Space: the Bridge between Mathematics and Physics. The Emergence of Quantum Mechanics.

/* Artem S. Shafraniuk, artem.shafraniuk@gmail.com */ Mon 24, Oct 2016

Abstract

Measuring something tangible on a spatial background yields quantum mechanics out from the measurements themselves. The wave and particle nature confusion comes from confusing the objective with the measured, the latter usually being subjective. At last, the road to a single-dimensional version of quantum mechanics is opened.

This is a paper incorporating quantal topology, algorithmic information theory, axiomatic probability, Kolmogorov complexity, quantum mechanics, and wavelets. We can cover a piece of space with a quantale, in any such way that the structure, and orientation of such a quantale is preserved, as well as the dimensionality of the space. Originally, a quantale has been invented by Mulvey [1], for the sake of quantization of spaces. The definition of a quantale is an upper-join semi-lattece, which mimics that of an event space in the theory of probability. A quantale has a forest (or tree) -like structure, where all the leafs correspond to elementary events. What is the relation of a quantale to a space? Quite simple, it simply covers it, and a subset of a set in a quantale covers only a subset of what that set covers. It's clear to see that if a function is defined on the space covered by that quantale, and this function's value approximation depends on where in the quantale the corresponding function arguments are, then this function's approximation, together with this quantale, define a probability space. It's easy to see, then, that the elementary events of this probability space are that quantale's leafs, because any other set of the quantale (corresponding to an event, nonelementary one,) can be composed out of them. Now, let's see how this plays a role in a statistical experiment, where an actual event happens, and the quantale mimics the sample event space, only just up to the nonviolation of the principle that the leafs are elementary, and the composite events are composed of them, so that the quantale simply covers the function's argument, but without knowing the function itself. So the question arises, what is the relation of that quantal event space to the actual function governing the event distribution? This is especially actual in the setting where this function is not known, but such a quantal approximation may, in fact, be constructed, say, from knowing a set of outcomes of such experiments, whence each of them yields an actual valid outcome. Next, let's set a goal of reconstructing the best possible approximation of the function above, based upon such a quantale, as above, when the latter, the quantale is "best", in the sense of accounting, adequately and completely, for all (say, of all that we have,) experimental outsomes. This looks like we're fitting a function to a pattern, an so it is. From probability theory, let's recall, the genuine pattern of randomness is the Bell curve.

Till now, our exposition lacks one more concept, to decide upon the solution. It is called algorithmic complexity, or Kolmogorov complexity, giving rise to algorithmic probability, Solomonoff [2]. As our next step, let's recall about a long-standing problem, or question, in quantum mechanics, about whether is primary, wave-, or statistical-nature of the randomness in an outcome of measurement of observation. In the setting of our exposition's momentum, we can see that it's natural not to know the function in question, because the function covers exactly all the outcome space, an all we can know is get a series of standalone outcomes, repeating the measurement in the same setting each time. So what should we do in order to get the best prediction of the actual event distribution, having only a set of outcomes? Right, for example, employ algorithmic probabilities.

Then we get the best possible approximations of the actual event distribution over the whole background space in 3 different ways, and what all the three approaches yield coincides. The first is, to interpolate the quantale with the Bell curves ("if it's unknown, the best approximation of it is as if it was random, no matter what it is, provided that it really is unknown"), giving their sum, of these (rescaled) Bell curves. The second is, to find out the distribution of algorithmic probabilities, so that it coincides with the experimental data (for all the known outcomes), and provides the best predictions for all the unknown inputs. (This is normally done by finding the Occam's razor- simplest probability distribution- yielding algorithm.) The third is, to use wavelets to decide. Then all the three approaches will say just one same thing: that when you deal with repeatedly measuring an unknown, but one and the same, observable, in a setting with background space, you will get the statistial approximation coincide with the wavelet approximation. Figuratively speaking, "because the simplest wavelet curve does the best approximation (may be extrapolation, or may be interpolation), for what the experimenter knows nothing about, except for that this is one and the same parameter, which is being measured and approximated." For wavelets, see [3].

At last, let's turn to the wave/particle nature question of a multi-outcome composite experiment. Let's say, doube-slit. At first, the explanation. As D. Bohm [.] has put it, there are implicate and explicate orders. But the author of this want to add, that the explicate is the illusionary, observed one. So does this resolve the issue? Well, we do not observe the objective mechanism that decides the experimental outcome. We do, in fact, only observe the measureables/observables we're provided with through the measurement. [4]

PS: Just to make it go further: Take one-dimensional case of quantum mechanics. Then particles become strings, and everthing wavelets...

Bibliography

[1] C.J. Mulvey, J.W. Pelletier, "On the quantisation of spaces." J. Pure Appl. Math. 175 pp.289-325, 2002

[2] R. J. Solomonoff. "A formal theory of inductive inference: Parts 1 and 2." Information and Control, 7:1--22 and 224--254, 1964

[3] Burrus, C. S, Gopinath, Ramesh A and Guo, Haitao "Introduction to wavelets and wavelet transforms: a primer." Prentice Hall, Upper Saddle River, N.J, 1998

[4] Bohm, David, "Wholeness and the Implicate Order." London: Routledge, 1980

PS. Please spread the word, feel free to send, and forward, this article to the people you know, & don't know, if allowed!