Contribution ID : **164** Type : **parallel talk**

Search for baryonium and the physics of FAIR

Monday, 2 June 2014 18:10 (0:20)

Collaboration

Abstract content

The attempts to detect exotic states in nucleon-antinucleon system have a long unsuccessful history. However, several recently performed experiments allow to isolate specific partial waves and see certain structures. These experiments include anti-protonic atoms, J/ψ decays and nuclear absorption of antiprotons. One has a consistent evidence for a weakly bound and fairly broad S-wave quasi-bound state. We [1] argue that this state is seen in the J/ψ decays into a state named $X(1835)$ [2], and in the threshold enhancement in radiative decays to proton-antiproton system [3]. In this contribution we concentrate on a model for $J/\psi \to p\bar{p}, meson(\gamma)$. The assumption that mesons are formed in the final state emission from the baryons offer a consistent description of the rate and the spectra in cases of : π, ω, ϕ. It fails in the case of the radiative decay. One has to assume that the photon is emitted by quarks in the early stage of the decay. Next, the final state interactions of the nucleon and anti-nucleon pair generate two peaks observed by BES in the proton-antiproton invariant mass. One peak is due to a quasi-bound state (baryonium) while the other is due to shape resonance in this system. These decays are of interest for the FAIR project at GSI as they offer a doorway to the J/ψ formation in nuclei. Our model allows quantitative predictions.

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Session Classification : Parallel Session B4