The Munich Accelerator for Fission Fragments (Project MAFF)

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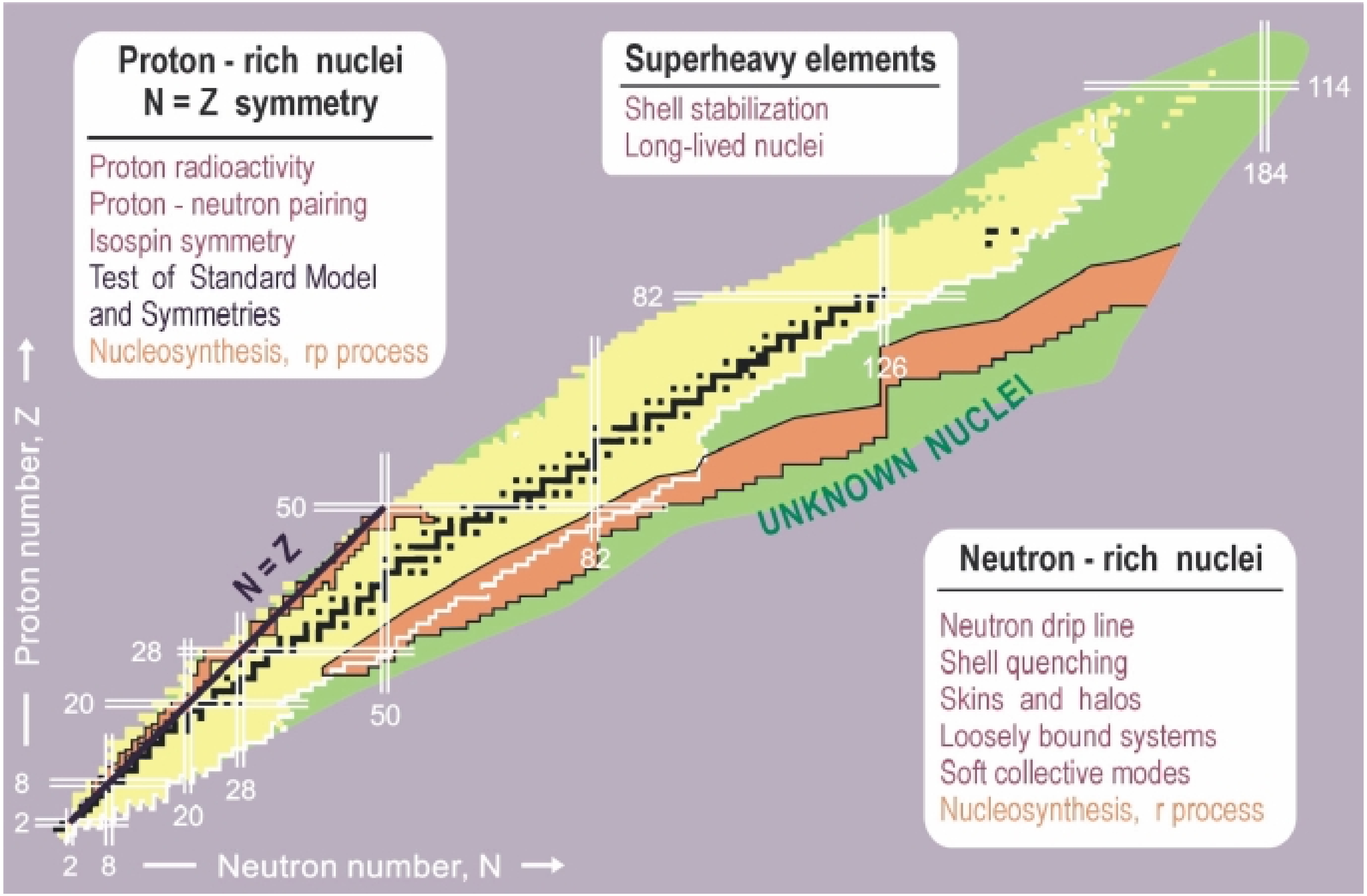
the unknown (borrowed from GSI)



Research Reactor Munich II

Estimates

power in target: 3 kW = 200 MeV · 10^{14} fissions/s

for 10^{14} fissions/s and 1g ^{235}U

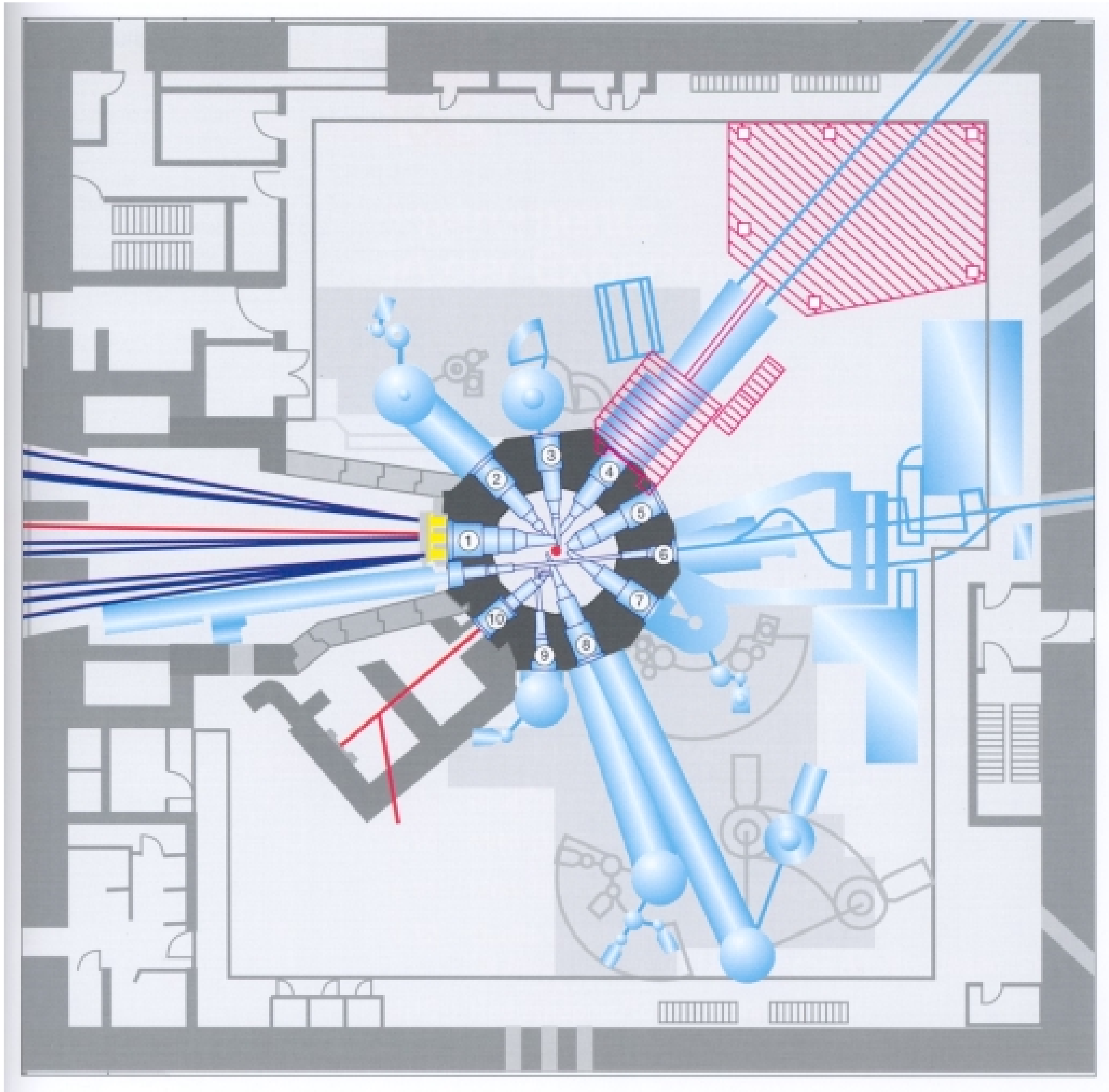
I need 10^{14}/s = 600 barn · 6 · 10^{23}/235 · 6 ·10^{13}/cm^2/s neutron flux

