Present status of the beam transport line from SRC to BigRIPS

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The beam transport line that delivers a primary beam extracted from SRC to the BigRIPS target has been operated since 2007 and is called the "T-course" beam line. The T-course beam line consists of three bending magnets and 17 quadrupoles.[1,2] All of them are of the resistive type, and the maximum magnetic rigidity of the beam line is 8.0 Tm. Two identical 50° bending magnets DMT2 and DMT3 in the T-course are "2-Tesla" room-temperature dipoles, the maximum current of which is 650 A. Here we report the incident we faced in 2017 at the DMT3 magnet.

Since the DMT2 and DMT3 magnets are designed as high-field resistive-type magnets with sufficiently uniform field distribution, saddle-shaped correction coils are installed in the gap of the magnet in addition to the main coils. The main and correction coils are excited in series with one power supply. As shown in Fig. 1, the 12-layer main coil consists of 6 double pancakes in which a 13.5 × 13.5 mm hollow conductor is wound 6 times in each layer. For the correction coils, a 14 × 10 mm rectangular hollow conductor of is wound 6 times in each layer, forming a 2-layer double pancake. The correction coil end is located between the main coil and the pole end.

At the beginning of the uranium beam time in October 2017, we found that one of the correction coils in the DMT3 magnet was damaged. Figure 2 shows the excitation voltage at each pancake of the DMT3 coils logged on October 14. The voltage of the lower correction coil was unstable and much lower than that of upper correction coil. We concluded that the layer isolation of the lower correction coil was damaged. We then investigated the lower correction coil by inserting a fiberscope CCD camera into the space between the main coils of the DMT3 magnet. Damage to the epoxy isolation between the coil layers was found at many places on the outer circumference of the lower correction coil (Fig. 3).

In order to proceed with the scheduled beam time, we have isolated the lower correction coil from the excitation circuit, and the DMT3 magnet was re-excited after increasing the flow rate of the cooling water for the coils. After beam-time suspension for 5 days, a uranium beam was transported from SRC to the BigRIPS target and scheduled experiments were performed. The excitation current of the DMT3 magnet during the beam time was approximately 647 A, which is close to the maximum current of 650 A. The temperature and excitation voltage of the DMT3 coils were carefully monitored during the beam time.

A new correction coil is being fabricated at Toshiba, and the disassembly of the DMT3 magnet and installation of the new coil is scheduled for March 2018. The origin of the incident is under investigation.

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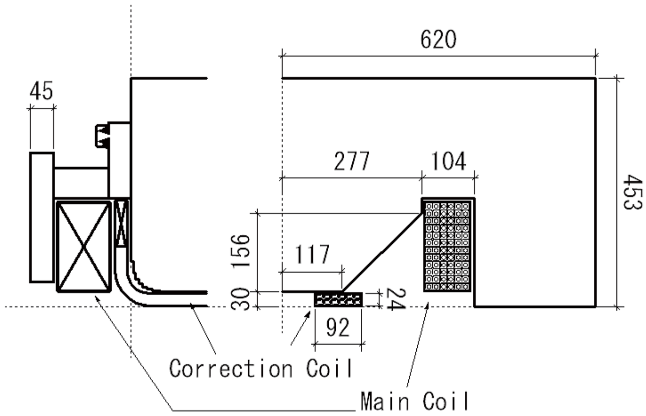

Fig. 1. Schematic of the upper-half cross section of the DMT3 magnet.

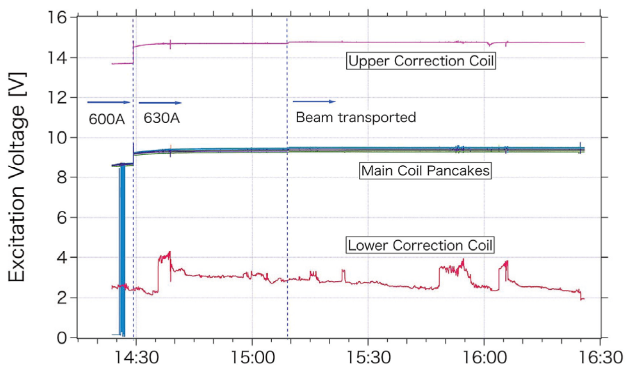

Fig. 2. Excitation voltage at each pancake of the DMT3 coils.

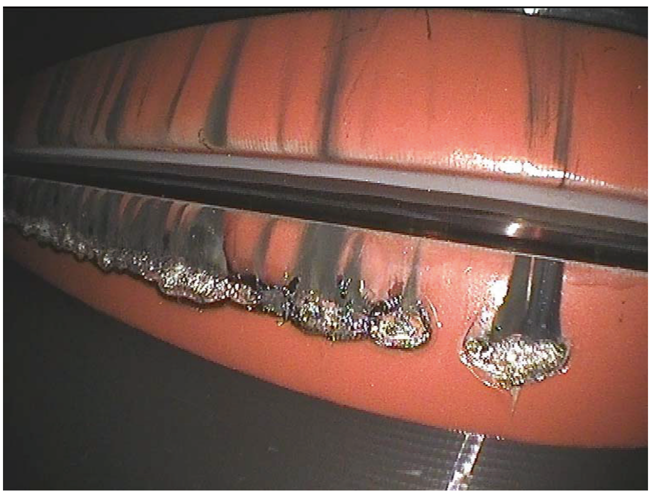

Fig. 3. Damaged correction coil of the DMT3 magnet.

References
1) K. Kusaka *et al.*, RIKEN Accel. Prog. Rep. **39**, 259 (2006).
2) K. Kusaka *et al.*, IEEE Trans. Appl. Supercond. **18**, 318 (2008), and references therein.