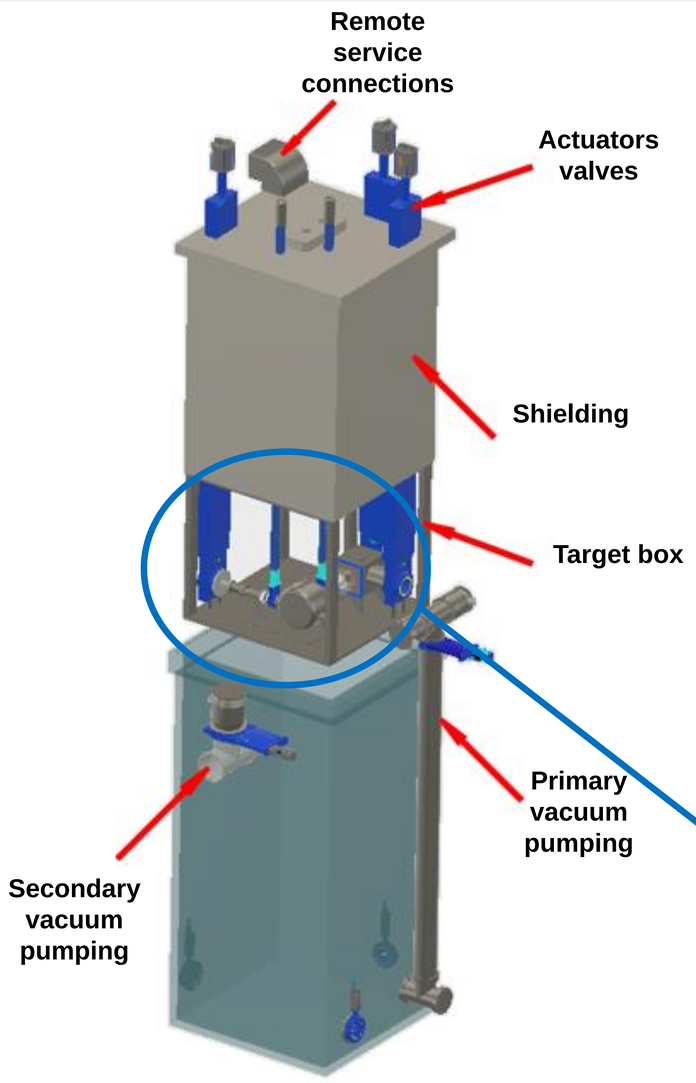
First simulations of RIB-extraction in the ISOL@MYRRHA target module

Philip Creemers [1] ***& Kim Rijpstra*** [1]

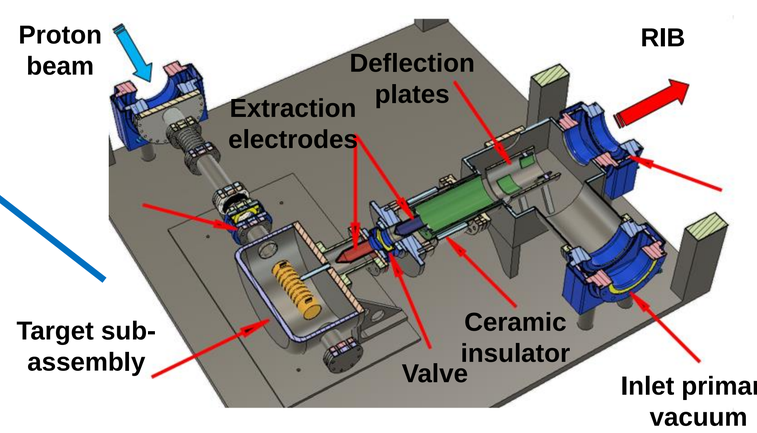
[1] *Belgian Nuclear Research Centre, SCK•CEN, Mol, Belgium*

