ABSTRACT

What is measurement and why does it exist? Measurement might be the natural process that separates the boundary of the multiverse from the interior of the multiverse. Measurement might exist because there is a 26-dimensional model for bosonic string theory. What might be the empirical predictions of string theory? Wolfram suggested that nature has a model consisting of 4 or 5 simple rules that define a finite automaton — if Wolfram's idea is correct then string theory might be the intermediary between the automaton and the automaton's predictions. Mathematical considerations indicate that some form of string theory is nature's way of unifying quantum field theory and general relativity theory. There might be 3 basic possibilities for nature's fundamental model: (1) string theory with the infinite nature hypothesis, implying the string landscape, superpartners, and eternal cosmological inflation; (2) string theory with the finite nature hypothesis, implying the Fernández-Rañada-Milgrom effect, the Space Roar Profile Prediction, and the existence of a modified Standard Model with precisely 64 fundamental particles; or (3) string theory replaced by a much more complicated generalization of string theory, implying the existence of dark energy stars or other unknown phenomena. This communication suggests an approach to Wolfram's automaton and possible implications.

WHAT IS MEASUREMENT?

"The value of a physical quantity as a result of a measurement has a degree of uncertainty, due to unavoidable errors, of which one can recognize the source but never establish the exact magnitude." — Giulio D'Agostini, 1996

http://arxiv.org/pdf/physics/9611016v1.pdf "A Theory of Measurement Uncertainty Based on Conditional Probability"

One might say that measurement is the act or process of determining the value of some physical quantity or attribute. An implicit or explicit measurement might be the act or process of a conscious agent or a happenstance of nature.

"Each photon is governed by laws of probability and behaves like a cloud until it is detected. It passes through both slits, not one or the other, and arrives everywhere at the detector array, with a large probability of arriving at certain detectors, a small probability of arriving at others, and zero probability of arriving at still others. Yet finally, if the detectors are sensitive enough to be triggered by single photons, each photon will be detected somewhere—somewhere quite specific. Where a particular photon will be detected is completely unpredictable. After many photons are detected, the calculated distribution of probability over the many detectors can be verified. The act of measurement is the transforming act that collapses uncertainty into certainty." — John Archibald Wheeler

http://books.google.com/books?id=zGFkK2tTXPsC&pg=PA331 "Geons, Black Holes, and Quantum Foam: A Life in Physics"

"The wave function tells where the electron might be, not where it is. But, to my mind, the Schrödinger wave fails to capture the true essence of quantum mechanics. That essence, as the delayed-choice experiment shows, is measurement." — J. A. Wheeler

http://books.google.com/books?id=zGFkK2tTXPsC&pg=PA339 "Geons, Black Holes, and Quantum Foam"

Could measurement be nature's way of separating the boundary of the multiverse from the interior of the multiverse? Is there a fundamental geometric or topological distinction between physical certainty and physical uncertainty?

QUESTIONS

Do the following 4 questions belong among the 10 most important questions concerning the foundations of physics? Are dark energy, the inflaton field, dark matter, and the space roar closely related natural phenomena? Do the monster group and the 6 pariah groups enable M-theory to have a computational method? If X is to string theory as Kepler's laws are to Newtonian mechanics then what is X? Is Milgrom the Kepler of contemporary cosmology?

Phil Gibbs ("Fundamental Physics 2013: What is the Big Picture?", Nov. 26, 2013, blog, vixra.org) gave his blog readers some questions to contemplate: "What is dark matter? What are the mechanisms of cosmic inflation? What mechanism led to the early production of galaxies and structure? Why does the strong interaction not break CP? What is the mechanism that led to matter dominating over antimatter? What is the correct theory of neutrino mass? How can we explain the fine-tuning of e.g. the Higgs mass and cosmological constant? How are the four forces and matter unified? How can gravity be quantised? How is information loss avoided for black holes? What is the small scale structure of spacetime? What is the large scale structure of spacetime? How should we explain the existence of the universe?"

http://blog.vixra.org/2013/11/26/fundamental-physics-2013-what-is-the-big-picture

Note that in Gibbs's questions the strong interactions are explicitly mentioned only once. If there are only 3 fundamental particles to be added to the 61 fundamental particles of the Standard Model of particle physics then the axion might be a logical choice if we believe that Gibbs's questions are well chosen. Thus the choice of graviton+inflaton+axion might the most reasonable according to what I call the "Fuzzy Energy Tensor Hypothesis".

https://en.wikipedia.org/wiki/Peccei–Quinn_theory

http://vixra.org/abs/1401.0101 "Is the Space Roar an Essential Clue for Quantum Gravity?"

