J-PARC 50 GeV Proton Synchrotron

J-PARC E15
June 6, 2008

MEMORANDUM

J-PARC E15 status report

The J-PARC E15 collaboration

Abstract

This memorandum provides a status report on Cylindrical Detector System (CDS) for J-PARC E15, with particular emphasis on the evolution of the experiment over the last year. Construction of CDS detectors are almost on schedule. All the construction work of major component of the CDS will be completed by end of summer 2008 and detector commissioning at J-PARC site is planned around July-August 2008 and continued by end of March/2009. We expect all detector components will be ready by April 2009.

1 Cylindrical Detector System

1.1 Cylindrical Drift Chamber

1.1.1 Mechanics

One of the main detector for the E15/E17 experiment is the Cylindrical Drift Chamber(CDC). Construction of the CDC has been completed in mid-March/2008. Figure 1 shows the picture of CDC which is now stored at KEK. Once test facility at J-PARC (Tokai) has been ready to use, we will move CDC to J-PARC for full system test which is now scheduled in mid to end of June/2008.

Figure 1: Picture of the CDC

1.1.2 H.V. distribution board

Normally, H.V. for a CDC will be supplied by daisy chain from the feedthrough connector using wires. However, the CDC for E15/E17, we are testing the use of a printed circuit board (PCB) to feed the H.V. for field wires. Figure 2 shows the 1st prototype HV distribution board. Prototype HV connector

Figure 2: H.V. distribution board prototype connected on CDC prototype for test

board were tested with CDC prototype and no problems are found. Therefore we fabricated HV distribution board for all CDC wires. Figure 3 shows real CDC HV distribution board fabricated and Figure 4 CDC equipped with full HV distribution boards.

Figure 3: H.V. distribution boards

1.1.3 Signal collection board

Because technology chosen for the HV distribution has been succeeded with custom pin socket and normal PCB, we decided to use same way to collect signals from chamber to Pre-Amplifier card. Prototype Signal collection board has been delivered which is shown in Figure 5.

1.1.4 Pre-Amplifier card prototype

One of the requirement for the pre-Amplifier card is compactness of the card itself. Picture of prototype pre-Amplifier card is shown in Figure 6. The size of the pre-amplifier card is designed as 70 mm in width and 37 mm length.

16 analogue signals from sense wire will be processed to digital signal on the card. Newly developed Amplifier-Shaper-Discriminator (ASD) chip by designed KEK will be used for this card.

The test of prototype pre-Amplifier card with prototype CDC is now in progress. Figure 7 shows prototype preAmp card on CDC prototype

