

ABSTRACT

In previous contest papers I have shown how reality arises from the existence of a simple mathematical structure among the infinite many structures. This conjecture that reality is fundamentally a mathematical structure was conceived by me independently of Tegmark's, however I have shown the concept with concrete implementation. In this paper I will elaborate on the implantation which I have shown previously and report on the interesting results which I obtain when I simulate the system in two ways, one in continuum and the other in discrete which the system is capable of naturally.

INTRODUCTION

The fact that all sciences use mathematics is obviously not a surprise, what is so surprising is how successful it is used in modelling reality even to its most deep details. That has led to eventually to conjecture by many people that reality IS nothing but a mathematical structure. Such conjecture answers the big philosophical and practical question, why something rather than nothing.

But the problem that stood in the way was that the physics that has been developed was dependent on experiment to both model reality and to confirm it. This process has proven to be very slow to get to the bottom of what the nature of reality is, and that led physics to be content with describing how reality works rather than **explaining** the complete ontology of the actual entities and the mechanisms involved. While that was acceptable for the majority of mainstream because the system was more geared toward application of physics rather than deeper philosophical question. However, eventually even the mainstream started to question itself when it was faced with the daunting issue of unifying the two main pillars of physics i.e. quantum mechanics and general relativity.

So, it was back to the drawing board. What is space, what is time, what is photon, what is electron, what is charge, why quantum and so on. These issues which were swept under the carpet was not an option anymore. To be fair, many mainstream physicists did try many ideas, however, these were considered to be a luxury rather than necessity. Moreover, even if good unconventional ideas were introduced the mechanism for developing them was politicly and socially impossible as the situation shows.

Meanwhile, people outside mainstream had a different motive and could not wait for the slow process of mainstream to tell them what in the world reality is. While many of the efforts were heroic but they suffered even more shortcomings. Although many had good ideas but again it was very hard to develop them further because of the nature of non-professional physicists working process.

The unconventional ideas from both communities were always limited in their scope. For example, some limited systems were used to calculate the experimental constants with most being pure numerology, so even if they were correct, no insight was really presented only faint

suggestion. Also, many ideas were exotic and confusing mishmash of particle and cosmology that confused rather than clarified not to mention the farfetched consciousness based ideas. None of these ideas were able to look at the problem from its roots and have everything appear naturally out of the system rather than force feed it to get isolated results. My idea in the next section shows how to overcome this limitation by finding the root cause and have a system that has the proper structure extracted from the correct philosophical underpinning of what reality is.

WHAT IS FUNDAMENTAL?

In the previous section I painted a quick picture of the present state for pursuing the goal of finding out what reality is, that is what is the fundamental entity if any and how these entities relations lead to the reality that we experience.

After studying a lot of physics over the years and being an engineer myself it was obvious to me that reality had a very deep relationship with mathematics. Two aspects of this relation stuck in my mind. One, is that classical physics at its heart was very simple Newtonian formulas we are familiar with and yet to solve the simplest problem (as an engineer) a lot of simplification assumptions had to be made with still ugly looking equations with even more ugly looking approximate solutions. And quantum mechanics was not any different, that is, the basics were so simple. Another is that both seem to be “compelling” truths that we accept more than anything else. So, we have one practical aspect and one philosophical one.

That led me to think that reality and mathematics (a particular structure) must be one and the same. **This structure had to be simple, basic but showed all the present physics in a clear and COHERENT way. That is, what are space, time, mass, charge, spin, interaction and most of all why the electron, the proton and “photons” exist. They should be interrelated aspects of a fundamental system.**

But what is this structure? How did its design come about. Not being the all-powerful god, I thought I would start with the simplest system/structure and incrementally complicate it until it hopefully reproduces reality as we know it through physics.

So, what is the simplest system in mathematics? Two numbers I thought, which would also represent a line (the numbers could be Real or integer, but more on that later). Now, suppose you want to choose a number and see what relation it has with those two numbers. It is immediately clear that you must choose some number which is in between those two numbers otherwise the system would be ill defined. And since we have the choice to use ANY number, that means we have to choose a random number uniformly over the range of the two numbers. That will lead to automatically to the concept of a reality based on probability. As a matter of fact, if we thought of those two numbers spanning the universe, then the probability is associated with the photon exactly as in the standard QM theory, that is, the photon is everywhere with uniform probability. Now we can generalize the system a bit more by choosing another two numbers, then the system allows more possibilities. If we visualize the two original numbers and the two new numbers as line segments then we can define few relations, such as, let’s call the first D and the second L and

set a relation. Also, L_s (start of the line) and L_l (if the end to left) and L_r (if the end to right), of course L is absolute of L_s-L_r or L_s-L_l i.e. $L_l=L_r$. The same can be done for D . All chosen randomly.

System one

L_s, L_-, L_+ are all on line D then the system leads to particle in a box when we associate L_s to particle position and D to the box length.

