Ion source diagnostics and ion beam diagnostics for ECRIS

- intensity
- profile
- emittance
- space charge compensation
- light/X-rays coming from plasma
- …

Intensity measurements

- Load on extraction PS
- Faraday cup
- Beam transformer
- Flying wire
- Charge state distribution by spectrometer
- Charge state distribution by TOF
- …

Profile measurement

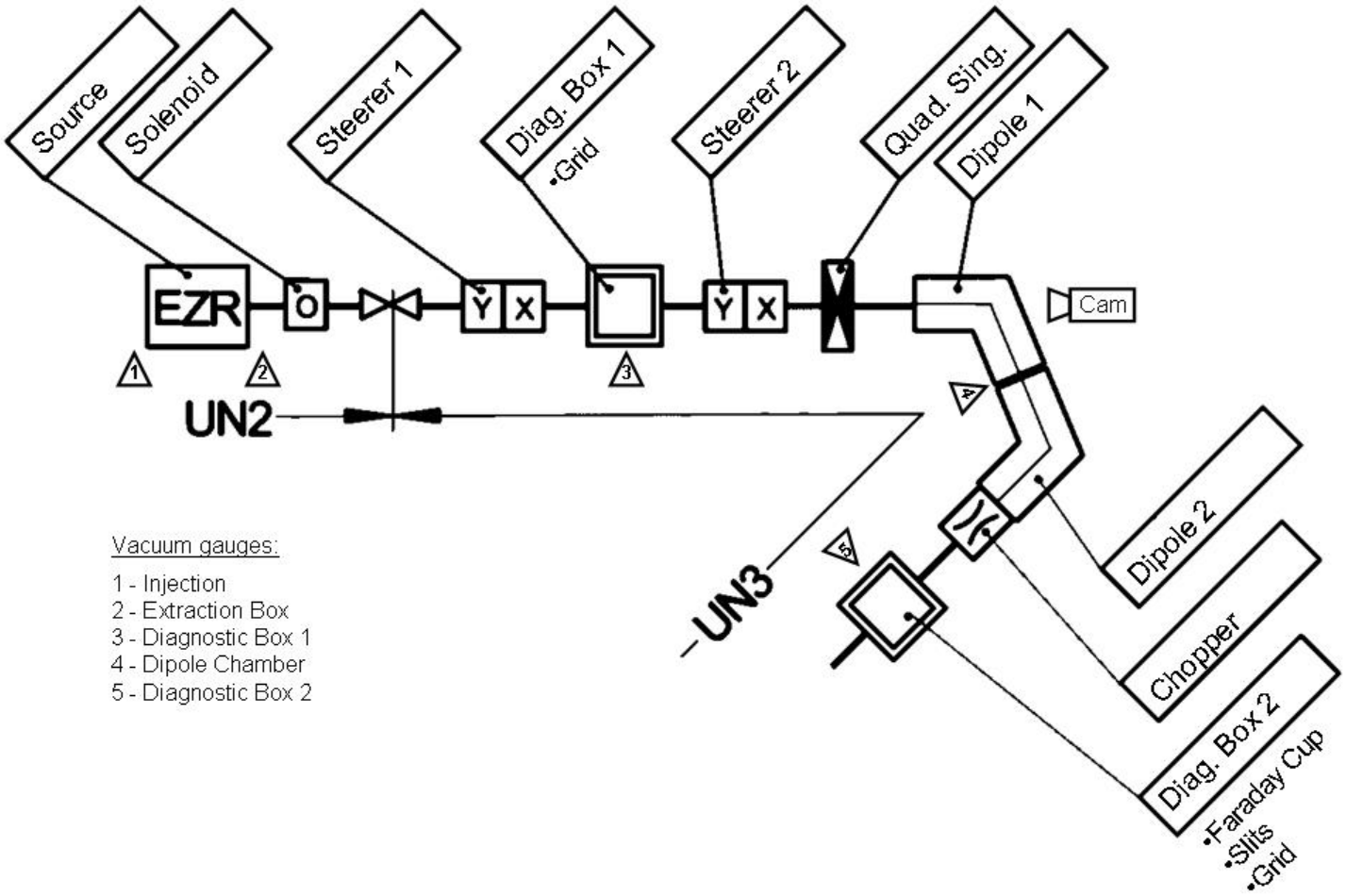
- Viewing targets with BaF, … provide real profiles, confirmed by μ-FC arrays.
- Lifetime of viewing targets is limited.
- A lot of secondary electrons will influence the ion beam.

