

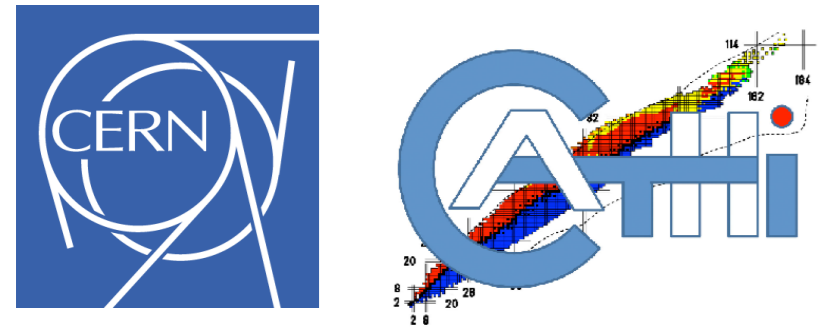
HIE-ISOLDE FARADAY CUP PROTOTYPE TESTED AT CERN

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Abstract



In the framework of the High Intensity and Energy (HIE)-ISOLDE project at CERN, a beam instrumentation R&D program is on-going for the superconducting upgrade of the REX-ISOLDE heavy-ion post-accelerator. An overview of the preliminary tests of the HIE-ISOLDE Faraday cup prototype is presented, focusing on the challenging specifications required by the HIE-ISOLDE LINAC. The length constraint of the diagnostic boxes results in a very compact Faraday cup design. Containing secondary electrons with this design is highly challenging, therefore additional enhancements are proposed to ensure a correct measurement of beam intensity. The design status of the Faraday cup is presented as well as the results of some experimental tests.

Table 1 - Nominal beam parameters*

| Scenario | Energy (MeV/u) | Typical Beam Size at waist, $\pm 3\sigma_{rms}$ (mm)* | $\epsilon_{x,geo.}^{rms}$ (π mm mrad) | $\epsilon_{x,norm.}^{rms}$ (π mm mrad) | $\epsilon_{x,geo.}^{95\%}$ (π mm mrad) | $\epsilon_{x,norm.}^{95\%}$ (π mm mrad) | Time Structure |
|---------------|----------------|---|--|---|---|--|------------------------|
| High Energy | 10 | ± 2.7 | 0.60 | 0.09 | 3.14 | 0.46 | Bunched @ 101.28 MHz |
| Medium Energy | 5.5 | ± 3.0 | 0.81 | 0.09 | 3.95 | 0.45 | Bunched @ 101.28 MHz |
| Low Energy | 0.3 | ± 6.3 | 3.55 | 0.09 | 17.8 | 0.45 | Debunched @ 101.28 MHz |

*Given at the approximate location of the beam diagnostic box between the doublet quadrupoles, $\beta_x = \beta_y = 2.2$ m.

The Diagnostic Box has a modular design with 6 ports. In Fig. 4, from top right and going clockwise we have: slit scanner, pumping port, stripper/attenuator foils, Faraday cup (>1 pA), solid-state detector and vertical collimator slits. The short FC is also a Profile Monitor together with the slit scanner.

