

The 'man-made' Universe

by
Constantinos Ragazas¹

FQXi 2015 Essay Contest, *Trick or Truth*
submitted March, 2015

Abstract: The purpose of this brief and hurried essay is to initiate discussions with others here and elsewhere on some ideas that have been fermenting in my mind for a very long time. Many of these ideas have in various forms appeared in my previous FQXi Contest Essays, *A World Without Quanta?* (2010) and *The Metaphysics of Physics* (2012); and in my Chapter, *The Thermodynamics in Planck's Law*. In this essay I introduce *The Anthropocentric Principle: Our Understanding of the Universe is such as to make Life possible*.

Biographical: Retired from teaching, but not from learning. I am Free and Independent to the core! Among my many and varied intellectual interests and pursuits are Art, Philosophy, Physics and Archeology. In recent years I have written on and participated in various online discussions on Stonehenge, Gobekli Tepe, The Phaistos Disk, The Great Pyramids and others. In frustration, I have given up on Politics.

In my FQXi 2010 essay [3] I write ,

Mathematics is a tool. It is a language of objective reasoning. But mathematical 'truths' are always 'conditional'. They depend on our presuppositions and our premises. They also depend, in my opinion, on the mental views we use to think. [...]

We can have beautiful mathematical results based on any view of the Universe we have. Ask the Ptolemy with their epicycles! But if the view leads to physical explanations which are counter-intuitive and defy common sense, or become too abstract and too removed from life and not supported by life, than we must not confuse mathematical deductions with physical realism. Rather, we should change our view! And just as we can write bad literature using good English, we can also write bad physics using good math. In either case we do not fault the language for the story. We can't fault Math for the failings of Physics.

The failure of Modern Physics is in not providing us with 'physical explanations' that make sense. A 'physical view' that is consistent and confluent with our experiences. That will not put us at odds with ourselves, with our understanding of our world and our lives. Math may not be adequate. Sense may be a better guide. 'Time travel' does not make sense. 'Backward causality' does not make sense. 'Multiversities' do not make sense. And though these have mathematical validity in the theories of physicists, they cannot be taken as physically true.

And in my FQXi 2012 essay [3a] I state further,

[...] we need not dispute the Universe exists independent of us. 'What' has happened and 'why' are the relevant questions here. And these cannot so easily be answered. These require Mind to know. And knowing depends on our particular perspectives, beliefs and prejudices. And on our past history. Our theories of the Universe. But a theory is a view. The very word 'theory' in Greek means 'divine view'. Every thought we have is a view we have. Physics without a view is thinking without a thought.

Our understanding is deeply rooted in the 'view' we have. If we believe in 'atoms', our explanations will be in terms of atoms. And if we believe in 'spirits', our explanation of 'what happened' will be in terms of spirits. In all cases, our explanation will only be a description of 'what happened'. Using words and ideas drawn from our beliefs. Though we can agree the Universe exists independent of us, our knowledge of the Universe cannot exist independent of our mind. Thus, how knowing happens is central to knowing what happened. And in this regard, the minds of physicists are no different than the minds of ordinary people. Only the beliefs and methods differ. To think otherwise is hubris!

[...] seeking to know what is the Universe is no more possible than seeking to know another person, as they are truly.

¹ Retired math faculty member of The Lawrenceville School, cragaza@Lawrenceville.org , kostadinos@aol.com

But we can only really know ourselves, our thoughts and feelings. Knowing another person truly is being the other person!

If 'what is' is the Physical real, than what is 'what is' is our Metaphysical thought of 'what is'. Knowing all that we know is only in our Mind, it is self-evident we cannot know 'what is'. But can only know our observations and measurements and thoughts and understanding of 'what is'.

