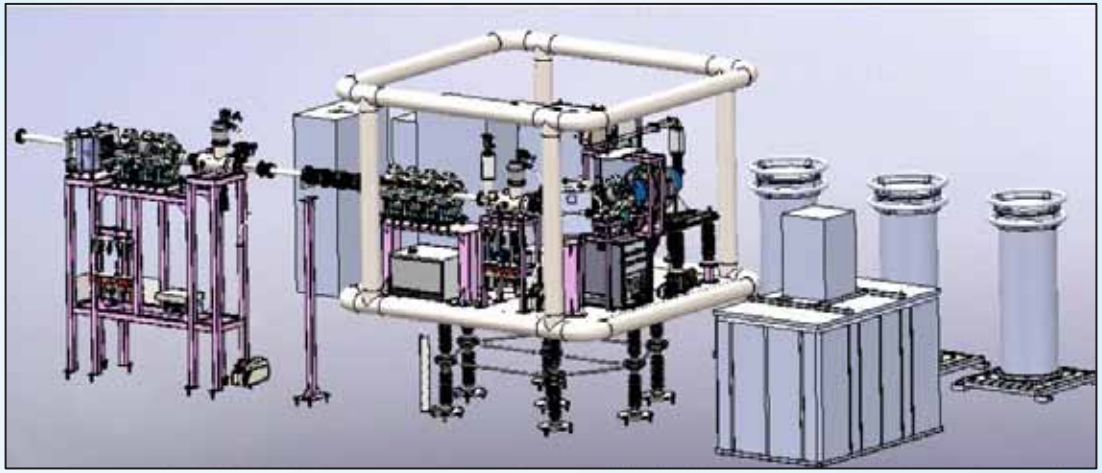
Characterization of 2.45 GHz ECR Ion Source Bench for Accelerator-Based 14-MeV Neutron Generator