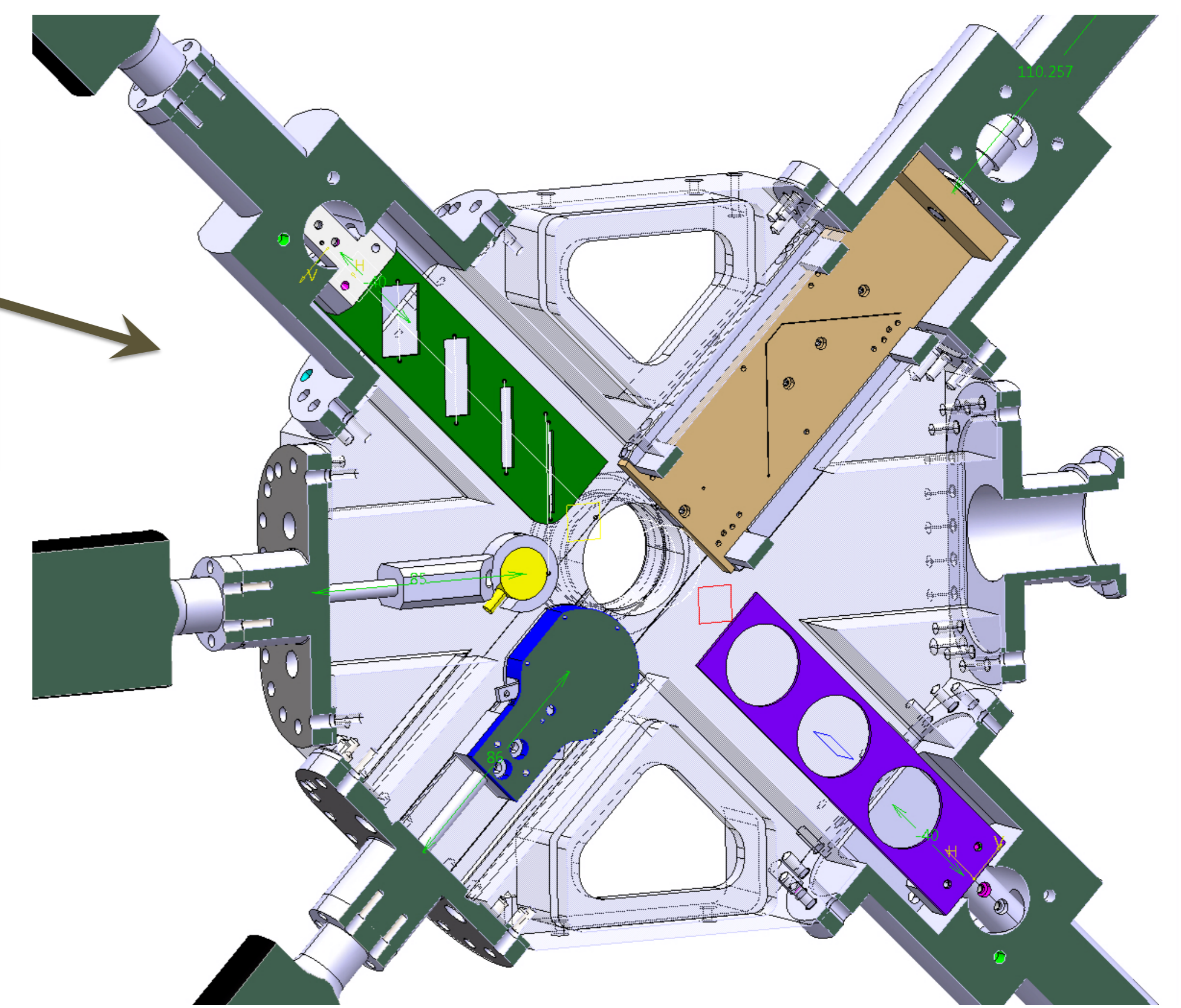


Figure 4. Cross section of the diagnostic box.

