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Constrained instantons in scalar field theories

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In QFT, a metastable vacuum state can decay through quantum tunnelling. The calculation of the decay rate relies on instantons —a kind of non-trivial classical solution in the Euclideanized theory. However, sometimes theories with metastable vacua do not have any instanton solutions, thus rendering the usual method of calculating decay rates unusable. An important example of such a theory is the Electroweak theory, where vacuum decay is directly related to baryon number violation, but where there are no instanton solutions to mediate the decay.

In this talk, I will discuss a method for computing the decay rate in such theories using constrained instantons. It is based on a perturbative approach by Affleck from the 1980s, which we have generalised and made fully non-perturbative. I will begin by outlining the method in general, and I will then apply it to a simple toy model - a single, real, massive scalar field in 4 dimensions.

Primary author: GAWRYCH, Kinga (Imperial College London)

Presenter: GAWRYCH, Kinga (Imperial College London)

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