Workshop on recoil separator for superheavy element chemistry

GSI, Darmstadt 20-21 March, 2002

Transmission of the JYFL gas-filled recoil separator RITU

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Related talks from JYFL:

J. Uusitalo: Windowless operation of the JYFL gas-filled recoil separator

T. Enqvist: About the design of a gas-filled separator

RITU

History

- Design based on experience from SASSY1, NASE
- Designed for studies of heavy and superheavy elements
- DQQ → QDQQ
- Magnets, power supplies from Danfysik
- Operation started in 1993
- Total cost 320,000 euros

Present

- Jurosphere campaigns
- SACRED campaigns
- about 55 RDT experiments mainly in the Pb region and around ^{254}No
- 22 new isotopes from ^{164}Ir to ^{211}Th

Future

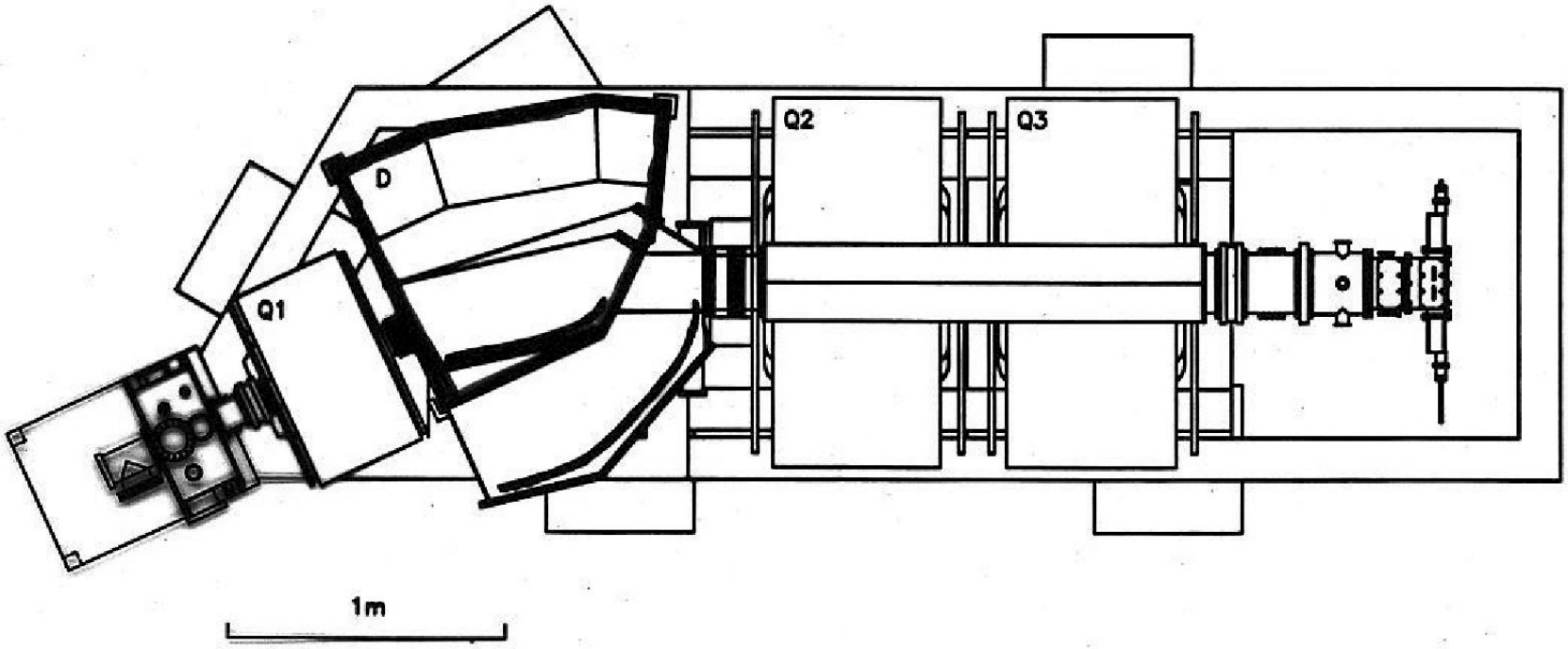
- Juroball in 2003
- GREAT in 2002

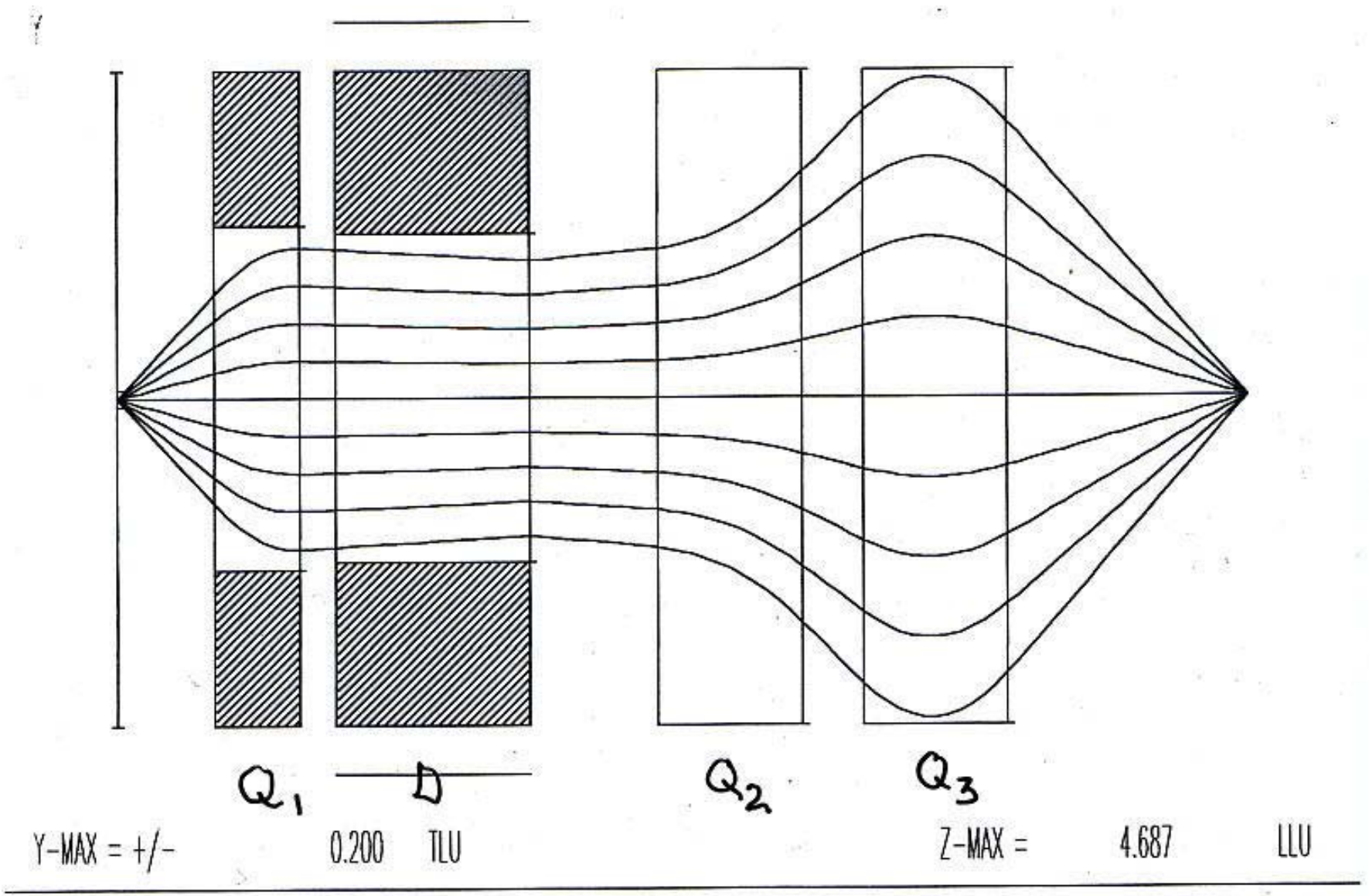
RITU parameter values

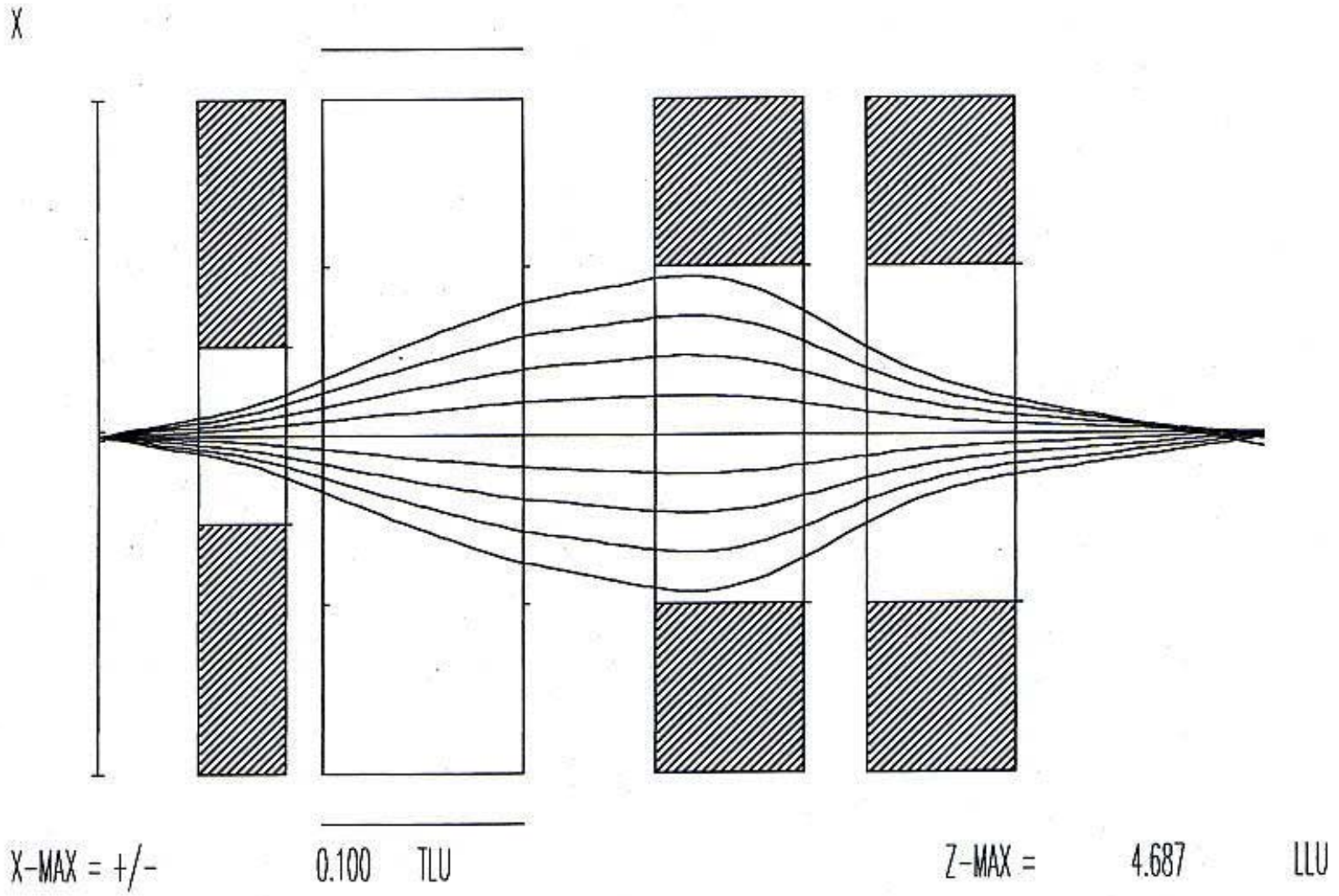
Magnetic configuration	$Q_vDQ_hQ_v$	D pole gap	100 mm
Maximum beam rigidity	2.2 Tm	Q_1 maximum grad.	13.5 T/m
Bending radius	1.85 m	Q_1 effective length	350 mm
Acceptance	8 msr	Q_1 aperture diameter	105 mm
Dispersion	10 mm/%	$Q_{2,3}$ maximum grad.	6.0 T/m
Mass resolving power	100	$Q_{2,3}$ effective length	600 mm
Dipole bending angle	25°	$Q_{2,3}$ aperture diameter	200 mm
Dipole entrance angle	0°	Total weight	17500 kg
Dipole exit angle	–25°	Total length	4.8 m