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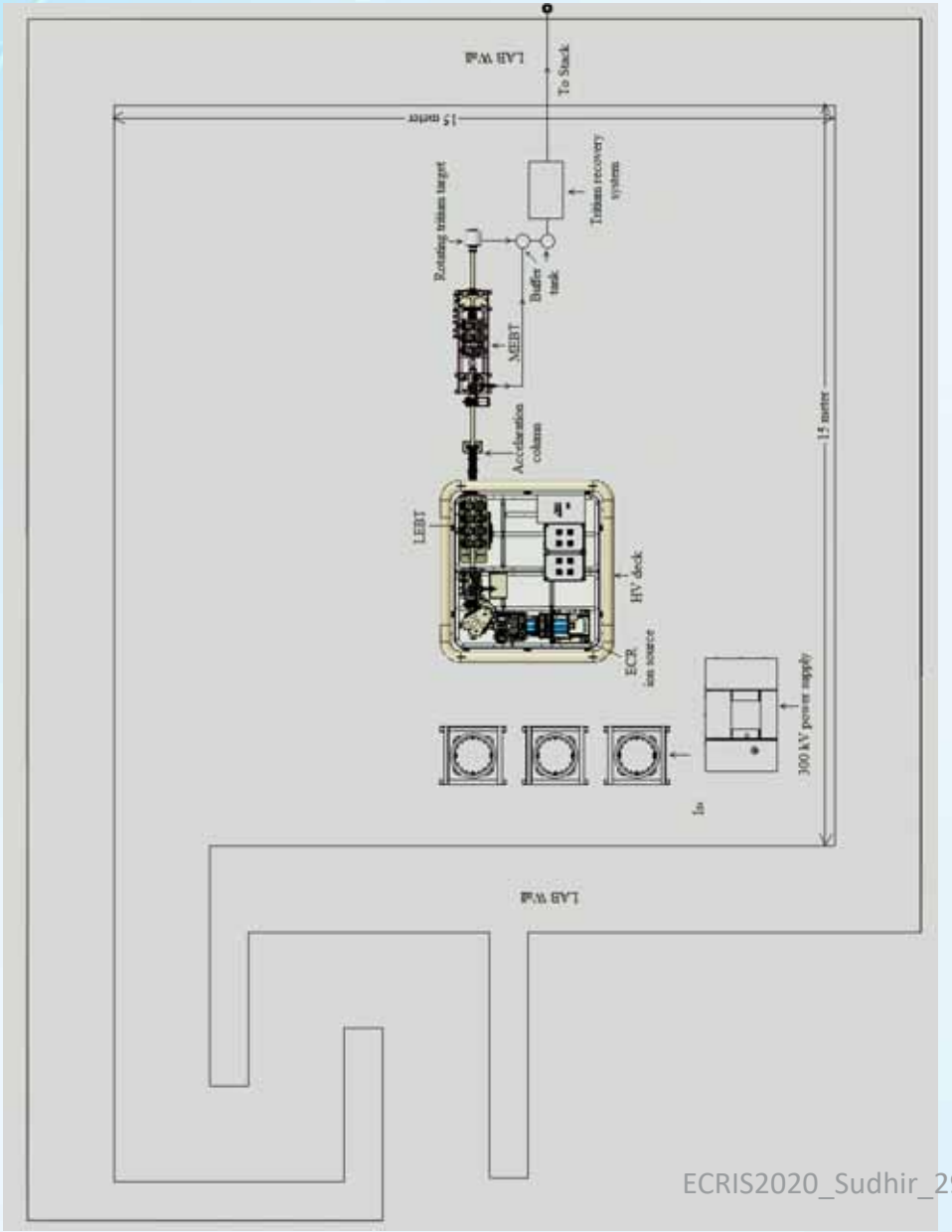
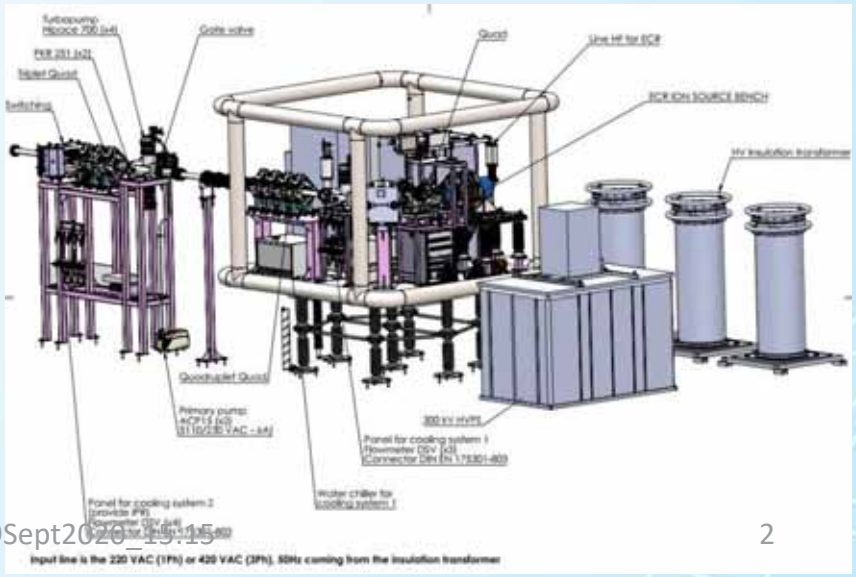
Upcoming 14-MeV neutron Facility at IPR



Parameter of 14-MeV Neutron Generator	
Type of Machine	DC Electrostatic Accelerator
Max Acceleration Voltage	300 kV
Type of Beams	D^+ Ion
D+ Ion Current	20 mA
Vacuum Pressure	1 x 10^{-7} mbar
Target	Tritium, 140 Ci
Estimated Neutron Yield	~ 1 -5 x 10^{12} n/s

