Study of Double Strangeness Nuclei by Hybrid-Emulsion Method (KEK-PS E373)

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Our group has been performing the KEK-PS E373 experiment to search for nuclei which include two units of strangeness(S=-2). In the previous experiment(KEK-PS E176), the existence of double-Λ hypernuclei which are stable against the strong decay was confirmed[1]. The observation of the double hypernucleus provided the lower limit for the mass of the stable H-dibaryon, which was predicted as a 6-quark state by Jaffe in 1977[2]. However, because there remained two kinds of interpretation of nuclide, it is still unknown whether $\Lambda - \Lambda$ interaction is attractive or repulsive. In E373, we will search the double-strangeness nuclei such as double-Λ hypernuclei, Ξ^- hypernuclei and H-dibaryon at the stopping point of Ξ^- with ten times more statistics than in E176.

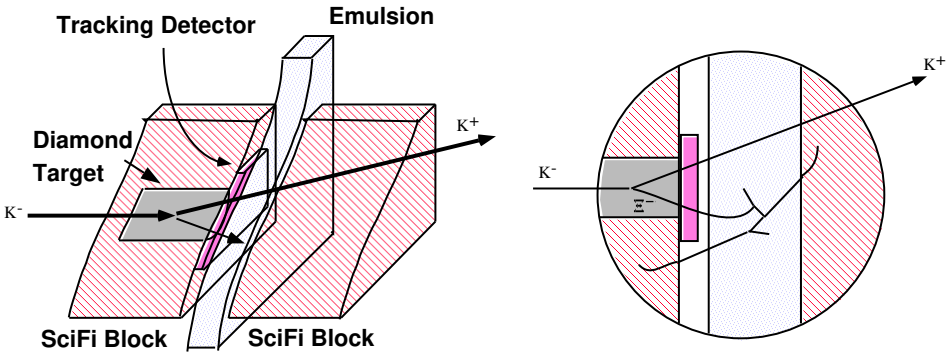

Figure 1: Schematic view of the target region.

Fig.1 shows a schematic view of the target area and fig.2 shows a layout of the experimental set up.

The 1.67GeV/c K^- beam induces a $'p'(K^-, K^+)\Xi^-$ quasi-free reaction in the diamond target. The produced Ξ^- is slowed, stopped in a nuclear emulsion and expected to produce a double-strangeness nucleus with some probability. We have developed a high resolution tracking detector using scintillating micro fibers(Fiber-Bundle) to measure the position and the angle of the Ξ^-[3]. In a test experiment using proton beam, the angles of the tracks were determined with an r.m.s precision of 25mrad and the positions were determined with an r.m.s precision of 74μm with this very thin detector of about 4mm thickness. Fast protons and π^-s from the weak decay of double-hypernuclei are detected by the range counter of scintillating mono-fiber blocks(SciFi-Blocks) located on both sides of the emulsion stack. The SciFi-blocks are also used to determine the vertex point of (K^-, K^+) reaction and to identify the decay of Ξ^-s.

In 1998, 45 stacks of emulsion plates made from about 30 liters of nuclear emulsion were exposed with the beam. Fig.3 shows the preliminary results of the analysis of the data obtained

