

# Perspective studies of charmonium, exotics and baryons with charm and strangeness

Monday, 5 June 2023 15:36 (22 minutes)

The spectroscopy of charmonium-like states together with the spectroscopy of charmed and strange baryons is discussed. It is a good testing tool for the theories of strong interactions, including: QCD in both the perturbative and non-perturbative regimes, LQCD, potential models and phenomenological models [1, 2, 3]. An understanding of the baryon spectrum is one of the primary goals of non-perturbative QCD. In the nucleon sector, where most of the experimental information is available, the agreement with quark model predictions is astonishingly small, and the situation is even worse in the strange and charmed baryon sector. The experiments with antiproton-proton annihilation and proton-proton (proton-nuclei) collisions are well suited for a comprehensive spectroscopy program, in particular, the spectroscopy of charmonium-like states and flavour baryons. Charmed and strange baryons can be produced abundantly in both processes, and their properties can be studied in detail [1, 2, 3].

For this purpose an elaborated analysis of charmonium and exotics spectrum together with spectrum of charmed and strange baryons is given. The recent experimental data from different collaborations (BaBar, Belle, BES, LHCb, ...) are analyzed. A special attention was given to the recently discovered XYZ-particles. The attempts of their possible interpretation are considered [4 - 7]. The results of physics simulation are obtained. Some of these states can be interpreted as higher lying charmonium and tetraquarks with a hidden charm [5, 6, 7] and strangeness [8, 9]. It has been shown that charge/neutral tetraquarks must have their neutral/charged partners with mass values which differ by few MeV. This hypothesis coincides with that proposed by Maiani and Polosa [10] and need confirmation nowadays. Many heavy baryons with charm and strangeness are expected to exist. But much more data on different decay modes are needed before firmer conclusions can be made. These data can be derived directly from the experiments using a high quality antiproton beam with  $\sqrt{s_{pp}}$  up to 5.5 GeV planned at FAIR and proton-proton (proton-nuclei) collisions with  $\sqrt{s_{pN}}$  up to 26 GeV planned at NICA.

## References

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**Session Classification:** Heavy baryon spectroscopy

**Track Classification:** Heavy baryon spectroscopy