Holism, Physical Theories and Quantum Mechanics

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Abstract

Motivated by the question what it is that makes quantum mechanics a holistic theory (if so), I try to define for general physical theories what we mean by `holism'. For this purpose I propose an epistemological criterion to decide whether or not a physical theory is holistic, namely: a physical theory is holistic if and only if it is impossible in principle to infer the global properties, as assigned in the theory, by local resources available to an agent. I propose that these resources include at least all local operations and classical communication. This approach is contrasted with the well-known approaches to holism in terms of supervenience. The criterion for holism proposed here involves a shift in emphasis from ontology to epistemology. I apply this epistemological criterion to classical physics and Bohmian mechanics as represented on a phase and configuration space respectively, and for quantum mechanics (in the orthodox interpretation) using the formalism of general quantum operations as completely positive trace non-increasing maps. Furthermore, I provide an interesting example from which one can conclude that quantum mechanics is holistic in the above mentioned sense, although, perhaps surprisingly, no entanglement is needed.

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