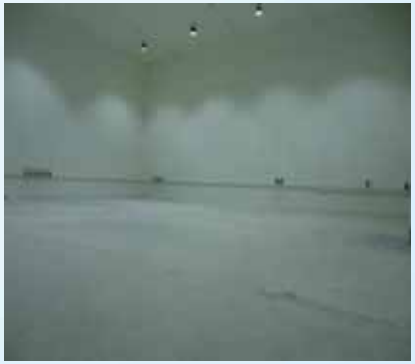
3D view of the 14-MeV neutron Generator



Neutron & Ion Irradiation Laboratory

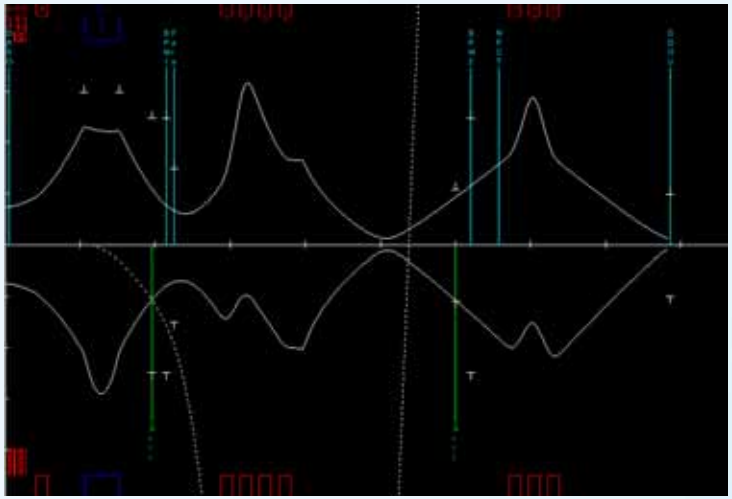
Neutronics Laboratory Building South - East side view

