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Renormalization-Scale Uncertainty in the Decay Rate of False Vacuum

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It is sometimes discussed that we may be in a meta-stable vacuum and its decay time is longer than the age of universe. In most papers, the decay rate is estimated without calculating the pre-exponential factor because they believe that it is much less significant than the exponential suppression factor. What we point out is that this estimate can involve a large error owing to the renormalization scale uncertainty. Since the renormalization scale is relevant in calculation of bounce solution and its action, it modifies the decay rate and the uncertainty can be comparable to the exponential factor. To control the scale dependence, we explicitly calculate the pre-exponential factor and show that it is greatly reduced.

Authors: Dr ENDO, Motoi (KEK); Prof. MOROI, Takeo (University of Tokyo); SHOJI, Yutaro (University of Tokyo); NOJIRI, mihoko (KEK)

Presenter: SHOJI, Yutaro (University of Tokyo)

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