A veil separates the observable, knowable Universe from the unknowable and unmanifested. What's behind that veil, because it's unknowable, can be anything. In such dark void we can see anything we wish and fear. Thus what is the Universe is only in the mind of the thinker. This is no less so in Physics than in Politics or Prehistoric Archeology. We thus create fantastic fabrications explaining 'what is' according to the beliefs we project on uncertain shadows in the darkness of Plato's cave.

Any theory we have of 'what is' the Universe is in essence Metaphysical. Thus all our Physical views of the Universe are Metaphysical. Further,

The use of math in Physics does not make Physics immune to Metaphysics. The Pythagoreans are a good example of that. Math is also used in parlor magic tricks. But do we need to know the magician's trick to know the magic is not real? Perhaps in some sense the same is true in Modern Physics. Some mathematical deductions of physicists may turn out to be elaborate 'math tricks' taken as 'real' and even hidden from the 'quatum magicians'. I show 'energy quanta' and Planck's Law, for example, are not Universal Law of Physics! But simple truisms in mathematics [2, 10]. Just like the Pythagorean Theorem is. On the other hand, magic like 'time travel' and 'backward causation' are just not real. I trust my senses on this over any 'mathematical proof'. Though math provides 'logical certainty' it cannot provide the truth of what is the Universe. Nor can Physics! All math models of Physics that seek to describe what is the Universe lead eventually to metaphysical nonsense and unreality.

We know there are limits to math. "Gödel's incompleteness theorems ... establish inherent limitations of all but the most trivial axiomatic systems capable of doing arithmetic" [31]. Thus, I argue, any math model of what is the Universe will be limited and may therefore even distort our views of the Universe. And just as, according to Gödel's theorems, we can have true statements in any model which can not be mathematically proven; we can also have false statements about the Universe which can be mathematically proven. From Logic we know false statements can be proven to be true if our premises are false. Thus, if a math model makes false assumptions in its view of the Universe (as, for example, the Photon Hypothesis or the Spacetime continuum) we could mathematically prove what physically is false. But physicists are so lured by math they trust the math more than their senses. By doing so, the math models they create will not be 'faithful to Nature'.

Can we truly know the Universe through Mathematics? Or the Universe we think we know is ultimately Mathematical Truisms that keep us faithful to our logical reasoning; and to our interpretations of these Truisms according to the (Meta)physical view we have.

To mathematically know a quantity $E(t)$ is to know its value for all values t . A fundamental question of Physics is this:

Can we know a physical quantity $E(t)$ (energy, for example) directly by our measurements of it where in the interaction of measurement an amount ΔE is absorbed by the sensor at each absorption cycle and E_{av} is the average of $E(t)$ at the sensor at each cycle?

I show it is not possible to know $E(t)$ [2, 53]. Though our measurements will chart a 'linear function' of $E(t)$ over time, the quantity $E(t)$ can be any integrable function. Furthermore, the relationship between $E(t)$ and the ΔE and E_{av} manifested in our measurements is a Planck-like mathematical identity that describes the interaction of measurement; the functional relationship between the quantity $E(t)$ at the sensor at time t , the amount ΔE absorbed by the sensor, and the average E_{av} at the sensor for each absorption cycle. [2, 12]

With math identities that describe either measurement or the interaction of measurement we have convergence between theory and experiments². Thus, the more accurate our measurements get the more indistinguishable the experimental graph and the theoretical curve get. This is clearly so with the Pythagorean Formula. And experimental data show this is also the case with Planck's Formula for blackbody conditions [29]. There is no known explanation for this. Other than awe and wonderment of how accurately Planck's Law fits Nature. But my result showing Planck's Formula is a mathematical identity explains this remarkable coincidence between theory and data [2, 10].

² Always assuming the premises to the theorem are satisfied.

The equally remarkable accuracy and wide use of QM suggests QM likewise may be a mathematical truism that describe interactions of measurement for more complicated conditions. The close similarity of my equations defining energy and momentum (using the quantity η^3) and Schrödinger's equations, also argue this may be so [2, 9]. As with Planck's Formula (a mathematical result) QM may also be a mathematical theory of measurement interactions applied to Physics and to other fields as well.