burnup of ^{235}U after 52 days = 17%

$$N/N_0 = \exp(-700\,\text{barn}\cdot 6\cdot 10^{13}/cm^2/s\cdot 52\ days) = 0.83$$

Experimental
Hall

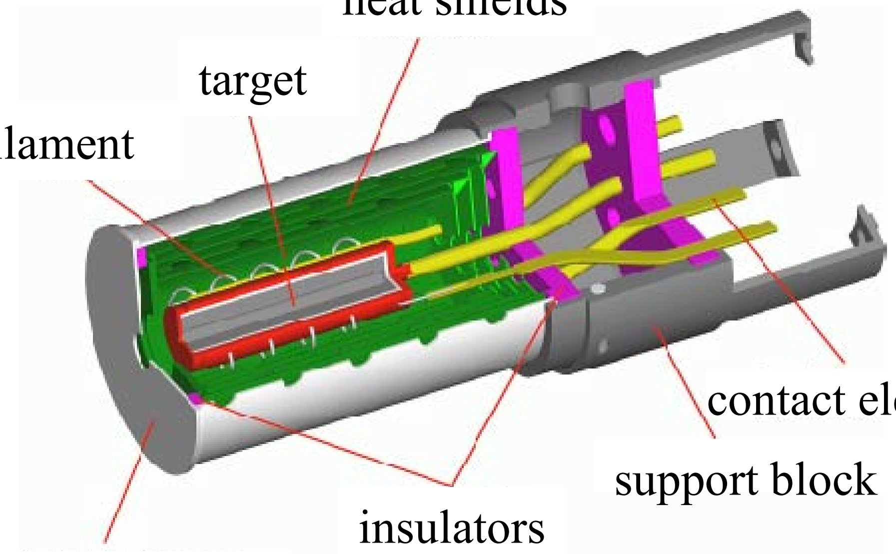
reactor
with
throughgoing
tube



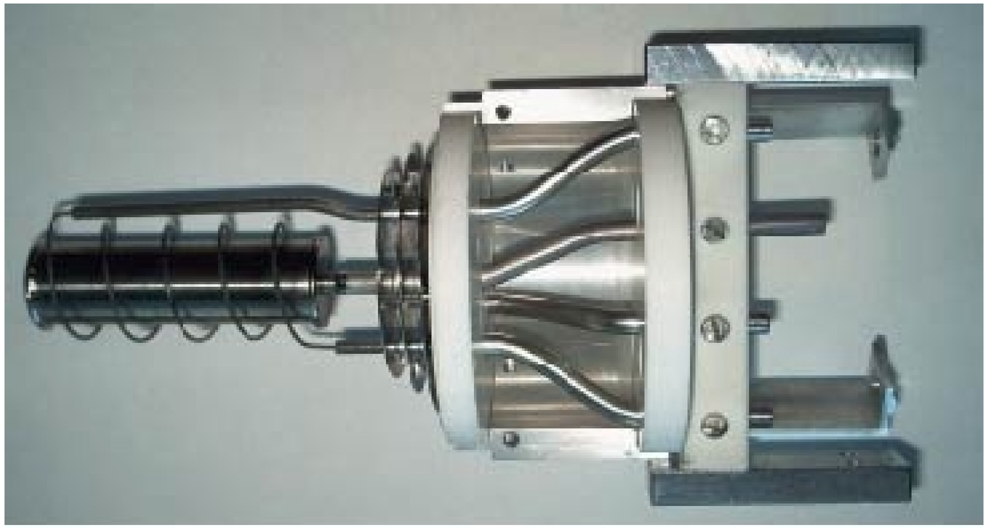
Target –Ion source

Target: glassy carbon
loaded with ≤1g ^{235}U
T ≤2400°C
in Re container

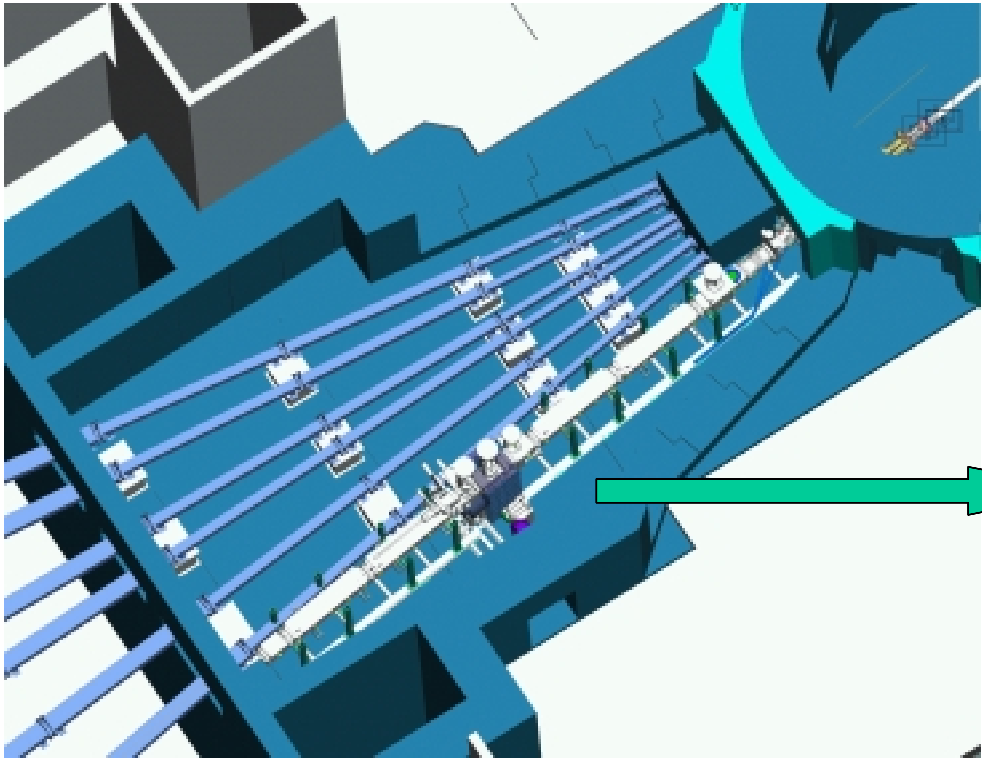
emittance @ 30keV
12 π mm mrad



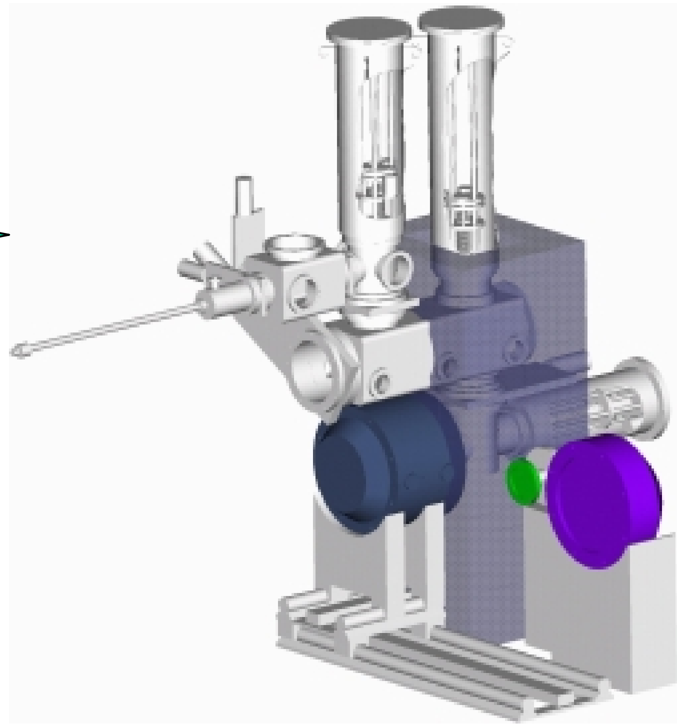
1st Prototype
emittance @ 30keV
in 1st tests:
25 π mm mrad

