Report

The authors are critical of the stochastic part of the modified Schrodinger equation depending on the quantum state of the system, in objective collapse theories. It is not clear to me why the authors find this objectionable. I request the authors to look up

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for the very general and plausible conditions under which stochastic modification of the Schrodinger equation essentially uniquely leads to collapse models. And this does imply that the stochastic component can depend on the quantum state of the system. I hope the authors will agree that objective collapse means spontaneous collapse, i.e. collapse does not require the presence of a measuring apparatus. Yet, the collapse inducing mechanism can be state dependent; in fact it should be so. Because the most likely explanation of the origin of stochasticity is coarse-graining of an underlying deterministic evolution (which is non-unitary but norm preserving). Randomness then arises as a consequence of ignorance of the fine-grained dynamics, quite like in coin tossing and in Brownian motion. The authors suggest that objective collapse is being caused by coupling of the quantum system to a universal noise field, and in order to preserve universality the coupling must be state dependent. However, we do not know whether there indeed is such a noise field in nature. It is much more reasonable that the noise field is a representation of coarse-graining of a deterministic underlying dynamics. Thus, I am not at all convinced that the coupling to the stochastic component ought to be independent of the state of the quantum system. Also, the authors have not investigated whether such a requirement on their part is consistent with the no-signaling condition.

The other important criticism concerns the derivation of the Born probability rule. The authors' own derivation of the Born rule by fine-tuning the parameters of their model is not satisfactory at all! A different choice of parameters will contradict experiment! In conventional objective collapse theories, the Born role inevitably follows IF one assumes the non-unitary stochastic evolution to be norm-preserving [for a proof see e.g. Chapter 6 of Stephen Adler's book `Quantum theory as an emergent phenomenon']. Thus the real question to ask is: why should norm be preserved? This very important question remains unanswered in collapse models, and also in Adler's theory of trace dynamics described in the aforesaid book.

On the whole, I feel the authors exhibit an inadequate/incorrect understanding of the objective collapse theories developed by, and subsequently to, the seminal work of Ghirardi et al. (1986). The authors do not have any valid / admissible criticism of objective collapse theories. Of course those theories are phenomenological, and need further investigation: what is the origin of spontaneous collapse; what is the noise spectrum actually like (white, colored, …); why is norm preserved despite non-unitarity; is there a deterministic theory underlying objective collapse; is gravity involved; how to make relativistic collapse models, if at all that is possible. I respect the authors' interest in collapse models; however I think that interest should be directed towards the unresolved issues mentioned here; not towards questioning objective collapse model equations per se – those appear to be built on

reasonable physical premises, and if they are to be ruled out, that would be through testing them in the lab.

I cannot recommend this paper for publication in SciPost.