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Methods for computing the critical temperature of the electroweak phase transition

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Content :

In theories with spontaneous symmetry breaking it is possible to calculate the critical temperature of the phase transition between the symmetric and broken phases of the theory. In the Standard Model and its extensions, the temperature of the electroweak phase transition is interesting for a number of physical questions – for example when considering the observed matter/antimatter asymmetry, or when calculating the spectrum of gravitational waves generated by the phase transition.

However, the traditional way of calculating the critical temperature has long been known to give a gauge dependent result. In 2011, Patel and Ramsey-Musolf have shown how to calculate this temperature in a gauge-invariant way by consistently truncating the perturbation expansion.

In this talk we will compare these two methods of finding the critical temperature, exploring the differences between the results they yield, based on a code which we have developed. Using this code it is straight-forward to implement an arbitrary model – in this talk we will consider simple Standard Model extensions, in particular standard model effective field theory up to dimension 6 operators. We will also discuss possible future uses for the code, such as studying the critical temperature of the Two Higgs Doublet Model.

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