# Mathematics characteristics are universe characteristics

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**Abstract**

The scientific community treats mathematics and physics as distinct disciplines. Human mathematics derives from human perceptions of the physics of the universe. The characteristics of mathematics are characteristics of the universe like gravity is a characteristic of the universe. Several conceptual mysteries in physics may be better modeled by using mathematics as an observation. Such mysteries include shape of the universe, the double slit experiment, theoretical temperature of the universe, the past expansion of the universe, length contraction, time dilation, and a Theory of Everything.

## 1 Introduction

Because our ancestors survived, we are born into this universe with many inherited mechanisms and abilities. Many other abilities are possible in our universe. For example, we don't have claws or travel by crawling. But these abilities serve survival for other creatures. The abilities that we do have dictate how we perceive the environment and the universe.

The universe as a computer and the "Mathematical Universe Hypothesis" (Tegmark, 1998) descriptions consider mathematics as the core reality of the universe. The "Eternal Universe Hypothesis" suggests mathematics is merely a tool of physics. The suggestion herein is that mathematics is much more than a means to calculate but is not fundamental reality. Mathematics as we use it is observed to work and objects are observed to fall to Earth suggests mathematics, like gravity, is a characteristic of the universe. If the reality were different, perhaps physics would use a different math. A universe suggested by

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General Relativity (GR) would be isotropic and homogeneous. The concept of counting and boundaries would be an abstraction if it even developed. A universe suggested by Democritus of atoms filling all of space would have continuous of geometry an abstraction.

Science is humanity's method for creating models that can predict future physical events(Curd & Cover , eds.). Better prediction means longer survival for humanity. Mathematics helps physics predict because it is part of the reality of the universe.

This paper suggests mathematics works well in physics because the characteristics of mathematics are the characteristics of the universe[1]. The human basics of mathematics are discussed in section 2. Section 3 discusses some applications of this idea. The conclusion is in section 4.

# 2 Basics

One of the first things we perceive after birth is that we perceive. The universe sends signals to us such as light, sound, and pressure. Some animals have senses to perceive magnetic fields, electrical fields and other bands of light and sound. This leads to the ability to perceive discrete objects. We can trigger muscle movement resulting from the input sensor data and compare that with prior data and with a goal of survival - we can react. The structure of a brain and sensors allows this structure to reproduce and to survive.

Our perception of the universe and our perception mechanism forms the core of what our models can be. Instruments aid us in measurement of signals that are undetected by our senses and of both larger and smaller scales than our scale of $10^{-3}$ m to $10^{3}$ m. Our scale is $10^{\pm 3}$ of a standard in our perception range. Scales beyond this range such as quantum mechanics become stranger to us as the range expands. However, mathematics applies at all scales

The ability to recognize discrete objects and events allows us to recognize one object, two objects, etc. Counting has begun. We recognize one object and (plus) another object produces the recognition of two objects. Operations have begun. When objects are combined, the combination creates a new object and the ideas of equality and of comparing. Counting, operations, equality, and comparing create algebra.

We learn to recognize objects in space and note a distance between them. Physics models suggest objects such as trees are composed of molecules that are tightly bound. But our observation within our scale is that an object

[1]Last years entry suggested the fundamental principles of life and physics are the same (Hodge, 2014b).

is continuous and coordinated. Shapes become lines, surfaces, and volumes. Geometry has begun.

Geometry talks of extended objects. A point can exist in the extended object. Descartes considered the continuous as infinitely divisible. We can say an object is at a point or not. We could change scale and still talk of integer objects. Hence, an object has a boundary. The boundary at our scale seems firm and distinguishable. The boundary at smaller scales is less distinct. Determining if a subatomic particle is part of the object becomes difficult. But the subatomic particle appears to have a boundary. Mathematics is able to deal with the continuum and an object at ever–smaller scales.

Mathematics treats algebra and geometry as mutually exclusive. Trigonometry was created to combine algebra and geometry.

Division presents a quandary in both discrete mathematics and continuous math. We can take 1 ft. and multiply by 3 to make a yard. But we cannot always take a thing and make 1/3 of the thing by a scale change. There is no such point of 1/3 on a line. Is 1/3 real or is division an improper (non–physical) operation in physics?

Mathematics perceptions have difficulty dealing with analog variation and extendedness with a discrete description. Thus physics developed the idea of standards of measurement for turning analog physics into counting physics. A physics standard is assumed to be repeatable and invariant or, at least, varies significantly less than the tolerance of the experiment. Commonly accepted standards allow several experimenters to compare results. The relation of parameters created the need for proportionality constants. Some of these appear to be universal constants.

