

Acceptance and Emittance Studies at DREEBIT

This communication is based on the original publication.
A.Silze, E. Ritter, G. Zschornack, A. Schwan, F. Ulman
“Investigations of the emittance and brightness of ion
beams from an electron beam ion source of the Dresden
type”, Review of Scientific Instruments 81, 023303 (2010)

Emitter Meter Pepper Pot

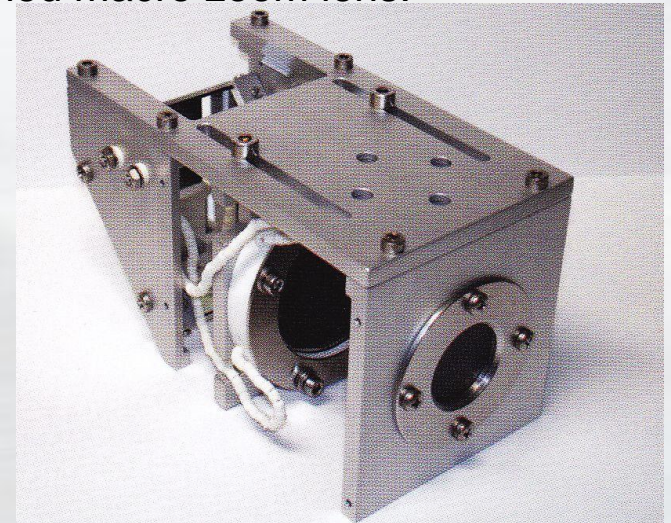


The components of the system are:

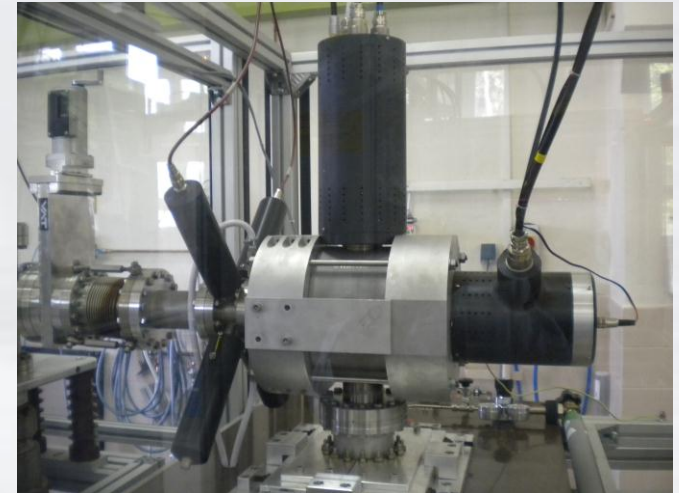
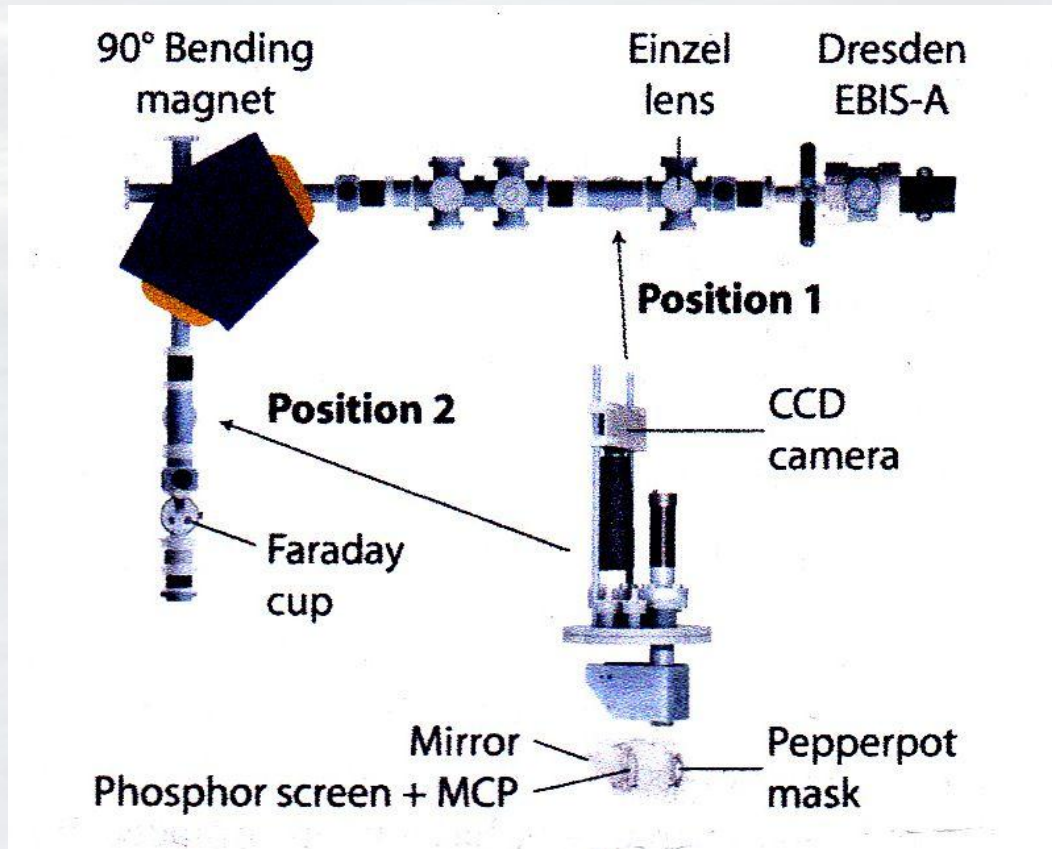
- the pepper-pot like mask of uniformly distributed holes with a distance of 1mm and diameter of 0.2 mm,
- the microchannel plate (MCP) and phosphor screen assembly,
- the mirror,
- a charge coupled device (CCD) camera outside and above the vacuum flange with the attached macro zoom lens.