Neutronics Laboratory Building East - North side view



Inside view of Neutronic Laboratory

40 keV, Low Energy Beam line



Results of beam optics simulations

Magnet Power supplies for Beam line

340 keV, Medium Energy Beam line

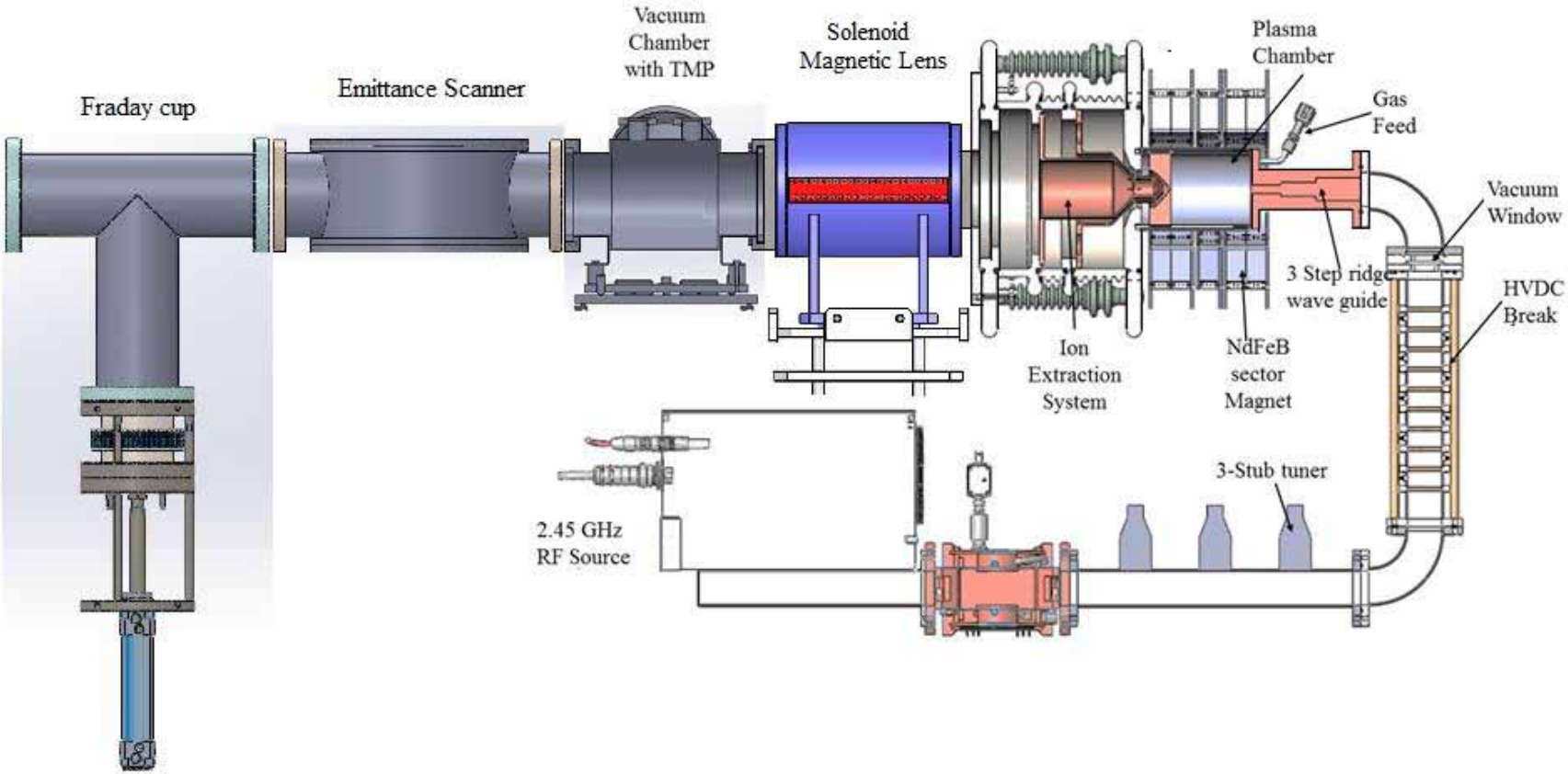
Command & Control System

Magnet Power supplies for Beam line

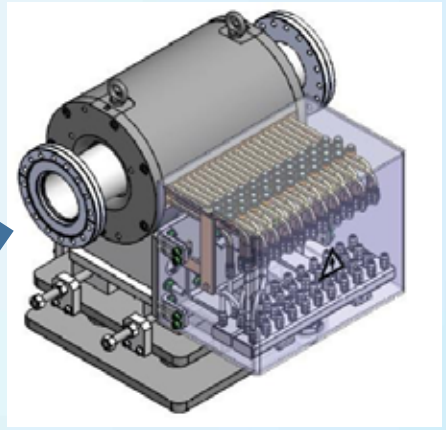
2.45 GHz High Current Source

Parameter	GANIL FRANCE	SILHI (SPIRAL -2) FRANCE	CEA/Saclay (IFMIF) FRANCE	PKUNIFTY CHINA	LBNL USA
Microwave Power	1200 Watt, 2.45GHz,	1200 Watt, 2.45GHz	2000 Watt, 2.45 GHz	800 Watt, 2.45GHz	700 Watt, 2.45GHz
Magnet System	Two Coaxial NdFeB permanent magnet Ring	Three Coaxial NdFeB permanent magnet Ring	Two solenoid configuration	Three Coaxial NdFeB permanent magnet Ring	Two solenoid configuration
Plasma Chamber	90mm diameter, Water cooled	90mm diameter, Water cooled	90mm diameter, Water cooled	40/50 mm diameter, OFHC Copper, with Al liner	92mm diameter, Water cooled
Beam Optics	4 electrode extraction system with 40 kV max,	5 electrode extraction system with 50 kV max,	5 electrode extraction system with 55 kV max,	3 electrode extraction system with 50 kV max,	3 electrode extraction system with 60 kV max,
Extraction aperture	7mm	3 mm	9mm	5mm	3mm
Beam Emittance (π mm mrad)	0.2	< 0.1	0.25	0.2	0.04
Max Beam Current	40 (P)	10 (D)	140(D)	100(D)	44(D)

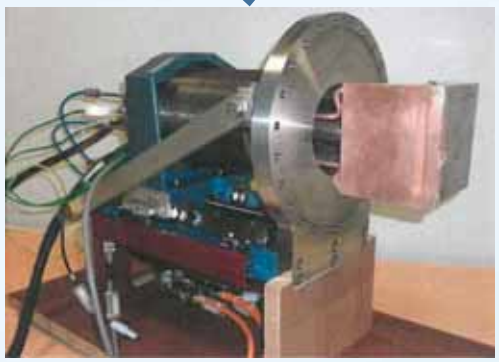
Schematic diagram of 2.45 GHz ECR ion Source bench



