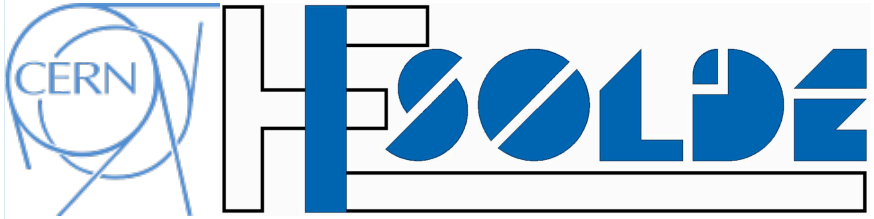


HIE-LINAC: accelerator status and a proposal for the experimental lines

M. Pasini on behalf of the HIE-ISOLDE study team
CERN BE-RF and Instituut voor Kern- en Stralingsfysica, K. U. Leuven

Overview

- The HIE-linac: a SC linac for Radioactive Ion Beams @ ISOLDE
- R&D activity
- Status of the project
- Beam line proposal
- Summary

HIE-ISOLDE Project: SC-linac

- SC-linac between 1.2 and 10 MeV/u (energies below 1.2 MeV are achievable but the machine is not optimized)
- 32 SC QWR (20 @ β_0=10.3% and 12@ β_0=6.3%)
- Energy fully variable; energy spread and bunch length are tunable.
- 2.5<A/q<4.5 limited by the room temperature cavity
- 16.02 m length (without matching section)
- New beam transfer line to the experimental stations

QWR cavities (Nb sputtered)

Low β

High β

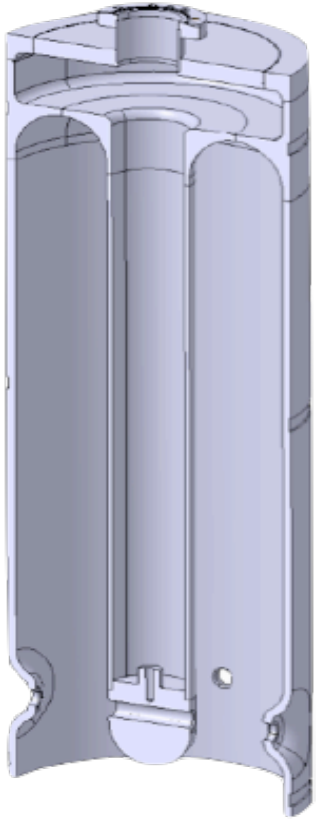
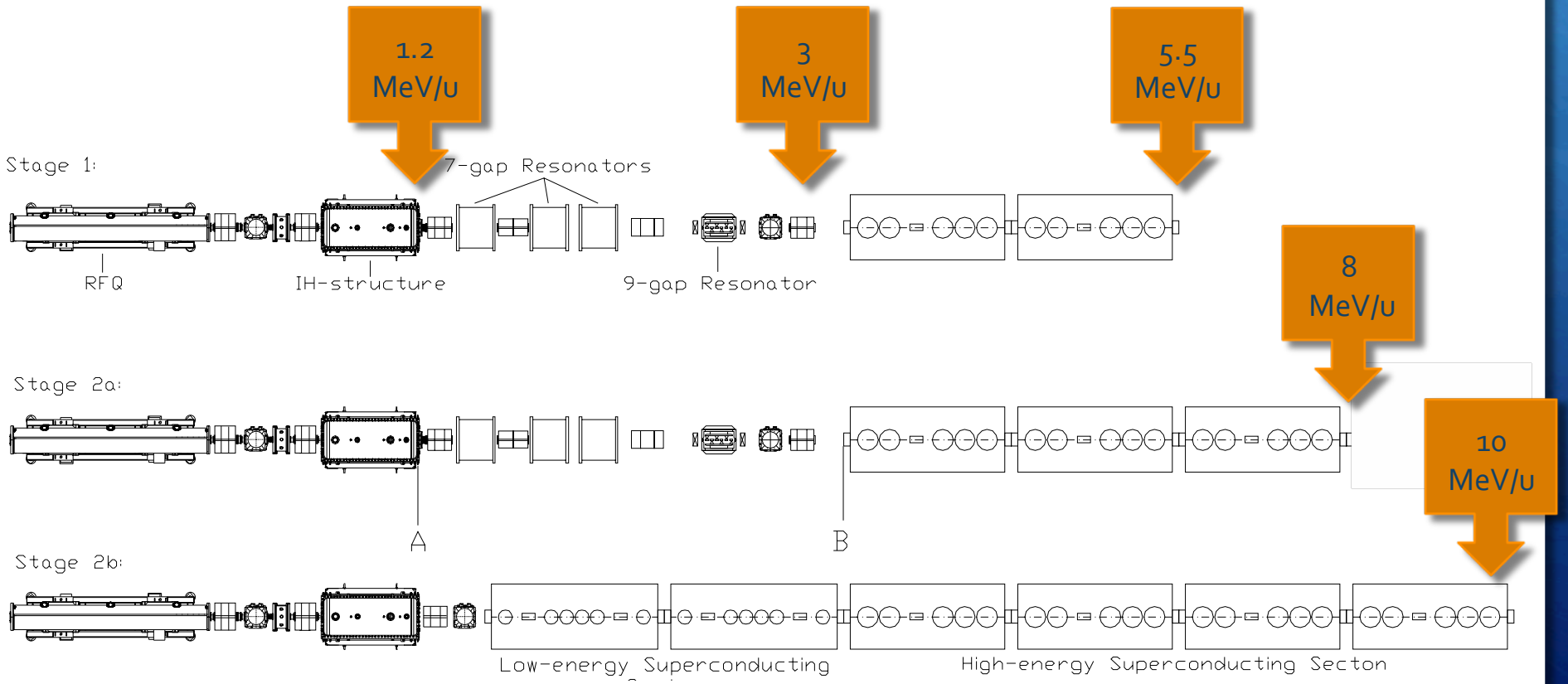


