Magnet system for a new beam transport line from IRC to E5 experimental room

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We constructed a new beam transport line to provide high-energy beams accelerated by the IRC to the E5 experimental room in the Nishina building for biological experiments. The magnet system of the beam transport line was designed on the basis of the following factors: (1) For economic reasons, magnet power supplies were not produced, and existing power supplies were used by switching. (2) The new transport beam line was connected to the second half of the existing RRC to the E5 beam line. (3) As a part of the new beam transport line uses the existing IRC bypass beam line in the opposite direction, the beam line optics was designed to reduce the number of magnets that require polarity change. (4) In order to be able to switch a large number of magnets or magnet polarity with a simple procedure, nineteen switches assembled in two control panels were laid out in one place.

Figure 1 shows the layout of the new beam transport line. The magnet power supplies were prepared in the following way:

•The DAKR magnet (1500 A-26 V) used the old DC power supply previously used for the fRC-MIC2. As this power supply could operate at various currents and voltages, it was installed in front of the RRC room so that it could be utilized as a spare of the several power supplies for the RRC when it was not used for the DAKR.

•The polarity switches were added to the power supplies for DMR3, DMR4, and DMR5 dipole magnets on the bypass beam line.

•Three dipole magnets, DMR6, DMR7, and DMR8, were connected in series and excited by the old fRC main power supply removed in 2012 for the enhancement of the fRC.[1] The auxiliary power supplies built into the power supply were used for fine adjustment of the magnetic field of individual magnets. The transistor banks in the auxiliary power supplies had to be modified to match the output power of each magnet.

•As the maximum current (300 A) of the existing power supply for the DMD5 dipole magnet immediately before entering the E5 room was insufficient, the 420 A-150 V power supply for RIPS-Q11 was used by switching.

•Fourteen new quadrupole magnets used the power supplies for quadrupole magnets on the IRC-SRC transport line by switching. The cables from the power supplies were wired to the magnets on the new beam transport line and the IRC-SRC transport line through load switching panels.

•The first steering magnet right after the IRC named STR00 used the power supply for STK01 on the IRC-SRC transport line by switching.

•All magnets on the new beam line except STR00 used the dedicated 10 A-60 V power supplies controlled by a Linux-based PLC named F3RP61.

Boring for the wiring through experimental vaults and relocation of the power supplies were completed in 2013. Wiring and an operation test of the power supplies were performed in the summer of 2014. In December 2014, the polarity check and excitation test for the all magnets were performed. In January 2015, we planned to carry out the commissioning of the new transport line using the 160MeV/u ^{40}Ar beam.

At present, the switching of the dipole and quadrupole magnets and their polarity is performed manually. In FY2015, we plan to operate switching automatically using buttons.

References

1) K.Kumagai et al.: RIKEN Accel. Prog. Rep. 46, 132 (2012).

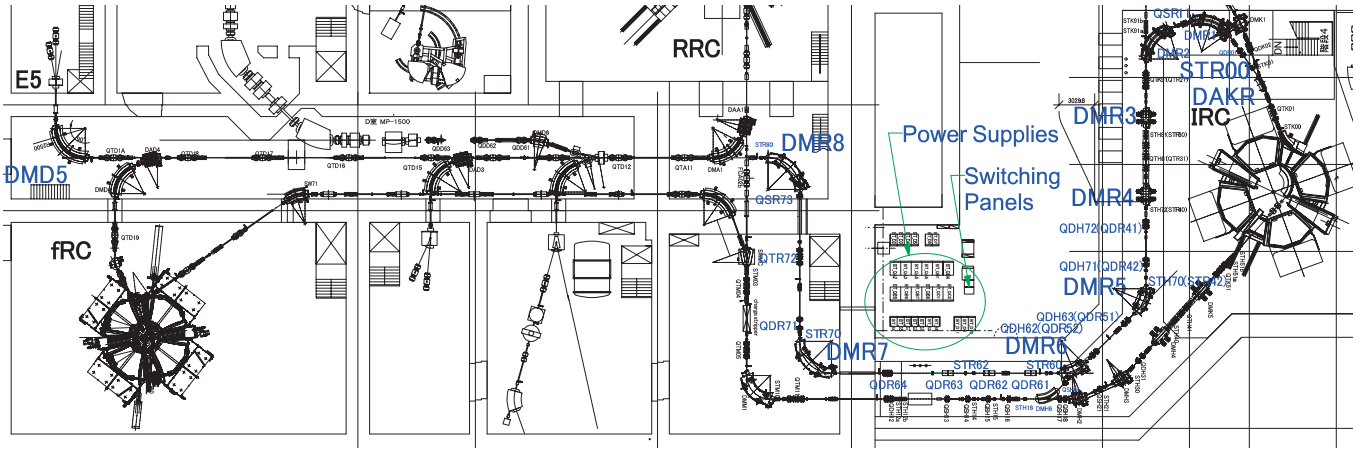

Fig. 1. Layout of the new beam transport line from IRC to E5.

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