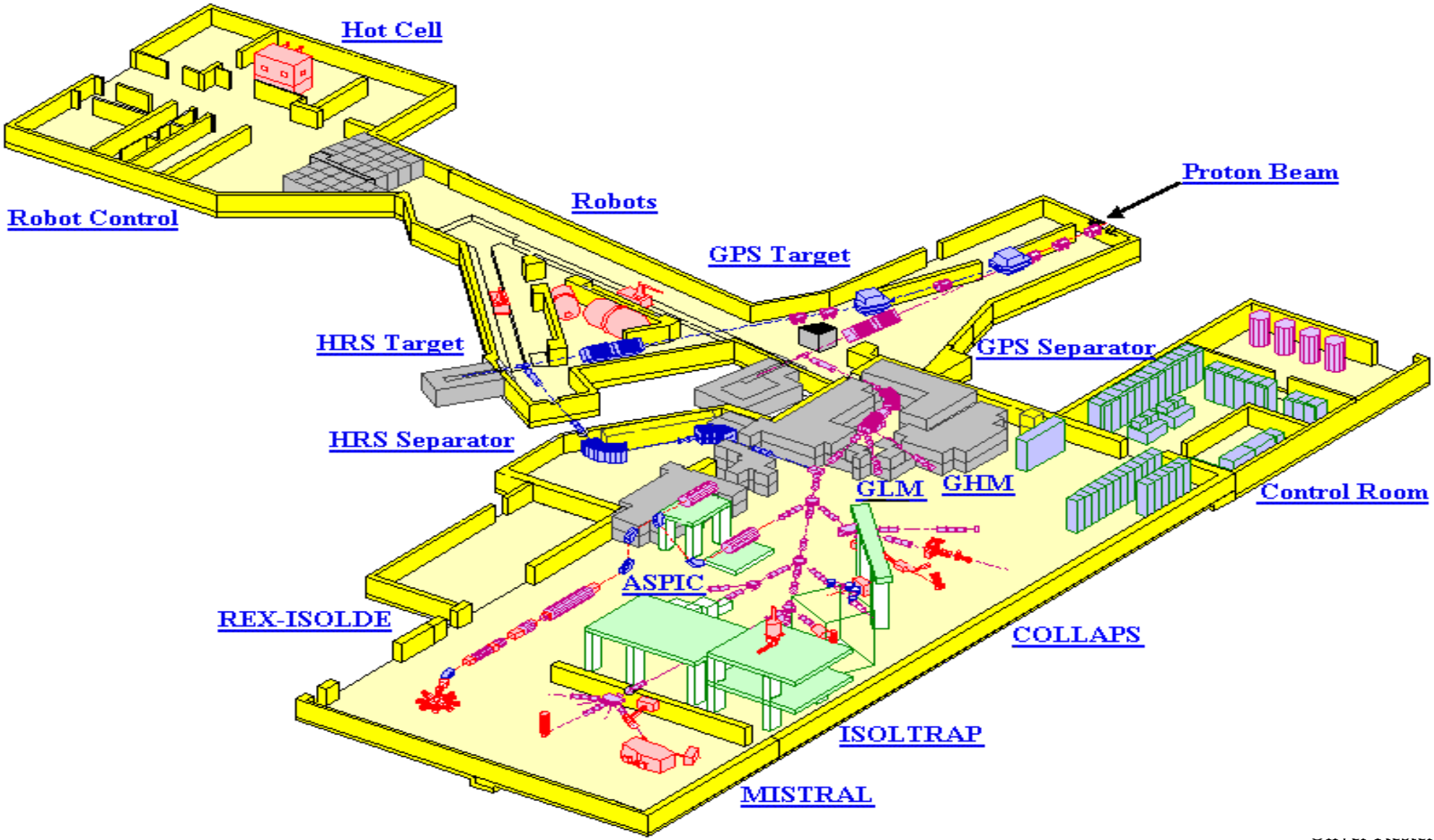
Status of REX-ISOLDE

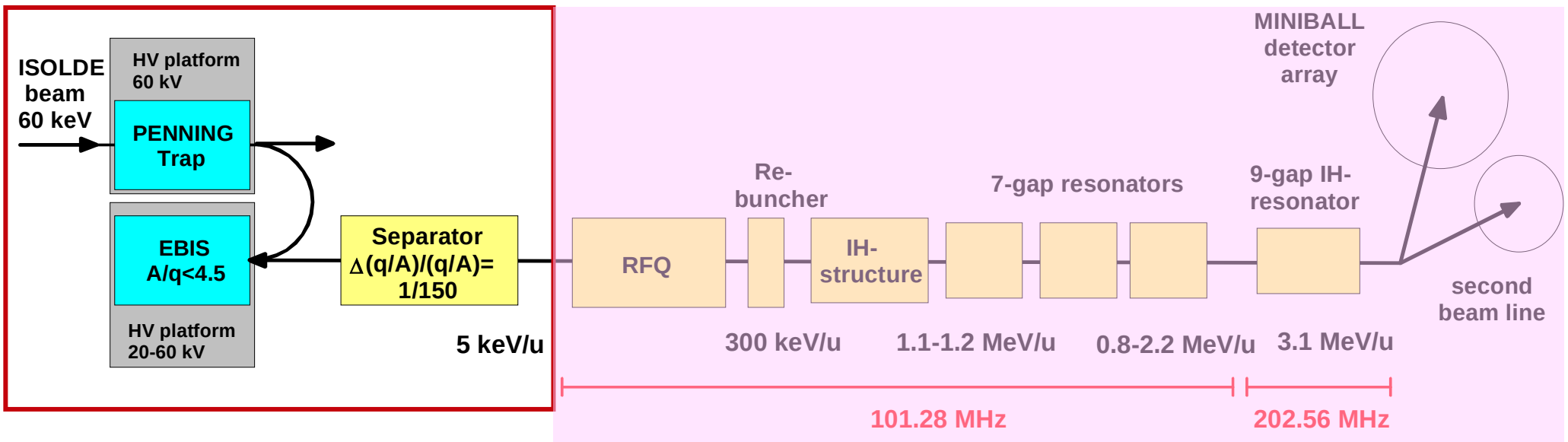
1. REX-ISOLDE overview
2. The low energy part of REX-ISOLDE
   - beam preparation and charge breeding
3. The REX-ISOLDE LINAC
4. upgrade above 4 MeV/u
   - infrastructure
   - 28 gap IH-structure

ISOLDE overview



REX-ISOLDE overview (present set-up)

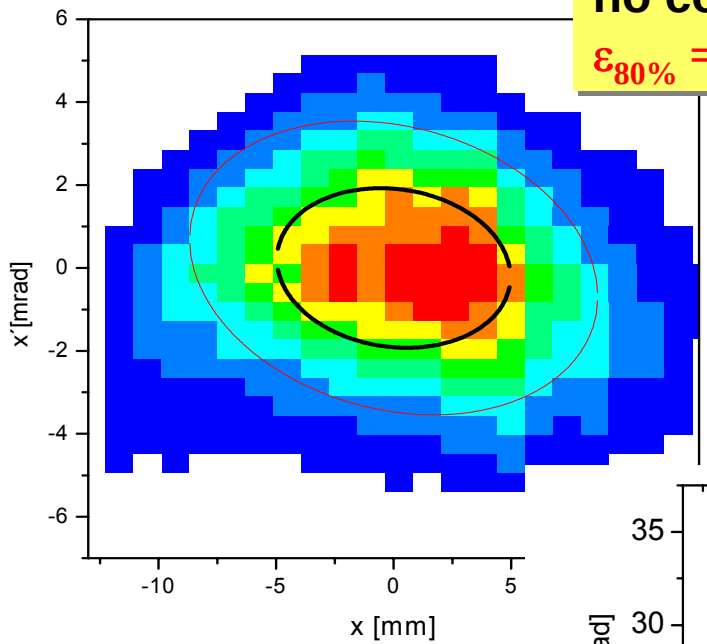
- operational since 2001
- charge state breeder and LINAC commissioned
- first nuclear physics results



Beam preparation with REXTRAP

no cooling applied

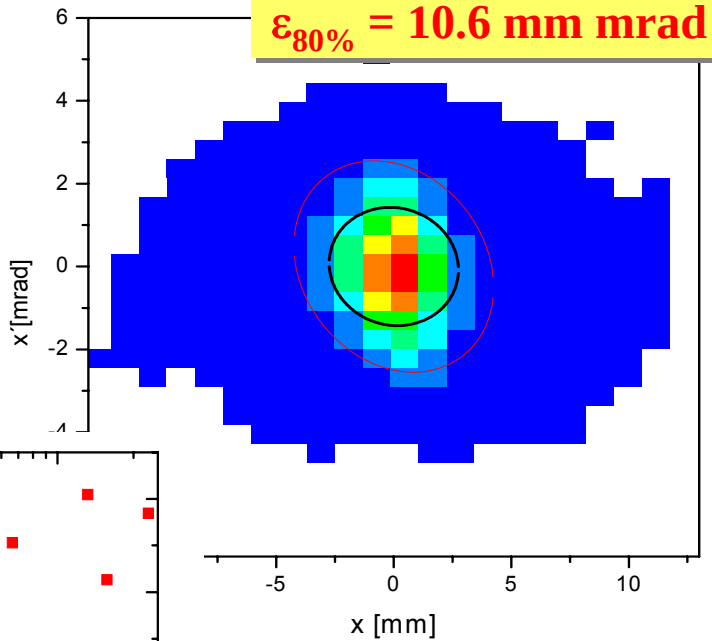
$\varepsilon_{80\%}$ = 30.1 mm mrad

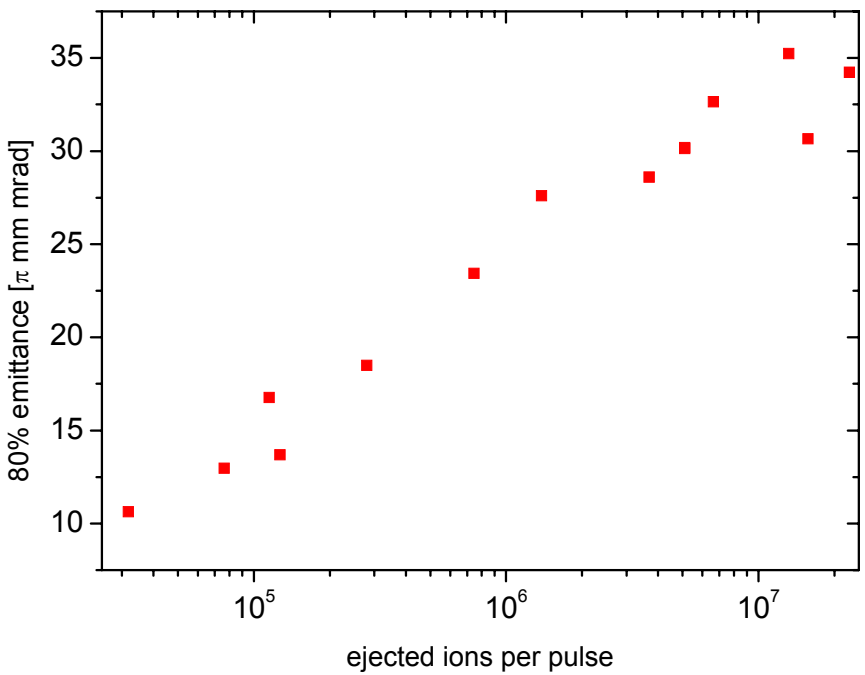


- 35000 $^{39}K^{+}$/pulse
- buffer gas Ne
- 20 ms cooling
- extraction energy:

