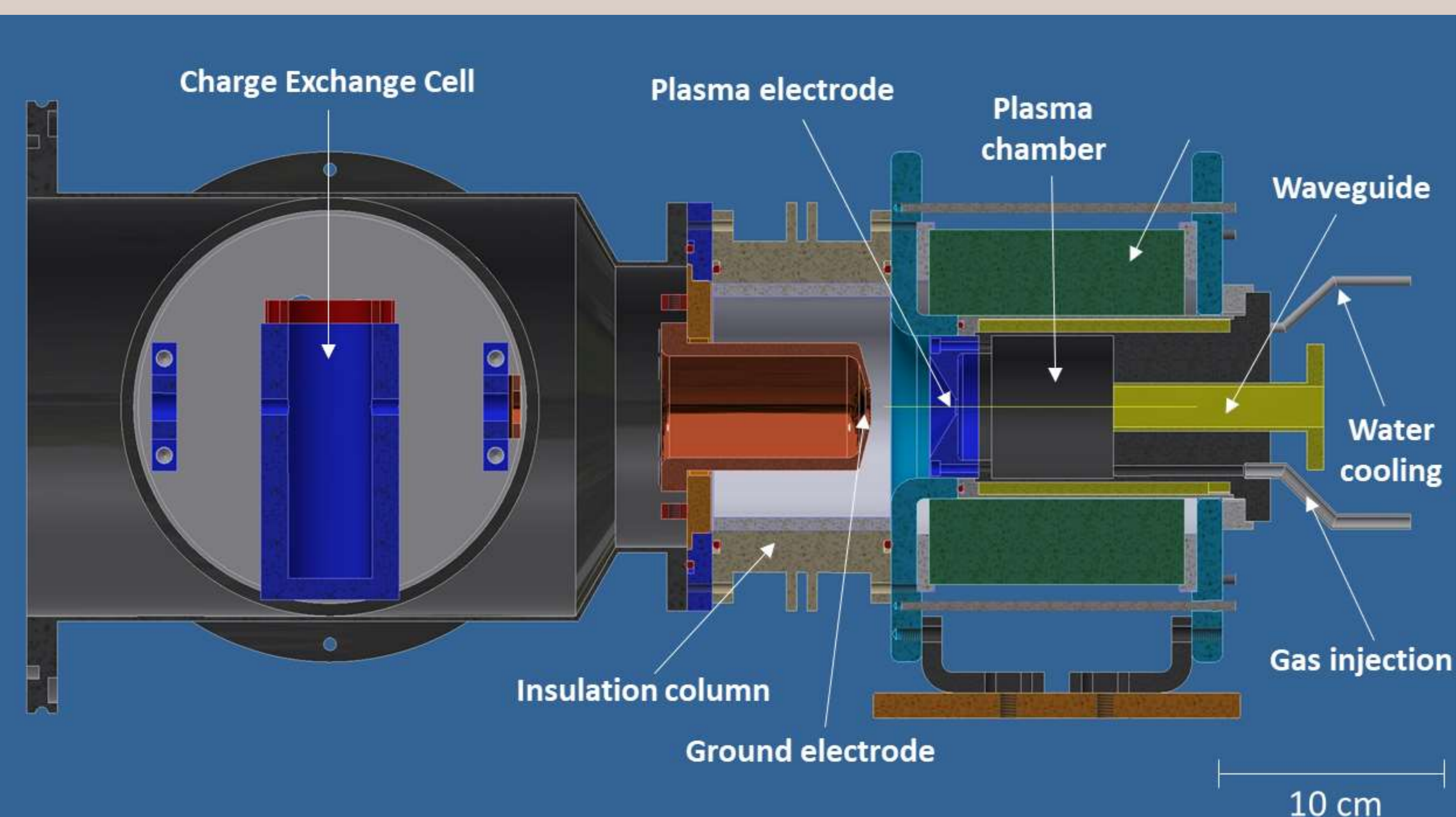


Abstract

A new source for the TANDEM accelerator of LNS has been designed and installed. It is called NESTOR (Noble Elements Source for accelerATORS) and consists of an ultra-compact ECR ion source operating at about 6 GHz, up to 40 W of RF power provided by a solid state power amplifier, coupled to a Li-Charge Exchange Cell (Li-CEC). It is engineered for the production of a wide range of 1^+ and/or 1^- ion beams from gaseous elements, in particular for noble gases. This work presents the characterization of the primary source and first operations of the whole setup on the HV platform (injector) of the Tandem. The He^+ beams have been formerly characterized in terms of current, beam shape (by BaF_2 beam viewers) and emittance (by the three-gradients method). Measurements have been carried out varying pressure, microwave frequency and RF power. Then, the source has been moved to the HV platform, coupled to the Li-CEC for first operations running in gas-exchange mode. Activities are ongoing to optimize beam transport towards the Tandem.

