The "God" Computer

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In 1990, the physicist John Archibald Wheeler suggested that every particle, every field of force, even the space-time continuum itself can be described as being derived as part of an apparatus or machine which handles binary data. This means that the entire universe could be nothing more than an elaborate digital computer – God's computer. This paper explores the idea that it is possible to break down all of the complex physical observations we see in the world to actions which are only binary in nature. This will be done by postulating a digital space which runs with minimal rules and reproduces the behavior of empty space and positrons and electrons. From there, the rest of the particles and fields of force are derived.

1. Introduction

The physicist John Archibald Wheeler suggested in 1990 that every particle, every field of force, even the space-time continuum itself can be described as being derived as part of an apparatus or machine which handles binary data. [1] Is it possible that the entire observed universe is some kind of simulation in some gigantic computer like in the movie "The Matrix"?[2] It is difficult to imagine how the complex world that we live in could eventually be described by 1's and 0's.

2. Building a digital space

If the universe is a computer, then one of the most basic things it must represent is the concept of space. Since a computer contains discrete bits, space can only be described as discrete bits of space or quanta. Space cannot be continuous, but must be defined as a set of discrete points like grains of sand on the beach. An easy way to describe this is to assign a block of memory bits to each "point" of space. For example, we might assign an 8-bit computer byte to represent every point in space. The 8 bits allow the space to have "properties". These memory points would be arranged to be next to each other to represent their position in space. Since space is 3 dimensional, you could imagine a point surrounded on all sides by other points. It would be surrounded by 26 other points and would look like a 3 X 3 cube. This is a bit difficult to imagine, so let's simplify it down to a one layer 2 dimensional space which can be shown in the following diagram which was created with Lego Digital Designer software.[3]

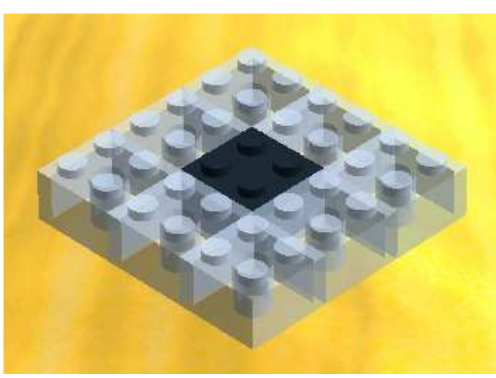

Fig. 1. 2 dimensional digital memory cell space

In Fig. 1, each point in space is surrounded by 8 other points. This can be further simplified by just considering a single 1 dimensional row.

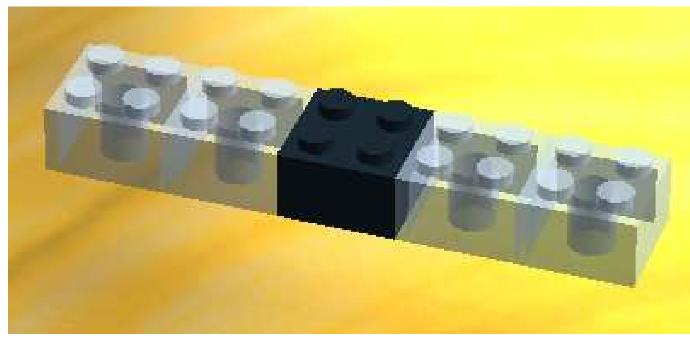

Fig. 2. 1 dimensional digital memory cell space

For 1 dimensional space each point is only surrounded by 2 other points and all of the memory cells are laid out linearly next to each other. This makes it easy to initially understand how digital space works. Three dimensional space will be shown to work the same way, but for simplicity we will start with just 1 dimensional space. We have defined this space as being 8-bit memory cells. We will give them an initial value of zero to designate that they are empty. So we have defined an empty digital space.