3 stages installation

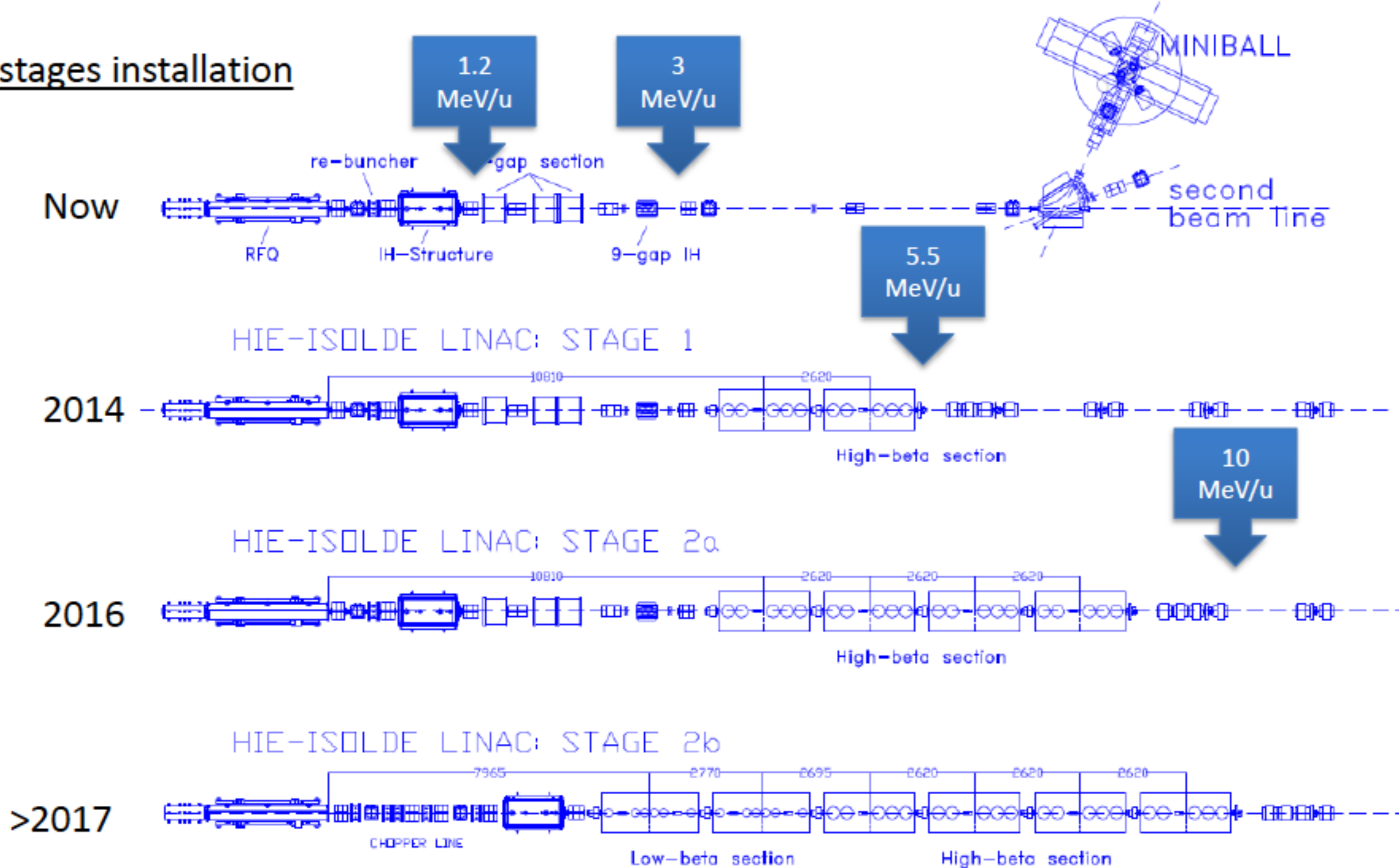


Figure 1. Layout of the HIE-ISOLDE LINAC in the different stages.

