what Bohm's beautiful holism in *Wholeness and the Implicate Order* might have looked like had he consulted a *Madhyamaka* Buddhist Master as to nonlocal Realism of Middle Way Two Truths reality.

Hence, Bohm spent his later years in reaction to Bohr's quantum notion of an observer-dependent reality—roughly, that spacetime stuff cannot exist before it's observed by a sentient observing, measuring consciousness. Bohm seeks an observer-independent Local Realism. But he does not fear the spooky idea of "consciousness". Indeed, Bohm's work may be understood as an attempt to integrate objective physics with the much feared subjectivity of "consciousness", objective, exoteric eternal nemesis of Western physical theory and praxis.

Bohm's proto-monistic panpsychic-cosmopsychic view (Ch. 13) is that finite subatomic objective physical reality and the non-separate subjective human and animal consciousness that perceives and observes it are both aspects or faces of the vast holomovement itself, infinite implicate order of the "unbroken whole" itself.

Indeed, for Bohm, who lived most of his professional life believing that human consciousness is either reducible to matter, or a subtle aspect of matter (constitutive panpsychism), came late to see that matter is indeed a physical instantiation of immaterial awareness-consciousness-being itself (monistic cosmopsychism, Ch.13)); and further, that human consciousness is an exoteric explicate instance of the nondual, innermost esoteric implicate order of this perfectly subjective primordial awareness-consciousness ground, rather than the other way round. Bohm goes so far as to say that the Implicate Order might be called "Spirit" (Hiley and Peat, *Quantum Implications*, 1987). More on David Bohm's attempt to save objective reality below in "Bohm's New Order: Saving the Appearances".

Well, was Bohm successful in his local realist effort to save the appearances of an otherwise illusory reality? The new "Holographic Paradigm" in physics has largely ignored Bohm's noble travail toward a consistent Local Scientific Realism. Astonishingly, post-Standard Model, "post-empirical" physics is trending toward a proto-Idealist nonlocal realist view that the entire physical cosmos is reducible to a diaphanous holographic type illusion! Both Newton and Einstein would have hated it.

We'll see in a moment that 21st century post-Standard Model physics has now largely forsaken its commitment to an observer-independently real local time and local space. Absolute

objective reality wherefore art thou! Old paradigm Metaphysical Scientific Materialism/Physicalism, and Holographic Idealism—strange bedfellows indeed. Post-Standard Model, post-objectivist physics just gets curiouser and curiouser.

Once again, I call for theoretical physicists, quantum cosmologists, philosophers of physics and cosmology, and Buddhist scholar-practitioners to dialogue over luncheon of apple pie and vintage port. Alas, for those of us who have not the tongues of spooky nonlocal metaphysics, nor the guts for rough hewn large ego debate, it might seem a bit like lunching with Richard III, or King Lear.

My own cognitive biases being as they are, I think that the nondual wisdom of the *Dzogchen* Buddhist contingent may "shake all that can be shaken" (Dōgen Zenji) of any remaining objectivist-physicalist bias closeted within the mathematical physicists "global web of belief" (Quine 1969).

A new reality knowledge-wisdom paradigm is emerging for Western science and culture. My argument hitherto, and indeed the titular theme of this book is that the objectivist metaphysic of Local Scientific Realism and Scientific Materialism/Physicalism represent a failed foundational ontology, and thus a failed epistemology for Science. Enter from above, our inchoate 21st century Noetic Revolution in Science, Spirit and Culture (Boaz 2020) wherein post-materialist, "post-empirical" physics, and Buddhist *Dzogchen* monistic cosmopsychism view and contemplative practice befriend one another (Ch. 13).

But first let us penetrate more deeply into our incipient post-quantum, post-Standard Model emerging physics paradigm, with a mind toward syncretic objective and subjective complementarity—even nondual unity.

Intimations of the Prior Unity of Science and Spirit. The Holographic Principle arises auspiciously in post-Standard Model Supersymmetric Superstring-M Theory models of Quantum Gravity (QGT). This refreshing trans-objective, proto-Idealist Principle was discovered by neuroscientist Karl Pribram, physicist Gerard 't Hooft, and adapted to String Theory by Leonard Susskind. And as we've seen, David Bohm made it nearly impossible to ignore the "hidden nonmanifest implicate order of the unbroken whole", infinite nondual perfectly subjective primordial ground in whom this all arises. This view is a Western parallel of our Primordial Wisdom Tradition nondual holism. However, the old classical paradigm is still alive and well in much too much recent theoretical physics.

Hence, fifty-six years after John Stewart Bell's 1964 spooky proofs for nonlocality and thus the logical impossibility of any local realist "hidden variables (λ)", our goal must be both the epistemic theoretical-mathematical, and the ontic metaphysical unification of: 1) the prodigiously practical benefits of the quantum—quantum computing, quantum microscopy, the laser, totally secure quantum cryptography, not to mention the not so practical nuclear bomb; 2) the perplexing incompleteness of that Quantum Theory of Bohr, Schrödinger and Feynman; and 3) the vexing philosophical void as to a settled ontology of what the Quantum Theory (QED) actually means for the essence and nature of appearing spacetime reality.

Is reality only objective and purely physical—Metaphysical Scientific Materialism/Physicalism (roughly Local Realism), Einstein's classical pre-quantum view—or is it Bohr's instrumentalist Antirealism; or perhaps a nice Buddhist centrist Middle Way between these two? Until we resolve such cognitive conundrums in a holistic nonlocal view there can be little progress toward a unified Theory of Quantum Gravity (QGT).

Let us here avoid the non sequitur that holds that we must first fabricate a consistent QGT *before* we can resolve the attendant metaphysical problems. This is placing the epistemological cart of relative theory and belief before the ontological horse of ultimate truth.

To be sure, these two are always already an interdependent unity. But we must first order our methodological priorities. That is to say, post-Standard Model physics must put its ontic house in order, and settle upon a consistent quantum ontology. A mathematically consistent QGT shall then follow, if it logically possible at all.

But is a mathematically consistent QGT possible given the very real limits of mathematical logic? Recall, the 1931 work of Kurt Gödel—his two legendary Incompleteness Theorems—and later his 1936 collaboration with J. Barkley Rosser which produced the much improved Gödel-Rosser Incompleteness Theorem (Ch. 4). This monumental discovery reflexively (using logic to deconstruct its own axioms) demonstrates that mathematical logic is logically incapable of accomplishing such a task in mathematical completeness.

