Hadronic Physics Summer School 2016

5. Search for Exotic Hadrons

Since its establishment in 1970s', the quark model [1] has been a success to describe heavy quarkonium spectrum below the open flavour threshold. However, the observation of the $X(3872)$ in 2003 brings us to reconsider the existence of other color neutral objects which do not fit the conventional quark model but are allowed by Quantum chromodynamics (QCD). The existence of exotic hadrons has been confirmed by the later observations of $Z_c(3900)$, $Z_c(4040)$, $Y(4260)$, $Y(4360)$, and so on. Although many explanations are proposed to understand these exotic candidates, such as hadronic molecule, tetraquark, hybrid, hadro-charmonium or the mixing of them, their nature is still unclear. As most of them are in the heavy quarkonium sector, we can employ the heavy quark symmetry to probe their nature. In the heavy quark limit one can search for exotic states with the low-energy parameters extracted from the well-known channels [2, 3, 4] because the exotic states within the same multiplet share the same low-energy parameters. Based on the hadronic molecular picture, the authors of Refs. [3, 4, 5] extract the parameters from the $X(3872)$ state by assuming it is an S-wave iso-singlet $D\bar{D}^* + c.c.$ hadronic molecule. With the extracted parameters, they study the heavy quark spin partners of the $X(3872)$, especially the X_2 with $J^{PC} = 2^{++}$.

The observation of the isospin triplet partners of $X(3872)$, i.e. $Z_c(3900)$ and $Z_c(4040)$, in BESIII [6, 7], Belle and CLEOc indicates that the other partners could exist. **In this group, after a calculation of the properties of the X_2 from the theoretical side, we will estimate its production rate in the current experiments.**

References

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