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Thermodynamics and the Polyakov loop in the covariant variational approach to Yang-Mills theory

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We extend the covariant variational approach for Yang-Mills theory in Landau gauge to non-zero temperatures. The renormalization of the system is revisited and it is shown how the zero-temperature counter terms can be used to render the system finite at *any* temperature. Numerical solutions for the thermal propagators are presented and compared to high-precision lattice data. To study the deconfinement phase transition, we adapt the formalism to background gauge and compute the effective action of the Polyakov loop for the colour groups SU(2) and SU(3). Using the zero-temperature propagators as input, all parameters are fixed at *T=0* and we find a clear signal for a deconfinement phase transition at finite temperatures, which is second order for SU(2) and first order for SU(3). The critical temperatures obtained are in reasonable agreement with lattice data. Continuing this investigation, we study thermodynamics and, in particular, the pressure of the Yang-Mills system, and compare to both lattice data and the results of the non-convariant Hamiltonian approach. Finally, we briefly discuss the inclusion of fermions and possible ways to extended our method beyond the Gaussian ansatz.

Summary

Primary author: QUANDT, Markus (Universität Tübingen)

Co-author: REINHARDT, Hugo (Universität Tübingen)

Presenter: QUANDT, Markus (Universität Tübingen)

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