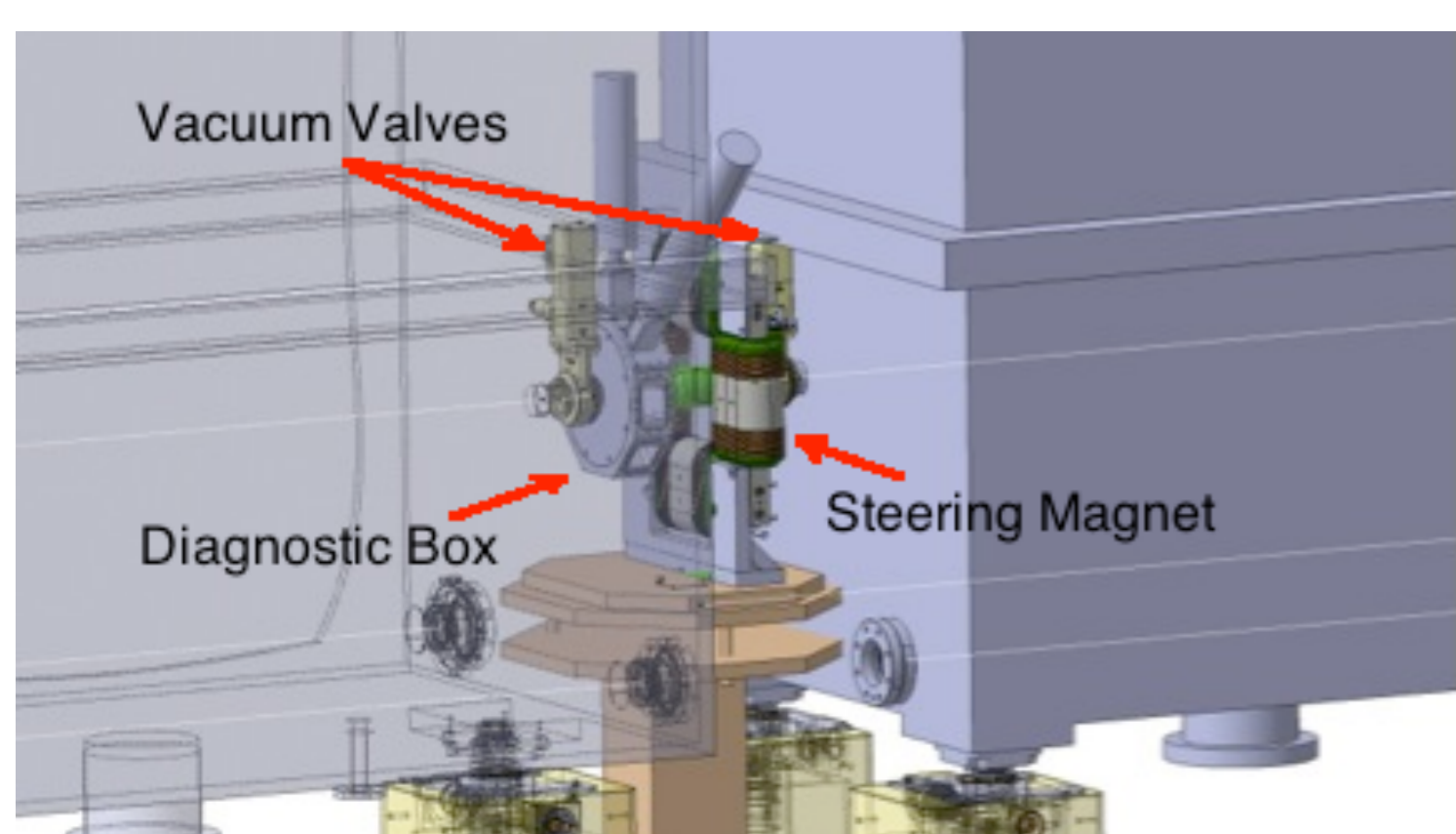


Figure 2. Computer model of the inter cryomodule region.

Figure 3. Simulations of the potential lines in the Faraday Cup with repeller ring (right), tungsten wires connected to the rep. ring (bottom left) and the collector plate connected to +500 V (bottom right).

HIE FC - slits in; $V_{rep} = -200$ V; $d = 10$ mm.