The convergence of theory and experiments for mathematical identities describing measurements contrasts sharply with the typical divergence between mathematical models and the empirical data. Thus, with mathematical models the more closely we look into the physical phenomenon modeled the more divergence we typically have with our theoretical calculations. Forcing fine tuning of our model. The need to add more epicycles to our theoretical orbits.

It may be argued what makes Physics different from Mathematics are its experimental confirmations of the mathematical deductions.

But do we find or create our experimental outcomes in some cases? Is it not possible to reach a point with our technology and our ability to manipulate Nature when we are able to create the experimental outcomes we design into our sophisticated instruments? As we are now able to create new substances in Chemistry and new organisms in Biology not existing before in Nature?

In an FQXi article, "The Crystallizing Universe", Kate Becker writes about the contradictory evidence of the double-slit experiment: [30]

"Gaze at the [detection] screen and you'll see an interference pattern generated by the light diffracting off the two slits and interfering on the other side. From this, you'd conclude that light must be a wave"

"Now [place] ... two detectors-one lined up with each slit-that can register individual photons. When you now repeat the experiment without the screen, the detectors tell you that the photons are sailing straight through the slits like bullets, with no hint that an interference pattern could ever have been produced. From this experiment, you'd conclude that light must be a particle."

"Could it be that light somehow "knows" what kind of experiment it is entering, and adjusts its behavior accordingly? It seems impossible, but experiment after experiment shows that if you're looking for a wave, light will act like a wave. Seek a particle, and light will be every inch a particle. Confused? So were quantum physicists."

Light does not know! But the detectors we use know. And they know because that's how we designed them. What we are observing is not the nature of light but the nature of the instruments used for the experiment. We observe what the detector is designed by us to show [21]. This is no different than people seeing what they are looking for. Our instruments may be defining Reality in other ways as well. Just as our politicians and news media are defining our Political Reality by shaping what we think and how we see.

[...]

Where is the fine line between evidence and interpretation? We discern our evidence using the same thinking and theories we use designing our instruments. With our advanced technology could we perhaps have built instruments producing designer outcomes?

We tend to find what we are looking for. Simply by ignoring all other occurrences. And we interpret the evidence according to our beliefs and the theories based on our beliefs. Our theories become filters to Reality. And our Knowledge the chiseled remains of a larger Universe. Thus our view of the Universe evolves to become the Universe. When it is only our view!

[...]

If our model does not pass through a data point close enough we add more terms; more degrees of freedom; more quarks and color; more epicycles to our theoretical orbits. More modern day angels dancing on our pinheads. And because our knowledge of 'what is' is coded in objective language, we call our knowledge science. We separate ourselves from our senses as we objectify our theories. But there comes a time when our theorica encapsulating our knowledge contradicts our senses. As is the case now with the many paradoxes of Physics. We have a choice to make. Do we trust our theories to tell us what is or do we trust our senses. History advises us to trust our senses. That's

³ The quantity η can be thought as the time integral of energy. Planck's constant h is such a quantity. See below for more on this.

what every great mind in the past has done!

The logical consistency, precise definitions and objective truths of Mathematics makes Mathematics an *ideal tool* for Physics. But we must not be lured into believing the *tool* cannot be misapplied. The mathematical sketches (truths) of '*what is*' are not the same as '*what is*'. The picture of a pipe, in Rene Magritte's painting "*this is not a pipe*", is not a pipe.

Mathematical models provide a coded methodology for organizing and cataloging the known facts in Nature's Library. But the Model is not the Library. Nor is it Nature. If using a search algorithm I enter the name of a book and get a coded ID where I can find the book in the Library; and using the code I find the book, have I predicted my findings? Assuming the Universe here and now is an orderly and well maintained Library and the mathematics that codes the 'facts of the Universe' is free of self-contradiction, I can be fairly certain I will come up with the experimental outcomes I have predicted. But if the mathematical model does not take me to the correct predicted outcome, I modify the model. And continue believing the Universe is in order. I do what all 'true believers' do. Trust in God even in contradiction.