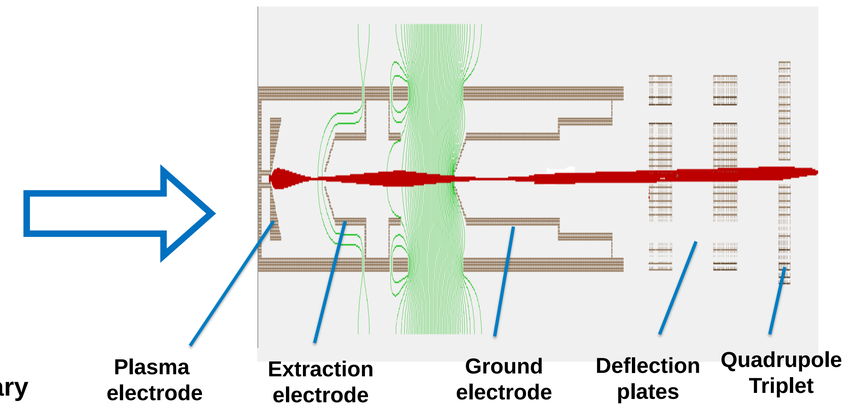
E-mail: pcreemer@sckcen.be



Motivation

- ISOL@MYRRHA-phase 1: 100-MeV protons will be used to produce radioactive ion beams (RIB) through the isotope separation on-line (ISOL) technique
- Conceptual design of the facility together with its target module: special attention towards a quick and reliable target exchange
- The target module integrates the target and ion source, the RIB-extraction electrodes and the RIB-deflection plates
- Experimental studies require a good mass resolution, which is highly influenced by the beam quality
- Beam quality and shape are determined by the ion source and the geometry and potentials of the extraction electrodes
- Ion-beam optics found with an automated optimization algorithm within the particle-trajectory calculation code SIMION



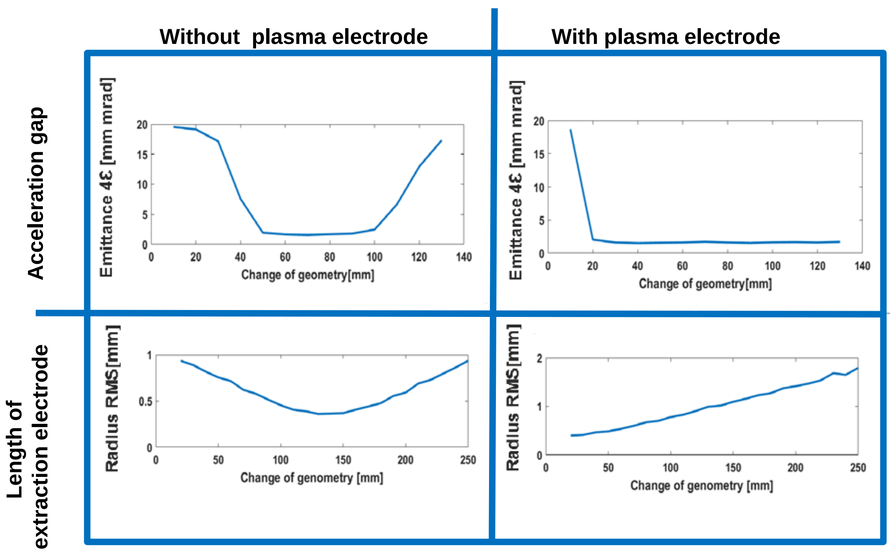


Plasma electrode

When introducing the plasma electrode (a cone-shaped electrode around the ion source), two interesting aspects are noticed while scanning the acceleration gap and length of the first extraction electrode:

- The emittance is less dependent on the size of the acceleration gap
- The shorter the extraction electrode the smaller the beam

