Estimated secondary beam intensities in g-RISING experiments

Results and input files can be seen under:
/misc/rising/mocadi/pieter/gRISING/FragmentBeamTargetDegrader.*

Parameters for fission cases:

- ^{238}U primary beam @ 750 Mev/u
- 418 or 1023 mg/cm^2 ^{9}Be target with 221 mg/cm^2 ^{93}Nb stripper foil
- 5, 6, 7 or 8 g/cm^2 S2-degrader
- Settings optimized for ^{130}Sn and ^{135}Te

FRS beam line parameters for simulations

FRS Objects updated by Frank 10 June 05

FRS-object	material	thickness (mg/cm^2 – mm)
Ta		
SIS window	Ti	10 micron
SEETRAM	Ti	13.5 mg/cm^2
target	^{9}Be	
stripper	Nb (natural)	221 mg/cm^2
S1		
S1-wedge	AlMg3(from ATIMA)	
Slits		
S2		
Scint21	C9H10 (BC420)	choose e.g. 3 mm
S2-wedge	AlMg3(from ATIMA)	(adapt thickness and profile angle)
Slits		
S3		
Slits		
S4		
MW41_vac_Ti_FRS	Mixture (from ATIMA)	100mm
exit window	Ti	90 mg/cm2
	Air gap	170 mm
MUSIC-TUM 41	Mixture (from ATIMA)	460 mm
	Air gap	140 mm
MUSIC-TUM 42	Mixture (from ATIMA)	460 mm
	Air gap	150 mm
RISING MW42_AIR	Mixture (from ATIMA)	100 mm
	Air gap	150 mm
Scint41b	C9H10 (BC420) is this in some vacuum ? windows ??	– 3mm or 0.5 mm
	Air gap	100 mm
Slits	Air gap	330 mm
	Air gap	200 mm
Degrader (glass wedge) or (Aluminum)	SiO2/SiO2(from ATIMA) or AlMg3(from ATIMA)	Variable (488 – 6252 mg/cm2) or Variable (48.6 – 7646 mg/cm2)
Air gap	air	~ 1 m (~ 100 mg/cm^2)
Plastic degrader / crystal	C8H8 / Cu	To be decided / 1800 mg/cm2

418 or 1023 mg/cm^2

5, 6, 7 or 8 g/cm^2

Chosen scintillator thicknesses for simulations

Should be swapped in future simulations?