Physics is blurring and confusing 'object' with 'observation'. And trusting and believing math will lead us to the truth of what is the Universe. Physicists argue what is 'objective' must be 'observable' and what is 'observable' is 'objective'. What we see is all we get ... and all we can know. Appearance is Reality and Reality is Math. Thus the only problem for Physics is finding the right mathematical model that describes the Universe. Physicists believe the Universe can be mathematically modeled. But this is a metaphysical belief!

We shouldn't base Physics on metaphysical beliefs of what is unknowable to us. But starting with our measurements and limiting our theories to how measurements happen – never asking or answering the question what is the Universe – we can formulate physical theory that makes sense. And mathematical deductions that will not mislead us with mystical and metaphysical illusions. I sketch below my approach to such Physics. Starting with η^4 as primary we can define the following physical quantities in terms of it:

Summary: *We cannot know what is the Universe. Models of the Universe go beyond the physical and so are metaphysical in essence. And all attempts to know what is the Universe ultimately fail. Physics can avoid such fate by limiting its scope to measurements and to mathematical identities (and not models) describing measurements and interactions of measurements. The Pythagorean Formula, for example, describes identically the measurements of length for right triangle conditions. While Planck's Formula describes identically the interaction of measurement of energy for blackbody conditions [2, 12]. And QM describes interactions of measurement under more complex conditions. The remarkable convergence of these between experiments and theory argues in favor of this view. Mathematical models, on the other hand, typically diverge and must be fixed to fit.*

In my derivation of Planck's Formula [2, 10] the quantity ' η ' is fundamental. This is the time integral of energy

$$\eta = \int_{t_0}^t E(u) du$$
 in units of joule-sec. It can be viewed as 'accumulation of energy' and as 'action'. Planck's constant

h is such a quantity. And the wavefunction describes the distribution of ' η ' in space and time. Starting with ' η ' as primary (undefined and undefinable), we can mathematically define physical quantities like energy, momentum, force, entropy and temperature. Planck's constant h we show [2, 7] determines the Kelvin temperature scale and is not some mysterious universal 'quantum constant', as currently thought. (see also Timothy Boyer's essay regarding Planck's constant h) [39]. Basic Law of Physics, I argue, should be mathematical identities relating measurements of physical quantities. And not Universal Law of what is. Which I argue is not possible to truly know. And may not even exist in the sense we think.

Following this approach and starting with the quantity ' η ', we naturally obtain (for blackbody conditions) a proportionality between entropy and time, $\Delta S = k\nu \Delta t$ [2, 6]. From this we discover the change of entropy, ΔS , is the 'amount of evolution/devolution' (depending on the rate constant ν) over a duration of time Δt . And this suggests the Second Law of Thermodynamics is not really about entropy, but about time. It can be restated as, "every physical process/event takes some positive duration of time to occur" [2, 6]. Thus the Second Law describes the nature of physical time as being duration Δt and not instantiation t as in the Spacetime continuum. This, I argue, may explain the inconsistency between Cosmology and Thermodynamics. An inconsistency that requires a patchwork of phantasmagorical theories to fix. But we can't fix Physics by adding more 'epicycles' to a flawed metaphysical view.

⁴ The quantity η can be thought as the time integral of energy in units of joule-sec. Planck's constant h is such a quantity. Though η is a variable while h is a constant.

Furthermore and consistent with my approach I am able to prove the following proposition: "If the speed of light is a constant, then light propagates as a wave" [2, 18]. Thus, Einstein's CSL Postulate contradicts his Photon Hypothesis. With this understanding that light propagates as a wave (and not as a particle projectile) we can now explain why the velocity of light in a medium is constant and independent of the velocity of the source or the observer. Thus, no need in SR to postulate CSL (see also Peter Jackson [49], Israel Omar Perez [43]).