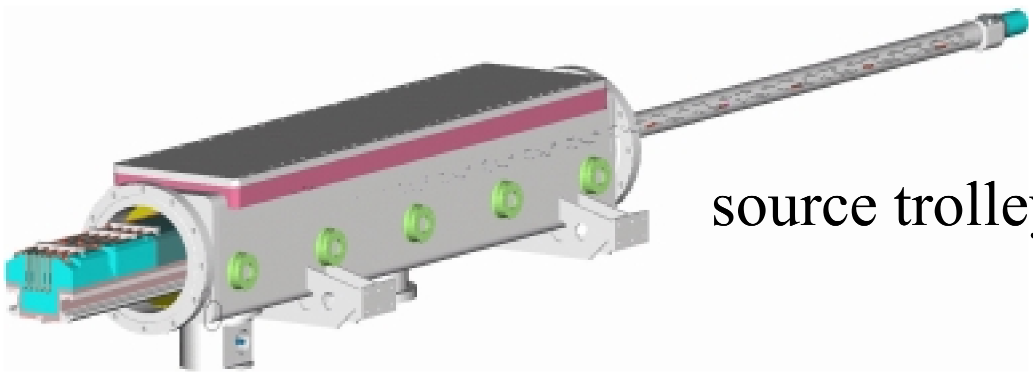


Source Change



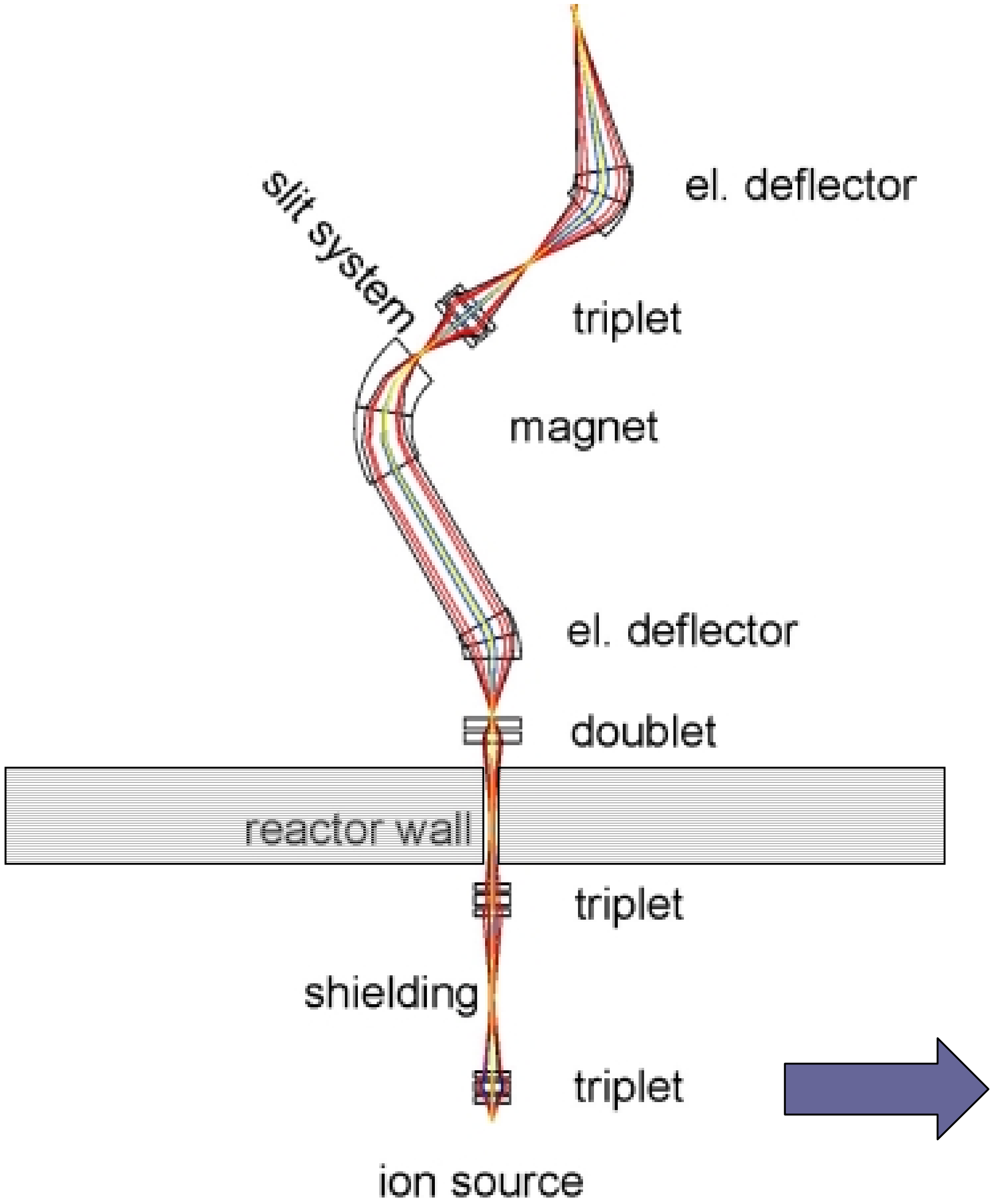
changing mechanism





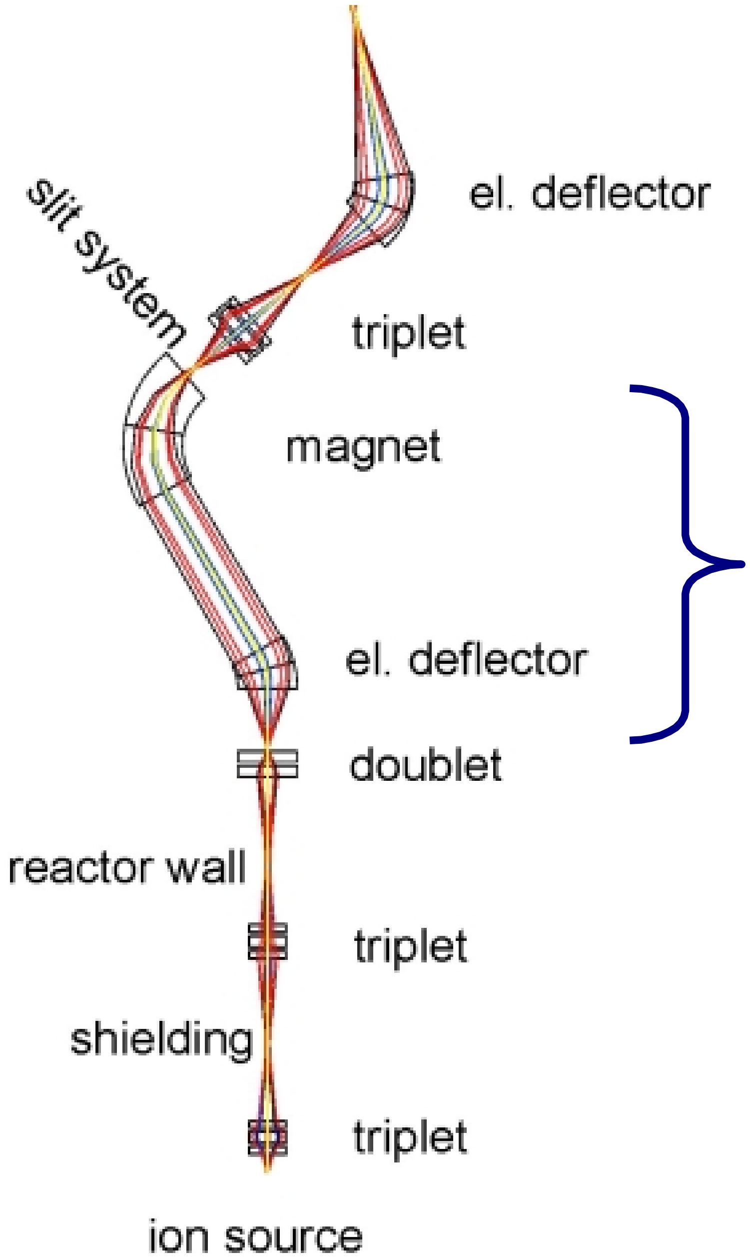
source trolley

Beam Extraction



light-weight quadrupole triplet

Mass Separator



1. Senkrechter Eintritt der Strahlen in das Magnetfeld. $\varepsilon' = 0$; $\Phi = 90^0$; $\psi = 