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Electrical Cross-Conductivity in the Hadron Gas

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Inducing an electric field in the QCD medium generates an electric current which is proportional to the matter's electric conductivity. Since quarks and hadrons also carry baryon and strange charge, such a field also respectively produces a baryon and strangeness current whose amplitude depends on baryo-electric and strange-electric conductivities. We dub the combination of these 3 properties of matter the cross-conductivity and proceed to calculate it in the hadron gas phase at and below temperatures corresponding to the phase transition between the hadron gas and the quark-gluon plasma. We use the newly-released SMASH transport code to simulate the hadron gas and the Green-Kubo formalism to extract the transport coefficients. After validating the approach for a simple system for which analytical results can be calculated (namely, pions, kaons and protons interacting with constant cross-sections), we gradually increase the number of degrees of freedom, up to reaching a state-of-the-art hadronic resonance gas as described by our current knowledge. Our results show that there are significant differences in the temperature dependence of the different components of the cross-conductivity as a function of the number of degrees of freedom. This new observable can in principle be computed on the lattice, and as such could be used to further constrain the properties of the hadron gas in the low temperature region.

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