

Establishment of a modern experimental technique of a Σp scattering experiment at J-PARC

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We are performing a scattering experiment between a Σ hyperon and a proton (J-PARC E40) at the K1.8 beamline in the J-PARC Hadron Hall. The purpose of this experiment is to investigate the ΣN interaction by measuring the differential cross sections of the $\Sigma^+ p$, $\Sigma^- p$ elastic scatterings and $\Sigma^- p \rightarrow \Lambda n$ inelastic scattering. The experimental data gives a strong constraint on the theoretical models of the ΣN interaction. The identification of Σp scattering event with a high statistics is important by overcoming the difficulties in the hyperon proton scattering experiment. We have introduced a new identification method of the Σp scattering event, which does not need to detect Σ particles directly. We used a new detector system called CATCH and two spectrometer systems installed at the upstream and the downstream of a liquid hydrogen target. A high intensity π beam of 20 M/spill was used to produce Σ particle. The momenta of π beam and scattered K^+ were measured by the spectrometers to reconstruct the momentum of a Σ beam produced via the $\pi p \rightarrow \Sigma K^+$ reactions. The scattering angle and the kinetic energy of recoil protons from the Σp scattering were measured by CATCH for the identification of the Σp scattering events by checking the kinematic consistency.

A part of the experiment was performed in 2018 and 2019 in J-PARC. As a result of analyzing the collected data, the Σ^- production and the $\Sigma^- p$ scattering reaction have been identified. It means that our new measurement and analysis method are successfully working well. Analysis for deriving the differential cross section of the Σp scattering is on going.