Ions cooled

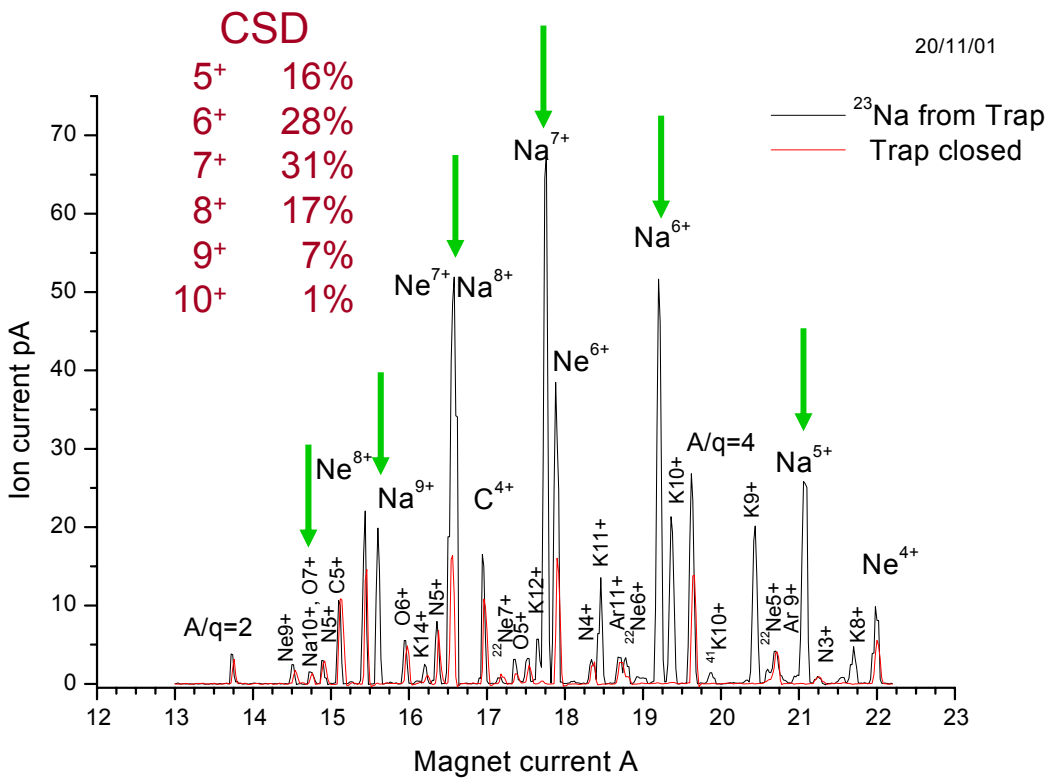
$\varepsilon_{80\%}$ = 10.6 mm mrad





REXEBIS breeding

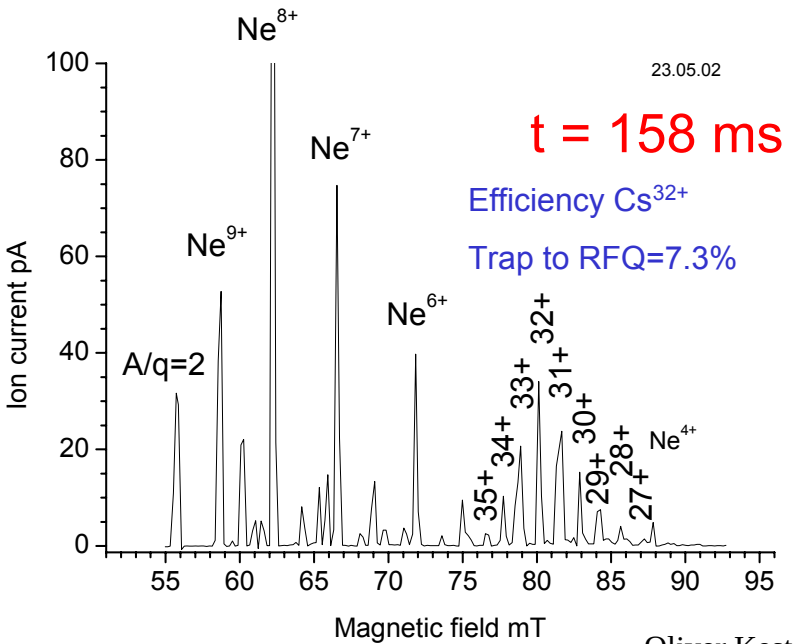
- isotopes bred from ^{7}Li to ^{156}Eu
- efficiency 5-10% overall
- small emittance 10 mm mrad (60 keV)



Efficiencies (design values)

- trap bunching: 90%
- beam transport: >85%
- EBIS injection: >50%
- EBIS $Q_i/\Sigma Q_i$: 30%
- mass analyser: 90%

→ Σ_{eff} **11%** in one charge state



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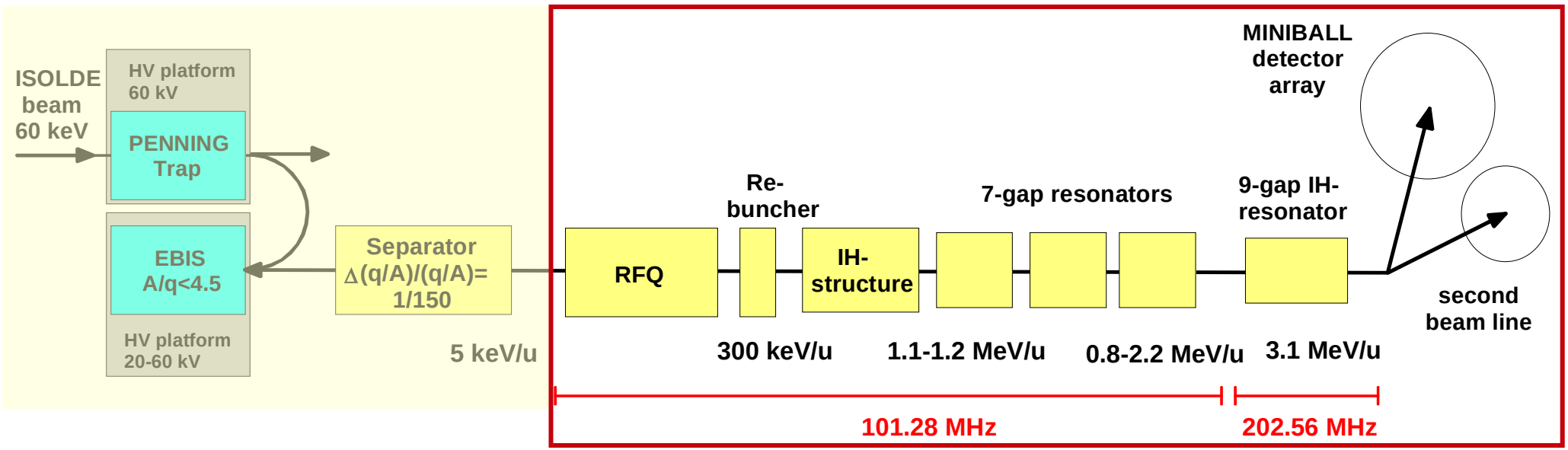
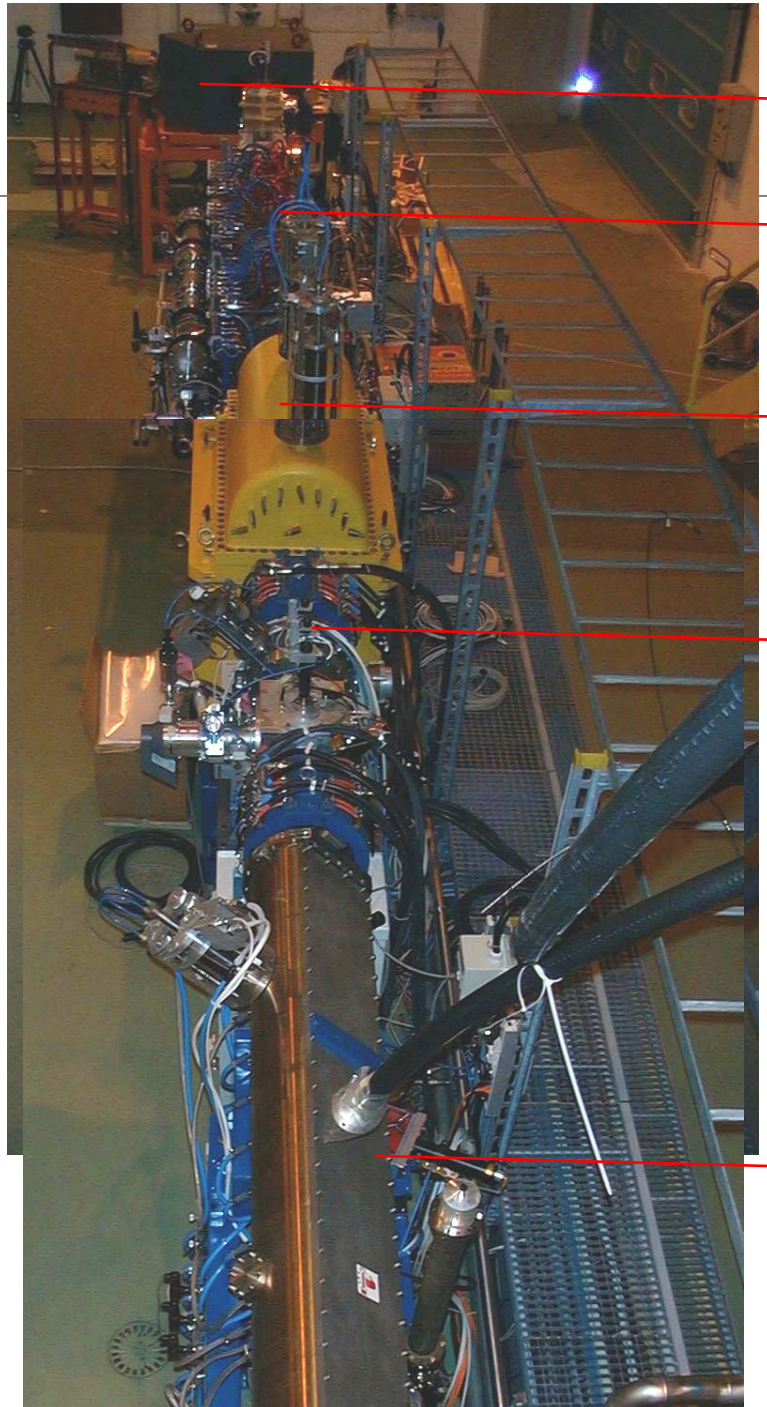
REX-ISOLDE overview (present set-up)

