▲ Questioning the Foundations Essay Contest (2012) (/t/questioning-the-foundations-essay-contest-2012)

### Cosmic Solipsism by Amanda Gefter

#### Amanda Gefter (/u/agefter) Sep 4, 2012

#### Essay Abstract

А

Cosmology is the study of the origin and evolution of the universe - the one we all love and inhabit. In this essay, however, I argue that the basic assumption of a single universe shared by multiple observers is wrong. Synthesizing the implications of black hole radiation, horizon complementarity, dark energy, observations of the cosmic microwave background and quantum logic, I argue that moving toward a true theory of quantum gravity will require us to give up the notion that we all share the same universe. Instead, I argue, each observer has their own universe, which constitutes a complete and singular reality.

#### Author Bio

I am a science writer, consultant for New Scientist magazine and 2012-13 MIT Knight Science Journalism Fellow. I have a master's degree in the philosophy and history of science from the London School of Economics.

# Download Essay PDF File (https://s3.amazonaws.com/fqxi.data/data/essay-contest-files/Gefter\_Gefter\_Fqxi\_essay.pdf)

#### [deleted] Sep 4, 2012

Amanda

I am agree with you and Max Born.

Max Born, "My Life & My Views" 1st Edition

"The average person does not realize that there is no way to verify whether his personal view (that tree green, etc.) the same as the view (on the same tree) from another person, and that the word "the same "is not there any sense."

♠ [deleted] (/d/1512-cosmic-solipsism-by-amanda-gefter/8) replied to this.

<b>&lt;</b>	Q Search Forum [deleted] Sep@2012	Sign Up Log In
	Ms. Gefter,	Log In to Reply
	Hi. I think this is a good essay because it deals with the important topic of how different observers in different reference frames might view reality. I've been trying to point this out as well. For example:	
		✿ Original Post

1. In my last FQXi essay and in a posting at my website, I try to show that a finite observer within an infinite set of finite balls might view each ball as an integer. But, a hypothetical, infinite-sized observer outside this set would not be able to see the boundaries of each of these balls (because they're infinitely small relative to him) and so the set would appear to him to be smooth and continuous.

https://sites.google.com/site/ralphthewebsite/filecabinet/infinite-sets-ii

3 of 52 posts

September 2012

2. The view of the absolute lack-of-all as "nothing" or "something" depends on how you think about this lack-of-all. That is, maybe, "something" and "nothing" are just different descriptions of the same thing. It's just that these descriptions are made by observers thinking about this same thing differently.

https://sites.google.com/site/ralphthewebsite/filecabinet/why-things-exist-something-nothing

Anyways, good essay!

♠ [deleted] (/d/1512-cosmic-solipsism-by-amanda-gefter/6) replied to this.

#### **4 DAYS LATER**

#### Wilhelmus de Wilde (/u/wde wilde) Sep 10, 2012

Dear Amanda: It was Yuri who made me attentive to your (well written) essay, and indeed there are paralels which does not mean crossing points. You would perhaps also be interested in reading "THE CONSCIOUSNESS CONNECTION" (https://fqxi.org/community/forum/topic/1370), where your "observer's unique de Sitter horizon" is treated as the "Subjective Simultaneity Sphere" but not in the same way, because the radius of my SSS can change. I also have a solution for the so called "solipsism" by introducing the cutting circles of the SSS's that are forming Objective Simultaneity, this process is also called "decoherence" and qo forms the "history" of our universe.

hope to meet you on my thread.

and good luck in the contest.

Wilhelmus

#### Benjamin Dribus (/u/bdribus) Sep 12, 2012

Dear Amanda,

I really enjoyed your essay. It is one of the most thorough and clearly focused contributions on the subject of covariance (i.e. observer dependence/independence) in the contest. I share your deep interest in this important subject. A few itemized remarks:

1. One of the most important points, in my opinion, is the absolutely crucial role of spacetime structure in constraining "particle states." As you point out, such states arise in Minkowski spacetime via the representation theory of the Poincare group, and altering (or removing) this background changes the picture completely. Many approaches to quantum gravity involve very complicated spacetime microstructure, and this makes the use of covariance in the form of spacetime symmetry to determine particle states problematic even locally. There is another possible interpretation of covariance, however, and this interpretation is much more general than group symmetry. It is based on order theory, and is related to the relativity of simultaneity. In this interpretation, different frames of reference are, in general, no longer related by a group action, but by different refinements of the causal order. I describe this in more detail in my essay here: On the Foundational Assumptions of Modern Physics (https://fqxi.org/community/forum/topic/1386).

2. You discuss several different types of horizons (black holes versus cosmological horizons, etc.) I'm probably preaching to the choir here, but there is some disagreement about the equivalence of different types of horizons and the implications for observer independence. There is an essay by Tanmay Vachaspati in this thread called "Preferred observers in quantum gravity" that discusses this and may interest you... along with yours, it was one of the more interesting submissions on covariance.

3. You mention Rovelli's relationism; if you look at my essay you'll see that I have a lot of sympathy for this point of view. You might be interested in some of the submissions here on that topic; for instance Jorge Pullin's essay on the measurement problem.

