A scientist's report on the earthquake and KEK's accelerator test facility

The earthquake takes its toll on one of KEK's hallmark experiments

A huge 9.0-magnitude earthquake descended on us at about 14:46 on 11 March 2011 Japan standard time. The ATF (accelerator test facility) was operating for ATF2 beam-tuning and we were going to have a background study for the interaction point beam size monitor. Some of us, including me, were working in the electronics hut of the beam size monitor. Another of us was at the electronics of the LLR (Laboratoire Leprince-Ringuet at CNRS/IN2P3 in France) background study. All were in the assembly hall. We heard a huge sound, which filled the hall, and experienced large lateral movements as if we were on air for several minutes! The ceiling crane ran away and power cables fell down from the ceiling. The cables prevented us from exiting through the front door. We could exit from a side door. Our other colleagues in the ATF control room had evacuated the building already and were situated outside the assembly area. No one was injured either at ATF or at KEK.

On the afternoon of 14 March, we inspected the inside of the concrete shields with flashlights in the dark to quickly evaluate the damage and make an estimate of the recovery time. Our conclusion could not be perfect because it was only a flashlight inspection.

First, we inspected the linear accelerator from the radiofrequency gun to the beam transport line. A bellows and a beam pipe were broken just upstream of the last accelerator tube; the upstream part (the steering and quadrupole magnets) was displaced to the north. Several bellows are slightly damaged at other accelerator tubes. The area around the radiofrequency gun seems fine. The damage is not serious, but the parts need replacement and realignment.

Next, we inspected the beam transport line and the north part of the damping ring. They seem to be in good shape, except for possible damage at the ceramic chamber of the SLAC kicker.

Then, we entered the extraction and ATF2 beam line. All the quadrupole magnets were sitting on the movers, which reassured us very much. They were tied to the support with two wires, which help create an earthquake-proof structure. One of the wires was cut at almost all the quadrupole magnets. The setup worked as expected! No magnets had fallen down. The other instruments looked fine, including wire scanners, optical transition radiation instruments, and the Shintake monitor with lead shields.

So, the whole beam line seems to have suffered little damage. However, the waveguides from the pulse compressor to the acceleration tubes may be deformed since there is no bellows to absorb external force. Also, realignment is needed for all of the beam line from the radiofrequency gun to the ATF2 beam dump.

When we looked at the concrete shields, we observed evidence of the fierce earthquake. The concrete blocks were displaced about a few centimetres from south to north at several places. The biggest displacement is one at the interaction point region — the concrete block was displaced about five centimetres since it sits on shims made of stainless steel, which is slippery.

The primary damage to ATF, with fallen cable racks and cables. It will require about a month to repair.

The quadrupole magnet sits on the mover. One of the wires was cut. The earthquake-proof apparatus worked as designed.

Images: Nobuhiro Terunuma

At this moment, we do not know how long recovery will take. Even if we could recover quickly, the power shortage means that we may not operate the ATF for some time.

-- Toshiaki Tauchi