A/q < 4.5 , f = 101.28 MHz / 202.56 MHz

duty cycle = 10%, rep. rate < 50 Hz

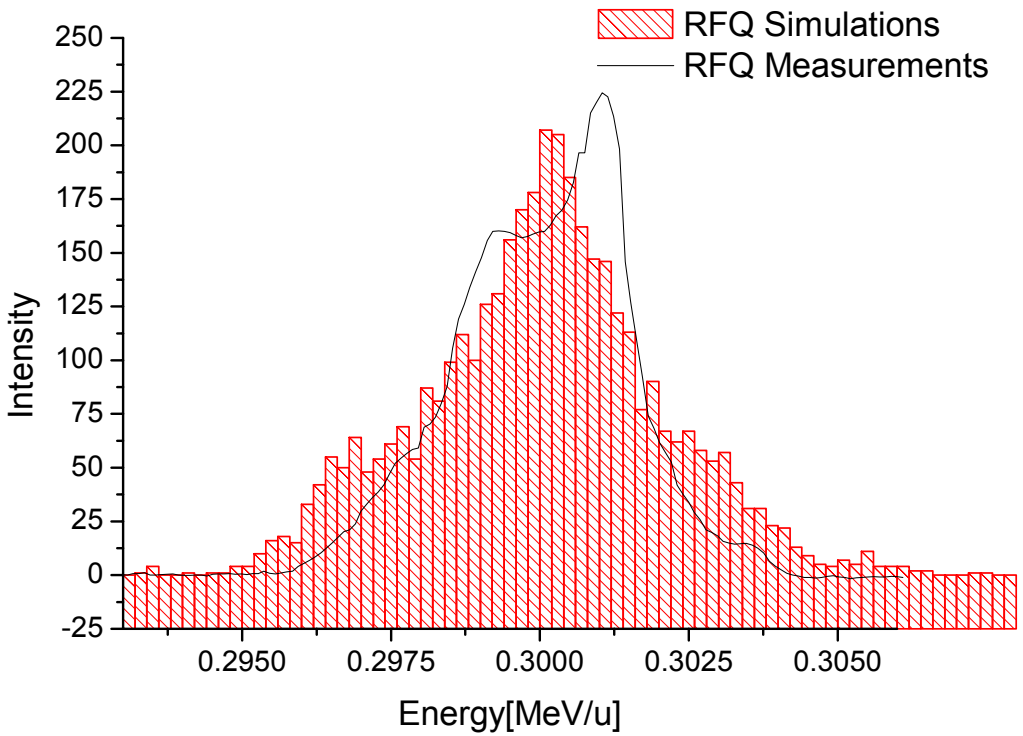
max. E = 2.9 MeV/u



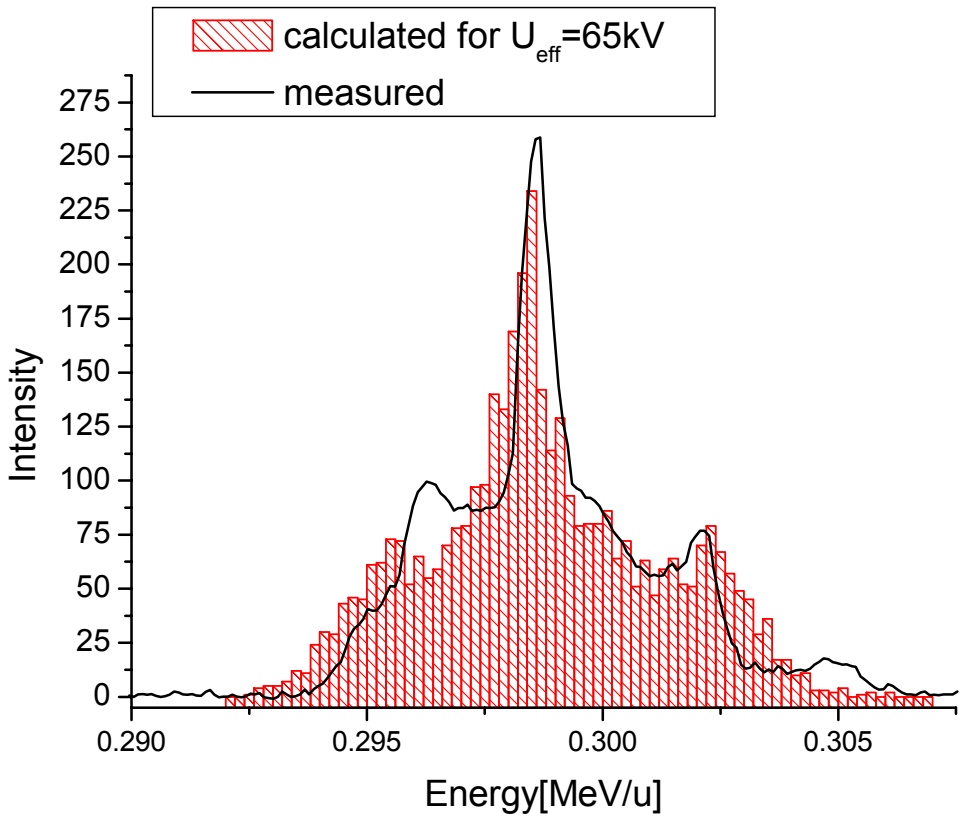

Bending magnet
7-gap resonators
IH-structure
matching section
RFQ

energy spectra RFQ + re-buncher

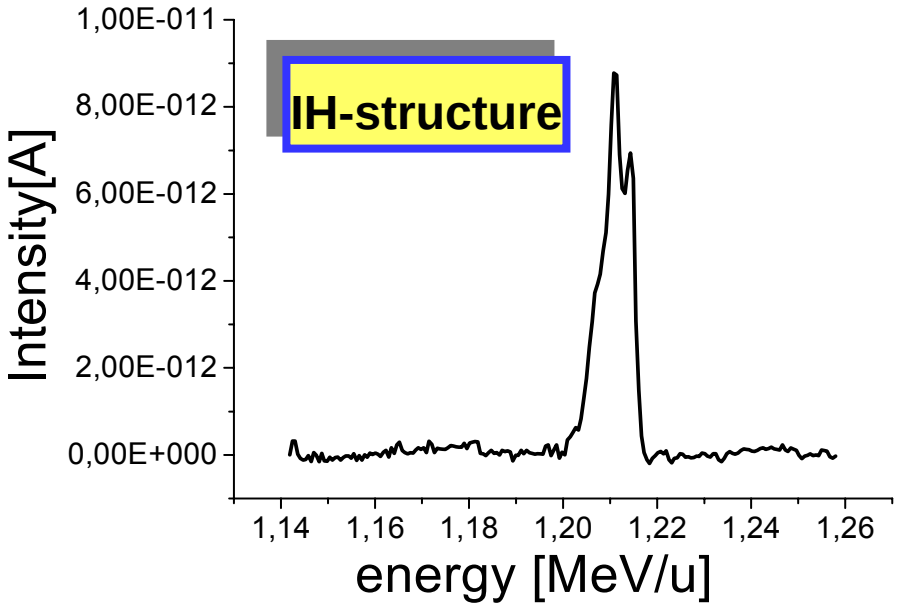
RFQ

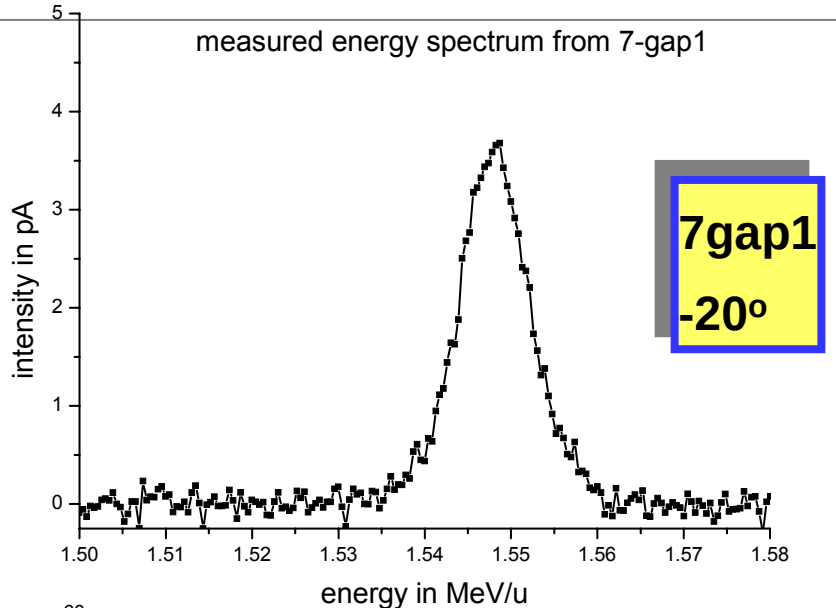


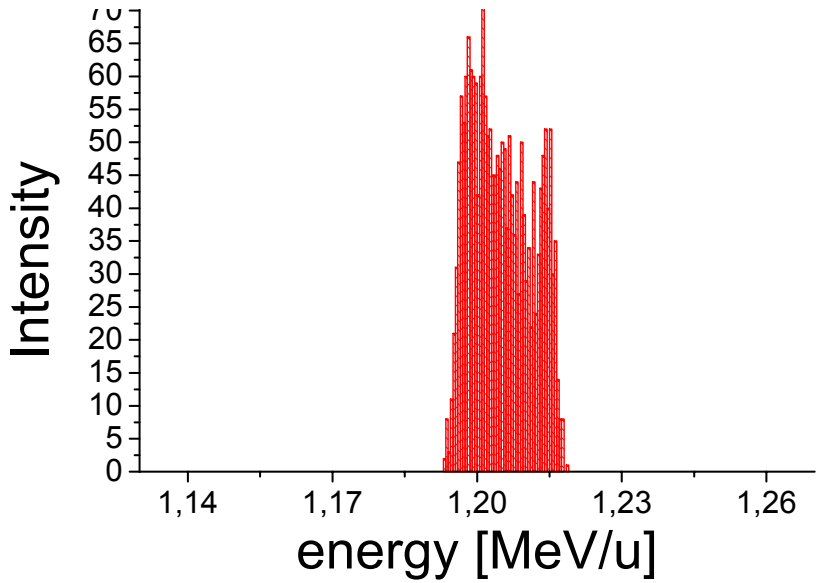
