EUROPEAN SPALLATION SOURCE

Beam Physics

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Catania, NCFE meeting
2017 Jan 17

STATUS

- Last November we had a beam physics review with two external reviewers, Deepak Raparia (BNL) and Tomofumi Maruta (KEK/J-PARC currently in FRIB). The committee reviewed amongst others, the status of the beam physics, off-nominal linac studies, lattice life cycle.

  - ISRC and LEBT:
    - The latest drawing available from LNS has been implemented in TraceWin

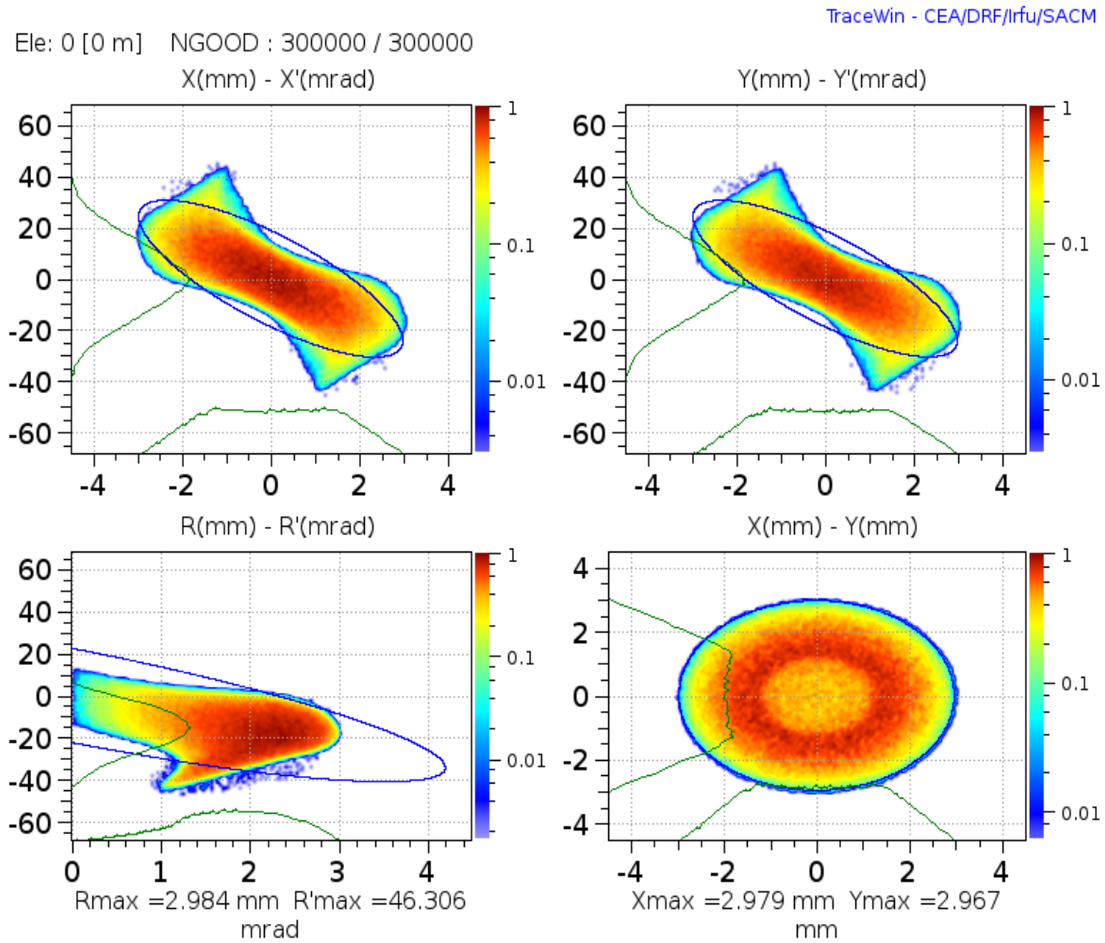
  - RFQ:
    - The Beam Physics representation of the RFQ has not been changed for several years (good), and the model is is use.

  - MEBT:
    - Constant communication between Ryoichi and the Bilbao team for different aspects of the MEBT lattice.