Original design:

A. Pikin, A Kponow, J. Ritter and V. Zajic,
Pepper Pot Emittance Meter,
(Brookhaven Natinalab., Upton, NY,2006),
Technote.



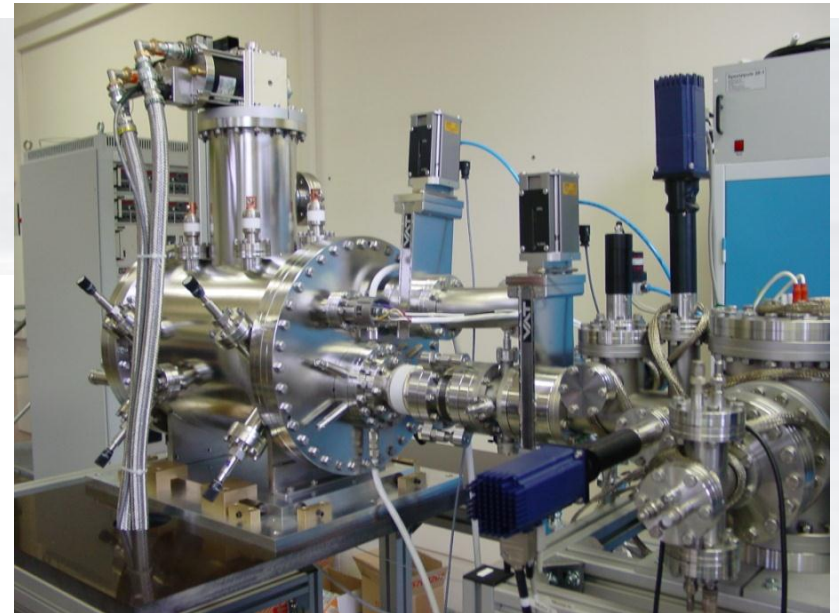
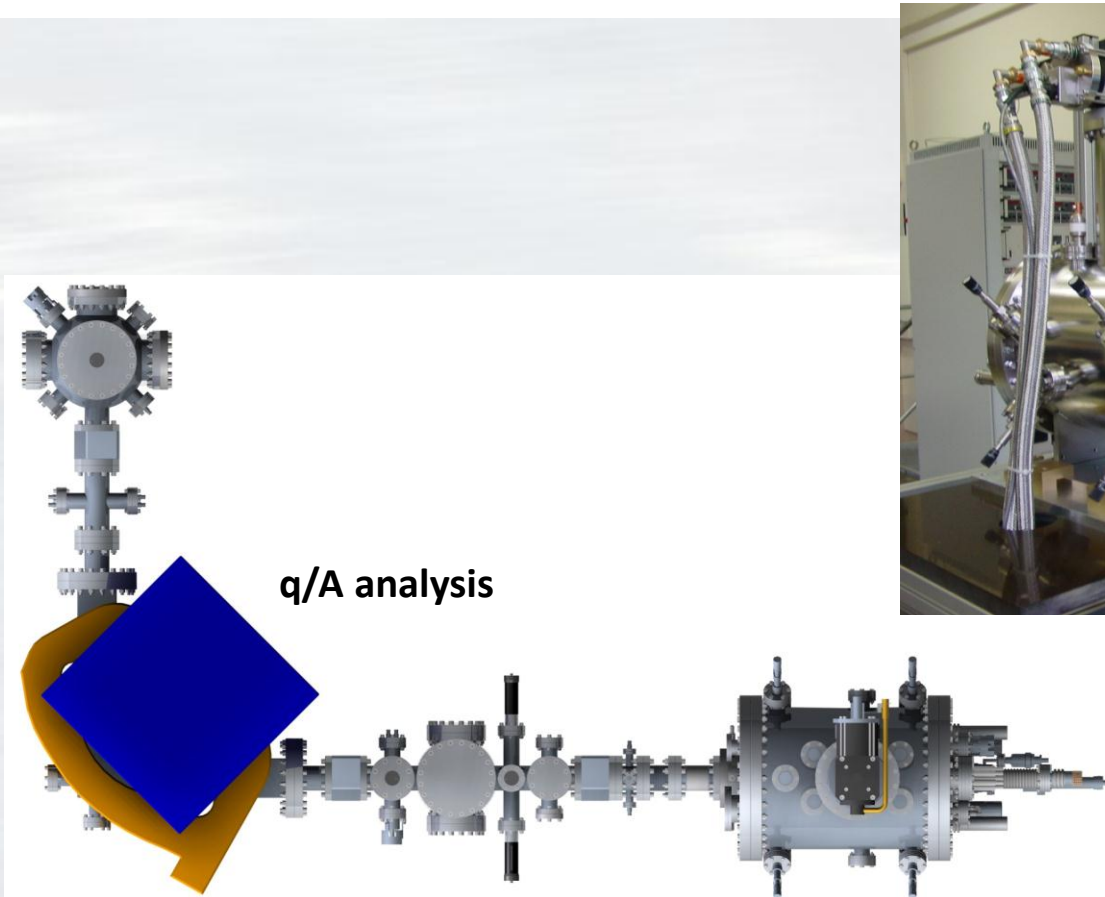
Beam Line for Dresden EBIS-A