I particularly appreciate your broad point of view and synthesis of several different problems that are usually considered separately. Take care,

**℅**Now

Reply

В

W

#### Ben Dribus

Amanda Gefter (/d/1512-cosmic-solipsism-by-amanda-gefter/7) and [deleted] (/d/1512-cosmic-solipsism-by-amanda-gefter/9) replied to this.

#### [deleted] Sep 12, 2012

#### Hello thinkers,

Indeed but the determinism is the determinism. We can have indeed different points of vue, that will not change the universal determinism and its evolution spherization. In fact an apple is an apple. An flower is a flower, a paraticule also, and this and that, a star, a planet, a water drop, a wave,this or that, brains, eyes, hands, in fact the mass is the mass and we perceive it with relativity but the mass is the mass, and the light is the light. We contemplate just due to these two main gauges, the m and the hv. a photon is a photon, with its serie of uniqueness. So we can interpret diffrently but the Universal3D sphere is the same for all in a pure physical coherence of course. All roads do not go to Roma at my knowledge, so the determinism is an essential parameter permitting to sort the bad convergences.

It is a simple evidence of our universality in evolution. We arrive at the uncompleteness due to our relativistic limits of understanding and perception of all the 3D scales.

It is important to make the difference between our limits, physical, deterministic and rational, and the bizare hidden variables, irrational. The real understanding of this uncompleteness is in accepting opur young age at this universal scale. The time like a pure constant of evolution, duration implied by the rotations of spheres at all scales !

**Best Regards** 

#### Amanda Gefter (/u/agefter) Sep 12, 2012

Hi Ben,

Α

Thank you so much for your encouraging and insightful comments. I'm so glad you share my interest in the profound significance of covariance and observer-dependence/independence. The history of physics seems to suggest that separating the invariant from the observer-dependent is the key to getting at the true reality beneath, and I'm fascinated by the ways in which quantum gravity undermines invariances that even relativity and quantum mechanics had left intact.

#### With regard to your comments:

1. I agree that the question of how to define global or even local observables in quantum gravity is extremely important and mysterious. Personally I am intrigued by the notion that while for AdS or asymptotically flat spacetimes you can retain some kind of invariant boundary observables, you can't seem to do so in de Sitter space, precisely because the de Sitter boundary is observer-dependent. This to me is suggestive that reality is far more observer-dependent than it seems.

I've just read and greatly enjoyed your eloquent essay - though I think I'll have to read it a few more times to understand it! (That's a reflection of my nonexistent mathematical background, not of your essay!) I'm curious if it is in any way related to Tom Banks's work on holographic spacetime? As I understand it, he argues that the causal structure of spacetime can be reconstructed from quantum commutation relations up to a rescaling of lengths and times, and then you can use the holographic principle (because it gives you an area as a function of the number of quantum states) to include scale and now you've got spacetime structure. I believe in his work the observables are noncommutative matrices on the boundary of each "reference frame". Sorry if that's totally irrelevant. In any case, I'm in full agreement that the manifold won't survive quantum gravity - the dualities of string/M-theory certainly point in the direction of a kind of emergent spacetime. In your model, with its basis in binary elements, would you say that the world is "made of information"? And is that information observer-dependent?

2. You're absolutely right - I probably should have mentioned that there is disagreement about how much we can extrapolate the lessons of black hole horizons to cosmic horizons; even Susskind himself has gone back and forth over whether horizon complementarity applies to the de Sitter horizon. Personally, however, I'm unconvinced by arguments that they shouldn't be treated equally. They are mathematically equivalent, they share the same properties of entropy, temperature, etc... yes, there are physical differences (the dS space doesn't "evaporate away", etc) but it just seems to be telling us something general and profound and as a structural realist I see every reason to treat them as equivalent - not least of all because of the equivalence principle!

Thanks again for your comments and for your fascinating contribution, which I will now go and re-read :)

All best,

Amanda

[deleted] Sep 12, 2012

What is your opinion about my essay?

http://fqxi.org/community/forum/topic/1413

[deleted] Sep 13, 2012

Amanda

i think you are reincarnation from George Berkeley

http://en.wikipedia.org/wiki/George\_Berkeley

#### Amanda Gefter (/u/agefter) Sep 13, 2012

Hi Yuri,

Α

Thanks - I take that as a compliment! However, the solipsism I'm talking about is not a kind of Berkeleyean idealism. I'm not arguing that everything exists only in the mind; in fact, I'm not talking about "minds" at all, but merely reference frames or causal patches. The "solipsism" lies in the fact that, according to some exciting new ideas in theoretical physics, each reference frame defines its own unique yet objectively existing universe. Covariance demands that we can talk about reality equally well from any frame, but the holographic principle and horizon complementarity demands that we restrict our description to a single frame at a time.

All best,

Amanda

[deleted] Sep 13, 2012

Thank you. Very interesting comment.

Have you read my essay?

http://fqxi.org/community/forum/topic/1413

Amanda Gefter (/d/1512-cosmic-solipsism-by-amanda-gefter/14) and [deleted] (/d/1512-cosmic-solipsism-by-amanda-gefter/37) replied to this.

#### [deleted] Sep 15, 2012

#### Dear Amanda,

you may have a look to my essay (and rate it). It is related to many aspects with yours.

