Amplitude analysis and heavy-meson decays

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Decays of heavy mesons containing a b (or $\bar{b}$) quark are extremely interesting for a variety of reasons. Several experiments measuring these have been constructed mainly with the intention to study the breaking of matter–antimatter symmetry (or, more precisely, CP symmetry, the combination of charge conjugation C and parity P) in the weak interactions that govern these decays. CP violation is a prerequisite for the prevalence of matter over antimatter in the observed universe.

However, it has turned out that the same experiments can also yield fascinating insights into questions of hadron spectroscopy by closely investigating the decay products, which can be composed of light (u, d, s) or other heavy (c) quarks. Most hadronic states appear in the form of *resonances*, and to understand their properties requires a decomposition of reaction amplitudes into *partial waves*, as well as a detailed understanding of the *complex phase motion* of these partial waves. The theoretical tools required to perform such studies are collective referred to as *amplitude analysis* [1].

Decays of $\bar{B}^0_d$ ($b\bar{d}$) or $\bar{B}^0_s$ ($b\bar{s}$) mesons into a J/ψ ($c\bar{c}$) and a pair of pions have been measured in detail by the LHCb collaboration at CERN [2,3], as well as further interpreted theoretically [4]. The focus has been on the pion–pion final-state interaction and the resonances contained therein; but a further point of potential interest might be to search for new, *exotic* resonances that decay into $J/\psi\pi^\pm$ (as these cannot have a quark-model explanation as a simple quark–antiquark state). In this working group, we want to investigate the similar decays $\bar{B}^0_{d/s} \to \psi(2S)\pi^+\pi^-$ (compare Ref. [5]), and discuss the discovery potential in the data available from LHCb.

References

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