Λ_c enhancement from strongly coupled quark-gluon plasma

S. H. Lee,1 K. Ohinishi,1 S. Yasui,2 I. K. Yoo,3 and C. M. Ko

1Institute of Physics and Applied Physics, Yonsei University, Seoul 120-749, Korea
2Department of Physics, National Taiwan University, Taipei 10617, Taiwan
3Pusan National University, Pusan 609-735, Republic of Korea

Because of the strong attractive color-spin interaction between two quarks in the flavor anti-triplet and color anti-triplet channel, the [ud] diquark has played an important role in the structure of hadrons. Assuming that stable bound diquarks also exist in strongly coupled quark-gluon plasma that is produced in relativistic heavy ion collisions, we have studied their effects on the yield of Λ_c in these collisions [1]. Based on the quark coalescence model for hadron production from the quark-gluon plasma, we have calculated the contributions to Λ_c production from both the normal three-body coalescence of independent c, u and d quarks and the two-body coalescence of the c quark and the [ud] diquark. The resulting Λ_c to the D^0 yield ratio, which is the same in heavy ion collisions at the Relativistic Heavy Ion Collider (RHIC) and the Large Hadron Collider (LHC), is shown in Fig. 1 for different scenarios as a function of the temperature of the quark-gluon plasma. It is seen that the Λ_c/D^0 ratio at the critical temperature T_c = 0.175 GeV is about 0.11 without diquarks and increases to about 0.44 in the presence of the diquark [ud] with mass m_{[ud]} = 0.6 GeV (thin solid line), corresponding to a loosely bound state which can hardly exist near T_c. If the diquark mass has the minimum value m_{[ud]} = 0.455 GeV (bold solid line) due to the attractive color-spin interaction, the Λ_c/D^0 ratio becomes even larger and has a value of about

Figure 1. Yield ratio Λ_c/D^0 as a function of temperature.
Therefore, the diquarks in quark-gluon plasma raise the $\Lambda_c/D^0$ ratio by about a factor 4 - 8 in comparison with the case without diquarks. A similar enhancement is found for the $\Lambda_b/B^0$ ratio between bottom baryons and bottomed mesons. The study of $\Lambda_c/D^0$ and $\Lambda_b/B^0$ enhancements in relativistic heavy ion collisions would thus open a new way to find the existence of QGP in heavy ion collisions and also provide an experimental tool to probe the diquark correlation in quark-gluon plasma. This would, in turn, confirm the diquark structure in heavy baryons with a single heavy quark.