

Studies of spin-dependent interactions in hyperon-proton scattering [E452] with a newly developed track-detector SCITIC [T485, T498, T511].

In order to study the hyperon-nucleon spin-orbit interactions, a new track detector named SCITIC (scintillating track image camera) has been developed, and asymmetries of the polarized Σ^+ elastic scattering on protons have been measured.

The polarized hyperons, Σ^+ and Λ , were produced through the $p(\pi^+, K^+)$ reactions at $p_\pi = 1.6$ GeV/c in a liquid-scintillator active target, and tracks of the hyperon scattering events were recorded with the SCITIC (Fig.1(a)) [1]. The track image in the liquid scintillator was focussed on a photocathode of an image intensifier (IIT) through an optical lens system, and after multiplications of the photoelectrons in 4-stages of IIT, the picture was recorded with a CCD camera. Two or three sets of SCITICs were used to take pictures from different angles to reproduce a three-dimensional event pattern (Fig.1(b),(c)). The hyperon-scattering events were selectively stored with trigger signals from a spectrometer indicating the kaons. Roughly, 800,000 pictures have been accumulated, and about 1/10 of them have so far been analyzed.

Results of the analyses are summarized in Fig.2. Major motivation of the present experiment [E452] was to compare the effects of spin-orbit interactions on the left/right asymmetry $(N_L - N_R)/(N_L + N_R)$ in the elastic scattering of polarized Σ^+ and Λ hyperons. The Σ^+ hyperon was known to be polarized as large as 0.8 from previous experiments[2] as shown in Fig.2(a). The polarization of Λ determined from the present analysis was also large (Fig.2(c)). Data on the left/right asymmetries for both Σ^+p - and Λp -scatterings are shown in Fig.2(b) and (d), respectively. Results from a reanalysis of the E289 data are also included.

Although analyses of 10-times more data with more sophisticated data-taking systems and more elaborated analyzing tools are under way, data from the early stage of this experiment indicated a large Σ^+p spin-orbit interaction in contrast to the case of the Λp .

The smallness of ΛN spin-orbit interaction has been indicated in the old Λ -hypernuclear experiment by the Heidelberg-Saclay collaboration at CERN in 1978[3], and confirmed by recent experiments at KEK and BNL with better precision. Based on a naive quark-model picture, H. Pirner[4] has pointed out that, in contrast to the ΛN system, the spin-orbit interaction must be large in the ΣN system ($V_{LS}^{\Lambda N} \simeq 0$, $V_{LS}^{\Sigma N} = \frac{4}{3}V_{LS}^{NN}$). K. Yazaki[5] has also indicated a possible large spin-orbit interaction for the ΣN system, while the ΛN LS-interaction is small due to cancellation between anti-symmetric and symmetric LS-terms. The present results support these theoretical suggestions.

References

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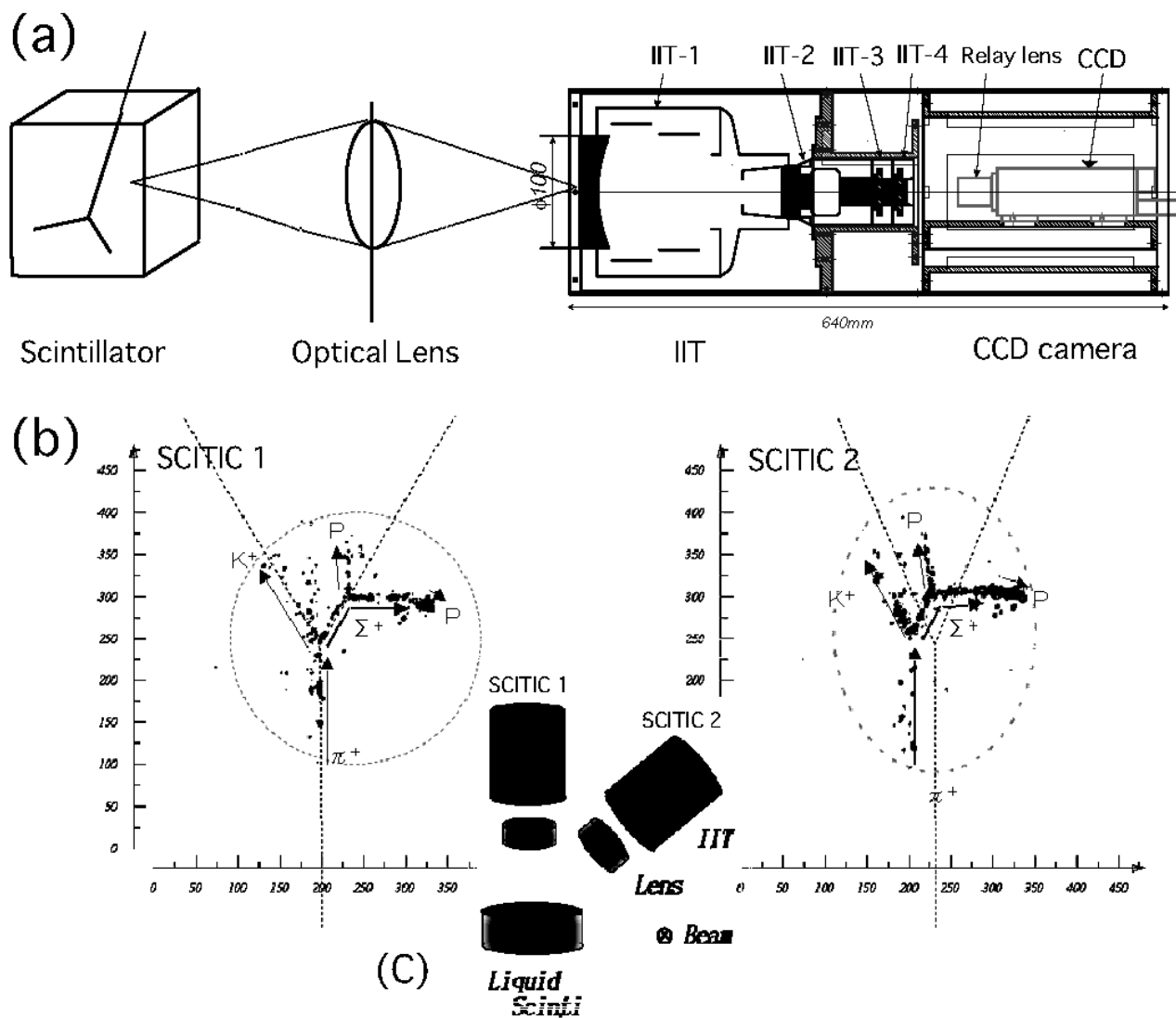