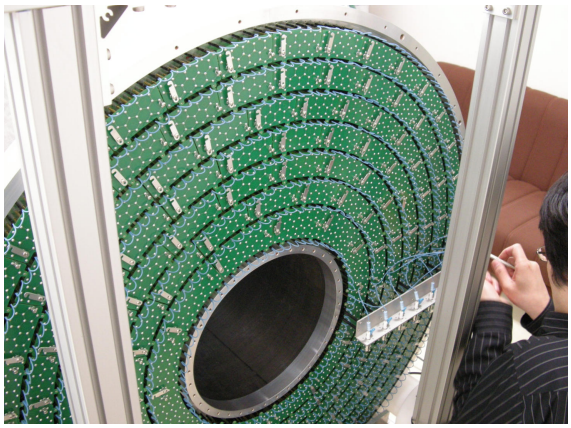

Figure 4: H.V. distribution boards on CDC

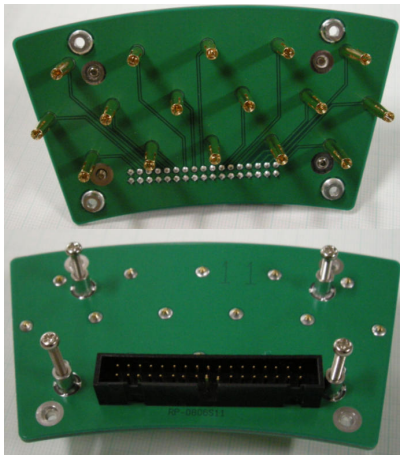

Figure 5: Prototype signal collection board for CDC

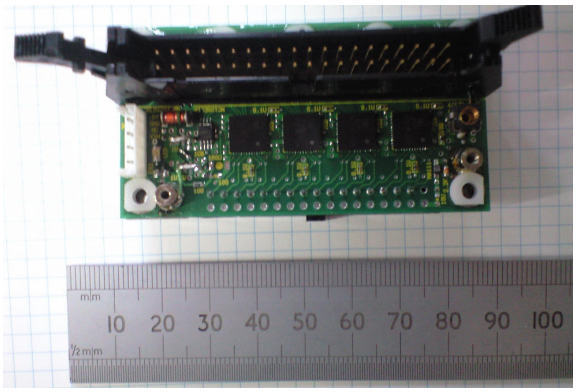

Figure 6: Prototype Pre-Amplifier card

and Figure 8 shows the snap shot of the test, the graduate student fighting against pre-amplifier to reduce noise level.

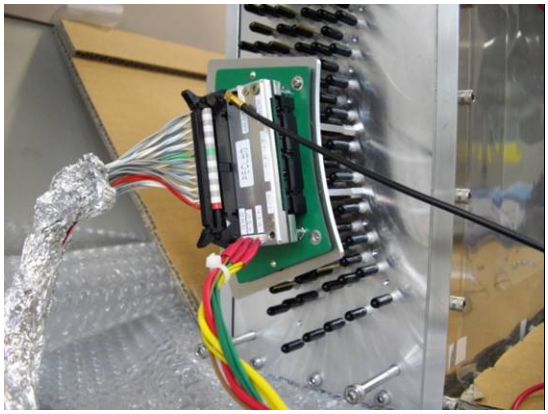

Figure 7: Prototype pre-amplifier card on CDC

Test is performed with β ray from $^{9}0$Sr. We placed two thin scintllator on top and bottom of the CDC prototype. Events are taken with the coincidence of the two scintillators. Figure 9 show typical event display together with x-t function of the CDC which is reconstructed from the data. To extract efficiency for the CDC prototype, we are now taking data with cosmic ray. Results will be available soon.

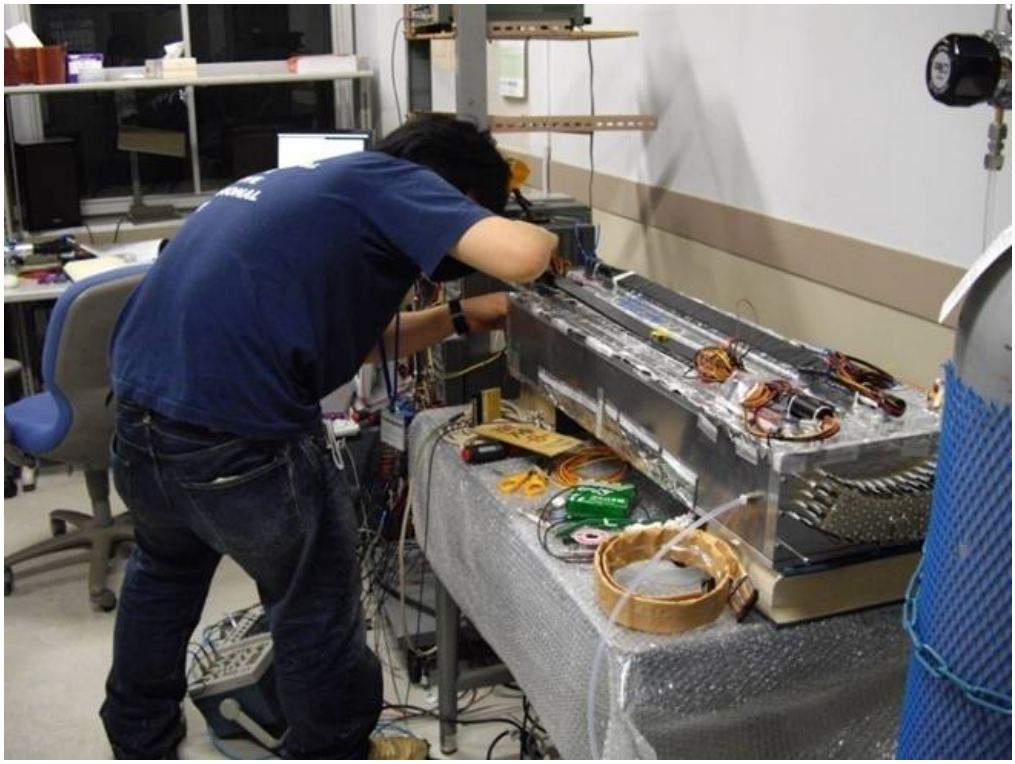

Figure 8: Snap shot of the pre-amplifier card test at test bench.