The relation of objects over duration created the need for causation. This further created the idea of mapping or mathematical transformation. Transformation mathematics has triggered many arguments about the reality of the parameters on the transformed side of the equation such as a wave in quantum mechanics (QM) and space–time in GR. The number models are often non–local abstractions that yield non-physical results such as infinity, singularities, and negative numbers for measures of physical parameters. These concepts are difficult to use in mathematics and in the universe.

Human mathematics has recently discovered fractal (self–similar) math. Fractal mathematics allowed an easier description of complex structures such as tree branching and natural landscapes.

Mathematics that we use developed out of the physics of the universe. Therefore, mathematics is part of the physics of the universe.

# 3 Applications

How nature chooses the laws of physics may be unknowable. But the idea that the mathematics that has evolved should work suggests there is a unique way to model events. For example, the four known forces are thought to be unifiable. Quantum field theory suggests there are infinite combinations and that there is not a unique combination. This suggests Quantum field theory is incorrect or incomplete.

"Unique" also suggests the statistics of QM is really a measure of measurement error as the Bohm Interpretation suggests. The Bohm Interpretation argues against ideas of infinitely many paths of particles until a collapse happens. Mathematics characteristics may eliminate many of the possible interpretations of QM as being unphysical.

Newtonian mechanics has a calculation problem as $r \to 0$ where $r$ is the distance between the centers of objects. This produces a singularity at $r = 0$ with which mathematics has difficulty. This characteristic is carried into GR. GR suggest the universe is homogenous to avoid the $r \to 0$ issue. Where mathematics has difficulty is where the physics should conceive of another model for the universe such as very close to matter and for the description of matter.

Mathematics shows only two mutually exclusive characteristics in reality - discrete (counting) and continuous (geometry). Perhaps there are only two mutually exclusive constituents in the reality of our universe. One constituent is matter that is discrete and has boundaries. Democtitus' atoms are indivisible and are the smallest matter that has distinct boundaries. The other constituent is continuous such as Descartes' plenum. The plenum is infinitely divisible with infinite differentials possible. Continuous allows waves. Waves through Fourier (a transform function) analysis can reduce any analog observation or function to waves that may not be real. But if matter has a dimension in the universe, it cannot be part of the continuum (infinitely divisible). This suggests physics should be seeking not more space dimensions for Descartes' atom, but fewer.

Consider Newton's idea for light. Light is a particle (discrete corpuscle) traveling and making waves in an aether. The aether's density variation produces gravity similar to Descartes' plenum. The particle causes waves in the aether. The waves travel faster than the particle and directs the particle (Newton, 1704). Thus, the interference in double slit experiments is explained. This is similar to GR - matter distorts space which then influences mass motion. Perhaps the "space" of GR, the wave medium of QM, and the plenum are the same physical constituent. If the frequency of the wave is related to the particle, resonance produces quantum entanglement.

A boundary is where a significant increase in energy is needed to move beyond the boundary or to remove a piece of the matter. If there is a smallest piece of matter, matter as we currently think of it may be a combination of other smallest pieces and of a portion of the continuum.

The same mathematics applies at all scales. All scales should have analogies at our scale. Fractal mathematics implies the fundamental principles at these scales should produce models at all scales. Another closely related mathematics is the scale relativity model (wikipedia, Dec. 2014).

The fractal principle suggests that observed geometric relationships apply in all levels of systems. Because $\pi$ = circumference / diameter in two dimensions, $\pi$ must be the same number in three dimensions. The division by two is another universal concept. The division by two for each dimension into equal angles yields the right angle. The relatively easy developments of Euclidean geometry compared to curved space geometries suggest the universe is flat.

Life on Earth can increase although entropy increases because Earth is an open system with energy supplied by the Sun. That fractal mathematics works suggests the universe must also be an open system. This suggests the universe is not adiabatic.

Mathematics negative feedback loops and their implementation have proven very useful. Negative feedback loops suggest a narrow output parameter range may be maintained for long periods when there is a wide variation in inputs. A negative feedback is used in many engineering application such as temperature control. A negative feedback loop is postulated to approach homeostasis in living beings. Perhaps the universe has negative feedback loops instead of "fine tuning" in any form. Further, if the measurements suggest "fine tuning", then a physical mechanism is part of a negative feedback loop. For example, the ratio of the central mass to the mass of the bulge is constant implies there exists a negative feedback mechanism (Merritt & Farrarese, 2001). The problem for physics is finding the feedback loop. The discovery process begins with the fundamental principle that the universe is composed of nested, negative feedback loops. The concept of survival of the fittest is a negative feedback loop where the unfit are removed after a test. Smolin (2014) has suggested a cosmological selection process to mimic the survival of the fittest of biology.

