Construction of New Beam Line

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The construction of new beam line for the heavy ion beam delivery and beam diagnosis is now in progress. The overview of the beam line is shown in Fig.1. The beam line serves to deliver particles extracted from AVF cyclotron to each experimental room without further acceleration by the Ring cyclotron. Then, the heavy ion physics using high intensity beam will be performed with the combination of newly constructed Super Conducting ECR ion source and upgraded AVF cyclotron. Another important function is to diagnose the extracted beam to tune the AVF cyclotron for the preparation of the high resolution beam. Two dipole magnets, BA1 and BA2 for 90 degree bending, are located anti-symmetrically to get the large dispersion at the focal plane for monitoring the beam energy spread.

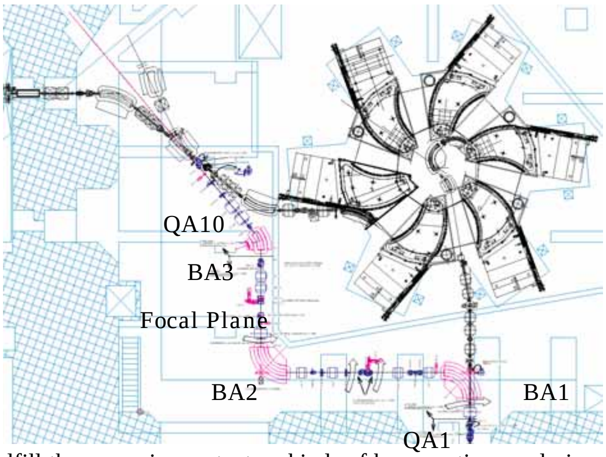

Fig.1.The overview of new beam line. It skips the Ring cyclotron and is connected to each experimental room veer existing switching magnet. Three dipole magnets are configured in the beam line. Two of them (BA1 and BA2) have the bending angle of 90 degree, and the remaining (BA3) has 40 degree bending angle. We have 10 quadrupole magnets in total from QA1 to QA10. The large bore size magnets are used at QA2~QA5, QA7 and QA8, where the beam size become large compared with other drift region.

To fulfill those requirements, two kinds of beam optics are designed as follows. Design calculations of beam optics have been done by computer codes ORBIT and TRANSPORT.

1. <u>Achromatic mode</u>: In this mode, the beam injected into the new beam line is doubly focused in the focal plane just after the quadruple magnet QA6. When the beam emittance is measured, the quadruple magnets QA7 and QA8 are not excited and used as a drift space. The wire monitor installed downstream of QA8 is used to measure the emittance. This mode is also used to deliver the beam into each experimental room such as West, Neutron, and East.
2. <u>Dispersive mode</u>: The beam profile and energy spread are measured with this mode. To monitor the energy resolution of extracted beam accurately, this beam line is utilized as a high resolution monochrometer with a maximum dispersion of 1200 mm and magnification of M_H(horizontal)~M_V(vertical)~1. The wire monitor located at focal plane is used for the measurement of the beam energy spread.

The obtained beam optics is shown in the Fig.2. It should be noted that the multiple components and effective curvature of the flat pole edges in dipole magnets, which are evaluated by precise field calculation with three dimensional simulation code OPERA-3D described in the next report, are included into the optics calculation. We made a curvature on the upstream edge of BA2, where the dispersion becomes large, to minimize the second order optics matrix element (|), so that the focal plane become vertical with respect to beam direction. In these two optics modes, we do not have to change the polarity of all the quadruple magnets located in the new beam line. The beam diagnosis equipments such as viewers and wire monitors are installed at each node and the focal plane. The test beam transportation will be done in this spring.

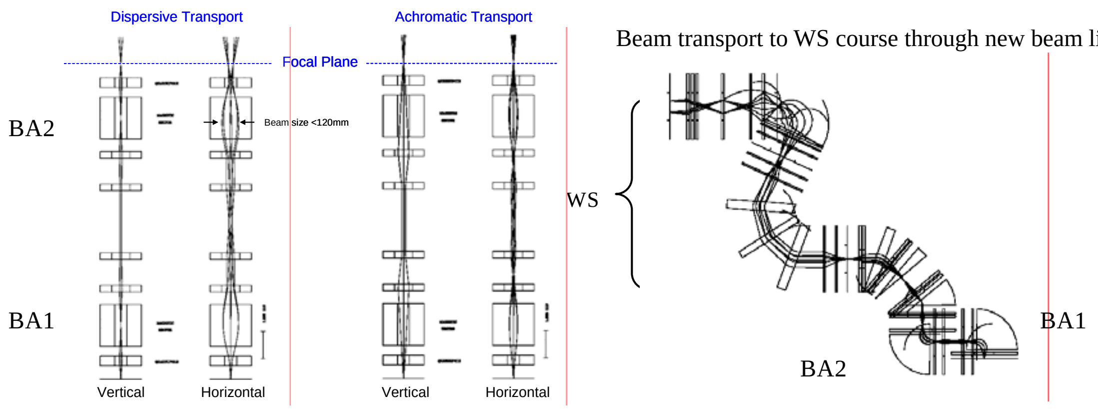

Fig.2.The left figure shows the two types of beam transportation, namely achromatic mode and dispersive mode. The right figure shows the example of beam transportation to WS course in West experimental room with dispersive mode.