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Calculation of the Electric Conductivity of Hot Hadronic Matter

The determination of transport coefficients plays a central role in characterizing hot and dense nuclear matter. In the present work we calculate the electric conductivity of hot hadronic matter by extracting it from the rho-meson spectral function, as its zero-energy limit at vanishing momentum. Recent calculations of the electric conductivity in hot nuclear matter have been performed in different approaches but show significantly varying results.
Using hadronic many-body theory, we calculate the rho meson self-energy in a pion gas. Previously the effects of in medium nucleons and delta particles on the pion cloud of the rho propagator have been calculated. However the effects of thermal pions on the pion self-energies were not included. This requires the determination of the relevant interactions between in-medium pions and the rho meson, and the calculation of these interactions. This calculation requires the dressing of the pion propagators in the rho self-energy with pion-rho loops. To maintain gauge invariance one must calculate vertex corrections to the rho self-energy loops. Using guidance from previous works, we calculate these vertex corrections relativistically. The resulting spectral function is used to calculate the electric conductivity of hot hadronic matter. In particular, we analyze the transport peak of the spectral function and extract its behavior with temperature and coupling strength. Our results suggest that, while obeying lower bounds set by conformal field theories in the strong-coupling limit, the pion gas is a strongly coupled medium.

Preferred Track

New Theoretical Developments

Collaboration

Not applicable

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