

Abstract

An RF-driven long-lifetime H⁻ ion source operating at 50 Hz with 1.5% duty factor and 35 keV beam energy is currently under development for the ISIS Neutron and Muon Source at Rutherford Appleton Laboratory. The new ion source is designed operate with an upgraded medium energy beam transport (MEBT) that will provide improved transport efficiency and reduced beam losses. This paper will give an update on the progress made on the project and an overview of the development of the support equipment required for the operation of the ion source with an emphasis on the details of the RF and high-voltage power supply systems.

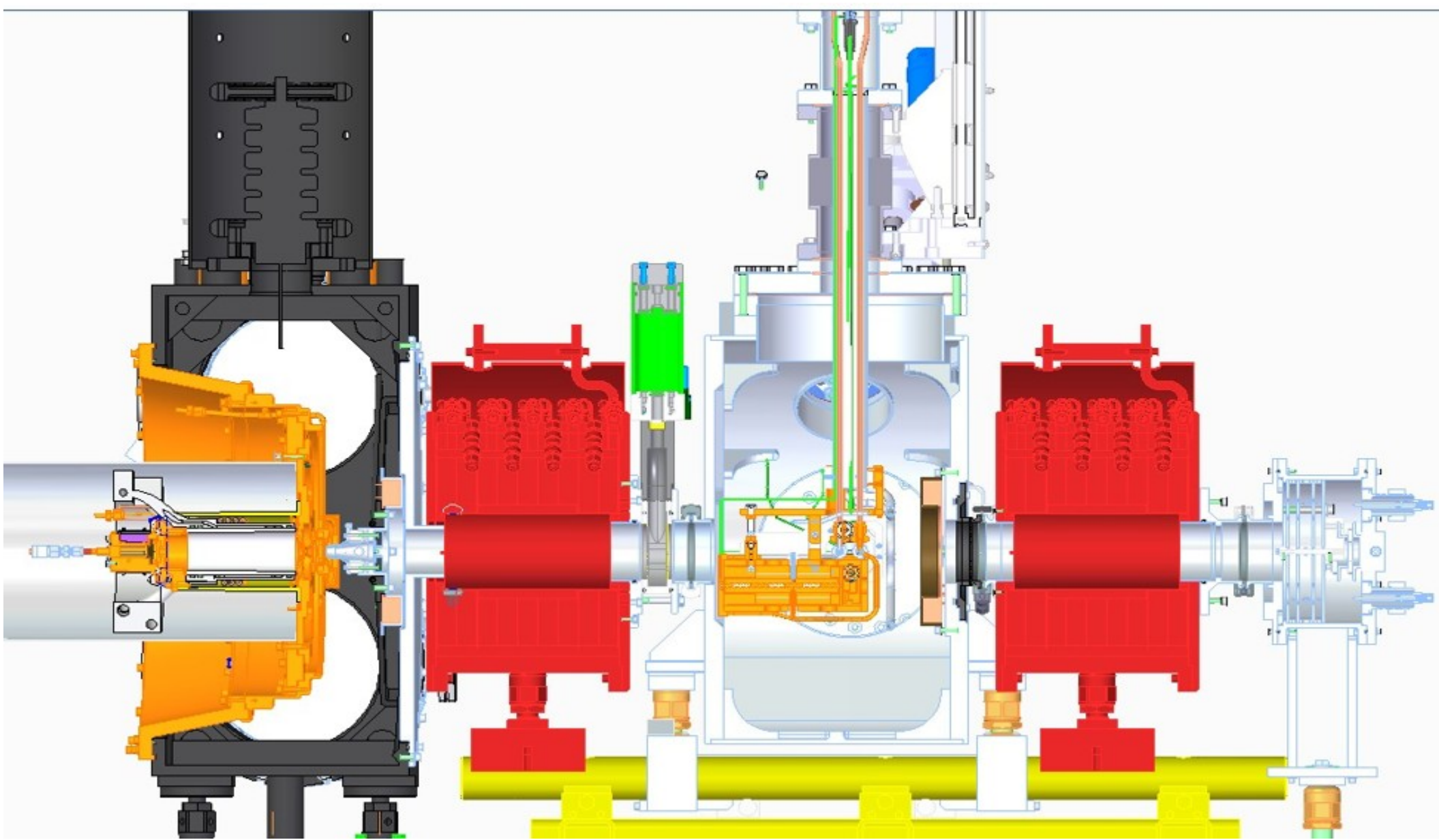


Figure 1. New RF Ion Source and LEBT

The Ion Source and MEBT upgrade project at RAL is intended to improve the beam transfer efficiency into Tank 1 of the Linac, allow the installation of beam chopper and change to more reliable inductively coupled plasma RF driven ion source. An overview is show in Figure 1.