Table 1: Cavity design parameters

Cavity	**Low β**	**highβ**
No. of Cells	2	2
f (MHz)	101.28	101.28
β_0 (%)	6.3	10.3
Design gradient E_{acc}(MV/m)	6	6
Active length (mm)	195	300
Inner conductor diameter (mm)	50	90
Mechanical length (mm)	215	320
Gap length (mm)	50	85
Beam aperture diameter (mm)	20	20
$U/{E_{\mathrm{acc}}}^2$ (mJ/(MV/m)^2	73	207
$E_{\mathrm{pk}}/E_{\mathrm{acc}}$	5.4	5.6
$H_{\mathrm{pk}}/E_{\mathrm{acc}}$ (Oe/MV/m)	80	100.7
R_{sh}/Q (Ω)	564	548
$\Gamma = R_{\mathrm{s}} \cdot Q_0$ (Ω)	23	30.6
Q_0 for 6MV/m at 7W	$3.2 \cdot 10^8$	$5 \cdot 10^8$
TTF max	0.85	0.9
No. of cavities	12	20

HIE-ISOLDE LINAC - layout

3 stages installation



R&D activity

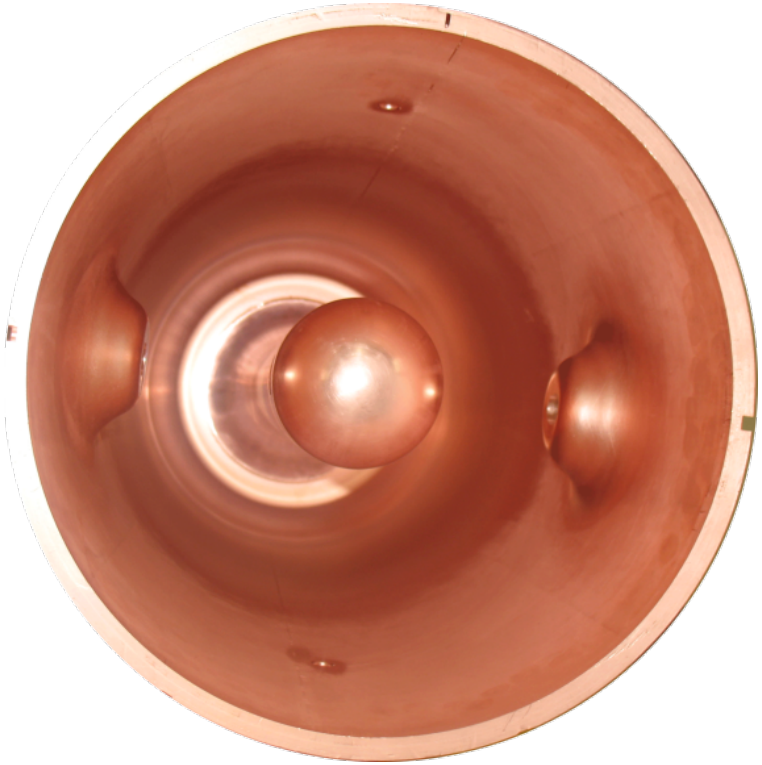
- **High β cavity prototype**
  - **Copper substrate manufacturing**
  - **Chemical etching**
  - **Nb sputtering**
- **RF – Beam dynamics studies**
- RF sub-system prototypes
  - Tuner
  - Power coupler
- SC solenoid prototype
- Cryomodule design
- **Infrastructure design**

