Observer as the mathematician's "constant" and the physicist's "quantum".

By Chidi Idika*

March 4, 2015

I argue here that a great deal can be explained about the tango between physics and mathematics just by comparing and contrasting the foundational issues in both. Issues captured by the Peano axioms in mathematics versus quantum theory in physics. Both these "foundations" are concerned with developing, in my view, a generic notion of the reference frame/initial condition and by extension describing the dynamics of its evolution/devolution. I claim precisely that while the Peano axioms represent this state as the "constant" (number bases) quantum theory represents it as the "wave function" (quantum of observables). Crucially, both foundations agree that this state is the *threshold* of events. Indeed both foundations insist that one thing a threshold is not is the event proper i.e. an observable. Strangely this picture is in line with Pythagoras' assertion that: all that exist is sound (think, "spins" or wave packets as signifying the natural numbers; observables) vis-à-vis the "fundamental"/number bases (if wave function) as signifying the observer proper. It is my conclusion that this collective picture can indeed go one notch up to become our theory of quantum gravity in that it supplies the basic testable postulate that: we being the observer in question our sensory threshold (mind) is then our proper quantum of observables/natural unit. Meaning, quantum gravity likely will be man's best instance ever of the indistinguishableness of mathematics and physics.

……

Put "personally", to witness at its peak the unreasonable effectiveness between physics and mathematics don't go too far from the notion of your mind as your initial condition—your mind as by definition that which returns the truth value of propositions from either which way. Oddly thus your mind is the same thing we must know materially as the "nothing" (the VEV). QM thinks of it as the harmonic oscillator (the uncertainty). Gödel probably calls it the the undecidable (Formal System).

A Kind of Lorentz Invariance:

If I saw a flower and it was honestly to me red in colour and then you saw the same flower but it was in your eyes blue might there be a way we could predict ahead correctly via calculations the colour you will see without you not being the one to report? To do this we are going to need basically "something" that converts between your view and my view. I argue that this thing will represent then the most general notion of yourself and myself put together in one notion. I conclude that this notion can only be physically the "nothing". It is in my view the only better thing to the notion of "energy" in that energy can (1.) convert from one form to the other and which goes to say conversely (2.) it has no particular form [of its own]. Thermodynamics conceives this same thing as entropy. My hypothesis is that no trait can capture the nature of this state better than the notion "nothing". It is same, propose, that Peano's axiom called a constant but it gets a physical life of its own as the "quantum". If this be the reference frame/observer and it is really the mathematicians constant then Lorentz invariance should generalize as the log identigy:

$$\log_b(x) = \frac{\log_k(x)}{\log_k(b)}.$$

Wherein any given observer is the number bases and numbers proper (seen whether as logarithmic, natural or real) are like the "positions"/quanta on a spectrum. So the observer really is a particular kind of "nothing" seen whether as the constant of Peano's or the quantum of Plancks or of Einstein's. The observer is a unique "natural unit". Just as physical entropy is by definition one particular degree of freedom out of the many, in fact infinitely many, there can be.

Comparative Postulates:

Put differently, while both mathematics and physics abstract nature we are going to need something that will in turn abstract both physics and mathematics. I argue that the term "nothing" or "mind" (as implying the unconscious/threshold; entropy; VEV; uncertainty) does this job adequately. We shall be demonstrating this by first comparing the foundational frames of mathematics and physics and then in turn comparing these two frames (in fact rewriting these two frameworks in terms of the notion "observe").

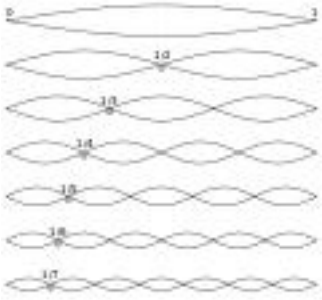
We will regard here that the basic postulate in mathematics is the Peano axioms (or in a perhaps more characteristic language the set theory) and we shall regard that the basic postulate in physics is quantum theory (in more applied language the Standard Model of particle physics).