I have sketched out in simple terms some broad outlines of a new physical view of Physics. In this view, energy propagates continuously while it interacts discretely. No 'measurement problem' here. Nor 'wave-particle dilemma'. But before 'manifestation of energy' there is an 'accumulation of energy' etc. Eric Reiter in his FQXi 2012 essay [50] argues for a similar loading theory proposed by Planck and others. But whereas such loading theory argues for continuous absorption and explosive emission, I believe both absorption and emission, being 'manifestations of energy', are discrete. What in my view is continuous is the 'accumulation of energy' etc prior to such 'manifestation of energy'; whether absorption or emission. Such 'accumulation of energy' is below the 'measurement threshold' and so not directly observable. This results in a time delay and a duration of time needed for any physical event to manifest.⁵ Manifestation happens when local equilibrium conditions occur while there is an interaction. The Physical Realism in this view resolves current paradoxes and brings us back to our senses. Physics happens at the point of measurement.

In conclusion, we are reasonably led to the following philosophical view. **The Anthropocentric Principle: Our Understanding of the Universe is such as to make Life possible.** The profound truth of this can best be seen when we consider the broader human experience in person and political life.

This contrasts to the **Anthropic Principle** in Physics which states *the Universe is such as to make Life possible*. Quoting from the Wikipedia article [56],

In astrophysics and cosmology, the anthropic principle (from Greek anthropos, meaning "human") is the philosophical consideration that observations of the physical Universe must be compatible with the conscious and sapient life that observes it. Some proponents of the anthropic principle reason that it explains why the Universe has the age and the fundamental physical constants necessary to accommodate conscious life. As a result, they believe it is unremarkable that the Universe's fundamental constants happen to fall within the narrow range thought to be compatible with life.

The strong anthropic principle (SAP) as explained by John D. Barrow and Frank Tipler (see variants) states that this is all the case because the Universe is compelled, in some sense, to eventually have conscious and sapient life emerge within it. Some critics of the SAP argue in favor of a weak anthropic principle (WAP) similar to the one defined by Brandon Carter, which states that the universe's ostensible fine tuning is the result of selection bias: i.e., only in a universe capable of eventually supporting life will there be living beings capable of observing and reflecting upon any such fine tuning, while a universe less compatible with life will go unheeded. Most often such arguments draw upon some notion of the multiverse for there to be a statistical population of universes to select from and from which selection bias (our observance of only this Universe, apparently compatible with life) could occur.

Such contrast in emphasis to 'what is' the Universe is fundamental, in my view, and can help explain the metaphysical mysteries Physics is engulfed.

Acknowledgments: I am grateful to FQXi administrators and members. I appreciate the sponsors of this essay contest for their support.

Constantinos

⁵ This is consistent with The Second Law of Thermodynamics as restated [2]

References:

- [1] Planck, Max (1901) *On the Energy Distribution in the Blackbody Spectrum*, Ann. Phys. 4, 553, 1901 (equation 11)
- [2] Ragazas, C. (2011). *The Thermodynamics in Planck's Law*, *Thermodynamics: Interaction Studies*, Juan Carlos Moreno-Pirajan (Ed.), ISBN: 978-953-307-563-1, InTech, Available from: <http://www.intechopen.com/books/thermodynamics-interaction-studies-solids-liquids-and-gases/the-thermodynamics-in-planck-s-law>
- [3] Ragazas, C. (2011). *A World Without Quanta?*, FQXi essay (2010/11) topic: "Is Reality Digital or Analog?" <http://fqxi.org/community/forum/topic/908>
- [3a] Ragazas, C. (2012). *The Metaphysics of Physics*, FQXi essay (2012) topic: "Questioning the Fundamentals" <http://fqxi.org/community/forum/topic/1406>
- [4] Ragazas, C. (2010) *The un-Hinging of Stonehenge*, TheFacultyPublishingGroup.com , vixra.org
- [5] Ragazas, C. (2010) *A Planck-like Characterization of Exponential Functions*, TheFacultyPublishingGroup.com , vixra.org
- [6] Ragazas, C. (2010) *Entropy and 'The Arrow of Time'*, TheFacultyPublishingGroup.com , vixra.org
- [7] Ragazas, C. (2010) *Let there be h: An Existence Argument for Planck's Constant*, TheFacultyPublishingGroup.com , vixra.org
- [8] Ragazas, C. (2010) *Prime 'physis' and the Mathematical Derivation of Basic Law*, TheFacultyPublishingGroup.com , vixra.org
- [9] Ragazas, C. (2010) *The meaning of ψ : An Interpretation of Schroedinger's Equations*, TheFacultyPublishingGroup.com, vixra.org
- [10] Ragazas, C. (2010) *Planck's Law is an Exact Mathematical Identity*, TheFacultyPublishingGroup.com , vixra.org
- [11] Ragazas, C. (2010) *The Temperature of Radiation*, TheFacultyPublishingGroup.com , vixra.org
- [12] Ragazas, C. (2010) *The Interaction of Measurement*, TheFacultyPublishingGroup.com , vixra.org
- [13] Ragazas, C. (2010) *A Time-dependent Local Representation of Energy*, TheFacultyPublishingGroup.com , vixra.org
- [14] Ragazas, C. (2010) *A Plausible Explanation of the Double-slit Experiment in Physics*, TheFacultyPublishingGroup.com, vixra.org
- [15] Ragazas, C. (2010) *The Photoelectric Effect Without Photons*, TheFacultyPublishingGroup.com , vixra.org
- [16] Ragazas, C. (2010) *Stocks and Planck's Law*, TheFacultyPublishingGroup.com , vixra.org
- [17] Ragazas, C. (2011) *What is The Matter With de Broglie Waves?* TheFacultyPublishingGroup.com , vixra.org
- [18] Ragazas, C. (2011) *"If the Speed of Light is a Constant, Then Light is a Wave"*, TheFacultyPublishingGroup.com , vixra.org
- [19] Ragazas, C. FQXi post Constantinos replied on Oct. 1, 2010 @ 17:48 GMT <http://fqxi.org/community/forum/topic/639>
- [20] Ragazas, C. FQXi post Constantinos wrote on Jul. 23, 2010 @ 20:49 GMT <http://fqxi.org/community/forum/topic/640>
- [21] Ragazas, C. FQXi post Constantinos wrote on Apr. 28, 2010 @ 04:08 GMT <http://fqxi.org/community/forum/topic/630>
- [22] Ragazas, C. FQXi post Constantinos replied on Apr. 17, 2010 @ 18:56 GMT <http://fqxi.org/community/forum/topic/655>
- [23] Ragazas, C. FQXi post Constantinos replied on Sep. 8, 2010 @ 02:14 GMT <http://fqxi.org/community/forum/topic/655>
- [24] Ragazas, C. FQXi post Constantinos replied on Oct. 1, 2010 @ 21:02 GMT <http://fqxi.org/community/forum/topic/639>