The great David Hilbert, Einstein's pal and rival, in 1915 to be the first to publish a General Theory of Relativity, spent his life in quest of a complete and consistent "finitary", non-reducible axiomatic set that included all of mathematical logic. Classical mathematics must be formalized in a complete system that includes all of the propositional content of finite number theory. Indeed, a noble, but metaphysically fraught consummation.

Hilbert is usually seen as an instrumentalist due to his view that this propositional content, the real and ideal statements, "have no inherent meaning in themselves". In short, mathematics is an instrument. The propositions of transfinite mathematics have no truth value beyond their internal consistency. However, this should not be construed as nihilistic skepticism as to the local reality of material existence. Hilbert was a Scientific Local Realist, in the mode of his friend Einstein. His instrumentalism was methodological only.

Kurt Gödel's work in Incompleteness Theory was motivated by the classical bias of "Hilbert's Program"; and is nearly universally interpreted as having "proved" the metaphysical conjecture that Hilbert's optimistic, Kantian intuitionist grail quest for a classical formalization of all mathematics in an axiomatic form is finally and forever *kaput!* One hundred years later it appears that it is.

We must always ask in this regard, should the formal consistency of any mathematical system constitute a definition of the truth of the finite objective existence of the pre-formal numbers, the data that it systematizes? What then is the ontological status of these mathematical bits, objectively real or subjectively ideal; and what is their place in the whole system or process of human cognition? Heady questions for philosophers of mathematics; and not for metaphysically timid. But beyond our scope here.

Great logician/mathematician and philosopher of mathematics Sir Bertrand Russell's "Russell Conjugation" addresses the problem of the limits and incompleteness of absolute logical consistency in human cognition. His "Concept A": Human cognition consists of: 1) objective factual, logical content and methodology; and 2) subjective emotional content and methodology —how does one *feel* about these facts?

These two modalities of human cognition are inherently an interdependently prior and present unity. So, our knowing of arising physical, mental and emotive reality is much more than what we think we know merely objectively, factually and logically. The rest of human cognition is subjective, emotional, even spiritual. We always interpret our facts emotionally, although not always consciously so, and such feeling states feed back to influence the objective "facts". In short, these two are intrinsically interconnected.

If we must view this process in a linear manner, metaphysical cognition often begins in our *feeling* states about our experience; but the process works both ways. This twofold cognitive process—1) and 2) above—facilitates an understanding and acceptance of inevitable, "all too human" cognitive bias.

Perhaps, as we transition into the new 21st century noetic (body-mind-spirit unity) wisdom paradigm we shall now at long last recognize that no mathematical theory shall result in a unified Theory of Everything, especially in its QGT cloak. Logic is but a fragment of the story of human cognition. "Spooky" Metaphysical ontology, like it or not, completes the story.

Planck, Bohr, Heisenberg, and Schrödinger understood the radical non-objective *ultimate* nature of *relative* conventional spacetime reality. Einstein did not. Dirac did not. Susskind has not. Weinberg? Who knows? Who shall rise to this occasion? There are now abroad in the upper strata of our cognosphere young new paradigm physicists who are not frightened by metaphysical ontology, and are thus learning philosophy of physics, including Buddhist *Dzogchen* syncretic wisdom; precious few of them. A few philosophers of science have a deep understanding of the requisite physics and quantum cosmology mathematics. Let's move some of these folks into physics departments in order to expedite this coming re-unification of physics and philosophy. After all, physics was a branch of philosophy for four centuries of European Enlightenment Modernity. Let philosophy, both West and East, guide physics once again.

We have seen that the Bohr-Heisenberg 1928 Copenhagen Interpretation of the quantum theory makes no ontological assumptions about a "real", inherently existing objective physical reality "out there", nor the objective existence of such a world's elementary particles. It is rather, a nomic speculative theory about the cognitive relationship of the consciousness of the observer/experimentor to quantum event information and its measurement in time.

Bohr ultimately concluded that the purpose of physical theory is not the discovery of new intrinsic truths about a representational pre-given, pre-existing observer-independent reality "mirror of nature" (Rorty), but rather to clarify and explore the relationship of our cognitive perceptual and conceptual structures—our consciousness—to the quantum information bits (qbits, *visana*) arising from a presumed physical atomic baryonic reality base—a RWOT (*Atomic Theory and the Description of Nature*, 1934).

This vital, ontologically relative, antirealist, nominalist alternative philosophy of physics—that the theoretical constructs of physics (particles, waves, fields, forces) are but pragmatic, descriptive instruments, and not independently objectively real "things" or "objects" is called Instrumentalism, or Nominalism, or Operationalism. It is opposed by the local Neorealism of Einstein, Bohm, and the "hidden variables" realists, and by the stochastic "Probable Realism" of Pragmatist C.S. Pierce. Not to mention our massmind "Common Sense Realism"—Sir Bertrand Russell's "metaphysics of the Stone Age".

Bohr, Kuhn, Quine, Maudlin, Callander and many other philosophers of science have pointed out that the laws of physics are highly idealized nomological (law like) cognitive constructs that describe the *quantitative* behavior of appearing material objects within the context of a theoretical model, but do not descriptively, and should not prescriptively or *qualitatively* presume to describe an essentially existing ontological nature or essence or an observer-independently existing reality, let alone an impudent logically impossible Theory of Everything (TOE).

Recall in this connection, that the proper concern of Science is to describe what relative appearing spacetime reality *does*, how it behaves; not what it is; its ultimate essence and nature. That remains a question for speculative metaphysical ontology.

Thus has scientific objective certainty fallen on hard times. Ontology is the crucial post-empirical dimension of metaphysical speculation that undergirds such judgments. Perhaps it goes without saying, but we need both. Objective and subjective. Valorizing and idealizing one voice of human cognition over against the other is an all too common form of ignorance (*avidya*, *ajnana*, *hamartia*/sin

Therefore, the laws of physics are idealized models that are limited to their mathematical formalism, and cannot, *ipso facto* causally enrich speculative ontology. Scientific laws provide pragmatic, nomic, exoteric, relative-conventional and conditional explanations of phenomena arising in and through the conceptually ineffable ultimately subjective Kantian *noumenon*—innermost esoteric basal primordial ground state matrix that is Plato's First Principle—prior to the "ambiguity barrier" created by the phenomenological limit of conceptual, discursive theory and belief. To penetrate this ostensible barrier we must utilize first person, introspective, transpersonal, even trans-conceptual contemplative technologies, as in for example Buddhist contemplative mindfulness meditation practice (Appendix D, E).