45^0$; $\Phi_e = \frac{\pi}{4\sqrt{2}} = 31^0\,50'$; $l'_e = \frac{a_e}{\sqrt{2}}$. Diese Werte wurden dem Spektrographen in Fig. 3 zugrunde gelegt. Es sind zwei Strahlenbündel verschiedener Geschwindigkeit schematisch eingezeichnet, die den Strahlengang deutlich machen.

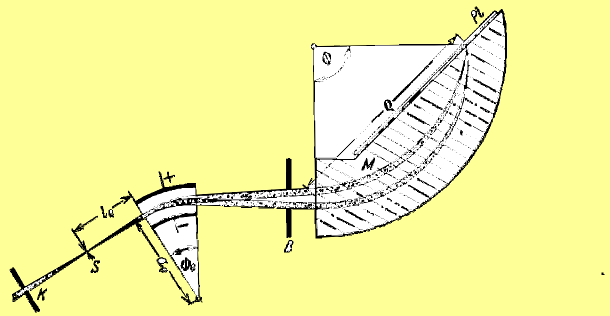


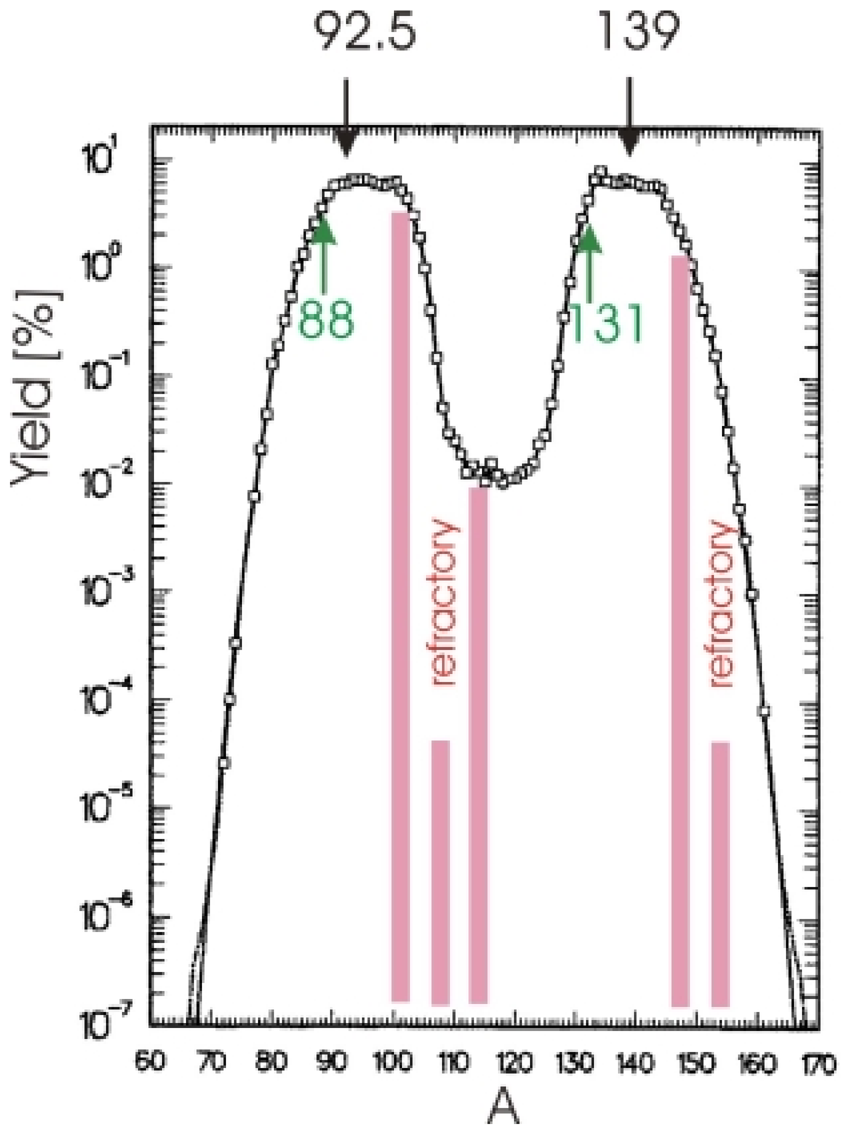
Fig. 3.

