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Baryon-Meson Couplings using Partial Wave Analysis Techniques at the HADES Experiment

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The High Acceptance Di-lepton Spectrometer (HADES) at GSI plays a crucial role in exploring baryonic resonance characteristics and their mesonic decay channels. The pion-beam facility at GSI enables the direct formation of baryonic resonances at a fixed center of mass energy ($\sqrt{s}$) in the s-channel. This provides a distinct advantage over proton-induced reactions and complements photo-induced studies conducted at other facilities. Partial Wave Analysis (PWA) techniques are indispensable for unraveling the intricate coupling of these resonances to various final states, particularly those involving two and three pseudoscalar meson production. Elementary pion-induced reactions on the proton, coupled with rigorous PWA, will yield unprecedented insights into the couplings of baryonic resonances to ρN and ωN final states. Such studies are vital for shedding light on phenomena like the melting of the ρ meson in heavy-ion collisions and the role of intermediary vector mesons in dilepton emissions.\\

In anticipation of a more comprehensive exploration of the resonance regions in pion-nucleon and nucleon-nucleon collisions a modular Partial Wave Analysis software package is currently under development. This experiment-agnostic package implements advanced frameworks, including the K-Matrix and N/D methods, designed for a refined and robust mapping of these resonance regions. This development is particularly timely given the approval of significant pion beam time at the GSI facility for the upcoming years, specifically targeting the third resonance region. Furthermore, a proposed pion beam experiment at the J-PARC facility in Japan is anticipated to complement the pion beam experiments at HADES, underscoring the long-term importance and applicability of this versatile PWA framework.\\

We will present the current status of this software, showcasing illustrative fits of the HADES pion-proton reactions in the second resonance region, demonstrating its capabilities and the significant potential of this new analytical framework for the upcoming experimental campaigns.

Collaboration

HADES

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