

The Alignment Method of The Emulsion Plates for Ξ^- Hyperon Tracking on J-PARC E07

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In the J-PARC E07 experiment, we will search for double Λ hypernuclei. Double Λ hypernuclei are produced via capture reaction of Ξ^- hyperons in nuclear emulsion sheet. Tracks of Ξ^- hyperons are followed with a newly developed automated track following system. A technique for position alignment of adjacent emulsion sheets has been developed by using pattern matching of beam tracks within $1\mu\text{m}$ at 10^{-5} error rate.

KEYWORDS: J-PARC E07 experiment, Double Λ hypernuclei, Emulsion, Automatic tracking, Beam pattern matching

1. Introduction

In the J-PARC E07 experiment, it is planned to detect double Λ hypernuclei with 10 times higher statistics than the previous experiment, KEK-PS E373. Double Λ hypernuclei are produced via capture reaction of Ξ^- hyperons by nuclei in nuclear emulsion, where the Ξ^- hyperons are produced by quasi-free ‘p’(K^-, K^+) Ξ^- reaction in a diamond target located upstream of the emulsion sheets. To avoid time-consuming job by human, candidate tracks of Ξ^- hyperons can be followed with a newly developed automated tracking system.

An emulsion stack consists of 12 emulsion plates with 0.5mm thick emulsion coated on both sides of a thin polystyrene film. For the success of the automated tracking of Ξ^- hyperons, accurate plate-by-plate alignment of the emulsion plats is an essential task.

2. Parameter Tuning of Beam Pattern Matching

2.1 Required Conditions for Pattern Matching

Technique of precise plate-by-plate position alignment has been developed with pattern matching of beam tracks which were recorded in emulsion plates. When there are more than 100 spots of the beams in one view of microscope ($110\times130\ \mu\text{m}^2$), it determines successful connection of the track satisfying the following three conditions. First, it is required that all the 740 test samples of track connection must be correctly connected. Second, in J-PARC E07 it is necessary that the probability of mistaken track