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Studies of Baryon Transition Form Factors with HADES

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The High Acceptance Di-Electron Spectrometer (HADES) [1], installed at GSI/FAIR Helmholtzzentrum in Darmstadt, was designed for spectroscopy of positron-electron pairs in heavy-ion reactions in the SIS-18 energy range (1-2 GeV/nucleon). The main goal of this experiment is to study inclusive e+e- production in pion, proton and ion induced reactions at various energies to provide information on a radiation from baryonic matter. Various models predict that this radiation proceed via intermediate rho meson. The properties of the meson are strongly modified in the cold or hot dense nuclear matter due to vector meson-baryon couplings. These couplings can be directly studied in the resonance Dalitz decays R $\longrightarrow$ Ne+e-. Such decays provide also information on the electromagnetic baryon-resonance transition form factors (eTFF) in the time-like region.
The studies of the resonance Dalitz decays offer a great opportunity to study eTFF in a direct way. The HADES collaboration has measured the Delta(1232) Dalitz decay in p+p collisions [2] delivering, for the first time, the $\Delta \rightarrow$ pe+e- branching ratio. In the next step, using combined measurements of hadronic and dielectron final states in π-N collisions and Partial Wave Analysis (PWA) developed by the Bonn-Gatchina group [3], the contributions of N*(1440), N*(1520) and N*(1535) to two pion and dielectron final states have been studied. As a result cross sections for $\Delta\pi$, $N\rho$, $N\sigma$ isobar contributions have been extracted. In the dielectron channel the off-shell ρ meson contribution to the Dalitz decays of N*(1520) and N*(1535) have been obtained and allowed for extraction of the mass dependence of the effective time-like eTFF [4]. Studies of angular distributions of emitted electrons have provided an additional important information on hadronic spin density matrix elements [5]. The recent upgrade of the HADES detector [6] made possible to study also electromagnetic decays of hyperons. First measurements at HADES on both virtual and real photon decays, $Y \longrightarrow$ Ye+e- and $Y^* \longrightarrow Y\gamma$, have been performed in p+p collisions at 4.5 GeV [7].
The results of the HADES collaboration obtained with proton and pion beams will be presented. The eTFF will be compared to various versions of the Vector Dominance Model, to the quark-constituent model [8] and the effective Lagrangian model [5]. Prospects for HADES measurements at SIS-18 in the near future and in the further future at SIS-100 within the FAIR programme will also be discussed.

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