Beam Characterization of Five Electrode ECR Ion Source.

POSTER ID 3003

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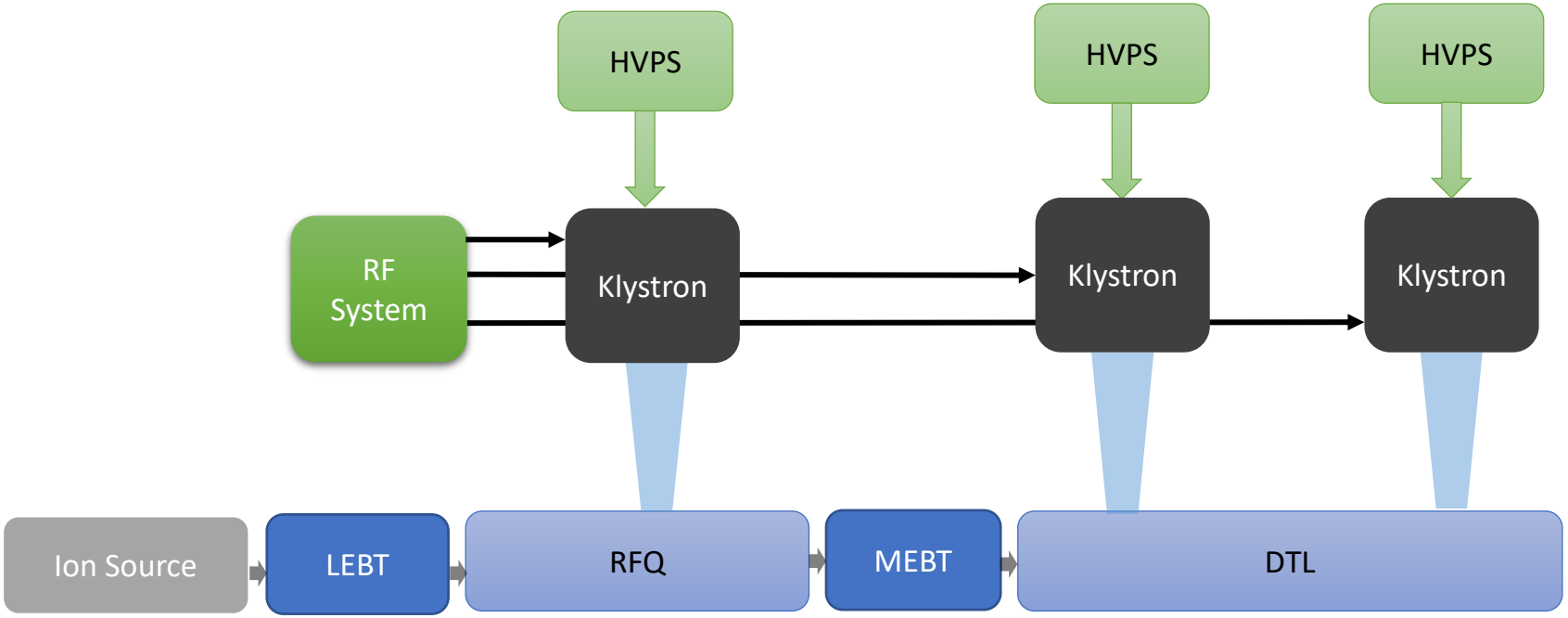
LEHIPA

