Are Hidden-Variable Theories for Pilot-Wave Systems Possible?

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Recently it was shown that certain fluid-mechanical 'pilot-wave' systems can strikingly mimic a range of quantum properties, including double-slit interference, quantization of angular momentum etc. How far does this analogy go? Could such systems also violate a Bell inequality, despite the fact they involve only local (sub-luminal) interactions ? Here the premises of the Bell inequality are re-investigated for particles accompanied by a pilot-wave, or more generally by a 'background' field. We find that two of these premises, namely outcome independence and measurement independence, are not generally valid when a resonant background is present. Then the Bell inequality cannot be derived anymore and is possibly violated. A key point is that this unexpected result can be tested. Since the detailed correlations in the mentioned hydrodynamic system are not known, we cannot yet propose a detailed experiment violating a Bell inequality; but a not yet fully specified class of experiments can be proposed. Finally, it is shown that certain properties of background-based theories also arise in Ising spin-lattices, where detailed calculations are possible.

Link to an arXiv article: https://arxiv.org/abs/1701.08194