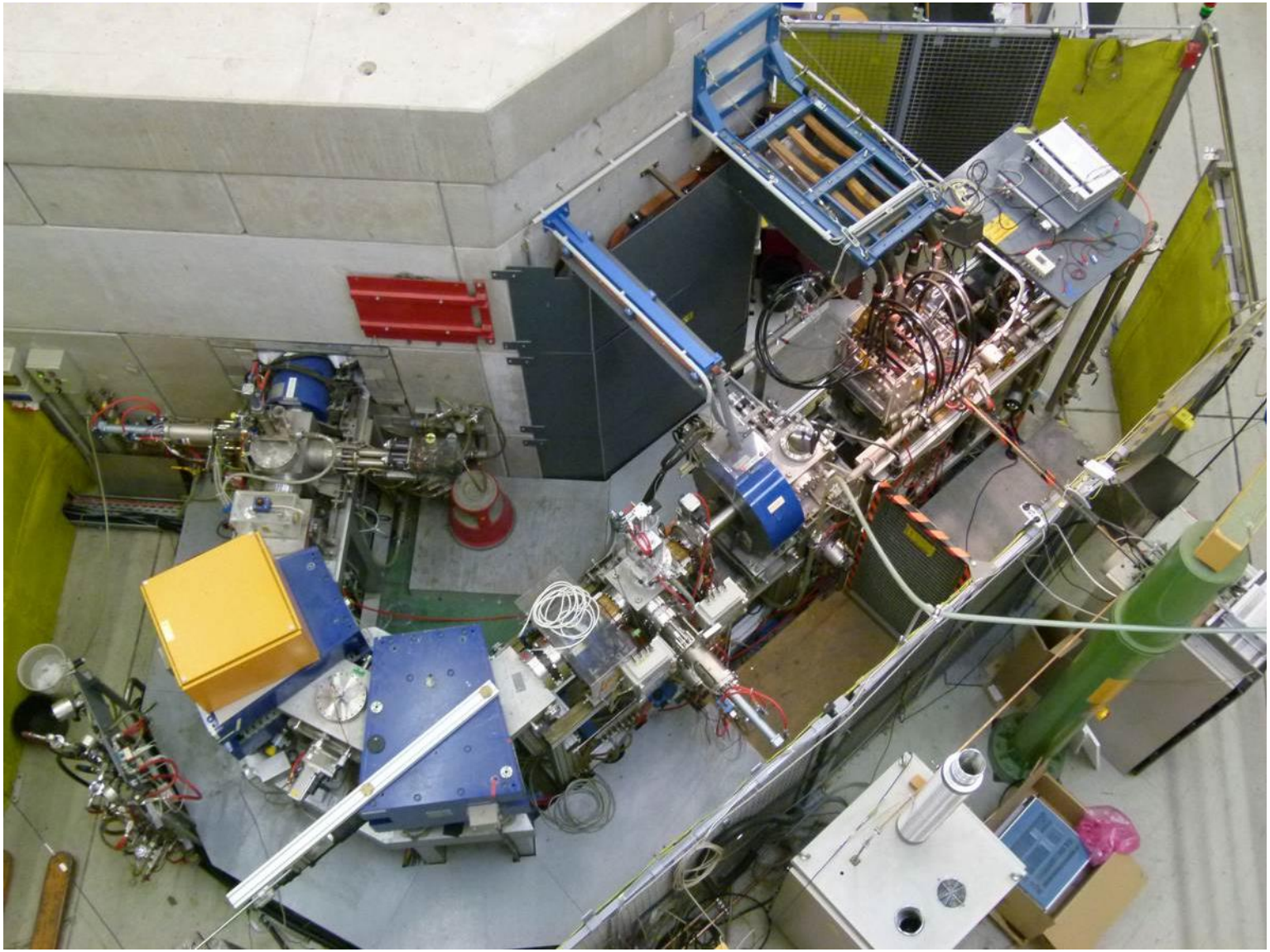
Emittance measurement

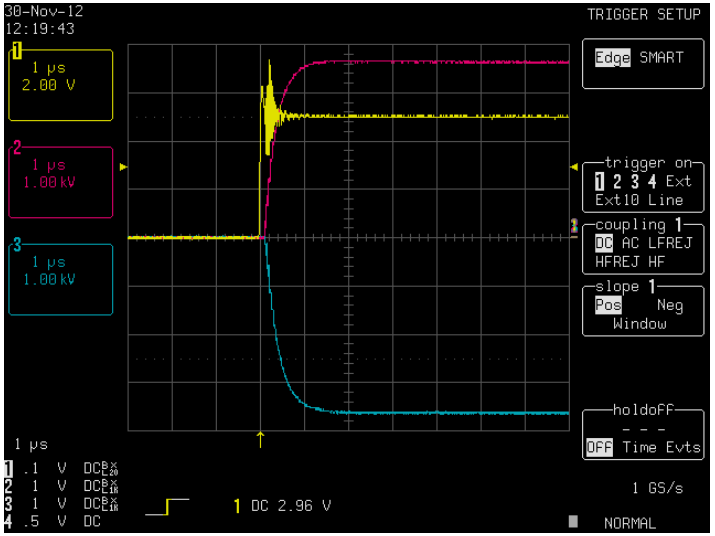
- Allison scanner not suitable for ECRIS. Because of integration in real space.
- Pepper pot gives 4D information, but software is still missing.
- Hardware problems (for our pepper pot, sensitivity of the CCD) still exist.
- Be aware: a huge amount of electrons will influence the measurement in both cases.

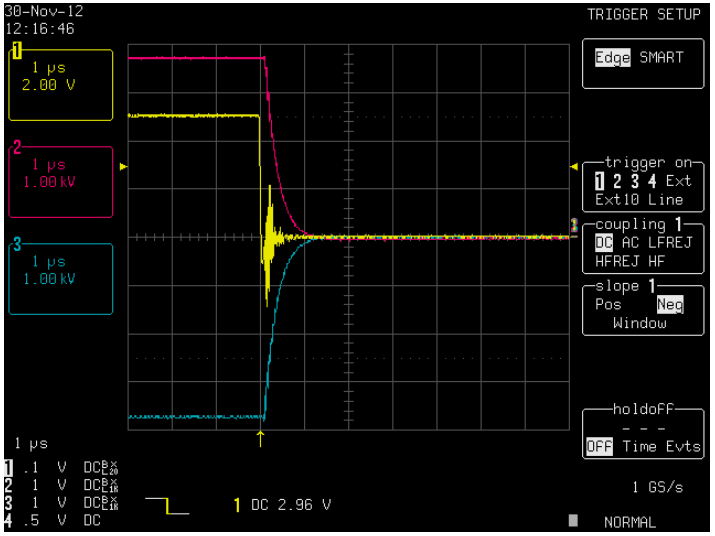
Space charge compensation

- biased wires
  - positive bias: electrons will be removed from the beam as long as the space charge potential is less positive than the applied voltage.
- biased tube/ring
