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Equilibration in classical Yang-Mills dynamics

Understanding the mechanisms causing rapid thermalization deduced for high-energy heavy ion collisions is still a challenge.
Thermalization is not fast enough in perturbative esitmate, and several instabilities in the classical Yang-Mills (CYM) equation have been considered. In this work, we have evaluated the equilibration time from the chaotic behavior of CYM [1]. We have developed a method to evaluete intermediate Lyapunov exponents (ILEs) by integrating the equation of motion for an intermediate time period. Sum of positive ILEs gives the entropy production rate in intermediate times, and is found to follow (energy density)ˆ{1/4} as expected from the scale invariance of CYM.
As a phenomenological application we conclude that for pure gauge theories with random initial conditions thermalization occures within few fm/c, an estimate which can be reduced by the inclusion of fermions, specific initial conditions etc.

[1] T. Kunihiro, B. Muller, A. Ohnishi, A. Schafer, T.T. Takahashi, A. Yamamoto,Phys. Rev. D {\bf 82} (2010), 114015 [arXiv:1008.1156].

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