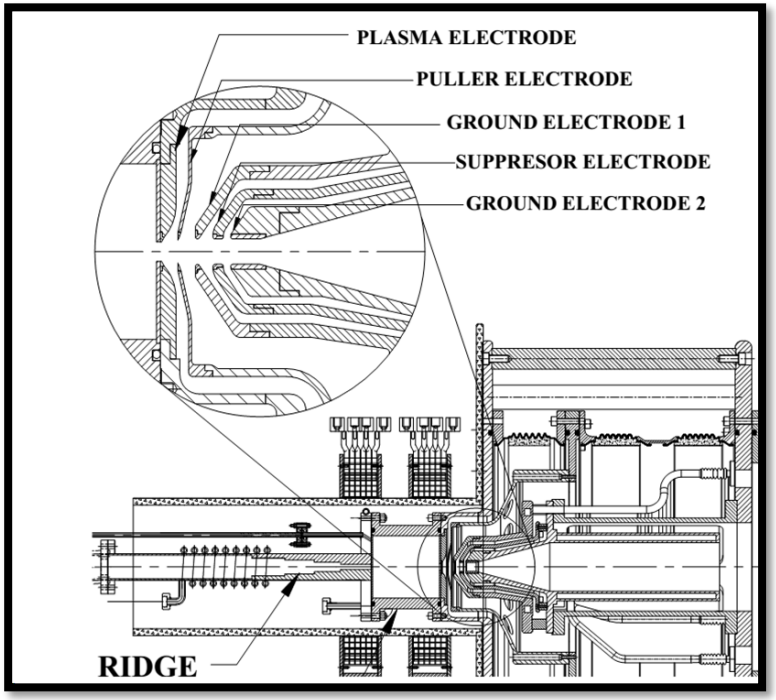


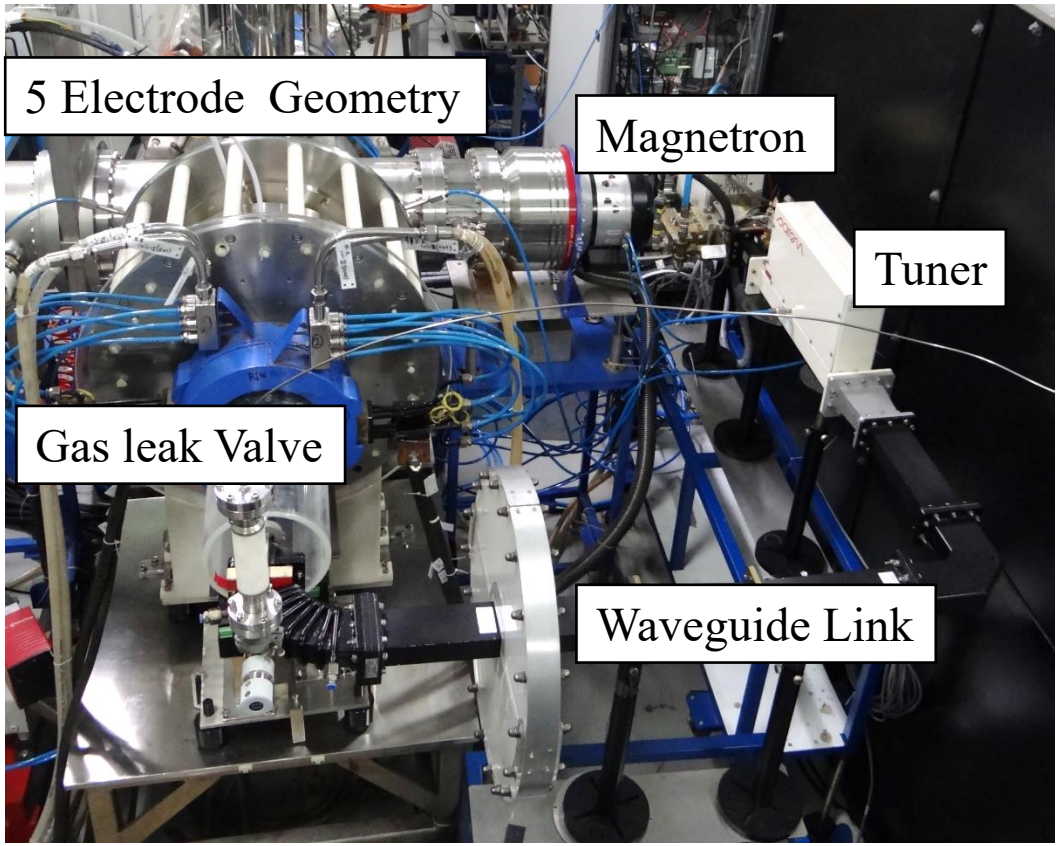
Ion source is front End of LEHIPA.
Requirement of Ion source,

- Emittance 0.2 π.mm.mrad
- Proton fraction 90 % or more
- Beam current 10-30 mA

Presently three electrode ECRIS is operational in LEHIPA. The five electrode ECRIS characterization is going on.

