Bohmian Mechanics and Contextuality

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Prerequisites

I am not assuming you have any special knowledge about the subject; only undergrad level quantum mechanics is assumed

Background | Bohmian Mechanics

The Quantum Mechanics that is taught, is usually the one which uses the 'Copenhagen interpretation'. This interpretation asserts that the most complete possible specification of an individual system, is in terms of ψ which yields only probabilistic results. While it can be shown to be consistent, it is worth exploring the reasons for believing this assertion. David Bohm[a] in an attempt to investigate the truth constructed a theory with 'hidden variables' that in principle completely specified the system but in practice get averaged over. He was able to show that his theory yields the same results as Quantum Mechanics in all the physical situations he considered. Such a theory is worth studying because the following are at stake. (1) Clarity: The widely held notion that at the atomic level, we must give up any concievable precise description of nature, is plain false because there exists a counter example. (2) Accuracy of conclusions: The Bell test showed that there can't be hidden variable theories. Yet Bohmian Mechanics (Bohm's hidden variable theory) does violate Bell's inequality. The important lesson here is that the Bell test excludes local hidden variable theories, and Bohmian mechanics is explicitly non-local.

Orthodox view: No precise description of nature is possible.
Bohmian Mechanics: A description of nature that is precise.

[a]Historically, de Broglie had formulated a similar theory and then gave it up until Bohm independently re-discovered it