What is reality?

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We see a physical world around us, but disciplines like sociology, psychology and computing study social, human and information systems that they also see as real. The physical world may underlie all science, but all science doesn't describe physical things. Indeed modern computing requirements analysis recognizes *levels* beyond physic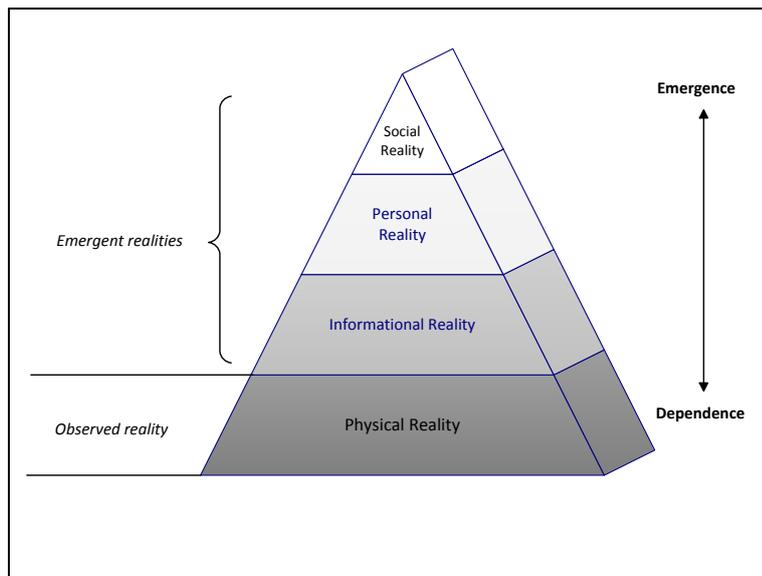al reality as shown in Figure 1 [1], each a new system that emerges from the one below when the observer *sees the world in a new way*, e.g. a line voltage becomes a bit of information when it is seen as a choice. In this way, social structures emerge from a personal meaning [2], meaning emerges from neural data, and data emerges from physical events. In simple *reductionism,* all reality should reduce to physical reality, but then along came a theory of quantum states that perfectly predict physical events and a theory that time and space contract and dilate on demand. What it all means, if anything, has been disputed for a century, *and the options are*:

Figure 1. Scientific realities emerge from physical reality

1. ***Physicalism****.* If the physical world is all there is, then quantum are just fictions that happen to work, and as Bohr said: "*There is no quantum world*". Yet this leaves us with a world where one can detect an object without physically touching it [3], a photon can choose its path after it arrives, things can instantly affect each other at any distance [4], and makes quantum theory a "theory of nothing" and light a "wave of nothing":

   "*... we accept as nonexistent the medium that moves when waves of quantum mechanics propagate.*" [5] p56.

   The argument that *the physics of physicalism* makes no sense is made elsewhere [6].

   Philosophical implications. If everything is physical so are *we,* so our consciousness is an epiphenomenon of neural complexity, so by 2050 complex robots will take us over [7]. The end-state of a purely physical universe is cold, dark and lifeless emptiness, by the second law of thermodynamics[1], giving the nihilism that we are pointless, consciousness is a superfluity and the universe is doomed[2]. Yet if the world *is* a machine so are those who say it, so why listen to them? And if they believe it, to argue it is like arguing that you are a figment of my imagination, futile. By physicalism, all argument, and so all science, is pointless.

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[1] That the universe is expanding into disorder.

