# High Resolution Ion Beam Profile Measurement System

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A high resolution system designed for measuring the ion beam profile in the ion implanter installed at the Ion Beam Laboratory of the Technological Nuclear Institute (ITN) in Lisbon, Portugal, is described. Low energy, high current ion implantation is becoming increasingly important nowadays.

In order to achieve this, the use of electrostatic lens to decelerate a focused ion beam is essential. One needs, however, to be able to measure, with high resolution, the 2D beam profile to guarantee that the beam remains focused. Traditional beam profile monitors use a matrix of detectors like Faraday Cups. This system is meant to be used offline and not during an implantation. It is made of a circular aluminium disc with a curved slit which extends approximately from the centre of the disc to its periphery. The disc is attached to the ion implanter target, which is capable of rotating on its axis. A cooper wire, positioned behind the slit, works like a Beam Stopper and the electric current generated, proportional to the beam intensity, is measured. As the ion implanter is capable of scanning the beam over the target, the combination of vertical beam scanning with aluminium disc rotation allows the beam profile to be measured continuously in two dimensions.

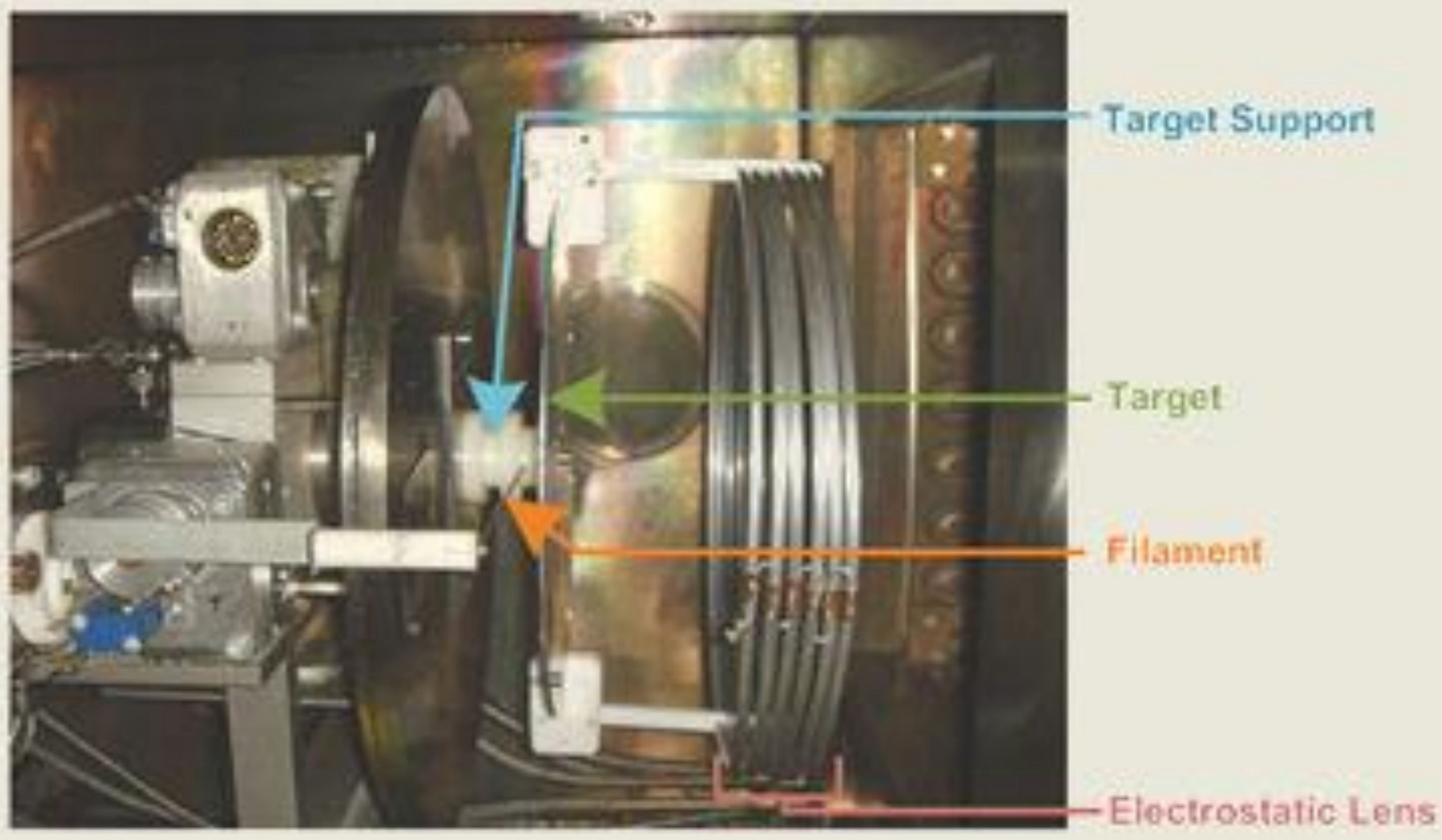



Figure 1 – Mechanical system implemented

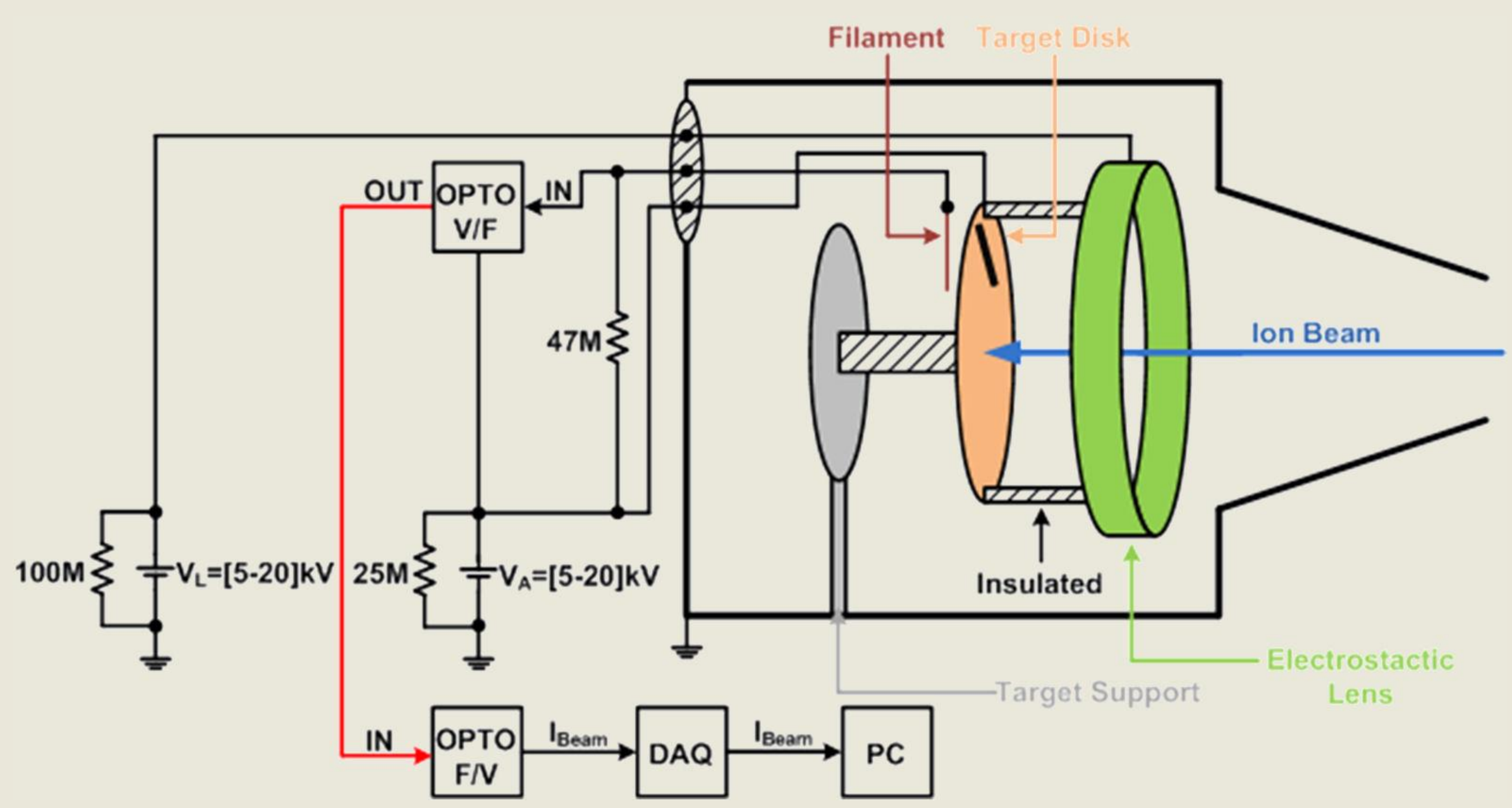



Figure 2 – System developed

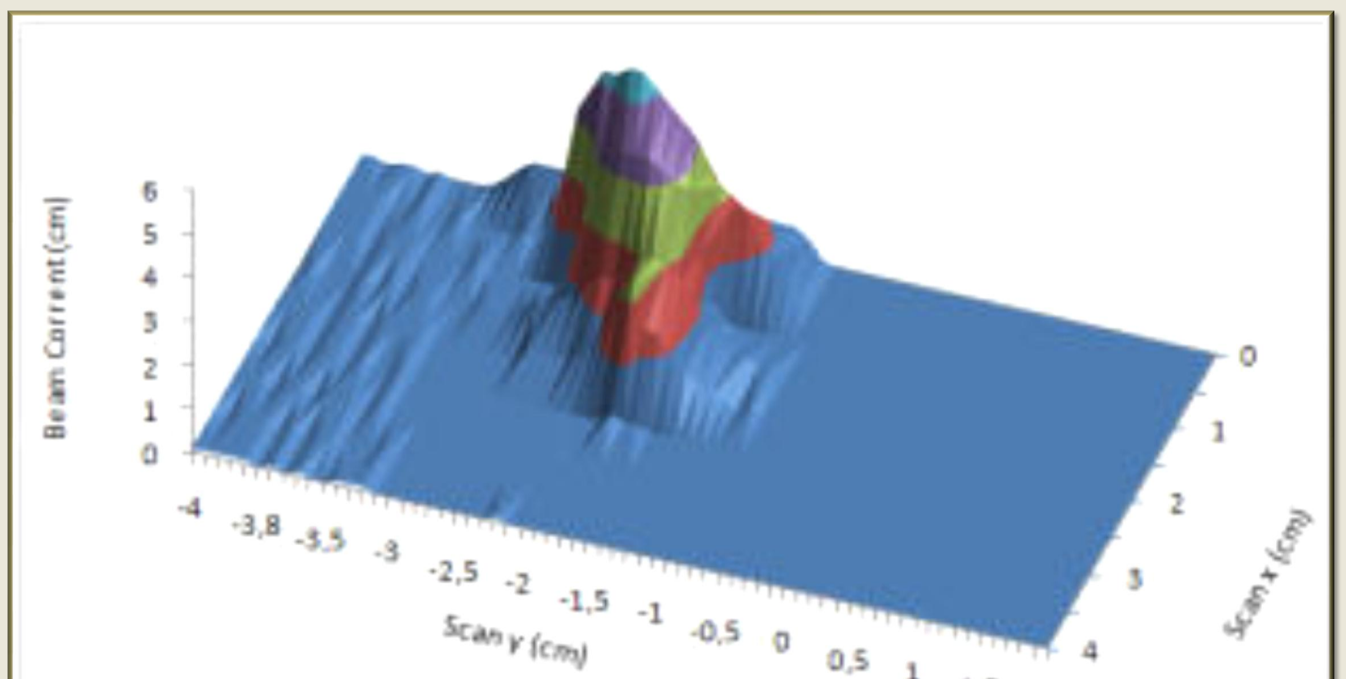
The system developed, figure 1, is composed by an insulated metallic disc of 25 cm diameter, which will be used as target, and a copper wire. The disc is mechanically attached to the implanter target, so it has the same rotating movement. This cooper wire is fixed to the chamber structure and is connected to a microammeter. This way, when the beam hits the disc (target), a small part of it hits the wire and creates an electron current which is measured (figure 2). With the filament placed horizontally, a focused beam can be scanned by rotating the target with the slit gap crossing the beam. If the beam current measured on the filament is collected we get a beam profile section in *x*. By scanning the beam in y using the implanter beam scanning system, we get x and y profile of the beam.

