

Multiquark Hadrons

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Earlier this year, the LHCb group [1] reported dramatic evidence for non-standard baryon states, *i.e.*, baryons with a substructure that is more complex than the textbook prescription that three quarks make a baryon. The signal is the peaking structure in the J/ψ - p invariant mass distribution produced in $\Lambda_b \rightarrow J/\psi K^- p$ decays shown in Fig. 1. The black points in the figure show the data and the red points show the results of a multi-dimensional amplitude analysis that includes a narrow state with $J^P = 5/2^+$ and mass around 4450 MeV (shown as a shaded blue histogram) and a wider state with $J^P = 3/2^-$ and mass near 4380 MeV (shaded magenta histogram). The LHCb group dubbed these states the $P_c(4380)$ and $P_c(4450)$. The presence of a J/ψ among the decay products and the non-zero baryon number guarantees that these states have a substructure of at least five quarks. This observation adds a new dimension to the previously reported spectrum of XYZ multiquark mesons.

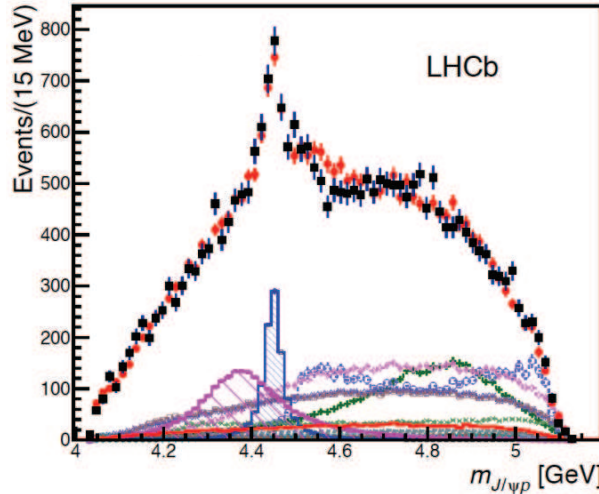


Figure 1: The J/ψ - p invariant mass distribution from $\Lambda_b \rightarrow J/\psi K^- p$ decays [1]. The black points are data from the LHCb experiment. The red points are results of a multidimensional amplitude fit that includes a $3/2^-$ resonance near 4380 MeV (magenta histogram) and a $5/2^+$ resonance near 4450 MeV (blue histogram). The other histograms show contributions from various $\Lambda^* \rightarrow K^- p$ resonances, none of which contribute peaks in the signal regions.

Another interesting recent result that may be related to multiquark hadrons in the strange sector, is a preliminary report from BESIII [2] of an anomalously large cross section for $e^+e^- \rightarrow \Lambda\bar{\Lambda}$ within ~ 1 MeV of the $\sqrt{s} = 2m_\Lambda$ threshold. This intriguing result suggests that something dramatic is happening in the six-quark $\Lambda\bar{\Lambda}$ system right at threshold, which is, in some ways, reminiscent of the $X(3872)$ meson, which is right at the $D^0\bar{D}^{*0}$ threshold.

In this talk, I will discuss these and some other recent experimental results related to the subject of non-standard, multiquark hadrons.

[1] R. Aaij *et al.* (LHCb Collab.), arXiv:1507.03414, to appear in Phys. Rev. Lett.

[2] C. Li *et al.* (BESIII Collab.), Poster at EPS-HEP2015, Vienna