Mattauch-Herzog Spectrograph

dispersion @ focal plane:
$\Delta x/\Delta m/m$ = 5mm/%
Full width @focal plane:
2.6mm (12 πmm mrad @ 30keV)

Resolution: $m/\Delta m \sim 190$

Mass Distribution



A.C. Wahl, At. D. Nucl. D. Tab. 39(88)1

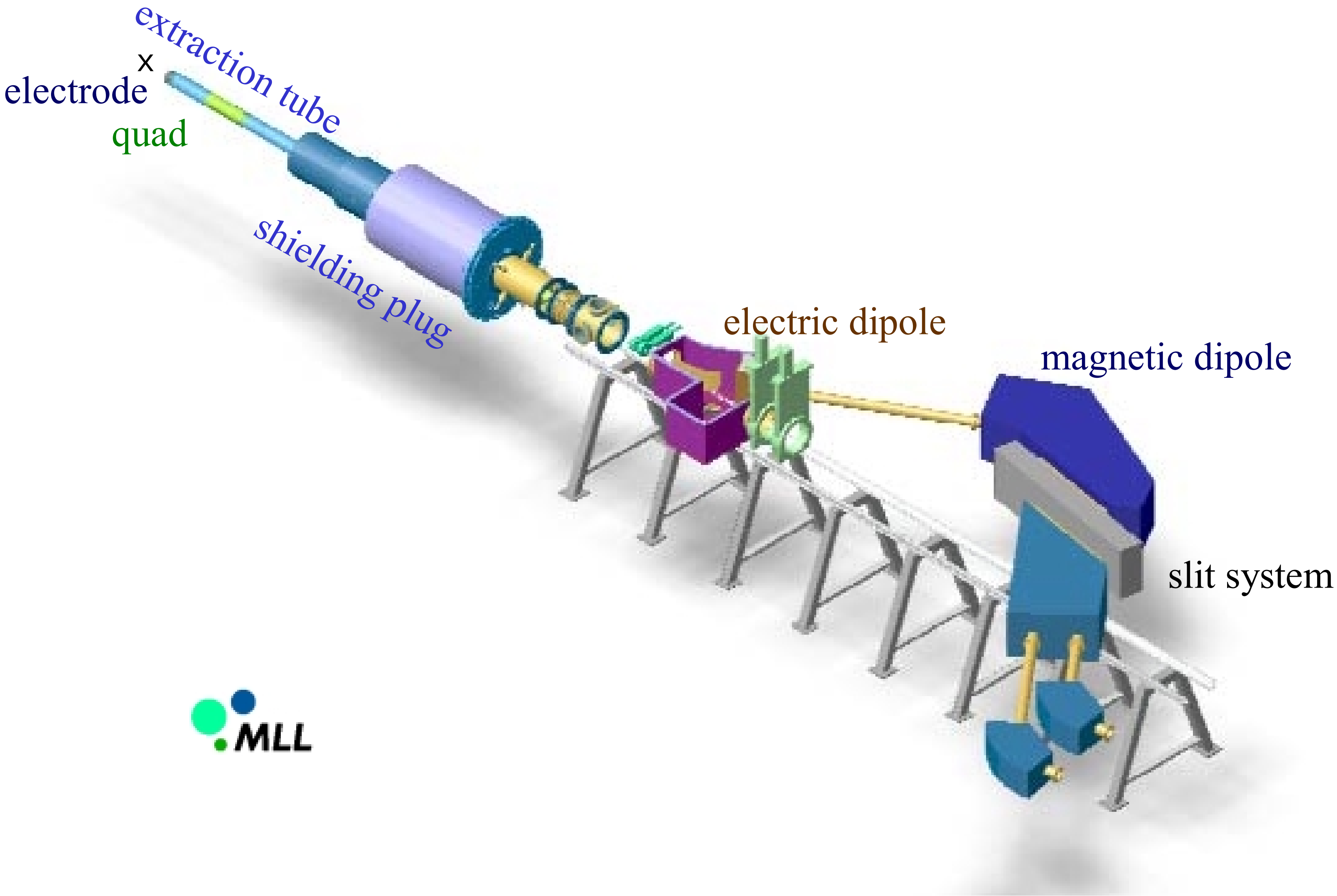
2 mass peaks:

$$\frac{A_1}{A_2} \approx \frac{139}{92.5} \approx \frac{131}{88} \approx 1.50$$

extract 2 beams with magnetic rigidities:

$$\frac{B\rho_1}{B\rho_2} \approx \sqrt{1.50} = 1.22$$

Extraction and Separation



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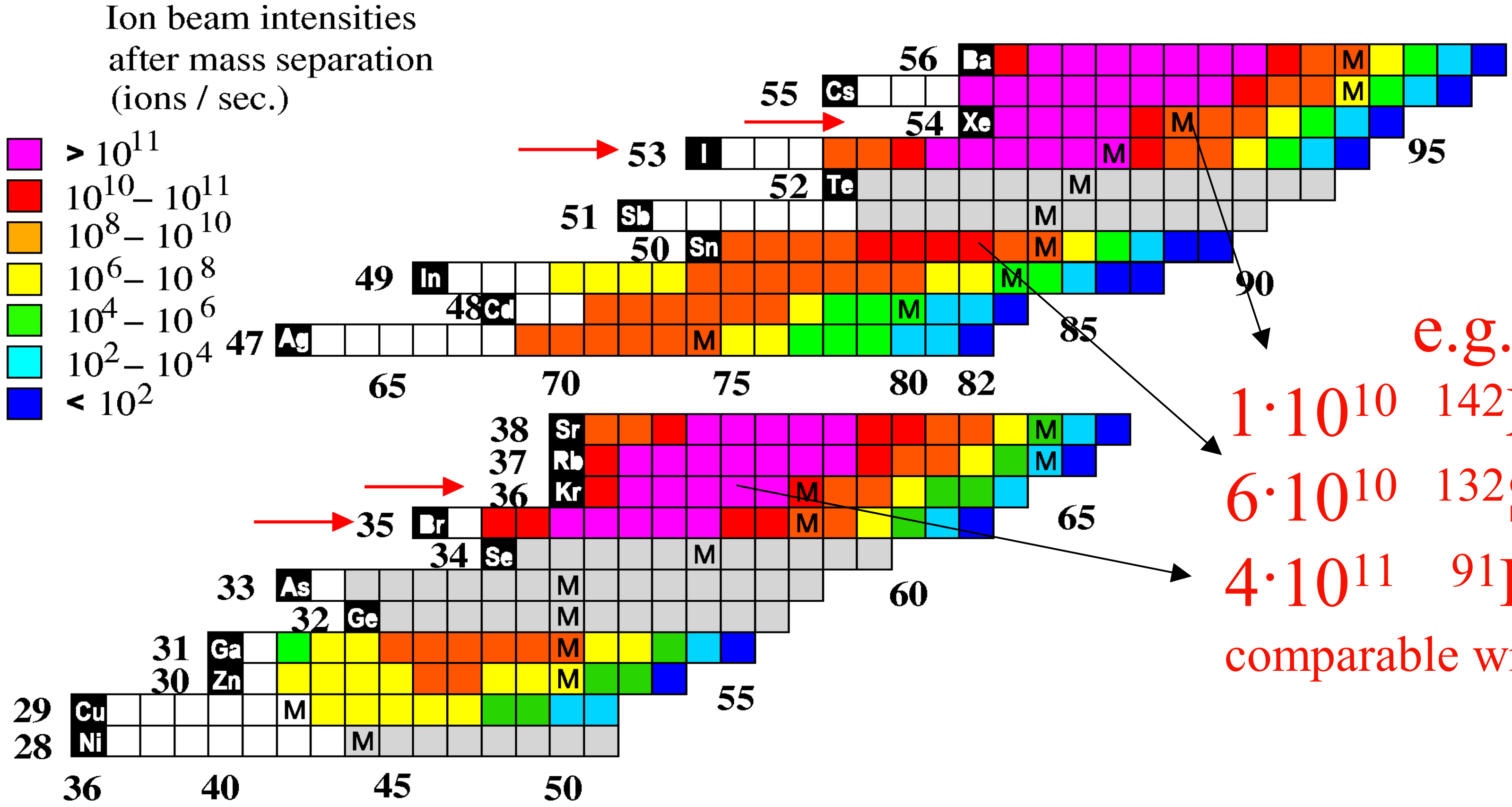
Expected Yields after Mass Separator

(for 10^{14} fission/s):



e.g.

$1 \cdot 10^{10}$ ^{142}Xe /s

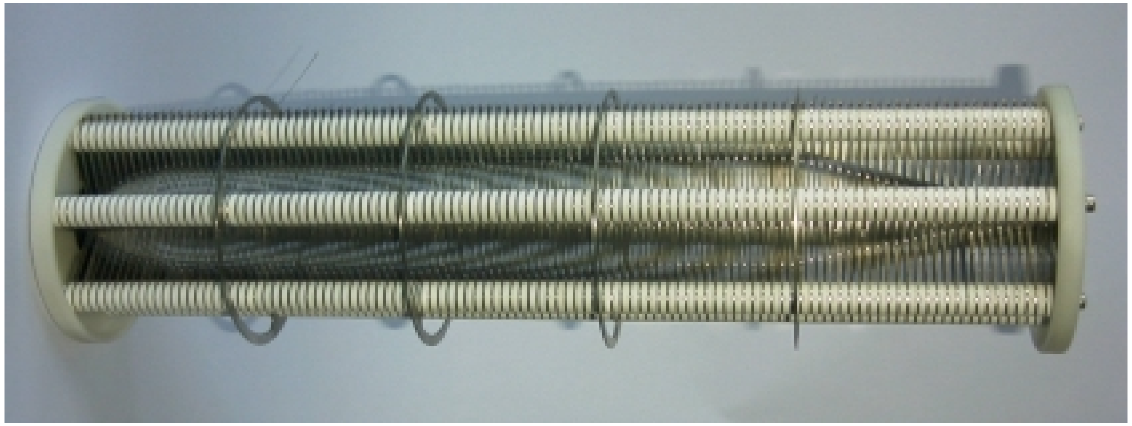
$6 \cdot 10^{10}$ ^{132}Sn /s

$4 \cdot 10^{11}$ ^{91}Kr /s

comparable with RIA

RF-Funnel

S. Heinz



operation parameters

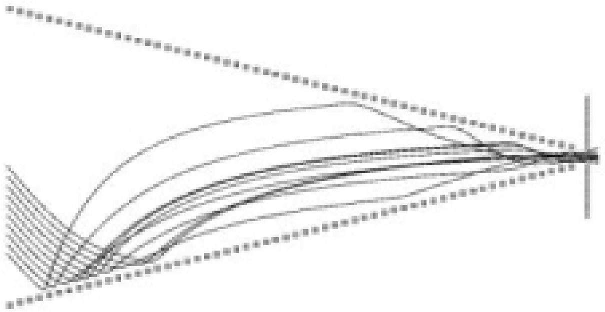
pressure:	~ 0.1 mbar Helium
RF frequency:	5 MHz
RF amplitude:	100 – 150 V_{pp}
DC field:	~ 0.5 V/cm

angular acceptance

$\Theta_{max} = 65°$ (simulation result)

transmission

90 %	(simulation, micr. model)
> 50 %	(first exp. results)