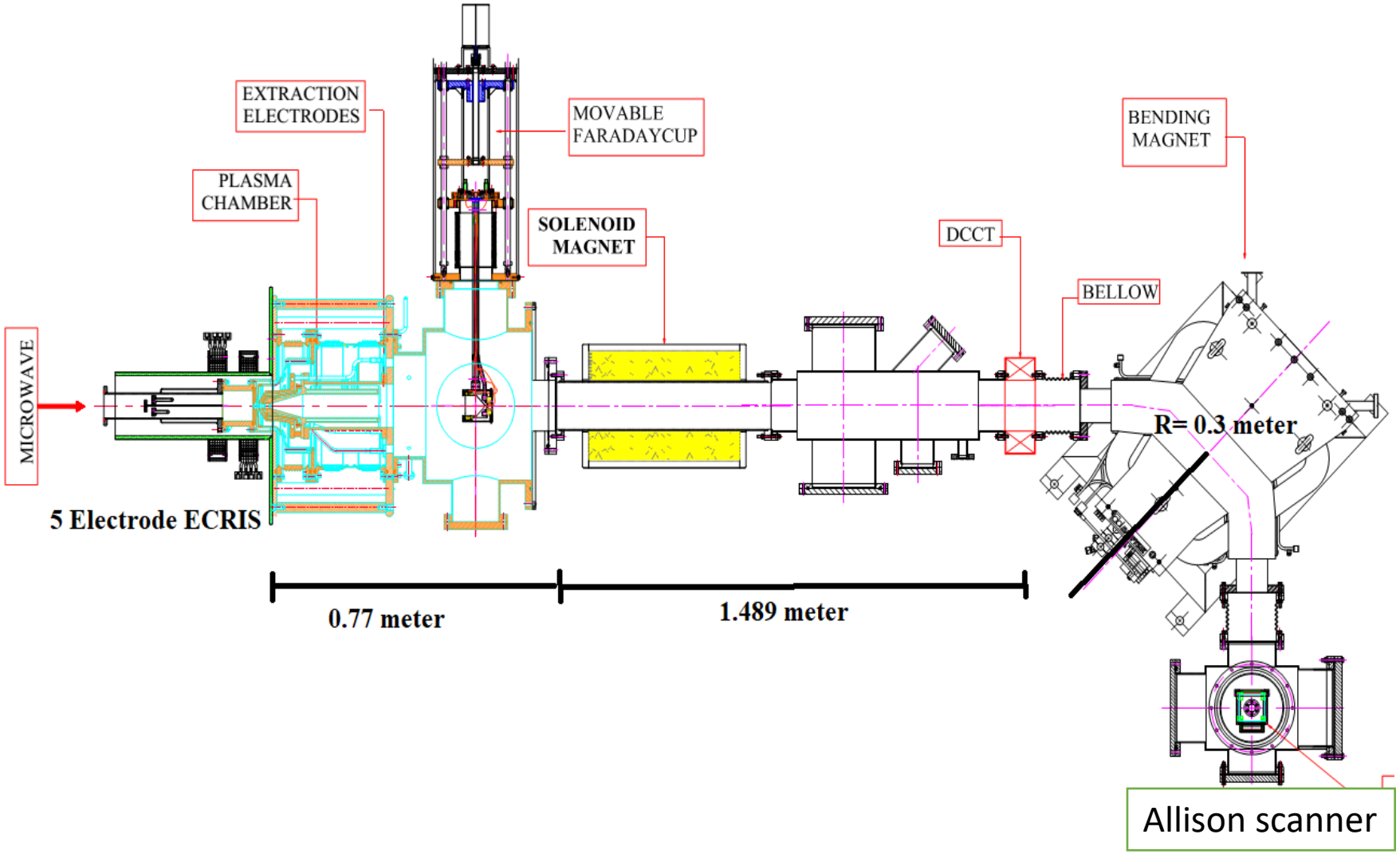
Five Electrode ECR Ion Source



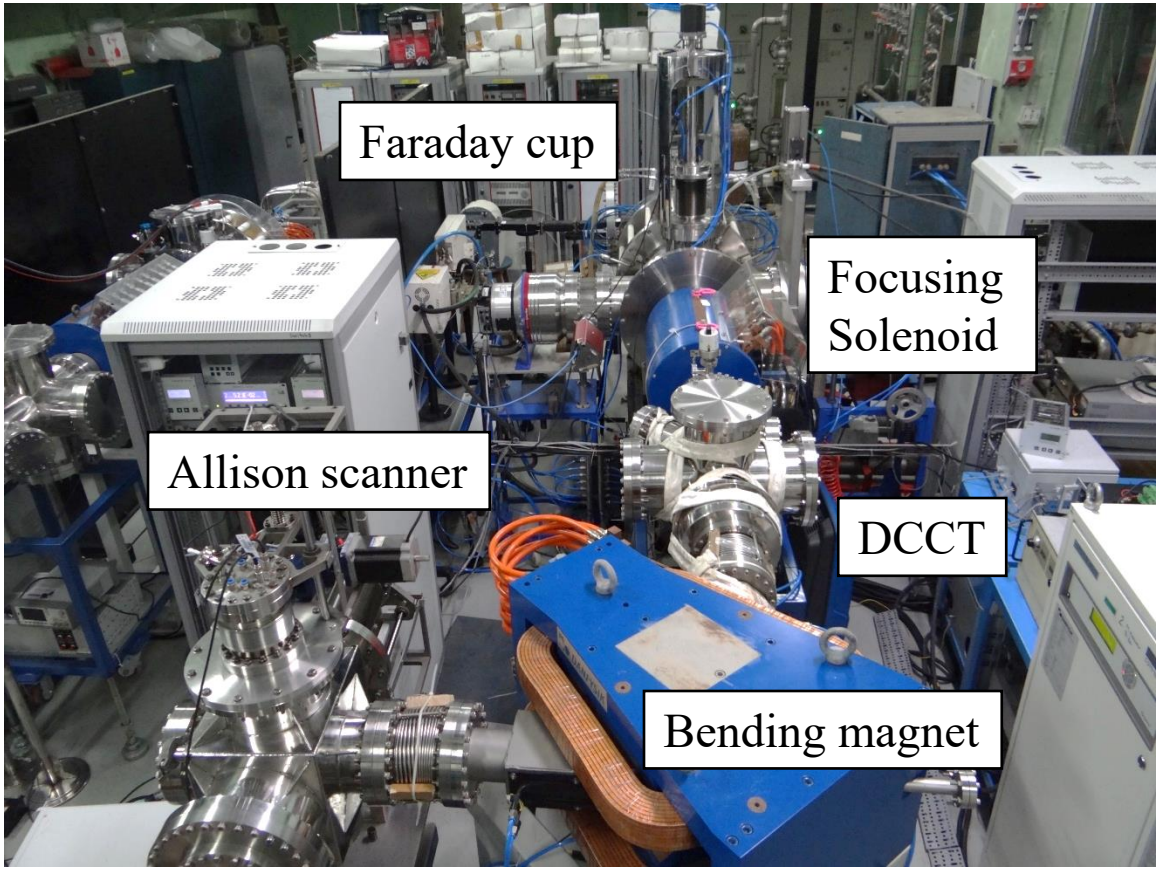


- The 5E ECRIS has been **designed for 50keV, 30 mA**.
- The **50 keV, 20 mA** beam is **extracted after system conditioning**.
- Beam Emittance measurement is conducted for pulsed beam of 50 keV by **varying puller voltage and operating gas pressure.**