#### Ioannis

★ [deleted] (/d/1512-cosmic-solipsism-by-amanda-gefter/17) replied to this.

#### [deleted] Sep 15, 2012

#### Hi Amanda,

I thought your essay was very well written and clearly argued.

I have two questions: What is an observer - a particle, an atom, a molecule, a cell or a larger living thing like a human being? If a particle is a type of observer with its own reference frame, would a molecule or a cell etc. be viewed as a type of composite reference frame?

#### Lorraine

Amanda Gefter (/d/1512-cosmic-solipsism-by-amanda-gefter/15) replied to this.

#### Amanda Gefter (/u/agefter) Sep 15, 2012

Hi Yuri,

А

А

В

I enjoyed reading your essay. I must admit I did not fully understand it, but you seem to be drawing some interesting connections.

All best,

Amanda

Amanda Gefter (/u/agefter) Sep 15, 2012

Hi Lorraine,

Thanks very much for reading my essay and for your comment.

I define an observer as a frame of reference. That is, a coordinate frame (to put it in the language of relativity), a causal patch (cosmology), or even a Boolean lattice (quantum logic). I would not consider a particle (or any group of particles up to and including living creatures) as an observer precisely because, once gravity is involved, the very definition of a particle depends on the reference frame (hence, for example, the accelerated observer sees Hawking radiation while the inertial observer does not).

All best,

Amanda

Benjamin Dribus (/u/bdribus) Sep 16, 2012

Dear Amanda,

(Replying down here because the subthread above got a bit long.)

I think Tom Banks starts with a lot more structure than I do... which might, incidentally, be necessary. The most obvious criticism of my ideas is that they may be too parsimonious to achieve sufficient explanatory power, but I do have some reasons to be hopeful that I can get somewhere worthwhile from this direction.

"Made of information" is a good description of my approach, although I wouldn't choose that terminology myself simply because it's already been used to describe a lot of theories that really involve a lot of auxiliary structures. The information is observer dependent, but not the laws of physics.

I have my doubts about a lot of aspects of recent black hole physics, simply because we know that it resides near the horizons of validity of the theories involved (no pun intended). I view it as worth taking seriously, and it's certainly worthwhile to explore the consequences, but I would not be surprised if certain aspects of it turn out to be artifacts of theory stretched beyond its bounds. Take care,

Ben

#### [deleted] Sep 18, 2012

#### Dear Amanda,

If you have found the time to read my essays you would note that our thoughts coincide apart from the different way of expression (due of my amateur education in physics). Each observer has his own reference frame and we can not examine any phenomenon taking two (or more) reference frames at the same time. However I propose that the deviating views by different observers is resemblance of their different frames and it does not mean a difference in Reality. It is like a view from an open window. Every observer has his own view that depends from his position and not to another Reality out of the window. Each observer can see a different part of the only one Reality because of his own position in relation to the window and the Reality out there.

The expression inside and outside of a Black Hole (BH) resembles mine real and virtual part in any universe. It is evidence that real observers can realize only the real part of their universe while the virtual observers only the virtual part. It is time however to try to resolve the rules of the virtual part of our Universe (if we consider ourselves as real observers).

During the BH's inhalation the information "lost" is transferred to a new universe which may be of different or the same dimensionality (hence the black holes' jets).

The quantum part of your essay can be related to World Line (WL) individuality of each event through spacetime that for many instances there are equivalent different paths close to the WL of events (see fig. 1).

Thank you for the "Experimental evidence of solipsism?" that is a straight evidence of NCS as well.

Best wishes, loannis

#### [deleted] Sep 19, 2012

Amanda -- Wow! I've read a lot of FQXi essays over the years, and this is one of the most interesting I've seen. One thing I didn't notice you tackling, though, was an explanation for the consistency among observations. I have an idea on that: The kinds of observers familiar to us -- biological and technological ones -- share a topological connection which makes inconsistent observations impossible. That idea is central to **my essay**,

(https://www.fqxi.org/community/forum/topic/1286) "Toward an Informational Mechanics," as is Rovelli's relational quantum mechanics (which I was thrilled to see you mention -- Rovelli just doesn't get enough love).

In my essay's comments section, there is some discussion about solipsism. I explained my thought that collective reality is a kind of "collective solipsism," but you're absolutely right that each observer frame corresponds to its own universe. It's just that topologically connected observers necessarily observe common informational features of the

universe, and I think it is precisely this commonality and consistency that creates the appearance of a single universe. I hope you have a moment to check it out.

Great work again, and best of luck in the competition.

Amanda Gefter (/d/1512-cosmic-solipsism-by-amanda-gefter/22) replied to this.

[deleted] Sep 19, 2012

Hello Ms Gefter,

I beleive that you speak about the interpretations of this Universe. You know the Universe is the same for all. That said we perceive it with our own emotions correlated with our education. The universe is the same sphere for all. In fact I beleive that you cannot say so your conclusion about the universe. We cannot confound an interpretation with a pure determinism.

Let's take a simple example. Imagine that you like the color of the planet mars, red. and that a friend, him does not like the red color of this planet. It does not mean that this planet mars does not exist or that it exists two planets mars for example.