A first attempt was made to satisfy the beam requirements (35 mA, 300 us, 50 Hz) with an uncaesiated ion source operating in the region of 2 - 4 MHz, no cusp magnets, external filter magnets, a novel 2.45 GHz microwave ECR ignition gun, biased plasma electrode and 2-stage extraction system.

During the initial commissioning of the uncaesiated ion source several emittance scans were undertaken, shown in Figure 2. The results from this were promising, showing that the emittance was within specifications. The large number of co-extracted electrons (on the order of amperes) was, however, severely limiting both for the extraction electrodes and the power supply, this limited running of the ion source to 6.25 Hz.

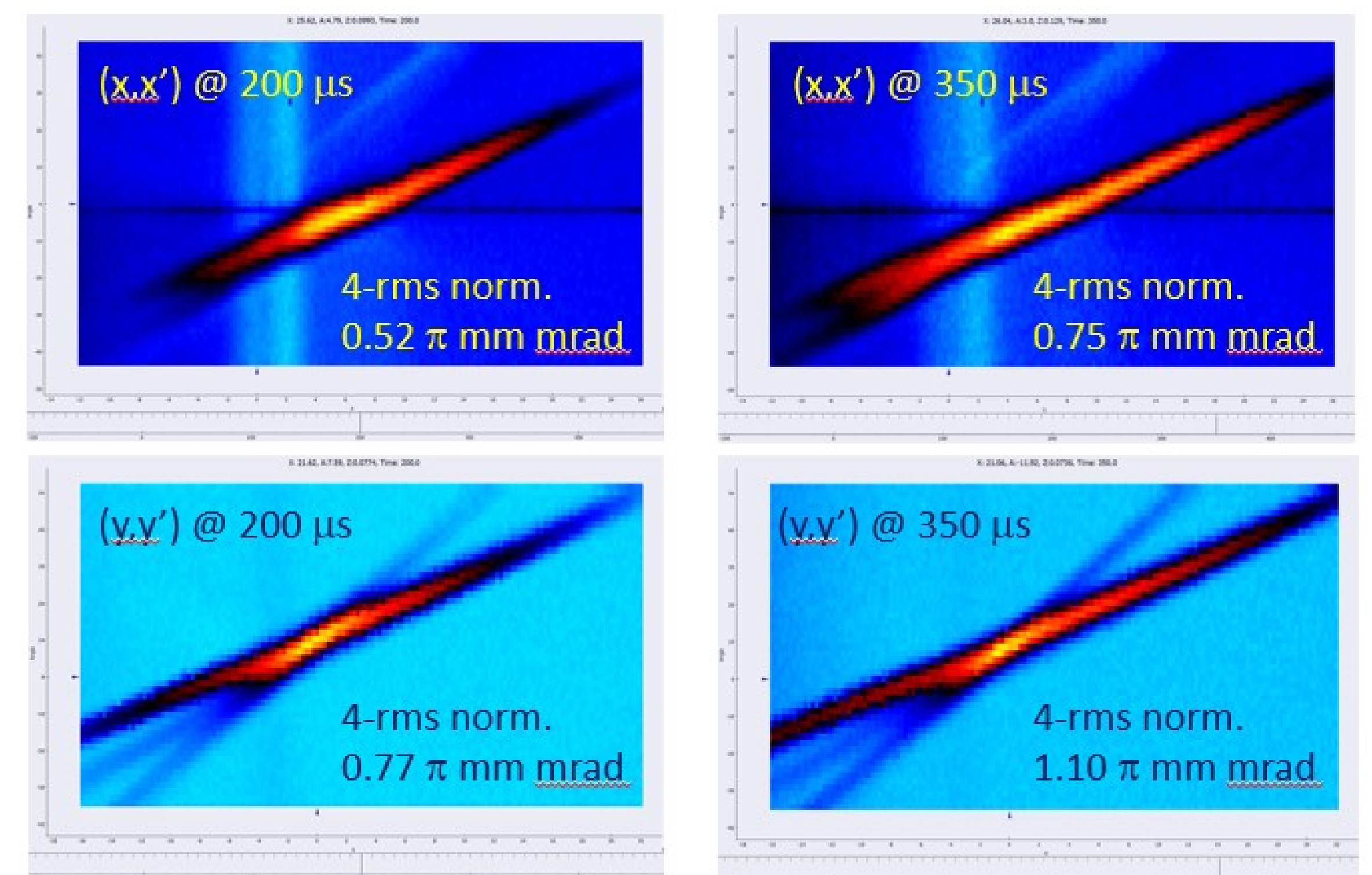
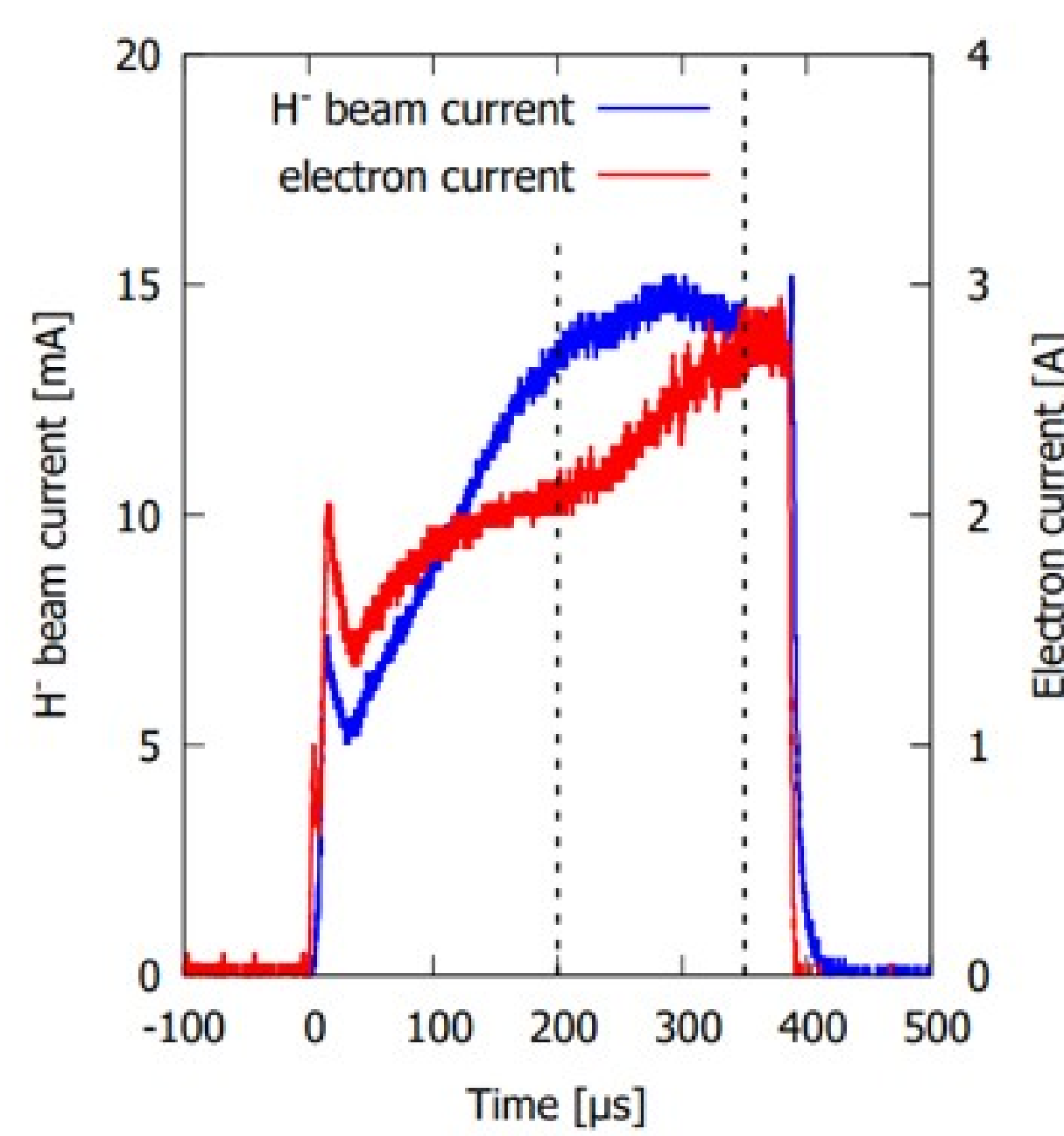


