Comment

The old and new Concepts of Physics
An open-dialogue journal

www.uni.lodz.pl/concepts

Comment on PHYSICS STANDING ON BASELESS PLATFORM

Edward Kapuścik
Department of Physics and Applied Informatics, University of Łódź
Łódź, Poland
and
H. Niewodniczański Institute of Nuclear Physics
Kraków, Poland

I think that some comments on the Bhattacharjee paper are necessary because the problem discussed by the Author is not so trivial as it might seem. Dealing with physical quantities we not only must properly take into account their physical dimensionality but also we must remember the physical meaning of these quantities. For example, the x, y and z components of the positions of material points all are measured in the units of length and therefore we formally can add them but what is the physical meaning of the sum of such different components?

Mathematics solved this problem for us by introducing many dimensional spaces with component wise addition. It is trivial to extend this idea to the set of all physical quantities which appear in the given physical problem. Different physical quantities, even those with the same dimension but different meaning, will appear as different components of a vector in the space of physical quantities (SPQ). Defining the addition as component by component operation we have a linear space in which addition never leads to physically meaningless expressions like $p + q$, where p is momentum and q some coordinate.

The SPQ is well-defined provided the system of units was chosen at the beginning. A change of the system of units is then represented by a map

$$(SPQ) \rightarrow (SPQ)',$$

where $(SPQ)'$ is the space of physical quantities expressed in the new system of units. The vectors of $(SPQ)'$ are obtained from the vectors of (SPQ) by a diagonal matrix whose diagonal elements are the conversion factors from the old units to the new ones.

Physical quantities changes also by changing the inertial reference frames in which physical phenomena are described. A passage from one inertial reference frame to another such frame requires some transformation rules for the physical quantities and we arrive to maps of the type

$$(SPQ)_{Frame1} \rightarrow (SPQ)_{Frame2}$$

implemented by non-diagonal matrices in the case when all physical quantities transform linearly.

All relations between physical quantities like

$$E = \frac{p^2}{2m},$$

or

$$p = mv$$

are realized as maps (in general, nonlinear) in the same (SPQ).

The above described structure of (SPQ) is especially essential in quantum physics where physical quantities are represented by self-adjoint operators. In the standard formulation of quantum physics there is no internal restriction which forbids addition of operators which correspond to physical quantities with different physical dimension or physical quantities with the same dimension but different physical meaning.