1+3+5+7+11+13=40 I don't see an other number :)

**Best Regards** 

Amanda Gefter (/d/1512-cosmic-solipsism-by-amanda-gefter/23) and [deleted] (/d/1512-cosmic-solipsism-by-amanda-gefter/28) replied to this.

[deleted] Sep 21, 2012 Dear Amanda in last issue of Russian magazine http://ufn.ru/en/articles/2012/9/ you can read Letters to the editors "Einstein Moon" http://ufn.ru/en/articles/2012/9/h/ It seems to me soliptic view.

Peter Jackson (/u/pjackson) Sep 21, 2012

Dear Amanda.

Ρ

Your thesis first sounds shocking, as intended, but; 'the truth will first look wrong as it will be unfamiliar.' (Feynman) so it's in with a shout. I think you find much of the path to truth, but suggest you then drift off to hypothesise and question. I hope you may read my essay which suggests a direct mechanistic and deterministic path in a similar direction, and some causal answers to co-variance. This nevertheless agrees or has analogies with your views;

"...we must never speak of more than one observer or universe at a time."

the "...observer-dependence of the vacuum."

"...multiverse cosmology will have to give way to a new kind of cosmology, one that is radically frame-dependent."

"...it is equally valid to describe reality from any one of an infinite number of possible reference frames."

"...each observer's reference frame defines a complete universe, and anything outside the frame is considered merely a redundant description"

I agree your identification of the low quadrupole, 'axis of evil' and the other CMB anisotropies, to which a solution emerges (consistent with electron twin vortex spin). A consequential recycling mechanism is more referred in the end notes, last years essay and elsewhere. ("...the black hole evaporates and eventually blinks out of existence, presumably taking all internal information with it."). But then returns.

A very well written, courageous and well argued essay. I really do look forward to your comments on the 'hard reality' analogies underlying the theatrical surface of mine.

Very best wishes

Peter

Amanda Gefter (/d/1512-cosmic-solipsism-by-amanda-gefter/26) replied to this.

Amanda Gefter (/u/agefter) Sep 22, 2012

Hi Karl,

Α

Thanks so much for your kind comment! I'm so glad you enjoyed the essay.

The question of consistency among observations is a fascinating one. For me, the key insight comes from Rovelli and from the lessons of horizon complementarity: there is no view from outside the universe, no superobserver who can see across reference frames. That means that any time two observers "compare notes", the comparison is itself an ordinary quantum mechanical interaction. That is, if I compare my observations with yours, the act of comparison takes place within a single reference frame – mine or yours but never both simultaneously. There's no "view from nowhere" from which we can compare two observers' perspectives independent of a reference frame.

I just had the chance to read your essay and I thought it was fantastic. I'll post some thoughts over on your page.

Thanks again!

All best,

Amanda

Amanda Gefter (/u/agefter) Sep 22, 2012

Hi Steve,

Α

Thanks for reading my essay and for your comment. I appreciate your view; however, the point that I was trying to make in my essay is that while common sense would suggest that we all live in a single universe and that different observers' perspectives are merely different descriptions of one and the same reality, the latest advances in theoretical physics suggest otherwise. That is, we can assume, as you do, that there is one single reality occupied by several observers, but in doing so we actually violate the laws of physics (we clone information, for instance). Put another way, the laws of physics only make sense within a single reference frame at a time. This, to me, is both shocking and profound.

Best,

Amanda

[deleted] Sep 23, 2012

#### Amanda,

Your thesis vitally depends on miraculous theoretical results like this one:

"...Hawking particles objectively exist according to observers outside the black hole and objectively do not exist according to the unlucky observers who fall in."

In my view, juggling with such results, without questioning the underlying assumptions, leads you nowhere. The miraculous results may simply be absurd consequences of false assumptions. Let me give examples of an opposite approach:

#### Lee Smolin, The Trouble With Physics (https://www.amazon.com/Trouble-Physics-String-Theory-

Science/dp/0618551050): "Einstein's special theory of relativity is based on two postulates: One is the relativity of motion, and the second is the constancy and universality of the speed of light. Could the first postulate be true and the other false? If that was not possible, Einstein would not have had to make two postulates. But I don't think many people realized until recently that you could have a consistent theory in which you changed only the second postulate."

Joao Magueijo, Faster Than the Speed of Light (https://www.amazon.com/Faster-Than-Speed-Light-Speculation/dp/0738205257): "Lee [Smolin] and I discussed these paradoxes at great length for many months, starting in January 2001. We would meet in cafés in South Kensington or Holland Park to mull over the problem. THE ROOT OF ALL THE EVIL WAS CLEARLY SPECIAL RELATIVITY. All these paradoxes resulted from well known effects such as length contraction, time dilation, or E=mc^2, all basic predictions of special relativity. And all denied the possibility of establishing a well-defined border, common to all observers, capable of containing new quantum gravitational effects."

Pentcho Valev

Amanda Gefter (/d/1512-cosmic-solipsism-by-amanda-gefter/25) and [deleted] (/d/1512-cosmic-solipsism-by-amanda-gefter/27) replied to this.