RFQ+re-buncher

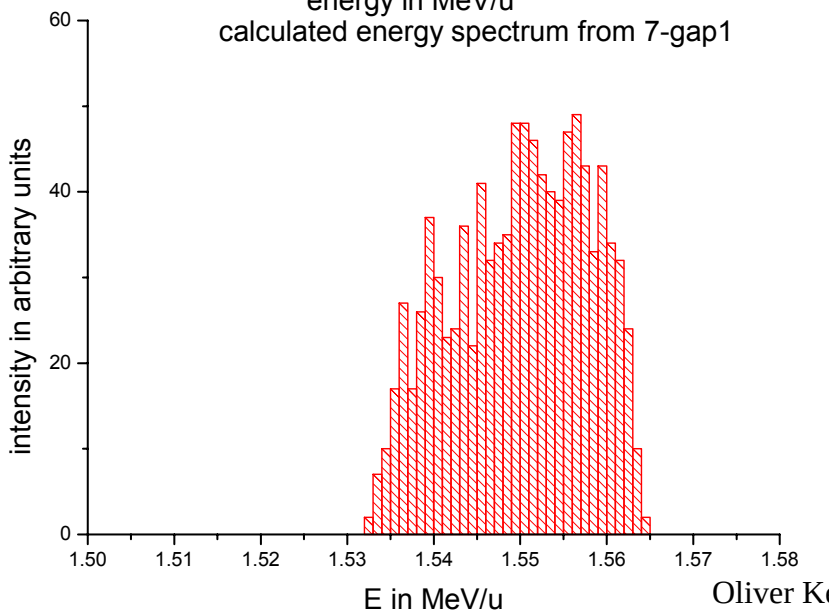


Phase tuning; energy spectra









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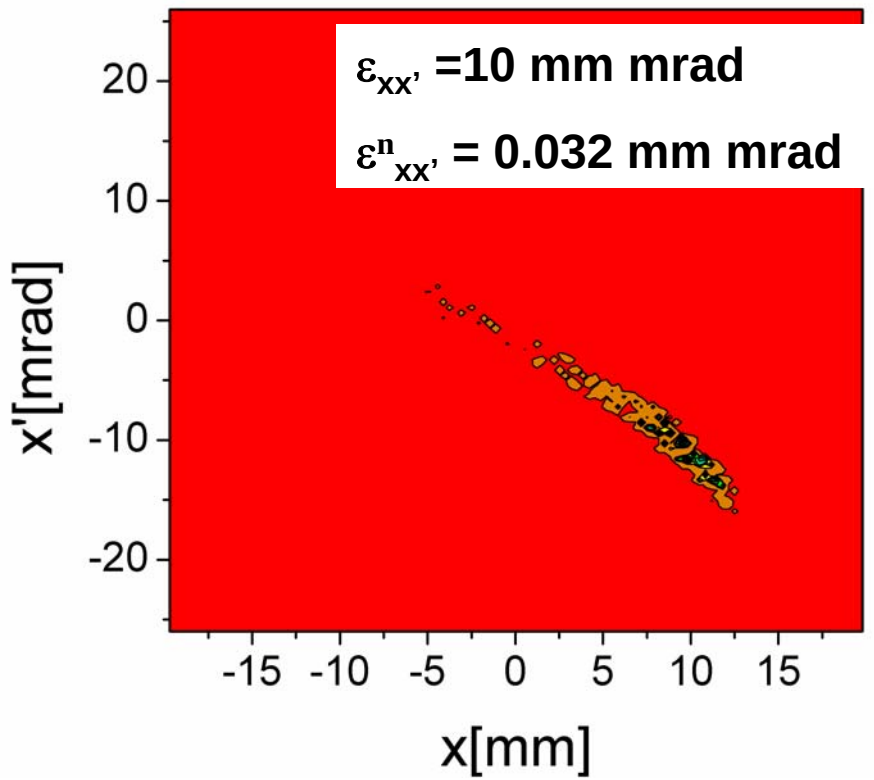
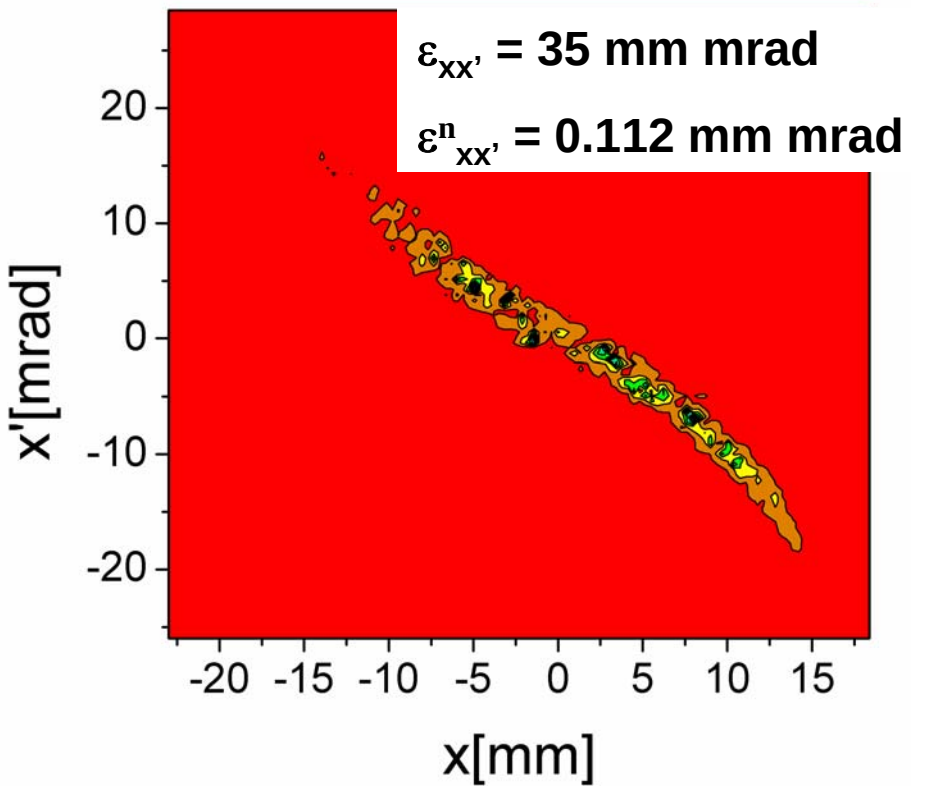
Transverse emittance in front of the RFQ

Highly charged from residual gas



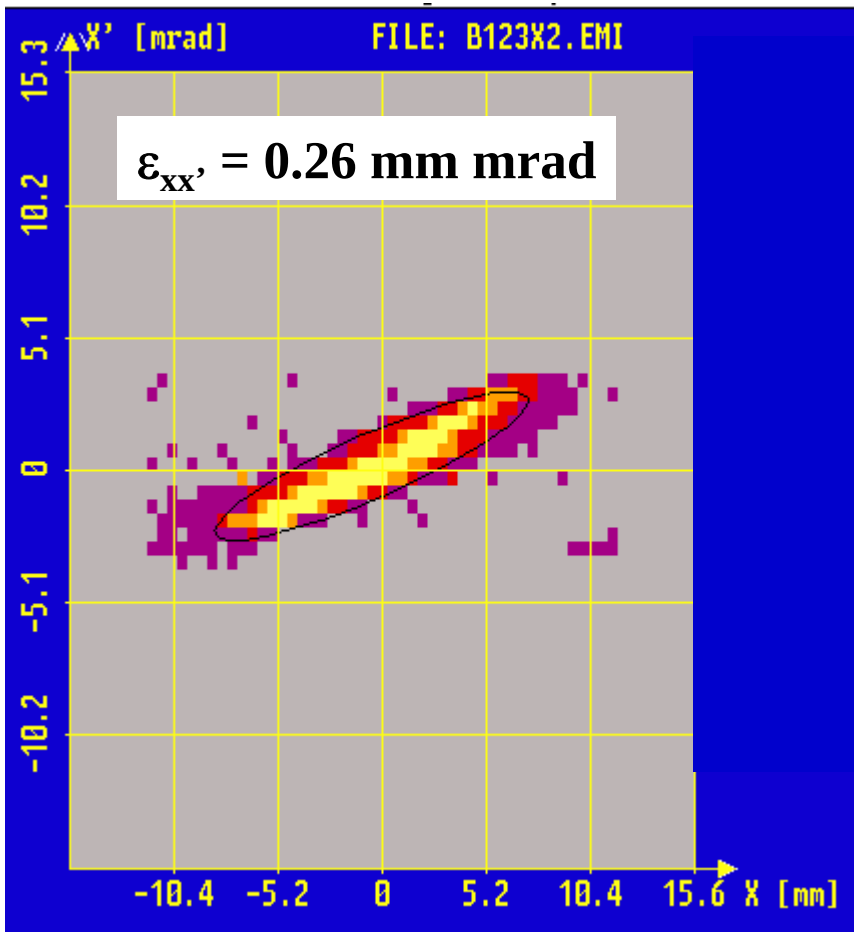
Electron beam compensated with He^{+}-ions