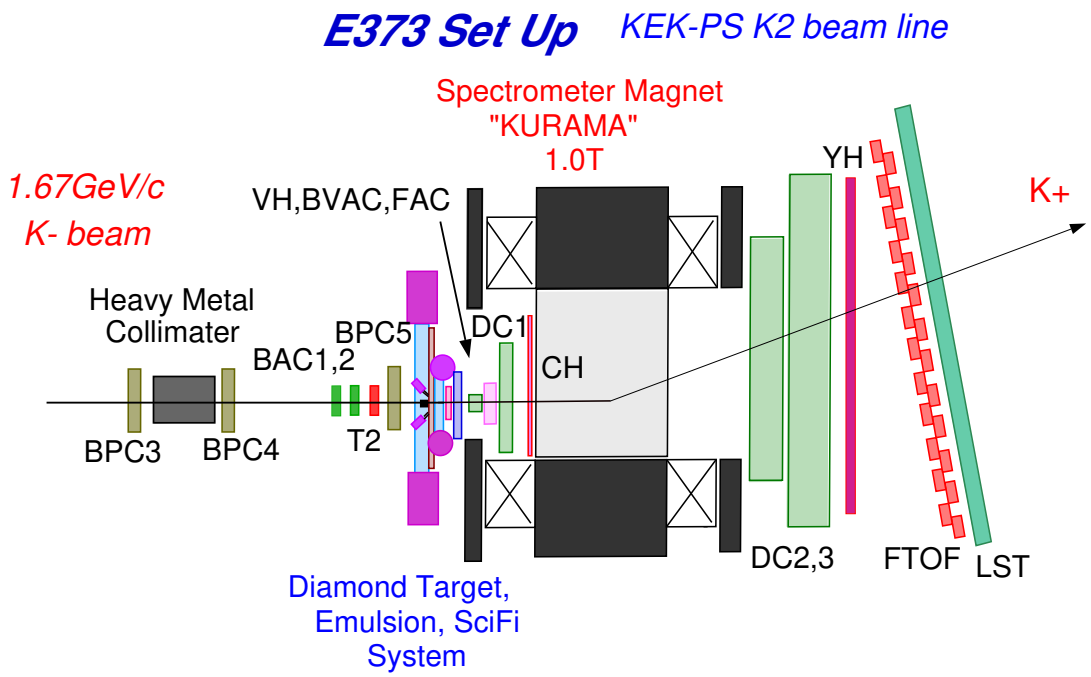

Figure 2: experimental set up

with the spectrometer for the 14 emulsion stacks. In fig.3(a), K^+s are clearly distinguished from protons and πs. For these data, 14,530 (K^-, K^+) events were obtained. From this result, about 47,000 (K^-, K^+) events are expected for 45 stacks.

The image scanning is being done for the events identified as the (K^-, K^+) reaction. The events which show the topology of

- no thick track in the Fiber-Bundle image,
- wrong vertex position,
- the decay of Ξ^-

are rejected by the image scanning. Fig.4 shows an example of the production and the decay of a Ξ^-. This is the reconstructed image obtained with the upstream SciFi-block. It was found that about 25% of the (K^-, K^+) events survive this rejection. The image of Fiber-Bundle detector of these events is being analyzed and the corresponding track will be scanned in the emulsion.

We expect that several hundreds of the stopped Ξ^- events will be found in the 45 emulsion stacks. It is scheduled that about 50 stacks will be exposed in 1999. We hope that tens of double-hyper nuclei will be identified in this experiment.

References

[1] S.Aoki *et al.*, Prog.Theor.Phys. 85 (1991) 1287.

[2] R.L.Jaffe, Phys.Rev.Lett. 38 (1977) 195.