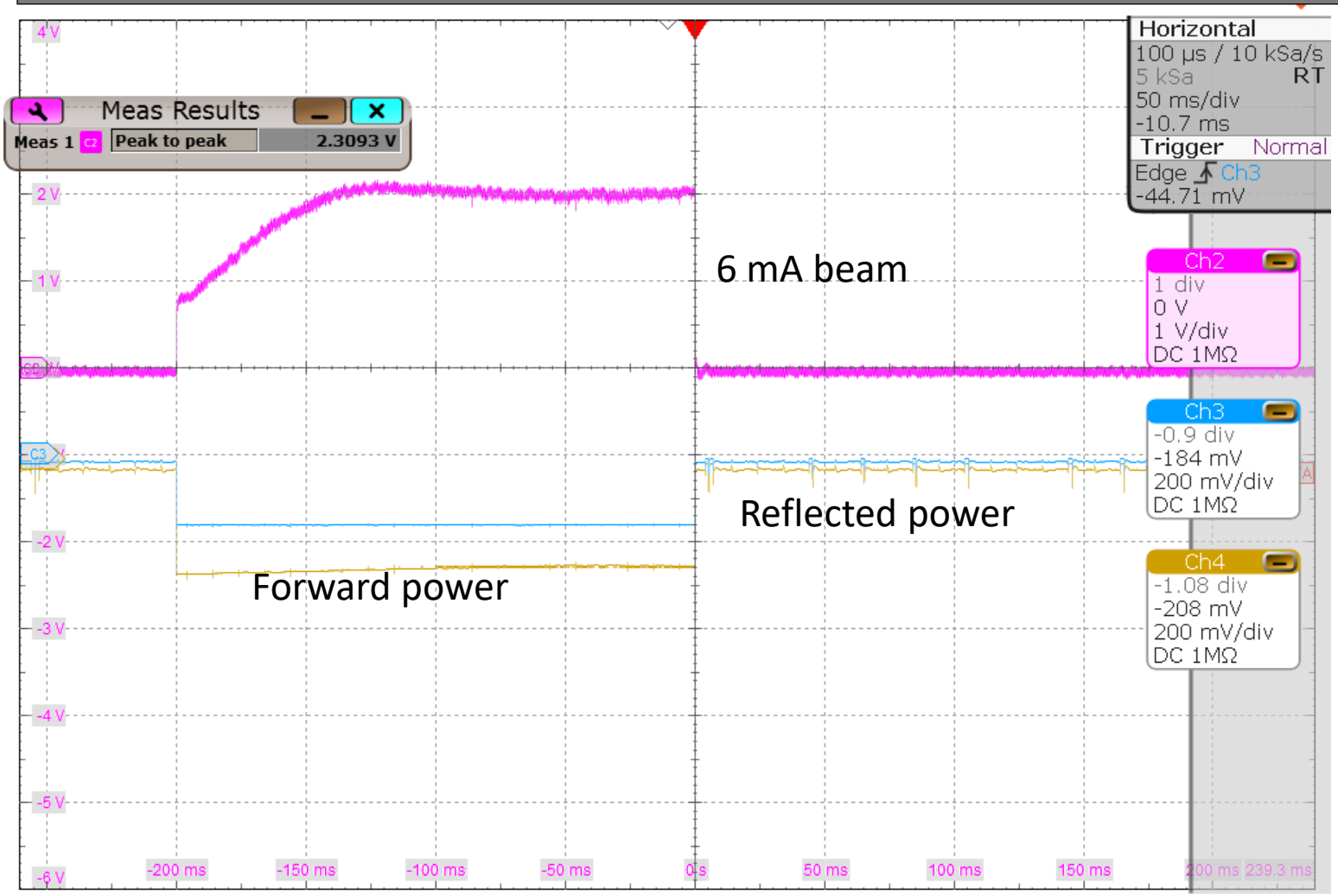
Emittance measurement layout



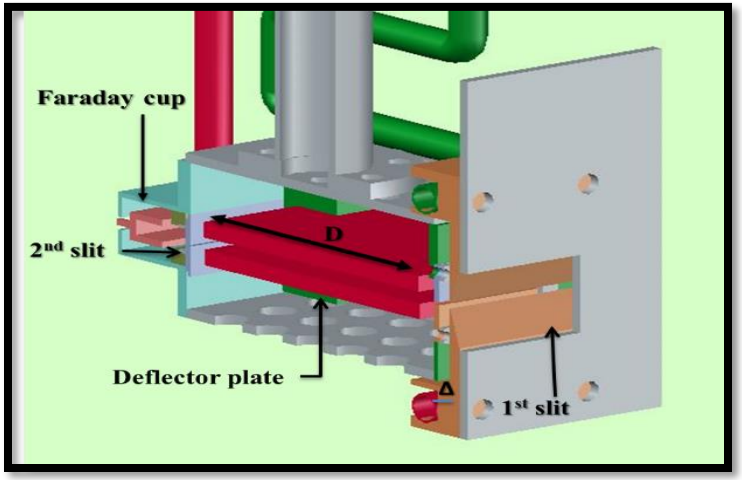
Emittance measurement setup

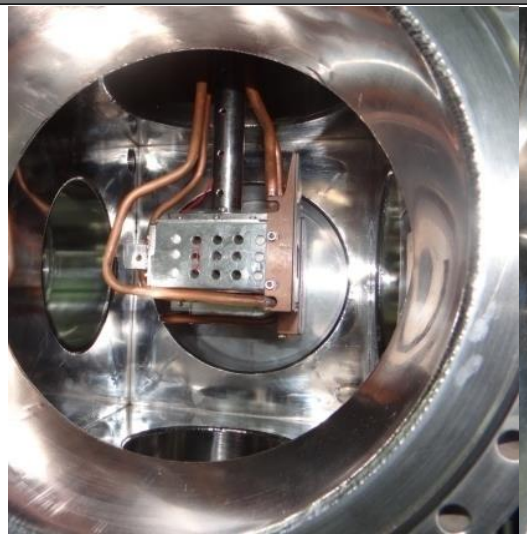


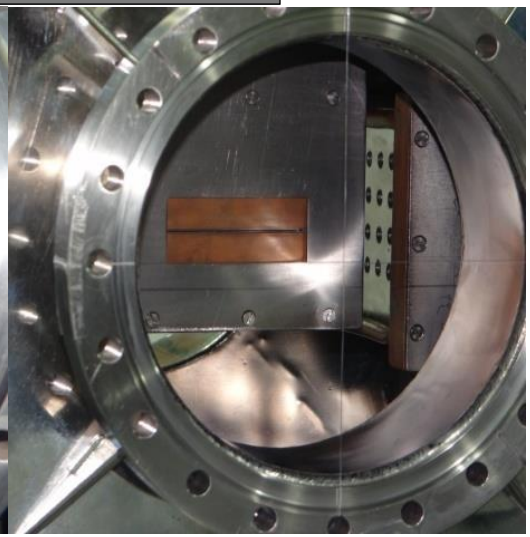
50keV beam extraction



Allison scanner

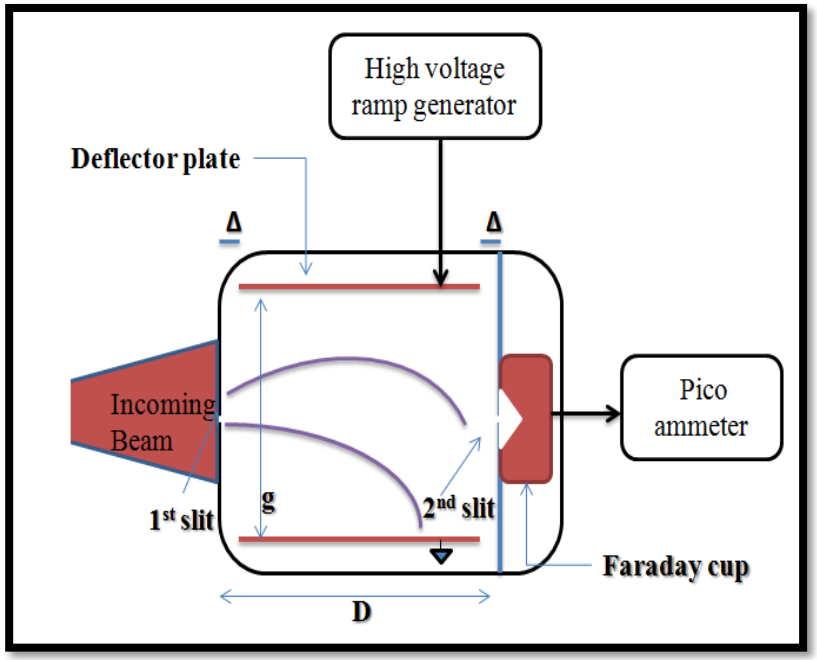




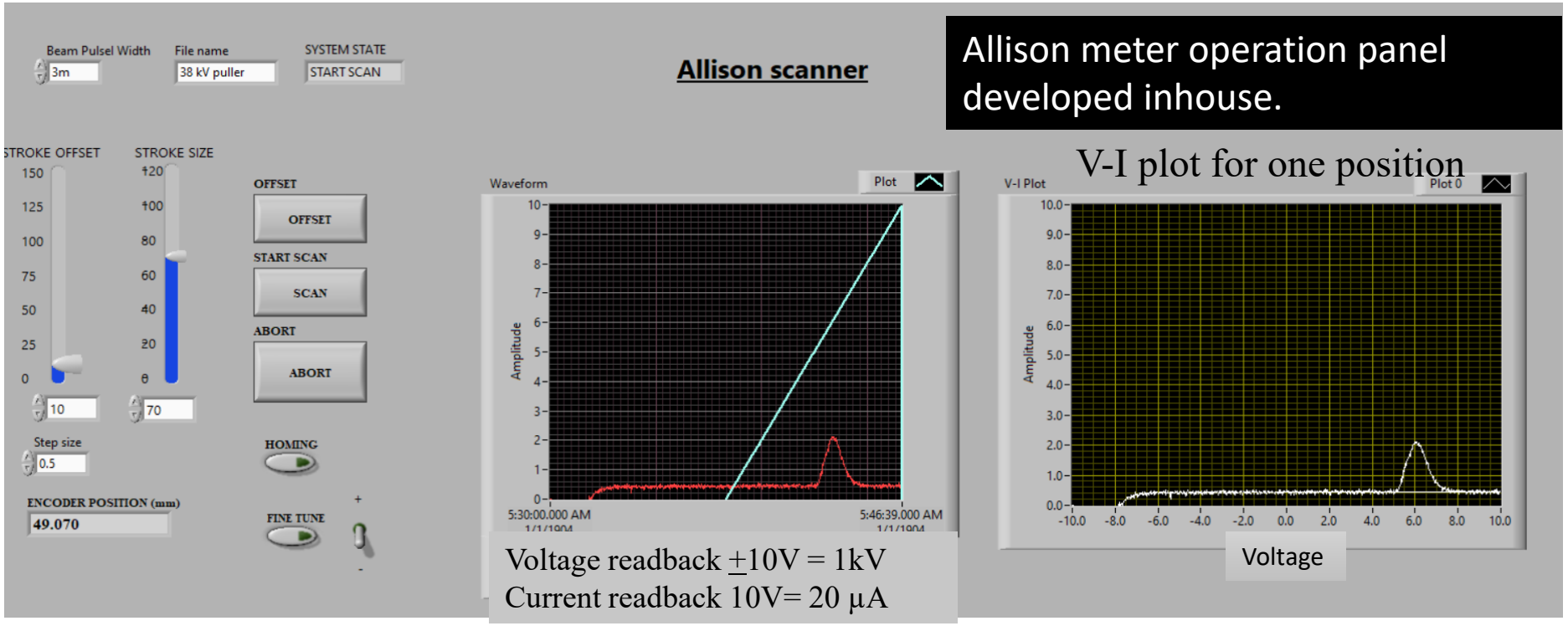


