

Mass spectrum of noncharmed and charmed meson states at finite temperature in extended linear-sigma model

A. V. Friesen^{1*}, Yu. L. Kalinovsky¹, A. N. Tawfik²

¹Joint Institute for Nuclear Research, Dubna, Russia

²Basic Science Department, Future University in Egypt, Egypt

*e-mail: avfriesen@mail.ru

The present study focuses on the low-energy phenomenology associated with quantum chromodynamics (QCD), where mesons and their interactions serve as the pertinent degrees of freedom, rather than the fundamental constituents of quarks and gluons. The presented work examines the mesonic potential contributions to the Lagrangian of the extended linear sigma model (eLSM) for (pseudo-)scalar and (axial-)vector meson fields across various quark flavors. Given that SU(4) configurations are completely based on SU(3) configurations, the possible relationships between meson states in SU(3) and those in SU(4) were explored at finite temperature. For the finite-temperature case the mean-field approximation with the Polyakov loop was used.

The temperature dependence of meson masses shows that although various meson states exhibit unique patterns in their mass changes with temperature, they all seem to share a similar range of dissolution temperatures. This implies that the critical temperature marking the phase transition from hadrons to quarks varies slightly depending on the meson states. Such near-universality of the dissolution scale suggests that the deconfinement transition is a relatively sharp phenomenon, despite the diversity of hadronic species. The quarkonium states, formed by a quark and its antiquark, are largely unaffected by variations in the temperature. This resilience makes heavy quark onia particularly useful probes of the hot medium, as they remain bound up to temperatures close to the transition.

Список источников

1. A. N. Tawfik, A. I. Ahmadov, A. Friesen, Yu. Kalinovsky, A. Aparin, M. Hanafy, *Particles*. **8**, 9 (2025).
2. A. Friesen, Yu. Kalinovsky, N. M. Rfeek, A. A. Alshehri, A. N. Tawfik, arXiv: 2512.22198, (2025) (under publishing in PRC).