Dresden EBIS-A

Electron current - 60 mA
Electron energy - 8.7 keV

Beam Line for Dresden EBIS - SC



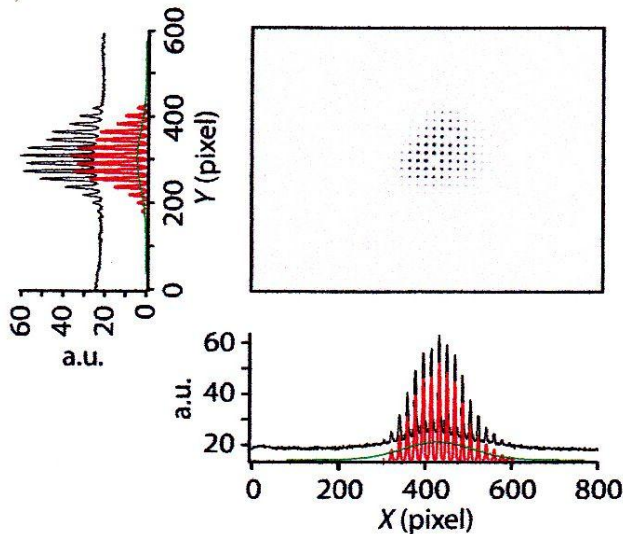
Dresden EBIS-SC

Electron current - (100 – 400) mA
Electron energy - (10 – 139 keV)