Figure 1: (a) Schematic illustration of SCITIC. (b) Typical pictures of hyperon scattering seen by two sets of SCITIC arranged as shown in (c).

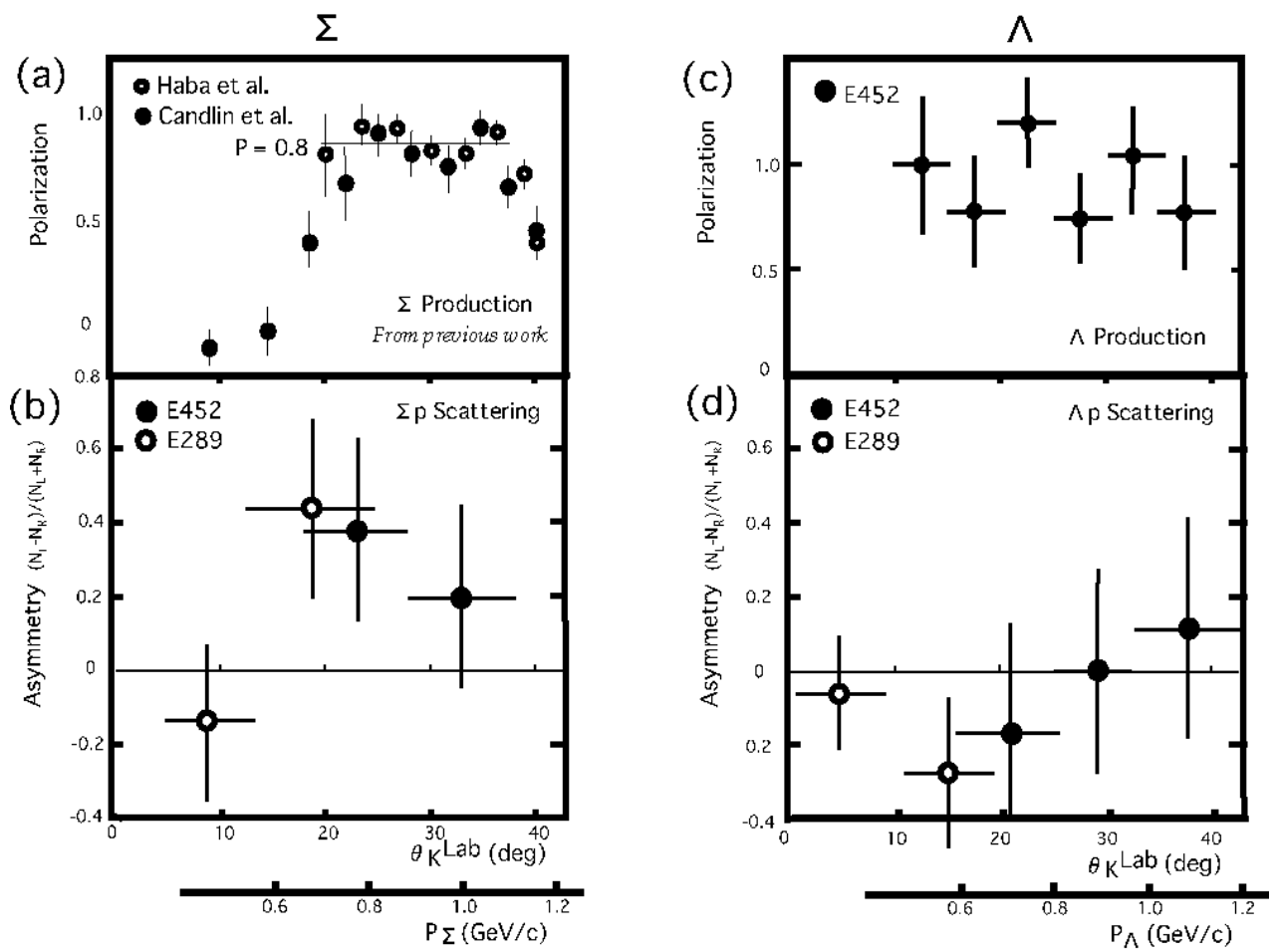


Figure 2: Hyperon polarizations following the (π^+, K^+) reactions[2], and asymmetries of the polarized hyperon scattering on protons: (a) Σ^+ and (b) Λ .