

High statistics Σp scattering experiment using high intensity pion beams at J-PARC

K. MIWA¹, J.K. AHN⁸, Y. AKAZAWA¹, S. CALLIER⁹, N. CHIGA¹, P. EVTOUKHOVITCH¹⁰, S. HASEGAWA², S. HAYAKAWA⁵, T. HAYAKAWA⁵, K. HOSOMI², R. HONDA⁵, S.H. HWANG², M. IEIRI³, M. IKEDA¹, K. IMAI², S. ISHIMOTO³, W.S. JUNG⁸, H. KANDA¹, K. KOBAYASHI⁵, T. KOIKE¹, Y. KONDO², S.H. KIM⁸, J.L. KIM⁸, J.W. LEE⁸, Y. MATSUMOTO¹, M. MORITSU⁵, Y. NAKADA⁵, M. NAKAGAWA⁵, I. NAKAMURA³, M. NARUKI⁴, Y. OGURA¹, L. RAUX⁹, A. SAKAGUCHI⁵, H. SAKO², Y. SASAKI¹, S. SATO², T. SHIOZAKI¹, K. SHIROTOMI⁶, H. SUGIMURA², S. SUZUKI³, C.d.L. TAILLE⁹, H. TAKAHASHI³, T. TAKAHASHI³, T.N. TAKAHASHI⁶, H. TAMURA¹, M. TANAKA³, K. TANIDA², Z. TSAMALADZE¹⁰, M. UKAI¹, H. UMETSU¹, T.O. YAMAMOTO¹, K. YOSHIMURA⁷

¹*Department of Physics, Tohoku University, Japan*

²*Japan Atomic Energy Agency (JAEA), Japan*

³*High Energy Accelerator Research Organization (KEK), Japan*

⁴*Department of Physics, Kyoto University, Japan*

⁵*Department of Physics, Osaka University, Japan*

⁶*Research Center for Nuclear Physics (RCNP), Japan*

⁷*Department of Physics, Okayama University, Japan*

⁸*Department of Physics, Korea University, Korea*

⁹*OMEGA, IN2P3/CNRS - Ecole Polytechnique, France*

¹⁰*Joint Institute for Nuclear Research, Russia*

E-mail: miwa9@lambda.phys.tohoku.ac.jp

(Received December 15, 2015)

In order to test theoretical frameworks of the Baryon-Baryon (BB) interactions and to confirm the “Pauli effect between quarks” for the first time, we have proposed an experiment (J-PARC E40) to measure low-energy hyperon-proton scattering cross sections of the $\Sigma^+ p$, $\Sigma^- p$ elastic scatterings and the $\Sigma^- p \rightarrow \Lambda n$ inelastic scattering in the momentum range of $400 < p$ (MeV/c) < 700 in the laboratory system. Experimentally, we detect two successive reactions of the Σ production ($\pi^\pm p \rightarrow K^\pm \Sigma^\pm$) and the Σp scattering ($\Sigma p \rightarrow \Sigma p$) in the same liquid hydrogen target. The former is measured with two magnetic spectrometers, and the latter with a scattered proton detector (CATCH). By using a high intensity π beam, we estimate that more than 10,000 scattering events can be identified. In this experiment, we aim to provide good quality scattering data to test the theoretical models of the BB interaction.

KEYWORDS: Hyperon proton scattering, ΣN interaction

1. Introduction

The important motivation of the study of the Baryon-Baryon (BB) interaction is to investigate rich aspects of new multiplets which appear under the flavor SU(3) symmetry. The BB interactions between two octet baryons are labeled by the irreducible flavor multiplets as

$$\mathbf{8} \otimes \mathbf{8} = \mathbf{27} \oplus \mathbf{8}_s \oplus \mathbf{1} \oplus \mathbf{10}^* \oplus \mathbf{10} \oplus \mathbf{8}_a. \quad (1)$$

Four multiplets, that is, $\mathbf{8}_s$, $\mathbf{10}$, $\mathbf{8}_a$ and $\mathbf{1}$, which appear under the flavor SU(3) symmetry, are expected to show a variety of features and interesting phenomena at the short-range region in the theoretical