Quantum Uncertainty Revisited. Together the two pillars of the Quantum Theory—Heisenberg's Principle of Uncertainty and Bohr's Principle of Complementarity—are foundational to the emerging proto-subjectivity of any propitious quantum theory ontic interpretation, and to the objective mathematics of quantum mechanics that opens it to a post-classical compatible theory of gravity, to wit a consistent QGT.

Quantum theory now has a dozen or so epistemic and ontic interpretations. ("In search of a post-quantum ontology", below.) Which one shall we merge with Dr. Einstein's GRT gravity? You can see the problem. Physics must get its quantum house in order. *A consistent theory of Quantum Gravity will arise when a viable quantum ontology is settled.*

It is urgent in this regard to identify the two inter-dimensional cognitive features of the Quantum Theory: 1) the *objective* mathematical formalism and methodology of quantum mechanics—matrix mechanics and Schrödinger's wave function Ψ ; and 2) the theory's *subjective* philosophical interpretation—metaphysical-ontological. The former is objective; the latter provides subjective speculation as to the theory's *ontic* implications for the ultimate nature of the whole of reality itself, and the *epistemic* challenge, how we shall know it. These two faces of the theory are interdependent and must be considered as a prior whole. It is most important to understand this unifying point as we and differentiate the two, lest we conflate, reduce, and pathologize too much.

Bohr's complementarity view was in this regard an astonishing bit of wisdom virtuosity, especially considering the fraught mechanistic physics culture of the times. But we must augment his proto-nihilist instrumentalism with a centrist middle way view—something between hard materialist mechanism, and soft flaky instrumentalist nihilism.

In short, we need a subtle wisdom view that balances the two metaphysical extremes of objective permanent eternal existence (Metaphysical Materialism/Physicalism), and nihilistic non-existence (Metaphysical Idealism). Something like the Buddhist Mahayana Two Truths—Relative and Ultimate—that we encountered in Chapter 2 and 3.

Recall that this Two Truths trope understands the appearing spacetime forms of *relative* reality as an explicate material really "real world out there" (RWOT) arising and being in the all embracing primordial ground of the vast, formless, implicate unbounded whole itself. But these forms of existence being here in time are "absent and empty any trace of intrinsic reality".

That great interdependent whole utterly transcends yet includes and embraces the instantiated physical and mental parts arising therein. Remember that these two reality dimensions of the boundless whole are not essentially separate. They are an ontologically prior and epistemologically present unity.

As Gautama Buddha told: "Form is empty; emptiness is form". These realms are always already a unity. We are in no way separate from That. Form arises within the basic space of emptiness; and has never departed it.

The Quantum Theory and Einstein's relativity theories attempt to describe the physical behavior of the spacetime dimension of Relative Truth—matter and energy as it arises continuously from its primordial ground.

Two "Perfect Theories". The almost infinitely tiny scale that is the Planck length (10^{-35} meters) is defined by three fundamental physical constants—the velocity of light c in the vacuum of space; Newton's gravitational constant G ; and Planck's own constant h , the quantum of action itself. Matter-energy has a dual nature; it is both wave *and* particle. In a word, Bohr's complementarity.

This mysterious, proto-mystical Quantum Theory provides our present theoretical understanding of the arising, the nature, and the structure of the microscopic subatomic world, all

the way back the beginning, if there was one; and thus of our macroscopic world all the way up to cosmic large scale galactic structure, black holes, and beyond to the very fate of cosmic structure two or three trillion years hence.

Newton's gravity G of Einstein's GRT, and the Quantum Theory in its Quantum Field Theory (QFT, QED, QCD) incarnation, are the two foundational pillars of physics. The mathematical incommensurability of these two has created a conceptual nightmare, and a profound opportunity for quantum cosmology, as we shall see. The quantification of gravity, if it is indeed quantifiable, is physics' grail quest. What seems lost in this frantic quest for absolute objective certainty is the remembrance that mathematics itself is inherently incapable of it. What to do?

The Nature of the Quantum: Objective and Subjective. What *is* this diaphanous quantum, really? Its etymology is the Latin *quantus*, “measure of quantity”. But is quantum reality a real *physical* entity; a kind of spacetime stuff? No. It is a concept, a mathematical formalism, a *measure* of the minimum quantity of energy in any physical interaction. It is thus a “hypothesis of quantization” that limits the magnitude of any physical property to certain discrete energy level values; the minimum value of any physical entity in a given physical interaction. The quantum is not a thing, or an object but a *measure* of things and objects. The main problem with Quantum Theory is, as we shall see, the elusive "measurement problem" that teeters precariously at the margin just between objective and subjective cognition.

What does this all mean for ontology; the inescapable question of what actually is, the real, or antireal *ultimate* nature of arising physical and mental reality; and for our ethical choices? Plato told it well: "No small matter is at stake; the question concerns the very way that human life is to be lived" (Republic Book I). This is the subjective qualitative wisdom aspect of being arising from our quantitative calculations. If we desire to know the whole shebang, then we must engage both faces of our human cognition—objective and subjective. The Copenhagen School's evasive dictum, "Shut up and calculate" is an instrumentalist obscurantist ploy to dodge the inevitable qualitative questions of our being here in spacetime form. Human being in time requires post-calculation aesthetics and ethics; does it not?

Is all this arising experiential mental and physical stuff merely physical, or ultimately reducible to physical brain structure and function, as the prevailing objectivist functionalist philosophy of Scientific Materialism/Physicalism would have it? Is that all we are, Lewis Carroll's (Alice's) reductionist purely objective “bag of neurons”. Perhaps there are more things in heaven and earth than are dreamt of in our materialist philosophies.

We are now prepared to enter into these two reality dimensions—the Two Truths that are Relative and Ultimate, exoteric objective explicate and esoteric subjective implicate—of the great nondual noetic whole itself, the very nature of mind, ultimate Big Mind, with its myriad relative Small Mind arising multiplicity—multidimensional world of our received objective and subjective experience.

First, let us revisit the structure of the ontic and epistemic failure of the old Enlightenment Metaphysical Scientific Materialism/Local Realism paradigm that has resulted in our present

Kuhnian "scientific crisis", with its subsequent 21st century "Noetic Revolution" in science, spirit and culture (Boaz 2020).