[2] So as in the Queen song Bohemian Rhapsody: "*Nothing really matters – at all.*"
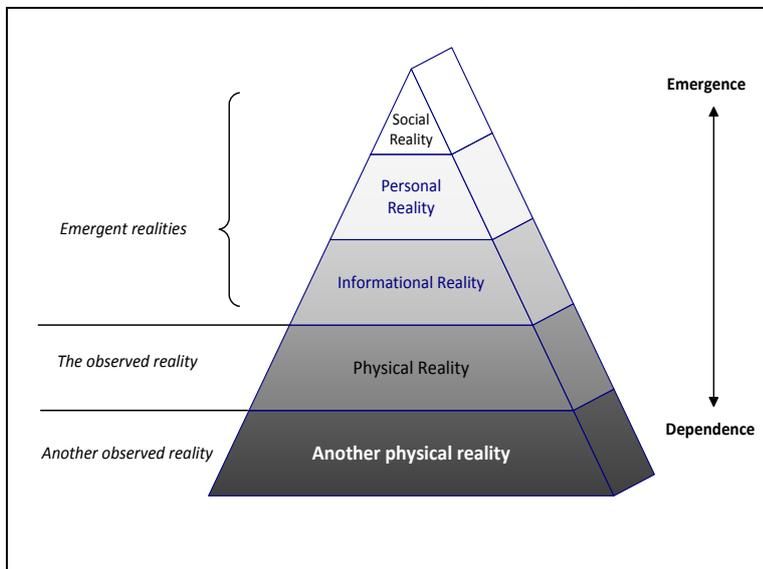
2. ***Dualism.*** In this equally common view, the physical world is *not* everything as the *body* also has a *spirit,* a conscious part made of different stuff entirely. Yet how can *two* distinct realities interact? How can praying to a distant heaven alter the physical laws here on earth?

   Philosophical implications. Dualism can attribute heaven, hell, a spirit world, miracles or the paranormal to another world that will be revealed only when we die. Yet it gives a *God of the gaps,* whose domain is only areas that science has not yet advanced into.

3. **Virtualism.** Beyond the hopelessness of physical realism and the faith of dualism lies another option that at first seems quite unlikely – that the physical world is a *virtual construct* generated on demand by quantum processing[3]. Framed as the *virtual reality conjecture* it is testable by science, but a virtuality can arise in many ways:

   a. **The Matrix option** *(physical virtualism).* In the movie *The Matrix,* a physical world apart created a virtual construct indistinguishable from a physical world to its inhabitants (Figure 2), as intelligent machines wrote the code, set the initial conditions, then ran it on a *really big computer*. The issues facing this view are:

      i. *Performance*. Physical computers can't generate even simple quantum outcomes - to handle the quantum processing of even a few molecules:

      "*… would need more memory space that there are atoms in the universe as a whole, and would take more time to complete the task than the current age of the universe.*" (Lloyd, 2006) p53.)"

      A finite program can simulate any output by the Church-Turing thesis [8] and quantum theory specifies the output, so a universe of universes *could* generate ours, or our virtual time could be stopped and restarted, so a second of our time *could* take a billion years to process, but it is unlikely.

Figure 2. Physical reality emerges from another physical reality

      ii. *Quantum compatibility*. Quantum states don't act in physical ways, as they:

      "*... appear and disappear in a way that physical states can't, entangled quantum entities ignore the speed of light constraint, quantum entities tunnel past barriers no physical particle can pass ....*" Chap 1, p6.

      If what quantum theory describes is physically impossible, physicality cannot be its base. Physical operations just can't do what quantum states do.

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[3] For this argument, see here

iii. *Infinite regress.* If the physical world is by its nature virtual, the other physical world generating it would also need another one below it, and so on, giving a "turtles all the way down" problem[4].

iv. *Consciousness.* The consciousness of players in the Matrix came from people plugged into data streams in a battery farm in another world. This just defers the issue of where consciousness come from to that world.

v. *Explanatory power.* That our physical world is created by another physical world just like it adds no new knowledge to what we already know.