Figure 2. Initial beam pulse and emittance measurement

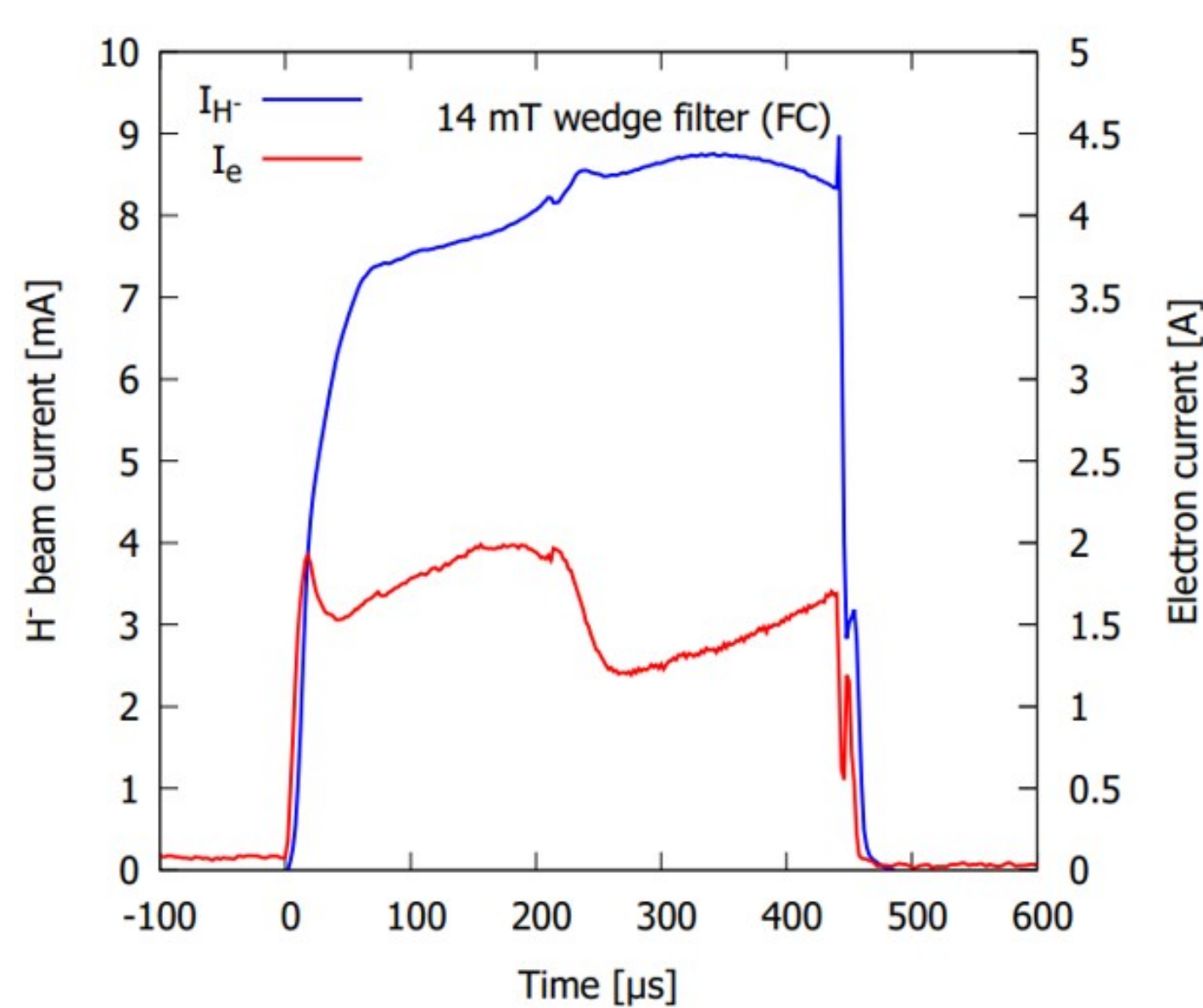


Figure 3. Beam with optimised filter field

Parameter	Value
RF power	58 kW (f)/ 8 kW (r)
RF frequency	3.37 MHz (50 μs)
	3.39 MHz (350 μs)
H ₂ feed rate	17 + 17 sccm
PE voltage	14 V
Extraction voltage	11.2 kV (36 kV)
Solenoid #1	460 A
Solenoid #2	475 A