Our goal shall be clarification of the past waning scientific paradigm—the mathematical incommensurability of quantum theory with the gravity of General Relativity—with an eye toward a *noetic reconstruction* that advances the wisdom of uncertainty; the exoteric relative uncertainty in quantum nonlocality; and the noetic uncertain leap into our trans-conceptual Wisdom Mind.

Next, we shall revisit the Mahayana Buddhist Two Truths nonlocal realist metaphysic that will map conceptually onto the new emerging post-Standard Model physics paradigm. Let the outcome serve as an admittedly fragmentary foundation for the incipient Noetic Revolution that is now abroad in our human wisdom cognosphere. A fraught and ambitious metaphysical labor, to be sure.

Quantum Nonlocality/Entanglement: The Collapse of Local Objective Reality. "Local Realism" is the ontological "global web of belief" (Quine 1969) that unites Metaphysical Realism/Scientific Realism (a physical, observer-independent real world out there-RWOT) with the relativistic "Principle of Local Causality" (local causal action)—cause and effect—every effect has a prior cause.

Quantum nonlocality is, broadly construed, quantum entanglement (holistic interconnectedness). "The essential fact of quantum mechanics is entanglement...the glue holding spacetime together" (Leonard Susskind). For bestower of the quantum wave function—Erwin Schrödinger and his prodigious quantum wave function equation (Ψ)—"Entanglement is the defining trait of quantum mechanics, the one that enforces its entire departure from classical (physics)".

Leading edge philosopher of physics Tim Maudlin (2011) states the paramount importance of quantum entanglement/nonlocality for recent physics: "The discovery and proof of nonlocality is the single most astonishing discovery of twentieth century physics." "Quantum entanglement is responsible for connecting up spacetime into one piece" (Mark Van Raamsdonk). Ernst Mach, mentor to Einstein: "We reach our ideas of spacetime in and through the interdependence of all things on one another".

Holistic quantum entanglement reveals the intimate interconnectedness and interdependence (Middle Way Buddhist *pratitya samutpada*) of all of the relative parts, the multiplicity of particulars of the unitary primordial unbounded whole (*mahabindu*) in which, or in whom they arise.

Holistic quantum entanglement occurs when a physical quantum system consisting of a pair or a group of particles interacts such that the quantum state of any particle cannot be determined independently of the other, or others, but must instead be determined by the system as a whole.

This holistic constraint obtains even when the particles of the quantum system are "spacelike separated" by huge superluminal intergalactic distances. The rub? Astoundingly, particle A in an

entangled two-particle system “knows” the measurement outcome of particle B although no information signal, no electromagnetic/light causal connection has traveled between them. They are thus connected via some weird nonlocal, non-causal superluminal “spooky action-at-a-distance”. Einstein hated it.

Newton’s gravity is a classical (non-quantum) physics example of such inexplicable action-at-a-distance. It functions instantaneously with no electromagnetic signal transfer. This acausal weirdness—the earliest intellectual tension between locality and nonlocality—concerned Newton greatly. But he did not attempt to explain it, or to explain it away. Wisely he capitulated to the eternal great gravity mystery: “I feign no hypotheses”. “Whereof one cannot speak, one must remain silent” (Ludwig Wittgenstein).

Thus the “individual” particles of such quantum states cannot be separate, but must interact as part of a vast interconnected whole! Such “spooky action” drove the great local realist mind of Einstein to distraction. We are beginning to appreciate the inherent limit of binary conceptual objective cognition, devoid of its cognitive intuitive subjective counterpart.

Bohr's great breakthrough was to point out that all such dual cognitive pairs—objective and subjective, position and momentum, particle and wave, true and false, existence and non-existence, finite and infinite—are, from a holistic inclusive perspective, complementary. The inherent dualities of the cognitive dimension of spacetime form, or Relative Truth, are transcended yet embraced in the subtler unity of the all-inclusive dimension of Ultimate Truth, a deeper ontic strata of formation, even of a formless, timeless ground of being, by whatever concept, belief or experience.

Thus it is, in the world of spacetime Relative Truth an observer’s consciousness—by whatever problematic definition—is inherently, cognitively entangled/connected to the boundless whole of the observed cognitive, connotative, affective system; in a word, holism. This prodigious quantum wave function (Ψ) formalism is mathematically and philosophically consistent with Bohr’s complementary wave-particle duality of light; Heisenberg’s matrix mechanics uncertainty relations; philosophical indeterminism; and holistic non-causal quantum non-locality of a hitherto spacetime *local* atomic particle. To wit, the particle *is* the quantum wave function. Indeed, as to ontology, the universal wave function Ψ is all there is.

The existence of Ψ superposition states—all possible states for a particle before measurement by a consciousness “collapses” or “decoheres” Ψ into a “real”, objective, even physical spacetime particle *eigen* state—is a logically necessary result of wave-particle duality. (Recall, light travels as a wave, but is absorbed and emitted as a particle.)

We’ve seen that light is *both* a particle and a wave. Again, this fact is an exemplar of Bohr’s great quantum Principle of Complementarity: some object relations in nature have inherently complementary (dual) properties that cannot be observed or measured simultaneously. We’ve also seen that these properties are called “non-commuting observables”; e.g., the persistent dualities of particle position/momentum, of entanglement/coherence, as well as wave/particle.

Therefore, Bohr’s *Principle of Complementarity*, with Heisenberg’s *Principle of Uncertainty* (indeterminacy)—these two prodigious pillars of the quantum theory—are inherently “real” qualities/relations of nature. Appearing spacetime reality is intrinsically *observer-dependent*! All

this of course, contradicts the classical (non-quantum), determinist, *observer-independent* metaphysic of Newtonian, and even of Einsteinian relativistic mechanics. Spooky new knowledge paradigm indeed. And none too soon.

It was this “lucid mysticism” (Pauli) of the Bohr-Heisenberg collaboration with its holistic quantum entanglement/nonlocality—Einstein’s “spooky action at a distance”—that begat the catastrophic violation of the essentialist scientific realist relativistic *principle of locality* (principle of local causality): no signal or causal information between “space-like separated” particles can exceed Einstein’s light speed limit; yet superluminal speed seems required for one entangled particle of a two part quantum system “singlet” pair to *instantaneously* “know” the spin state of the other particle, even when separated by many light years.

Metaphysical Local Realism is what one does to dodge spooky quantum nonlocality and give us all a cognitively safe local place to hang out. Locality provides stuff a place to be! For physically embodied consciousness instantiations this seems—*ceteris paribus*—like a great idea. How could it be otherwise? How indeed?