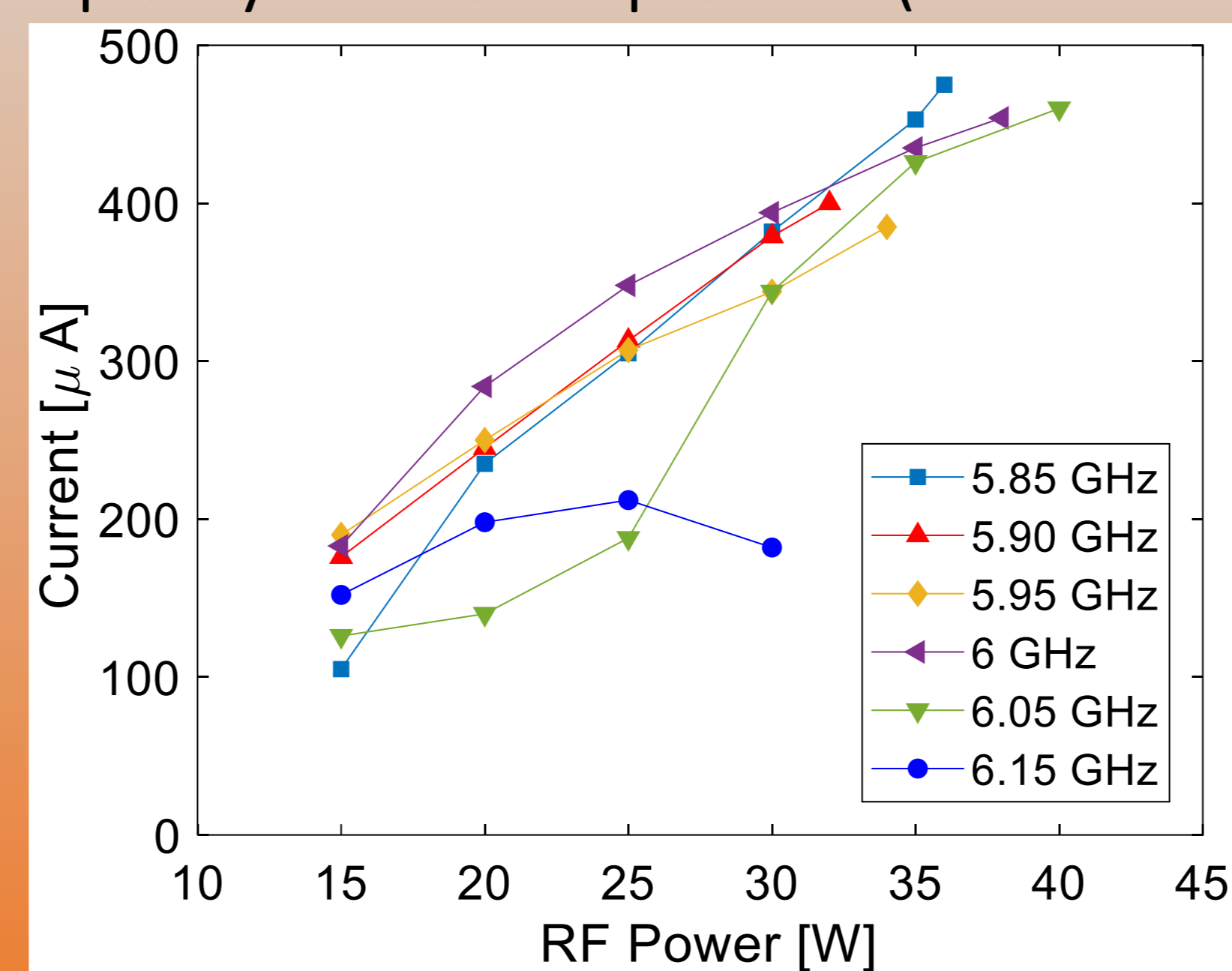
Scheme of the ECR ion source and Li-CEC



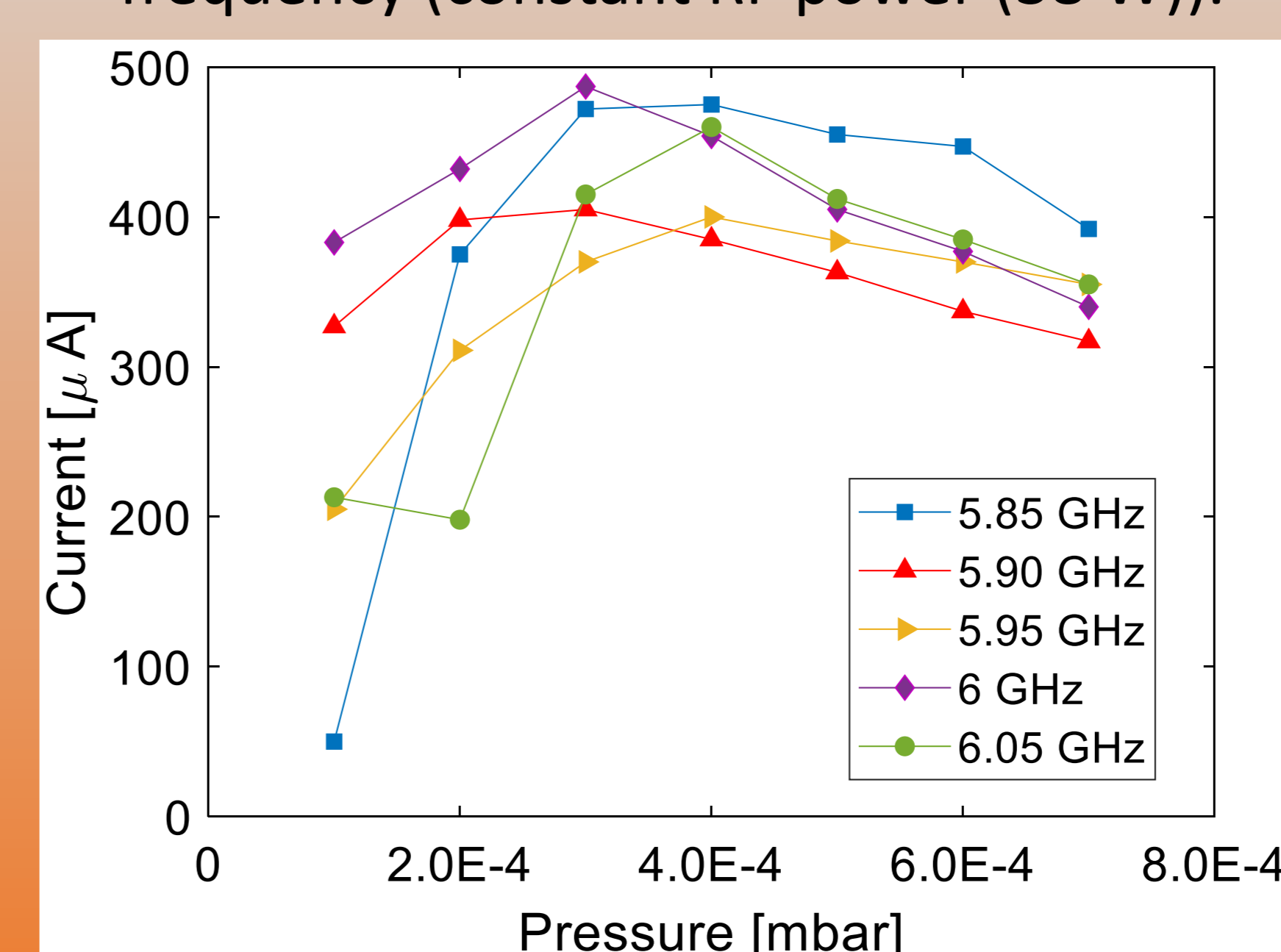
NESTOR is based on the coupling between an ultra-compact ECR ion source – whose total size, including ancillaries is of $30 \times 30 \times 30 \text{ cm}^3$ – to a Li-based Charge Exchange Cell

Results on the primary He^+ source

Extracted current as a function of RF power and frequency at constant pressure ($4 \cdot 10^{-4}$ mbar).



