Abstract

Physical Observations as Eigenforms

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In quantum mechanics, there is a difference between a value-attributing proposition and a state-attributing proposition. The difference is important for making sense of the curious 'fact' that sometimes in quantum mechanics we are able to numerically distinguish objects from one another although all of their properties are the same. Leibniz's law tells us that two objects are the same iff they share all of their properties. The curious fact seems to violate Leibniz's law of identity. It does not.

One way of dealing with this is modally. Van Fraassen is an example of someone who chooses this route. But we can be more precise than just adding a modal operator to (potential) properties. Following Kraus and Arenhart (2017, 172) we can think of the difference mathematically, or logically, in the following way: it is analogous to the difference between absolute (invariant) notions and relative notions in set theory. An example of a relative notion is the cardinality of the reals in a first-order theory. Skolem's "paradox" is that a first –order theory attributes the same cardinality to the reals as it does to the natural numbers, thus, apparently violating Cantor's diagonal proof. The reason Skolem's paradox is *not* thought to be problematic is that we *can* tell the difference in the cardinality if we step *outside* the theory and look "in" on the notion of cardinality of the reals from a larger (second-order) theory. Skolem's paradox is only one example. In mathematics, what counts as an absolute notion and what counts as a relative notion depends on the pair: object-theory and meta-theory.

I should like to extend the thoughts of van Fraassen and the mathematical modelling of the curious fact suggested by Kraus and Arenhart. The extension is to the contemplation of several, (i.e., more than two) mathematical theories, each modelling some phenomena. We see the several theories in play when we learn about the relativity theories in the way suggested by the Andréka-Németi group.

If we individuate mathematical theories by their axioms, and close each under some operations, then the Andéka-Németi group develop several theories to capture, or describe, or understand, or model, the various phenomena of the relativity theories. In their approach, we do not have one object theory and one meta-theory. We actually have several object theories, and sometimes several meta-theories. The observations being captured can then be thought of as meta-eigenform: a fixed point under a transformation from one theory to another. It is exactly under the scrutiny of an observed phenomenon from several theories and view-points that we come to understand the phenomenon in question.

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