Philosophical implications. In this view, our virtual reality is run by another world of machines, aliens or beings from the future (even us). Yet why would advanced beings on a virtual trip visit this world of suffering? Unless it is a reform facility where we get a debrief when we die (the last judgement), then are either sent back (reincarnate), retire to a rest home (heaven) or get penal servitude (hell). As anyone can make up any story they like, the reader can believe as they wish.
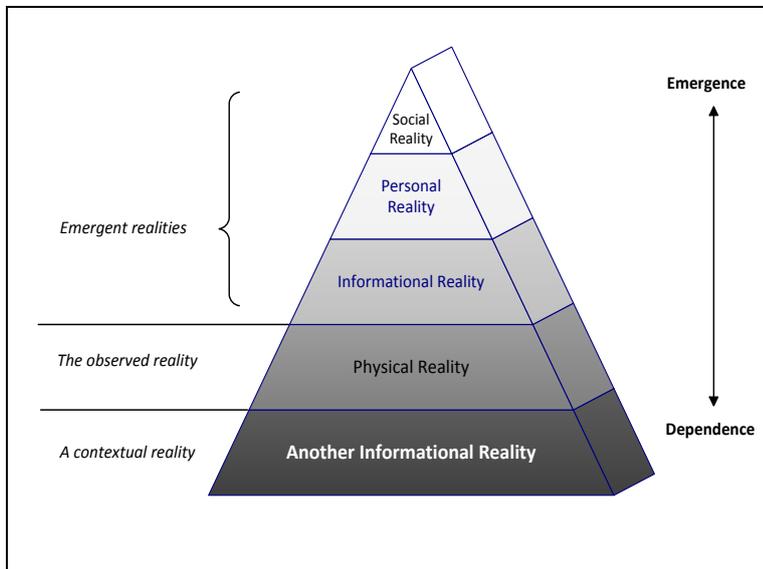

Figure 3. Physical reality emerges from an information reality

b. ***The simulation option (information virtualism).*** Here a stand-alone program whose base is irrelevant *simulates* the physical world in all its detail (Figure 3). Classical programs can simulate quantum logic gates so in theory quantum collapse, entanglement and superposition *could* be classical processing in another context. The issues now are:

i. *Performance.* In theory, the difference between classical and quantum processing is just degree, but even to process one electron whose quantum wave spreads over a galaxy and collapses to a random point is beyond our best super-computers[5]. If a ton of earth came over a wall we couldn't see beyond and our only tool was a teaspoon, we might think that many teaspoons did it, but the more likely answer is a dump-truck. Classical processing with its bit-teaspoon explains quantum mechanics *in theory* but not *in practice*[6].

ii. *Quantum compatibility.* Classical processing is based on the *bit*, a choice of one of two physical states, while quantum processing is based on a *qubit* that

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[4] In an apocryphal story, a scientist lecturing that the physical universe depended on nothing else was challenged by a little old lady who said it was on the back of a giant turtle. He laughed, and asked her what the turtle was standing on, but got the reply "*Sonny, it's turtles all the way down*". In this analysis, that answer fails.

[5] A Milky Way volume of 1.6×10^{60} cubic meters divided by a Planck volume of 4.2×10^{-105} cubic meters is about 551 bits, which for a 10^{-43} seconds Planck time is over 5×10^{45} Hertz of processing power for one quantum event. As our best supercomputers are only just breaking the PetaHertz barrier (10^{15} Hertz), to calculate even the simplest quantum processes takes months or even years.

[6] As Yogi Berra said: "*In theory, there is no difference between theory and practice. In practice, there is.*"

can be two physical states at once. Classical processing can *emulate* quantum processing but not *be* it, because it is implemented differently.

iii. *Infinite regress.* Software specified abstractly it is just symbols, like Egyptian hieroglyphics, until implemented. A classical bit only exists relative to a *state not chosen,* so every set of bits has an implementation context [9].Processing *by definition* changes information that *by definition* implements states, so the bottom of Figure 3 needs a level below it, giving an infinite regress.

iv. *Consciousness.* If everything is software, consciousness must arise when it reaches a certain level of complexity, but no evidence at all supports this view.

v. *Explanatory power.* Saying a simulation describes reality if it works but tweaking it when it doesn't isn't science, as the standard model forgot (Chap 4.6.4). That a classical simulation can emulate *some* quantum events is not a testable scientific theory.