Basic postulatess of Mathematics:

Says the Peano[i] axioms:

(a.) Zero is a natural number.
(b.) Every natural number has a successor in the natural numbers.
(c.) Zero is not the successor of any natural number
(d.) If the successor of two natural numbers is the same, then the two original numbers are the same.
(e.) If a set contains zero and the successor of every number is in the set, then the set contains the natural numbers.

Figure 1



A wave analogue of the Peano Axioms perhaps: standing waves in a string — the fundamental mode and the first 6 overtones.
(courtesy: Wikipedia)

It seems to me that once we can picture the number zero (or in probabily terms the number 1) as analogous to the fundamental (Or just "speed"?) of a system of waves then the rest analogy generally fall in. The overtones will be altogether the equivalent of a linear scale or a successor function; this as captured by axiom 4. And then axiom five represents essentially the/a standing wave—in the sense precisely of a wave packet. The point then will be that one cannot really compare wave packets; they

are a Markov chain. Put conversely the only way to compare a system of waves is to be the fundamental in question. Here then is essentially a no cloning theorem.

Any wave packet is really as complete as any other. You are either as the relevant fundamental or you are not. It will appear that this sense that the observer/fundamental/number bases is by definition a singularity basically redefines observables or observable reality as what has been known as the qualia.

Basic Postulates of Quantum Theory:

Mark Tuckerman does for me here a fine introit. In his view the fundamental postulates of quantum mechanics concern the following questions:

1. How is the physical state of a system described? I will say a system is a fundamental/number bases namely the observer as/or the wave function. It is the very notion "non-local"/…
2. How are physical observables represented? I say observables are the harmonics/number coordinate i.e. the very notion "position" as prescribed by a given fundamental
3. What are the results of measurements on quantum mechanical systems? I say the observer is the measurement per se. It then is the proper quantum measurement. What we see normally as measurement/classical measurement is actually a disturbance of the subsisting measurement. Every other unit of measurement is not then a natural unit of/or measurement only the observer is, observer as representing initial condition* is the measurement/constant of propotionality and a unique one at that.
4. How does the physical state of a system evolve in time? Again they evolve as harmonics i.e. the path/scale of modulation or "dispersion" of the relevant fundamental/constant.
5. The uncertainty principle. Every certainty (measurement result) has an intrinsic uncertainty (threhold/initial condition). It is the same I have called simply the observer. And you cannot clone it; you are either the bona fide observer or you are not it.

The above understanding helps mitigate the seemingly intimidating mathematics. Now the exact fundamental postulates of quantum theory are:

Postulate 1.) Any system can be described by a wave function.
Postulate 2.): Any observable (i.e., any measurable property of the system) can be described by an operator. The operator must be linear and hermitian.
Postulate 3.)**:** The only possible experimental results of a measurement of an observable are the eigenvalues of the operator that corresponds to such observable.
Postulate 4.) The average value of many measurements of an observable O, when the system is described by function $\psi(x)$, is equal to the expectation value $\bar{O}$, which is defined as follows,

$$\bar{O} = \frac{\int dx \psi(x)^* \hat{O} \psi(x)}{\int dx \psi(x)^* \psi(x)}.$$

Postulate 5.) The evolution of in time is described by the time dependent Schrodinger equation:

Eventually we shall not here concern ourselves too much with the math. It should suffice if we can just achieve accurate if simplified common notion/imagery of the reasoning involved. For this I say again the standing wave (and in extended detail the Huygens's principle or Doppler Effect or Bell intensity scale) should serve our basic modelling.

