

Installation of return BT line from IRC

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The return beam transport (BT) line from IRC to the E5 room was installed from FY2012 to FY2014 because of the biology experiments requiring a higher energy beam by a relatively heavy ion such as an Ar beam. In particular, the installed return BT line was from dipole magnet DMKR to dipole magnet DMA1, as shown in Fig. 1. The installation of the return BT line was supported by the ‘Formation of Tohoku Marine Science Center’ of the Ministry of Education, culture, Sports, Science and Technology, Japan. Table 1 shows the installation schedule of the return BT line. The return BT line was primarily installed in the maintenance period during every summer and winter.

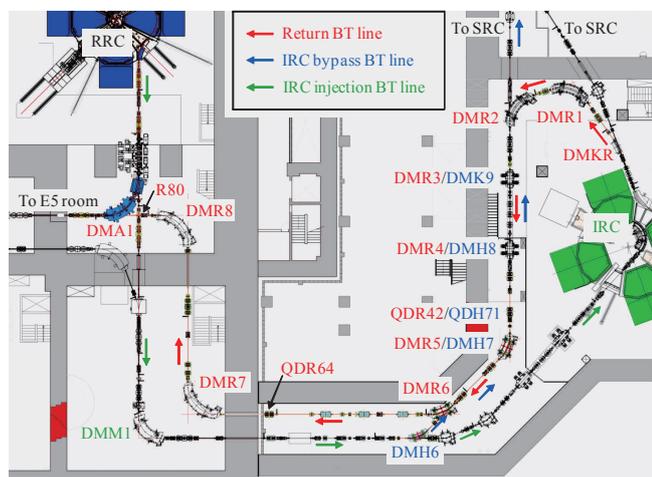


Fig. 1. Layout of the return BT line.

As preparatory works, all necessary components and works were first listed and the installation schedule was planned in FY2012. We arranged some existing components that we could use, and listed some new components that had to be produced and work that had to be done. Some quadrupole magnets, all profile monitor (PF), chambers, turbo molecular pumps (TMP) were produced in FY2012 because these components were already designed and the models chosen. A part of IRC bypass BT line and the infrastructure were modified and constructed in FY2013 before the installation of the return BT line. After temporary removal of a part of IRC bypass BT line from dipole magnet DMH6 to double quadrupole magnet QDH71, a telfer was constructed in the area from dipole magnet DMR6 to double quadrupole magnet QDR64, and some openings (holes) were made in the wall and floor in order to lay some cables in the summer of 2013. Because the old

Table 1 Installation schedule of the return BT line.

FY2012	Preparatory works and production of some quadrupole magnets, all PF, chambers, and TMP
Summer of 2013	Removal of part of the IRC bypass BT line, modification of old DMH6, construction of telfer, and boring of the wall and floor
Winter of 2013/2014	Production of new DMH6 and power supply, carrying in of some magnets and stands, laying of some cooling water piping, and installation of removed IRC bypass BT line
Summer of 2014	Installation of return BT line, except the IRC bypass BT line, laying of all cooling water piping and cables for magnets, modification of DMA1, and production of FC, N-DIM, RP, GV, and stands
Winter of 2014/2015	Set up of all PF, FC, N-DIM, vacuum pumps, laying of all cables for monitors, and finally operation check
Jan. 2015	Acceleration test with Ar beam

DMH6 was used as a new DMR6, the chamber and outer yokes of the old DMH6 were reversed to change the direction of flange after the dismantlement of the old DMH6, a new DMR6 was assembled, and a new DMH6 was produced. In addition, a power supply of DMKR, some stands, and ducts were produced in FY2013. Three double quadrupole magnets that were used in the old RILAC line were transferred from the E21 room to IRC room. After all magnets, stands, and chambers were carried in the area from DMR6 to QDR64, the removed IRC bypass BT line, including the new DMH6 and new DMR6, was again installed according a new line design in the winter of 2013/2014. All of the return BT line except the IRC bypass BT line was installed in FY2014. Some quadrupole and steering magnets that were used in the old line were transferred from the E2 and E4 room to the E1 and RRC-A room, and all chambers and stands were also carried in each area. While almost all of the return BT line was installed in the summer of 2014, all cooling water piping and cables for magnets were laid, and the outer yokes of DMA1 were replaced with new ones that were fabricated such that a beam duct could be installed from the chamber R80. All faraday cups (FC), network device interface modules (N-DIM), rotary pumps (RP), gate valves (GV), stands, ducts and cables for monitors were produced by the summer of 2014, and these components were set up gradually. Finally, the operation check was smoothly done without any problem, and the first acceleration test with the Ar beam in the AVF-RRC-IRC mode using the return BT line was successfully completed in the end of January 2015.

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