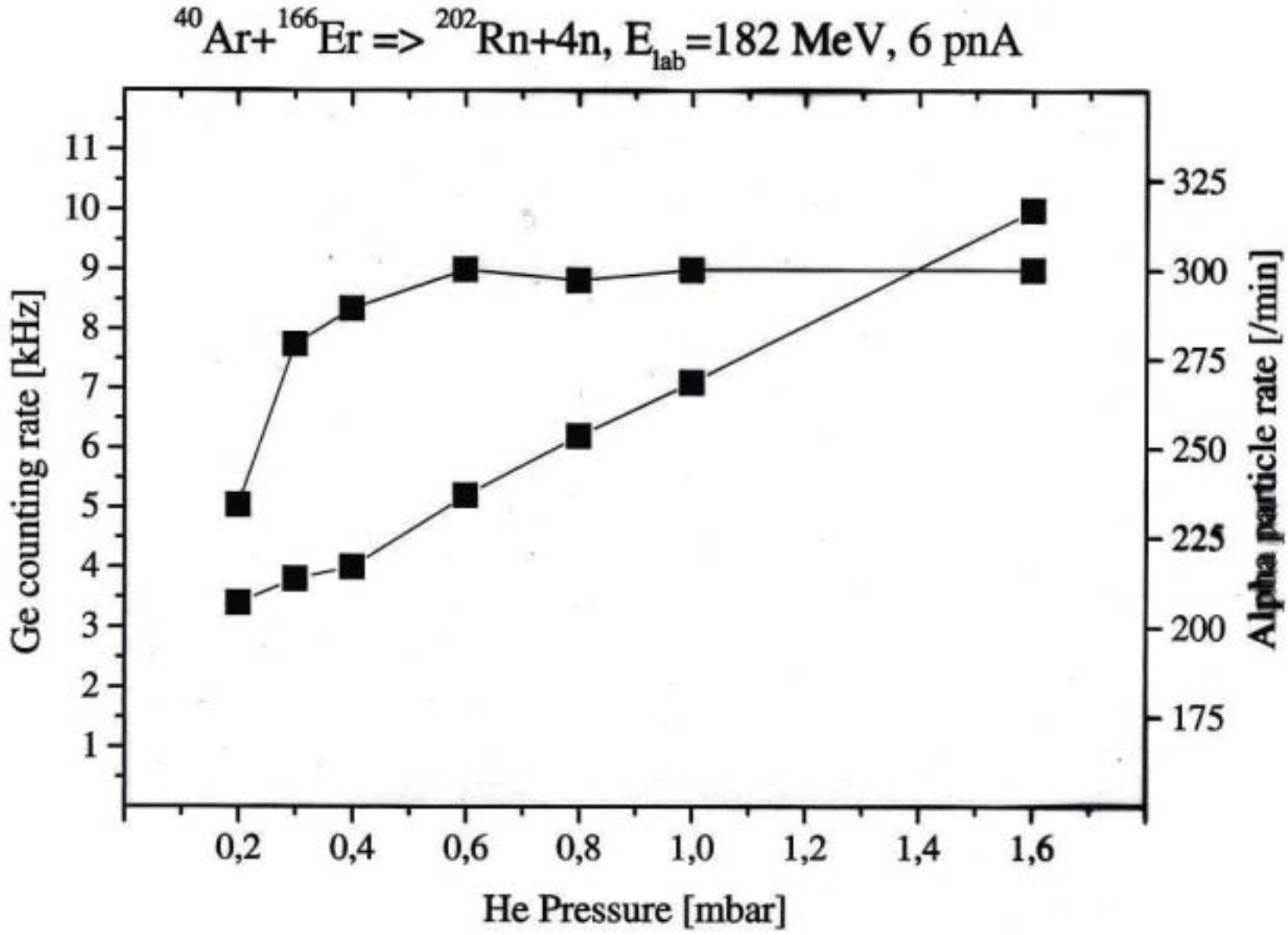
M. Leino *et al.* Nucl. Instr. Meth. B **99** (1995) 653