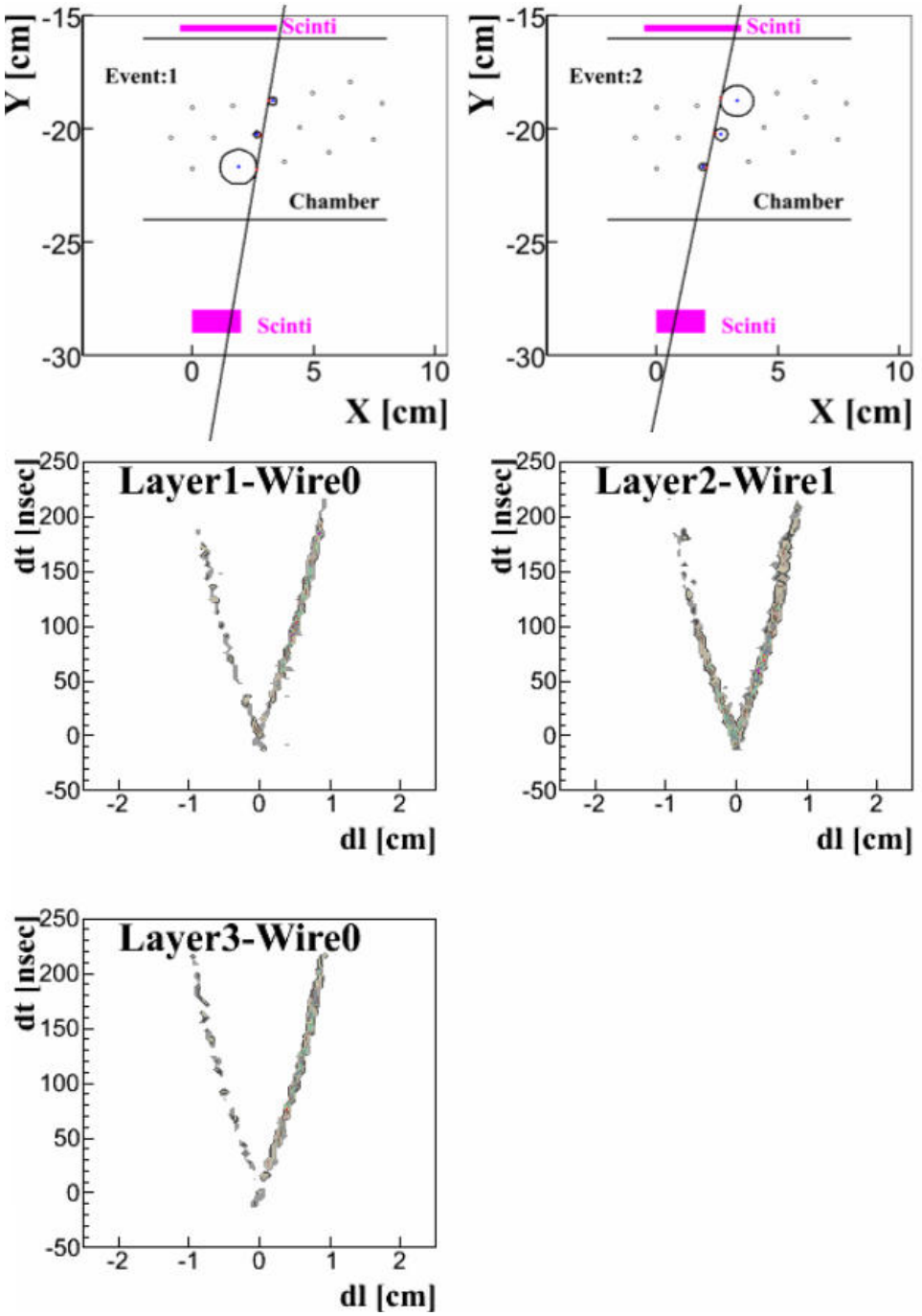

Figure 9: event display and x-t function of CDC prototype with pre-amplifier card which is taken at test bench