Parameters	Dimensions
Slit 1 thickness (S1)	0.3 mm
Slit 2 thickness (S2)	0.3 mm
Gap in Deflector plate (g)	4 mm
Deflector Length (D)	80 mm
End Gap (Δ)	5 mm
x_m'	±83.3 mrad
V_{max}	1000V@ 50 kV

Allison meter developed Indigenously



Allison scanner operation panel



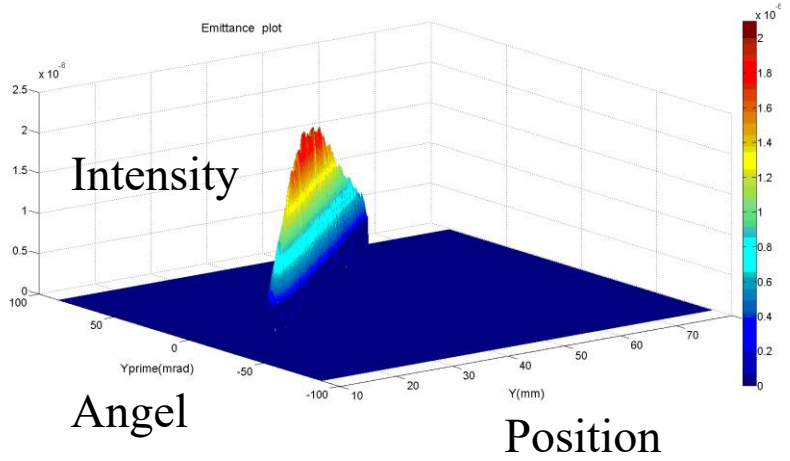
Allison meter operation panel developed inhouse.