Philosophical implications. A simulation implies a designer, who devised the rules, wrote the code, set some parameters "just right" [10] then booted it up at the big bang to run ever since, with perhaps the odd miracle or saint tweak. If all is software the paranormal is possible if we alter the code. I can be uploaded[7] to my own virtual heaven with spouse and kids at my age of 35, or even with the 72 virgins the Hadith writers added to Islam. Yet isn't a virtual heaven also a fake heaven? And if we upload and download minds, isn't a copy of me by definition not me? Isn't a world of code just as mechanical as any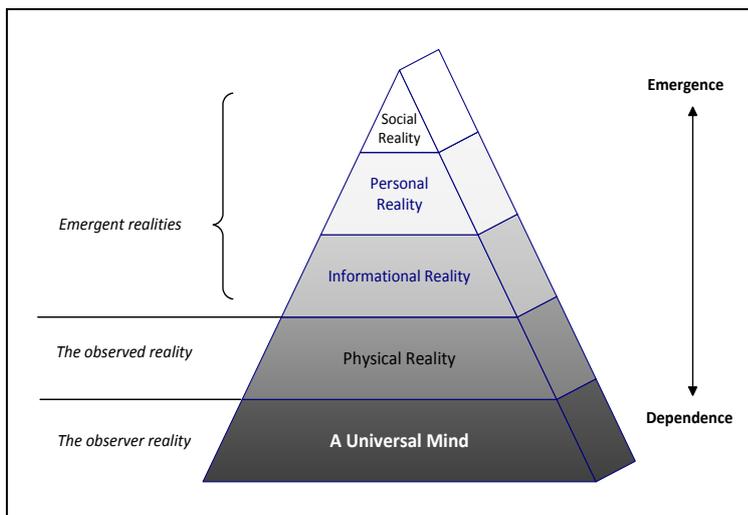 physical machine? Did the great coder start it up and walk away for 13.8 billion of our years, like an absentee landlord, or watch it the whole time like the ultimate voyeur? If our world was a *beta release,* do later versions have improved rules like *not* rewarding evil? As anyone can take any view, the reader can believe as they wish.

Figure 4. Physical reality emerges from a universal mind

c. ***The universal mind option (mind virtualism).*** Did a *universal mind,* like ours but much bigger, create reality as a multi-person dream[8] (Figure 4)? In psychology, our brain constructs reality and in quantum theory, physical events don't exist until observed, so is a universal mind of mystic traditions like the Vedas feeding us a great dream? Are we just reality data channels on a universal broadcast? The issues now are:

i. *Performance.* A higher mind feeding billions of beings a storyboard of a universe of billions of galaxies interacting for billions of years is a multi-user dream of staggering proportions. How is consistency maintained?

ii. *Quantum compatibility.* If we are dreaming, the universal mind can just say "be" and it is, so why invent quantum states? Or does it *tailor* its detail,

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[7] See http://en.wikipedia.org/wiki/Mind_uploading
[8] For example, see Harun Yahya's claims.

inventing dinosaurs when we find fossils and new particles when we build accelerators, like a parent making up a fairy story to a child?

iii. *Consciousness.* If you and I are dreamers what about dogs or insects? To a psychopath *people* are unreal, so is killing an *insect* like that? In our games, avatar pixels represent people but *non-player characters* (NPCs) are empty pixels, not occupied by any being. What in our world is like that? If as Rumi said: "*I was a mineral that became a plant that became an animal that is now a man*", when in that evolution was consciousness added? Each of us is from a fertilized egg that divided, so unless one-celled amoebae are conscious[9], when did the growing aggregate of cells become conscious?

iv. *Explanatory power.* If we are dreaming, consistency requires a basic rule-set that say includes Newton's laws, but that causality needn't actually occur, as it does in a simulation, but only *appear* to occur, as it does in a movie. Yet for that reason, a rule-set made-up after the fact to match what is observed cannot predict anything new.

