Meson Production in Antinucleon Annihilation on Nuclei

Stefanie Lourenço[(a)], Horst Lenske[(a)], Slawomir Wycech[(b)]

[(a)] Inst. f. Theoretische Physik,JLU Gießen,Heinrich-Buff-Ring 16,35392 Gießen,Germany
[(b)] National Center for Nuclear Studies, Hoza 69, 00-681, Warsaw, Poland

A central activity of the upcoming FAIR@GSI facility will be the use of antiprotons for a large variety of investigations at PANDA and other detectors like AIC [1]. The focus of the studies is on the one hand to understand antimatter-matter interactions and on the other hand to use antiproton beams for spectroscopic studies of hadrons. The aim of our work [2] is to understand antinucleon-nucleon ($\overline{N}N$) and antinucleon-nucleus ($\overline{N}A$) interactions theoretically. A consistent theoretical description for the reaction process is desired. This includes the initial state interactions, the particle production in the reaction stage and the final state interactions of the emitted mesons with the residual nucleus. For the initial state interactions we use the t-ρ approximation, by folding the $\overline{N}N$ t-matrix with microscopical densities taken from self-consistent Hartree-Fock-Bogoliubov (HFB) calculations [3]. To describe the $\overline{N}N$ t-matrix we follow established approaches, e.g. the Juelich-Bonn model [4] and the Paris model [5] accounting for $\overline{N}N$ elastic scattering by the G-parity transformed NN interactions and the strong dispersive contributions from the coupling to the annihilation channels. The final state meson-nucleus interactions are described with optical potentials such as [6]. Since they are required over wide energy ranges, we have extended the pion optical potentials by explicitly including nucleon resonances beyond the $\Delta(1232)$-resonance. Adopting this ansatz we presently focus on two meson production in the exit channel. The production amplitude is given by t-channel baryon-exchange diagrams and, for heavy resonances, by direct s-channel annihilation into intermediate vector or scalar mesons, subsequently decaying into two mesons [4]. We describe the production amplitude in a fully quantum mechanical eikonal distorted wave Born approximation (DWBA) approach by solving a Schroedinger equation with relativistic kinematics. Results for $\overline{N}A$ elastic scattering and πA elastic scattering, reaction cross sections and meson production on stable and neutron- or proton-rich exotic nuclei are presented. As an interesting mechanism for single meson production Pontecorvo-type reactions are discussed.

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E-mail: stefanie.lourenco@physik.uni-giessen.de