cooling performance

reduction of energy spread

input: $\Delta E = 100$ eV

output: $\Delta E = 5$ eV

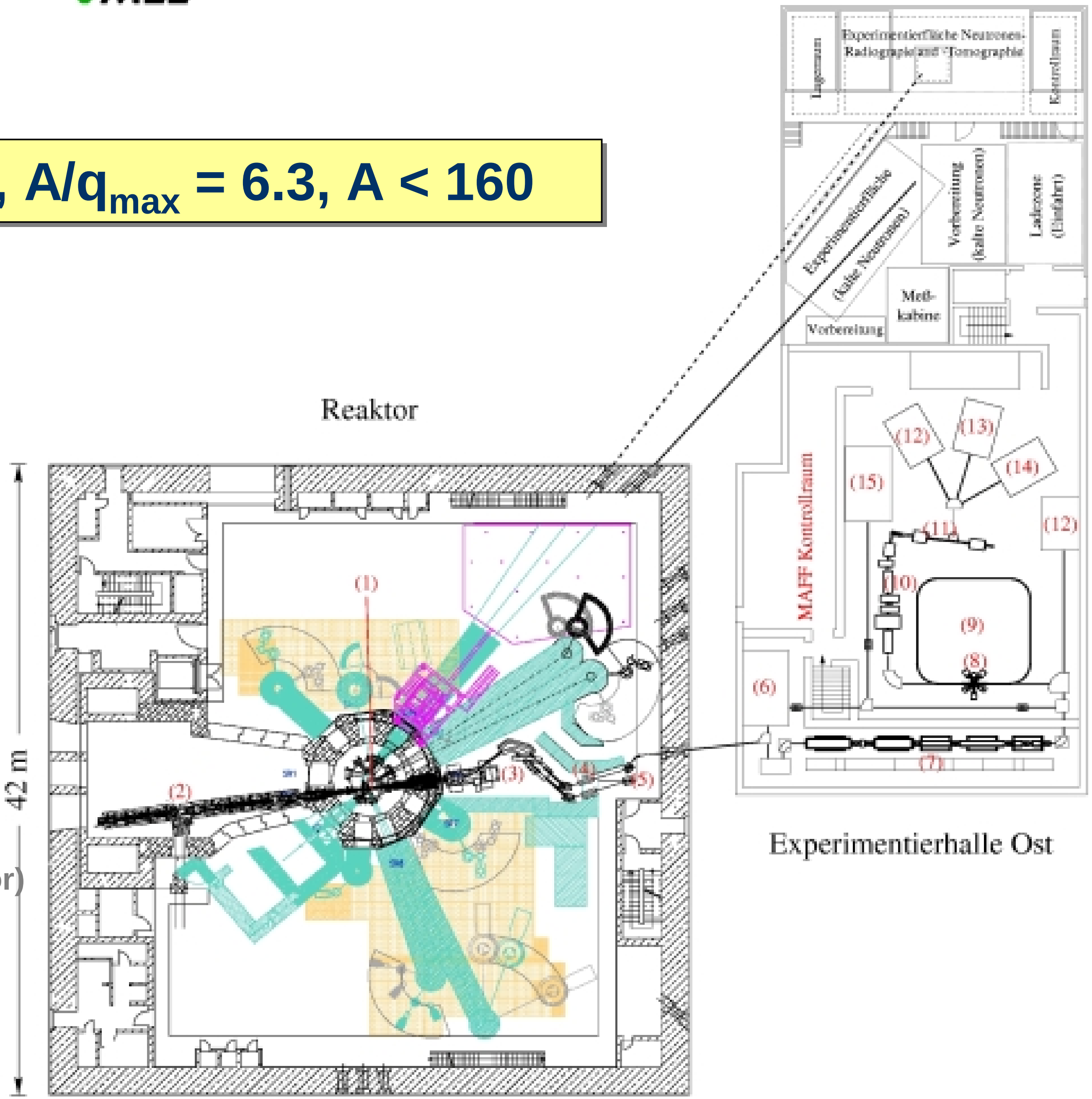
emittance: from $\varepsilon_T = 36\ \pi$ mm mrad

@30keV to $\varepsilon_T = 6\ \pi$ mm mrad

MAFF II

3.7-5.9 MeV/u, A/q_{max} = 6.3, A < 160

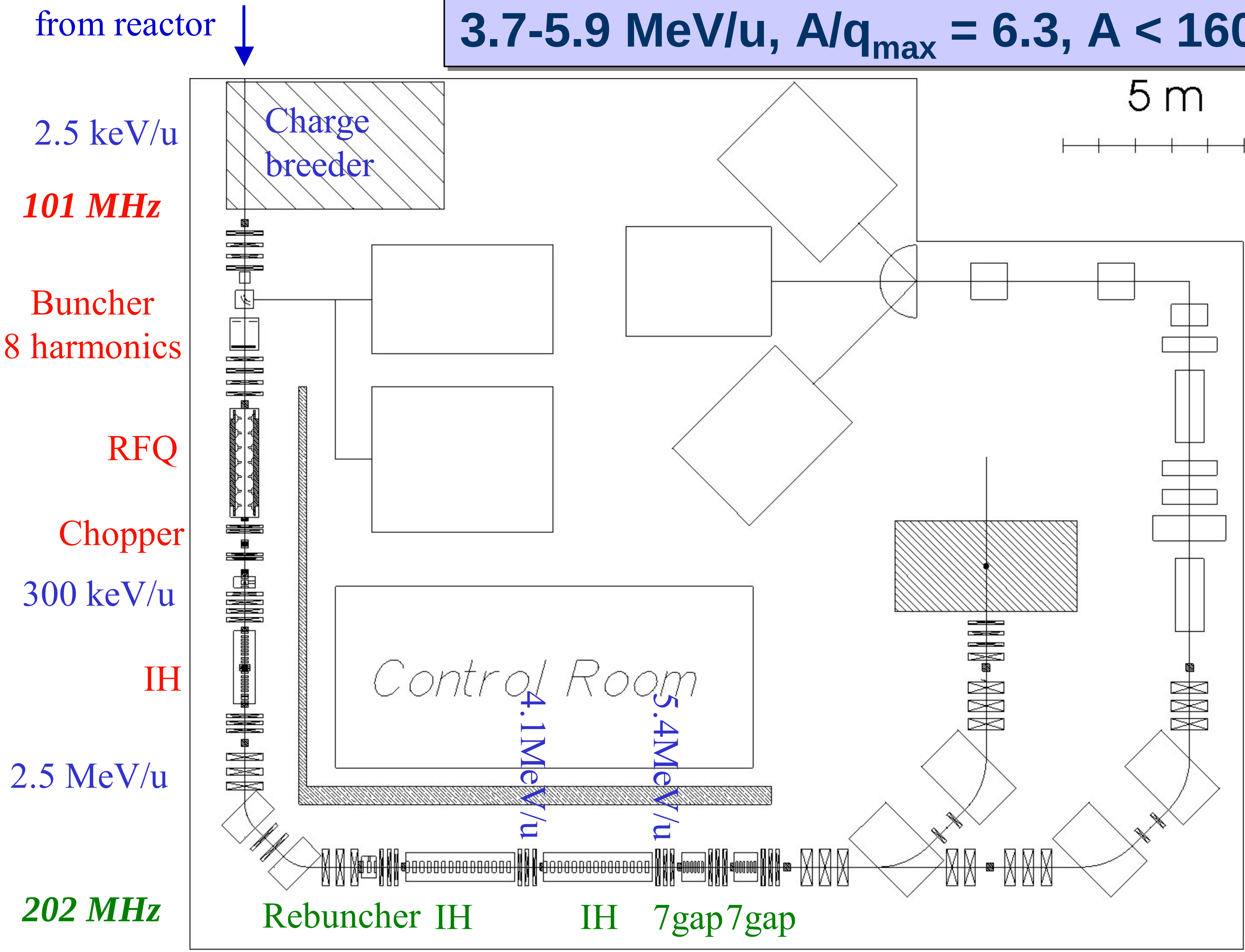
1. Target-ion source
2. Source exchange unit
3. pre-separator
4. Buffer gas cooler
5. High res. Separator
6. charge breeder
7. Linac
8. MINIBALL
9. Recycler Ring
10. MORRIS (gas-filled separator)
11. MAFFTRAP
12.-15 experiments



