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Inclusive analysis of Σ(1385)+/- hyperons production and decay in 4,5 GeV p+p reactions in HADES

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The exact structure and inner workings of nucleons have been debated since the existence of quarks was first postulated. Since then, a large amount of experimental evidence has been gathered, indicating that nucleons and their excited states are not simple static quark states but are significantly influenced by the dynamics of baryon-meson interactions. In this context, it is interesting to extend studies from simple nucleons to particles where one light quark in a nucleon is replaced by a heavier strange quark, the so called hyperons, and their excited states such as for example Σ(1385), Λ(1520) or Λ(1405). There are many competing models which describe the internal structure of these hyperons, including those based on the dynamical state generation. In order to determine which of the models are the closest to nature, it is helpful to measure radiative decays (with emission of a photon or e+e- pairs) and hadronic decays, e.g. Λ(1520) ⟶ Σ+(1385) π-, Σ(1385)+/- ⟶ Λπ+/- or Λ(1405) ⟶ Σ π. These decay channels are largely unexplored at present, which is the motivation for the project presented in this talk.
The focus of the presented analysis is the inclusive study of the production and decay of Sigma Σ(1385)+/- hyperons produced in measurements of proton-proton reactions at beam energy of 4.5 GeV performed in the HADES experiment at FAIR in February 2022 [1]. This analysis allows for expansion on older studies based on measurements in lower energies, with much higher production cross-section, as well as incorporating new analysis methods, such as utilization of machine learning methods.

[1] J. Adamczewski-Musch et. al. (HADES Collaboration); Production and electromagnetic decay of hyperons: a feasibility study with HADES as a phase-0 experiment at FAIR; Eur. Phys. J. A (2021) 57: 138

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