Huygens Principle Rephrased:

We may think of fundamental nature as one single black body cavity[ii]; the same that Huygens' Principle calls simply "speed of light". Now one is saying that by Huygens' principle we must think of any particular reference frame/initial condition in this system of waves as the "wave front" (phase velocity) "v_0". By fact of being our reference frame it acquires the status of a fundamental i.e. it is the standing-ness or stationary state for it cannot to its own self be moving. But because this fundamental/"constant" is not in principle measurable we must think of it mathematically simply as the number bases/imaginary unit—Newton's infinitesimal. This in wave mechanics terms must be the whole point of Huygens' principle: any given observer/threshold is the phase velocity (phase space). It is that wave speed by which we may render any system of progressive waves stationary i.e. a wave packet, similar to infinitely adding many waves to get a sufficiently localised wave packet[iii] You may think of "V_0" simply as a quantum relativistic definition of light, in which case its observables i.e. modulations/phase states signify the interference patterns or refractive indices. This will be analogous to the Bell relative intensity scale by which with any reference intensity/speed I_0 we define relative intensity thus:

$(I/I_0)\ \log 4$ = observable (relative intensity)……..(1.)

We adopt here log 4 instead of the Bell scale log 10 simply because one is talking here of I_0 as a phase space such that all evolution/modulations come in basically 4 orthogonal axes. We have thus effectively a quadruple moment analogous to the 4-vector in GR. In other words it may be said that the observer as here the phase space per se and in the macro case the space-time of GR is a 4-vector simply because he is by definition a phase space. It is in this sense of space-time as simply phase space that we may understand that observable space is in Huygens' Principle terms same as the "oldest light" i.e. group velocity "V_g" relative, that is, to any given reference frame namely phase velocity "V_p". By Huygens principle there necessarily is the oldest light. And there necessarily is also the "newest light" which we can think of as the refractive index (interference pattern) "n", it can be positive, negative or zero (constant). Here defines it then as the common notion "time" and as simply same as observable matter. Namely where "n" is negative we have matter wave or simply wave nature. And where "n" is positive we have "mass"/corpuscular nature u. Accordingly, a zero or constant refractive index "±n" should be what to understand as the spin zero or boson or even conversely same to be known as the elementary charge.

One is saying simply that in the 4-orthoganal axes/phase space sense the Bell intensity scale becomes expressly the Huygens' Principle defining equation for phase velocity V_p:

$(V_g / n) = V_p$ …….(2)

Or conversely, solving for n, we have that:

$(V_g / V_p) = n$ …….(3)

Where then "n" is in log4 (meaning it is progressively the harmonics/overtones of V_p) we have effectively n as a wave packet i.e. Huygens' "wavelets" namely a wholesale modulation of the

original/initial condition (a phase space modulation). This then is the sense in which we must understand mass simply as a reduced Compton wavelength. And it must be in a non-dispersive media i.e. in the scenario of "n" = 0 same ultimately as the common notion "frequency", precisely Planck's v in hv = E. Meaning, a relativistic Planck constant "h" should be what we understand here by the "phase velocity" V_p.

Conversely, the group velocity V_g should be analogous to the exact Compton wavelength λ_c in question that is then reduced to mass by the equation:

$(V_g / V_p) \log 4 = n$ ……(4)

And it must generalize to the common notion "wavelength".

Put simply, the phase velocity (V_p) in that it signifies here a stationary state must be same as a phase space namely Huygens' "wave front" and Einstein's "speed of light" and by extension is same too as the "space-time" (geodesic) in GR or "quantized space" notion in quantum mechanics. It is simply the constant of proportionality between wavelength (as by definition "space"; group velocity V_g) and frequency (as by definition "time"; refractive index; interference pattern). So a reference frame/initial condition or simply threshold (exemplified in our instance by man h_0) must be analogous to π or 4π or 8π etc.

The mathematics analogue must be that when you have an irrational number (e.g. π, base of natural logarithm) as your number bases it is as well that you have an imaginary unit as your operator. Indeed irrationality (unmeasurable-ness; infinity) is the truest nature of a constant. For it captures intrinsically the undecidable-ness of Gödel's incompleteness theorem. It captures intrinsically the very Netonian notion "infinitesimal". This same as signifying per se *any* initial condition (threshold; standard; unit; constant) is physically what we should understand by the Heisenberg uncertainty notion.