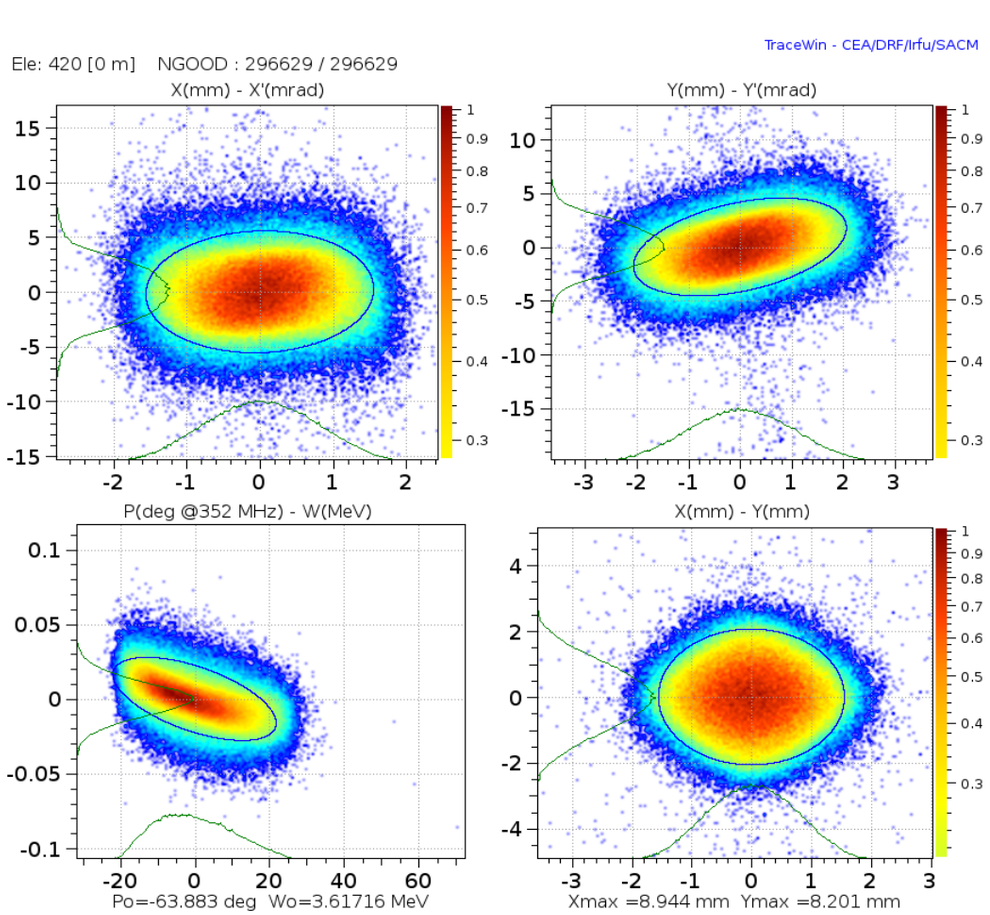
  - DTL:
    - The mechanical geometry of the DTL has not changed and therefore majority of the factors have been fixed for a while now.

Beam profile (ISRC to RFQ)

- The LEBT was under redesign and therefore for the End-to-End simulations we used a beam generated at the RFQ input.



