Contribution ID: **61** Type: **not specified**

Theoretical approaches to dilepton production: What can we learn about in-medium effects from model calculations?

Wednesday, 24 September 2014 17:00 (30 minutes)

Low-mass dilepton pairs from heavy-ion collisions are considered good probes for chiral symmetry restoration and the in-medium properties of vector mesons. However, the complexity of the different contributing sources is a challenge for theory; a satisfying description of dilepton production in heavy-ion collisions covering all energy ranges from SIS to LHC is yet to be found. Transport approaches (e.g. UrQMD and GiBUU) are successfully used to obtain a realistic microscopic description of the collision dynamics. However, such microscopic models usually do not include any in-medium effects and are limited to hadronic degrees of freedom. We present an alternative approach that uses coarse-grained output from transport calculations to extract local thermodynamic properties and determine thermal dilepton emission rates by application of in-medium spectral functions. A big advantage of this approach is the ability to cover all collision energies and the whole space-time evolution in a unified description. We analyze the results of our transport and coarse-graining calculations and compare them to experimental data. Special focus is set on recent HADES results and the future CBM experiment. Both approaches show that the baryonic coupling of the rho meson is crucial for the understanding of dilepton spectra, especially at high baryon densities as at SIS or FAIR energies.

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Session Classification: Talks