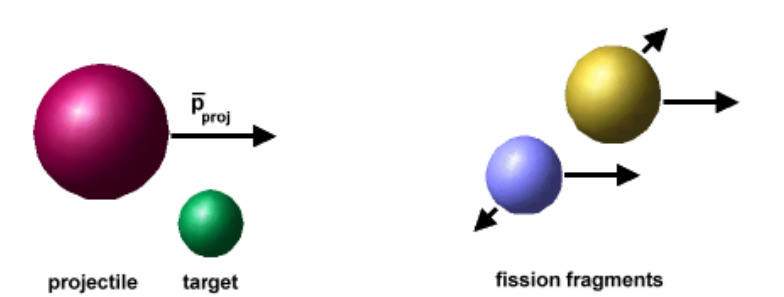
Not considered in simulations

Charge states after the target I

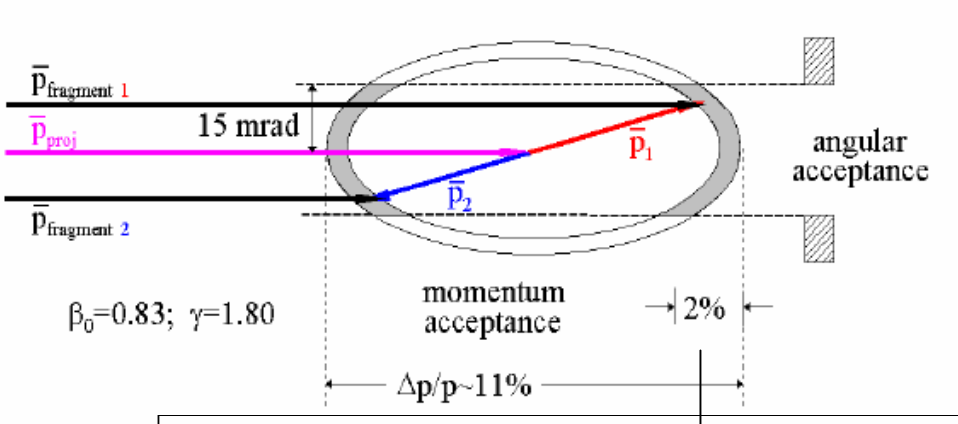
Beam	Target thickness	Q(0)	Q(1)	Q(2)	Q(3)
^{238}U	1032 ^{9}Be	0.2673	0.4978	0.2280	0.0066
^{238}U	1023 ^{9}Be + 221 ^{93}Nb	0.7615	0.2207	0.0176	0.0
^{130}Sn	1032 ^{9}Be	0.8663	0.1304	0.0033	0.0
^{130}Sn	1023 ^{9}Be + 221 ^{93}Nb	0.9953	0.0046	0.0	0.0
^{135}Te	1032 ^{9}Be	0.8494	0.1457	0.0049	0.0
^{135}Te	1023 ^{9}Be + 221 ^{93}Nb	0.9938	0.006	0.0	0.0