Ion source exit

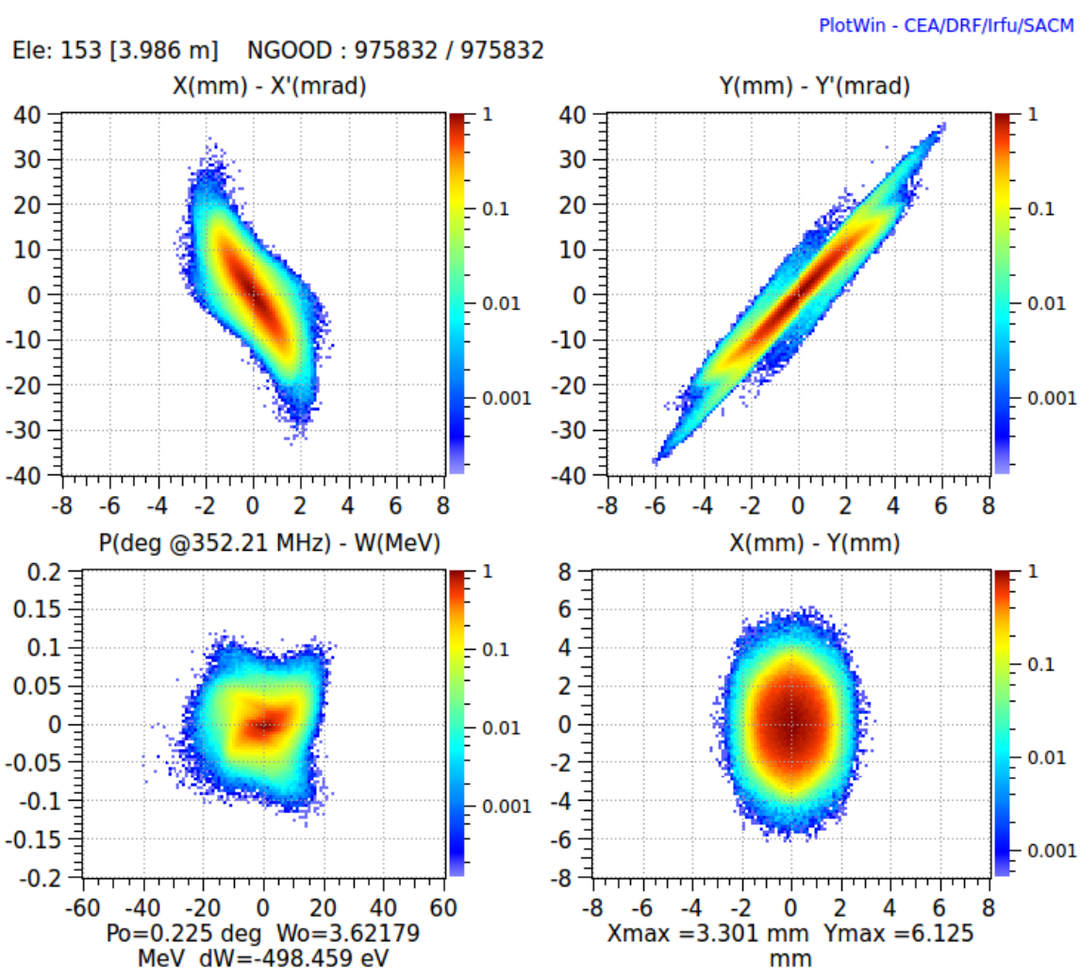


RFQ exit

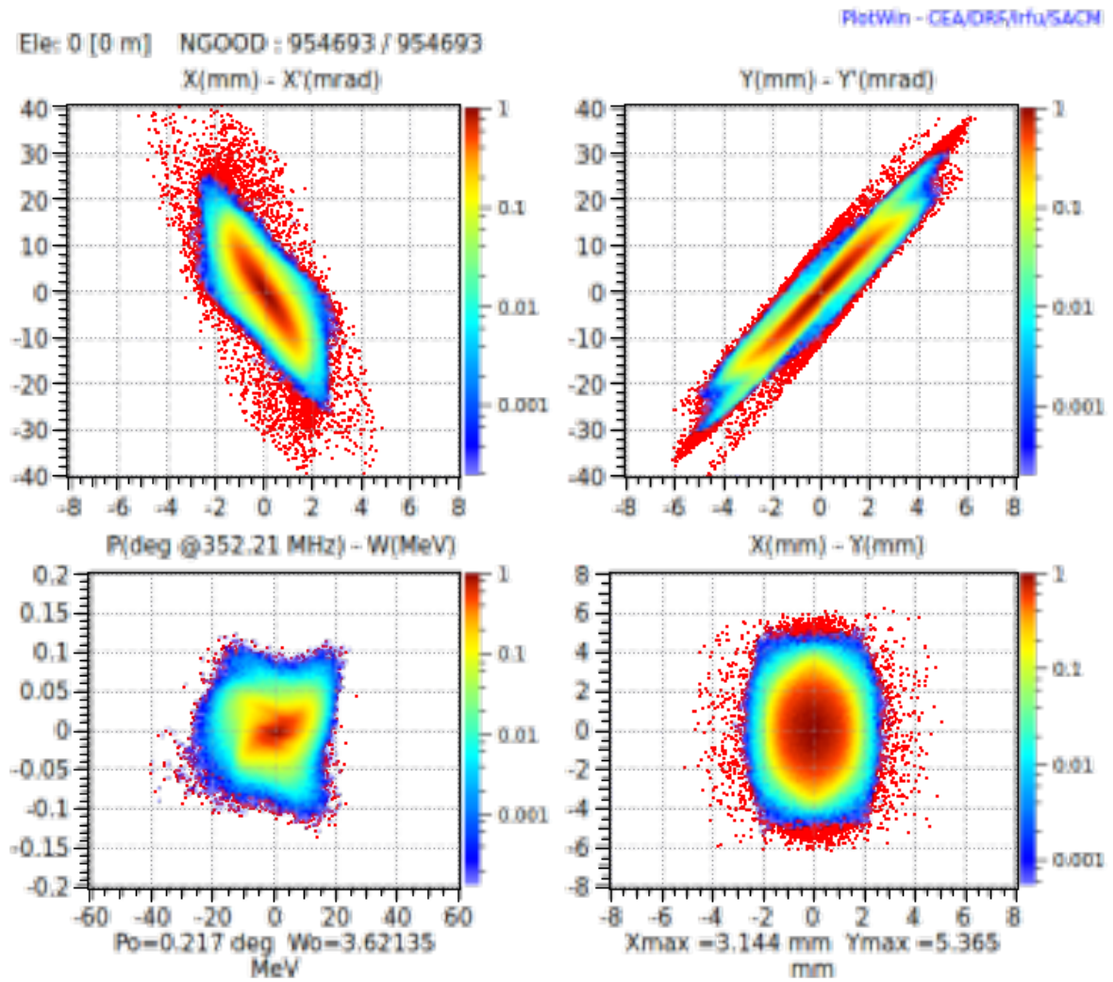
MEBT Beam

- Due to the weaker focusing than RFQ and DTL, it is hard to avoid beam quality degradation. The focus of the lattice design was to minimize the degradation as much as possible by avoid a small beam size.
  - Emittance growth (relative difference): (14.6%, 16.5%, 2.0%) (with collimators (10.9%, 11.4%, 1.4%))
  - Halo growth (difference): (0.11, 0.57, 0.21) (with collimators (-0.05, 0.30, 0.19))
- 3 collimator units (each blade removing up to ~0.1%) allow to cover the phase space and partially compensate the degradation. Because of the larger aperture difference between DTL and SCL, the collimators show no influence to the losses in SCL in simulations

Nominal MEBT output



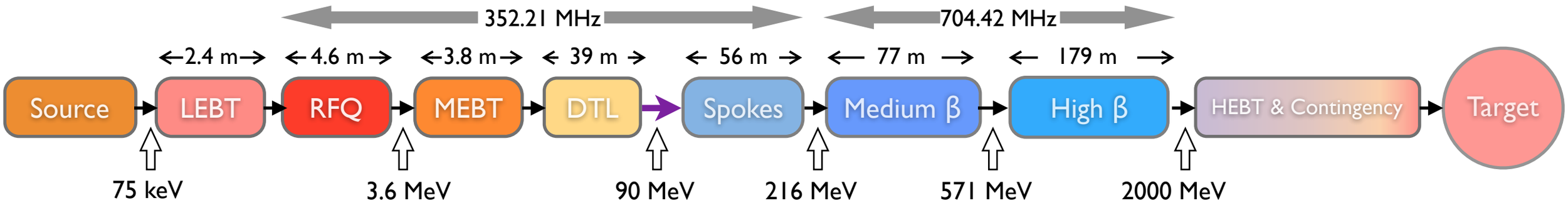
Output with collimators / Acceptance



CHANGES

- Last year it was decided, with the approval of the AMT and the TB, that any changes to the lattice can happen only after a change request has been submitted to the AMT and it is approved by the TB.
  - The beam physics does not expect that the mechanical layout of the components stay fixed, however, it is needed that any lattice change requests are routed as agreed by the TB.
    - If there is a proposal for a change, we can discuss it initially,
    - if the change seems feasible a change request has to be prepared an submitted to the management

The ESS Linac



	Length (m)	W_in (MeV)	F (MHz)	β Geometric	No. Sections	T (K)