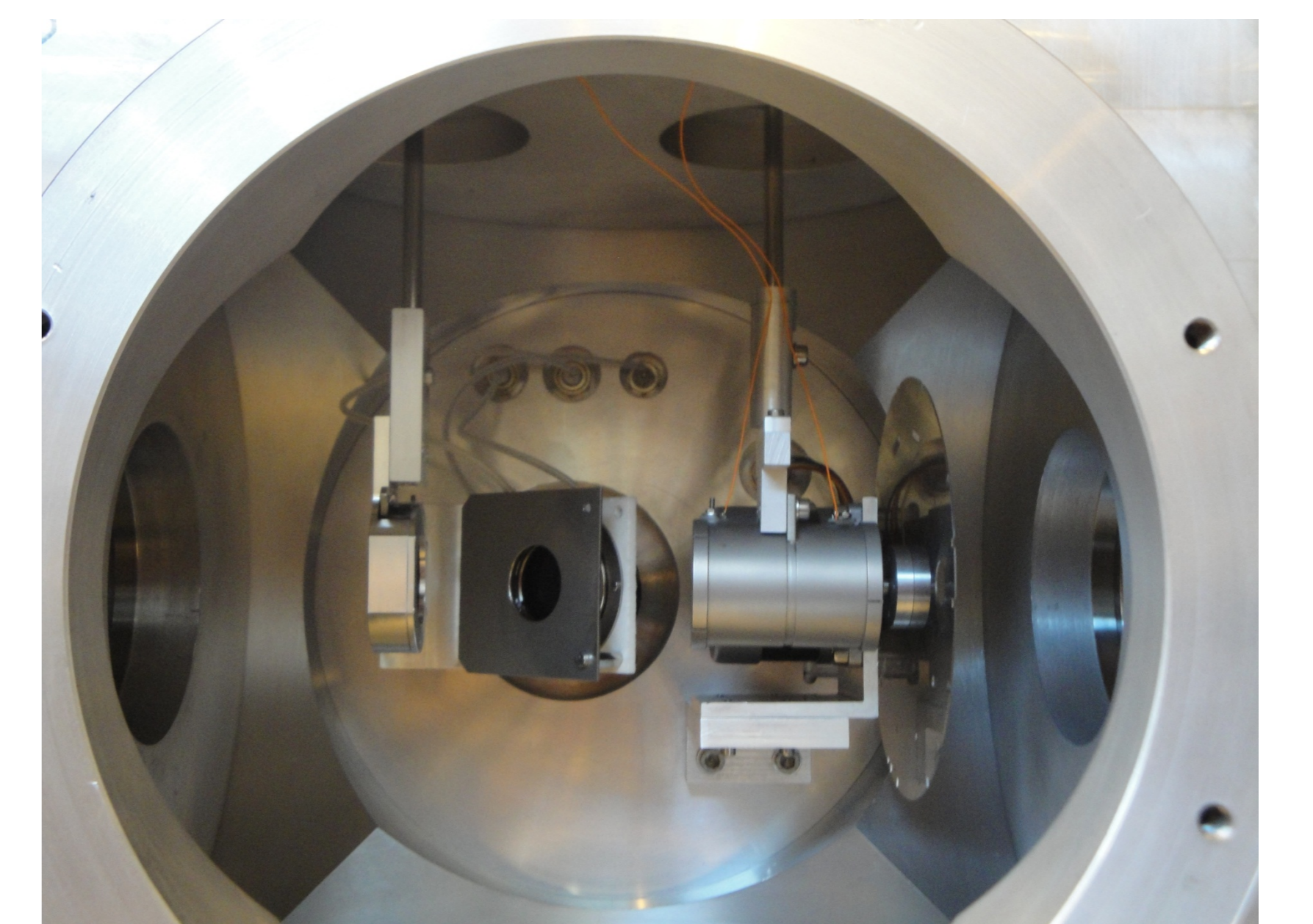
