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Investigating the Σ0 Production in p(3.5 GeV)+p Collisions

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Strangeness production at intermediate energies in p+p collisions is of particular importance to the field of hadron physics, since investigating the creation mechanism of strange baryons near threshold deepens our understating of its internal structure. This study presents the exclusive reconstruction of the p+p⟶p+K++Σ0 at beam energy 3.5 GeV with the HADES detector setup. The daughter Lambda hyperon Σ0⟶Λγ (BR ≈ 100 \%) was reconstructed with the decay mode Λ⟶pπ− (BR ≈ 63.9 \%) partly within the main HADES acceptance and partly within the forward wall acceptance. A kinematic refit was applied by constraining the secondary proton and the pion to the nominal Λ mass and the overall missing mass to the photon mass. In total, 2613 events were reconstructed and used to investigate the dynamics of the reaction p+p⟶p+K++Σ0 by studying the angular distributions in the CMS, Gottfried-Jackson and helicity frames. The acceptance corrected CMS distributions of the Σ0 and the proton show anisotropies. This is more pronounced in the case of the proton, which is the expected behavior if pion exchange dominates the Σ0 production process. In addition, the helicity angular distributions are far different from isotropy, which is a clear indication that there is a resonant component of the Σ0 production. In order to provide a better description of the experimental distributions, a partial wave analysis using Bo-Ga PWA has been performed. The Bo-Ga PWA determines the contribution of different non-resonant and resonant partial waves to the pK+Σ0 production. However, due to the poor statistics, it was not possible to obtain an exact contributions of nucleon resonances. Nevertheless, resonances with mass around 1.710 GeV/c2 (N∗(1710)) and 1.900 GeV/c2 (N∗(1900) or Δ∗(1900)) are certainly required by the PWA fit. The total production cross section of the Σ0 hyperon was obtained by integrating the yield for the different angular distributions and found to be σ=18.50±2.32(stat)±1.70(syst) μb. In addition, the ratio R(pK+Λ/pK+Σ0) was found to be 1.91 ± 0.35 in agreement with the general trend towards the high energy limit of 2.2, which has been determined experimentally for ϵ> 700 MeV.

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