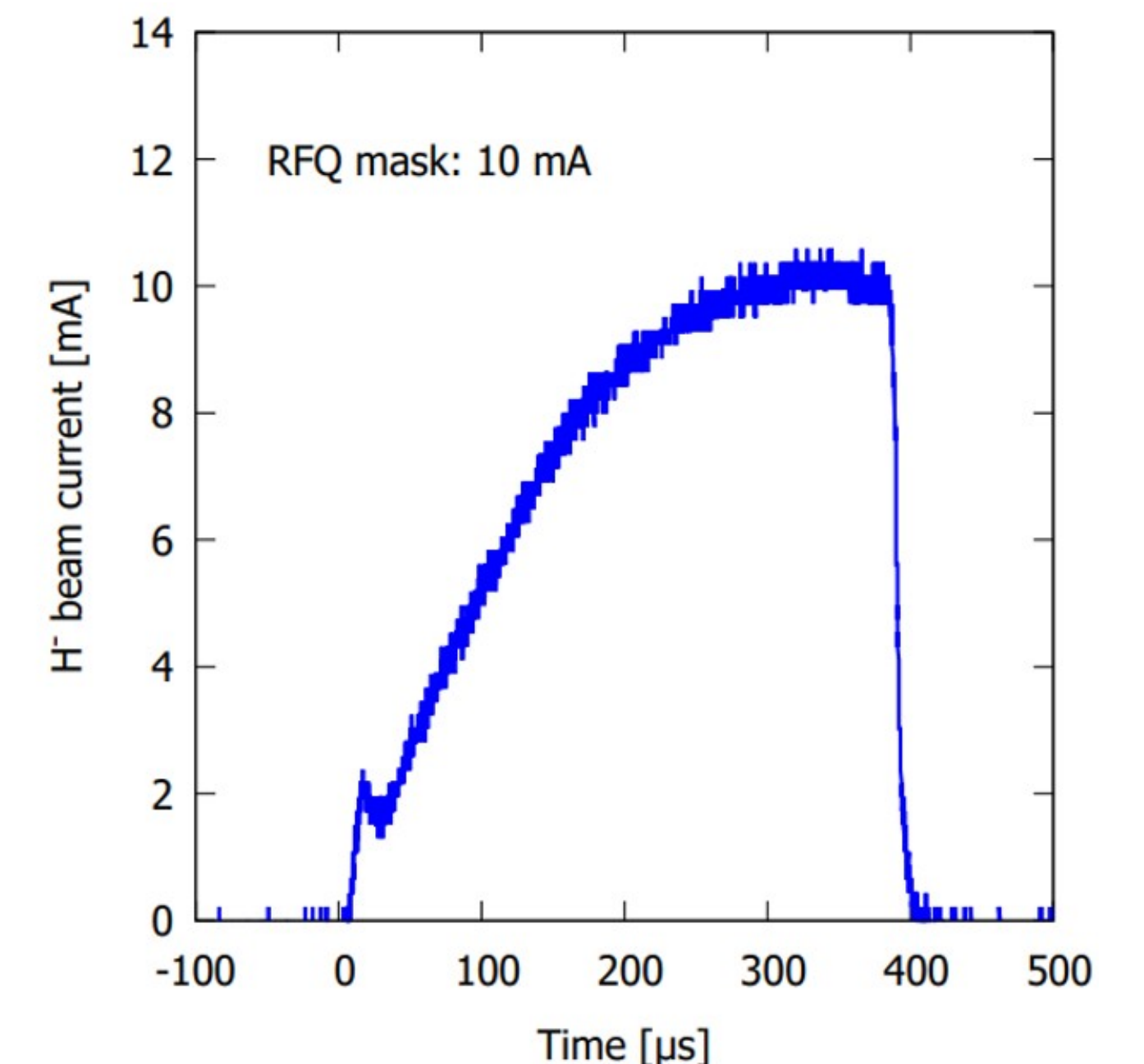
