Review of: "Quantum Mechanical and Classic Measurement Result Quantities are Equal (Even though their Numerical Values are Not)"

Olivier Brodier[1]

1 University of Tours

Potential competing interests: No potential competing interests to declare.

The manuscript develops a point of vue which is aimed at unifying the way one considers a quantum mechanical measurements and a classical measurements. This point of vue is base on the notion of calibration. It is claimed that, by interpreting quantum experiment uncertainty as a calibration process, one could avoid certain paradoxes of quantum mechanics measurement theory. The discussion is interesting. However there are points that are not clear at to me, and other points that are so unclear that they raise objections in the way I understand them.

1) The style is very generic and abstract, even in the examples, and expliciting the notations for each example would greatly simplify the discussion. For instance in section 5.4, where the reader actually discovers by himself that it is about EPR argument, what is the practical meaning of n_a and u_{am} ? Are the n_a numbers equal to +/-1 like in EPR argument ?

2) The author proposes a definition of a measurement result quantity as a sum over smaller units, namely Q of equation (1). I don't really understand how this definition relates to the practical aspects of a measurement process. For instance, I can object that, in practise, a quantity is often defined as a fraction of something rather than a sum of intervals. For instance, the modern definition of the meter is the distance traveled by light in 1/300000000 second. So the meter is defined through the fraction of the interval of a second, not a sum of intervals. And then the centimeter is a fraction of the meter, which can be built in practice by, let's say, Thales theorem. Hence, the actual scheme is quite opposite to what suggests the example 5.1, and the error made on the meter will then not be a sum over the errors made on the centimeter. Furtherly, the given example of the thermometer in the oven seems incorrect to me. Indeed, it is said that the marks are drawn step by step, each mark having an error +/-1/m, and that, at the end, the errors sum up and give a Gaussian. But I don't agree with this, because to me the Nth mark, for instance 70°, does not actually depend on the previous marks. That is, even if I make a strong error on the 69th mark, the 70th mark is given by the physical process of dilatation of mercury and will therefore only depend on the precision of the oven's own calibration, that is, +/-1/m, and the reading precision of mercury's level. In other words, the error on the 70th mark can never be 7°, it will always be 0.1° as any other value, assuming that oven's error is indeed 0.1°.

3) According to section 3, an eigenvector in quantum mechanics is supposed to be interpreted as a unit U. But this is not how things are done in practice. Quantum physical properties have regular units, like the classical ones, which are all included in the eigenvalue, not the eigenvector. For instance, in standard approach, a spin 1/2 measurement values are identified as +/-h/2 Joule second, whereas the eigenvectors are |up> and |down>, or (1,0) and (0,1). Does the author

mean that |up>, or (1,0), is a unit U ? Or does the author mixes up eigenvector with eigenvalue ? The author himself gives lambda as a unit for x and p in his example of Heisenberg's microscope, and lambda is quite not an eigenvector.

4) The author considers quantum mechanical uncertainty as the smallest quantization of the calibration process. However he skips the discussion about the fact that this uncertainty is a quantity which is calculated over many measurements, but that each measurement has its own quantization which is determined by the measurement apparatus. This quantization can be much smaller than the uncertainty. For instance, current low noise camera can detect a single photon, and this detection will activate a single pixel of the camera. However, for instance in the double slit experiment, the size of the pixel can be much smaller than the position uncertainty of the photon, which can be a delocalized spherical wave. It means that a single measurement in quantum mechanics does not obey the scheme of the author's Relative Measurement Theory. In particular, if a wavefunction has uncertainty Deltax, but is measured with an apparatus which has precision deltax smaller than Deltax, then its uncertainty becomes deltax after measurement. Then, if follows a momentum measurement, then uncertainty before measurement will be h/deltax, and, if the momentum measurement is made with precision deltap, then uncertainty will become deltap after measurement. This feature does not happen in classical physics, and I don't see how Relative Measurement Theory can reconcile them ?