Philosophical implications. A multi-player dream world is still a *fake*. Even if a law of karma feeds our past acts back to us in the future, what we do doesn't really matter. And why would a supreme mind torture itself with the nightmare of our world, of disease, murder and tragedy? If I dreamt up a world, it would be better than this one! That some great being invented a fantastic story to fool us all is an unlikely anthropomorphism[10], but again anyone can make up what they want after the fact.
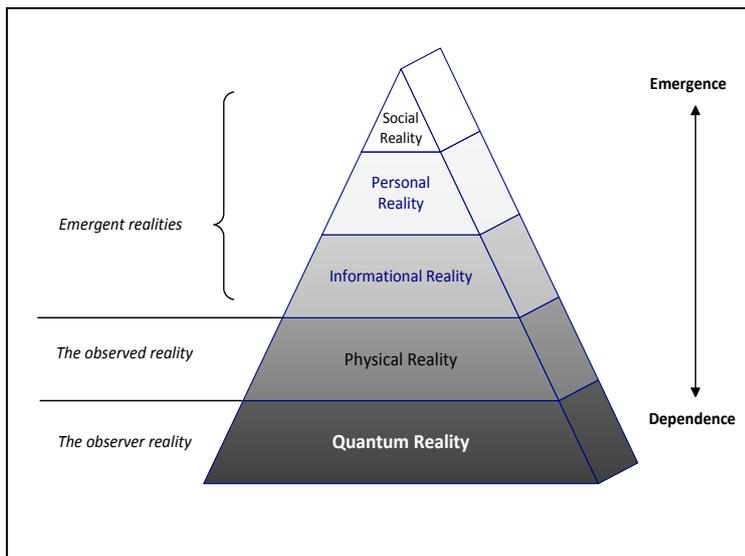

Figure 5. Physical reality emerges from quantum reality

d. **Virtual realism** *(pure virtualism).* Is that a primordial quantum reality generates physical reality but does not itself derive from it in any way (Figure 5). In this *cosmic paganism*, what we call the "big bang" was the primal *observer* interacting with itself to generate the *observed,* as a virtual construct (Figure 6). The details are given elsewhere (Annex A), but both quantum theory and relativity *assume* an observer, as a wave function must be observed to collapse and all movement is in an observer frame of reference. One reality providing both the observer and the observed is all that is needed for a reality like ours to begin. The *interaction* we call physical reality then evolved from light into matter into life into sentient beings like us in an *unbroken sequence of events*, with no external intervention or formal design. Speculation beyond the observer and the observed, on other worlds, programmers or super minds, is imagination, but *reverse engineering physical reality* is not making things up, because it must fit what is seen in a consistent model, where quantum theory describes

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[9] If so, does the universal mind get bored?

[10] The *anthropic principle,* that the universe we are in must be compatible with humans, is a truism, but to say that what we see must be objectively real <u>because</u> *we* see it is an *anthropomorphism*.

the particle "applications" and relativity theory their time and space "operating system". The previous issues are now resolved as follows:

i. *Performance.* A non-physical quantum quintessence isn't subject to physical limits, so quantum (not classical) processing in a client-server link *can* create the information we call the physical world.

ii. *Infinite regress.* A non-physical network has no physical regress, quantum processing has no contextual regress as the qubit of its processing is context free (Ch 2.2.1), and an observing reality has no observer regress.

iii. *Quantum compatibility.* Quantum states as program waves can spread on a network to overload it, causing a reboot that the collapse of the wave function describes, where quantum programs merge and reallocate their processing. The equations are the same, but now quantum theory is no fiction.
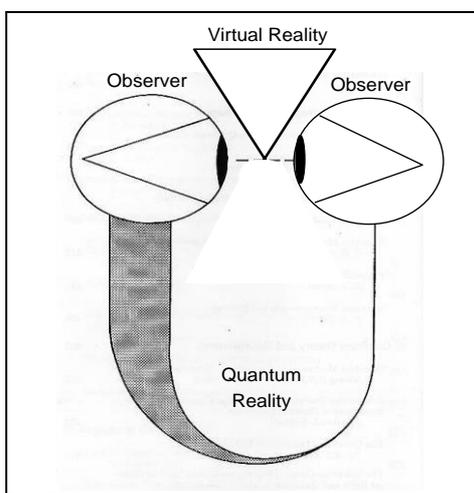

Figure 6. A quantum reality sees itself

iv. *Consciousness.* This model derives the observed from the observer, not vice-versa, so consciousness always was but the physical only exists if observed so every electron is a "player". The rationale is Conway's free will theorem, that *if any part of the universe has free will it all does, but if any part doesn't, then none of it does* [11]. In this view, everything is conscious in its own way, and there are no empty pixels at all.