Figure 2 also shows the two high voltage (20 kV) sources used. One biases the lens ($V_L$) and the other biases the target ($V_A$). The resistances of 100 MΩ and 25 MΩ will allow a better stabilization of the voltage, avoiding any voltage fluctuations, while resistance of 47 MΩ is intended to measure the beam current.

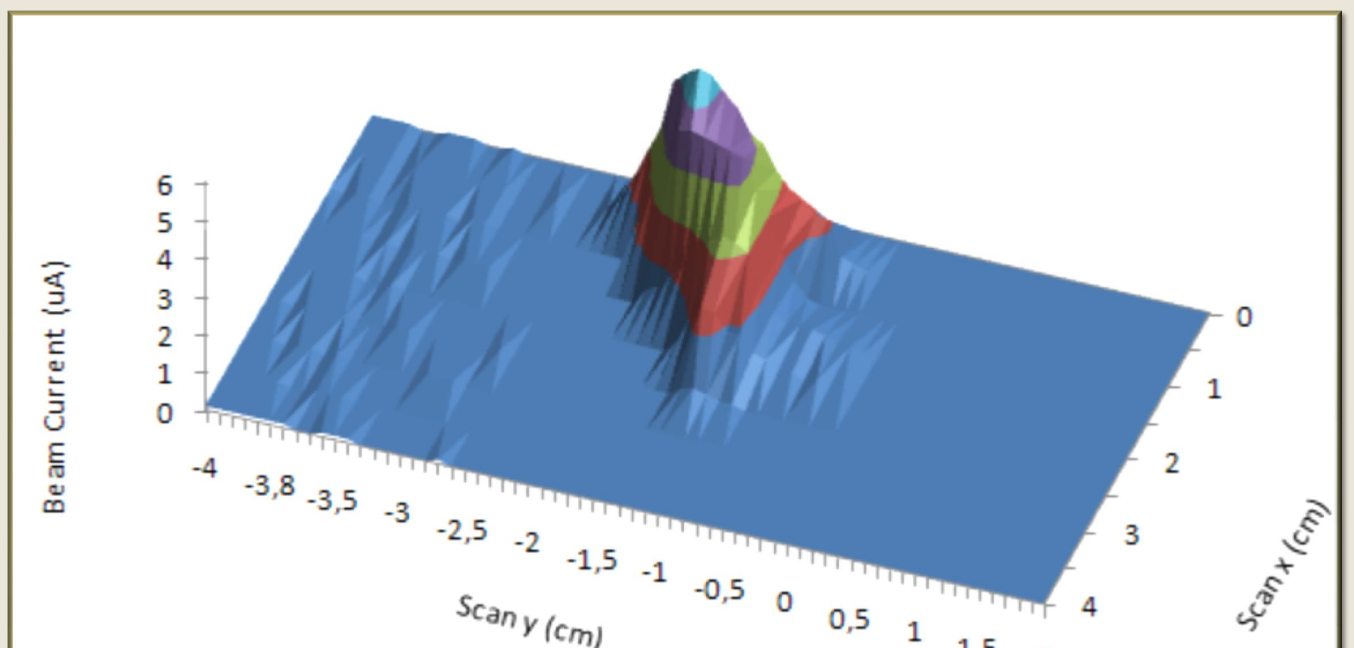
The experimental results presented in this work corresponds to an ion implantation of Argon, with a beam current of 100 μA, energy of 15 keV. The area of scan (x and y) is 5x7 cm$^2$. The scan x corresponds to the rotational steps of the target. There are two distinct results: (1) with the target at 10 kV and the electrostatic lens with 0 kV (figure 3a); (2) with the target with 10 kV and the electrostatic lens with 12 kV (figure 3b). For the first case, the electrostatic lens is not charged, which means that ion beam is more scattered and less homogeneous. In the second case, it is possible to see the ion beam is more focused on the target.

The ion beam profile measurement system developed makes integrant part of the optimization to the ion implantation, which also contemplates the deceleration of the ion beam to low energies. Checking the beam profile is important to assure the implantations are done, even at low energies, are done adequately. In particular, as a corollary, we were able to determine that the electrostatic deceleration developed for this accelerator is able to reduce the beam energy while maintaining the beam focused.

In addition is possible to obtain data for deceleration, in the future, the system will permit to test new configurations for beam focus for lower energy.




3a)




3b)