#### Amanda Gefter (/u/agefter) Sep 23, 2012

Hi Pentcho,

Α

I wholeheartedly agree that questioning our assumptions is crucial to make progress in physics - and of course that is the whole point of this essay contest!

The "miraculous theoretical result" you refer to is very well accepted in the physics community. I have yet to come across any legit disproof of Hawking's calculation, which itself is based on the extremely well-tested equations of quantum mechanics and general relativity. Could Hawking turn out to be wrong? Of course. In the meantime, I think it's important to follow these profound theoretical discoveries to their logical limits and see where they lead. As I explain in my essay, I am further convinced by the convergence coming from physics as wide-ranging as quantum logic and the cosmic microwave background data.

Thanks for your comment.

Best,

Amanda

Amanda Gefter (/u/agefter) Sep 23, 2012

Hi Peter,

Α

Thanks very much for your comment. I look forward to reading your essay.

Best,

Amanda

#### [deleted] Sep 23, 2012

Hawking assumes the speed of light is constant in a gravitational field (and so contradicts both general relativity and Newton's emission theory):

Stephen Hawking (https://ircamera.as.arizona.edu/NatSci102/NatSci102/text/extplaydice.htm): "Both Mitchell and Laplace thought of light as consisting of particles, rather like cannon balls, that could be slowed down by gravity, and made to fall back on the star. But a famous experiment, carried out by two Americans, Michelson and Morley in 1887, showed that light always travelled at a speed of one hundred and eighty six thousand miles a second, no matter where it came from. How then could gravity slow down light, and make it fall back."

Stephen Hawking, A Brief History of Time, Chapter 6 (https://www.amazon.com/Brief-History-Time-Stephen-Hawking/dp/0553380168): "Under the theory that light is made up of waves, it was not clear how it would respond to gravity. But if light is composed of particles, one might expect them to be affected by gravity in the same way that cannonballs, rockets, and planets are.....In fact, it is not really consistent to treat light like cannonballs in Newton's theory of gravity because the speed of light is fixed. (A cannonball fired upward from the earth will be slowed down by gravity and will eventually stop and fall back; a photon, however, must continue upward at a constant speed...)"

Do you agree with Hawking? Is the speed of light constant in a gravitational field? Did the Michelson-Morley experiment show "that light always travelled at a speed of one hundred and eighty six thousand miles a second, no matter where it came from"?

Pentcho Valev

#### [deleted] Sep 23, 2012

Dear Ms Gefter,

You are welcome.

ps:The observation permits to improve the knowledges. The dynamics seem universal at all 3D scales. A hymenoptera(a bee) see the same dynamic with a pure relativity. If on an exoplanet, some intelligent creations see, they see the same relativistic dynamic of rotations of spheres. If a bird flies, so it utilizes the same physical laws, like made an airplane. In fact it is the same for all lifes in fact and all dynamics, so all rotations and motions implying rules of complementarity of evolution. The observations everywhere inside our universal sphere shall be always under the same universal dynamic of spherization in fact. The Universe is unique and bounded, with a specific universal equation of spheres.

I beleive strongly that in fact the importance is to differenciate the philosophical interpretation(multiverse) and the pure realistic determinism of uniqueness and the correlated intrinsic laws(Universe).

Fortunaly for our equations, laws, constants and SI :) furthermore. If not, we violate our laws, physical and universal of this homogene and intrinisic and bounded spacetime.

**Best Regards** 

#### [deleted] Sep 23, 2012

Thanks for this provocative and persuasive argument. The notion that reality may be observer-dependent by virtue of it being tied to perception which is necessarily user-specific leads me to wonder if what actually IS can ever be truly known. Also, I wonder if what actually is could be subject to the Hawthorne effect (from the social sciences, I think) whereby that which is being observed changes as a result of efforts to observe it. And then what?

#### [deleted] Sep 27, 2012

#### Dear Amanda,

a very relevant, well written essay. Good luck.

◆ Amanda Gefter (/d/1512-cosmic-solipsism-by-amanda-gefter/34) and [deleted] (/d/1512-cosmic-solipsism-by-amanda-gefter/35) replied to this.

Olaf Dreyer (/u/odreyer) Sep 27, 2012

Dear Amanda:

O

What a nice and provocative essay.

I have one, very basic, question: For concreteness I will focus on the question of observer dependence of the notion of particles. If one looks at Unruh's calculation that gives a thermal spectrum of particles for the accelerated Rindler observer and no particles for the Minkowski observer isn't it true that the calculation starts from the same state in the same space-time for both these observers? While it is true that the two descriptions by the two observers are different it is also true that there is one description from which both of these can be derived.

So why shouldn't I call this one description (Minkowski space R<sup>4</sup> together with vacuum state |0>) the one universe? If you want the description for a particular observer just tell me how she moves and I will tell you what she sees.

I think what I said here for particles remains true for the other examples you cite (with the possible exception of quantum mechanics).

All the best.

Olaf

Amanda Gefter (/d/1512-cosmic-solipsism-by-amanda-gefter/33) replied to this.

Amanda Gefter (/u/agefter) Sep 27, 2012

#### Hi Olaf,

А

Thanks so much for taking the time to read my essay, and for your great question.