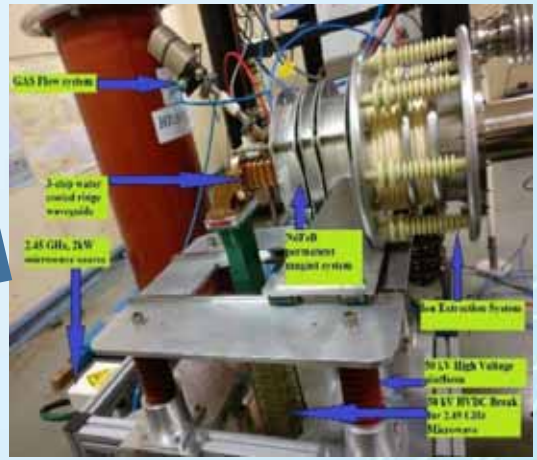
2.45 GHz ECR ion source bench at IPR



Magnetic lens, 0.350 T, 255mm, 40 mm half aperture

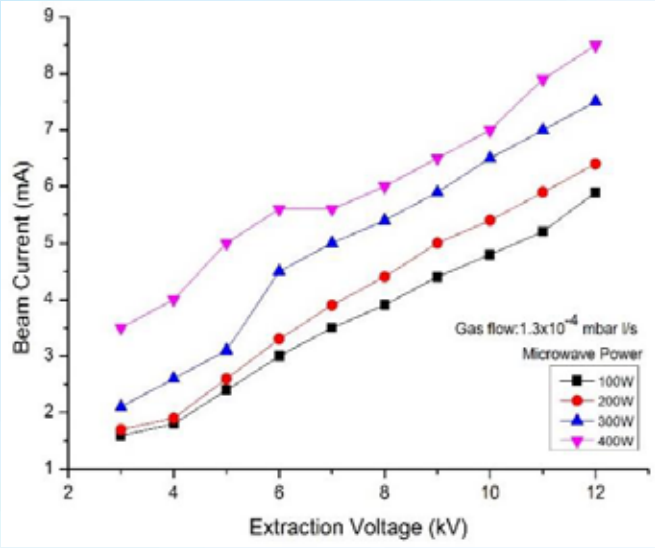


Allison scanner

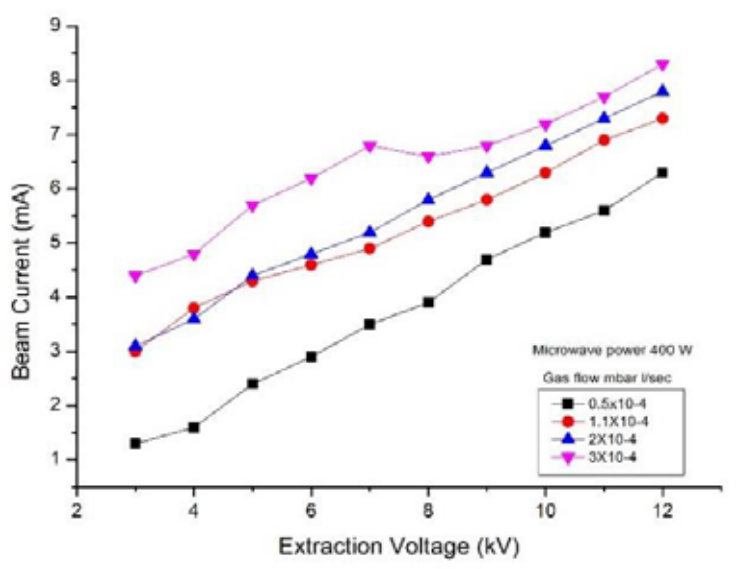


2.45 GHz ECR Ion Source

Results of ion beam Extraction

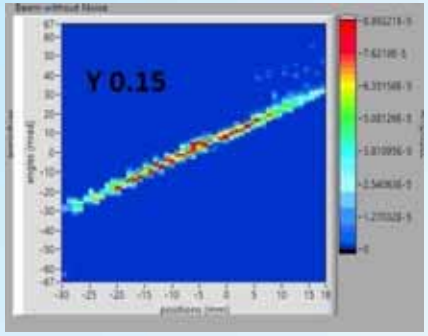


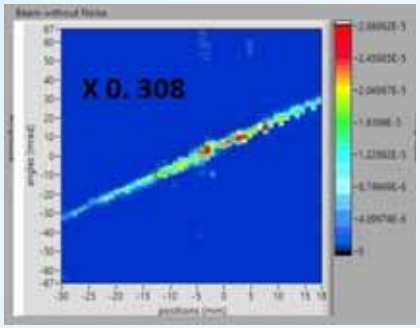
Measurement deuterium beam current as function extraction voltage & microwave power

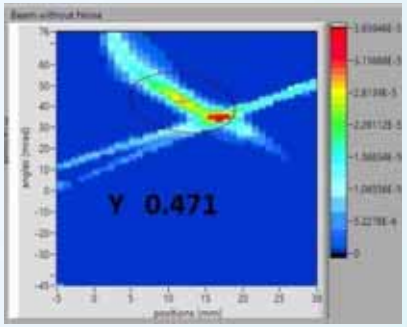


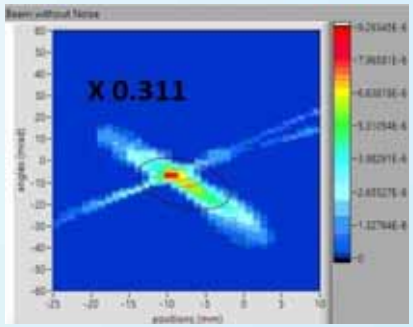
Measurement deuterium beam current as function extraction voltage & pressure (mass flow rate) with fix microwave power 400 W