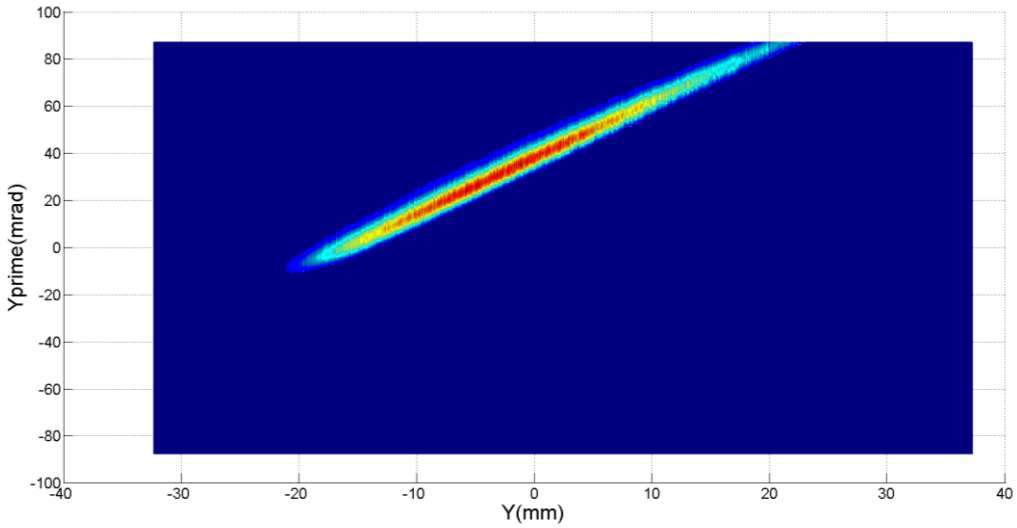
V-I plot for one position

Voltage readback ±10V = 1kV
Current readback 10V= 20 µA

- User has to set the offset, stroke size & step size.
- In one V-I scan, 1000 V-I data are stored.
- Save results in excel file with given name.

Emittance plot





Parameters	value
Beam	50 keV, 8 mA
Emittance RMS	33.1376 π mm. mrad
Emittance RMS Normalized	**0.3421 π mm. mrad**
β	2.9151 mm/ π.mrad
α	-6.8421
γ	16.4024 mrad/π.mm
Error in RMS emittance	± 0.011

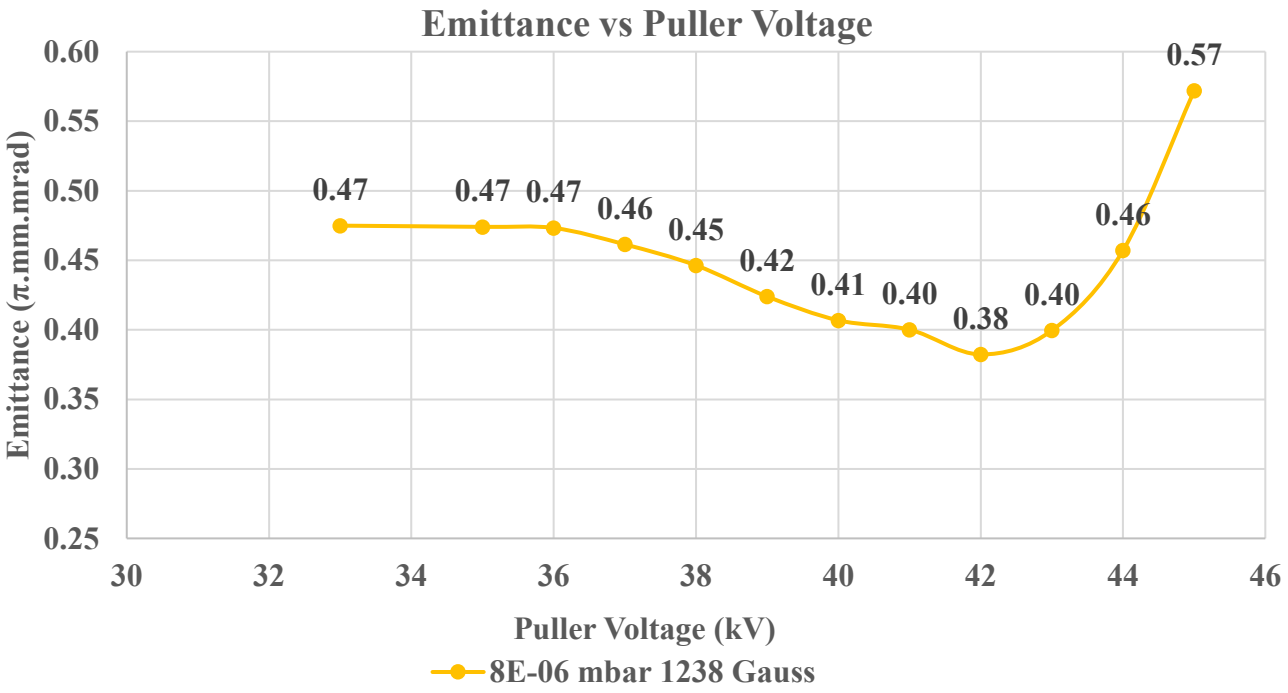
$$\varepsilon y.rms = \sqrt{< y^2 >< y'^2 > - < yy' >}$$

$$\varepsilon y.rms.\text{norm} = \gamma_{rel} \cdot \beta.\, \varepsilon y.rms$$