3. Defining particles

Now that we have defined "empty space", what kinds of particles should be defined? One particle that we know exists in the universe and appears to be completely fundamental is the electron. We have never been able to determine if the electron is made out of anything – it appears to be fundamental. The electron also has an anti-matter partner named the 'positron'. This particle is identical to the electron in every way except it has the opposite charge. We also have much experimental evidence that this particle really exists. So let's just start with the electron and positron as the first particles we will define in the digital space. We could simply assign a positron as a +1 value and an electron a -1 value. That would seem to make sense except that one of the properties of the electron and positron is that they attract one another and just assigning numbers to space wouldn't cause them to attract. In fact, the way we have defined digital space, they would just sit there forever since there is no mechanism to cause them to move at all. So how do we get the positron and the electron to be attracted to the opposite charge and repelled by a similar charge?

4. Making waves

In order for there to be any movement in this system, there must something that "moves" or "changes". One way to do this is to change the value of a memory cell. For example, a cell could be turned from zero to -1 to represent the appearance of an electron. This is represented in Fig. 2 as clear cubes representing zero and the black cube representing the -1 electron value. However, once the electron is created, the movement stops. To have continuous movement, we need to add another simple action to the system which is that the value of the electron spreads out from the electron. So the -1 value will spread left and right to the adjacent zero cells which are shown in gray in Fig 3.

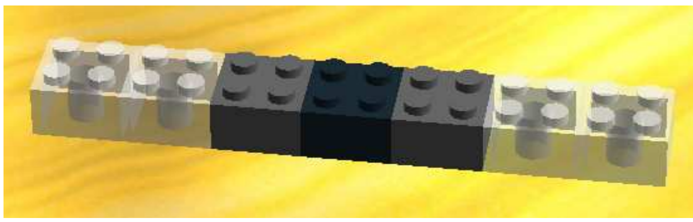

Fig. 3 An electron -1 value spreads to take 3 points.

A domino effect then flips the values from zero to -1 and it progresses as a wave through the digital space. So now we have movement like a wave. All the digital computer needs to do is enforce the simple rule that if the -1 value of electron is transferred to adjacent blank memory cells.

5. God's clock

This action of the electron value expanding to other blank cells presumes that this must be happening at some regular interval. In a personal digital computer, the rate at which anything changes is controlled by a quartz crystal which is vibrating at a precise frequency. This frequency is used like a "clock tick" in the computer. Everything happens during this clock tick and nothing can go faster than this clock tick. The concept of "time" for a digital computer is defined by the tick of this clock. If the clock were to suddenly stop, then the state of the computer would not change and it could be said that "time" has stopped for the computer. Time hasn't stopped in an absolute sense, but for the computer, it has stopped because nothing is changing. The clock also defines a minimum amount of time that is possible. Time within the universe in general may be infinitely divisible, but just like space comes in indivisible points, and computer memory come in indivisible cells, time in a computer comes in fixed quanta. Everything has to run at the master clock rate. Nothing can happen faster or slower than the master clock. So if the universe we observe really is a digital computer, then we should be able to observe that everything changes at exactly this same clock tick everywhere in the universe. So any particle which is changing state on Earth, should be changing at exactly the same rate as any particles in Alpha Centuri. If we were to find experimental evidence for this, this would support the idea that the universe is a digital computer running on God's clock.

6. Making Electrons Repel each other

In this digital space, the presence of an electron causes a wave to spread out infinitely, but what happens if there is another electron in the digital space? Both of these will spread out their -1 value until they run into each other. When they run into each other, the logical thing for them to do is to add together to produce a value of -2.

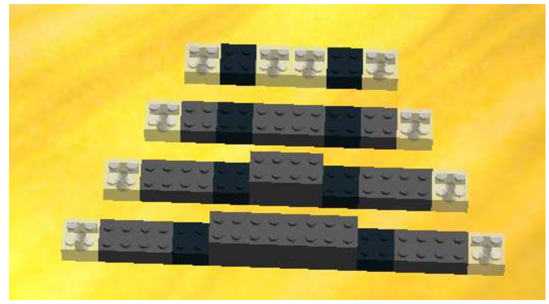

Fig. 4. What happens when 2 electrons interact

Fig. 4. Shows 4 ticks of the clock. The top represents 2 electrons separated by 2 empty cubes. The next tick shows the gray wave spreading from the electrons. The third tick shows the -1 values adding to -2. This is shown in the diagram as 2 blocks stacked on one another. At this point, the electron in black sees a value of -2 on one side and a value of -1 on the other side. We want to make electrons repel each other, so we add a new rule that says that if an electron is between an absolute higher number and a lower number, the electron will move towards the lower number. The fourth tick shows the electrons moving 1 step away from the center. The -2 value represents a "high" pressure compared to the -1 which is a lower pressure. In our common experience, when a particle is caught between a high pressure area and a low pressure area, the particle moves towards the low pressure, so this is the intuition that this rule captures. For each tick of the clock, the electrons will move apart from each other and this represents how electrons are repelled from one another.