All things being equal, spacetime stuff is never conceptually equal. It's locally and nonlocally entangled. Stuff is interdependently entangled in the vast nondual whole in which, or in whom this all arises.

The "spooky" antirealist, indeterminist, observer-theory-dependent *principle of nonlocality* is the natural result of quantum entanglement. Thus, quantum entanglement is an acausal or *non-causal* connection between two particles of a singlet quantum particle system, due to a shared two-particle wave function Ψ that may, quite counter-intuitively, instantaneously, superluminally bridge light years of “spacelike” distance. Wow! Good old fashioned prosaic Metaphysical Local Realism sure seemed a lot more sane. Is seemingly unnatural quantum entanglement the price paid for our incessant quest for perfect objective certainty? The irony here is thick enough to drown in.

Einstein’s deep realist faith that the antirealist, instrumentalist (forget ontology, “shut up and calculate”) 1928 Bohr-Heisenberg Copenhagen Interpretation of the Quantum Theory was “incomplete” was founded upon the two foundational metaphysical assumptions of Isaac Newton’s marvelous classical consilience, the determinist physics of: 1) *objectivity*, mass or atomic reality is purely physical and objective, that is, it exists observer-independently of any conscious observer; and 2) *locality* of the laws of physics—everything happens locally via cause and effect contact among moving bodies.

Einstein’s two aspects of locality: 1) *separability* of local objects, and 2) the “principle of local action”, or the *principle of locality* (locality means sub-light speed local relativistic causality) which stipulates that mechanics—motion of atomic/subatomic particles—must be local; action among atomic baryonic *objects* occurs only through direct local contact via an information signal. This means that any nonlocal “action at a distance” (classical Newtonian gravity "Big G" notwithstanding) must occur through a causal information bridge that connects local “timelike separated” objects. That bridge is electromagnetic (light) signals. Is it a bridge to far?

Form Is Emptiness: Relativity, Quantum and Buddhist Uncertainty. Einstein's Special Relativity Theory (SRT) was published in 1905 as *On the Electrodynamics of Moving Bodies*. Its two basic postulates are: 1) the principle of relativity: all inertial reference frames are equivalent regarding the laws of physics; and 2) the invariance or constancy of the speed of light c : the velocity of light in the empty vacuum of space always has the same value, c . We shall see that the second postulate is derived from the first.

Astoundingly, from these two simple principles arose in the West an entirely new dynamics of physical spacetime reality!

Of all the brilliant minds of his generation, only Herr Professor Einstein could see that the null result of the 1887 Michelson-Morley experiment in search of the mysterious "luminiferous ether"—the presumed infinite invisible non-interacting medium through which wavelike light was presumed to propagate through the vacuum of "empty space"—required the denial of an ether. Thus, the ether concept portended, along with the discoveries of Planck's black body radiator "ultraviolet catastrophe", and Einstein's photoelectric effect, a radical new 20th century physics, namely, Relativity and the Quantum Theory.

Now, upon the cusp of the 21st century we seek an equally radical unification of these two theories—the great desideratum that is the unification of woefully incommensurate Quantum Field Theory (QED) with General Relativity Theory (GRT) in a post-empirical, post-quantum quantized gravity—a mathematically consistent Quantum Gravity Theory (QGT). We shall see once again that Buddhist Middle Way philosophy of mind and cosmology shall point the way.

Be that as it may, what *is* this mysterious light carrying ether? Nineteenth century physics resulted in the triumph of the wave theory of light over Newton's particle theory. Thomas Young and Augustin-Jean Fresnel are our heroes here. Light is a vibration in a medium. But what is this strange interstellar medium; and what are its properties? There were many theories but no demystifying solutions. So Einstein, in his SRT, simply dumped the idea.

James Clerk Maxwell postulated in his 1861 Electromagnetic Theory of Light that light is an electromagnetic wave and so travels at the invariant absolute speed c of his electromagnetic field theory, later to become the massless photons of the uncertainty of Quantum Electrodynamics (QED) traveling randomly and uncaused throughout spacetime reality at c —physical, trans-objective wisdom of uncertainty. This discovery threatened our sacrosanct meta-theoretical Principle of Causality—causes must proceed their effects. A metaphysical sticky wicket, to say the least. More on this below.

Maxwell demonstrated that we may assign a numerical value to the velocity of light in the empty vacuum medium of space which is independent of the motion or velocity of the light source. It was Maxwell's great discovery that is the very conceptual ground of SRT, GRT and QED.

Einstein's second postulate of SRT—the absolute universal, invariant constant speed of light c , which is also the speed at which all massless particles and their fields, including gravitons and their gravity waves travel, regardless of the motion of their source, or the inertial reference frame of an observer. In both SRT and GRT light speed c unifies the two physical dimensions of time and space via the familiar equation $E = mc^2$.

Our understanding of the prodigious objective physical stuff of space and time became the unity of Minkowski's four dimensional manifold, the 4-D "spacetime continuum". Our notion of physical stuff would never be the same. It took Einstein's old math Professor Minkowski to point out this geometric continuum to a mathematically naive Einstein. Minkowski once called the young Einstein, who scarcely showed up to class, "a lazy dog".

Nevertheless, it was Einstein's intuitional Zen Mind-Beginner's Mind that penetrated the cognitive biases and presumptions of the day to reveal a great new scientific truth. The failure of the ideological spatial plenum known to 19th century physics as the "ether wind" to show up for Michelson and Morley became the primary experimental pillar of Einstein's Special Relativity Theory. Einstein explained in his 1905 SRT theory:

The phenomena of electrodynamics as well as of mechanics possess no properties corresponding to the idea of absolute rest (a stationary ether).

They suggest rather that...these same laws...will be valid for all frames of reference for which these equations of mechanics hold good. We will raise this conjecture...to the status of a postulate, and also introduce another postulate...namely, that light is always propagated in empty space with a definite velocity c which is independent of the state of motion of the emitting body.

With these few words Dr. Einstein forever changed our view of the world.

Einstein once considered the name *Theory of Invariants* for his new SRT theory because the second of these two basic postulates asserts that the spacetime separation of two "spacelike" events—events connected by an electromagnetic (light) signal—is the same, i.e. invariant (absolute) in all inertial reference frames or systems.

