Physical reality and the mathematical laws – a new philosophical approach

Jose P. Koshy

Abstract

Is what we observe real? In this paper I argue that the physical world is as real as we feel – the term 'reality' is defined unambiguously. The domain of physics includes only real situations, whereas the domain of mathematics includes non-real situations also. So the role of mathematics (in the domain of physics) has to be clearly defined. Here I propose a new philosophical approach (to define the role of mathematics): the properties are physical, but the laws are mathematical.

1. Introduction:

We humans collectively believe that unravelling the secrets of nature is something we are expected to do; all our intellectual pursuits are guided by this underlying philosophy. To understand nature, we require some basic frame-work to work upon. Here also the approach is philosophical: we believe that basically the world works in a certain way (that is, we accept a certain world-view), and then try to explain the rest rationally. As we get more and more data from our observations and experiments, our world-view changes. We can say that our philosophical approach to understand nature changes with time.

2. Mathematical physics:

The fact that bodies obey mathematical laws was known even before Newton. However, it was Newton who generalised this to include everything in the universe. The mathematical laws he proposed serve also as physical statements. This was the crucial difference that opened up a new approach, which we can call the 'philosophy of mathematical physics'. The underlying idea behind this philosophy is that mathematical laws are essential to understand the physical world; these laws can be used to 'explain the changes' and 'define the properties'. Since then, the physicists are being guided by this philosophy.

The classical Newtonian physics, however, follows a weak version of this philosophy: the definitions derived from the mathematical laws have physical meanings. However, the importance given to mathematics ultimately led to the present situation where definitions derived from the mathematical laws have no physical meanings. This represents the strong version. The scientific community as a whole supports the philosophy of mathematical physics; however, there are a few dissenting voices**,** especially against the strong version.

If we analyse the existing laws/theories, the dominant role of mathematics can be understood. The tables given below show the mathematical parts and the implied physical parts of existing laws/theories. Table-1 shows the basic concepts. These have no mathematical parts. These are based on our observations, and have clear physical meanings. Table-2 shows the classical Newtonian laws. Here, the implications based on the mathematical parts have clear physical meanings. Table-3 shows the later theories. Here, the definitions derived from the mathematical parts have no clear physical meanings.

Table -1

Law/theory	Mathematical part	Physical part
Concepts of matter, space and time	No mathematical part	At the ordinary level, 'matter has mass, volume, energy and force' and 'space and time act as separate entities'
Concept of conservation	No mathematical part	States some properties of matter cannot be destroyed

Table -2

Law/theory	Mathematical part	Implied physical part
First law of motion	Law governing motion irrespective of the entity that moves	Bodies, if left alone, moves along straight lines or remain at rest; a body can move infinitely away
Second law of motion	Law governing the changes when force is applied	Force is something that creates acceleration; speed can be infinite
Third law of motion	Conservation law (if A gains B will lose)	(Conservation of momentum is not derived from the mathematical part)
Force laws	Laws used for calculating force between bodies	Forces of nature can be infinite; fields are infinite

Table -3

Law/theory	Mathematical part	Implied physical part
Second law of thermo-dynamics	Law governing the direction of changes	Defines entropy (disorder), which has no clear physical meaning
General theory of relativity	Law governing things at cosmic level and at speeds comparable to 'c'	Defines space-time, which has no clear physical meaning
Quantum mechanics	Law governing things at quantum level	Defines quantum states, which have no clear physical meaning

It can be seen that except for the basic concepts, the rest of the physical part are deduced from the mathematical part. The influence of mathematical physics is so thorough that no serious attempts have been made to verify whether alternate 'physical concepts' are possible in place of these. In short, physicists have neglected the physical part.

The mathematical part, on the contrary, gives a success story. The only drawback is that separate laws are used to explain things at different levels. The unification of physics based on the these laws has remained unsuccessful so far. Being mathematical-tools developed for the concerned levels, these laws may remain rigid, making unification unattainable. So unification based on physical concepts may be the only possible alternative. However, this requires a new philosophical approach that restricts the undue influence of mathematics.