v. *Explanatory power.* Reverse engineering physicality begins as a post-facto model, but over time it gives the testable predictions that:

a) Matter evolved. The model derives quarks and leptons from photons colliding, which the standard model doesn't allow. It predicts that when we collide extreme light we will get matter[11] (Ch4).

b) There is no Higgs. It rejects the medieval fiction that like creates like and so mass must create mass. The massive Higgs particle cannot by quantum theory be a boson [12], so it will be found to be a high order meson.

c) Empty space is null processing. If empty space were nothing it could not "curve", exert pressure or generate matter, as it does. The standard model has no null particle, so it fills dynamic space with invisible fields and virtual agents. If space is null processing, like a screen that is blank but still "on" and refreshing, there is no need for the current fields upon fields.

This model accepts the standard model's equations, but sees its invisible fields and virtual particles as a post-hoc fantasy on a scale not seen since Ptolemy's epicycles [13].

Philosophical implications

A reverse engineered model has fewer options for speculation than usual, as it has:

i. *No elsewhere.* There is no "other" place for a program, programmer or data of a virtual reality to reside. There is no uploading if there is nowhere to upload to.

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[11] In current theory, photons, being bosons, cannot collide. In this model, photons, being processing, can in the extreme case collide, to create matter that appears to be static because it is a recurring program reboot.

There is no heaven if there is nowhere else for it to be. Yet if this quantum flux stopped, mountains, seas and sky would vanish instantly like a movie that is done.

ii. *No conditions*. Is our universe just right for life by chance or did a benign creator make it so [10]? In this model, the first event was when a grid node "moved", to become *the first photon in the first space*. The ensuing chain reaction (inflation) created all the free energy of our universe, then the expansion of space healed the rip. Everything came from one event, so there was no pre-set design, but neither was it an accident, as a repeat would give the same laws of physics.

iii. *No control*. Like an orchestra with no conductor, each node in this network does its own thing. Von Neumann computers have a central processing unit (CPU) to keep time and direct events, but this system, like the Internet, the human brain and democracy, is *decentralized* [14].

	Traditional Views		*Virtualism*			
Question	*Physical Realism*	*Dualism*	*Matrix Option*	*Simulation Option*	*Universal Mind*	*Virtual Realism*
Does the physical world self-exist?	Yes	Yes	No	No	No	No
Are there two self-existing realities?	No	Yes	No	No	No	No
Does classical bit processing generate physical events?	No	No	Yes	Yes	No	No
Do quantum waves spread and collapse as quantum theory says?	No	No	No	Yes	No	Yes
Is there a world apart from our experience?	No	Yes	Yes	Yes	Yes	No
Does consciousness "emerge" from what is not conscious?	Yes	No	No	Yes	No	No
Do physical events have non-physical causes?	No	Yes	Yes	Yes	Yes	Yes
Can this view predict new physical facts?	Yes	No	No	Yes	No	Yes

Table 1. How various views of reality answer key questions

iv. *No mistakes.* If I choose option A over B and it fails, it is a mistake, but if an *evolution* takes options A and B and one fails, it isn't an error if the other doesn't fail, and if both fail nothing else was possible. Quantum processing tries every possible option before each physical event, to give *the best of all possible*

worlds[12]. If the evolution of light into matter preceded the evolution of life by billions of years, that the latter gave us is not "*improbability on a colossal scale*" as Dawkins says, but rather built into the origins of our universe.

Conclusions

Table 1 compares the previous theories on key reality questions. In physical realism the physical world is as it seems - self-contained and self-sufficient. Dualism agrees, but also offers the hope of a reality beyond the machinery of physicality. In contrast, virtualism in general sees the physical world as a construct generated on demand, rather than being real in itself.