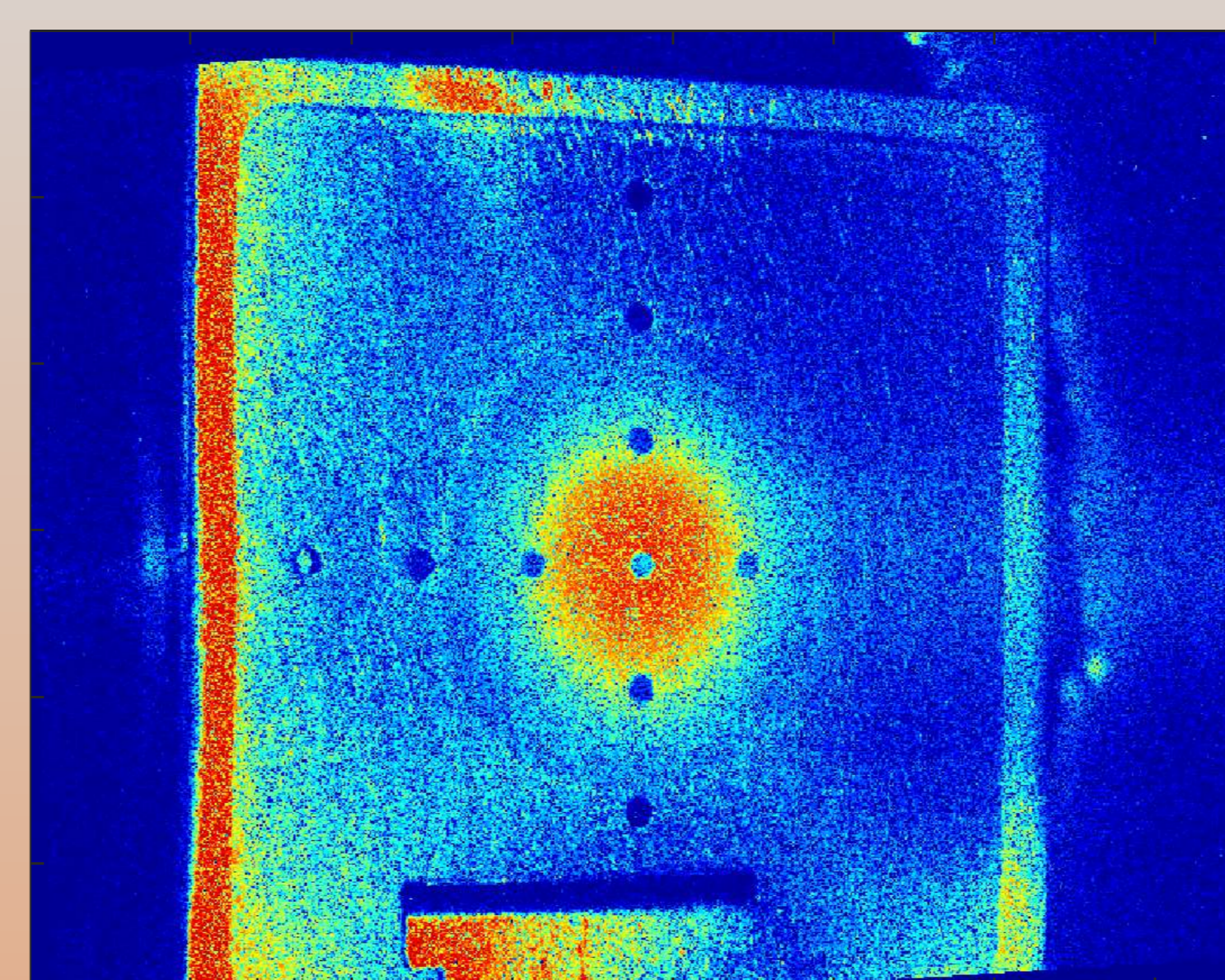
Extracted current vs. pressure, at different RF frequency (constant RF power (38 W)).