LINAC Design

Matteo Pasini - see Poster

3.7-5.9 MeV/u, A/q_{max} = 6.3, A < 160



Experiments

Physics with MAFF

- neutron-rich exotic nuclei (Coulex, Transfer, g-factors)
- superheavy elements (SHE)
- nuclear astrophysics
- radiochemistry with SHE
- nuclear medicine

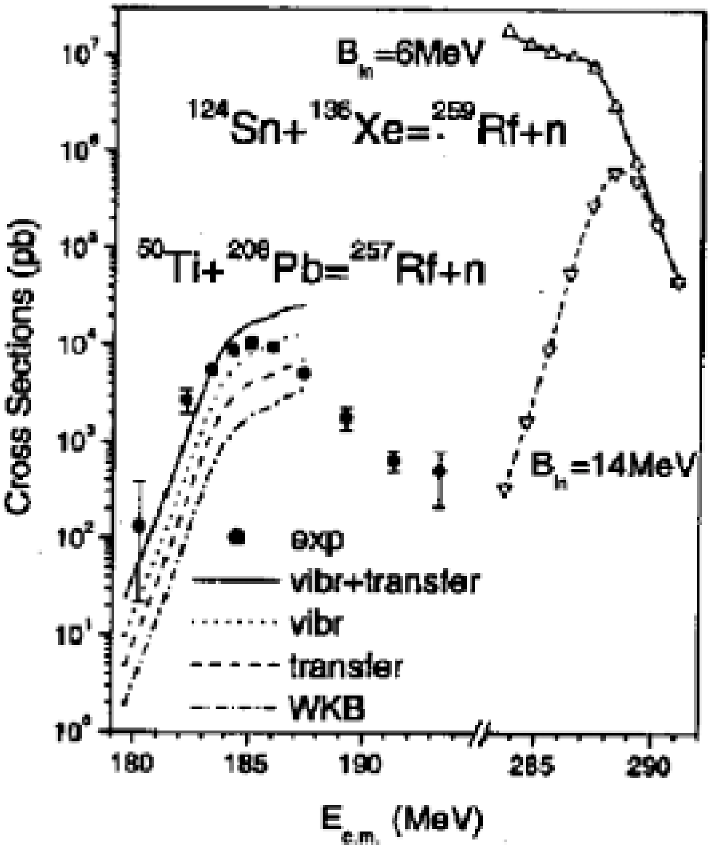
Instrumental R&D

MAFFTRAP
Miniball
AGATA
recycling ring
gasfilled separator MORRIS
He stopping cell

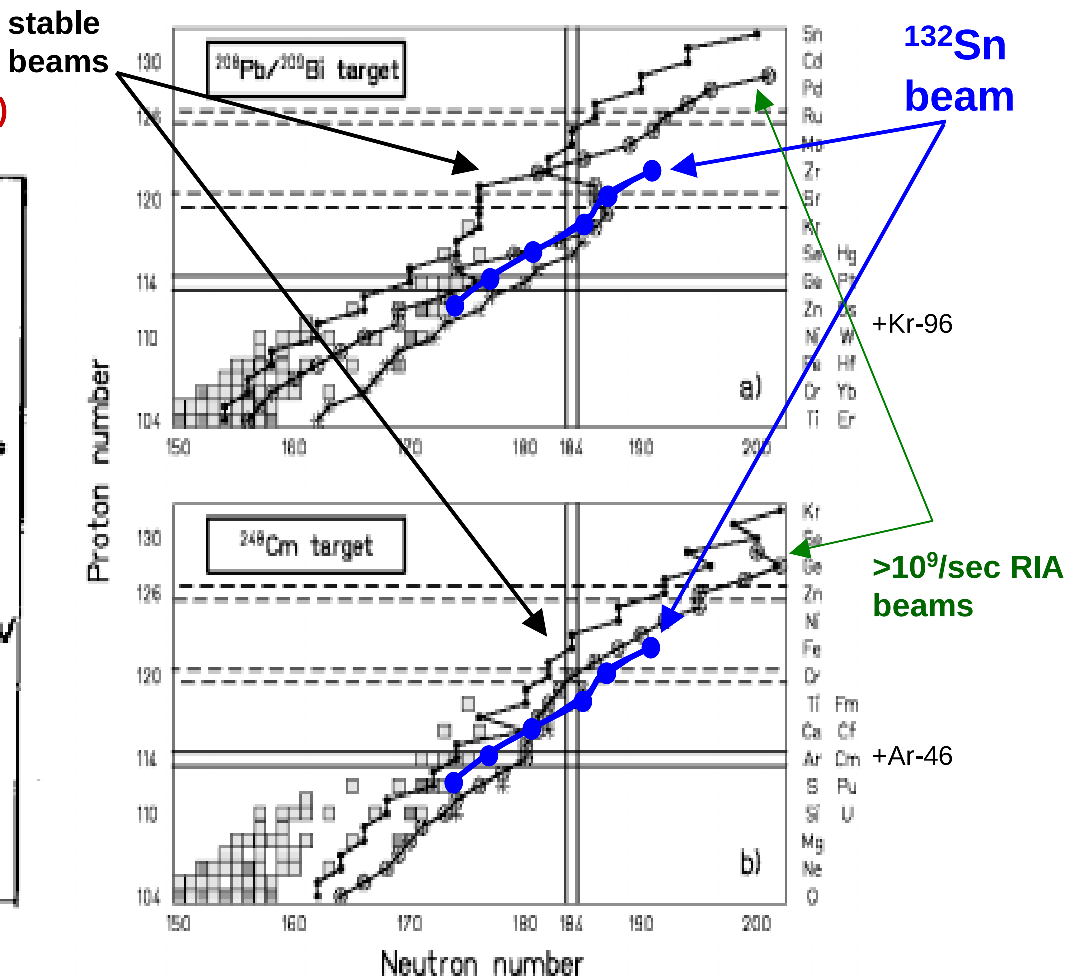
Laser ion source
RF Funnel
EBIS or ECRIS

SHE with Symmetric Reactions

V.Yu. Denisov,
Prog. Nucl. Part. Phys. 46, 303 (2002)



S. Hofmann, EPJA 15, 195 (2002)



will be tested at GSI (S.Hofmann et al.)

Time scale and costs

	MAFF I		MAFF II	exp. hall
Schedule	→ 2008	→2008	→ 2010	2006-2008
Components	16.6M€ +	2.1M€(R&D)	~5M€ for acc. + help from many European Institutes	~8M€
Personnel	5.4M€ (of which 2.7M€ exist)			