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HADES investigations of baryon-photon couplings in p - p and π - p reactions

Wednesday, September 15, 2021 6:00 PM (20 minutes)

Radiative transition of an excited baryon to a nucleon with emission of a virtual massive photon converting to dielectron pair ($R \rightarrow N e^+ e^-$ Dalitz decays) provides important information about baryon-photon coupling at low $q^2 = (m_{e^+ e^-})^2$ in time-like region. Enhancements in electromagnetic Transition Form-Factors ($eTFF$) at q^2 close to vector mesons (ρ/ω) poles have been predicted for $N(1520/1535)$ and $\Sigma(1232)$ by various calculations reflecting important role of pion cloud (see for example [1]). The understanding of these couplings is also of primary importance for interpretation of the emissivity of QCD matter studied in heavy ion collisions via dilepton emission [2]. Indeed, low mass dilepton distributions measured in Heavy ion collisions indicate the dominant role played by rho meson with the spectral function strongly modified by interactions with baryons in fireball. Understanding of the role played by vector mesons in $eTFF$ of baryons and in the emissivity of QCD matter plays prominent role in the physics programme of HADES experiment at GSI/FAIR.

The first measurements of the Σ^+ $\rightarrow p e^+ e^-$ and Dalitz decays of higher mass resonances in $p+p$ collisions have been already concluded [3, 4], confirming the important role played by ρ meson in baryon transitions. Those measurements were followed by studies of pion-proton reactions using secondary pion beam available at GSI. Two pion and ρ , for the first time, dielectron production in the second resonance region were studied. The two pion data have been analysed with Bonn-Gatchina PWA together with results of other experiments allowing for the separation of $N(1520/1535)$ resonance contributions and their various decay channels. In particular off-shell ρ meson contribution has been extracted providing important constraint for the interpretation of dielectron spectra measured in the same experiment. In the latter case electron angular distributions in the virtual photon rest frame have been analysed allowing for extraction of the hadronic spin density matrix elements as a function of virtual photon emission angle providing independent information about spin and parity of the involved resonances, as proposed in [6]. This presentation will summarize most important results obtained in proton and pion induced reactions. In the outlook HADES plans to extend studies of Baryon Dalitz decays to hyperons in $p+p$ collisions will be presented, too [7].

[1] G. Ramalho and M. T. Pena Phys. Rev. D 85, 113014

[2] P. Salabura and J. Stroth Prog.Part.Nucl.Phys. 120 (2021)

[3] J. Adamczewski-Musch et al. [HADES Collaboration], Eur.Phys.J. A53 (2017) no.9, 188

[4] J. Adamczewski-Musch et al. [HADES Collaboration], Phys. Rev. C 95 (2017) no.6, 065205

[5] J. Adamczewski-Musch et al. [HADES Collaboration], Phys.Rev.C 102 (2020) 2, 024001

[6] E. Speranza, M. Zetenyi, B. Friman PLB764(2017) 282

[7] J. Adamczewski-Musch et al. [HADES Collaboration] Eur.Phys.J.A 57 (2021) 4, 138

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