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Unstable Hadrons in Hot Hadron Gas in Laboratory and in the Early Universe[1] INGA KUZNETSOVA, JOHANN RAFELSKI, Department of Physics, The University of Arizona — We study kinetic master equations for reactions involving the formation and the natural decay of unstable particles in a thermal expanding hadronic gas in the laboratory and in the early Universe. We consider here for the first time the role of the decay channel of one (hadron resonance) into two daughter particles, and also by token of detailed balance the inverse process, fusion of two (thermal) particles into one. We obtain the thermal invariant reaction rate using as an input the free space (vacuum) decay time and show the medium quantum effects on $\pi + \pi \leftrightarrow \rho$ reaction relaxation time. As another laboratory example we describe the K+K$\leftrightarrow \phi$ process in thermal expanding hadronic gas in heavy ions collisions. A particularly interesting application of our formalism is the $\pi^0 \leftrightarrow \gamma + \gamma$ process in the early Universe. We also explore the fate of charged pions and the muon freeze-out in the Universe. Another interesting field of application of our formalism is the study of short lived hadronic resonances, which are in general not able to reach yield equilibrium. We study the evolution of hadron resonances in small drops of QGP and use the insight gained to generalize the dynamics to QED effects as well.

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