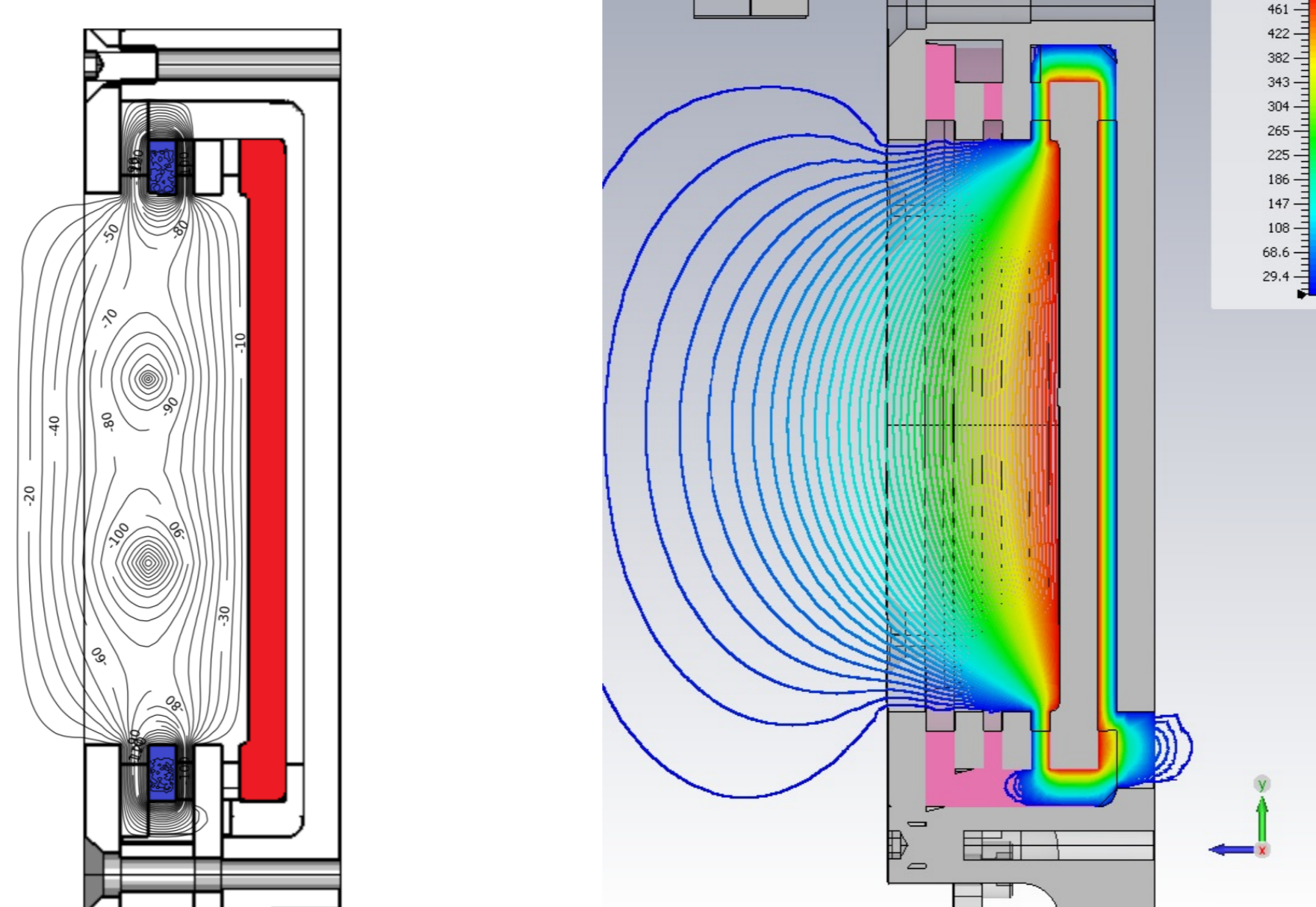