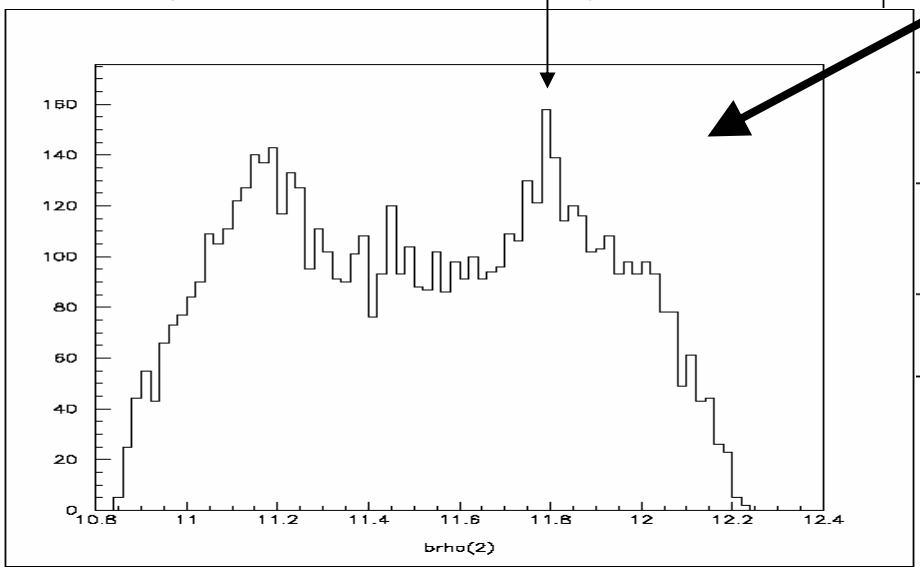
Charge states after the target II

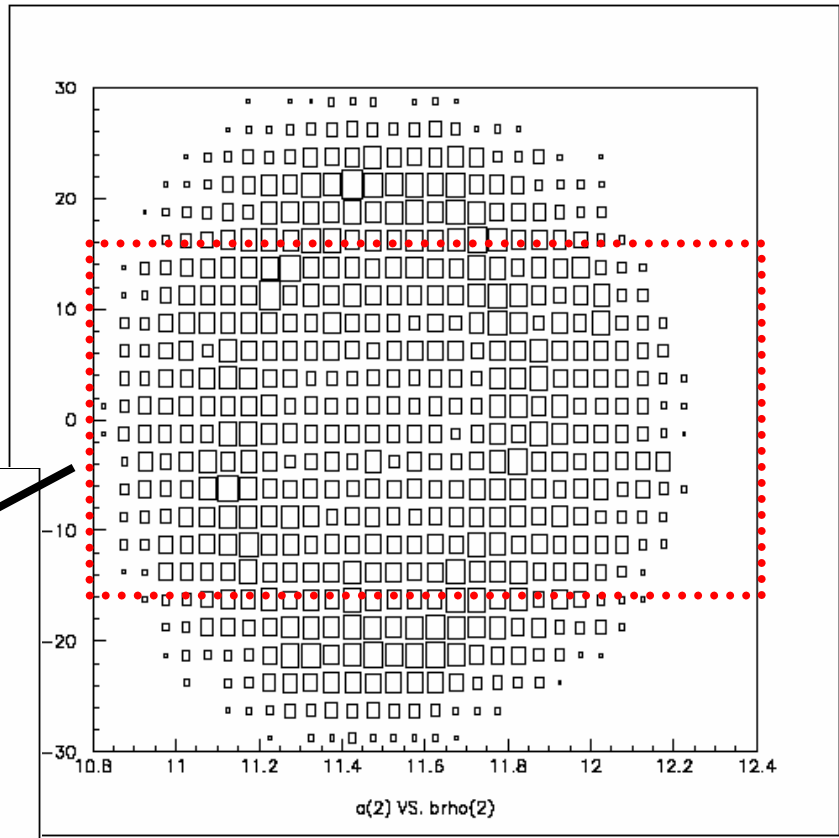
Beam	Target thickness	Q(0)	Q(1)	Q(2)	Q(3)
^{238}U	418 ^{9}Be	0.247	0.4988	0.2495	0.0067
^{238}U	418 ^{9}Be + 221 ^{93}Nb	0.7615	0.2207	0.0176	0.0
^{130}Sn	418 ^{9}Be	0.8679	0.1289	0.0032	0.0
^{130}Sn	418 ^{9}Be + 221 ^{93}Nb	0.9953	0.0046	0.0	0.0
^{135}Te	418 ^{9}Be	0.8507	0.1445	0.0047	0.0
^{135}Te	418 ^{9}Be + 221 ^{93}Nb	0.9938	0.006	0.0	0.0



$^{238}U\,@\,750MeV/u + ^{9}Be \rightarrow ^{130}Sn$



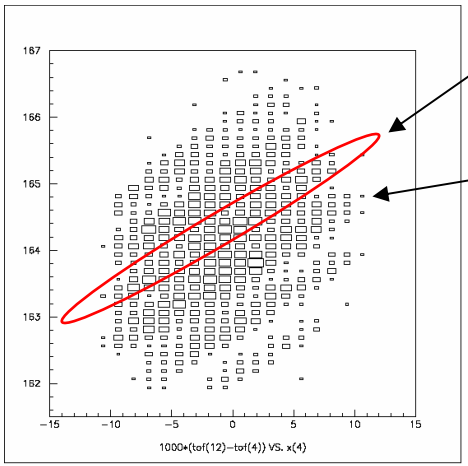




Selecting the right degrader thickness I

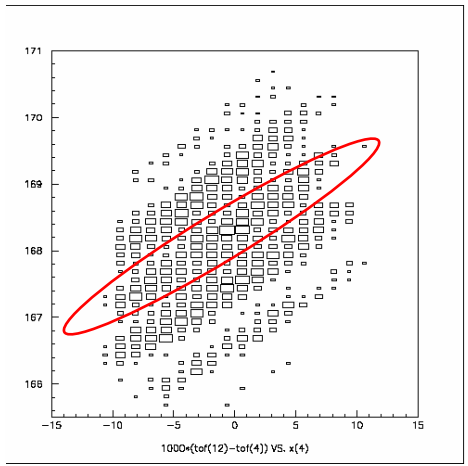
Comparing the Z-AoQ resolution for the 1023 + 221 Be/Nb target for ^{130}Sn

