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SPALLATION
SOURCE

Accelerator Division

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Medium Energy Extraction

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1 Introduction

To allow for medium energy beam extraction from the main linac beam two extraction sections have been added to the latest linac, FDSL_2012_05_15. The first branching section is located right after the DTL and the second banching section is located between medium and high β elliptical cavities. The preliminary layout of these two area is presented in this note.

2 The first branching section

The first branching section is located right after the last tank of DTL and before the first superconducting cryomodule in the spoke section. The same area is used for the differential pumping section which creates a gradient in vacuum level, required between the normal conducting linac and the superconducting linac. A schematic view of the first branching section is shown in Fig. 1. The total length from the end of last quadrupole of DTL to the entrance of the warm vacuum valve of the first spoke cryomodule is 1830 mm.

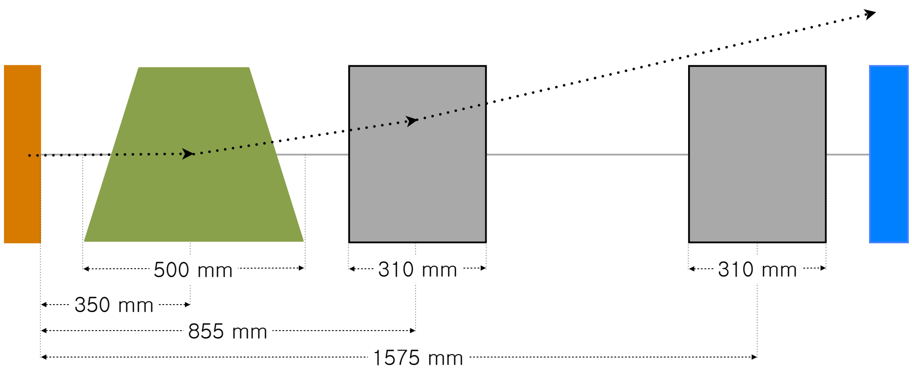

Figure 1: Schematic view of the first branching section (scaled longitudinally).

The green dipole in Fig. 1 is a 1.2 T dipole bending the 79 MeV beam out of DTL by 27°. However, as it is shown in the figure this diversion will not clear the first quadrupole downstream of the dipole. The possible solutions would be having a smaller quadrupole with narrower transverse extension or having a quadrupole with a second aperture specially designed for this purpose. The transverse diversion of the beam center at each face of the downstream quadrupoles and the first spoke cryomodule is 141 mm at the near face of the first quadrupole and 320 mm in the far face, 649 mm at the near face of the second quadrupole and 871 mm at the far face, and 942 mm at the position of cryomodule as shown in Fig. 2. The beam properties at the input are the beam properties at the DTL output, but the beam properties of the extracted beam are strongly dependent on the shape of the dipole and the field inside the first quadrupole in case a double aperture quadrupole is used.

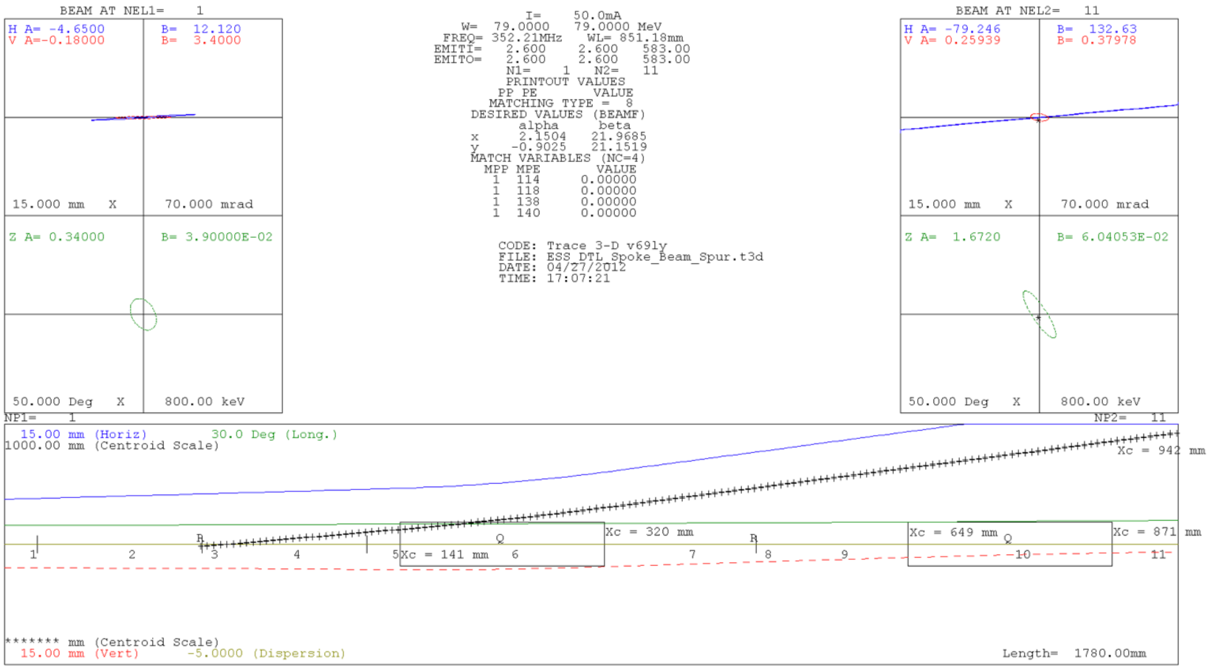

Figure 2: Trace3D simulation of the first branching section (scaled longitudinally).

3 The second branching section

After the last cryomodule of the medium β section an extra period with the same length, but leaving empty the cryomodule space, is added. This provides 5.8 m of free space between the two quadrupole doublets which is enough to extract the beam and clear the first high β cryomodule. To extract the beam a 1.8 m dipole with a field of 1.2 T bends the 623 MeV beam out of medium β section by 30°. The design and field of this dipole is identical to those used in the High Energy Beam Transport. Respecting the periodicity of the previous structure minimizes the drawbacks of this extra free space in the middle of accelerator. A schematic drawing of this section is presented in Fig. 3.

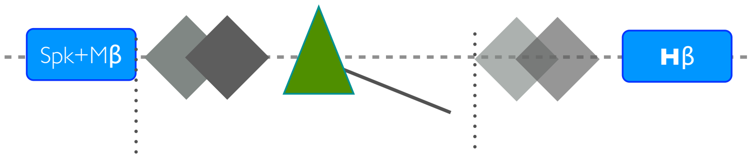

Figure 3: Schematic drawing of the second branching section, the area between the two vertical dashed lines (not to scale).

4 Further studies

The feasibility of having a double aperture quadrupole has to be studied and if such a solution is not feasible, a narrower quadrupole with required aperture of 30 mm radius and a field of $4-5$ T/m has to be designed. The short dipole for the first branching section has to be designed. The magnetic field value at the cavity position must be below the limit required by the cavity design which is one tenth of the earth's magnetic field.