**Beam-Profile/-Emittance Measurements at the Frankfurt ECRIS**

K.E. Stiebing, S. Enz, Th. Kruppi,
Institut für Kernphysik der Johann Wolfgang Goethe-Universität, Max-von-Laue-Straße 1, D-60438 Frankfurt am Main

---

**SCANNER.** Trapezoidal Aluminum screen rotates on a wheel around a Faraday cup of the standard beam diagnosis system measures the lateral beam distribution (primitive of the distribution density) in two orthogonal directions (X and Y) derivative delivers the beam density distribution (beam profile)

---

**Profile-/Emittance-Monitor:**

Combination of the SCANNER with a MOVING SLIT:

1. emittance monitor (similar to a slit grid system)
2. high resolution profile monitor (x/y-beam distribution)

---

See also:

Scanners at the IKF- Accelerator Centre:

**ECRIS 0° beam line**
- Scanning area: 70 x 70 mm
- Effective slit range: 50 mm
- Orientation: 45° to beam coordinates
- Slit – scanner dist.: 1.0 m
- Two slits (.05mm)
  - X - Y profiles
  - Y’ / Y” emittance
  - X / X’ emittance

**ECRIS analysed beam**
- Scanning area: Ø 30 mm
- Effective slit range: 50 mm
- Orientation: aligned with beam axis
- Slit – scanner dist.: 0.34 m
- One slit (0.5mm)
  - X - Y profiles
  - Y’ / Y” emittance

**Injection line FLSR (Frankfurt Low-Energy Storage Ring)**
- Scanning area: Ø 60 mm
- Effective slit range: 50 mm
- Orientation: aligned with beam axis
- Slit – scanner dist.: 0.64 m
- One slit (0.5mm)
  - X - Y profiles
  - Y’ / Y” emittances
Online program (position monitor)

Measured profile

Motor control for profile and emittance scans

Derivative of first slope

Derivative of second slope

Hole (Ø 3mm) on beam axis

Hole (Ø 3mm) displaced by 5mm in x direction from beam axis
Offline program (analysis of profiles and emittances)

1. Calibration of online spectra
2. Provides filters for noise reduction
3. Determines the area emittance at different levels of the relative profile height
4. Conversion of the data into format compatible for the EAS Code (determination of Twiss parameters)

Profile scan (left hand side) and mask (right hand side) testing the linearity of the profile scan. (Mesh size of the grid: 5 x 5 mm)

“Playing” with a quadrupol triplet (FLSR test bench)
**Analysis of Twiss parameters by EAS-code**

Emittance Analysis System (EAS)  
Accelerator Physics Group Codes Spallation Neutron Source (SNS)  
[www.sns.gov/APGroup/Codes/Codes.htm]

Series of measurements with the 0°-SCANNER at different voltages on the Einzellen (no other focusing)

**EAS code:**
1. all data  
2. data filter 30%  
3. data ellipse filter  
4. data ellipse filter + data filter 50%

**left:**  
Twiss parameters using RMS emittance

**right:**  
comparison of area emittances EAS and offline program
Measurements at the ECRIS beam (MD-liner + MD-electrode, HV= 15kV, $P_{RF}$=600Watt)

**Filament beam?**
(measurements without Q-3 in 0° beam-line)

**Scanner at FC90-2:**

Scanner at FC-0°: $U_{El} = 1012$V (opt.)

Scanner at FC-0°: $U_{El} = 500$V

Emittance: $44$ mm mrad

Emittance: $40$ mm mrad

Emittance: $82$ mm mrad

$\varepsilon_{85\%} = 192$ mm mrad

$\varepsilon_{85\%} = 85$ mm mrad

$\varepsilon_{85\%} = 63$ mm mrad