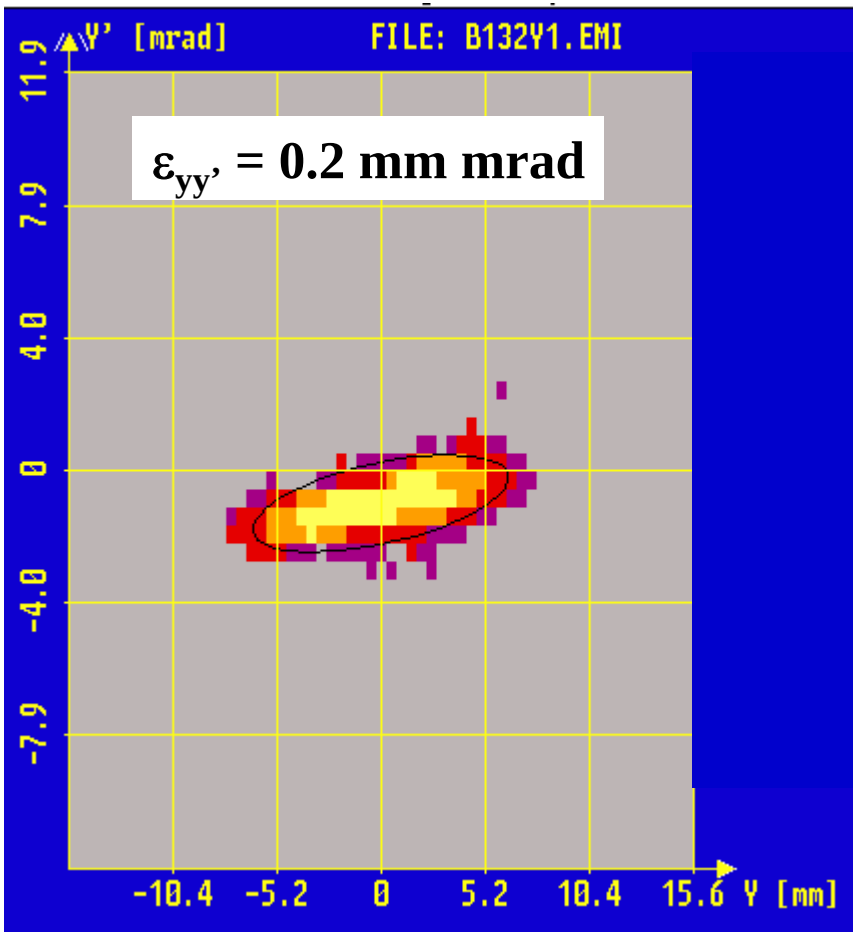


Normalized emittances (90%): RFQ+re-buncher

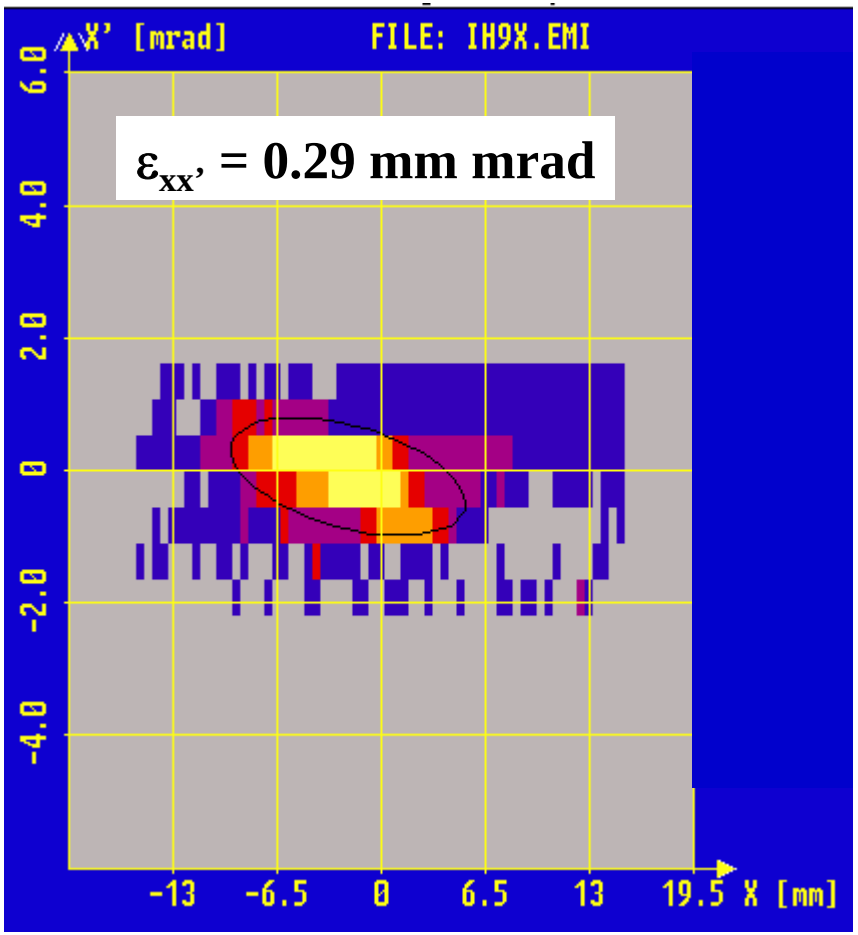
$\varepsilon_{xx'inject}$ = 0.25 mm mrad

