Accelerator Division

ESS AD Technical Note
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Linac Baseline May 2012

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This note documents the main parameters of the layout and lattice of the May 2012 Linac Baseline, named FDSL_2012_05_15, as uploaded to BLED the same month. Top-level parameters for this linac include 2.5 GeV beam energy, 50 mA beam current in the pulses, 2.86 ms pulse length and 14 Hz pulse-repetition frequency, producing 5 MW average beam power and 125 MW peak power. Among the important features implemented recently are:

- A MEBT with space for instrumentation, chopping and collimation.
- A DTL with a FODO structure that accelerates to 79 MeV instead of the previous 50 MeV to have a longitudinal phase advance at the end of the DTL that is almost equal to that of the spokes section.
- A modified phase law in the superconducting linac.
- Room for dipole magnets after the DTL and medium-beta sections to extract the beam into diagnostics or experimental stations.
- Dimensions of cavities and cryomodules that are more realistic than in earlier layouts.
- Medium-beta cavities that span a smaller range of particle velocities to reduce sensitivity to same-order cavity modes.
- Fully segmented cryomodules, with only four cavities per cryomodule in the high-beta section.
- Warm quadrupole doublets between the cryomodules of the spokes and medium-beta sections, and between every second cryomodule in the high-beta section.
- A HEBT with 4 m difference between tunnel and target level and with octupole magnets to spread the beam on a rectangular target window.

Figure 1 shows the schematic block diagram of the linac layout. The total projected length of this layout, from the ion-source extraction to the centre of the target monolith (thus not including the extension of the ion source), is 601.9 m.

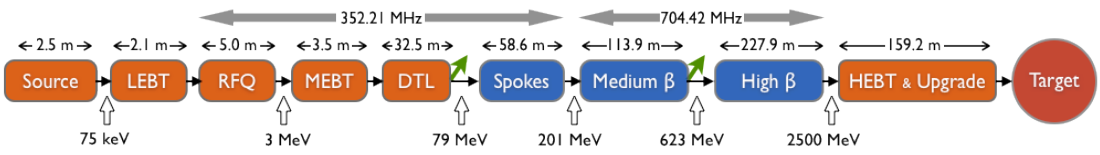

Fig. 1. Schematic block diagram of the FDSL_2012_05_15 linac layout.

Table 1 lists important parameters of this layout. In Figure 2 are shown the cavity voltages, defined as the integrated field multiplied by the maximum transit-time factor, in the superconducting part of the linac and also the power transmitted to the beam per cavity from the DTL to the end of the high-beta section.

Parameter	Device	Value
Length (m)	LEBT RFQ MEBT DTL Spokes Medium beta High beta	2.1 5.0 3.5 32.5 58.6 113.9 227.9
No. of cryomodules	Spokes Medium beta High beta	14 15 30
Cavities per module	Spokes Medium beta High beta	2 4 4
Optimal beta Geometrical beta	Spokes Medium beta High beta	0.50 0.67 0.92
Transition energy (MeV)	Source–RFQ RFQ–DTL DTL–spokes Spokes–medium beta Medium–high beta	0.075 3 79 201 623

Table 1. Main parameters of the FDSL_2012_05_15 linac layout.

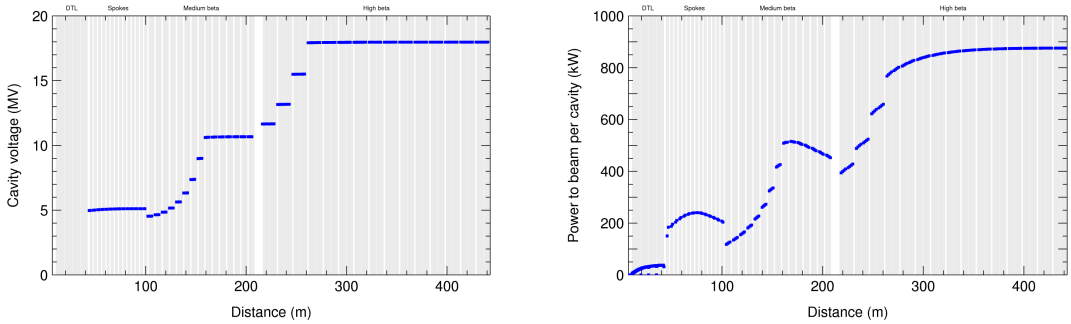

Fig. 2. Cavity voltages, defined as the integrated field multiplied by the maximum transit-time factor, in the superconducting part of the linac (left), and power transmitted to the beam per cell of the DTL and per cavity in the superconducting linac (right). Gray backgrounds indicate position of DTL tanks and cryomodules.