J-PARC Status after the Earthquake on 2011 March 11

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ABSTRACT

Japan Proton Accelerator Research Complex (J-PARC) is the brand new accelerator complex in Japan. J-PARC consists of three stages of accelerators, the proton linear accelerator (LINAC) of 181 MeV, the rapid-cycle 3 GeV proton synchrotron (RCS), and the main 50 GeV Proton Synchrotron (50 GeV-PS). The design beam intensity of 50 GeV-PS is 15 μA, i.e., a beam power of 750 kW. This high-power primary proton beam will intensively produce rare secondary and tertiary particles such as kaons, pions, antiprotons and neutrinos in order to facilitate progress in nuclear and particle physics.

Now construction of J-PARC was completed and the beam was accelerated by 50 GeV-PS up to 30 GeV, which is project’s first goal. The first slow beam was extracted to the Hadron Experimental Hall in January 2009 and the first fast beam was delivered to T2K experiment in April 2009. Beam power for T2K increased gradually and has reached 145 kW in March 2011. Beam power of slow beam was limited up to 5 kW by the beam loss at the extraction devices from 50 GeV-PS. However, very good extraction efficiency of 99.6% has been achieved after the stimulated beam study and the first high beam power operation of several tens kW was scheduled in April 2011.

At 2:46pm on March 11 in 2011, Tohoku Region Pacific Coast Earthquake hit J-PARC. Approximately 40 minutes later, tsunami of a height of about 4m and the maximum run-up of about 6m attacked the shore of the J-PARC site. Fortunately tsunami did not flow into J-PARC site thanks to geographical features around the J-PARC. Finally it was found that no one was injured by the earthquake and tsunami at the J-PARC site. In addition, no radiation problem happened in J-PARC.

After the earthquake, we could perform the first inspection throughout the J-PARC facilities on March 17. Then we found, fortunately, there was almost no obvious structural damage in the accelerators and experimental facilities due to many underpins underneath the buildings. However, all roads around the buildings and the utilities such as water pump stations and electric transformer yards had severe damages. After those inspections and urgent rescue actions for facilities, we could start regular recovery works of our J-PARC facilities. Japanese Government supported us strongly, too.

After some detailed inspections of our accelerator and experimental facilities, we found that all the magnets and related beam devices such as beam monitors slipped off in the range of mm to cm from their appropriate positions. These are relatively small troubles but number of devices which should be restored is so big. Therefore we needed long time for re-alignment of all the devices slipped off. Now, as you may know, we have completed the rebuilding of our experimental facilities by the end of 2011 and J-PARC accelerator complex started the beam acceleration at the same time. Experimental programs have already re-started in January 2012. We aim to perform full 9 cycles (200 days) operation for users in 2012.

Even during the hard work days for J-PARC recovery, our scientific motivation to bring new physics results is still continuing. Experimental data accumulated before the earthquake have been analyzed intensively. The first good indication of new physics has come from T2K collaboration. We found that 88 neutrino events were detected by the Super-Kamiokande, i.e. the far detector of T2K experiment. Among them, six candidate events were cleanly identifiable as electron neutrino interactions. In the current T2K experiment, possible background for electron neutrino event is simulated to be approximately 1.5. Then the probability of the existence of electron neutrino appearance is estimated to be 99.3%, suggesting the appearance of electron neutrinos for the first time. The other interesting result came from E19 experiment at Hadron Experimental Hall. Experiment to produce pentaquark Θ⁺ by strong interaction has been performed via p(π−,Κ−) reaction. Unfortunately no significant peak indicating Θ⁺ production was seen. However possible structure of Θ⁺ is strongly limited by this E19 result.

In the Varenna2012 Conference, new physics outputs from J-PARC will be presented as well as the recovery story of J-PARC.