Review of: "On Qubits and Quantum Information Technologies"

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In this paper, the claim is made that superposition is not a physical property, and that recent efforts on utilizing this as a resource for computing or communication are therefore bound to fail. The author argues that the confusion arises due to the omission of the fact that measurements can only be performed to finite precision, and that this imprecision is what leads to the seemingly probabilistic behavior associated with superpositions. Furthermore, the claim is made that the lack of superposition does not invalidate certain aspects of quantum theory and leaves it as a useful theory in other contexts.

I think the paper identifies an interesting central concept - the limited precision of measurements - that may be underappreciated by parts of the community. However, I struggle to see how the proposed interpretation fits with both the theory that it claims to augment and with the empirical evidence.

As I see it, incompatible observables (and hence different bases of eigenstates, thus the possibility of superposition) are a central part of quantum theory. Without it, I can't see how one can have a wavefunction (a superposition over positions) or spin as we know it. I therefore find the claim that quantum mechanics is still valid without superpositions to be unconvincing.

What seems to be proposed instead is a theory where the (well-defined) properties are revealed by measurements with small imperfections - in essence, a hidden variable theory. This could still be an interesting direction, but I think it leaves two questions that I would like to see addressed in future work. Firstly, measurement outcomes in quantum systems are quantized, meaning the probabilisticness doesn't tend to manifest as small deviations. Particles in Stern-Gerlach experiments go either up or down; atoms in a quantum simulator either fluoresce or don't. How the ability to have such macroscopically stochastic outcomes works in his theory is unclear to me. Secondly, there are a lot of observed properties of quantum systems that seem related in an essential way to signed superpositions, including interference in two-slit experiments and Bell-inequality violations. Fitting these into his framework - an alternative to superpositions - seems like a necessary first step to an alternative to quantum theory (and one that has posed a significant challenge for a lot of hidden-variable approaches).

So in short, I think that thinking about the implications of imprecision in measurements is important and interesting, but the aggressive claims about the impossibility of superposition need more thorough explanation to be convincing to me - it

seems a very radical claim, and it isn't clear to me how the substitute interpretation given can explain the experiments that led to the introduction of superposition as a concept in the first place.