➢In parallel preparation of a test stand for QWR at CERN

Inner and Outer conductors

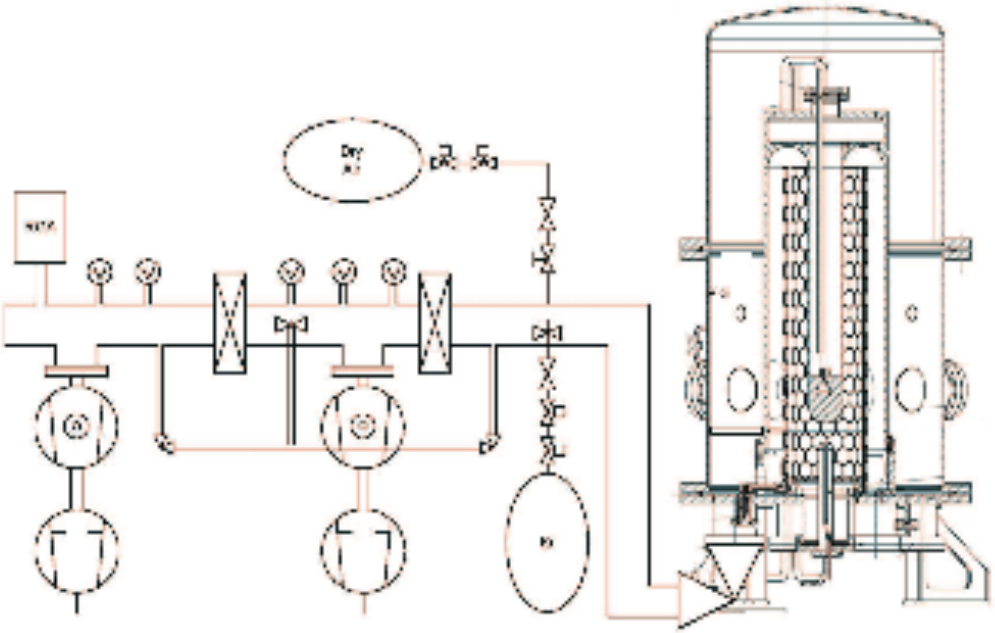
THPPO010

Cavity copper substrate

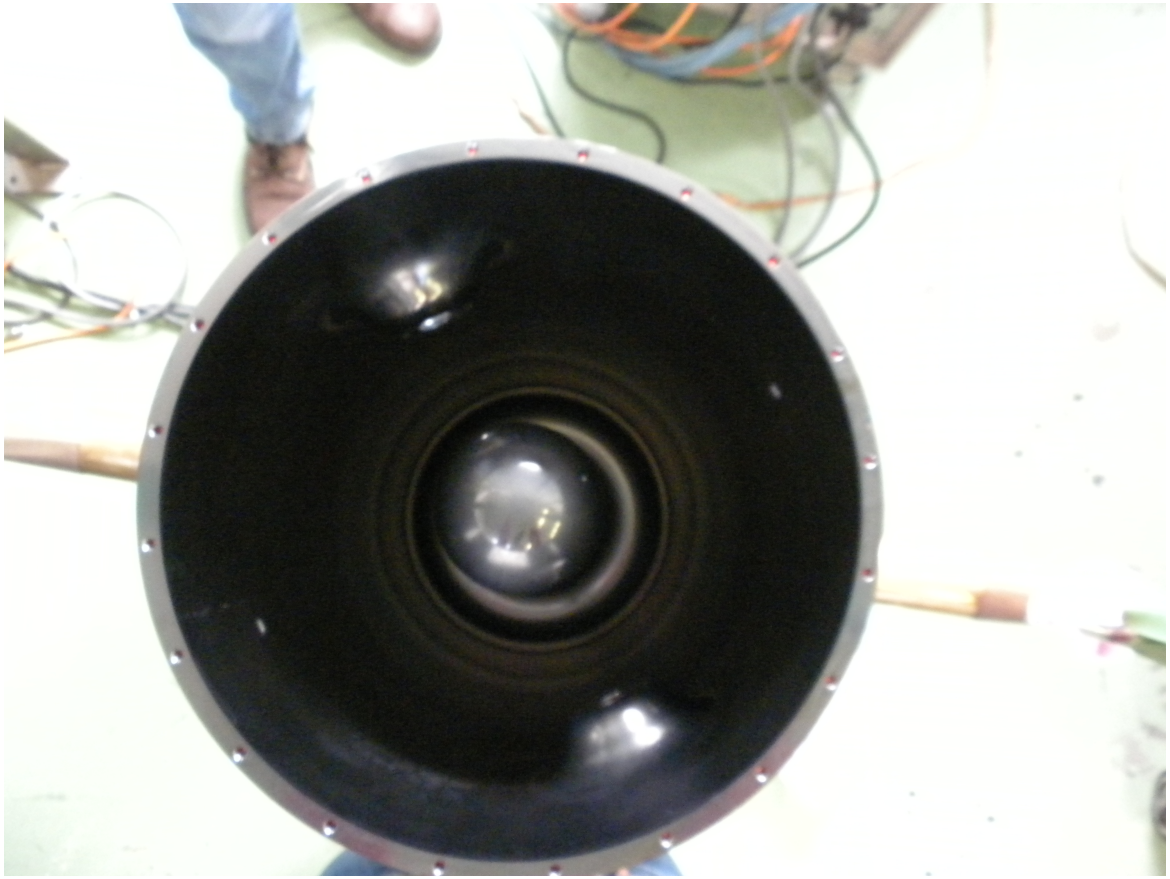