QUANTUM GRAVITY AND STRING THEORY

"In conventional quantum field theory, you can make sense of a point in spacetime, a spacetime event in Einstein's sense. But in string theory, when you look carefully, that concept really isn't there." — Witten, 2010 Newton Medal lecture

http://www.youtube.com/watch?v=tofbMx8ZTQ4 "String Theory and the Universe: Edward Witten - YouTube" (22:50 of 1:00:14)

"For now, we have to be satisfied with the fact that string theory automatically generates quantum gravity while the pre-string framework of physics makes this impossible (as far as we understand). This is a key point since after all gravity and quantum mechanics are both part of nature and they need to be combined somehow. String theory is the only real idea about combining them and has proved to be remarkably powerful." — Witten, 2010

http://scgp.stonybrook.edu/archives/996 "ed witten's take on string theory"

"Possibly strings, together with higher dimensional D-branes, are here to stay as mathematical entities in the description of particles at the Planck length, but I for one expect that more will be needed before a satisfactory insight in the dynamical laws of our world is achieved. — Gerard 't Hooft

http://www.staff.science.uu.nl/~hooft101/lectures/stringnotes.pdf "Lecture Notes String Theory", p. 75

"My claim is simple, as explained umpteen times in my papers: I construct REAL quantum mechanics out of CA like models. I DO have problems of a mathematical nature, but these problems are infinitely more subtle than what you people are complaining about. These mathematical problems are the reason why I try to phrase things with care, trying not to overstate my case. The claim is that difficulties that are still there have nothing to do with Bell's inequalities, or the psychological problems people have with entangled states." —G. 't Hooft, Aug. 9 '12 at 13:32, physics.stackexchange.com

"Too few CA states to factor big numbers ... bravo, this the one point where my theory makes a prediction, and I mentioned this in some of my papers: my prediction is that there will be difficulties to fabricate the 'perfect' quantum computer. You know that the quantum computer is based on two conflicting requirements of its physical system: you need the absence of interactions in order not to disturb the quantum coherence of states, while interactions will be needed to read off what the states are. My prediction is that the CA underlying our physical world will generate interactions that cannot be turned any sort of way, so the space between Scylla and Charybdis is finite, and will generate failures in the quantum computer." — G. 't Hooft, Aug. 11 '12 at 22:46, physics.stackexchange.com

"What I have here is a Lorentz invariant theory equivalent to the model generated by the original superstring theory, but acting like a cellular automaton. It IS a cellular automaton. Any passengers left?" — G. 't Hooft, Aug 14 '12 at 10:08, physics.stackexchange.com

http://physics.stackexchange.com/questions/32203/discreteness-and-determinism-in-superstrings

G. 't Hooft, Han Geurdes, J. Christian, and many other theorists have worked on refutations of Bell's theorem and/or the replacement of quantum theory by some deterministic theory.

https://en.wikipedia.org/wiki/Bell's_theorem

Is measurement 100% compatible with the Copenhagen Interpretation and the Heisenberg uncertainty principle?

BOHR, EINSTEIN, AND MEASUREMENT

"The photograph of those gathered at the fifth Solvay conference on 'Electrons and Photons', held in Brussels from 24 to 29 October 1927, encapsulates the story of the most dramatic period in the history of physics. ... Bohr would be returning to Denmark disappointed that he had failed to convince Einstein to adopt his 'Copenhagen interpretation' of what quantum mechanics revealed about the nature of reality. Instead of yielding, Einstein had spent the week attempting to show that quantum mechanics was inconsistent, that Bohr's Copenhagen interpretation was flawed. Einstein said years later that 'this theory reminds me a little of the system of delusions of an exceedingly intelligent paranoiac, concocted of incoherent elements of thoughts'." pages xi-xii of “Quantum” by Kumar

"No one knew how to interpret the equations of quantum mechanics, what the theory was saying about the nature of reality at the quantum level. Questions about cause and effect, or whether the moon exists when no one is looking at it, had been the preserve of philosophers since the time of Plato and Aristotle, but after the emergence of quantum mechanics they were being discussed by the twentieth century's greatest physicists. With all the basic components of quantum physics in place, the fifth Solvay conference opened a new chapter in the story of the quantum. For the debate that the conference sparked between Einstein and Bohr raised issues that continue to preoccupy many eminent physicists and philosophers to this day: what is the nature of reality, and what kind of description of reality should be regarded as meaningful?” pages xiii-xiv of “Quantum” by Kumar

“Maxwell pointed out that the real reward for the 'labour of careful measurement' was not greater accuracy but the 'discovery of new fields of research' and 'the development of new scientific ideas'.” page xvi of “Quantum” by Kumar

http://books.google.com/books?id=XSIssqPhDbEC "Quantum: Einstein, Bohr, and the Great Debate about the Nature of Reality", 2008 by Manjit Kumar

Is conscious measurement always a small part of nature’s pattern of perfectly accurate measurement?