7. Representing Positrons

If electrons are represented by -1, then positrons can be similarly represented by +1. Instead of black bricks, we use dark red bricks to represent positrons and light red bricks to represent the spreading of the positive 1 value.

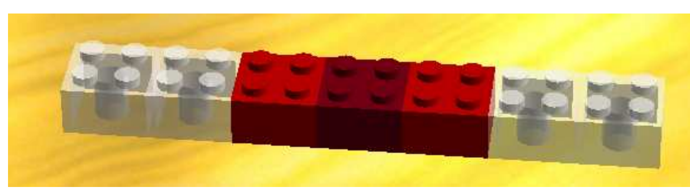

Fig. 5. Representing Positrons with red bricks

The positrons work exactly the same way as the electron except that the value is opposite. You can directly apply Fig. 4. to the positron. Instead of -1 values adding to -2, you get +1 values adding to get +2. This will also cause positrons to be repelled from one another. So we now have the concept of space, the concept of positrons and electrons, the concept that waves extend from positrons/electrons and the concept that similar charges repel.

8. Making opposites attract

So what happens if you put a positron and electron together in this digital space with the rules we have defined?

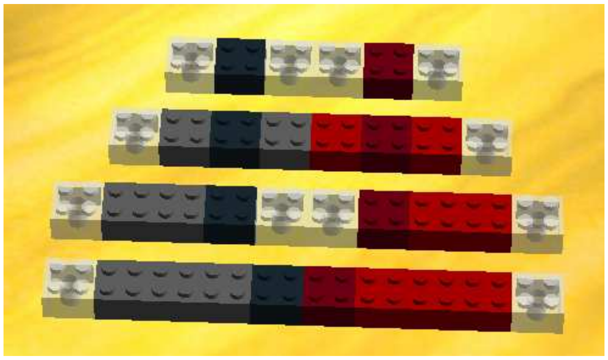

Fig. 6. Opposites attract by cancelling

Fig. 6 shows 4 ticks of the clock with an electron and positron spaced 2 cells apart. On the second tick, the waves spread from the positron and electron. On the third tick, the -1 and the +1 value have added to zero between the positron and electron. The electron and positron see a higher absolute value of 1 on the outside and a lower pressure value of 0 between them. According to the simple rules of digital space, the particle should move towards the lower pressure and this causes the positron and electron to move towards each other. On the fourth tick, the electron and positron are next to each other. The absolute value surrounding the electron and positron is equal to 1, so there is no further movement once the electron and positron come together. So digital space has the concept that opposites attract. All of this could be easily simulated on a common digital computer.

9. Expanding out into 3 dimensions

The real world is not 1 dimensional. Also, the force of an electron decreases as we get farther away from it. To add dimensions and to get decreasing force with distance, consider a cube as it grows by adding layers to it.

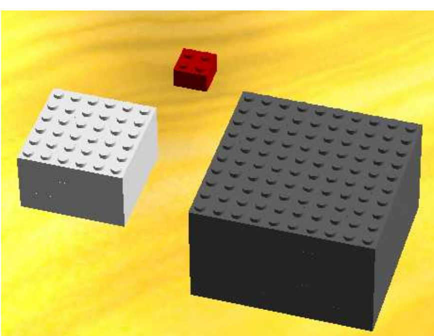

Fig. 7. A cube grows by layers

In Fig 7. we start with a single brick. Then we cover it with a layer of white bricks, then another layer of gray bricks on all sides. We keep growing the cube layer by layer so the outside surface becomes larger and larger.