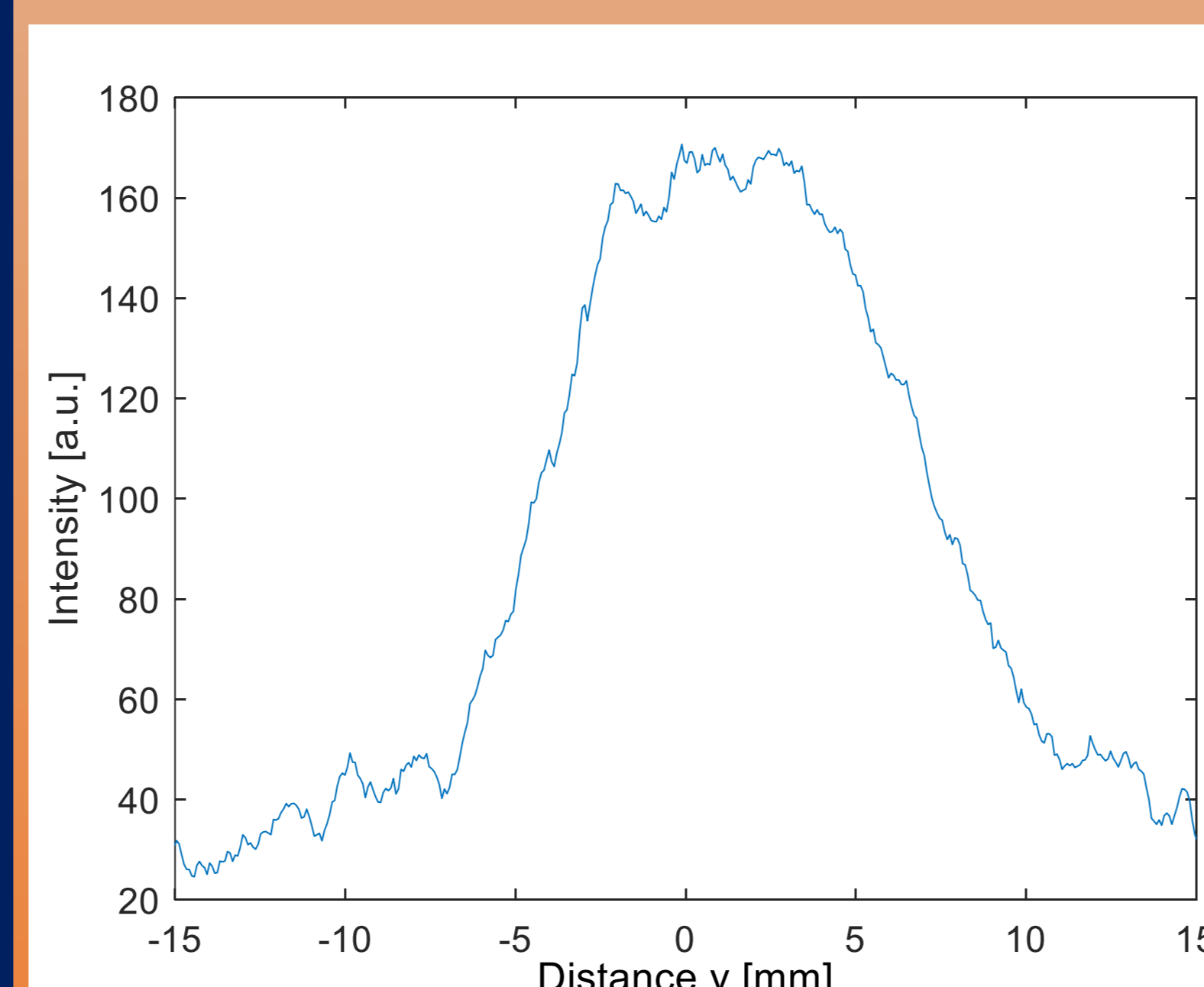
Beam emittance (A rough estimation by the three-gradients method)

Beam Intensity [μA]	ϵ_x [$\pi \text{ mm mrad}$]	ϵ_y [$\pi \text{ mm mrad}$]
480	14.13	15.07
420	13.24	14.05
345	11.82	13.30
260	11.26	11.89