$\varepsilon_{yy'inject}$ = 0.2 mm mrad

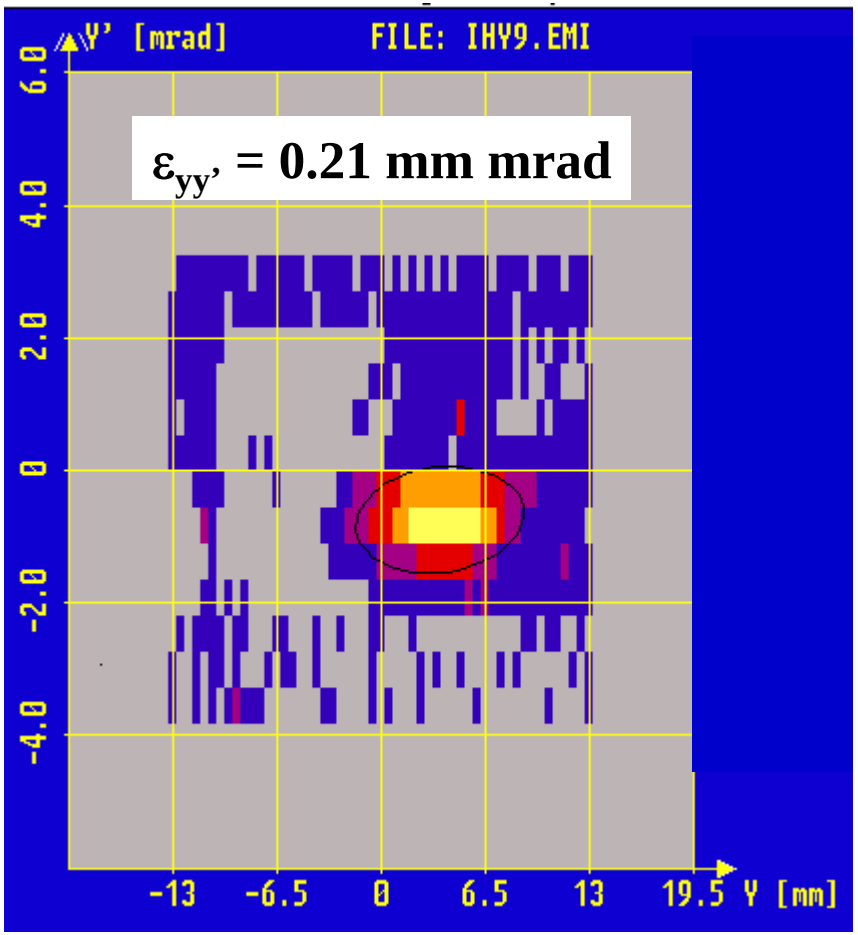




Normalized transverse emittance: IH-structure



$\varepsilon_{xx'} = 0.29$ mm mrad



$\varepsilon_{yy'} = 0.21$ mm mrad

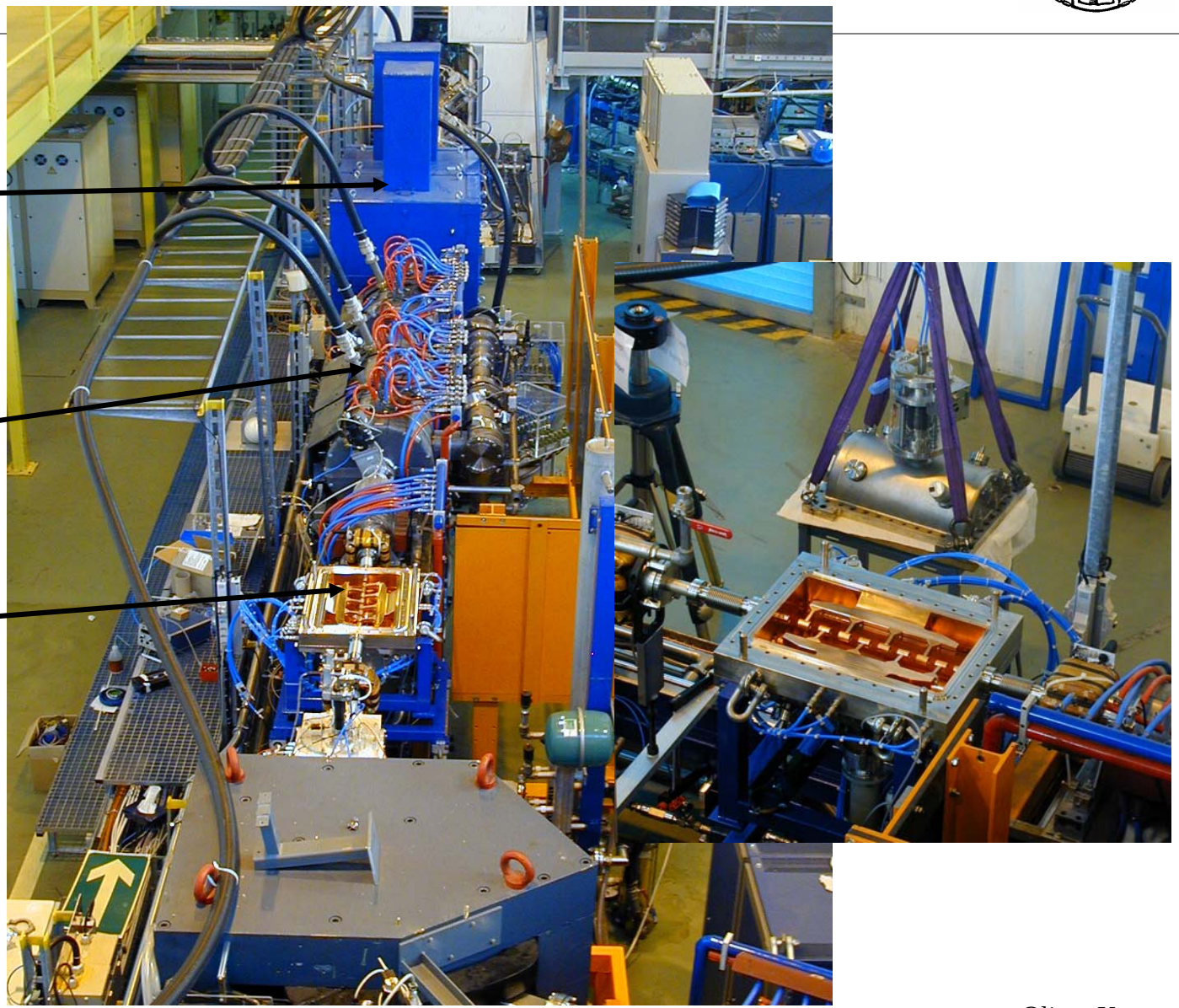
problems: low intensity (1nA), low angular resolution (20% error possible)