We've seen that the velocity of light in the vacuum of "empty space" is Maxwell's universal physical constant c , 299,792,458 meters per second. It is constant or invariant or absolute in all inertial or non-accelerating reference frames, the same for all observers, the light source, direction, position and time. Therefore, the speed of light is *not* relative; it is invariant or absolute in *all* systems of reference. So SRT belies the old platitude that "everything is relative".

Now, this second postulate—the absolute speed of light in the vacuum of space—is derived from the first postulate, the principle of relativity: the laws of physics (mechanics and electromagnetism) are the same, or invariant for all observers in uniform motion (inertial, non-accelerated motion), in any reference frame, anywhere in the cosmos. We can do the same physics an Alpha Centauri that we do on Earth.

Ten years later, through his ingenious GRT of gravity Einstein would address the inadequacy of SRT to account for accelerated motion via his astonishing Principle of Equivalence which unified inertial motion and accelerated motion, as we shall soon see.

This first principle of relativity is based upon the relativistic seed principle of Hendrik Lorentz and is known to the physics trade as *Lorentz Symmetry*, the observational symmetry or equivalence of observation of two observers moving relative to one another within the same inertial reference frame, regardless of the speed of the observers. Again, this means that the laws of physics are the same for all such observers, anywhere in this cause and effect universe. The laws of nature, physical and mathematical, are universal. We can practice the same math and physics anywhere in this physical universe, even the multiverse—sitting in a chair, or moving at near the speed of light.

A 2019 experiment with extremely accurate atomic clocks has proven once again the mathematics of Einstein's sublime SRT theory (*Nature*, March 14).

We'll see that curiously, the master's metaphysical conclusions as to what Relativity means for the *ultimate* nature of physical reality, namely his Metaphysical Local Realism is not quite consistent with his conclusions as to the nature of Special Relativity elaborated above. But fortunately for physics the great master was a physicist and not a philosopher.

In any case, for Einstein's SRT, no observer's reference frame is privileged, not even ours here on the earth. In other words, all reference frames are equally privileged. Once again, the privileged reference frame of Maxwell's "luminiferous ether" as a medium for the propagation of light—the belief of the day—was denied by Einstein—thus opening a way for the two postulates of Special Relativity itself, then, with the addition of his monumental Principle of Equivalence, the gravity of General Relativity (GRT).

Yet, in a few years the quantum theory with its ZPE vacuum zero point energy field would show that Einstein's "empty space" was not so empty. A salubrious proto-medium for the propagation of electromagnetic energy, and of gravity, has, to this day, yet to be seriously considered. Buddhist *Abhidharma* and *Kalachakra* cyclic time cosmology, realized through our clear-light Bodhi Mind/Wisdom Mind must, in this regard be seriously considered (Ch. 3, 4 above), like it or not.

So, for SRT temporal relations are not absolute. Time and space are relative to the reference frame of an observer. For Einstein in 1905, spacetime is, a bit unexpectedly, *observer-dependent!* That is to say, the existence of spacetime stuff is real only to the consciousness of an observer. This is of course the nonlocal view of the quantum theory of Einstein's nemesis Niels Bohr, so vigorously debated in the EPR debates of 1934.

Newton's absolute, *observer-independent* objective time and objective space is denied by Einstein. Indeed, light disregards common sense (Lorentz) transformation laws of classical mechanics altogether. On the accord of the master: "The laws of physics are invariant (absolute) with respect to Lorentz transformations" (Lorentz co-variance).

We've seen that Einstein's first Special Relativity postulate generalizes Galilean-Newtonian relativity to include more than Newton's laws of mechanics, but Maxwell's laws of

electromagnetism as well. As Einstein's relativity is founded in the classical relativity presuppositions of Galileo, Leibnitz, Newton and Poincare, just what is this new essential physics foundation? Let us now begin to consider this "force" acting at a distance that is Newton's "Big G" gravity arising in Einstein's prodigious GRT field equations.

Einstein inherited the 17th century mechanics of the great mind of Sir Isaac Newton. The concern of mechanics is the motion or behavior, indeed the position of point like physical particles or "corpuscles" of matter located in space as a function of time. This was of course before the 19th century view of the nature of light as a wave spread out in space.

Space and time for Newton in his monumental *Principia Mathematica* were ill-defined, but he considered them to be ontologically absolute, existing independently of any conscious observer. In other words, for Newton spacetime stuff appears observer-independently. Still, he defined the motion of a body in space, its position, as *relative* to the motion of other bodies. "Instead of absolute places and motions, we use relative ones" (The *Principia*, 1687). This view constitutes the Galilean-Newtonian relativity legacy bequeathed to Einstein from Newton.

So, particle position and momentum are relative, but for Newton, acceleration seems to be absolute. Now the defining property of a particle is its inertial mass m which physically links its acceleration \mathbf{a} with "force" via the famous equation $\mathbf{F} = m\mathbf{a}$ where \mathbf{F} is Newton's classical universal law of gravitation \mathbf{G} , "Big G", the gravitational constant used by Einstein to generalize his SRT inertial mass to GRT gravitational mass via his sublime Principle of Equivalence—the physical equivalence of inertial and gravitational mass.

Newton's Big G may be stated thusly: the gravitational force between two spacetime objects is proportional to the mass of each, and inversely proportional to the square of the distance between them. Big G is the empirical constant utilized to connect Newton's universal law of gravitation to Einstein's GRT. In the GRT field equations G quantifies the relation between spacetime geometry and Einstein's GRT energy momentum tensor. Heady wine indeed.

The notation for acceleration due to gravity g ("little g") on the earth's surface is $F = mg$. For example, to overcome g and accomplish escape velocity in order to enter an earth orbit, an upward accelerating force $m\mathbf{a}$ must be produced that is greater than the downward gravitational force mg . Recall that Einstein's fabulous GRT Principle of Equivalence reveals the equality of inertial and gravitational mass.

$\mathbf{F} = m\mathbf{a}$ is of course Newton's famous Second Law of Motion: for a constant mass, force equals mass times acceleration. The net force on an object is equal to the mass of the object multiplied by its acceleration. Double the force, double the acceleration; double the mass, halve the acceleration. A constant force acting upon a massive body at rest results in acceleration of the body in the direction of the force.

To be sure, Newton's mechanics have now been replaced by relativistic mechanics, but still work quite well for macroscopic objects at solar system scale distances and velocities. They got us to the moon and back, after all. It is at the Planck Scale, micro and macro Planck scales, and at speeds approaching light speed that Einstein/Lorentz operators must be factored in.

