Contribution ID: **16** Type: **Presence talk**

Ab initio description of antiproton-deuteron hydrogenic states

Monday 8 April 2024 17:10 (35 minutes)

Low-energy antiprotons are known to be promising tools to probe the nuclear structure [1]. In particular, the measurement of antiprotonic atom decays and nucleon-antinucleon annihilation products is expected to provide reliable data to study the tail of nuclear densities, which has motivated the antiProton Unstable Matter Annihilation (PUMA) project [2] at CERN. Although a qualitative picture of what will happen in the PUMA experiments is known, a fully microscopic treatment of the antiproton-nucleus systems remains to be developed. Our main aim is to solve the few-body Schrodinger equation for the cases accessible by ab initio methods. It is also of paramount importance to test the model-dependence of physical observables relative to the nucleon-nucleon and nucleon-antinucleon interactions input.

Optical potentials are traditionally used to account for the complex annihilation dynamics [3]. In the present work [4], we consider an alternative approach based on a coupled-channel potential, where the annihilation is modelled by the addition of effective meson channels [5]. The model-dependence is investigated by considering the microscopic calculation of the antiproton-deuteron annihilation: the scattering lengths and the resonance energies of the antiprotonic states are computed by solving the Faddeev equations in configuration space [6], and then compared to those obtained with optical models [7].

References

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Track Classification: Nuclear and Hadronic Physics with antiprotons and antineutrons