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Renormalization group improvement for thermally resummed effective potential

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Effective potential is a standard tool to analyze thermal phase transitions. It is known that perturbative expansion at zero temperature breaks down at high temperature due to infrared divergence. To cure this problem, thermal resummation is indispensable. However, the renormalization group (RG) invariance that is present at zero temperature is lost by such a thermal resummation. In this talk, I will begin by showing the RG non-invariance of resummed effective potential in phi-4 theory up to the 2-loop order, and then propose a scheme in which RG invariance holds order by order in resummed perturbation theory. As an example of first-order phase transition, we consider an extension of the phi-4 theory. Our numerical analysis shows that renormalization scale dependences in our scheme could get milder significantly than those in the MS-bar scheme at 1-loop level, while at the 2-loop level the difference between the two schemes are less pronounced as long as couplings are moderate in magnitude.

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