THPPO010

Sputtering system



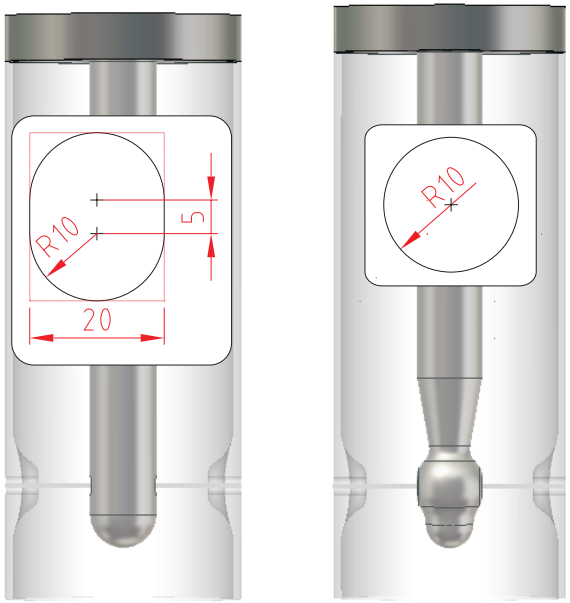
Cavity sputtered

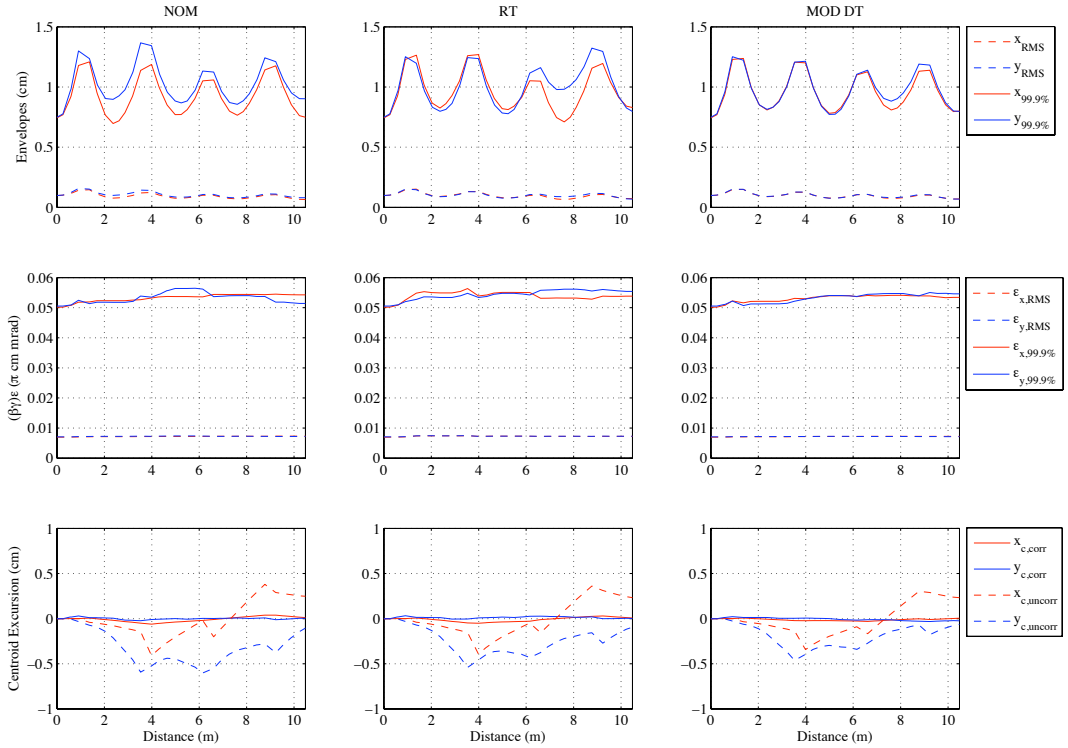


November 5th 2009

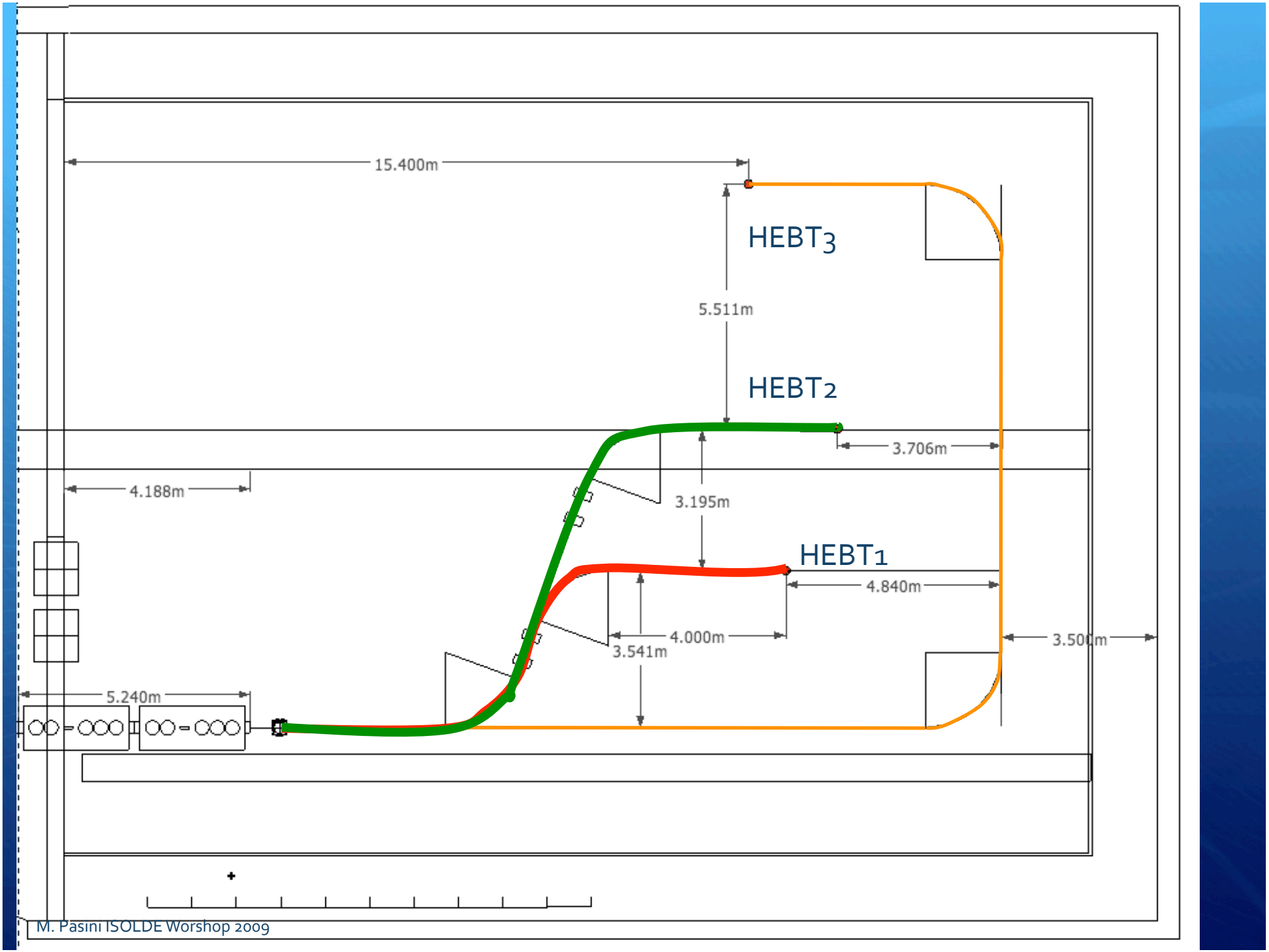
High β section Beam Dynamics studies

- Beam Port shape studies





Beam Lines proposal


15.400m
HEBT3
5.511m
HEBT2
3.706m
4.188m
3.195m
HEBT1
4.840m
4.000m
3.541m
3.500m
5.240m