- [25] Ragazas, C. (2010 - 2012) posts in various FQXi blogs including but not exclusive the following <http://fqxi.org/community/forum/topic/640>, 655, 630, 617, 652, 631, 650, 618, 637, 639, and others <http://fqxi.org/community/articles/display/136>
- [26] Öz , H., *The Law Of Evolutionary Enerxaction and Evolutionary Enerxaction Dynamics* , Seminar presented at Cambridge University, England, March 27, 2008, <http://talks.cam.ac.uk/show/archive/12743>
- [27] Öz, H., *Evolutionary Energy Method (EEM): An Aerothermoservoelctroelastic Application*, in: *Variational and Extremum Principles in Macroscopic Systems*, Elsevier, 2005, pp. 641-670.
- [28] Frank, Adam (2010) , *Who Wrote the Book of Physics?* Discover Magazine (April 2010)
- [29] Wikipedia, (n.d.) http://en.wikipedia.org/wiki/File:Firas_spectrum.jpg
- [30] Becker, Kate "The Crystallizing Universe", FQXi Forum <http://fqxi.org/community/forum/topic/630>
- [31] Wikipedia, (n.d.) http://en.wikipedia.org/wiki/Gödel's_incompleteness_theorems 07/13/2012
- [32] Robert L. Oldershaw wrote on Jun. 16, 2012 @ 00:37 GMT <http://fqxi.org/community/forum/topic/1283>
- [33] Anthony Aguirre wrote on May. 19, 2007 @ 00:32 GMT http://www.fqxi.org/community/forum/topic/1265#post_54726
- [34] Paul Reed replied on Jun. 5, 2012 @ 07:01 GMT http://www.fqxi.org/community/forum/topic/1265#post_54726
- [35] Jim Holt , http://www.nytimes.com/2012/06/10/opinion/sunday/what-physics-learns-from-philosophy.html?_r=2
- [36] Wikidepia, (n.d.) <http://en.wikipedia.org/wiki/Metaphysics> (11:01, 10 June 2012)
- [37] Robert J. Langdon, Prehistoric Britain, <http://robertjohnlangdon.blogspot.com/>
- [38] Brian John, Stonehenge Thoughts, <http://brian-mountainman.blogspot.com/>
- [39] Timothy Boyer, *Is Planck's Constant h a "Quantum" Constant? An Alternative Classical Interpretation*, FQXi 2012 Essay
- [40] Edwin Eugene Klingman , *The Nature of the Wave Function*, FQXi 2012 Essay
- [41] Roger Schlafly, *Nature Has No Faithful Mathematical Representation*, FQXi 2012 Essay
- [42] Robert L. Oldershaw, *Misleading Assumptions* FQXi 2012 Essay
- [43] Perez, Israel Omar "The Preferred System of Reference Reloaded" FQXi 2012 wssay
- [44] Putnam, James FQXi post *James Putnam replied on Oct. 1, 2010 @ 21:52 GMT* <http://fqxi.org/community/forum/topic/639>
- [45] Kancharla, Sridattadev "Conscience Is the Cosmological Constant" FQXi 2012 essay
- [46] de Wilde, Wilhelmus "The Conciousness Connection" FQXi 2012 essay
- [47] Blumschein, Eckard "Questioning Pre-Mathematical Intuitions" FQXi 2012 essay
- [48] Bruiger, Dan J. "Does Nature Have a Definite Information Content?" FQXi 2012 essay
- [49] Jackson, Peter "Much Ado About Nothing" FQXi 2012 essay
- [50] Reiter, Eric Stanley "A Challenge to Quantized Absorption by Experiment and Theory" FQXi 2012 essay
- [51] Wikipedia, (n.d.) <http://en.wikipedia.org/wiki/Parmenides> 08/14/2012
- [52] Wikipedia, (n.d.) <http://en.wikipedia.org/wiki/Heraclitus> 08/14/2012
- [53] Ragazas, C. "The Metaphysics of Physics", TheFacultyPublishingGroup.com , vixra.org
- [54] Tamari, Vladimir F. "Fix Physics! - Reverse Engineer Relativity, Quantum Mechanics and the Standard Model, Get Rid of Outdated Assumptions, Consolidate, and Reconstruct on New First Principles" FQXi 2012 essay
- [55] Kyriakos, Alexander G. "Crisis in Physics. Which of Our Basic Physical Assumptions Are Wrong?" FQXi 2012 essay
- [56] http://en.wikipedia.org/wiki/Anthropic_principle (03/04/2015)