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Electromagnetic probes from SIS18 to LHC energies in coarse-grained transport simulations

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Electromagnetic radiation in heavy-ion collisions at SIS18, FAIR, SPS, RHIC and LHC energies is studied within an approach which uses coarse-grained transport simulations to calculate thermal dilepton and photon emission applying in-medium spectral functions from hadronic many-body theory and partonic production rates based on lattice calculations. The microscopic output from the Ultra-relativistic Quantum Molecular Dynamics (UrQMD) model is hereby put on a grid of space-time cells which allows to extract the local temperature and chemical potential in each cell via an equation of state. The comparison of data and model outcome shows that the invariant mass and transverse momentum spectra can be described by a cocktail of hadronic decay contributions together with thermal emission from broadened vector-meson spectral functions and (for higher collision energies) from the Quark-Gluon Plasma phase. Besides a comparison to existing experimental data, predictions for LHC energies are presented and it is analysed under which conditions one might observe signals of a phase transition at FAIR energies. We argue that the high luminosities available at the future Facility for Antiproton and Ion Research enable systematic studies of - e.g. - system size, energy and momentum dependence, which would allow for better constraints on existing models and a deeper insight into the structure of the QGP phase diagram.

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