In the Matrix option another physical world creates ours, the simulation option uses processing and the universal mind option uses a great thought. In virtual realism, what creates reality isn't physical states, bit states or mental states. As in the Matrix option, the physical world *mediates* reality, as an email mediates a person, but there is no "other" physical world. What we see is an *interface* to the real world, not a picture of it. As in the simulation option we see a processing output, but quantum processing only generates the conceivable outcomes - an observer outside the calculation *chooses* one to be physical reality. As in the mind option, a first existence did indeed divide, but into photons not minds. The latter evolved into matter, plants, animals and us in a seamless progression, with no need to draw arbitrary lines on the continuity of evolution.

No voyeur is watching from on high, but if everything is observing everything else nothing is hidden. No fixed record is needed if the physical world *is* the system database. A virtual reality is not fake if it is the *only way* a reality like ours can start. There is no heaven but here and now, no program but our choices, no programmer but "I", and no controls but the construct. Our reality can't be saved, uploaded or rerun, because:

"*The moving finger writes, and having writ moves on, nor all thy piety nor wit can lure it back to cancel half a line.*"

The two great movements of humanity, religion and science, address the two great questions, "*Who am I?*" and "*What is reality?*" The contribution of this model is to make them both the same question, as it puts reality behind us as well as before us. It suggests that we are outside a virtual world looking in, as well as inside a physical world looking out.

References

[1] B. Whitworth and A. Ahmad, *The Social Design of Technical Systems: Building technologies for communities*. The Interaction Design Foundation, 2013.

[2] J. Bone, "The social map and the problem of order: A re-evaluation of 'Homo Sociologicus,'" *Theory Sci.*, vol. 6, no. 1, 2005.

[3] P. G. Kwiat, H. Weinfurter, T. Herzog, A. Zeilinger, and M. A. Kasevich, "Interaction-free Measurement," *Phys Rev Lett*, vol. 74, p. 4763, 1995.

[4] A. Aspect, P. Grangier, and G. Roger, "Experimental Realization of Einstein-Podolsky-Rosen-Bohm Gedankenexperiment: A New Violation of Bell's Inequalities," *Phys. Rev. Lett.*, vol. 49, no. 2, pp. 91–94, 1982.

[5] R. B. Laughlin, *A Different Universe: Reinventing physics from the bottom down*. New York: Basic Books, 2005.

[6] B. Whitworth, "The emergence of the physical world from information processing," *Quantum Biosyst.*, vol. 2, no. 1, pp. 221–249, 2010.

[7] R. Kurzweil, *The Age of Spiritual Machines*. Toronto: Penguin Books, 1999.

[8] M. Tegmark, "The Mathematical Universe," in *Visions of Discovery: Shedding New Light on Physics and Cosmology*, R. Chiao, Ed. Cambridge: Cambridge Univ. Press, 2007.

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[12] Where an optimist is one who believes this is the best of all possible worlds, and a pessimist fears it is so.

[9] G. McCabe, "Universe creation on a computer," *StudHistPhilosModPhys36591-625*, 2005.

[10]   P. Davies, *The Goldilocks Enigma*. Penguin Books, 2006.

[11]   J. Conway and S. Koch, "The free will theorem," *Found Phys*, vol. 36, no. 10, p. arXiv:quant–ph/0604079v1, 2006.

[12]   E. Comay, "Physical Consequences of Mathematical Principles," *Prog. Phys.*, vol. 4, no. October, pp. 91–98, 2009.

[13]   J. Baggot, *Farewell to Reality: How fairytale physics betrays the search for scientific truth*. London: Constable, 2013.

[14]   T. Berners-Lee, *Weaving The Web: The original design and ultimate destiny of the world wide web*. New York: Harper-Collins, 2000.

Annex A: Reverse Engineering Reality

In this ongoing project, the following chapters are mostly done:

1. The physical world as a virtual reality. The evidence, logic and method of the project.
2. Simulating space and time Space and time expressed in processing terms.
3. The light of existence. A photon as a Planck program spreading by instantiation.
4. The matter glitch. How light evolved into matter.

The following are not yet done:

5. Bit-shifting space (gravity and how matter moves)
6. The ego illusion (the psychology of the "self")
7. Who am I and what is real? (the philosophy of quantum theory)

Any comments, critical or not, are welcome. Any ideas to support this project are also welcome.