When a proton or electron sends its value, it can only do so to adjacent memory cells. A single brick can only be surrounded by 26 other memory cells. (That is 3x3 = 27 cells, then subtract the cell in the middle = 26). In the next clock tick, these same 26 cells now make their way to the gray cube which has 98 cells on the outside. So the 26 cells are now diluted into 98 cells. This reduces the strength by about ¼. A chart of how many cells are on the outside and the dilution ratio is:

Cube Edge Length	Outside Cube Count	Relative Strength	1/r^2 value
3	26	1/1	1
5	99	1/3.8	1/4
7	244	1/9.4	1/9
9	485	1/18.7	1/16
11	846	1/32.5	1/25
13	1351	1/52	1/36

It can be seen that as the wave from the positron/electron spreads out, it is diluted and weakened. For comparison, a 1/r^2 value is given in the last column. For the first 4 rows, the match is pretty close to 1/r^2, but after that it drops off much more rapidly than 1/r^2. It would be an interesting experiment if we could measure the strength of the electrostatic force from a positron at the tiniest dimensions. If the relative strength dropped off as predicted by the digital space model, this would also be good evidence that the world actually is modeled as digital space. As you consider larger and larger volumes, the "squareness" of the space will go away and any set of wave spreading from a center would take on a 1/r^2 relation as a simple matter of geometry, so the non 1/r^2 force relationship would only exist at tiny dimensions.

10. Building Space out of Positrons and Electrons

The digital space has positrons and electrons which are attracted and repelled from one another. What can we do with these two fundamental particles to explain the rest of the universe? One thing that can be explained is "what space is made out of". If we left the memory cells as 0, this would mean that space is "empty" and has no properties. This isn't very interesting, so let's do the opposite and completely fill space with positrons and electrons. Let's say that when the computer is started, it will randomly initialize each cell to either a positron +1 or an electron -1. By chance 50% will be positrons and 50% will be electrons. Since opposites attract, the positrons and electrons will quickly pair up and space will stabilize into regions of checkerboard pattern of positrons and electrons. Each of these paired up positrons and electrons effectively creates a combined particle which will be called a 'poselectron'. The poselectron is a dipole particle since it still has a positive and negative side. Since the positrons/electrons are all up against each other, the +1 and -1 waves coming out of them are almost completely neutralized which makes the space static. Digital space is made out of a sea of closely spaced poselectron particles.

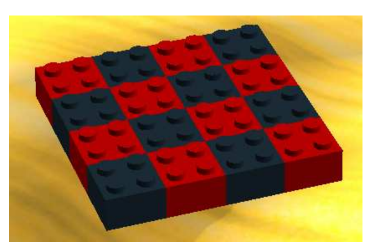

Fig. 8. A Checkerboard of space

11. Creating the Electromagnetic Wave

Fig. 8 shows these blocks tightly packed against each other, however, it would be more accurate to show the blocks as if they were all connected with springs so that each particle would be allowed some displacement and compressibility. This could be modeled as a numeric property of the particle cell. If we imagined pushing on one edge of this space, the only way it could move is if the positrons and electrons get displaced and move out of the way. This would send a wave through the space. The amplitude and frequency would depend on how you pushed space. This gives the digital space the important property of being able to carry a "wave" and this would correspond to the real property of space to carry the electromagnetic wave. This wave is carried as fast as the clock will allow and sets an absolute speed limit for the wave. This corresponds to the real property of space which is to set an absolute limit on the speed of electromagnetic waves which is the speed of light.

12. Representing the proton and the neutron

The standard model of physics provides us with a zoo of particles that have been observed. However, most all of them last for only the tiniest fraction of a second. Their lifetime is so short that they largely play no observable role in the everyday world. In fact, the only 2 particles that appear stable (besides the positron and electron) are the proton and the neutron. Everything else rapidly decays into positrons and electrons or energy events like gamma rays. For the purposes of a digital simulation of the macro observable world, these fleeting particles can be effectively ignored for now.