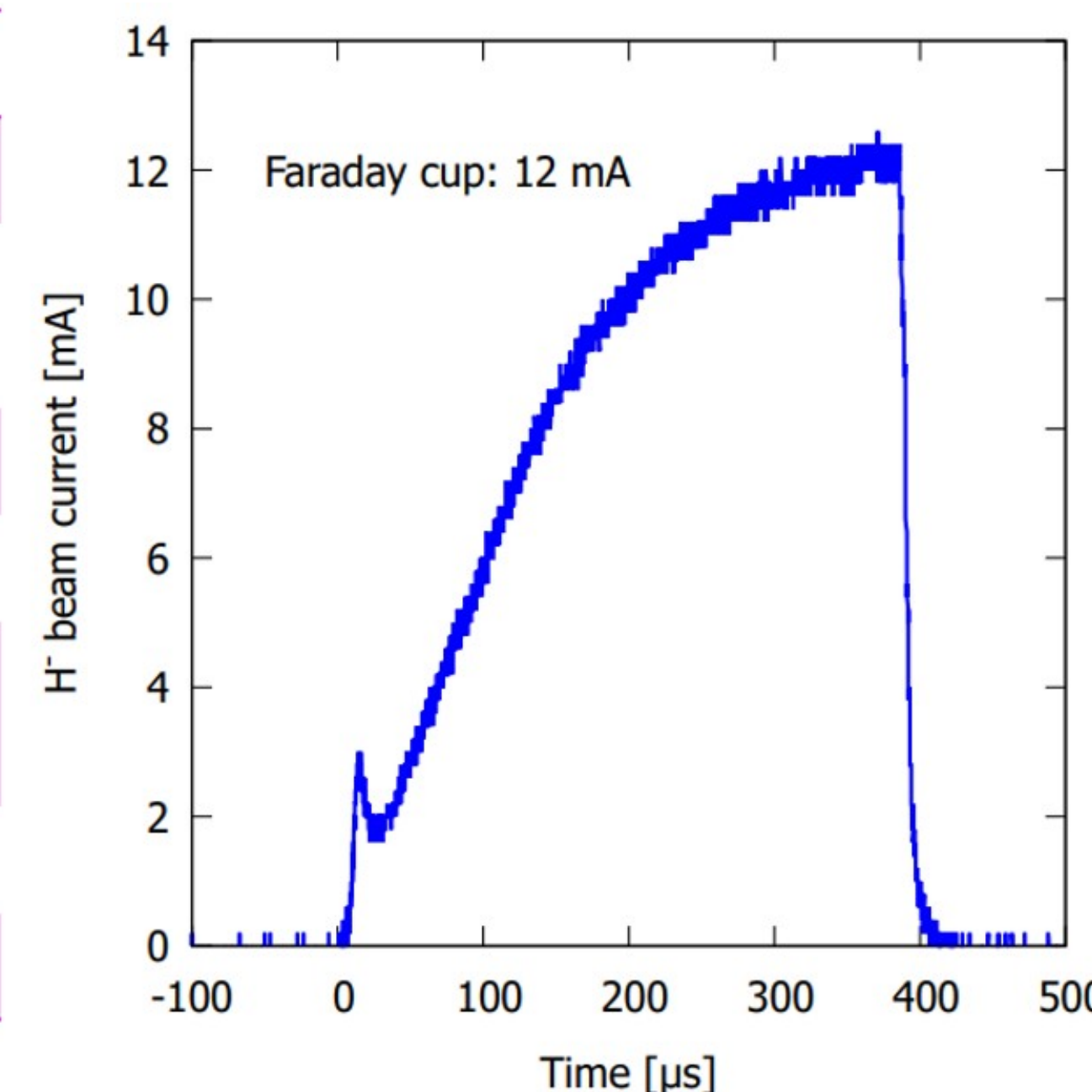