I agree with you that in the Rindler case, you can think about two observers that start in the same universe, then have radically different but equally correct views of that same universe (rendering particles observer-dependent). As you say, you can translate between them (with a Bogoliubov transformation rather than a Lorentz transformation). That alone doesn't obviously demonstrate the solipsism I'm arguing for, though the observer-dependence of the vacuum (with none being more "true" than another) is kind of the first clue that there is some degeneracy in the nature of the universe. But take the case of an elephant falling into a black hole. An accelerated observer outside the black hole will see the elephant burn up before it crosses the horizon, its ashes radiated back out to infinity. But an inertail observer who falls in with the elephant sees it alive and well inside the black hole before it hits the singularity. If you assume that these two observers occupy one single universe, then it's a universe in which the elephant's quantum state has been cloned, violating the laws of quantum mechanics. If you want to keep the laws of physics intact, you're forced to give up the notion of a single, shared universe and instead restrict to a single observer's frame. I suspect there's a way to make this same argument for a Rindler observer, but it's not as intuitive, since he can always stop accelerating, rejoin the inertial observer and compare notes. Nonetheless, while he is accelerating you would surely violate the laws of physics if you described both their points of view with a single global geometry. This becomes especially relevant when you consider that we live in an asymptotically de Sitter universe, and that each observer has their own event horizon.

To my mind, this tells us something very powerful. That's not an original insight - I am taking cue from Susskind, Bousso, Banks, etc. Banks in particular argues that we have to generalize this argument to say that physics only makes sense within a single causal patch and that everything outside that observer's horizon should be considered pure gauge. What's original (and undoubtedly controversial!) in my piece is the attempt to connect this view with the low quadrupole in the CMB and with quantum logic.

Thanks again.

All best,

Amanda

А

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F

Amanda Gefter (/u/agefter) Sep 27, 2012

Thanks very much!

[deleted] Sep 28, 2012

With not long to the end of community voting your consideration of my own would be very much appreciated. Kind regards Georgina.

Philip Gibbs (/u/pgibbs) Sep 29, 2012

This is a very original and thought provoking idea, good luck.

#### [deleted] Sep 30, 2012

Did you rate my essay?

#### Frederico Pfrimer (/u/fpfrimer) Sep 30, 2012

#### Dear Amanda

Very interesting essay! Thanks for the suggestion! Now I could for the first time understand some of the basic ideas about the problem of information in black-holes. But I have a question, if the universe is not shared by all the observer, what is shared by all observers?

I have some ideas about it that can possibly give you some insight, well I hope so... One of the main problem was that apparently there was information being cloned if you look from to observers at the same time. However, there should be some correlation between any two observers. In this case, the total entropy (or information) will not be the sum of each observer's entropy. Actually I think two observers are completely correlated such that their total entropy equals each one' entropy. This might explain why "we can never speak about more than one at a time." and also why "according to which each observer's reference frame defines a complete universe, and anything outside the frame is considered merely a redundant description.". In information theory, if you add a redundant description the information content is not increased!

I also agree that the existence of more than one reference frame can lead you to non compatible Boolean logics, each frame has a Boolean logic but the comparison cannot be done using a Boolean logic. But I think this notion is different from the notion of quantum mechanics. I mean, your ideas add something new to quantum mechanics (general relativity reference frames and observers), so they cannot be explained by pure QM, we'll need something new, probably quantum gravity or quantum general relativity.

Wish you all the best! And good luck on this contest!

Frederico

Dear Amanda,

goes ad infintum.

#### Wilhelmus de Wilde (/u/wde wilde) Oct 1, 2012

## W

### I liked very much your New Scientist article about mathematics and reality, especially the part about the dodecahedron, it is our consciousness but not in our reality. Tegmaark has some points, especially with the limits of our causal universe and the math's that go untill these limits, it is furtheron that our consciousness takes over and

It was Benjamin Dribus who draw again my attention on your essay (I posted before (september 10) in a post on [link:fqxi.org/community/forum/topic/1370] my thread [/LINK] , regarding the aspect of subjective reality that we both are treating.

I understand you are very busy, but perhaps you will find a split moment to read and or rate (or comment) my participation.

best regards

Wilhelmus

#### Conrad Johnson (/u/cjohnson) Oct 3, 2012

#### Hi Amanda -

С

Ρ

I came across this paper today. It's too technical for me, but if you haven't already seen it I think you'll be interested in the introductory section -- as a way of thinking about how the different universes of different observers are connected.

#### The Principle of Relative Locality (https://arxiv.org/pdf/1101.0931v2.pdf)

Conrad

➡ Wilhelmus de Wilde (/d/1512-cosmic-solipsism-by-amanda-gefter/42) replied to this.

#### Peter Jackson (/u/pjackson) Oct 3, 2012

#### Amanda,

I'd like to pass you a link to the paper I referred above with strong analogies to your work, if you have time to read it and discuss.

I hope you manage to read my essay first as I look forward to your comments.

Best wishes

Peter

Wilhelmus de Wilde (/u/wde wilde) Oct 3, 2012

W

Ε

#### Dear Amanda,

The New Scientist special issue "WHAT IS REALITY" is very good, the perceptions of Henry Stapp and Matthew Donald have a lot of paralels with my own perception of reality.