1.2 Cylindrical Detector Hodoscope

The main purpose for the Cylindrical Detector Hodoscope (CDH) is to produce the charged particle trigger around target region for data taking. In addition, by offline analysis, the CDH system will be used to measure the time of flight (TOF) of charged particles together with the Start Counter system. Particle identification will be performed with the TOF information together with a flight length and a momentum given by the track fitting from the CDC. The minimum transverse momentum to reach the CDH counters is about 50 MeV/c, and the expected K and p separations with 200ps TOF resolution are up to 400MeV/c and 800MeV/c, respectively. The CDH system is located at a radius of 544mm from the target system covering a polar angle range from 54 to 126 degrees. The CDH system consists of 36 modules, and these modules are individually mounted on the inner wall of the solenoid magnet Figure 10. The scintillators are made of Bicron BC408, whose dimensions are 790mm in length, 99mm in width and 30mm in thickness. Hamamatsu type R7761 fine-mesh photomultipliers, with a 1.5 inch diameter and 19 dynode stages, were selected. They are operated under the magnetic field of 0.5T, with a typical gain of $3x10^6$. The design of the CDH system is substantially complete, and we have made test modules to check performance of the CDH system and matching between the CDH modules and other detectors, at RIKEN Wako campus as shown in Figure 11.

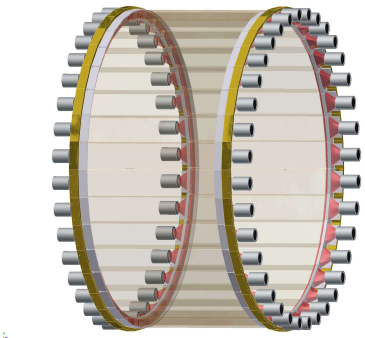

Figure 10: conceptual design of CDH

Figure 11: test modules of CDH with dummy solenoid magnet

Status of the preparation for the CDH construction is as follows. All fine-mesh PMTs has been ordered and delivered. In total, we already have 75 PMTs in our hand. The test to check gain for each PMT is now in

progress. Figure 12 shows setup for the PMT test at test bench. The design

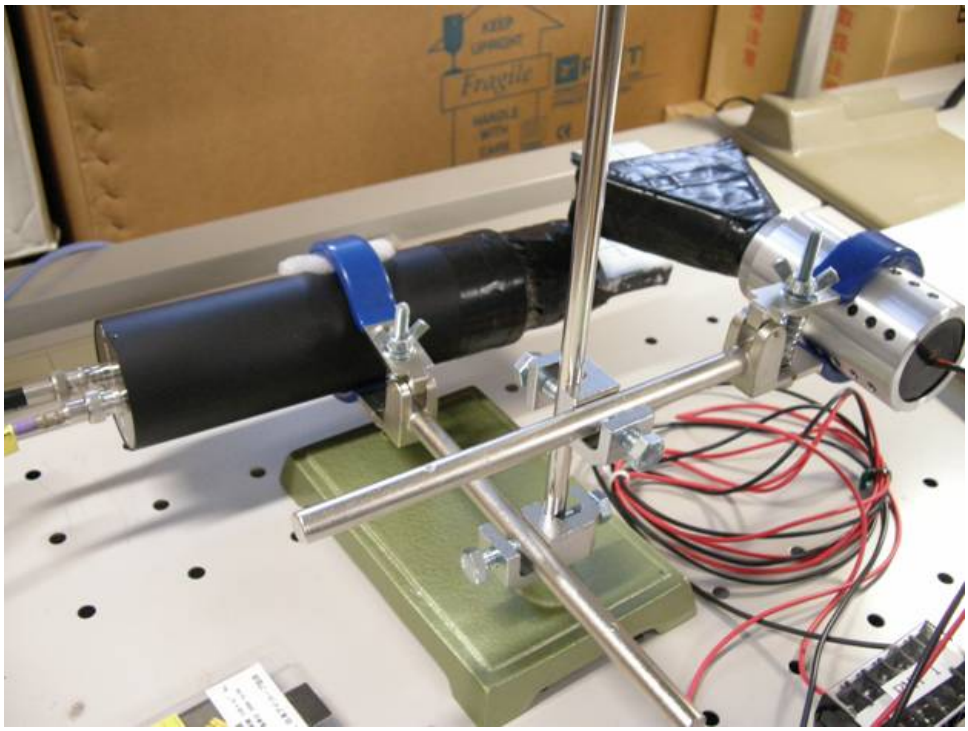

Figure 12: Test setup for CDH PMTs

of the CDH support structure is also on going. Figure 13 shows prototype CDH module in solenoid magnet. Now the fixing structure is on the final design state.