Standard model physics says that protons and neutrons are made out of 3 quarks. There are no 'quarks' defined in the digital world, so we obviously can't use that. The simplest thing to do would be to define a proton as 2 positrons fused to 1 electron. A neutron could simply be the same thing as a poselectron (1 positron + 1 electron). We would need something to differentiate the bonds between the particles in the protons, otherwise they would appear identical to the poselectron sea. So, the bonds can be numerically defined as 'smaller' which could be conceptualized as shorter and stronger springs between the proton and electron particles. So the digital world has defined all of the important stable particles required by the universe – positrons, electrons, protons and neutrons.

13. Defining Mass

Two interesting properties of particles are Mass and Inertia. If you were to stick a spare electron into the poselectron sea, it would displace some poselectron particles and it would just stay there and not move because it is surrounded on all sides by poselectron particles. Waves might move through the sea at clock speed (speed of light), but the electron is stuck there motionless. The only way that electron is going to move is if some 'force' is applied to it so that it forces its way past the poselectron bonds (the elements of the sea act as if held together by springs). The bonds between the poselectron particles actually have to be broken in order for the electron to take a different position. The amount of force it takes for a particle to break the poselectron bonds becomes the measurement of 'Mass' for an object. The greater an objects resistance to being shoved through the poselectron sea, the greater is its mass.

14. Making the proton 1836 times more massive than an electron

Let's consider a proton. It consists of 3 cells and its longest dimension is potentially 3 cells long. In order to shove this through the poselectron sea, it would have to displace and compress 3 poselectron cells compared to only 1 cell for an electron. We could imagine that as you compress the poselectron cells, the amount of potential energy stored goes up exponentially as well as the force needed to do the compression. The formula to represent the potential energy stored by the poselectron springs might be $PE = x^7$. Where x is the amount of compression. For an electron which only displaces a single cell this $PE = 1^7 = 1$. For a proton which displaces 3 cells, this would result in a potential energy of $PE = 3^7 = 2187$. Since the potential energy is equivalent to the force needed to store the energy and this force is measured as mass, this means that the proton would be have 2187 times more mass than an electron. In the real world, a proton is 1836 times more massive than an electron. The formula used in digital space could be modified so it matches this real world mass difference. The important thing to note is that a relatively small difference in displacement (from 1 cell to 3) can produce a huge difference in the perceived mass for a proton versus an electron. So digital space can define the concept of 'Mass' and can explain why the proton is 1836 times more massive than the electron.

15. What Causes Inertia?

As particles are shoved through the poselectron sea, the displaced poselectrons are then compressed and store up the potential energy provided by the force. This energy cannot be stored up for more than one click of the clock so in order to release it, it forces the electron through the next set of poselectron bonds and the displaced poselectrons are restored back to their original positions. This then causes a domino effect whereby the particle moves forward again, stores that energy in the poselectron sea and then releases it continuously. Thus, when a particle is set in motion, it stays in motion and satisfies Newton's first law of inertia. So the digital poselectron sea can not only define 'mass' as the resistance of a particle to be pushed through the sea, it explains how inertia works by continuously storing and releasing the energy used to move the particle in the first place.

16. Creating Magnetic Fields.

Another key property of space is that it can hold a magnetic field. A magnetic field and be described as lines of force that point in a particular direction. This can be emulated in digital space by controlling the alignment of the poselectron dipoles. The poselectron digital space would normally not be perfectly aligned. It would likely form small domains of aligned poselectrons but in general, the orientation of these domains would be random.

If streams of electrons are passed through the poselectron space, the poselectrons would move to align themselves in the direction of the moving electrons. This is like a comb that straightens your hair. All of the poselectron domains would then start pointing in the same direction and this alignment defines a magnetic field in digital space.

17. Creating Magnetic Force

A magnetic field must not only define lines of the field, it must be able to exert a magnetic force on objects. If an electron tries to pass through an aligned poselectron field at right angles to the field lines, it has to pass between the dipoles. When it does so, it will see a positive charge on one side of the dipole and a negative charge on the other dipole it is pushing aside. The electron will be attracted to the positive side and repelled by the negative side and this will cause the electron to deflect towards the positive side. This deflection is what we observe as the magnetic force.