9-gap IH-structure

REX-IH structure lead shield

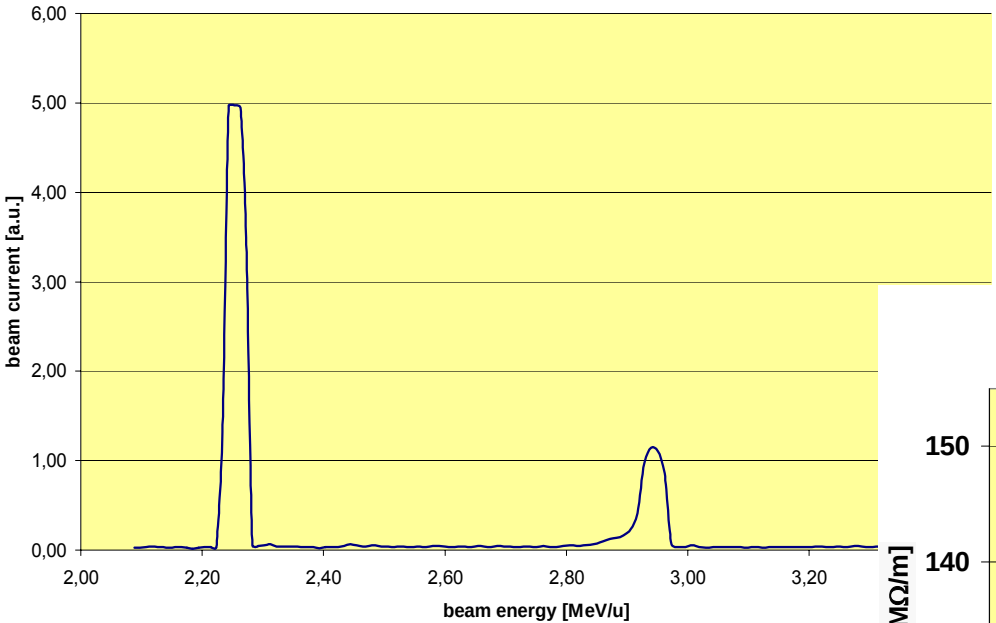
7-gap split ring resonators

9-gap IH-resonator



test of the 9-gap cavity in Munich

energy spektrum 70 kW rf-power

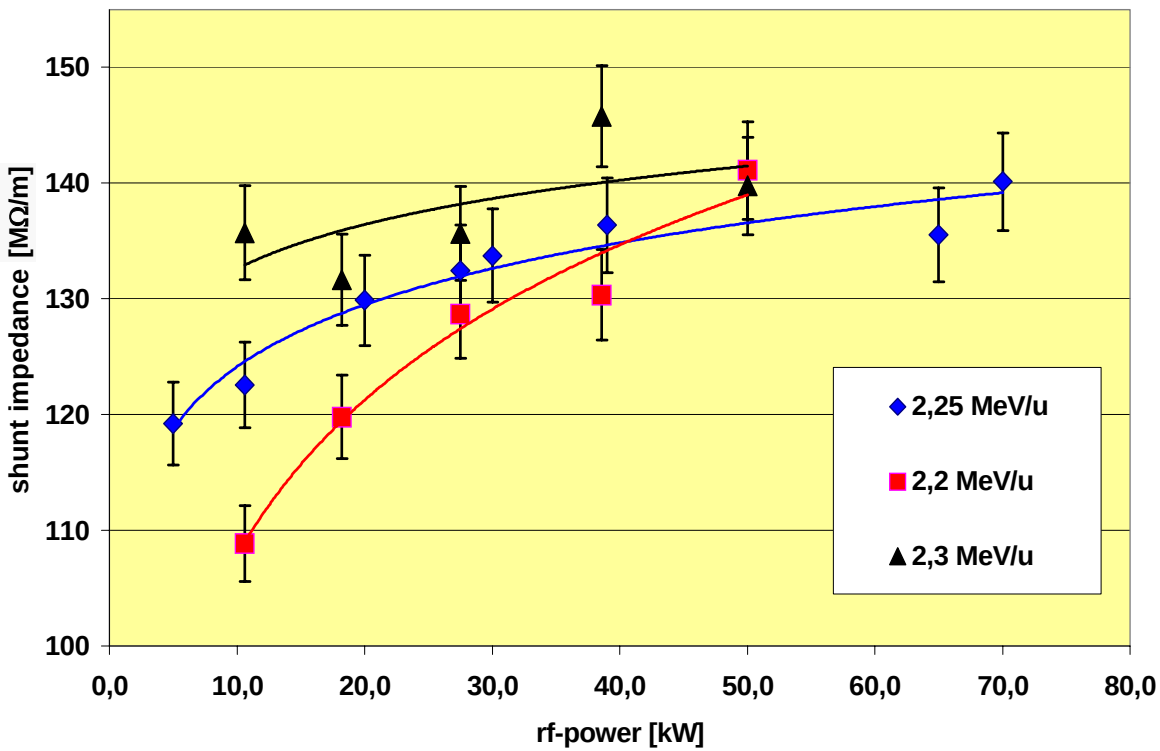


const cell length

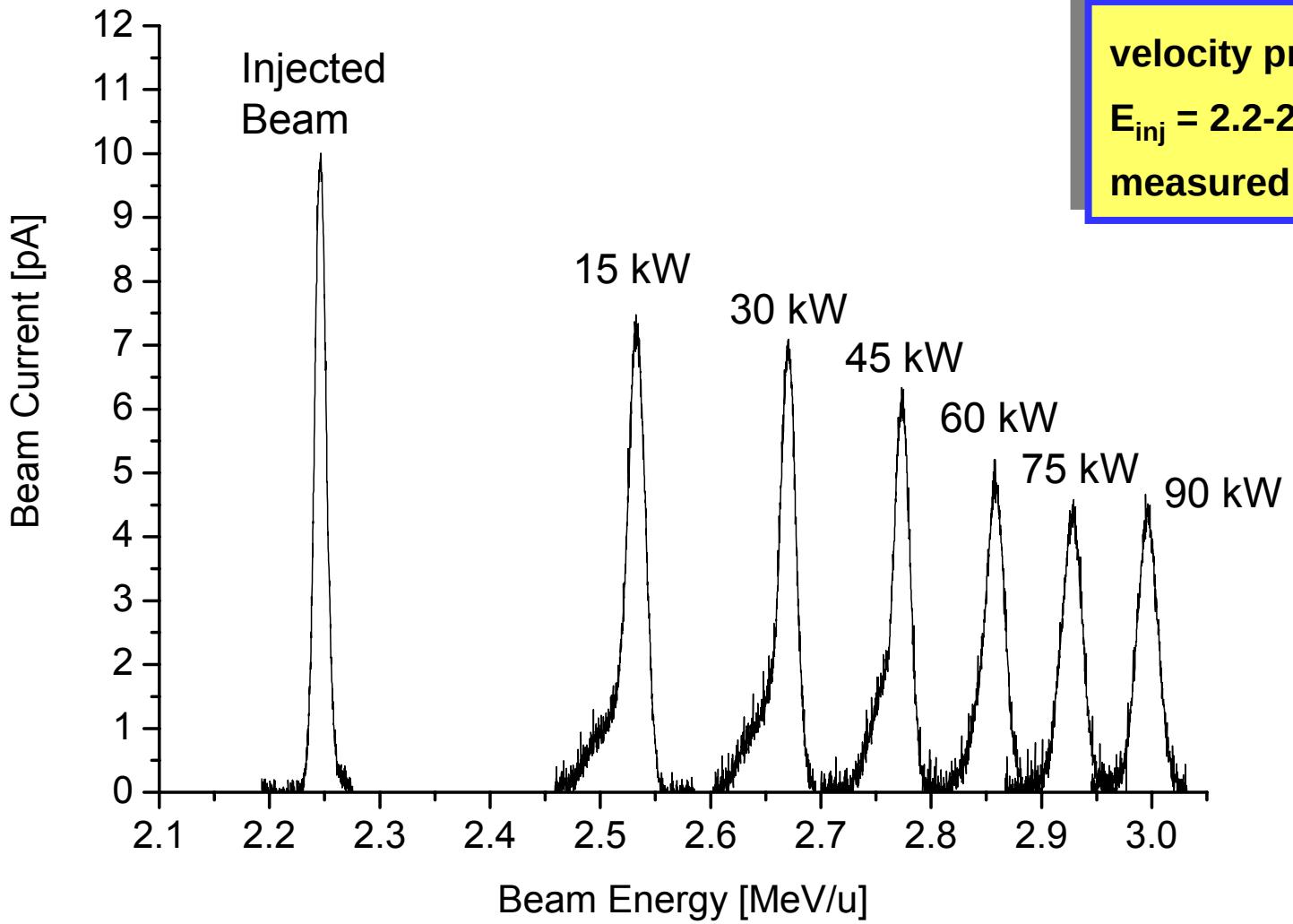
$ß_{synch}$ = 7.3% c (2.5 MeV/u)

O^{5+} (A/q = 3.2)