2 schedule

The detector construction and commissioning schedule is shown in Figure 14. The blue bar shows project proceed on KEK site, and the red bar shows project proceed on J-PARC site.

3 Summary

The design work for the cylindrical detector system (CDS) for E15 experiment is almost completed. Construction work of the real detector element

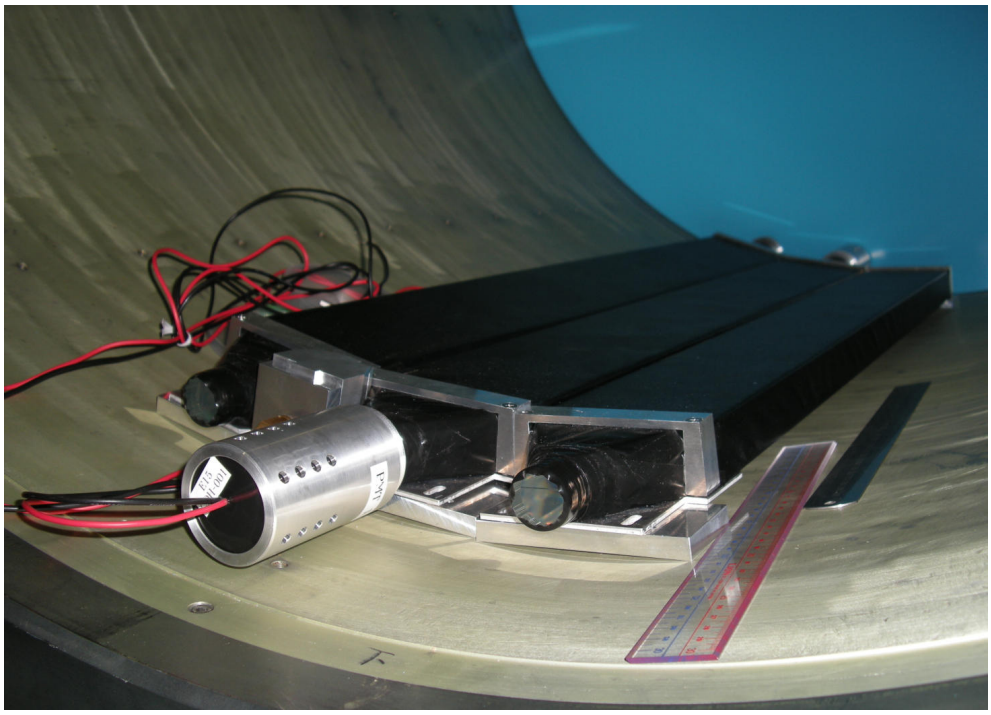

Figure 13: Prototype CDH modules in Solenoid magnet

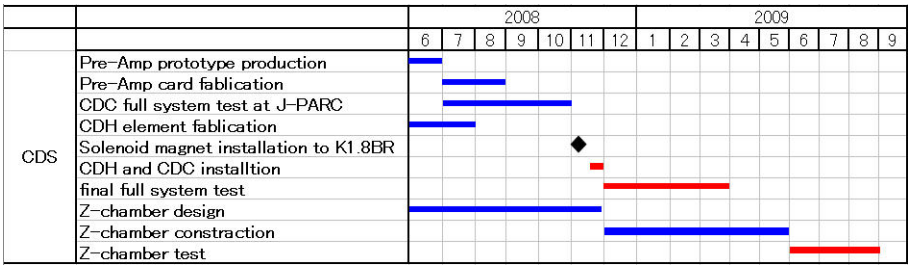

Figure 14: Detector construction and commissioning schedule

is now in progress. All detector components will be installed in solenoid magnet and ready for the experiment by April/2009.