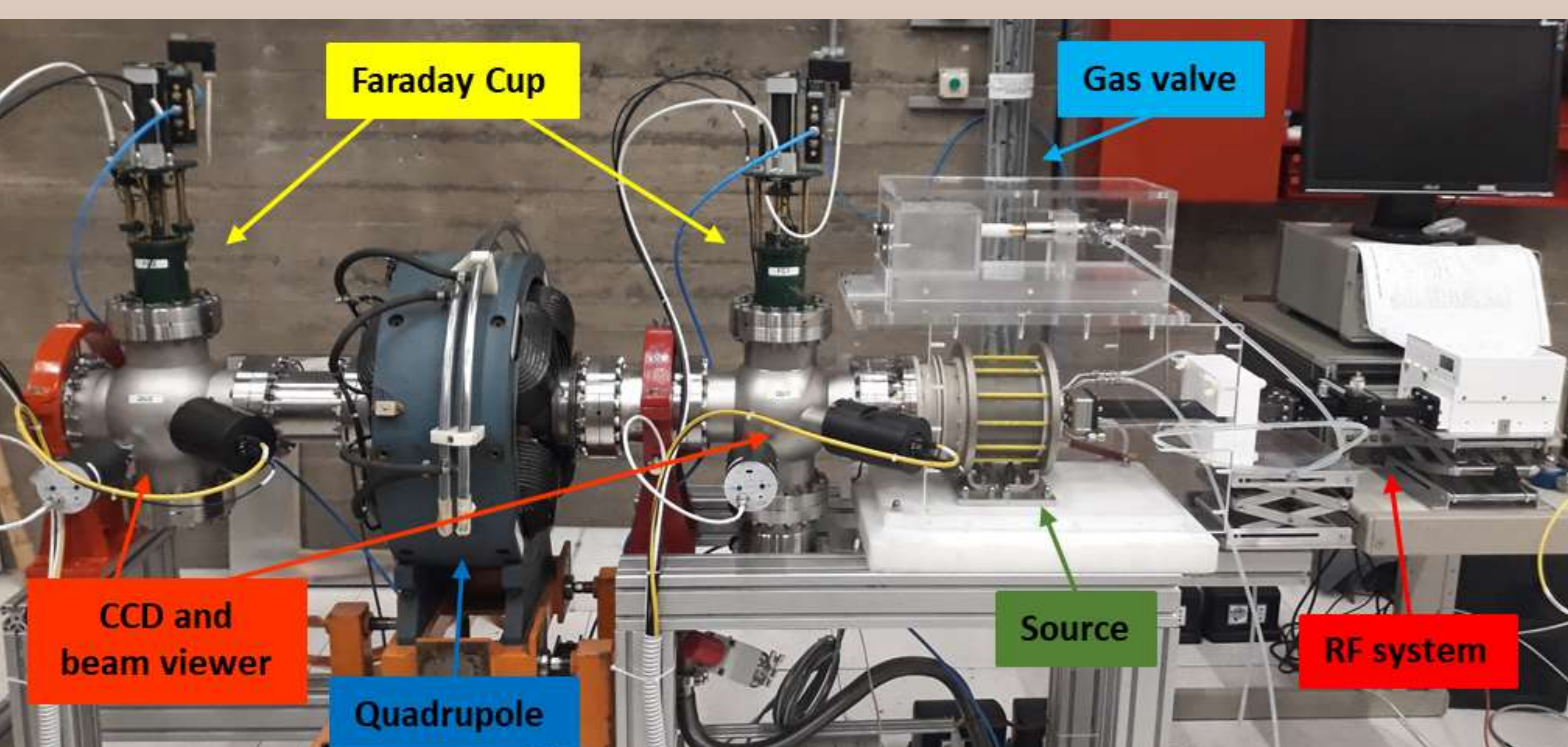
Beam imaging



Beam profile

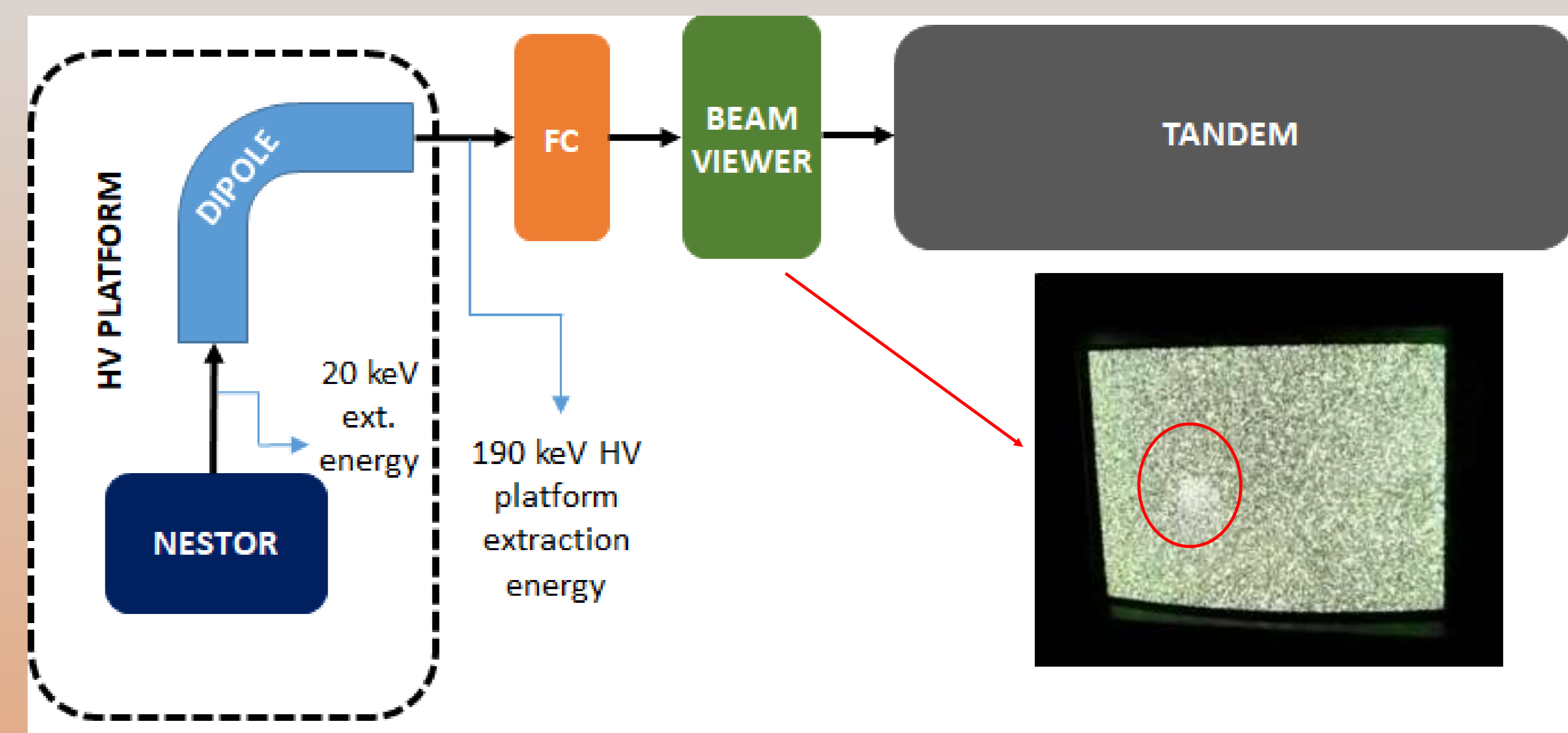


ECR ion source and beam line layout



The beam commissioning of primary source started in May 2020. The characterization of the He^+ beam has been performed by means of a Faraday Cup and a system consisting of a quadrupole and a beam viewer in order to perform the emittance measurement by the three-gradients method.

NESTOR installation and very first He^- beam



- NESTOR has been installed in early September 2020 on the 450 kV platform for the production of noble gases negative ions for the Tandem Accelerator;
- Preliminary tests have been carried out and few nA currents of He^- beams have been already measured;
 - Further numerical investigations on the beam optics are ongoing;
- Tests will continue during the major shutdown of the LNS facilities and will be focused in finding the best source tuning to increase the He^- beam including also the acceleration through the Tandem.

Beam optics simulations