REALITY, UNREALITY, AND MEASUREMENT

‘Rather than distinguishing between "real" and "unreal" we want to more clearly distinguish between quantities that are inherent in the physical system as such (independent from the choice of coordinate system), and quantities that depend on the coordinate system. The next step would be to demand that only quantities of the first kind enter the laws of physics. However, it has been found that this objective cannot be realized in practice, as has already been demonstrated clearly by the development of classical mechanics.’ — Einstein, 1918

http://en.wikisource.org/wiki/Dialog_about_Objections_against_the_Theory_of_Relativity

Does a multiverse model always involve a large risk of advocating unreality inaccessible to empirical refutation? If nature has an empirically valid multiverse model, then is it possible to find axioms that explain how measurement works vis-à-vis the alternate universes that comprise the multiverse? Is the concept of a complete infinity physically dubious?

"In the physics I have learned there were many examples of where the mathematics was giving infinite degenerate solutions to a certain problem (classical mechanics problems e.g.). There the problem was always a mistake in the physics assumptions. Infinity is mathematical not physical, as far as I know." — Maria Spiropulu
http://www.edge.org/discourse/landscape.html#spiropulu

In string theory with the infinite nature hypothesis, extra dimensions beyond 4-dimensional spacetime curl up and provide string vacua that lead to empirically testable predictions. In string theory with the finite nature hypothesis, Wolfram's mobile automaton uses Fredkin-Wolfram information below the Planck scale to build up approximations to quantum information and string theory. What does the preceding statement mean?

TIME, SPACE, ENERGY, AND FINITIST SPECULATION

Are time, space, and energy irreducible components of physical reality? Wolfram's mobile automaton has 4 basic components: (1) network of Fredkin-Wolfram information below the Planck scale; (2) updating parameter; (3) digital delivery machine that describes how Fredkin-Wolfram information is updated and readied for physical interpretation; (4) stringy transfer machine that describes how the approximations of quantum information are labeled for physical interpretation; this machine transfers the digital data into an approximation of physical reality. What does the preceding statement mean? Imagine a finite-state machine with a circular tape. On each display unit of the tape there is a network of information. As the tape rotates, the updating parameter (or read/write head) modifies the display unit of the tape. The holographic display unit reads the tape display unit and provides an approximate picture of physical reality. However, this Rube Goldberg machine is spread out among a huge, but finite, number of alternate universes. Do I really know what I am talking about? Of course not. To understand the details of such a scenario, a theorist would have to understand conformal field theory, the Leech lattice, the monster group, the 6 pariah groups, and the mathematical method of putting everything together to make precise empirical predictions.

My thinking on this is as follows: Time, space, energy, and quantum information are replaced by a finite network of Fredkin-Wolfram information below the Planck scale. Fredkin time, Fredkin distance, and Fredkin digit transition might be valid concepts within the finite network. The digital delivery machine creates immensely large sets of sets of Fredkin-Wolfram information as Wolfram's updating parameter updates the informational pattern of the network. The stringy transfer machine assigns various labels to the sets of sets of Fredkin-Wolfram information; these labels involve the physical interpretation of string theory as represented within the network of Fredkin-Wolfram information. The process of Wolfram's automaton is 't Hooft's superstring determinism but with multiverse

information stored in a distributed pattern across alternate universes instead of multi-abundant information stored in a big bang initial state. The multi-abundant information allows the simulation of randomness. The issue of multiverse versus multi-abundance of information is basically a choice between a multiverse with alternate universes or a universe with hidden multi-abundance of information. The Copenhagen Interpretation and the Heisenberg uncertainty principle can never be empirically refuted because alternate universes and higher dimensional storage of sub-Planckian information are inaccessible to experiment.

