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Holographic spin alignment for vector mesons

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We develop a general framework for studying the spin alignment ρ00 for flavorless vector mesons by using the gauge/gravity duality. Focusing on the dilepton production through vector meson decay, we derive the relation between production rates at each spin channel and meson's spectral function in a thermal medium, which can be evaluated by holographic models for a strongly coupled system. As examples, we study ρ00 for J/ψ and ϕ mesons, induced by the relative motion to a thermal background, within the soft-wall model. Spectral functions for J=ψ at T =150 MeV have significant resonance peaks, indicating that c–c¯ can exist as quasistable J/ψ mesons. However, no significant peaks for the ϕ meson are observed at the same temperature, implying that ϕ mesons are melting down at this temperature and spectral functions are interpreted as probabilities of unstable s–s¯ pairs. These pairs are related to free-streaming ϕ mesons by an instantaneous freeze-out assumption, which is performed by sandwiching the in-medium spectral function between the meson's free-streaming propagators. Then only states with invariant masses closing to the meson's vacuum mass survive during the freeze-out stage and contribute to final results. We show that ρ00 in the helicity frame for J/ψ and ϕ mesons have positive and negative deviations from 1=3 at T = 150 MeV, respectively, which consequently leads to different properties for their global spin alignments. In addition, we delve into the J/ψ meson's spectral function and spin parameters (λθ, λφ, λθφ) for different cases, assessing their response to variations in magnetic feld strength, momentum, and temperature.

Presenter(s) : ZHAO, Yan-Qing (HaiNan Normal University)

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