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$\Lambda(1405)$ 'golden channel' measured in p+p at HADES

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The nature of the (1405) hyperon remains one of the longstanding open questions in hadron physics. Since its prediction and discovery in the 1960s, its structure is still widely debated. With a mass located below the KN threshold, it cannot be explained within the constituent quark model. Furthermore, its line shape deviates from a Breit–Wigner distribution and depends on the production and decay channels. Interpretations of (1405) include a quasi-bound state KN and a dynamically generated meson–baryon molecule with a two-pole structure.

The exclusive channel pK^+ $(1405) \rightarrow (\,^0(\rightarrow\ (\rightarrow \mathrm{p}\pi^-)\gamma)\pi^0(\rightarrow \gamma\gamma))$ has been investigated using the HADES detector in proton–proton collisions at a beam energy of 4.5 GeV. The reconstructed invariant mass spectrum of $^0\pi^0$ shows clear contributions from the (1405) and (1520) resonances, as well as an enhancement near the masses of (1600), $\Lambda(1670)$, and $\Lambda(1690)$. Production of these states has been studied in function of the four-momentum transfer between the initial proton and the outgoing K^+. The obtained $(1405) \rightarrow\ ^0\pi^0$ mass distribution can be analyzed together with the pK^- invariant mass distribution, which shows an enhancement near the KN threshold. Potential for this study using a K-matrix formalism within a coupled-channel model will also be presented.

Collaboration

HADES

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