70 cm
S
C
Dr. V.P.Ovsiannikov

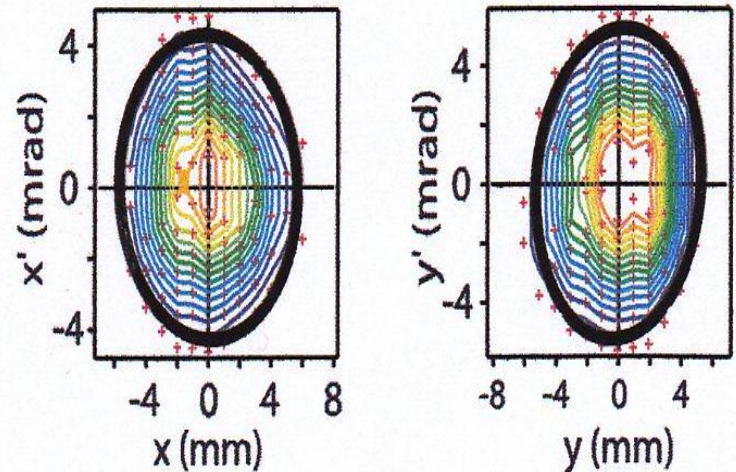
Emittance of the Unseparated Ion Beam

(EBIS-A)



Pepper-pot image and projections on the x- and y-axis.
Black line is a multiple Gaussian fitting of the projections.

$$\mathcal{E}_{x,rms} = 6 \text{ mm mrad}$$

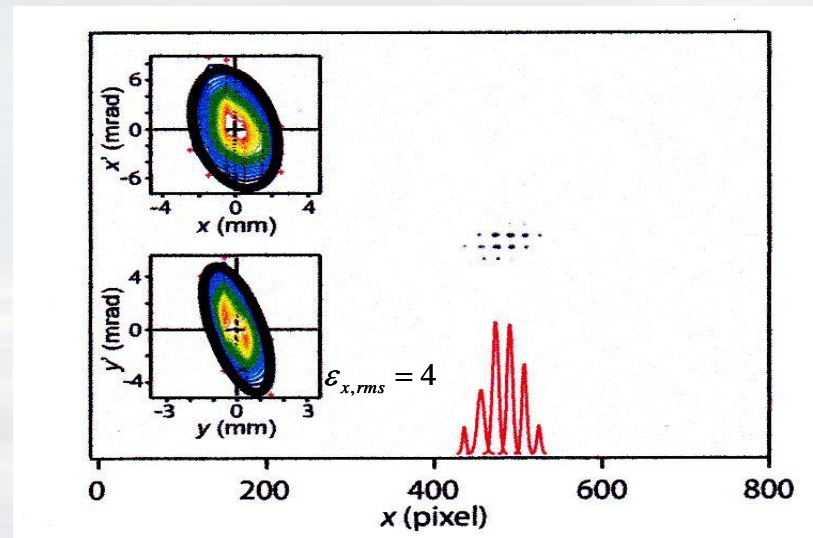


Trace space plots
of the x- and y - dimensions

$$\mathcal{E}_{y,rms} = 7 \text{ mm mrad}$$

Emittance of the Separated Ion Beam

(EBIS-A)