effective shunt impedances



9-gap IH cavity included in REX



velocity profile adjusted

E_{inj} = 2.2-2.25 MeV/u

measured at A/q = 3.5

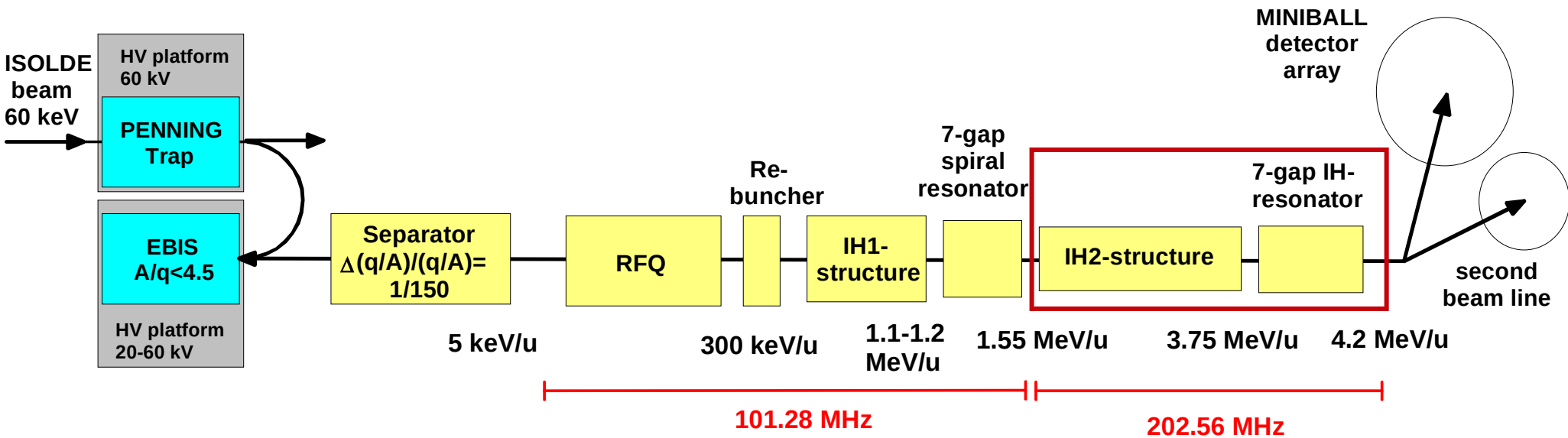
See poster of T. Sieber TUP13

REX-ISOLDE future set-up

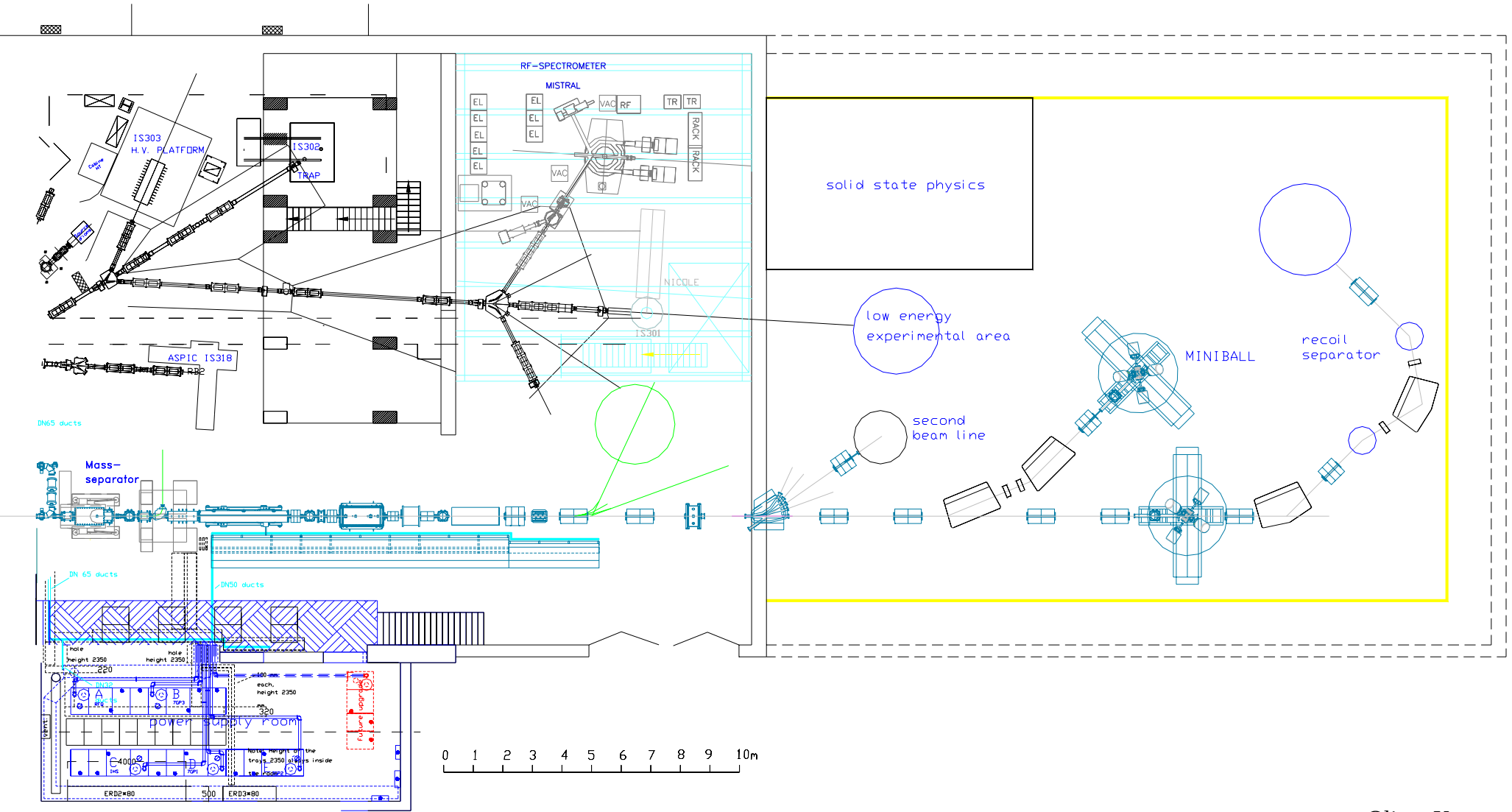
A/q < 4.5 , f = 101.28 MHz / 202.56 MHz

duty cycle = 10%, rep. rate < 50 Hz

max. E = 4.2 MeV/u



Extension of the ISOLDE hall



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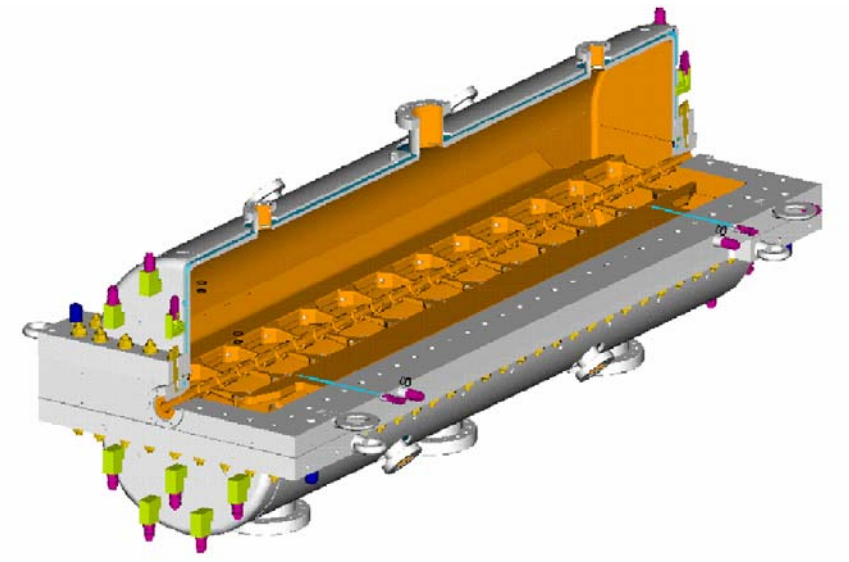
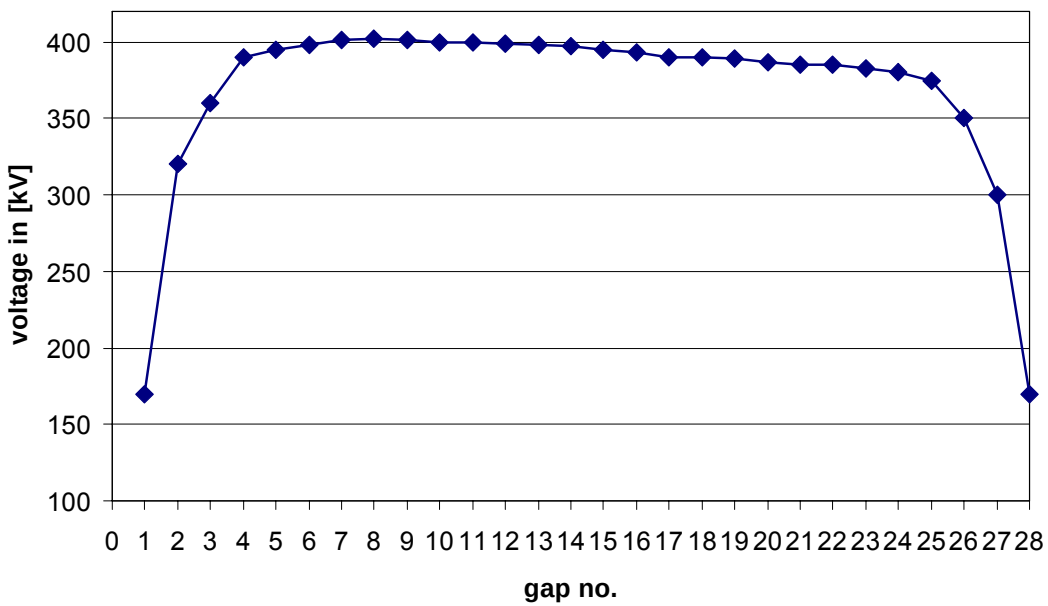
28-gap IH-structure





28 gaps
4 gaps –30°
24 gaps 0°

typical energy range for REX:
E ~ 1.5 – 7 MeV/u

effective shunt impedance:
160 – 180 MΩ/m

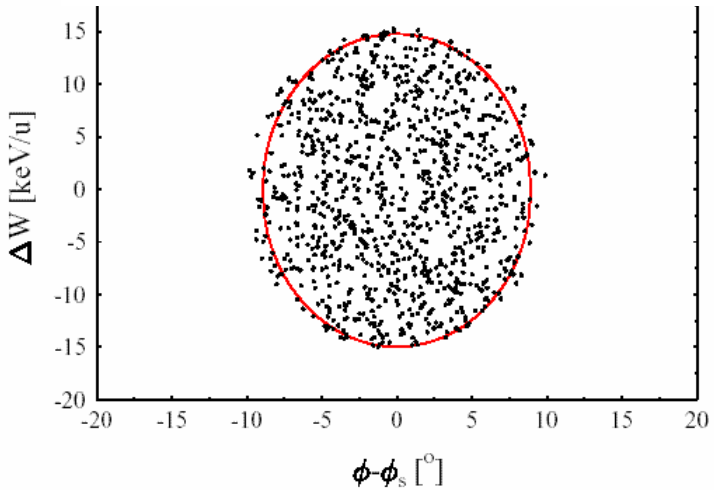
for energy gain of 2.2 MeV/u
10 MV effective voltage, (1.5m)

→ 400 kW rf-power

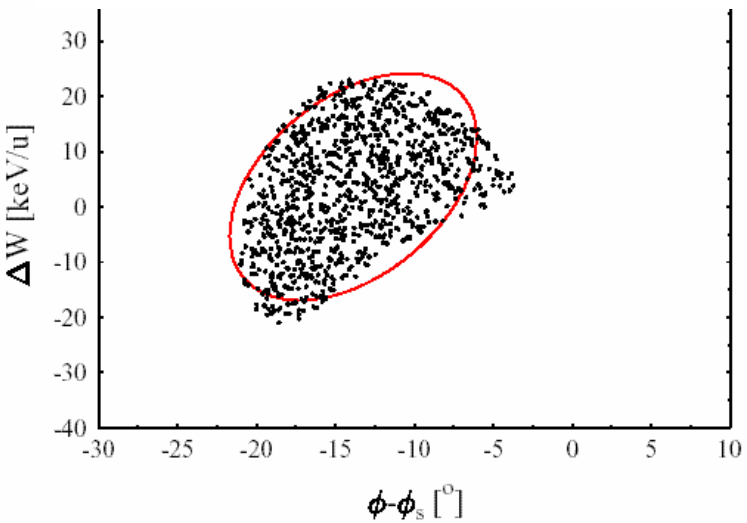
3 stage amplifier, 6 m long

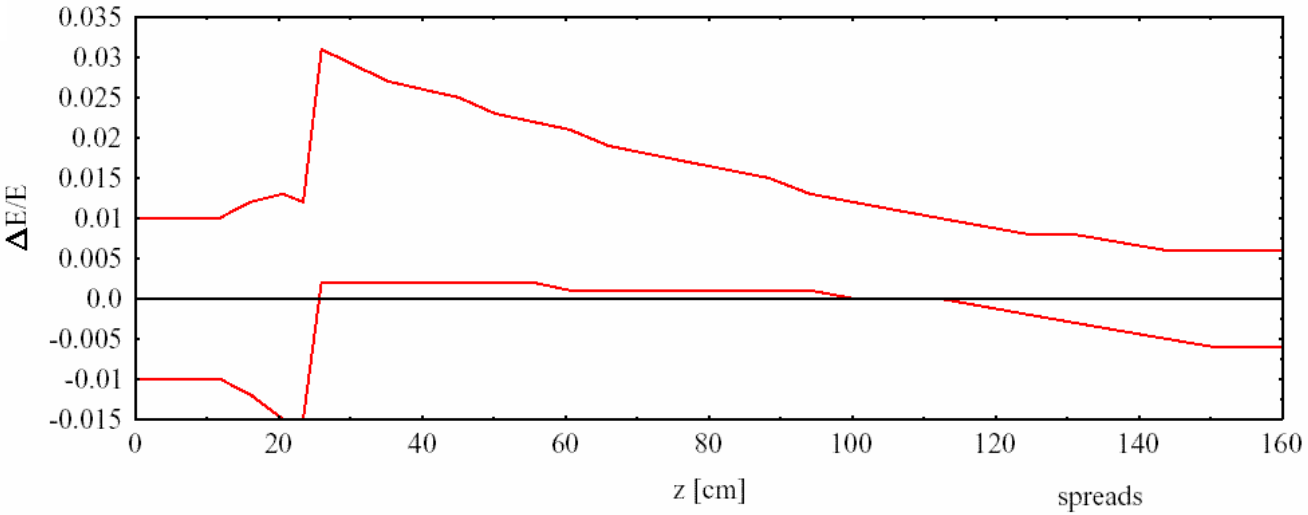
Development of the longitudinal emittance

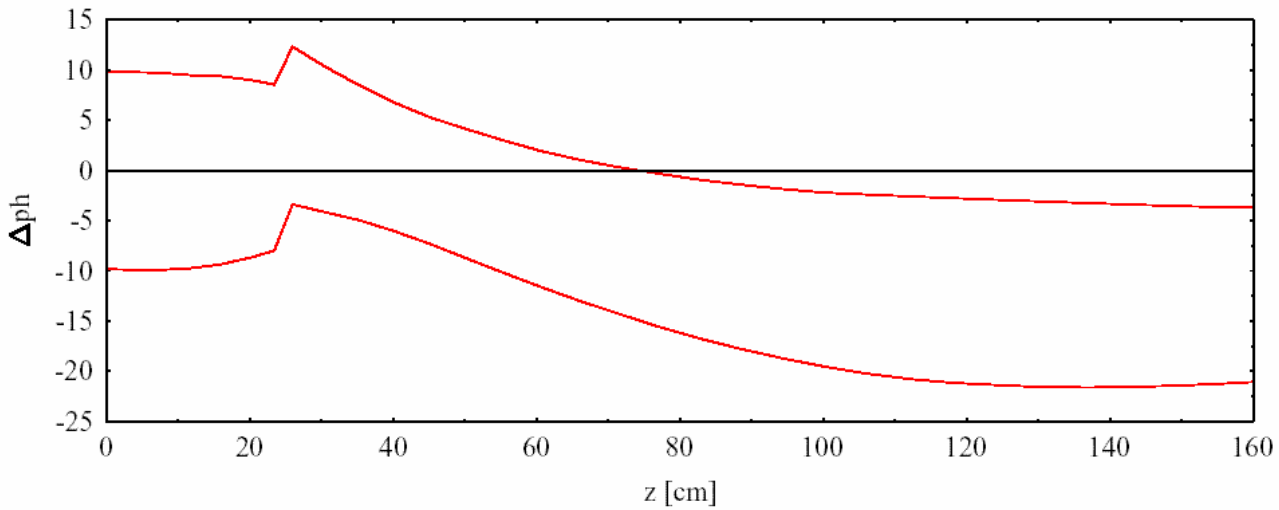
injection, ±10°, ±1%, 1.53 MeV/u



extraction, ±8°, ±0.6%, 3.75 MeV/u







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1. **Charge state breeder:**
   - beam preparation for the linac
   - beams of isotopes from different mass regions of the nuclear chart
   - excellent beam quality from EBIS is preserved

2. **Linac structures tune:**
   - beam energy spread analysed and phases adjusted accordingly
   - emittance measurements of the front part done
   - beams at 0.3, 1.2, 1.55, 1.85, 2.2 and 2.9 MeV/u are available

3. **Energy upgrade above 4 MeV/u**
   - 28-gap structure design almost completed
   - beam dynamics design for the new linac set-up completed
   - small emittance growth