I would like to sent my essay to them, is it possible that you give me their e-mail,

mine is

wilhelmus.d@orange.fr

If not possible, I understand, but a question is always possible.

Thanks

Wilhelmus

Eugeniu Alexandrescu (/u/ealexandrescu) Oct 3, 2012

#### Dear Amanda,

Wow! Your essay deserves the highest possible note -- and you got a 10 from me -- because it brilliantly explores (In the right direction!) which of our basic physical assumptions are wrong. Many thanks to Ben Dribus, who told me yesterday evening about your excellent essay.

So I would not argue with you when you "... argue that the basic assumption of a single universe shared by multiple observers is wrong." On the contrary, I fully agree with your perspective, and in my essay From Minkowski's Diagram to the Multispace Model of the Universe (https://fqxi.org/data/essay-contest-

files/Alexandrescu\_Alexandrescu\_M.pdf) I make the first step in the same direction by explaining "why" and most important "how" it happens that this universe is a multispace.

Yes, as you say, "... each observer lives in their own unique universe", but I realized that telling this fact like that was quite scary for some people, and that they had a tendency to disconnect themselves from my subject. Didn't you notice the same thing?

So in my essay, I preferred to use 'spacetime reference frames' instead of 'universes' and 'multispace' instead of 'multiverse,' nicely reminding the audience that this confirms Minkowski's 1908 declaration that the world is composed of an infinite number of spaces, as well as his multispace relativity.

You say "that we must never speak of more than one observer or universe at a time."

On one side, I completely agree. Each observer exists in his own universe. It is not for nothing that we instinctively feel we live in a 'bubble of perception.' And it's also true that we perceive the surrounding reality through our sense organs, filters that project this reality into our 'bubble universe,' our conscious self. So yes, each of us is 'one observer in his own universe.'

Yet, on the other side, it's not so simple. When do we start to talk about this 'own unique universe?' Is it the space surrounding our body? If you and me are ten feet away are we still in the same universe? What if we hug each other? If I look at my hand, is it inside or outside my universe?

Even more, we agree that in a multispace/multiverse world, "... each observer lives in their own unique universe." But each observer -- in fact each of us -- is made out of various organs, cells, and so on until these nagging pieces of matter called elementary particles. Do we have the right to say that quantum spaces are also little universes? After all, besides the size, the only difference between me looking at you through our universes, and seeing you, and looking at an elementary particle through its universe -- its quantum space -- is that I don't see this elementary particle. But

there is a simple and very physical explanation for that, which I also advance in my essay From Minkowski's Diagram to the Multispace Model of the Universe (https://fqxi.org/data/essay-contestfiles/Alexandrescu\_Alexandrescu\_M.pdf).

In fact, what I want to say is that this essay is just the tip of the iceberg. I spent several years to prove the Multispace Model beyond any possible doubt by finding convincing supportive evidence not just in physics, but also in cosmology and in Earth sciences.

I hope you have a moment to check it out and share your thoughts with me.

Best of luck in the contest.

Eugeniu Alexandrescu

S

Α

J

#### Sergey Fedosin (/u/sfedosin) Oct 3, 2012

If you do not understand why your rating dropped down. As I found ratings in the contest are calculated in the next way. Suppose your rating is [math]R\_1 [/math] and [math]N\_1 [/math] was the quantity of people which gave you ratings. Then you have [math]S\_1=R\_1 N\_1 [/math] of points. After it anyone give you [math]dS [/math] of points so you have [math]S\_2=S\_1+ dS [/math] of points and [math]N\_2=N\_1+1 [/math] is the common quantity of the people which gave you ratings. At the same time you will have [math]S\_2=R\_2 N\_2 [/math] of points. From here, if you want to be R2 > R1 there must be: [math]S\_2/ N\_2>S\_1/ N\_1 [/math] or [math] (S\_1+ dS) / (N\_1+1) >S\_1/ N\_1 [/math] or [math] dS >S\_1/ N\_1 =R\_1[/math] In other words if you want to increase rating of anyone you must give him more points [math]dS [/math] then the participant's rating [math]R\_1 [/math] was at the moment you rated him. From here it is seen that in the contest are special rules for ratings. And from here there are misunderstanding of some participants what is happened with their ratings. Moreover since community ratings are hided some participants do not sure how increase ratings of others and gives them maximum 10 points. But in the case the scale from 1 to 10 of points do not work, and some essays are overestimated and some essays are drop down. In my opinion it is a bad problem with this Contest rating process. I hope the FQXI community will change the rating process.

Sergey Fedosin (https://fqxi.org/community/forum/topic/1410)

Amanda Gefter (/u/agefter) Oct 4, 2012

Please make note of this correction:

In my essay's section on holographic spacetime, I attributed the theory to Tom Banks. However, it should have been attributed to Willy Fischler as well. My apologies for the omission.