In Huygen's Principle model of the speed of light this same is what we should mean by phase velocity/phase space/wave front. And this explains that the speed of light as a state is per se at once the unit and limits of information what physiology probably calls the all-or-none nature of the action potential. It is same pictured in a Bell intensity scale simply as the reference intensity I_0. In quantum mechanics the Bell theorem probably captures it simply as the de facto "equality" (correlation strength). One may say that the Schrodinger equations captures the irrational number bases as the wave function and which is why the actual physical meaning of the wave function must remain intractable. Here is proposing that it signifies simply the "observer". It is same we know first hand as the mind i.e. threshold or fundamental of events/sensibilities. Precisely I will represent in this discuss as the threshold potential* h_0 of the action potential in man. It is the basis of consciousness, consciuosness as by definition "observables". Put differently, the de facto observer is strictly speaking also the de facto entanglement (non-locality; super-positioning or just "space-time"). I will make the assumption that this is the same we call the "mind".

We the "nothing":

a) We the Vacuum Energy/Cosmological Constant:

First as an exercise in showing the Beyond the standard model value of the above sketch let me follow a John Baez[iv] assertion that one thing a credible theory of quantum gravity should do is explain the possibilities that vacuum energy of our universe is nearly zero but non-zero[v]. It seems that we can take h_0 as quite directly the cosmological constant/vacuum energy. For 55 millivolts being measured value of h_0 is equivalent in electron volts to 55 millielectron volts[vi]

b.) We the Neutrino Connection:

Now when simply we adopt sensory h_0 as our initial condition/reference frame i.e. by Huygen's model our phase velocity V_p and then adopt the CMB as our oldest light i.e. group velocity V_g, one can predict here that the zero index of refraction should be precisely the so-called neutrino "n_0" but strictly as an "oscillation" which zero refraction/"oscillation" one may understand simply as the relevant spin zero (boson). Namely:

$(CMB / n_0) = h_0$ ……(5)

Note that the neutrino is predicted to have a mass of about 0.06 eV. Here we can approximate legitimately down to 55×10^{-3} eV/c^2 as our zero (constant) refractive index. Thus:

$(CMB / h_0) \approx 10^{-22}$ coulombs ……..(6)

When CMB is in 230 x 10-6 eV, Indication is that this may be charge on the neutrino (beyond the standard model?) or charge equivalent of the nuclear magneton.

c.) We the Hoyle State:

Sir Fred Hoyle[vii] has arguing to the effect that the universe is precisely finetuned for the existence of life predicted that there is a definite an energy state of Carbon. Might we broaden it to mean the peculiar energy state that defines life—the observer/mind? The equation below is in need of investigation in this regard.

$(CMB / h_0) \log 4$ = nuclear magneton in Hz/T unit…….(7)

Naïve Set Theory Not So Naïve or the Only Trouble with Ether:

It may be at best paradoxical and at worst logically embarrassing to argue as we do here that man—the very agency making this present argument—is actually nothing. Indeed the case of so-called naïve set theory dramatizes in mathematics this kind of paradox/embarrassment. We will simplify the whole argument here by regarding that what exactly is naïve about naïve set theory is that it allows to be deduced that: the set of all sets (the "universe") is at once a member of itself and yet not a member of itself. This must be like trying to differentiate between the number 0 (as the empty set) versus the number 1 (as the universal set). We take here the position that the notion of empty set versus that of the universal set is akin to Godel's incompleteness versus completeness respectively. It is little use asking which of the two numbers is the proper Peano constant because by the Peano axioms any number can be the de facto constant. It is known that both numbers can indeed apply equally well. In other words the logical embarrassment of naïve set theory notwithstanding, it is in fact a logical situation asserted by Godel's second incompleteness theorem.