3. Definitions and properties:

The physical part of the laws/theories provides definitions and describes properties. The basic properties of matter were initially taken as real, a view that agrees with our observations, common-sense and rational thinking. However, now it is argued that reality need not be in agreement with our common-sense, and the later definitions and attributed properties clearly defy our common-sense. The reason for this, I argue, is the undue influence of the philosophy of mathematical physics.

So I propose that we go back to the time of Newton, and take matter, space and time as real entities. Apart from these three, there can be nothing else: no antimatter, no independent fields, no space-time, and nothing that goes against our common-sense. The basic properties are also real. Space is three-dimensional; time moves forward; and mass, volume, energy and force are non-interchangeable properties. These basic properties do not change with time; however when matter integrates, it acquires some emergent properties, which change with time.

The common argument against common-sense based reality is that it cannot be defined unambiguously. Here, it should be noted that this reality is about matter, space and time, and so a definition need include only mass, space and time dimensions. In a real world, these three can have only real positive values. So reality can be defined as follows:

> Any*thing we observe in this universe is real and is made up of matter; whatever may be its size and shape, the amount of matter in it and the space occupied by it will be greater than zero; and the period of time during which it remains in a certain form or at a certain position will also be greater than zero.*

4. The laws that govern the physical world:

What do the laws actually explain? Had the world remained static, there would have been nothing for us to explain. But the bodies around us change with time, and we require laws to explain these changes. However, the bodies always contain matter, and the only change that happens is in the arrangement of matter particles. So for any change to happen, the particles have to move physically from one position to the other. Or, changes happen by way of motion. Motion, at the same time, is a space- time relation that can be explained mathematically. So all changes follow mathematical rules, and hence the laws that govern the physical world are purely mathematical.

5. The new philosophy:

We have seen that bodies have real physical properties, and the changes that happen to them follow mathematical laws. From these, follow the new philosophy: the properties of the physical world are are real and physical, but the laws that govern it are mathematical. So properties should be defined in physical terms that have real physical meanings, no physical property can be deduced from mathematical laws, and there are no physical laws. Physics defines the properties of matter; given these properties, mathematics decides how matter integrates and how matter changes with time.

Based on the new philosophy, some rethinking is required. Table-4 gives some possible alternatives that have clear physical meanings. These constitute a set of related concepts that can give a rough picture of the universe in its entirety. Whether it is the right model or not, it reveals that alternate physical explanations are possible.

Table -4

	Alternate physical explanation possible
Motion	A fundamental property of matter; only 3-dimensional motion is possible in 3-dimensional space;
Light	Particles of matter moving along helical (3-dimensional) paths
Acceleration	One of the after-effects of force acting; F=ma is valid only for small changes
Speed limit	'c', is the natural speed of bodies having no internal energy, and hence the limit
Forces	Forces of nature are manifestations of reaction to motion; Energy and force act as action-reaction pair; both are finite ('c' decides the limit)
Positrons	Matter particles; neutrons contain electron-positron pairs
Universe	A finite three-dimensional system made up of galaxy-clusters that move at speeds comparable to light
Entropy	The kinetic energy of individual units of a system; entropies of galaxy-clusters decrease when entropy of universe increases
Space-time	The spherical surface of the universe; its curvature decreases with expansion

Based on similar physical concepts, the three-dimensional structures from electromagnetic radiations to the universe itself should be visualized. These physical structures, however, should be mathematically viable. That is, the integration of matter from the particle level to the cosmic level should be mathematically explainable. That will be the real unification of physics.

6. Conclusion:

The existing philosophy allows the domination of mathematics in the domain of physics: the mathematical laws not only 'explain the changes', but also 'define the properties'. This has led to a picture of an unreal physical world, where physical properties have no physical meanings. Based on the present mathematical laws, it may be impossible to unify physics. A change in philosophy limiting the role of mathematics to 'explaining the changes' will lead to a reality-based physics, and may eventually lead to the theory of everything.

Reference: nil