Figure 5. Picture of the HIE-ISOLDE Faraday cup prototype (left) and REX-ISOLDE Faraday cup (right) inside diagnostic box 6 (L20) at REX-ISOLDE.

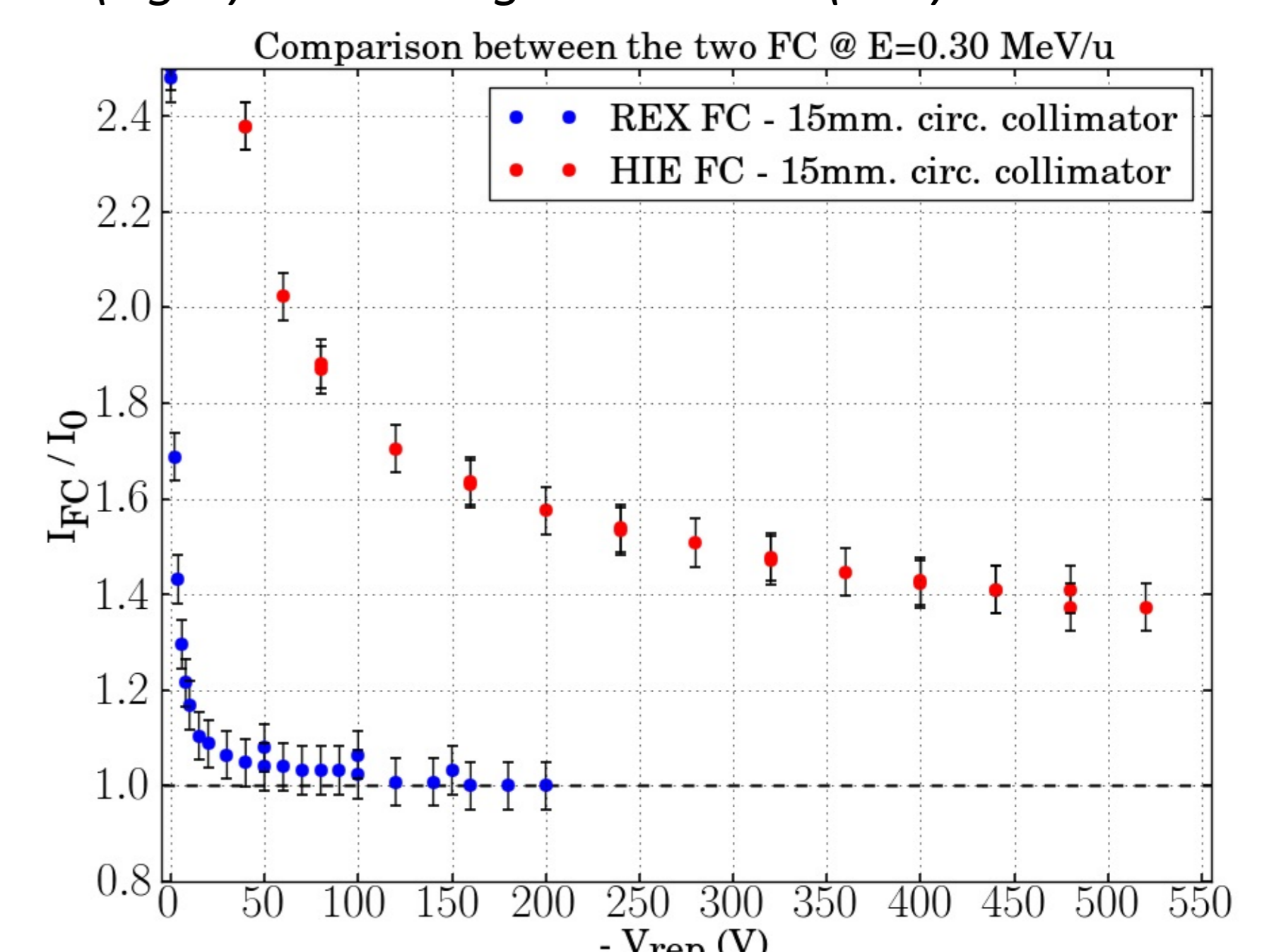


Figure 6. Beam currents measured by the REX cup (blue) and the HIE cup (red) using the repeller ring.