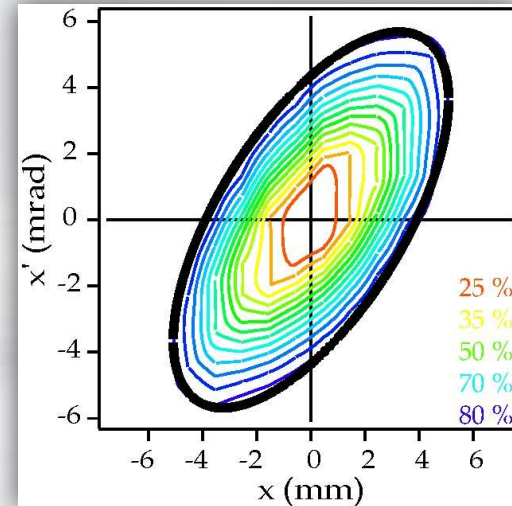
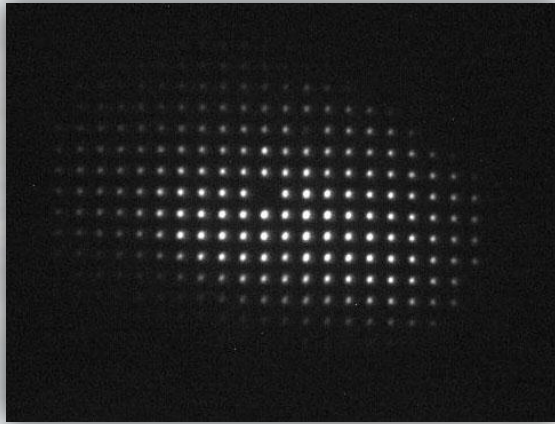
Pepper-pot picture and trace space plots of the C⁴⁺ with energy $E_{C^{4+}} = 39$ keV

$$\epsilon_{x,rms} = 4 \text{ mm mrad}$$

$$\epsilon_{y,rms} = 1.5 \text{ mm mrad}$$

Emittance of the Unseparated Ion Beam

(EBIS-SC)



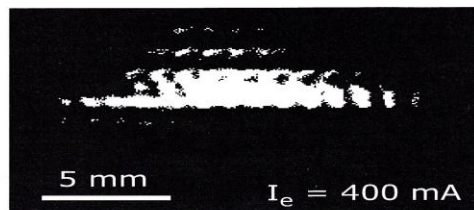
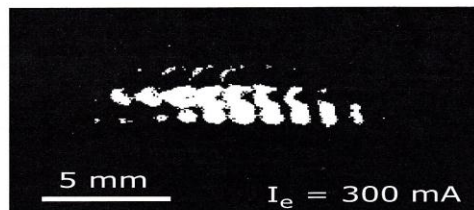
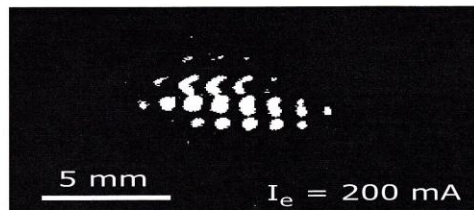
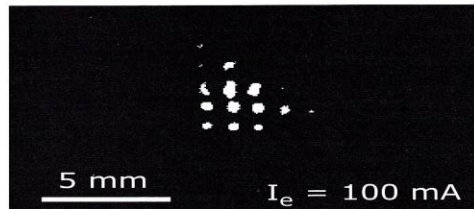
Pepper pot image and trace space fitting. Emittance meter is in 40cm after an extraction unit

Measured emittance:

$$\mathcal{E}_{x,rms} = 7 \text{ mm mrad}$$

Emittance of the Separated Ion Beam

(EBIS-SC)



In general, the expected result, namely, the increasing of the emittance and the energy spread has been detected with the increasing of the electron beam.

This process should be in relation with the increase of heating of ions in more dense electron beam and in a deeper ion trap.

The images of the ion beam of N^{5+} ions were recorded at electron beam currents of 100 mA, 200 mA, 300 mA and 400 mA, respectively.

The increasing of the electron current leads to a significant increasing of the energy spread of the ion beam in the horizontal plane.

The diameter of ion beam continuously changed from of about 3 mm for 100mA to 12 mm for 400 mA.