Contribution ID: **104** Type: **Talk**

Gluon radiation by heavy quarks

Tuesday 23 July 2013 15:40 (20 minutes)

It is generally assumed that in ultrarelativistic heavy ion collisions a plasma of quarks and gluons is produced, and then quickly expands and hadronizes. The main objective of present experiments at ultrarelativistic heavy ion colliders is to study this plasma. The study of the plasma properties is difficult because the initial momentum distribution of the light quarks is not known and that before being detected the system passes the chiral/confinement phase transition in which hadrons are formed. Hadrons interact on the way to the detectors what modifies their spectrum. Therefore soft light hadrons do not carry information on the early stage of the plasma.

The situation is much better for heavy quarks (c and b) which are created in hard processes. Here perturbative QCD allows for the calculation of the production cross sections (in contradistinction to light quarks) and these cross sections have also been measured. Also the details of the chiral/confinement phase transition are less important than for light quarks because, due to its mass, the momentum of the heavy quark determines the momentum of the open charm hadrons. In addition, the momentum distribution at production and at the transition is very different from that expected if the heavy quarks are in thermal equilibrium with the plasma of light quarks and gluons. Therefore the modification of the initial momentum distribution by the interaction of the heavy quarks with the plasma carries information on the plasma properties.

The interaction of the heavy quark with the plasma has two parts, elastic collisions and radiative collisions. For the first a model was developped [1] in which the cross section of the elementary interactions are calculated by perturbative QCD with a running coupling constant and an infrared behavior adjusted so as to match hard thermal loop calculations. Embedding these cross sections in the hydrodynamical description of the expanding plasma of Heinz and Kolb it was shown that the collisional energy loss underpredicts the measured energy loss of heavy mesons at large momenta as well as their elliptic flow by roughly a factor of two.

It is the purpose of the present work to extend our pQCD calculation toward the calculation of the radiative energy loss. To this end we compute the gluon emission cross section of a heavy quark colliding a light parton from the plasma in pQCD at leading order. We first derive the high-energy approximation that naturally extends results obtained by Gunion and Bertsch for the light quark sector to heavy quarks. We next show that it is possible to compute the complete energy dependence of the result. This allows us to assess the range of applicability in energy of the high-energy approximation. The latter has the advantage of leading to very compact expressions for the various integrated cross sections and also of making more transparent the discussion of various physical phenomena. We discuss in particular the relevance of the dead cone effect.

[1] P.B. Gossiaux and J. Aichelin, Phys Rev C78, 014904 (2008)

Author: GOUSSET, Thierry (Subatech)

Presenter: GOUSSET, Thierry (Subatech)

Session Classification: Low Energy / Heavy Flavour