

E384

PROPOSAL FOR EXPERIMENT AT RCNP

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TITLE:

High-rate beam tests of beam-line trackers and a three-dimensional event reconstruction tracker for J-PARC hadron experiments

SPOKESPERSON:

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EXPERIMENTAL GROUP:

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RUNNING TIME: Installation time without beam 3 days
 Beam and detector tuning time 1 day
 Data runs 3 days

BEAM LINE: Ring : WS course, NS course, or N0 course (to be decided later)

BEAM REQUIREMENTS: Type of particle $^1\text{H}^+$
 Beam energy 400 MeV
 Beam intensity ≤ 0.1 nA
 energy resolution ≤ 1 MeV
 beam profile ~ 30 mm ϕ FWHM

BUDGET: Experimental expenses 1600 thousand yen

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SUMMARY OF THE PROPOSAL

Currently, the beam rate of the K1.8 beam line at J-PARC is limited only to $\sim 10^6$ per spill to operate tracking detectors stably. With the advent of a 0.75 MW full-intensity J-PARC operation, secondary pion beam intensities up to 10^8 counts per second (cps) can be expected. It is highly desirable for beam tracking in such a high rate environment. To meet this demand, we JAEA/Seoul/Tohoku group have been developing a new high-rate tracking system with a Time Projection Chamber (TPC), Silicon Strip Detectors (SSD's), and scintillation fiber trackers.

The TPC is a central tracking device for a proposed experiment to search for the H-dibaryon at J-PARC. It is equipped with a gating grid and GEM's (Gas Electron Multiplier) for particle tracking under high-rate conditions. Intrinsic tracking performance has been already confirmed with electron and positron beams up to 10^5 at Research Center for Electron Photon Science, Tohoku University in Jan. 2011. SSD's and scintillating fiber trackers have been developed as high-rate beam trackers. We are planning to replace current beam-line tracking chambers with the scintillating fiber trackers at the J-PARC K1.8 beam line.

We propose a test experiment of a prototype TPC, SSD's and prototype scintillating fiber trackers, and a drift chamber with proton beams. The TPC will be placed in the central position. A fiber tracker and two SSD's will be placed upstream of the TPC, and another set of a fiber tracker and two SSD's will be installed also downstream of the TPC. SSD's define reference track positions for the TPC and fiber trackers. Track distortion of the TPC due to space charge of positive ions will be evaluated in details at the beam rates from 10^5 to 10^8 cps. Full acceptance four SSD's system will be read out with zero-suppression. Prototypes of the scintillating fiber trackers will be constructed in this fall and the first beam test will be performed. Furthermore, we will place a target in front of the TPC to simulate realistic experimental conditions, where we measure tracks scattered from the target at the same time with high rate beams. In addition, we will test a drift chamber for K^+ reconstruction, which will also accept K^- beams up to 10^6 cps at J-PARC.