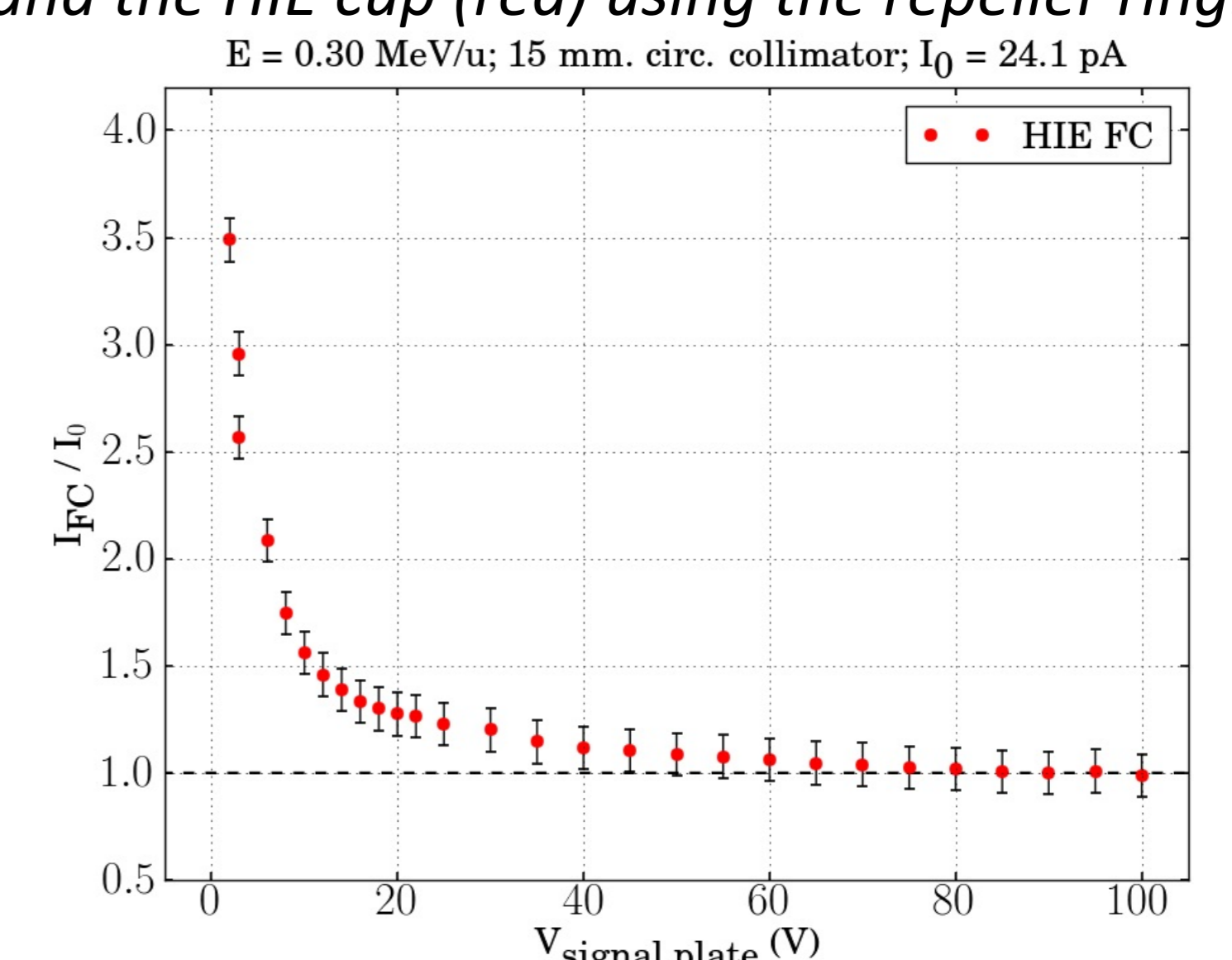


Figure 7. Beam current measured by the HIE cup using the polarized collector plate.

Summary

- 25 Diagnostic Boxes in total (7 along the LINAC and 18 in the beam transfer lines).
- Beam intensity range in the SC LINAC: <1 pA to nA
- Beam energy range in the SC LINAC: 0.3 MeV/u to 10 MeV/u ($A/Q=4.5$)