Many thanks,

Amanda

#### **5 DAYS LATER**

Jayakar Joseph (/u/jjoseph) Oct 9, 2012

Dear Amanda Gefter,

As the Coherently-cyclic cluster-matter paradigm of universe describes Homeomorphic segmental-fluctuations of universe, (https://fqxi.org/community/forum/topic/1346) the Causally disconnected multiverse universes is not expressional in this paradigm, in that the Cosmic solipsism is the effect of observer-eccentricity of segment in the holarchy of universe in reference with the observer locality.

#### Cosmic Solipsism by Amanda Gefter - QSpace Forums

With best wishes

Jayakar

#### [deleted] Oct 9, 2012

#### Dear Amanda,

When you say "universe," you appear to mean a classical universe, or a universe described on the basis of finite observations, or a description of a universe recorded using classical information. If this is the case, I believe your statement on p. 7 that "I suspect that this is exactly what quantum mechanics has been trying to tell us all along" is correct - what QM has been trying to tell us all along is that classical descriptions are observer-dependent. This is in one sense not at all surprising: descriptions based on observations could be observer-independent - truly objective - only if the observers involved were effectively omniscient. Classical physics assumes omniscient observers: observers who are correct and complete, up to measurement resolution, in the descriptions that they record.

That said, I do not believe that you can really define an observer as a reference frame. A reference frame is just an abstraction. Reference frames do not accumulate classical information. At the very least, I think you need to attach to your reference frame a list (possibly just one item long) of classical information and a method for updating the list with newly-acquired classical information. You must, in other words, provide some representation of how classical information is obtained and recorded. See my paper in Information 3 (2012), 92-123 for details.

The interesting question that emerges from this line of thought is: Is there any sense in which my impression (for example) that other observers 1) exist, 2) record classical descriptions roughly consonant with mine, and 3) engage in meaningful communication with me is accurate? As a realist, my assumption is that multiple observers exist, and that while our multiple descriptions are in some sense incommensurate in principle - we cannot, as you point out, actually inhabit each others' reference frames, and moreover we cannot observationally determine what caused any of our own or other observers' experiences - we nonetheless are all observing and recording classical information about the same (physical, quantum, real) universe. The interesting questions are whether this realist view is sane or insane, and if it is sane, how one can account, physically, for the apparent consonance of observations that allows different observers to (apparently) share both observational beliefs and the languages employed to communicate them.

Cheers,

Chris

#### 2 MONTHS LATER

#### [deleted] Dec 3, 2012

Amanda: I imagine you were as surprised as I was to win a Special Commendation in this contest. You may recall (above) that I was effusive after reading your essay -- it continues to be my favorite of the lot. So I think it's fascinating, if somewhat unexplainable, that we were both plucked out of the lot and recognized. I believe our essays share profound themes in common, which I didn't get to elaborate upon during the run of the competition. If you might be interested in continuing the discussion, and comparing notes on the contest (I hope you've gotten to read some of the fallout from the winners announcement), feel free to drop me a line at tenrec@pacbell.net. Have a good day.

#### **10 DAYS LATER**

#### [deleted] Dec 13, 2012

Will engineers ever benefit from the denial of one common objective reality?

Already Einstein's special theory of relativity abandoned the at least reasonable common time for the sake of taking the point of view of an individual observer.

This led to many obvious paradoxes. On the other hand, the vehemently claimed and defended, by a Wikipedia task force, benefits are not really so obvious. Opponents argue they can be explained otherwise too or even better.

I see in the essay nothing new but nonetheless the provocative style well suited for tabloid journalism.

Eckard

#### **15 DAYS LATER**

[deleted] Dec 28, 2012

#### Dear Amanda,

Congratulations on your prize. I hope you will find the truth of the singularity you have described in **Conscience is the** cosmological constant. (https://fqxi.org/community/forum/topic/1280)

Love,

Sridattadev.

♠ [deleted] (/d/1512-cosmic-solipsism-by-amanda-gefter/52) replied to this.

#### **16 DAYS LATER**

[deleted] Jan 13, 2013

Dear Amanda

I just discovered your wonderful article on Cosmic Solipsism, which I've found to be profound in its implications, scientifically accurate, and totally free of erroneous assumptions. This is a remarkable achievement.

I wonder if you would allow me to reprint the article on my website:

http://scienceandnonduality.wordpress.com/tag/science-and-nonduality/

Your article makes the scientific argument for what I have to say much better than I can ever say it.

[deleted] Jan 16, 2013

Dear Amanda,

"We can use the frame of any observer, and yet, fundamentally, there is only one."

I "is" that "only one" singualrity in all of us.

zero = i = infinity (https://fqxi.org/community/forum/topic/1280)

Love,

Sridattadev.

#### A MONTH LATER

[deleted] Feb 20, 2013

Dear Ms. Gefter,

I enjoyed reading your essay. I must admit a lot of it was over my head - I'm not a physicist. But I have two questions that I hope are valid anyway. What about the awful ethical implications of solipsism? I realize this is outside the scope of your article, but it is such a heavy consequence of the argument that it begs to be addressed. Second, if every frame of reference gives rise to a complete and singular reality, doesn't your argument say that the distinct frames of reference provided by my two eyes mean that my awareness is suspended between two universes? I'm anthropomorphizing. To state it a little more rigorously, aren't you saying that only a pointlike entity like an electron can define an unambiguous universe?

With best wishes,

Will

Write a Reply...