Příloha C

Abstract

The thesis *Interaction of mesons in hadronic medium and related processes* deals with the behaviour and properties of mesons in a hot and dense hadronic medium such as created in the relativistic heavy ion collisions. Firstly, we generally discuss some properties of the particles which have a connection with the motion of the particles in the hadronic medium; concretely the rate, collision width, and mean free path. We derive general formulas for describing such properties. Secondly, we apply these formulas to particular processes.

There is an emphasis on multi-particle reactions in the whole thesis. Collisions among particles forming the hadronic medium are usually calculated as binary reactions. This approach does not need to be accurate in a case if one of colliding particles is a resonance. The resonance has to be assigned by fixed mass which can be in principle largely spread. This fact is usually described by spectral functions which are unfortunately model dependent. Therefore it is more realistic to include a process of the creation of the resonance in collisions of stable particles, e.g. such particles which are decay products of the resonance. This approach takes into account also additional interferences which are mostly ignored. Similarly if the resonance is a final particle. In an experiment the resonance is not observed but the energy and momentum of its decay products are measured. That is why it is suitable to include also the decay of the resonance in the theoretical description of the whole process. Generally it is proper to calculated that collisions with resonances as the multi-particle reactions. The binary reactions can serve as the first approximation in that cases.

Firstly, we calculate the mean collision width of ϕ meson induced by reactions $\phi K^* \to \pi K^*$, $\phi K^* \to \pi K \pi$, $\phi K \pi \to \pi K^*$, and $\phi K \pi \to \pi K \pi$. The mean collision width is ascending function of a temperature of the medium. The results of all reactions are similar except one case. The mean collision width of the reaction with three particles in the initial and final state is approximately 2.3 times higher than the others. It can signify that K^* resonance is not such narrow as it is treated. It would be probably more suitable to calculate the motion of ϕ meson instead in the thermalized gas consisting of particles K^* rather the gas consisting

of pseudoscalar kaons and pions which can interact among themselves and create resonance K^*.

Other calculated quantity is the collision width of pseudoscalar kaon with a given energy. Except the energy this collision width is also function of its invariant mass and the temperature of the medium where kaon is propagating. We took into account only collision widths from three binary reactions, namely $K\pi \to K\pi$, $KK \to \pi\pi$, and $KK \to KK$. The highest contribution comes from the first reaction. This width is increasing function of the invariant mass of kaon and also the temperature of the medium. This quantity can be utilized in the imaginary part of the kaon propagator. Because kaon is stable in the sense of the strong interaction this collision width can prevent calculations from divergences which can occur when exchanged virtual kaon is on the mass shell.

Finally, we investigate a production of dileptons by interactions of pions. The production of prompt dileptons and photons is for a long time considered a powerfull tool for investigating the properties of dense systems created in hadronic and nuclear collisions. The theoretical calculations of the dilepton and photon yield from hadron gas are hampered by not uniquely known Lagrangian of the $a_1\rho\pi$ interaction. That is why we focused our effort to specify this Lagrangian. We suggest one way how to relieve this problem and make the predictions of the dilepton and photon production from hadron gas more reliable. We calculate the excitation curve of the e^+e^- annihilation into four pions in a resonance model and compare it to the experimental data of the cross section. The dominant $a_1\pi$ contribution is described by means of a two-component $a_1\rho\pi$ Lagrangian. Its mixing parameter is determined by fitting the $\pi^+\pi^-\pi^+\pi^-$ channel, where the $a_1\pi$ contribution alone is able to describe the data well. In the $\pi^+\pi^-\pi^0\pi^0$ channel, the $\omega\pi$ intermediate states are necessary for getting a good fit. The newly proposed $h_1\pi$ contribution further improves it. Finally, a common fit to both channels is performed aiming at obtaining a more precise value of the mixing parameter of the $a_1\rho\pi$ Lagrangian.