All other conditions the system becomes ill defined.

System two

Now if we choose two of the systems as above and set some basic relations between them such as

$D_0=D_1$, $D_0s -D_1s > D_0$ (or D_1) this no overlap and

L_0s is on D_0 and L_1s is on D_1 just as first system but $L_{0l}, L_{0r}, L_{1l}, L_{1r}$ can be anywhere from say D_0s to D_1s . Then setting relations between the L 's interaction can be derived by interpreted their lengths as energy and L 's point can be interpreted as space points. The the expectation values of L_s as related to "kinetic" energy indicating motion, fundamentally change in state indicating "time" passage a famous conjecture concept promoted by Barbour.

Then automatically the concept of particles AND their interactions automatically arise. The above IS THE FUNDAMENTAL SYSTEM.

This basic system will lead to all of Known physics with the added huge bonus of extracting the unknowns of the mainstream physics with very clear explanation which could arise to the level of ontology, but we will not rush just yet. Quite remarkable just as wheeler had predicted.

I will not go into the details since previous essays and website had the details, so I will only list them as references. In the later sections I will just make general remarks.

<http://www.reality-theory.net/>

<https://fqxi.org/community/forum/topic/2451>

Of course this system can be looked at with an equivalent mathematical systems like group theory and many others especially the concepts of geometric probability (https://en.wikipedia.org/wiki/Integral_geometry). However, the way I have stated it I think makes it simple to understand how reality arises from a simple mathematical structure.

GENERAL COMMENTS

Units of measurement :

The system is based on very simple computer simulation which has some similarity to simulating the Ising model and similar system but very different otherwise. All the programs have very simple setup which includes throwing random numbers and comparing them, then calculating the sum of lengths (that should give a strong hint of Feynman path integral) of the L and calculating the expectation values of L s after "interactions had taken place, that is about it.

The reader may run the list of Javascript programs here

<http://www.reality-theory.net/a.htm>

which includes

[Click here to go to the Bohr Model](#)

[Click here to go to the Hydrogen 1s](#)

[Click here to go to the Fine Structure Constant](#)

[Click here to go to the Electron Mass](#)

[Click here to go to the Spin](#)

[Click here to go to the gravity](#)

[Click here to go to the Proton Mass](#)

The main program is the Bohr model the rest is generalization of therefor. Interestingly, the system follows closely the standard QM development.

Moreover, the system automatically give the most general units of measurement known to physics (natural units). That is only "LENGTH" appears as a dimension and all other units become dimensionless because $L=T$ and $M=L^{-1}$ (-1 is exponent). So

$$[c] = L T^{-1} = L * L^{-1} \rightarrow \text{dimensionless}$$

$$[\hbar] = L^2 M T^{-1} = L^2 * L^{-1} * L^{-1} \rightarrow \text{dimensionless}$$

$$[G] = L^3 M^{-1} T^{-2} = L^3 * L^{-1} * L^{-2} \rightarrow L^2$$

So energy= $M=L^{-1}$

The system is naturally and remarkably of the natural unit system.

Continuum vs integer:

The system can use both Real and Integer numbers, and in both systems you always get finite answer no matter how high your energy goes as when using Real mainly because the energy represented by line length summed up according to weights dictated by the interaction makes the short segments naturally lose their effect in long range interactions and never blow up even in short range.

As can be seen in simulation of the electron/proton mass ratio simulation the system is scale invariant, that is multiply the $D0/D1$ by any number the linearity makes the system scale invariant and you basically you get the same curves. And when you are doing the electromagnetic interaction i.e. line crossing you always get the proton/electron ratio. The system is like a right angle triangle if you multiple all sides by some number the result is still a right angle triangle.

If integer numbers are used by uncommenting the following in the program

```
// p=Math.floor(p)
// li=Math.floor(li)
// p1=Math.floor(p1)
// li1=Math.floor(li1)
```

Then you will get some end of scale broken symmetry around 346 and the system will predict a slightly different number for the proton size. Also, it is interesting that you will only get the results for the magnetic anomalous results(in the spin simulation) if you use integers with the above code. It will not even work if use integer via the Math.round statement!

Gravity's weakness:

As can be seen in the gravity simulation, Newton law appear using the same system. But since we have run out on constraint for the length of the lines, now the only option is to but a constraint on the particle position L_s and choose them to be equal gives us GRAVITY. That sound very profound.

The only other issue is that the potential energy calculation does not give you if particles are attracting or repelling. So we must use the expectation values as as we did in the EM simulations. But L_0 and be hold no matter how big of a mass you choose and how close the two particles are the statistical nature overwhelms the tiny attraction, even for a more that trillion throws. That

shows how gravity is so ridiculously weak. But to get a finite results I will try later to simulate using google cloud with tens of CPU's.

CONCLUSION

Through the FQXI essays we have shown how reality arises from a FUNDAMENTAL mathematical structure which appears to be so simple. It could not have been otherwise.