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Qeios

Peer Review

Review of: "Local Everettianism and Asymmetric Relative Statehood"

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Thank you to Conor Husbands for sharing this interesting work contesting the locality of the Everett interpretation. I think the paper develops a creative synthesis of recent ideas in the literature on this topic. However, I do not think the paper's argument troubles Timpson and Brown's approach to locality, due to a mishandling of the paper's modified EPR setup that Howard Wiseman noted in his review. In the spirit of building on Wiseman's comments to help with future iterations of this work, I will first recount how I think the paper's modified EPR setup should be described in an orthodox approach to quantum measurement, and I will then describe the consequences for locality on an Everettian approach like Timpson and Brown's.

On an orthodox approach to quantum measurement, I understand the modified EPR setup to proceed as follows: after the second particle, S_2, passes through the half-silvered mirror, its position degrees of freedom enter into a superposition of two distant, well-localized states; subsequently, either the first observer measures the spin or the second one does, but not both. Note that the distant, well-localized states $|\uparrow_\theta\rangle_{O_2}$ and $|\downarrow_\theta\rangle_{O_2}$ of the rightward-traveling second particle should not alter the ready state of the first observer's new spin-measuring device; after all, that's what we would expect if we were to repeat the experiment with the first half-silvered mirror removed. Another way to make this point is to look at the probabilities yielded at the end of the paper's formal analysis. From the part of the setup borrowed from Timpson and Brown, we have $|\alpha|^2 + |\beta|^2 = |\alpha'|^2 + |\beta'|^2 = 1$. The paper correctly asserts that the first observer has a probability $\frac{1}{4}(|\alpha|^2 + |\alpha'|^2)$ to measure the second particle with spin up and $\frac{1}{4}(|\beta|^2 + |\beta'|^2)$ to measure it with spin down. However, this implies that the first observer has a total probability of $\frac{1}{2}$ to detect the second particle at all, as does the second observer.

On an Everettian approach, an intuitive gloss of the situation goes as follows: each observer will measure the second particle on some branch, but there is no branch where two observers measure one and the

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same particle in two different locations; thus, there should be no non-local influence. An analysis styled after the approach of Timpson and Brown seems to recover this gloss. First, consider the branches in which O_2 measures S_2, and recall that the states $|\uparrow_\theta\rangle_{O_2}$ and $|\downarrow_\theta\rangle_{O_2}$ should leave the first observer's spin-measuring device in its ready state $|\uparrow_\theta\rangle_{A_1}$. Thus, relative to that ready state, we should expect the second particle to be in a superposition of spin states; therefore, it is not in a determinate-definite state of spin relative to the first observer, as we would expect. Next, consider the branches where O_1 measures S_2. We can use an argument symmetric with the above to conclude that the particle will be in a determinate-definite state of spin relative to the first observer, but not relative to the second. In either case, there is no non-local interaction yielding determinate-definiteness.

Declarations

Potential competing interests: No potential competing interests to declare.

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