Emittance vs Puller voltage

System parameters :

Plasma EL	50 kV
Gas pressure	8E-6 mbar
MW Powe	920 W
Pulse Width	200ms, 1 Hz



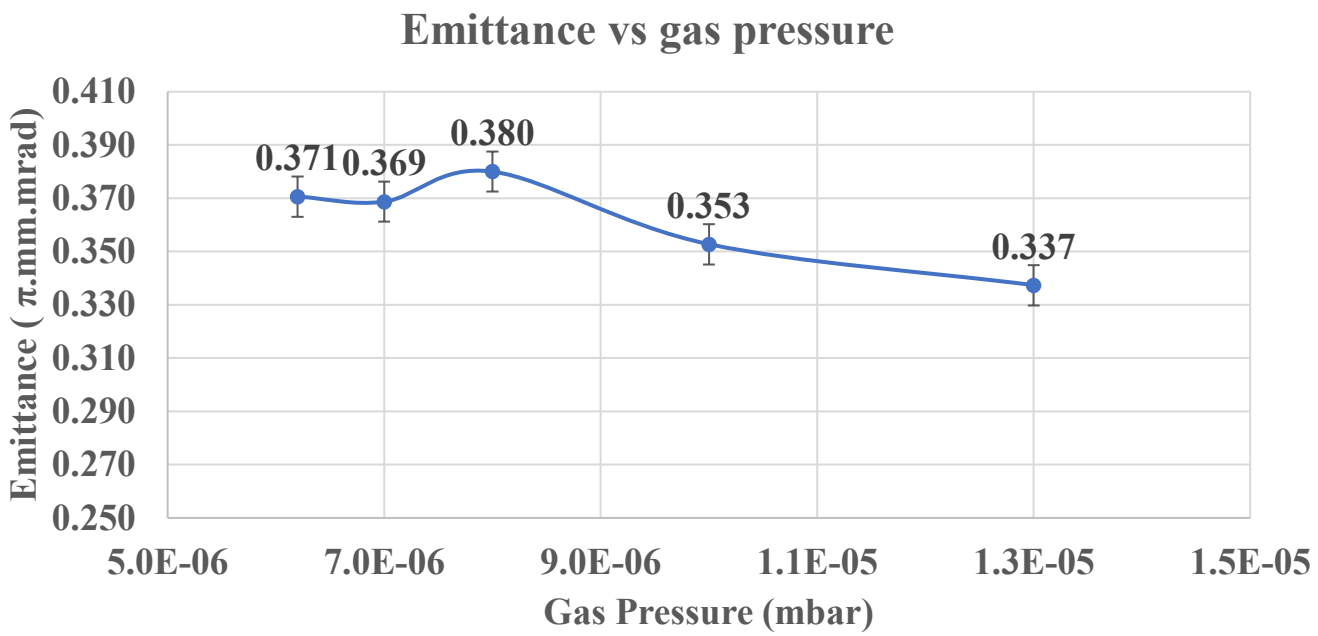
Result

Ion source is designed for 40 kV of puller voltage. Experimentally we are getting minimum emittance at 42 kV.

Emittance vs gas pressure

System parameters :

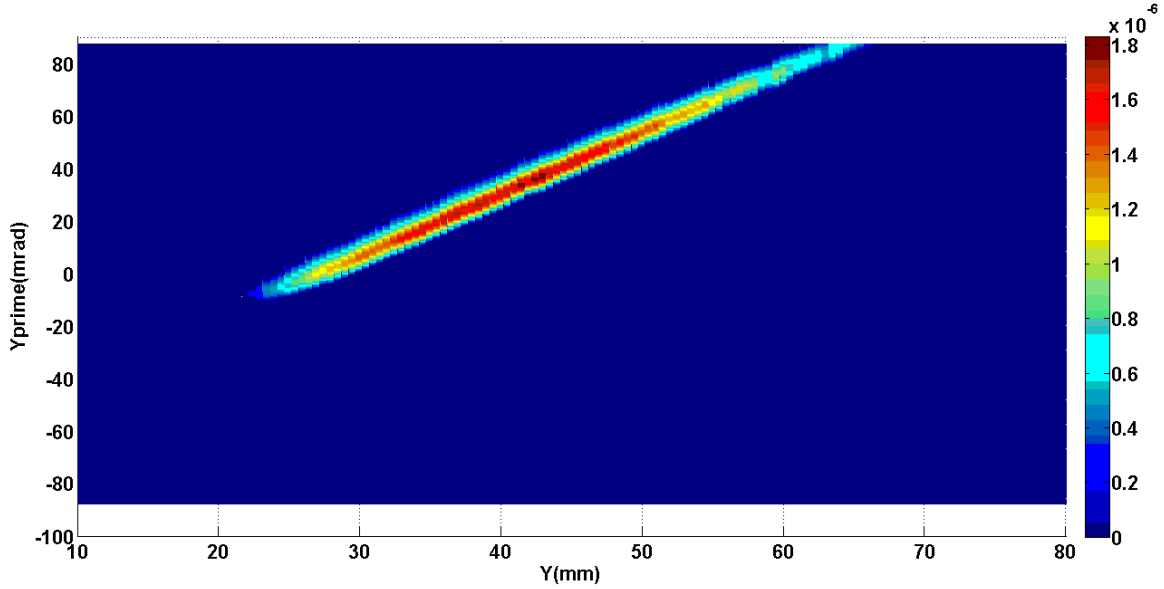
Plasma EL	50 kV
Puller EL	42 kV
MW Power	920 W
Pulse Width	200ms, 1 Hz