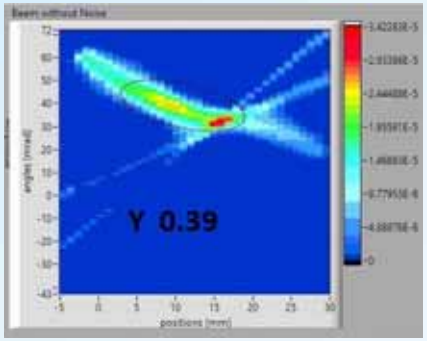
Results of Emittance measurements

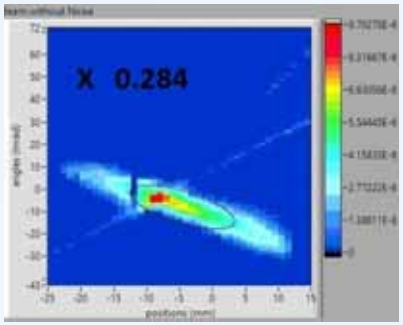


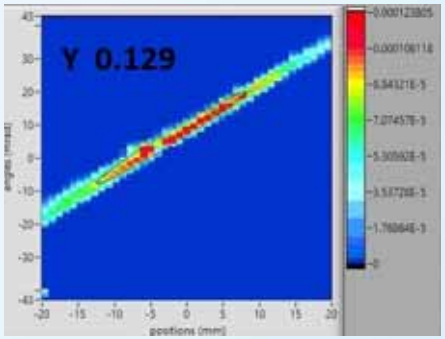


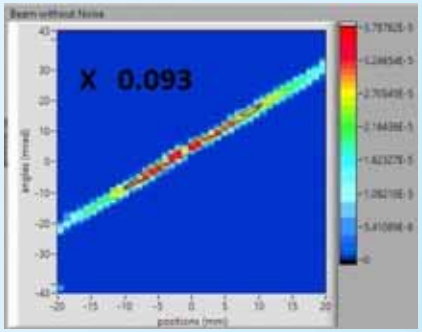


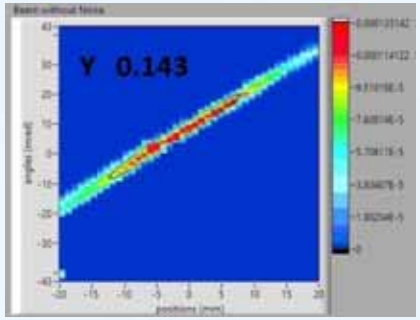


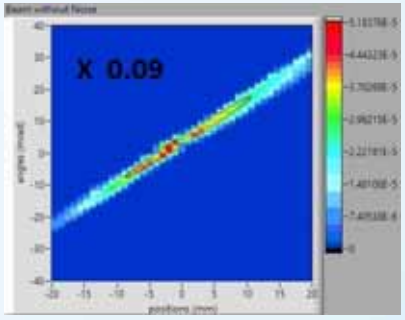


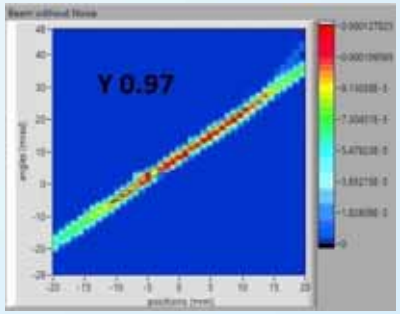


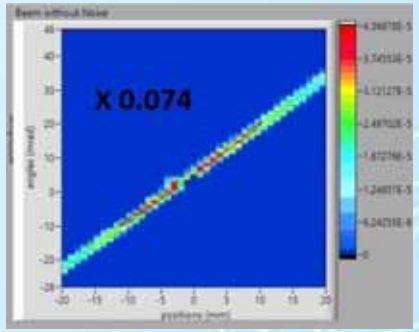












Summary

- ✓For the better focusing of the ion beam into the LEBT, the Einzel lens has been replaced with the magnetic lens (Solenoid)
- ✓To measure the beam emittance dual Allison emittance scanner has been integrated into the test bench.
- ✓The beam characterization experiments have been successfully performed.
- ✓The beam emittance, as well as beam profile, have been measured as a function of solenoid current.
- ✓The normalized emittance is < 0.2 pi.mm.mrad
- ✓The beam diameter is < 20 mm

Thank you !

धन्यवाद