What is at pain here is that, how can something be a set (i.e. a class of traits) and still be a null trait? But if in the physical however if what it actually means to be the empty set is to be the "base unit" and hence the undefined or indefinable namely the "uncertainty principle" of Heisenberg then quantum

mechanics operates basically a naïve set theory. It says in one breath that the universal set is by definition an empty set namely ultimate matter is non-material (non-local) yet it implies by same statement that the non-material (non-local) exists.

Indeed to argue otherwise as in the proverbial debate between Einstein and Niels Bohr is to attribute some material trait to fundamental matter, in pain of infinite regress actually. Even such theories as spontaneous symmetry breaking giving rise to mass cannot at last be other than how non-matter ("nothing") gives rise to matter ("things").[viii]

So, going with Bohr on this issue, the paradox by itself while it may be a deadlock in logic is not necessarily physically invalid. The very notion "constant" or "simultaneity" as Einstein shows is itself a paradox. Otherwise we are led to such modern questions as: are the universal constants of nature actually constant? The paradox becomes clear once you realize that to practically answer this question you are going to need yet some constant to measure the constant and so on in pain of infinite regress. The solution? Admit that something (matter) must come in the best case of occam's razor from nothing. I prefer to model this scenario as a case of Huygens principle such that ultimately one is talking of the Kramer-Kronig relation. Huygen's principle followed strictly should lead to the Kramer-Kronig relation. This justifies the situation that Huygens' principle is valid only in the forward direction but not simultaneously in the reverse direction. The physical meaning of Godel's theorem meanwhile may be illustrated as the fact that the whole of any path/scale is essentially a cycle i.e. a virtual work/imaginary unit (e.g. a standing wave or harmonic oscillator); it like voltage or simultaneity or a base unit cannot be a measurable value within itself without permanently "collapsing" i.e. modifying the system.

Barring admitting that the case of naïve set theory is actually consonant with quantum mechanics, general relativity, Godel's theorem, Bell inequality, Huygens principle etc the question arises how can speed of light that propagates entirely in the vacuum properly supplant [Newtonian] action at a distance from which it is running? Are we not seeing therein action-at-a-distance in a different guise? Has GR actually escaped the tyranny of nothing (non-local action)?

On the other hand shouldn't speed of light itself be what we mean by the "vacuum" proper so that Huygens principle explains the case of something (matter) arising from nothing—nothing being a particular threshold/reference wave front/phase velocity. Thus we can in the limits of Kramer-Kronig relations justify matter becoming again the nothing-in-particular; the un-decidable. The recent arguments for black hole radiation/information paradox seems to bring GR right to just such a scenario.

The good thing about naïve set theory must be then that its alternative should prove at last to be merely escapist. And the one real trouble with the ether concept must be that the "nothing"/vacuum or "constant" or "quantum" in fact does a much better job at being ether. The notion "vacuum" or nothing may indeed be relative but there can be no differentiating between two vacua just as there can be no *physically* differentiating between two imaginary units. All vacua are at last the vacuum. We must renormalize to our proper vacuum/quantum namely to man as by definition our working observer/the "initial condition" and hence the undefined or undefinable.

Conclusion:

But why may we think of a threshold as the observer? Simply that one cannot properly account for event of any kind without equally accounting for the means (say, news reporter; sensory system; unit or simply standard) by which one has come to be aware of (i.e. "generate") the event. It is same

argument essentially as the Dicke Weak Athropic Principle (WAP). If we grant then that man is our most a-priori of standards/units, i.e. our working observer, then man too is at last [to be] our proper definition of "uncertainty" (nothing; base unit; constant). Put dynamically, if the universe can be deemed to have evolved the mind (observer) then the mind can as well be deemed to have evolved the universe. But either way the mind/universe or "threshold" is to be understood strictly in the sense of "infinitesimal" (virtual exchange/singularity, virtual work, imaginary unit; harmonic oscillator; constant; potential; zero point energy; uncertainty etc). To illustrate, voltage by itself has no meaning in measurement (so voltage is a *limit* of information) only difference in voltage is any observable meaning (so this difference namely charge or the coulomb is the *unit* of information). Thus a pre big-bang state, in as much as it represents the threshold of events, is just as good as any other limit/unit of information namely a Peano's or Planck's or Einstein's "constant" —indeed any constant/threshold at all—whose subsequent modulations it is that signify the observables. It turns out a truism thus that the observer is by definition *not* an observable.