FURTHER SPECULATION

Consider the following speculation: Imagine a quantized metric tensor with 64 dimensions of uncertainty and a quantized energy tensor with 64 dimensions of uncertainty. These 64 dimensions of uncertainty somehow are approximations arising from Fredkin-Wolfram information below the Planck scale. Wolfram's automaton runs through an endless cycle of …, retrieval/update/storage, retrieval/update/storage, … — there is no beginning and no end because the automaton has only a finite number of states and neither halt state nor start-up state. Wolfram's updating parameter uses a network of Fredkin-Wolfram information to update itself and create approximations to quantum information, quantum field theory, and general relativity theory. There are a huge, but finite, number of alternate universes, which always occur in matter/antimatter pairs. Wolfram's automaton has 4 basic components: (1) network of Fredkin-Wolfram information; (2) updating parameter; (3) digital delivery machine that creates sets of sets of Fredkin-Wolfram information that lead to digital approximations of quantum information; (4) stringy transfer machine that creates labels for sets of sets of Fredkin-Wolfram information and specifies all of the transfers into the digital approximations of quantum information with approximations of string theory, quantum field theory, general relativity theory, and measurements of quantum information. Fredkin-Wolfram information is stored among the alternate universes, all of which are found on the boundary of the multiverse. Quantum information is nature's way of sharing Fredkin-Wolfram information among the alternate universes. All the measured quantum information occurs on the boundary of the 72-sphere. The multiverse is a 72-ball in which the multiverse boundary contains all the measured mass-energy while the multiverse interior contains most, but not all, of the nonmeasured mass-energy. The pairs of matter/antimatter universes occur on the 71-sphere which forms the boundary of the 72-ball. The multiverse boundary has 71 dimensions compared to the multiverse interior's 72 dimensions, because the interior contains both matter time and antimatter time while each alternate universe has either matter time or antimatter time but not both. In each alternate universe, measurement consists of the eigenvalues of a 64 by 64 matrix with 1 dimension of time, 3 dimensions of linear momentum, and 3 dimensions of angular momentum. There is a mathematical way of mapping 64 dimensions of quantum uncertainty into operations on 3 copies of the Leech lattice; this mapping explains the 3 generations of particles. Information processing on the multiverse boundary is representative of information processing in the multiverse interior according to AdS/CFT correspondence. https://en.wikipedia.org/wiki/AdS/CFT_correspondence

The digital delivery machine requires a huge number of updates from Wolfram's updating parameter to create one Planck time interval with multiverse approximations to quantum information. The stringy transfer machine runs through an endless cycle: …, big-bang/expansion/big-stop-to-the-big-bang, big-bang/expansion/big-stop-to-the-big-bang, … The cycle repeats every 81.6±1.7 billion years. All the alternate universes are mathematically isomorphic to each other and have the same physical laws, except that CPT invariance makes some universes right-handed and others left-handed in terms of parity. The string landscape, superpartners, and eternal cosmological inflation cannot be empirically refuted, because contrived D-brane interactions allow models of any plausible (or implausible) physics. What might refute the preceding speculation on string theory with the finite nature hypothesis?

MOND CHALLENGE TO DARK MATTER PARTICLES

Consider 3 conjectures: (1) The main problem with string theory is that string theorists fail to realize that Milgrom is the Kepler of contemporary cosmology. (2) The monster group and the 6 pariah groups enable M-theory to have a computational method. (3) The space roar consists of the electromagnetic radiation emitted by the inflaton field. Can we agree that it is useful to assume that string theory explains the foundations of physics? If we agree, for the sake of argument, on the value of string theory, then we need to know the answer to the following question: If X's law is to string theory as Kepler's laws are to Newtonian mechanics, then who is X?

http://www.weizmann.ac.il/weizsites/milgrom/ Mordehai (Moti) Milgrom, Weizmann Institute of Science

If Milgrom's acceleration law were wrong, then how could he possibly have convinced McGaugh and Kroupa? McGaugh and Kroupa began as skeptics on non-relativistic MOND and gradually became convinced that non-relativistic MOND is empirically valid.

McGaugh has a Ph.D. in astronomy from the U. of Michigan at Ann Arbor.

http://astroweb.case.edu/ssm/cv.html CV: McGaugh

Kroupa has a Ph.D. in astrophysics from the U. of Cambridge.

http://www.astro.uni-bonn.de/~pavel/life.html CV: Pavel Kroupa

What is the ultimate explanation for non-relativistic MOND?

Antonio Fernández-Rañada and Alfredo Tiemblo-Ramos propose "an explanation of the Pioneer anomaly that is a refinement of a previous one and is fully compatible with the cartography of the solar system. It is based on the non-equivalence of the atomic time and the astronomical time which happens to have the same observational fingerprint as the anomaly."

http://www.nrcresearchpress.com/doi/abs/10.1139/p2012-086#.UtZzJxwhZPw Parametric invariance and the Pioneer anomaly - vol. 90, no 10, Oct. 2012, Canadian Journal of Physics

http://arxiv.org/abs/1106.4400 "The dynamical nature of time", 2011, by Fernández-Rañada and Tiemblo

I suggest that in the standard form of Einstein's field equations the -1/2 should be replaced by -1/2 + dark-matter-compensation-constant. If empirical tests show that the alleged dark-matter-compensation-constant is not a constant (to within 30 decimal places of accuracy) then my basic theory is guaranteed to be complete rubbish and crackpot speculation. The empirical evidence suggests to me that dark-matter-compensation-constant = sqrt((60±10)/4) * 10^-5 and if sqrt((60±30)/4) * 10^-5 is wrong then the whole idea is wrong.