LEBT	2.38	0.075	--	--	1	~300
RFQ	4.6	0.075	352.21	--	1	~300
MEBT	3.81	3.62	352.21	--	1	~300
DTL	38.9	3.62	352.21	--	5	~300
LEDP + Spoke	55.9	89.8	352.21	0.50 (Optimum)	13	~2
Medium Beta	76.7	216.3	704.42	0.67	9	~2
High Beta	178.9	571.5	704.42	0.86	21	~2
Contingency	119.3	2000	704.42	(0.86)	14	~300 / ~2

INTERFACES

- There are 3 interfaces between different work units of the NCFE (seen from the beam's point of view):
  - ISRC-LEBT to RFQ
  - RFQ to MEBT
  - MEBT to DTL
- and one between DTL and the Spoke
  - DTL to Spoke ,LEDP (WP04)

- These BP interfaces should be resolved and agreed upon with the WU (in case they cause/require permanent changes) and can be handled within the limitation WU has identified, e.g. through requirements, by WP02 if there are only soft changes, e.g., field of the solenoids.

- DTL-Spoke beam physics interface would benefit from further coordination.

COMMISSIONING

- Soon we should be able to see the purple beam seen in pictures of the ion source in Lund!

- This needs planning for the commissioning which does include:
  - what we want to do
  - what we can do!

- The "Want" part is in theory only limited by our imaginations, however, in reality the installation schedule, BOT date and available equipment and people put a harder constraint on what we can do.
  - Considering this, we appreciate your inputs and suggestions for a successful commissioning of not only the front end, but the whole linac.

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Thank you!