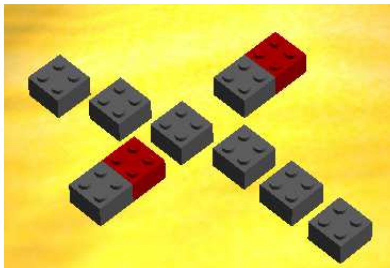

Fig. 9. Electrons deflected towards the left after passing through dipoles

18. Constructing atoms

We have already defined the existence of protons, electrons and neutrons. So atoms can simply be considered to be fused collections of protons, electrons and neutrons. However, they cannot be randomly arranged. They must be arranged to be as compact as possible and build out an octahedral shape. The octahedral shape represents growing out the six sides of a cube.

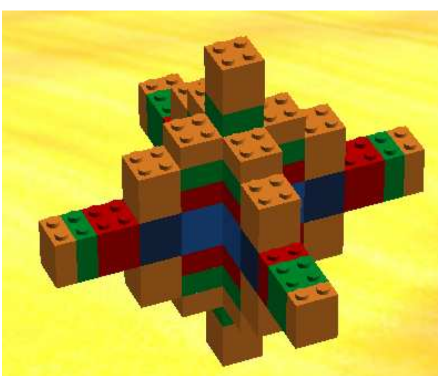

Fig. 10 An octahedral shaped Radon atom

The build up of the atoms is described by the Cubic Atomic Model[4]. The six vertices of the octahedral shape serve as the atomic binding sites and allow the creation of molecules which obey the observed molecular binding between different atoms.

19. Creating Gravity

The final force that has to be explained by a digital space is the force of gravity. All that is needed for a force of gravity is an attraction which is proportional to amount of mass that is present. The electrons in atoms are relatively loosely bound and can be easily removed. It can be defined that a certain small percentage of any mass will be missing electrons which leaves all mass with a positive charge which is in proportion to the amount of mass. This charge may seem small, but it exerts a force on all the dipole particles contained within the matter which is in the vicinity of the charge. The central positive charge causes dipoles in the surrounding area to orient their negative side towards the central positive charge. Because the negative side is now closer to the central positive charge than the other positive side of the dipole, the negative side exerts a stronger attractive force than the repelling force from the positive side. This causes a net force towards the central positive charge. We observe this force as gravity.

20. Conclusions

John Archibald Wheeler made a bold claim that every particle, every field of force, even the space-time continuum itself can be described as being derived as part of an apparatus or machine which handles binary data. This paper has shown one possible realization of this claim. Space has been defined as a computable array of memory cells. The basic Positron and Electron particles have been defined as specific properties within the memory cells of space. Their interaction has been defined to create attractive and repulsive forces which are consistent with the behavior of charges. The Positron and Electron combine to form the basic unit of space called the Poselectron. The sea of Poselectrons create a medium through which electromagnetic waves can propagate The same sea of attractive dipoles also gives the property of mass to particles passing through the sea. The dipoles also grant particles the property of inertia which allows them to keep travelling at their same speed. An alignment of the dipoles is what we observe as a magnetic field and electrons passing through this magnetic field are forced to deflect in what we observe as the magnetic force. Atoms can be defined as carefully constructed arrangements of fused protons, electrons and neutrons which combine to form molecular compounds. Gravity is a simple result of atoms losing a small percentage of their electrons which create a net positive charge which attracts all the other dipoles in nearby matter.

This defines all of the most important and basic particles and forces that can be easily observed in this world. Therefore, this is a realization of John Wheelers dream that the universe can be explained as a "God" computer. This has all been explained as a theoretical computer implementation. However, since it does an adequate job of describing forces like gravity, magnetism and charge, one may need to consider that this really does describe how the real world works. These ideas have been incorporated into models of real space [5]. Conventional scientific theories cannot explain how any of these attractive forces operate and so even if this paper were a complete work of fiction, it is remarkable in its ability to tie together all of these disparate phenomenon. So maybe John Wheeler was right after all and we all live in the "God" computer.

References

[1] Wheeler, John A. (1990), "Information, physics, quantum: The search for links", in W. Zurek, *Complexity, Entropy, and the Physics of Information* (Redwood City, California: Addison-Wesley)
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