Phases of QCD, Thermal Quasiparticles and Dilepton Radiation from a Fireball ◇

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We calculate dilepton production rates from a fireball adapted to the kinematical conditions realized in ultra-relativistic heavy ion collisions over a broad range of beam energies.

The freeze-out state of the fireball is fixed by hadronic observables. We use this information combined with the initial geometry of the collision region to follow the space-time evolution of the fireball. Assuming entropy conservation, its bulk thermodynamic properties can then be uniquely obtained once the equation of state (EoS) is specified.

The high-temperature (QGP) phase is modelled by a non-perturbative quasiparticle model that incorporates a phenomenological confinement description, adapted to lattice QCD results. For the hadronic phase, we interpolate the EoS into the region where a resonance gas approach seems applicable, keeping track of a possible overpopulation of the pion phase space. In this way, the fireball evolution is specified without reference to dilepton data, thus eliminating it as an adjustable parameter in the rate calculations. Dilepton emission in the QGP phase is then calculated within the quasiparticle model.

In the hadronic phase, both temperature and finite baryon density effects on the photon spectral function are incorporated. Existing dilepton data from CERES at 158 and 40 AGeV $Pb-Au$ collisions are well described, and a prediction for the PHENIX setup at RHIC for $\sqrt{s}=200$ AGeV is given.

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$\eta-\eta'$ Mixing in $U(3)$ Chiral Perturbation Theory ◇

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We investigate $\eta-\eta'$ mixing in infrared regularized $U(3)$ chiral perturbation theory by calculating the η and η' masses up to one-loop order. From this analysis it becomes obvious that even at leading order $\eta-\eta'$ mixing does not obey the usually assumed one-mixing angle scheme if large N_c counting rules are not employed.

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The $\eta'\to\eta\pi\pi$ Decay in $U(3)$ Chiral Perturbation Theory ◇

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The dominant decay mode of the η', $\eta'\to\eta\pi\pi$ is investigated within the framework of infrared regularized $U(3)$ chiral perturbation theory up to fourth chiral order and including one-loop corrections. We find reasonable agreement with experimental data and observe convergence of the chiral series.

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