The fate of our Universe arXiv:2009.04435+Work in progress

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The 5 Ws of vacuum decay:



A theory described by a potential with local minimum which is not the global minimum



Quantum tunneling makes a particle in the local minimum decay





Why in cosmology

Our existence in the Universe is threatened: our fundamental theory of particles (the Standard Model) tells us that we live on a false vacuum with very long lifetime $\tau \approx 10^{661} T_U$. Unknown (but necessary) physics at higher energies may consistently change this number (gravity, additional particles,...). If our vacuum decayed, all constants of nature would change, and we would probably die.



Decay probability

B is the most important one because it can give $e^{-B} \ll 1$. We find **B** by flipping the potential and finding a trajectory with some definite boundary conditions at t = 0 and $t = +\infty$.

To decay or not to decay? Our work assesses whether such trajectories are ruled out for theories scalar field+gravity, because maybe there is no way to satisfy the boundary conditions. Our method is general (independent on the field potential)

Theory	Decay?
Field	\checkmark
Field+EH	\checkmark
Field+EH+ $\phi^2 R$	\checkmark
Field+EH+ R^2	×
Field+ $\phi^2 R$	<u> </u>



Unless BarrierXfvField+R2X

New numerical method We also found a new numerical method to find the bounce. Allows to find bounces that were too difficult to find before (less integration time needed).