  - positive bias: electrons will be removed from the beam as long as the space charge potential is less positive than the applied voltage.
  - negative bias: electrons will be repelled from regions with negative potential.
- transversal field
  - The beam will be dumped (completely destroyed) as long as the field is present.


Source
Solenoid
Steerer 1
Diag. Box 1
•Grid
Steerer 2
Quad. Sing.
Dipole 1
EZR
O
Y
X
Y
X
Cam
1
2
3
4
5
UN2
UN3
Dipole 2
Chopper
Diag. Box 2
•Faraday Cup
•Slits
•Grid
Vacuum gauges:
1 - Injection
2 - Extraction Box
3 - Diagnostic Box 1
4 - Dipole Chamber
5 - Diagnostic Box 2







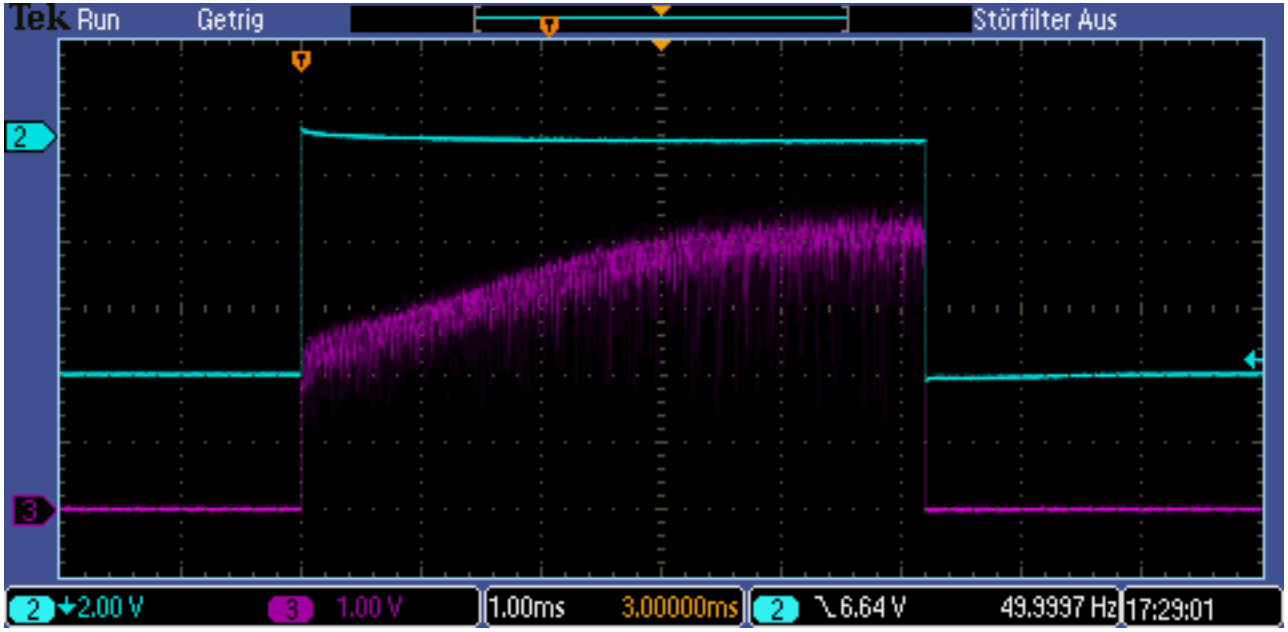
chopper signals:

yellow	timing
red	positive voltage
blue	negative voltage

action:

voltage on → no beam

voltage off → beam on, space charge compensation starts to build up.

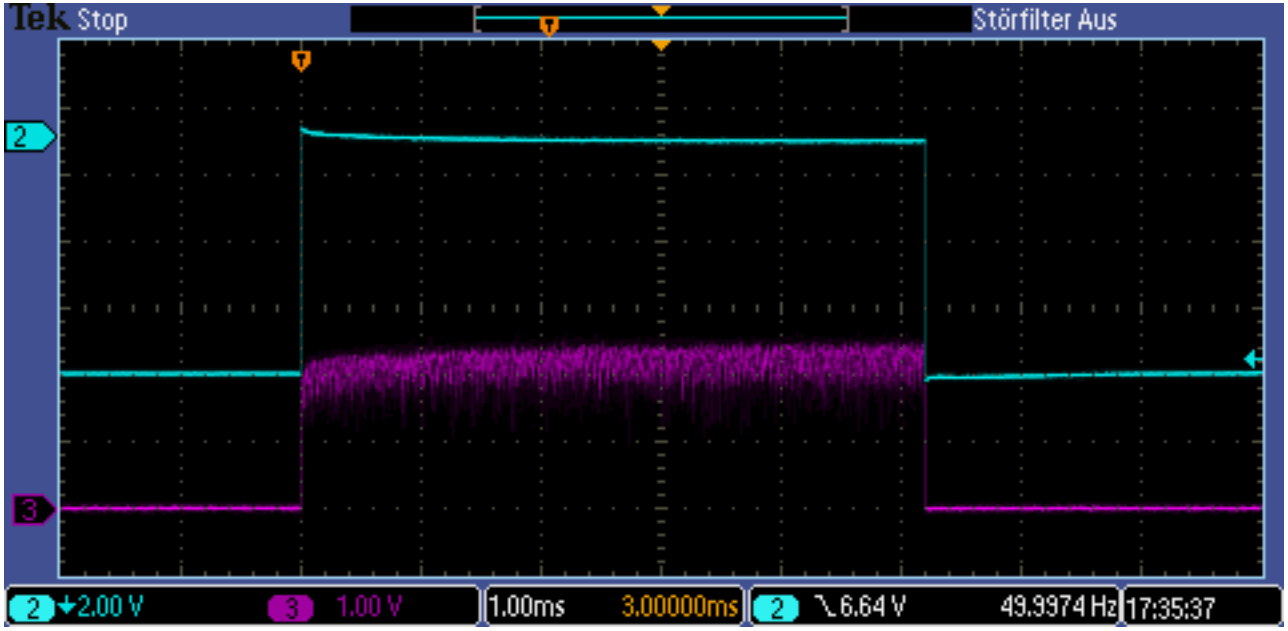


wire grid out →

3.5 ms compensation build up time.

He^+ ion beam 5keV,

$p \approx 10^{-7}$ mbar



signal: Faraday cup

blue: timing (chopper off)

magenta: 10kΩ (100 µA/div)

horizontal: 1ms/div

wire grid in →

0.1 ms compensation build up time

- View through the extraction hole into plasma.
  - suitable for oven control.
  - to check the action of screening, provided by the accel-decel extraction system.

Thank you for your attention!