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Vacuum stability limit from cosmological history

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The vacuum stability problem is usually studied assuming that at zero temperature the universe is in the electroweak-breaking vacuum. This may not be the case, however, as seen by checking the evolution history of the early universe in theories beyond the Standard Model. In such models the transition to the electroweak-breaking vacuum may not be possible and/or the universe may have evolved into a different vacuum state. Consequently, it is necessary to analyze the cosmological history to obtain the correct vacuum stability limit. We reveal that the above situations exist even in the simplest singlet extension of the Standard Model, propose a general procedure to identify them, and delineate the parameter space where this happens. We find that checking cosmological history can provide a more stringent and sometimes computationally cheaper limit of vacuum stability on new physics models than the traditional method.

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