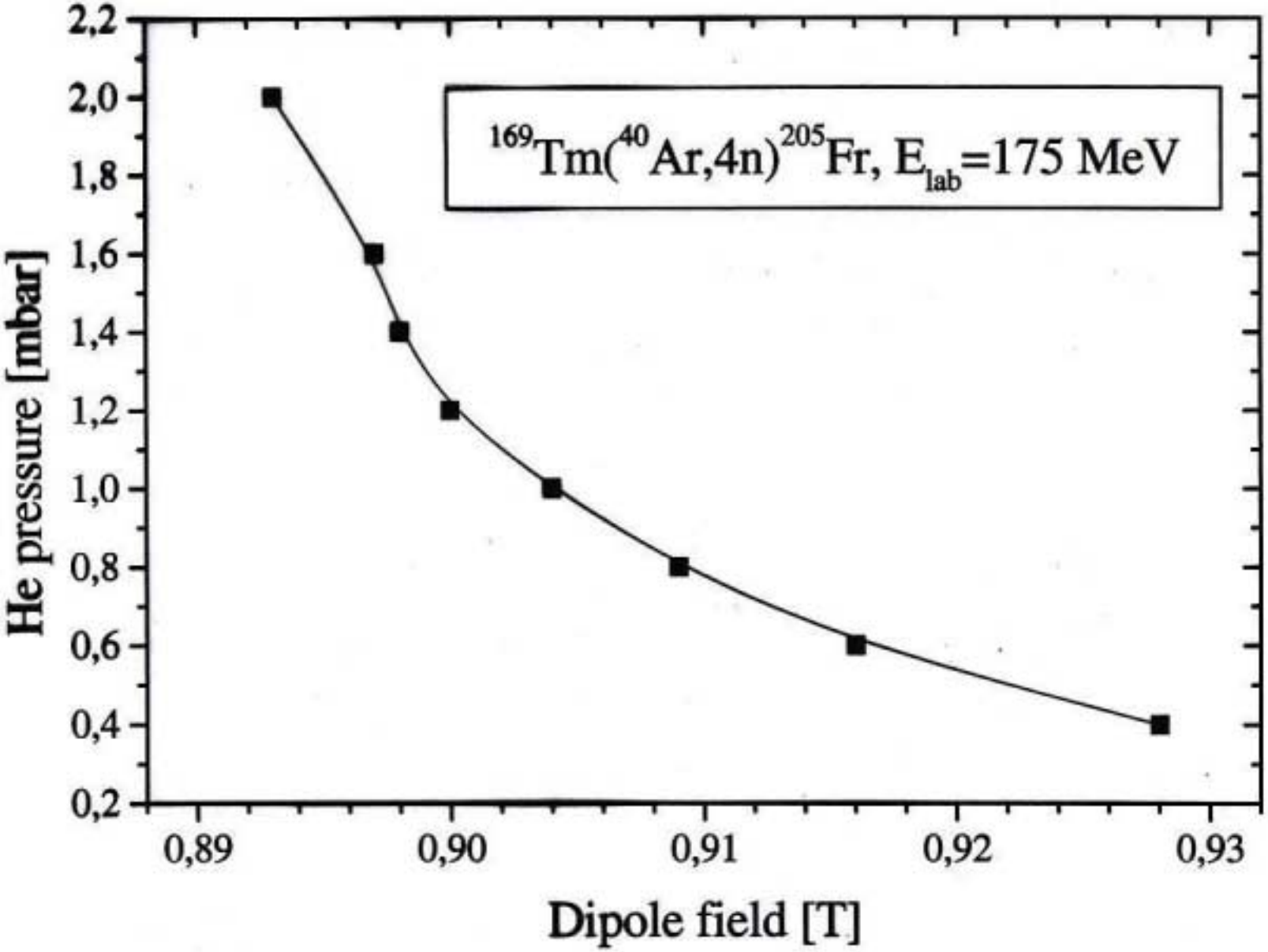
New dipole chamber and beam stop




Q1
D
Q2
Q3
Y-MAX = +/- 0.200 TLU
Z-MAX = 4.687 LLU


X
X-MAX = +/- 0.100 TLU
Z-MAX = 4.687 LLU


^{40}Ar+^{166}Er => ^{202}Rn+4n, E_{lab}=182 MeV, 6 pnA
Ge counting rate [kHz]
Alpha particle rate [/min]
He Pressure [mbar]
1
2
3
4
5
6
7
8
9
10
11
175
200
225
250
275
300
325
0,2
0,4
0,6
0,8
1,0
1,2
1,4
1,6


^{169}Tm(^{40}Ar,4n)^{205}Fr, E_{lab}=175 MeV
He pressure [mbar]
Dipole field [T]
2,2
2,0
1,8
1,6
1,4
1,2
1,0
0,8
0,6
0,4
0,2
0,89
0,90
0,91
0,92
0,93

Transmission of RITU

Methods used for determination:

- Comparison with SHIP and VASSILISSA data
- Recoil Decay Tagging experiments
- Support from calculations

Effect of Q_1 on transmission:
$\approx +30\%$ for $A_1/A_2 \approx 0.12$

Typical values from cross section data

Reaction	Meas.	Calc.
$^{208}Pb(^{18}O,4n)^{222}Th$ 0.25 mg/cm^2	0.15	0.12
$^{208}Pb(^{22}Ne,4n)^{226}U$ 0.40 mg/cm^2	0.15	0.14
$^{208}Pb(^{50}Ti,1n)^{257}Rf$ 0.45mg/cm2	0.55	0.68
$^{175}Lu(^{40}Ar,4n)^{211}Ac$ 0.45 mg/cm^2	0.45	0.50

Typical values from RDT experiments

Reaction	Meas.	Calc.
$^{172}Yb(^{28}Si,4n)^{196}Po$ 0.45 mg/cm^2	0.26	0.30
$^{141}Pr(^{40}Ar,4n)^{177}Ir$ 0.45 mg/cm^2	0.50	0.53