Review of: "Mass Creation via the Phase Transition of the Higgs Field"

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Potential competing interests: No potential competing interests to declare.

Comments on article "Mass Creation via the Phase Transition of the Higgs Field"

This manuscript discusses the "phase transition" of the Higgs model with two local minima.

The Higgs potential discussed by the Authors seems to have only two minima, but the Higgs potential of the standard model of particle physics has degenerate and continuous minima which can be transformed each other via SU(2) gauge transformation (the so-called "Mexican hat"). The Higgs potential of this paper is then just a model with discrete Z_2 symmetry, and this has to be emphasized somewhere in the text.

Assuming this model setup, I also have another important comment. When a potential has a Z_2 symmetry, the true ground state is unique. The Authors are stating that there are two vacua, where the Higgs field is almost localized in each well, but the true vacuum is actually the superposition of these two localized states, since there is a transition between the two states through the potential barrier with finite height. In this paper, it is implicitly assumed that the potential barrier is very high and that the time of transition between the two wells is much longer than the time scale taken by the external observer of the phase transition. If the quasi-static limit is taken, the true ground state is the superposition of the two localized states in each well (and in the leading nonequilibrium approximation, the vacuum should be oscillating).

I also have a suggestion on the organization of the paper. The discussion does not seem to be directed to a definite conclusion, and the discussion is scattering very much. I found this paper very difficult to read. I recommend the Authors to improve the logic and the flow of the discussion.