What is the physics foundation of relativity? Einstein states that the classical relativity of Newton, and of his own classical (non-quantum) Special Relativity is founded in "two physics balance principles": 1) the basic Principle of the Conservation of Energy; and 2) the basic Principle of the Conservation of Mass.

The first balance principle states that primordial energy (energy, momentum, angular momentum) arising as *relative* spacetime stuff from its utterly mysterious metaphysical (beyond or pre-physical) *ultimate* ground can be neither created nor destroyed. Nor can matter-energy arise ex nihilo, from nothing. Whence this mystical mass-energy substance? What is its actual nature? No one knows. Both Newton and Einstein are silent. Here be subjective metaphysical dragons.

Energy can assume different forms or states. For example, combustion converts stored chemical energy into thermal energy, which may in turn be converted to kinetic energy to run a generator which produces the electrical energy that lights our homes. Throughout these energy conversions, energy is conserved, that is, it is neither created nor destroyed.

Einstein's second balance principle, the Conservation of Mass, states that classical physics has extended the first balance principle to include not only mechanical energy, but as well, thermal, chemical and electromagnetic energy—that is, to all physical fields. This mystical energy, whatever it is, is conserved through all possible transformations.

What precisely is this unity that is mass-energy? Neither Einstein, nor anyone else has a clue. We bestow names upon it in the hope of grasping it conceptually. We presume that it is relative, objective and physical, but what is its *ultimate* nature? No one really knows. The limits of physics is the beginning of speculative metaphysics.

But the task of physics is to describe what matter does, relatively, not what matter is, ultimately. The greatest physicists have wisely refrained from metaphysical speculation as to the ultimate nature and source of mass/matter, all the while not so wisely presuming a purely objectivist, materialist/physicalist ontology. As philosopher Ken Wilber has said, "Hidden metaphysics is bad metaphysics."

Whatever matter actually is, it arises continuously from somewhere; from some basal trans-rational, numinous primordial source or ground, by whatever name or concept. And at this subtlest strata of ontic formation atomic baryonic mass-energy is what, or who we are; at least physically. Yet conceptually, we know it not. Enter, stage left, the noble cognitive discipline of metaphysics, including perennial wisdom contemplative metaphysics. Here Buddhist philosophy and practice offer solace and wisdom (Ch. 3, 4).

Still, we do know something about the relation of this mystical arising energy to mass. Einstein has told that $E = mc^2$. Inscrutable energy arises from its formless ineffable primordial ground as light-form. Light and mass-energy are equivalent. Everything is light.

Well, what do the experts say? Bohr, Heisenberg, Schrödinger, Dirac, Feynman, Stapp and maybe Weinberg all suggest a more or less nominalist or instrumentalist view—that mass-energy is not a local, physical spacetime existing *objective* reality, but is rather a nominally reified, stochastic, mathematical formal abstraction that has theoretical and pragmatic use. As with

Newton when asked of the ultimate nature of gravity, none of these great minds feign any metaphysical hypotheses as to the ultimate ontological nature of mass/matter. Still, most of them presume a biased closet metaphysic that is an objectivist physicalist ontology. Thus does physics arise from hidden metaphysics. An impudent, if mostly unconscious presumption resulting in all kinds of discomfiting philosophical error.

Ironically, the nominalist, instrumentalist antirealist view opens a way into the *subjective*, ontological interconnectedness/interdependence, and ontological relativity of Buddhist Middle Way *Madhyamaka Prasangika*, the great Two Truths foundation of *Ati Dzogchen*, "The Great Completion" of this formidable Two Truths duality (relative and ultimate); and indeed of the entire Mahayana Causal Vehicle (Ch. 3 above); not to mention the great noetic body/mind/spirit completion of the ordinary and extraordinary human beings who contemplatively practice, complete and perfect it (Ch.13).

We have seen that light-form, objective, relative physical mass-energy, arises in or through and forever participates in its perfectly subjective formless primordial boundless emptiness ground—unbounded whole itself—*mahabindu*, *shunyata*/emptiness, *dharmakaya*, Tao, *Nirguna Brahman*, God the Primordial Father, *En Sof*, Bohm's "implicate order of the unbroken whole", the quasi-objective/physical zero point energy field (ZPE) quantum vacuum ground potential (Appendix C, "Toward an Integral Ecology of Mind"). Thus does nonlocal quantum emptiness partake in this Primordial Wisdom emptiness ground.

Therefore, everything spacetime is light. Once again, Buddha told in his seminal Prajnaparamita Heart Sutra (H.H. The Dalai Lama 2005): "Form is empty; emptiness is form." Relative objective spacetime relative physical form is not other than its formless perfectly subjective ultimate emptiness ground. And emptiness itself is not other than its arising form. The cosmic relative dimension equation: $E = mc^2$ —all physical reference frames are equivalent regarding the laws of physics. The unified kosmic ultimate dimension equation: $RF = UE$ —Relative form is equivalent to ultimate emptiness. Spacetime form and its nondual emptiness base are always already a prior and present unity.

This aboriginal ontological duality of *relative* mass-energy and its basal *ultimate* emptiness ground substrate—this profound perennial wisdom Two Truths trope—is a trans-conceptual, nondual ("not one, not two, but nondual") prior ontic yet epistemic ever present unity!

Of the 20th century Relativity and Quantum Theory major players, only Niels Bohr—perhaps through his work in Taoism—would have understood this complementary "unitarity" (Bohr's term) of relationship of objective light-form, and its perfectly subjective formless emptiness ground—the Tao that cannot be told. "The Tao that can be named is not the primordial Tao" (*Tao te Ching*).

Bohr's nonlocal quantum uncertainty rests in and participates in our primordial "wisdom of uncertainty". That trans-rational wisdom expresses the very nature of our primordial Wisdom Mind (*gnosis*, *jnana*, *yeshe*), entirely free of the conceptual fabrications of our all too human "global web of belief" (Quine 1969).

Tibetan Buddhists (Vajrayana) know it as *rang rig* that bespeaks the innate directly reflexive and already present open and empty self-awareness of our *Bodhi* Mind-Wisdom Mind Presence

(*vidya, rigpa*). Such pristine nondual cognition is utterly free of all conceptual elaboration. Recognize, then rest in That.

Yes, it takes a little intellectual and emotional courage to surrender 40 centuries of European Enlightenment locally real purely physical stuff—our comfy objectively certain "real world out there" (RWOT).