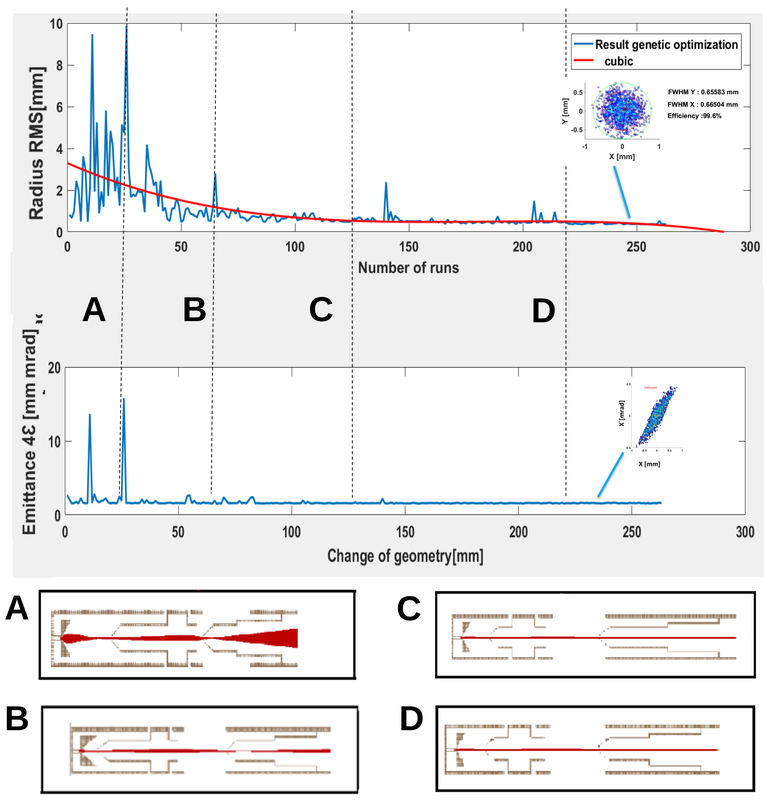
Due to mechanical and thermal constraints the plasma electrode will be useful within the beam optics.



Extraction electrode

For the design of the extraction electrode, a genetic optimization algorithm is used to find the minimum radius of the ion beam, which leads to the following set of parameters:

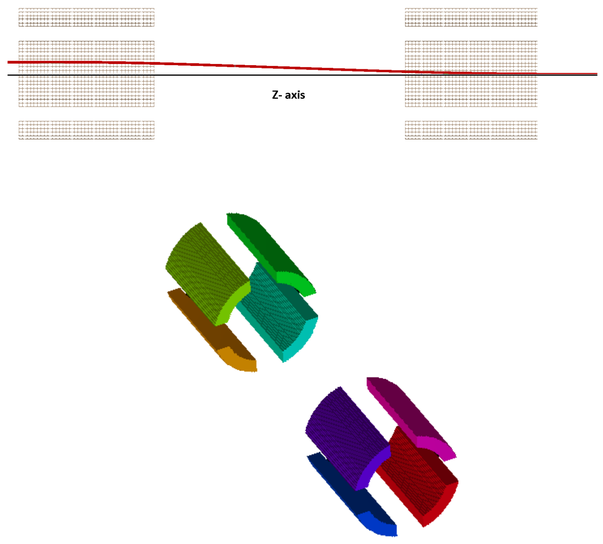
- Acceleration gap : 74 mm
- Length first electrode : 38 mm
- Angle plasma electrode and extraction electrodes: 33°
- Gap between first and second electrode : 183 mm
- Length second electrode :104 mm



Deflection plates

To cope with the mechanical misalignment of the optics, two sets of deflection plates are used. The required voltages were found by a simplex optimizer. The proposed design is capable to :

- Correct misalignment of 1 mm of the extraction electrode
- Correct misalignment of 5 mm of the target module



Discussion

- The computed emittance is 1,6 mm mrad as compared to 4 – 6 mm mrad found in literature.
- Simulation method validated with the results presented in [1].

Conclusion

- First conceptual design of the ISOL@MYRRHA facility is under development at SCK •CEN.
- Calculations of the beam optics were performed to determine dimensions of target module.

[1] A. Sen et al. “Extraction and low energy beam transport from a surface ion source at the TRIUMF-ISAC facility Volume 376, Nuclear Instruments and Methods in Physics Research Section B,1 June 2016, Pages 97-101