The temperature of the universe appears to be a fine tuned parameter and it is very close to the natural logarithm base $e$ K. Combining the characteristic equation that produces the $e$ solution, negative feedback loops, and a non–adiabatic universe can model $e$ K with a small oscillation as the theoretical temperature of the universe (Hodge, 2006). Oscillation suggests the temperature of the universe was once increasing. Increasing temperature implies increasing volume if there is no boundary and universe expansion that has been measured. The oscillation and the model also solve a problem of

Newtonian and GR gravity of how the universe can be unbounded, flat, and long–lived.

Combining the concepts of fractal mathematics and of feedback mathematics suggests proportionality constants are also the result of feedback loops. This structure repeats down to very few (perhaps one) relationship(s). For example, the equivalence principle could be the result of such a basic relationship(s). Therefore, the equality shouldn't be stated as a "principle" (assumption) but should result from other principles.

Many modern discussions are about the instruments used, the meaning of measurement, and whether transformed quantities such as space, time, and quantum waves are real. Many of these issues may be better discussed as the physics of the standards used in algebra to describe continuous situations. Consider a metal bar. The bar in a room could be defined as a standard length. All physics has to do is assume it is a standard. Take the bar to another room and compare it to a second bar with different composition and note they are the same length. Do the same for a third bar with different composition in a third room. Last, take all bars to the original room and compare. If the three rooms are at differing temperatures, the bars will be of different lengths. The coefficient of expansion is a reorganized physics phenomenon. But when we make a bar a standard, the unit of length becomes a function of temperature. Do the same type of experiment with the bars subject to differing velocities. The result this time is called "length contraction". Perhaps new physics is needed to describe the physical process of measuring or of the mechanism of velocity caused length changing.

Consider a pendulum clock as a standard. The physics of a pendulum clock is well understood. The gravitational force affects the clock duration between tick events. Raise the clock and note the clock rate changes. The gravity is less at higher altitudes. Putting one of two clocks that keep equal time on an airplane the starts (acceleration), flies around the world, and lands will yield ending different times on the clocks. The time change of the pendulum clock during takeoff could be the time required for takeoff - several seconds - if the bob is held to the rear of the airplane. When a pendulum clock is allowed to free–fall in gravity, the relative force between the mechanisms will cause clock time to slow. As the clock approached terminal velocity, the force on the pendulum will grow and at terminal velocity it's normal rate will return. The pendulum clock's gravitation (acceleration) time dilation is significantly different than the GR calculation. Because the mechanism of the pendulum clock is understood, the clock rate is not called time dilation.

The mechanism of radioactive or quantum decay is unknown. Sturrock (2014) and others have found a change in nuclear decay rate that appears related to the Sun. What would happen to a radioactive clock in free–fall or during varying acceleration such as in a centrifuge[2]? This would also be a test of the GR equivalence of gravity and mechanical acceleration. Gravity is a first derivative of a scalar. If gravity were a membrane, less gravity would be lower curvature (tension differential) of the membrane. If gravity were a density differential of a medium as Newton suggests, less gravity and greater time dilation would imply greater density farther from mass. Mathematics suggests proportionality, hence, a density relation. (Inverse relationships suggest a division.) If a time slowing were monitored such as the muon lifetime decay measurement, would the conclusion be that there was time dilation, that the density of the medium changed, or that acceleration forces such as gravity influences the mechanics of radioactive decay? The muon decay rate at the bottom of the mountain may be because its change in gravity is changing the physics mechanism of decay like in the pendulum clock. The difficult mathematics in GR may be indicating that a different physical model for decay should be sought or that the speed of light changes for different plenum ("space") density.

Mathematics is deterministic. Given an equation and the initial data, a definite result is calculated. This implies that the universe is deterministic. If there is free–will, then the mathematics humans have developed needs a new function like fractal development or a model of the mechanism of apparent free–will.

These considerations were used to create the Scalar Theory of Everything(Hodge, 2014a).

# 4 Conclusion

There may be no standard capable of fulfilling the physics definition of a standard that reflects the mathematics characteristic of different mutually exclusive discrete and continuous. Physics models that are mathematically difficult may be incomplete or inaccurate. Other models that use simpler mathematics and are simpler may be better for prediction. Perhaps the research should be to find the physics in situations where the standards produce counter intuitive results and are difficult to model rather than create complex mathematics descriptions.

Making physics more complex and less conceptual reduces the ability to predict and is, therefore, not the goal. The goal should be to make the universe more conceptually understandable. This aids understanding and predictability

[2]I am not aware of such experimental data. There is the experiment of putting a clock on a turntable that measured before and after that is different from "during". Perhaps this could be a suggested experiment for a FQXi research proposal.

that aids human survival. Considering mathematics methods as a physical observation would open new avenues of physics understanding and, perhaps, physics insight.

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