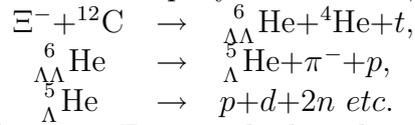


# Study of $S = -2$ Nuclear System by Emulsion and Scintillating Fiber Hybrid Method (PS-E373)

In the E373 experiment, about 40% of the data have been analyzed.

Among them, we have found two events with sequential decay topology of double- $\Lambda$  hypernucleus. The second "NAGARA" event ( formation and decay of a  ${}_{\Lambda\Lambda}^6\text{He}$  nucleus ) has confirmed attractive  $\Lambda\Lambda$  interaction by its energy of  $1.01 \pm 0.20 {}^{+0.18}_{-0.11}$  MeV, recently[1]. The nuclide and its decay mode have been uniquely identified as;



The event is shown in Fig.1 with the schematic drawing. This findings brought the 7th publication prize of JPS into the paper, "Direct observation of sequential weak decay of a double hypernucleus" [2], presented by KEK-E176.

The second event of twin single- $\Lambda$  hypernuclei event was found with the most clear topology in the world as shown in Fig.2. The events of this kind shall be expected to give us binding energy of  $\Xi^-$  in nucleus. Unfortunately, the event was not reconstructed uniquely, because the track (#5) escaped from emulsion stack and was not recorded in the fiber-block detector. However, the interpretations are understood as;

1.  $\Xi^- + {}^{12}\text{C} \rightarrow {}_{\Lambda}^7\text{Li} + {}_{\Lambda}^6\text{He}$   
 $B_{\Xi^-} = 1.6 \pm 0.3$  MeV ( $0.9 \pm 0.3$ , if  ${}_{\Lambda}^7\text{Li}$  is produced in the excited state.)
2.  $\Xi^- + {}^{12}\text{C} \rightarrow {}_{\Lambda}^7\text{Li} + {}_{\Lambda}^5\text{He} + n$   
 $B_{\Xi^-} = 1.1 \pm 0.4$  MeV ( $0.4 \pm 0.4$ , if  ${}_{\Lambda}^7\text{Li}$  is produced in the excited state.)
3.  $\Xi^- + {}^{14}\text{N} \rightarrow {}_{\Lambda}^9\text{Be} + {}_{\Lambda}^5\text{He} + n$   
 $B_{\Xi^-} = 10.0 \pm 1.0$  MeV ( $6.9 \pm 1.0$ , if  ${}_{\Lambda}^9\text{Be}$  is produced in the excited state.)

## References

- [1] H. Takahashi *et al.*, Phys. Rev. Lett. **87**, (2001) 212502.  
 [2] S. Aoki *et al.*, Prog. Theor. Phys. **85**, (1991) 1287.

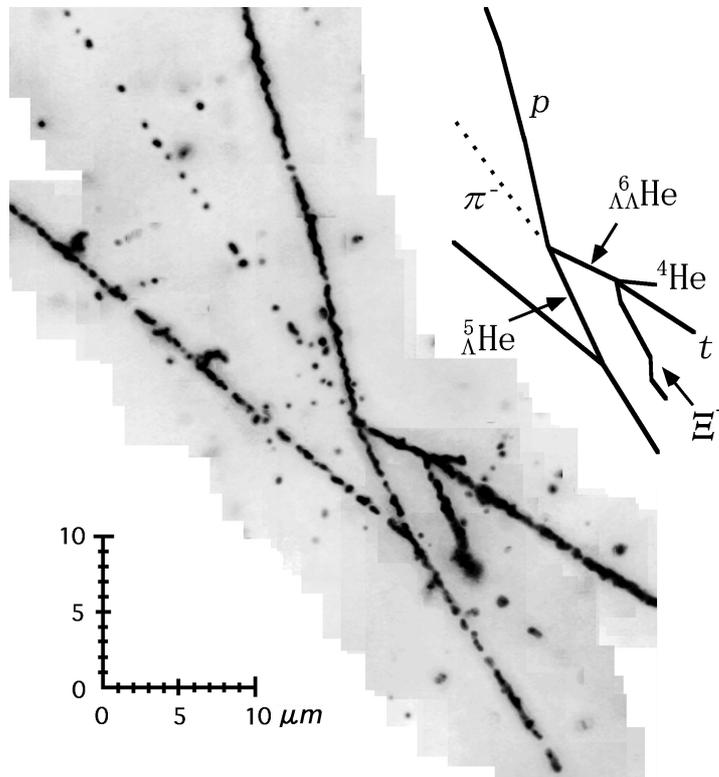


Figure 1. An emulsion image of  ${}^6_{\Lambda\Lambda}\text{He}$  double- $\Lambda$  hypernucleus (*Lambda*) with its schematic drawing.

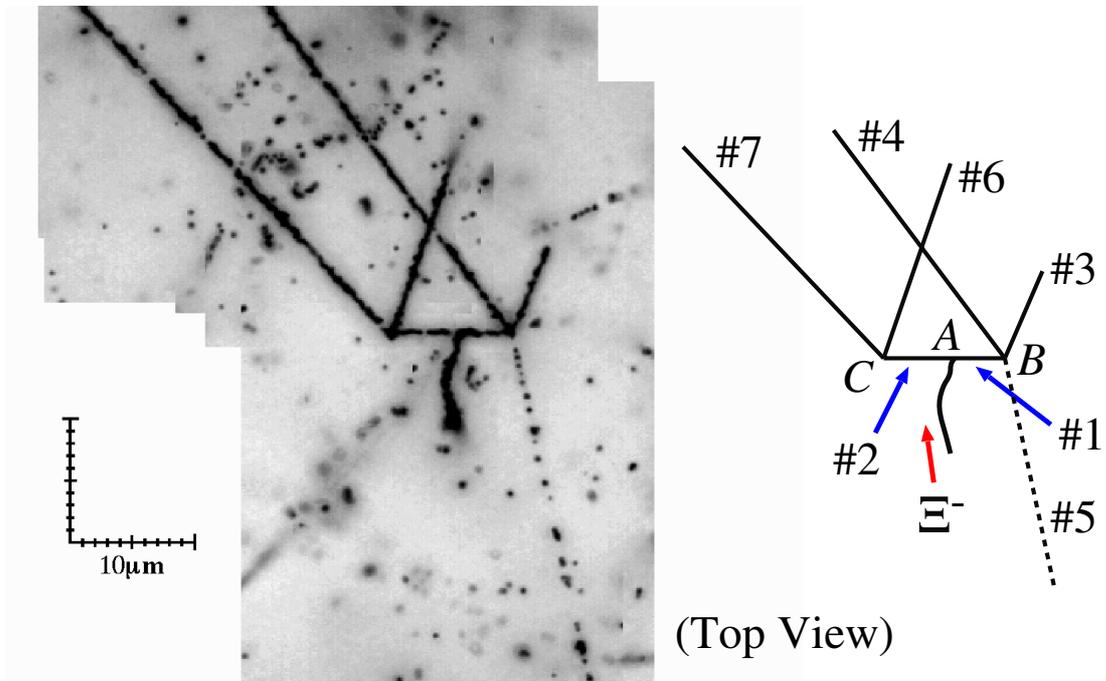


Figure 2. An emulsion image of the second twin single- $\Lambda$  hypernuclei event and its schematic drawing.