IS MATHEMATICS HINDERING THE EVOLUTION OF PHYSICS TOWARDS DEVELOPING A THEORY OF EVERYTHING?

Essay by Marts Liena

I often think of mathematical reality and the life of numbers outside of our universe. Whilst I think that the concept of mathematics is truly transcendent, it is the relationships between numbers that ultimately describes this and all possible other universes. Are these relationships also truly transcendent?

Our universe is just right for life – we know that because we are here!

But ‘Why are we here?’ is a question that science cannot answer. We are emergent observers of our universe whose intelligence is a measure of how well we construct these relationships to describe the universe we find ourselves in.

There are some who believe if we could find a ‘Theory of Everything (TOE)’ and if it had no free parameters then all universes would be similar and thus be favourable to life as we know it. A more unbelievable explanation along similar lines is that the universe is self-bootstrapping for life, through some quantum process that defies causality. I do not like these explanations. Some say that the universe was ‘designed’ for life. This implies a creator, but as I suspect that the majority of scientists are atheists so it would be better to believe that there are a multitude of universes, all different, and that this one just had ‘the right settings’ for life to evolve.

My position is that there was a creator, call her God or chance, who designed a universe so amazing that there is no fine tuning required at all. The job of Physics today is to nut out the TOE using the tools of observation, logic and mathematics. The astounding thing in my view is the selection of charge and spin as the agents of matter and of fields and electromagnetic radiation as a means of energy transfer. This is where the true beauty of the grand design lies and also in the way sublime complexity arises from simplicity.

To elaborate further on a TOE, what is required at the simple end is a reductionist theory based on symmetry that allows us to reduce all matter and space to a pair of particles, with clearly defined simple properties that can be expressed mathematically. The complex end of the TOE is already becoming well described by modern science, by which I mean chemistry, biology, information science, etc.

The Standard Model of particle physics is flawed, in that it has far too many free parameters. Quantum physics, despite its ‘mathematical map’ being so accurate fails in being able to construct an objective picture of reality. General Relativity, Einstein’s tour de force, nicely links space-time and matter at large scales, but has not been able to be reconciled with either the Standard Model or Quantum Physics. A TOE would need to bring these three areas of physics together. I believe that the reason
we have not made progress at the simple end of a TOE is because we have been beguiled and misled by mathematics at the expense of good philosophy. We have been at sea for decades with the promise of quantum computers and other quantum optical devices, soaking up vast sums of research monies. We have stood by as we committed two generations of our brightest young physicists to a variety of mathematical theories generically known as string theories, despite any string theory to date being able to make any quantitative testable predictions.

The particle theorists spend their time concerned about unification and symmetry breaking, without the intrusion of a decent physical philosopher asking whether in fact any unification is to be had at all. After all, the laws of physics may well be as identical at the creation as they are now. In short we may have been duped that unification and supposed symmetry breaking have occurred at all, despite numerous Nobel prizes being handed out to theoretical physicists for their good works on unification.

The language and content of mathematics has had an undue influence on physicists. It is, using a phrase of Eugene Wigner, “The Unreasonable Effectiveness of Mathematics in the Natural Sciences” that has sometimes stopped clarity of understanding of the underlying physical mechanisms.

A case in point is the ‘Block Universe’ model of cosmology, which continues to resound with the deterministic approach espoused by the great mathematician Laplace who remarked “Given for one instant an intelligence which could comprehend all the forces by which nature is animated and the respective situations of the beings who compose it – an intelligence sufficiently vast to submit these data to analysis – it would embrace in the same formula the movements of the greatest bodies and those of the lightest atom; for it, nothing would be uncertain and the future, as the past, would be present to its eyes.” However it is possible that we are dealing with a stochastic process, both at quantum scales and at cosmological scales, which will best describe the interaction of particles in space and time. If the physical model has inbuilt indeterminacy, such as assuming that each individual particle executes a motion which is independent of the motions of some of the other particles, then stochastic processes should be possible.

We ‘physical cartographers’ haven’t got our map quite right yet. I appeal to the physicists of today to listen carefully to the reductionist philosophers, as their simplistic roadmap may allow some of the dead ends of physical mathematics to be negotiated and removed.