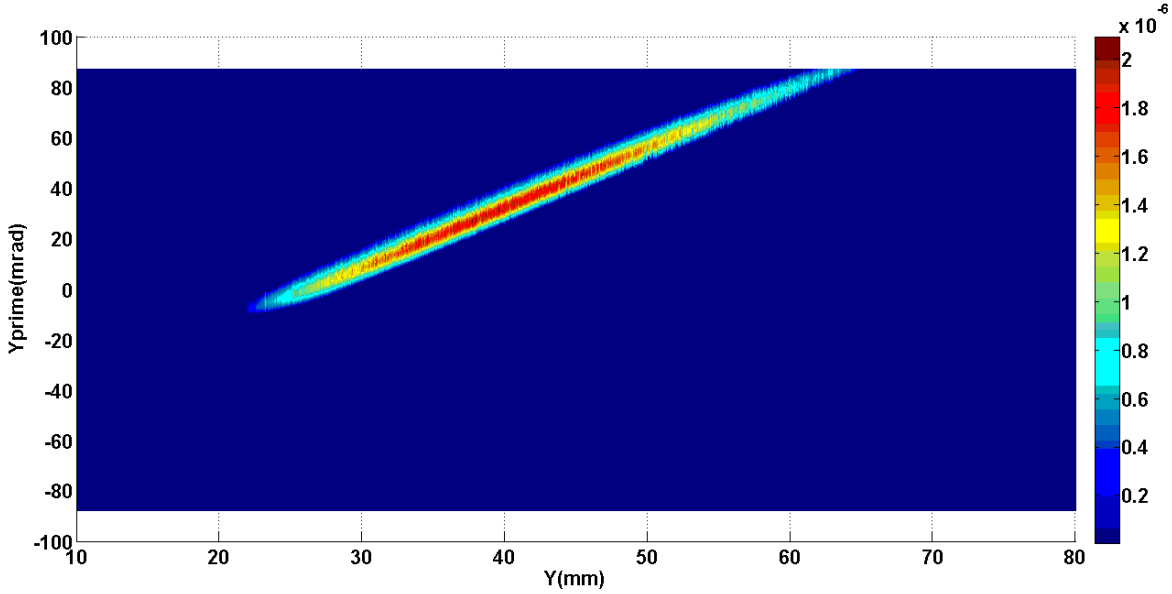
Result

Ion source emittance is improving as gas pressure is increased. More experiments will be conducted at higher gas pressures along with system tuning [ECR magnet coils, MW power].

Beam Emittance vs step size of scan



Step size = **0.5 mm**
EMS= 0.3614 π.mm. mrad
Time Taken =1.3 min

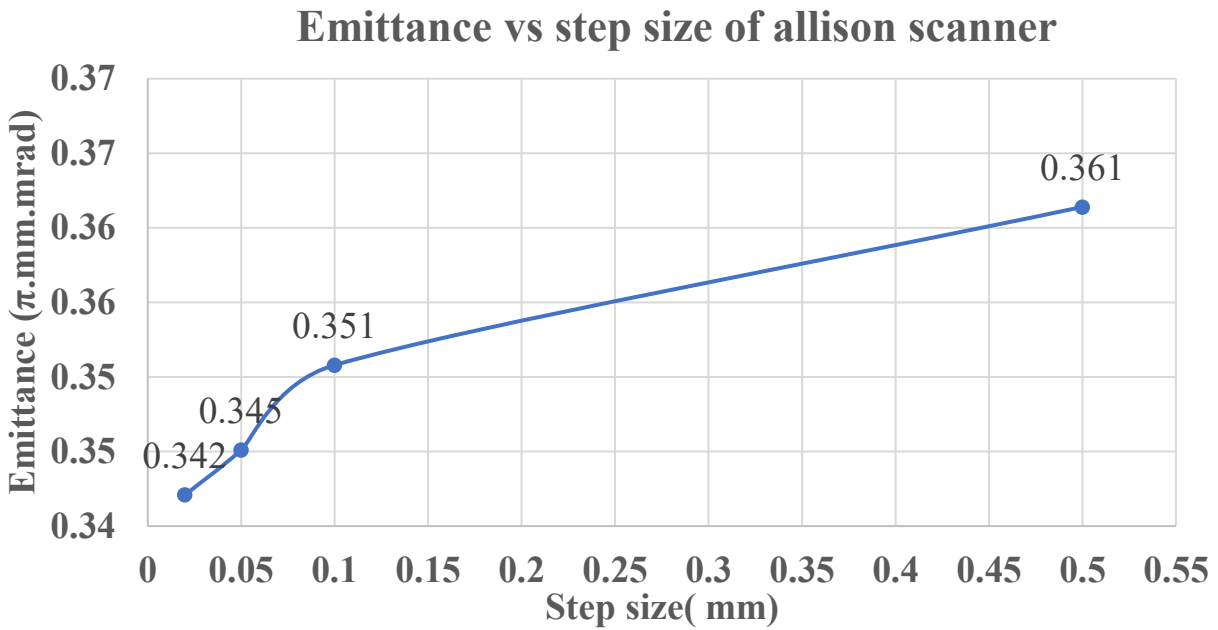


Step size = **0.05 mm**
EMS = 0.3451 π. mm. mrad
Time taken =13 min

Beam emittance vs step size of allison scanner

System parameters :

Plasma EL	50 kV,
Puller EL	42 kV
MW Power	920 W
Pulse Width	200ms, 1 Hz



Result

Taking fine step takes more time but the give more data for emittance plot.
Emittance value is improved by 5%.

Summary

- Five Electrode ECRIS is conditioning is going on, Presently 50keV, 20mA beam is extracted.
- Emittance measurement experiment conducted by
  - Varying puller voltage
  - Varying operating gas pressure

  for 50 keV H^+ beam emittance is in the range of 0.3 - 0.4 π.mm.mrad.

  [More experiments are going on].

Thank You

Stay Home Stay Safe