Strictly then, the observer state in both physics and mathematics may be pictured as the Newtonian "infinitesimal" (virtual work) or as the imaginary unit of a complex number or indeed as the standard model "virtual exchange" (quantum) between observables or in reality as the potential e.g. voltage. As an illustration consider that by itself a voltage (or indeed energy; constant) has no meaning in measurement. Only difference in voltage is any observable meaning. One therefore can overall liken mathematics to the potential and physics to the potential difference. This would be quite in the sense of Pythagoras that: all that exist is sound (think, "wave packets" as/or the numbers; the observables) vis-à-vis the "fundamental" if wave function as signifying the observer proper (the constant of proportionality between numbers as/or wave packets).

From here we can go straight to what should be the most basic postulate of quantum gravity (QG as signifying the greatest harmony there can be between physics and mathematics) namely: we as unarguably our own prime sample of the observer state are unarguably too our own quantum of observables (our own VEV or "virtual exchange particle" etc). Indeed one may hereby, aiming for Occam's razor, rephrase (unify?) the two foundational postulates of physics and mathematics thus.

Between Physics and Mathematics Possibly a Unifying set of Axioms:

(a) The observer is by definition the quantum of observables (number bases) and vice versa.
(b) The observer is *not* then an observable; for it has no *particular* observable trait whatsoever other than as the threshold/gauge invariance per se; pictured hitherto perhaps as the standing wave; harmonic oscillator/stationary state or conservation law/non-locality. Our picture of *observer* here may extend then the standard model notion of a "virtual exchange" (imaginary unit) between observables (observables as the real numbers).
(c) Observables are by definition simply the perturbations (modulations; "squared amplitudes") of the observer.
(d) Because *perturbations* are measured necessarily in logarithms (modulo) of some stationary state, there can be one and only one effective stationary state; it is the *de facto* observer.

Ultimately therefore the state "observer" is at once the unit of any information (measurement) and hence also the limits of same Zeh. Succintly, there can be no information at all except in so far as we adopt a particular threshold (unit of measurement) but a particular threshold adopted is by same token the effective limits on information. This explains that the ear is effectively "blind" and the eye is accordingly "deaf".

REFERENCES:

[i] Richard Dedekind, 1888. *Was sind und was sollen die Zahlen?* (What are and what should the numbers be?). Braunschweig. Two English translations:

a. 1963 (1901). *Essays on the Theory of Numbers*. Beman, W. W., ed. and trans. Dover.
b. 1996. In *From Kant to Hilbert: A Source Book in the Foundations of Mathematics*, 2 vols, Ewald, William B., ed. Oxford University Press: 787–832.

[ii] Casey Blood, No Evidence for Particles, Arxiv 0807.3930v1, retrieved 2013
[iii] **H. Dieter Zeh, Quantum discreteness is an illusion**, www.Zeh-hd.de, retrieved 2013
[iv] John Baez, "what's the energy density of the vacuum", June 10, 2011.
[v] Sean M. Carroll, "The Cosmological Constant", Living Rev. Relativity, 4, (2001), 1. URL (Jan, 2015):
http://www.livingreviews.org/lrr-2001-1
[vi] John Robert Burger, **The Electron Capture Hypothesis – A Challenge to Neuroscientists**, retrieved Jan, 2015
[vii] Evgeny Epelbauma, Hermann Krebsa, Dean Leeb, Ulf-G. Meißnerc,d "Ab intio calculation of the Hoyle State", Arxiv 1101.2547v2 [nucl-th] 2 April 2011
[viii] G. S. Paraoanu, Quantum Vacuum, arXiv:1402.1087v1 [quant-ph] 5 Feb 2014