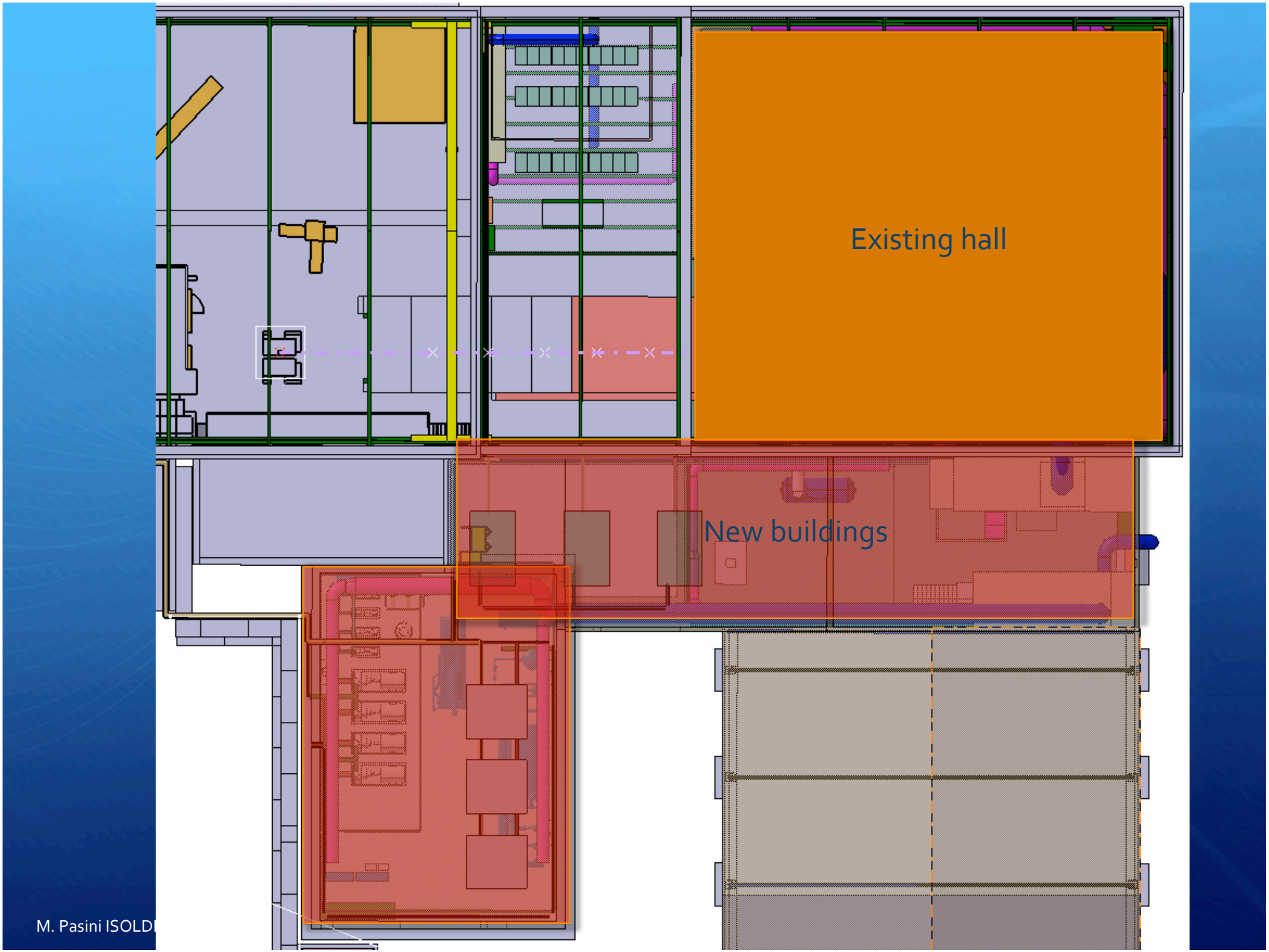
Beam Parameters

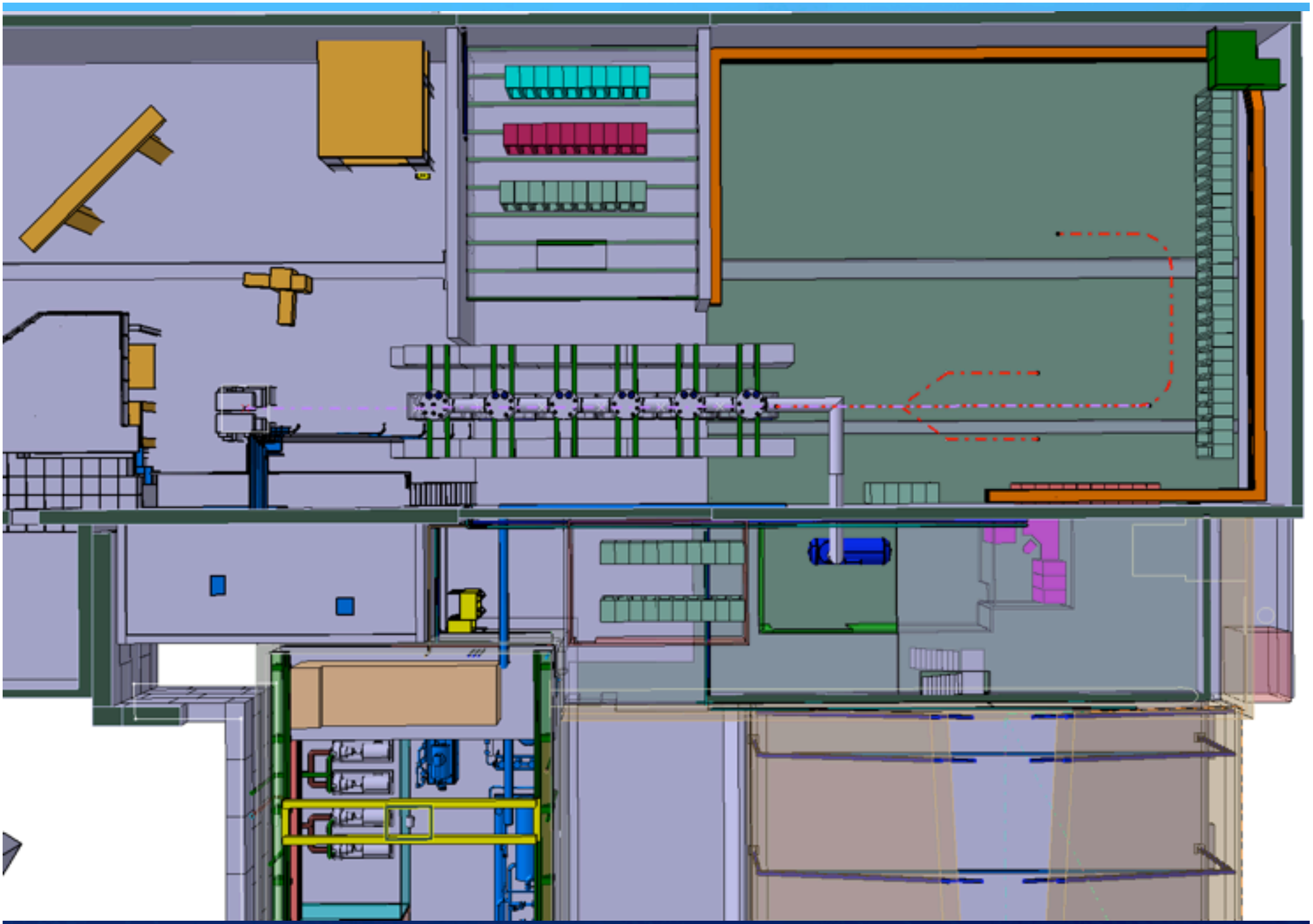
- In each target position we can achieve a beam spot of 2mm diameter with ±5mrad divergence (double focus, symmetric on horizontal and vertical plane) NB. This is at 10 MeV/u
- The focus matching section is telescopic so we can manage to have the target at different distances from the last quadrupole
- So far there was no specification given in term of logitudinal parameters, i.e. beam energy spread and beam (micro)bunch length.

To be noted…

- The transfer line will be the first thing we will install in order to minimize the down time of the facility. It must allow to transport the beam to the new experimental position even in the case that the accelerator will not completely be built.
- We need a decision over the next year on which HEBT to build first and which experiment will be installed (we need to know the footprint, special requirement for radioprotection, and all other parameter that can influence the layout of the hall)
- New experiments that requires “special” beam parameters and need a well collimated beam should go though a beam dynamics review in order to technically verify the feasibility of the set-up.

General infrastructure


Existing hall
New buildings



Summary

- Cavity prototype almost completed. Tests to be done @ TRIUMF as soon as possible
- Beam dynamics study for the high energy section completed.
- Study of the beam lines to experiments has started. Need to have confirmation on beam parameters that need to be delivered.
- Study of the general infrastructure and machine integration almost completed.
- For more info concerning the Linac please check out the website: http://hie-isolde.web.cern.ch

Acknowledgments

- HIE-ISOLDE design group
- ISOLDE physics and operation group
- LNL-INFN and TRIUMF
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- K.U. Leuven
- I would like to express my sincere gratitude to all those at CERN that have contributed and supported this activity

Thank you