[3] A.Ichikawa *et al.*, Nucl. Instr. and Meth. *in press*

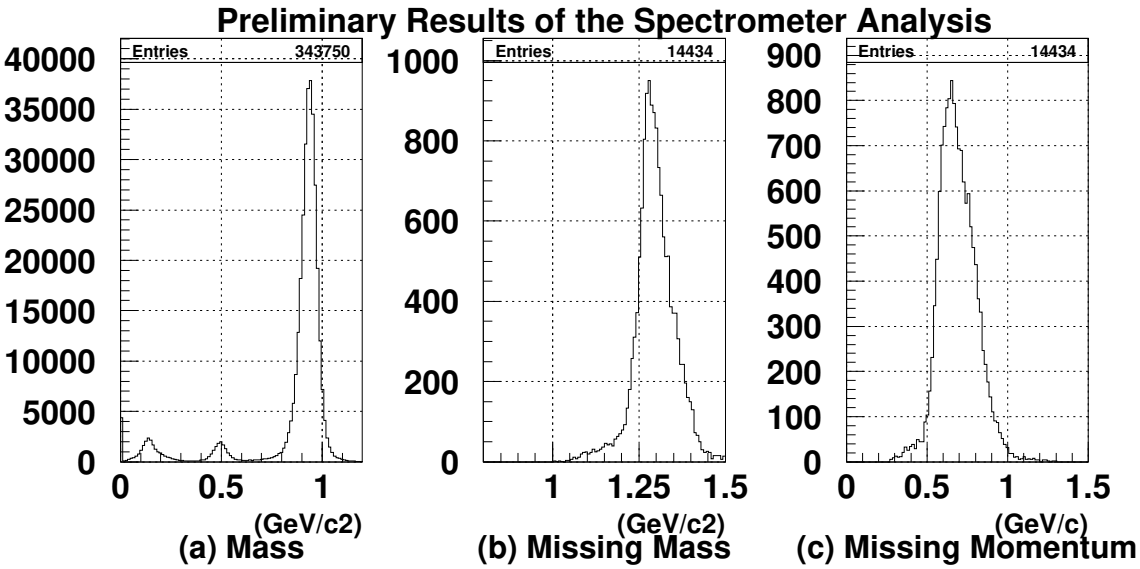

Figure 3: Preliminary results of the spectrometer analysis of the data for the 8 emulsion stacks. (a)Reconstructed mass distribution of the scattered particles. (b)Missing mass distribution of (K^-, K^+) events. (c)Missing momentum distribution of (K^-, K^+) events.

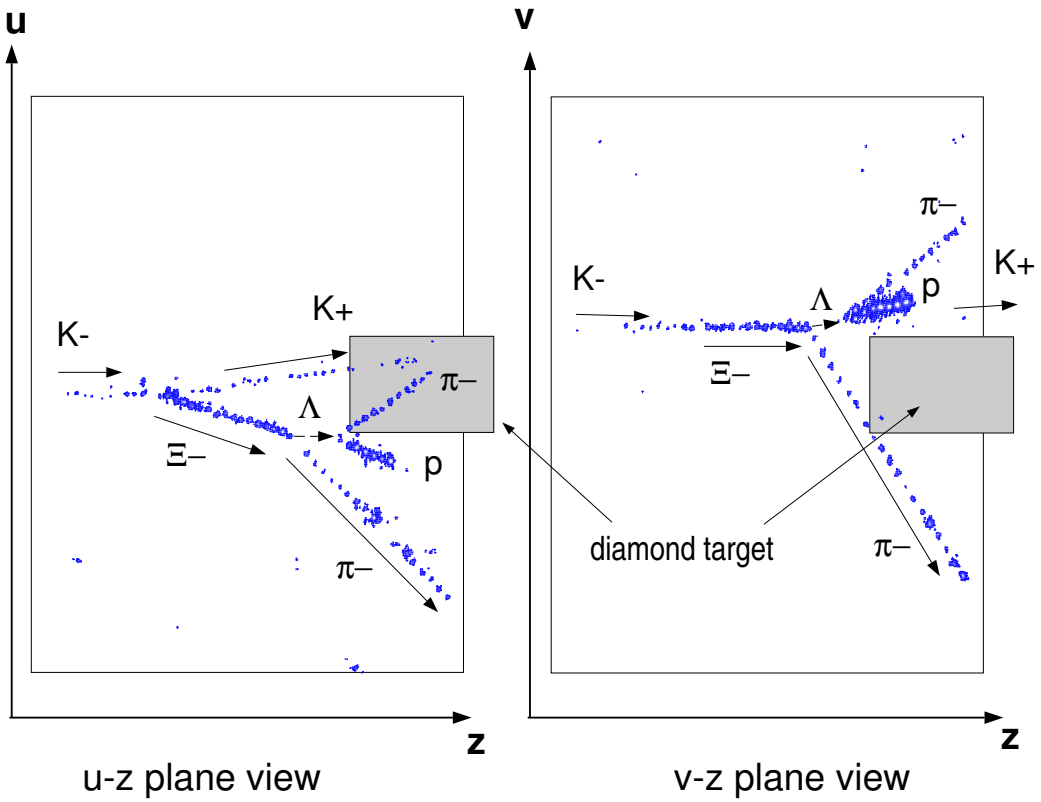

Figure 4: The reconstructed image of the production and the decay of a Ξ^- obtained with the upstream SciFi-Block.