Low Energy Beam Transport at KVI

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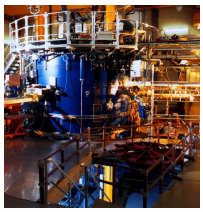
Abstract

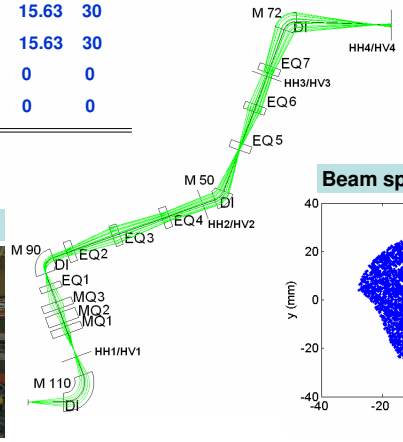
Optical properties of the low energy beam line between the Electron Cyclotron Resonance Ion Source and the AGOR cyclotron have been investigated. The beam emittance is measured with a 4D emittance meter based on the pepper-pot principle and the beam profile at various locations is determined with a multi-wire profile monitor (harp). The results are compared with calculations including fringe fields up to third order with the code COSY INFINITY. Calculations and measurements qualitatively agree; the total beam transmission has been estimated.

The characteristics of the bending magnets installed at the low energy beam line at AGOR facility

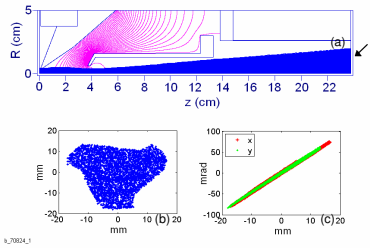
	M110	M90	M50	M72
Bending radius (cm)	40	24	29	24
Bending angle (degree)	110	90	50	72
Half aperture width (cm)	3.5	3	3	3
Entrance pole face angle (degree)	37	0	15.63	30
Exit pole face angle (degree)	37	0	15.63	30
Entrance curvature (cm)	0	0	0	0
Exit curvature (cm)	0	0	0	0

The AGOR Cyclotron



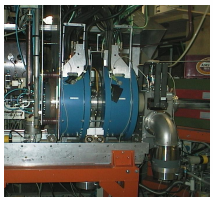


(a) Ion trajectories in the extraction region of KVI-ECRIS.
(b) Spacial distribution of ions at the ground electrode.
(c) Horizontal and vertical emittances at that position.

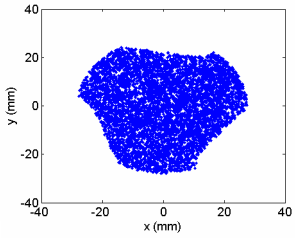


AECRIS

Ion = Ne 6+
Extraction rad = 4 mm
V_{ext} = 24 KV
V_{pull} = -100 V
B_{sol} = 0.7 T
Emitt = 80 pi mm mrad

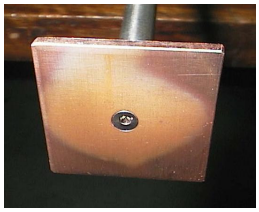


Beam spot by simulation

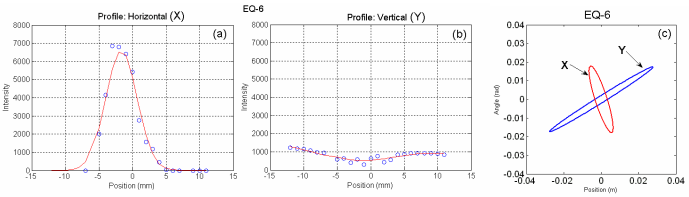


Beam spot on Cu Target

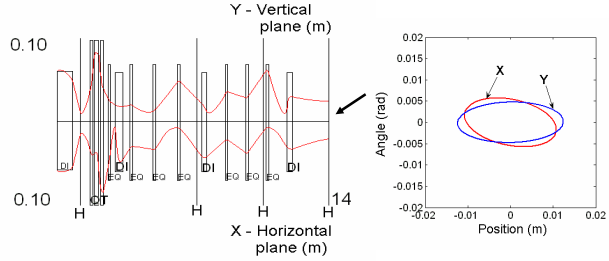
Size:40/40 mm



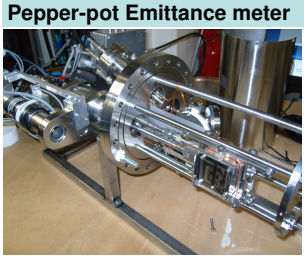
(a)&(b) Horizontal(x) and vertical(y) beam beam widths measured by the profile gridsHH3/HV3 (c) Calculated emittance plot at that position.



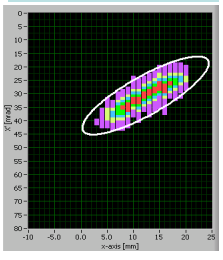
Vertical and horizontal beam envelopes of trajectories Ne6+ ions through the low energy beam transport line



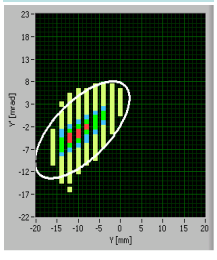
Pepper-pot Emittance meter



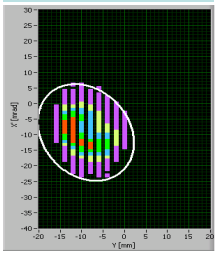
Phase-space x-x'



Phase-space y-y'



Phase-space y-x'



X-Emittance=110 mm mrad

Y-Emittance = 65 mm mrad

The device specifications

The angular resolution is defined by distance between the pepper pot sheet and the MCP (L=51.6 mm) and the effective size of the pixels at the location of the phosphor screen which is 44 micrometer.

Determination of the emittance

From the measured angular distribution we calculate the emittance. First we measure how many counts are produced by one ion depending on the high voltage on the MCP. Than the full measurement will be divided by this number to calculate the amount of particles involved. These values are used as a weight factor in the fit routine. The result of the fit routine will than show how many particles are within the calculated emittance.

Conclusion

- Calculation and experiment results shows that 30%-40 % of the beam is lost to the walls of the beam pipe during the drift from the end of the ground electrode to the entrance of the analyzing magnet.
- In practice we find typical beam transport efficiency from the focal plane of the analyzing magnet to the matching section of the AGOR injection line is typically 75%.
- Qualitative agreement between simulation and experiment results.

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