Contextuality in a deterministic quantum theory

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I am still in the process of writing my thesis (have 3 months left off of the 8 months allocated) and therefore can't submit a table of contents. The provisional abstract is as follows.

Abstract

Einstein started with showing that Quantum Mechanics (QM) must be incomplete if one assumes (a) realism and (b) locality. He wanted us to believe that there must be some theory which satisifed both (a) & (b) and can produce the intended results. Bell later showed that certain correlations between measurable properties must be bounded, given (a) and (b) hold. QM he showed violates this and therefore it doesn't satisfy atleast one among (a) and (b). This was confirmed experimentally.
We start with a theory which satisfies (a) but not (b), while being completely identical with QM in terms of experimental predictions. Such a theory should exist is by itself rather discomforting. Infact, the said theory, known as Bohmian Mechanics (BM), is deterministic. Which entails that while it maybe expected that the correlations can arise from the explicit non locality in the theory, we explore what happens to questions related to contextuality, which roughly asserts that deterministic assignment of outcomes is not possible.

More precisely, it is already known that usual formulations of contextuality (and other determinism tests) are for discrete degrees of freedom, viz. spins (for massive particles). Since Bohmian Mechanics doesn't claim that spins have pre-defined values, it is not surprising that both are compatible, yet the analysis is illuminating. It sheds light on how non-locality and contextuality are related. Further, tests of contextuality maybe extended to phase space (q, p). In this setting then, the tests show that (q, p) can't be deterministic, roughly speaking, while antithetically, BM is infact deterministic in (q, p)! To explore this apparent contradiction, we construct an appropriate test of determinism and analyse it in the framework of BM. Various possible extensions are discussed, with their advantages and limitations. A simplified extension of the Perse-Mermin construction is used to hint that BM, despite being a non-contextual hidden variable theory, can violate the KCBS inequality, suggesting that we need to refine the notion of contextuality. The root of the paradox, an innocuous oversight, has been recognized and delineated. For clarity, the Bell Test is extended to phase space and it is contrasted with the aforesaid, where this oversight doesn't cause any significant error. The analysis, in continuous variables, is further expected to provide insights into the relation between non-locality and contextuality, where the current understanding is limited.