Gravitational Wave Probes of Physics Beyond Standard Model 2

Contribution ID : 5

Gravitational waves and tadpole resummation: Efficient and easy convergence of finite temperature QFT

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Content :

We demonstrate analytically and numerically that "optimized partial dressing" (OPD) thermal mass resummation, which uses gap equation solutions inserted into the tadpole, efficiently tames finite temperature perturbation theory calculations of the effective thermal potential, without necessitating use of the high-temperature approximation. An analytical estimate of the scale dependence for OPD resummation, standard Parwani Daisy-resummation and dimensional reduction shows that OPD has similar scale dependence to dimensional reduction, greatly improved over Parwani resummation. We also elucidate how to construct and solve the gap equation for realistic numerical calculations, and demonstrate OPD's improved accuracy and precision for a toy scalar model. An example of the physical significance of OPD's improved accuracy is the maximal gravitational wave amplitude that a model is capable of generating, which Parwani resummation underestimates by two orders of magnitude. This highlights the need to bring theoretical uncertainties under control even when analysing broad features of a model. Given the simplicity of the OPD compared to two loop dimensional reduction, as well as the ease with which this scheme handles departures from the high temperature expansion, we argue this scheme has great potential in analyzing the parameter space of realistic BSM models.

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