Figure 4. Ion source parameters



Figure 5. Melted protection electrode

The filter field strength was optimised in the range of 11 - 17 mT to try achieve a higher beam current, an increase in both H⁻ and electron current was observed. The peak in beam current at the end of the pulse shown in Figure 3. suggests a problem in the extraction system.

The conclusion from the initial running is that in order to reduce the co-extracted electron current to manageable levels we must caesiate using a collar system based on the SNS design shown in Figure 6.

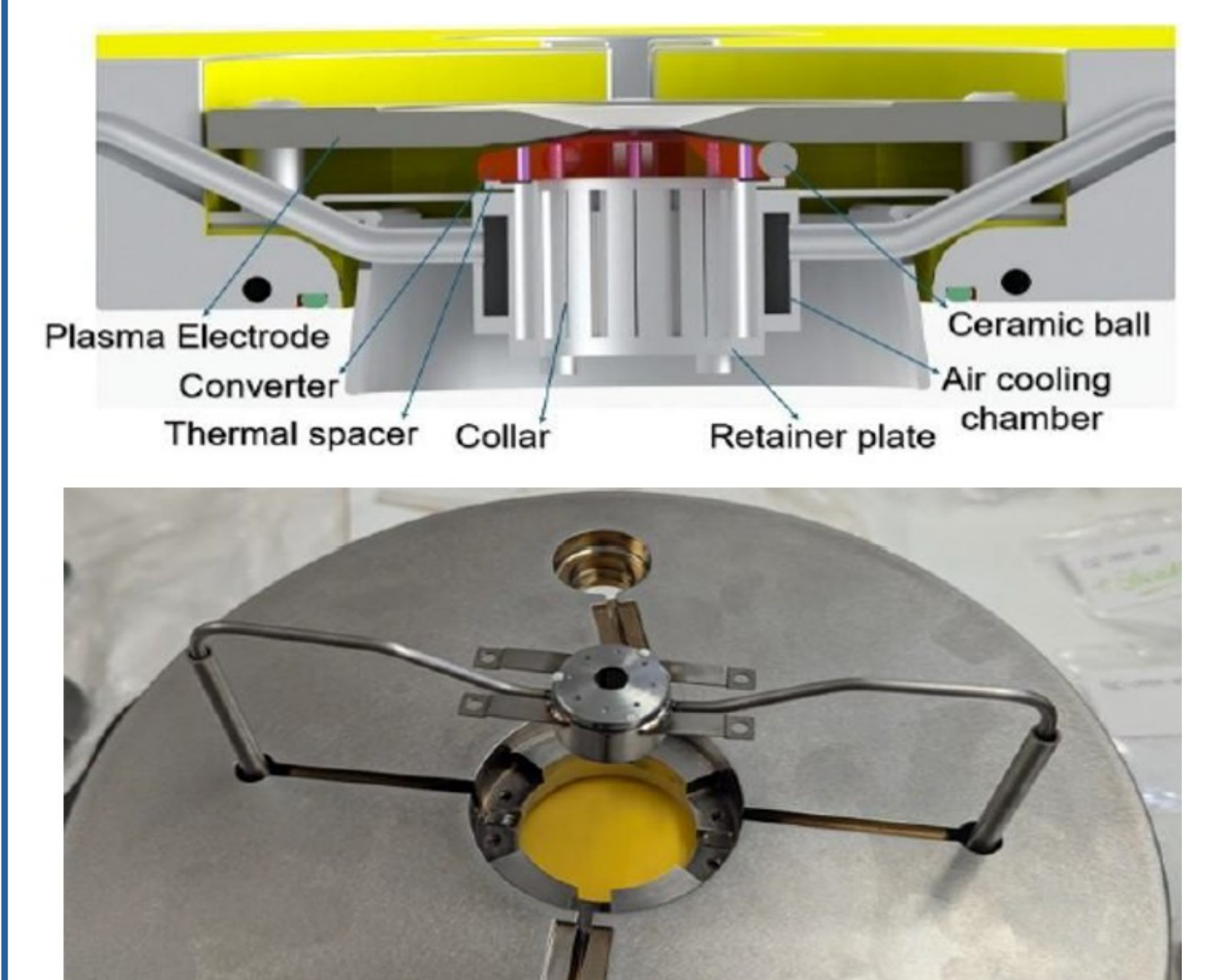


Figure 6. New Caesium collar and flange