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Hidden-charm pentaquarks as a hadronic molecule coupled to compact multiquarks

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Accelerator experiments have reported the exotic hadrons that cannot be understood in the ordinary hadron picture, describing baryons as qqq and mesons as $q\bar{q}$. The experimental observations indicate that the exotic hadrons have multiquark structures such as a compact multiquark, e.g. $qq\bar{q}\bar{q}$ and $qqqq\bar{q}$, and a hadron composite state called hadronic molecule. There have been a lot of works by using an effective model, QCD sum rules, lattice QCD, experimental studies etc. However, the exotic hadron problem is still an open question.

In this work, we investigate the hidden-charm pentaquarks P_c and P_{cs}, reported by the LHCb collaboration recently. Interestingly, there masses appear near the meson-baryon thresholds, indicating that a main component of the pentaquarks is a hadronic molecule. On the other hand, a compact-state structure has also been discussed in literature, where structures of their internal degrees of freedom, namely color, flavor and spin, have been investigated. In this study, we employ the hybrid model considering the mixture of the hadronic molecule and compact state. The hadronic molecular component has been considered to dominate in exotic hadrons near thresholds. We discuss the role of the coupling to the compact state, which plays an important role to provide the strong attraction in the hadronic molecule. By employing the hybrid model, we compute energies of these exotics and also discuss roles of the interactions.

Autore principale: YAMAGUCHI, Yasuhiro

Coautore: GIACHINO, Alessandro; HOSAKA, Atsushi (RCNP, Osaka University); SANTOPINTO, Elena (Istituto Nazionale di Fisica Nucleare); Prof. TAKEUCHI, Sachiko (Japan College of Social Work); TAKIZAWA, Makoto (Showa Pharmaceutical University)

Relatore: YAMAGUCHI, Yasuhiro

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