Heady wine indeed; and a bitter pill for the prevailing Western scientific and cultural ideology; our Greek materialist efflorescence that has resulted in Modern Metaphysical Scientific Local Realism, Materialism and Physicalism.

So, unlike the Buddhist *Yogachara* "Mind Only" School, and most of Indian and Continental Idealism, centrist Buddhist *Madhyamaka* Middle Way is a realist ontology. But it is far from the Scientific Local Realism of Einstein, and the rest of Science, wherein objective physically "real" states of matter exist independently of the consciousness of a sentient observer. Buddhist Middle Way is rather, an observer-dependent *nonlocal* Realism that parallels David Bohm's effort. This Buddhist Two Truths trope argues that arising spacetime reality is *relatively* real—just pinch yourself—but not *ultimately* real, existing permanently and independently of a conscious observer. Confusing and spooky to the uninitiated. Let's conceptually unpack it a bit.

We've seen in our early chapters that on the accord of the Buddhist Middle Way Two Truths trope physical/material mass-energy is *relatively*, conventionally observer-dependently real, but not observer-independently, intrinsically, absolutely or *ultimately* real. It is real enough to permit causality, scientific cause and effect. It is through our deep cultural background semiotic, conceptual "global web of belief" (Quine 1969). Ontological relativity again: our appearing realities are relative to our ontologizing, reifying constitutive concept-belief cognitive systems—our sociocultural web of belief. This is, broadly construed, the Mahayana Buddhist view.

Fantasmic indeed to 400 pre-quantum years of habitual, literalist, objectivist, physicalist, realist Baconian empiricist proto-Scientific Local Realism with its ontic ideological baggage that is Metaphysical Scientific Materialism/Physicalism.

To the classical, and to the common sense mind mass-energy has always been absolutely, observer-independently, physically real. Stuff exists whether there is anyone about in the cosmos to observe it. We've seen that QFT/QED and centrist Middle Way *Madhyamaka Prasangika* have changed all that. Be that as it may, from the relative epistemology you choose, arises the ultimate metaphysical reality you deserve.

Hence, as to Einstein's second balance principle—the conservation of mass—mass and its physical extension in space has always been presumed in realist classical physics as an essential, invariant and absolute quality of objectively "real" only physical matter.

The classical mind, and most of us enlightened post-classical folks, perceptually reify, then conceptually impute, then phenomenally designate local, absolutely existing objective physical entities located in space and time. This deep cultural background concept belief system constitutes our objective, material RWOT. Thus do we create our realities.

Hence is the classical mind, under sway of 400 years of Modern European Enlightenment—The Age of Reason—steeped in the idealization and valorization of objective reason and discerns not the subtler post-objective relativistic quantum event bits and moments (qbits, *vasana*) arising from the process of complementary, *reciprocal cognitive coupling*—the prior and present unity of conscious observer, and spacetime located event moment observed.

Our knowing perceiving subject and its separate object known—invidious archaic subject-object split—is healed via such noetic cognition (body, mind spirit unity). First knowing, then realizing this unitary nondual truth of the matter resolves a lot of epistemic and ontic conundrums; not to mention our dualistic existential anxiety about apparent but illusory separation from nondual godhead, however we may understand and experience That (*tat, sat*).

So, this classical, common sense metaphysical presumption of an absolutely objectively existing observer-independent "real world out there" (RWOT) did not ultimately survive the antirealist outcome of Einstein's SRT mathematics, but was transcended, subsumed yet included in the Principle of the Conservation of Energy which had, as Einstein put it, "previously swallowed up" the other energy fields. Energy arising from its primordial ground—by whatever name or concept (*namarupa*)—is always conserved. So now mass-matter are equivalent as mass-energy. Mass is solidified energy; energy is liberated matter. Einstein explains in his 1952 book *Relativity*:

The mass of a body is the measure of its energy content; if the energy changes by L , the mass changes in the same sense by $L/9 \times 10^{20}$, the energy being measured in ergs, the mass in grams.

But Einstein's local realistic metaphysical interpretation of his mathematics is, as previously noted, curiously antirealist. More below on this anomaly in Einstein's thought.

Therefore, the world's most famous equation, $E = mc^2$, has demonstrated that all matter, all of physical reality, including all of us, is essentially light energy—*prana, ch'i, shakti, lung, pneuma/Holy Spirit* (all of these terms translate "breath" or "spirit")—arising continuously, eternally upon the breath (spirit) from, and as, this light-life energy's vast basal primordial matrix ground state, just as the cosmogonies of our primary wisdom traditions have told from their ancient Hindu pre-Vedic, and Semitic pre-Canaanite beginnings.

Hence, our objectively appearing physical cosmos is not merely a linear chain of cause and effect from a "first cause" primordial Big Bang to the present, but rather a non-temporal or atemporal, timeless non-spatial, moment-to-moment continuity, emanation, manifestation, solidification, objectification and reification of light-energy arising from its formless, trans-conceptual, perfectly subjective original source ground state/condition; by whatever name (Appendix D, "Toward an Integral Ecology of Mind").

Recent cyclic multiverse theory is based in this perennial cyclic wisdom (Steinhardt and Turok 2007). If only theoretical physicists and cosmologists would engage it!

What then is the *ultimate* nature of the post-empirical, trans-conceptual contemplative recognition, then realization of this bright primordial ground state for human instantiations arising herein? What is the nature of this very foundation, the boundless whole, awareness-consciousness ground in whom this all is instantiated, that we may theoretically and pragmatically enhance our knowledge and wisdom of it; and all its participating particulars?

In the profound words of Tibetan Buddhist *Dzogchen* meditation master and scholar Chögyal Namkhi Norbu (1999):

It is the inherent nature of the primordial state to manifest as light,
which in turn manifests to produce the elements themselves, which
make up the whole material dimension...The spontaneously arising
play of this energy may be enjoyed as such by an individual who
remains integrated with his or her essential inherent condition,
in the self-liberating, self-perfected state, the state of *Dzogchen*.

This always already reflexively present Wisdom Mind Presence of the primordial unbounded whole itself—awakening to the arising play of life-light energy of *That*—is said by the masters of the three times (past, present, future) to be the enjoyment of the state of enlightened ultimate happiness itself, liberated happiness that cannot be lost (Ch. 13 below). How then shall we accomplish this? (Appendix D: "Let It Be: Basic Mindfulness Meditation").