5 g @ S2
98.8% f. s.
502 MeV/u
456 MeV/u



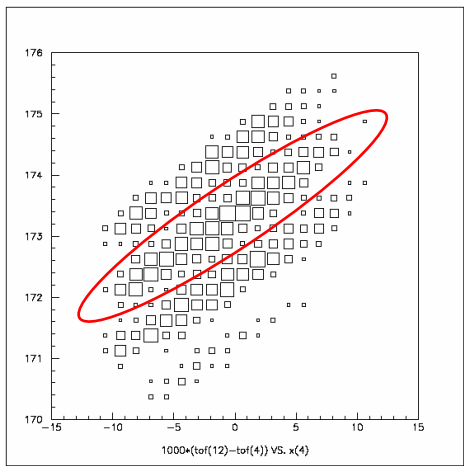
^{130}Sn

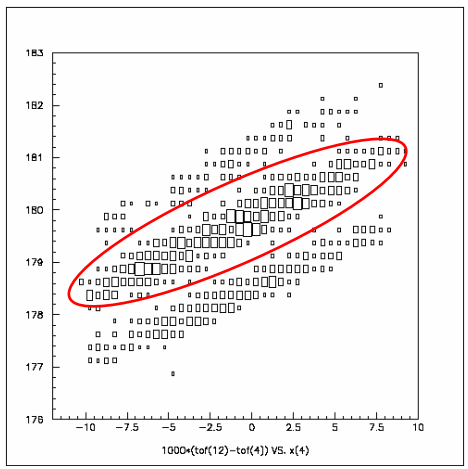
^{129}Sn



6 g @ S2
98.6% f. s.
457 MeV/u
410 MeV/u

7 g @ S2
98.3% f. s.
412 MeV/u
361 MeV/u





8 g @ S2
97.9% f. s.
363 MeV/u
309 MeV/u

Selecting the right degrader thickness II

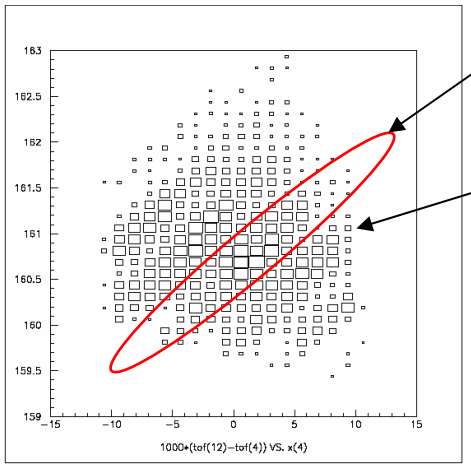
Comparing the Z-AoQ resolution for the 418 + 221 Be/Nb target for ^{130}Sn

5 g @ S2

99.0% f. s.

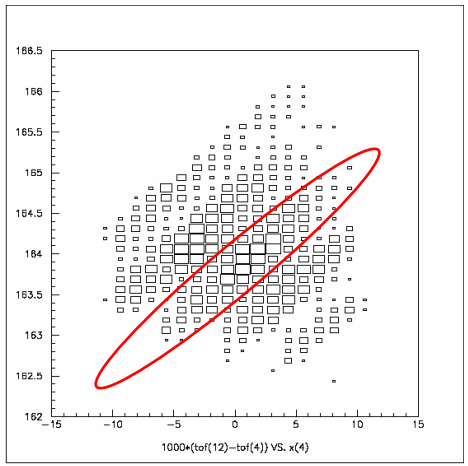
548 MeV/u

504 MeV/u



^{130}Sn

^{129}Sn



6 g @ S2

98.8% f. s.

505 MeV/u

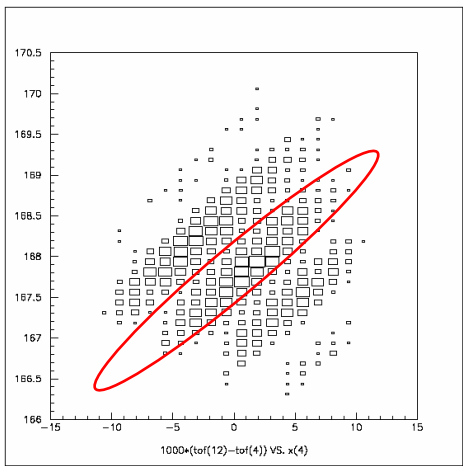
460 MeV/u

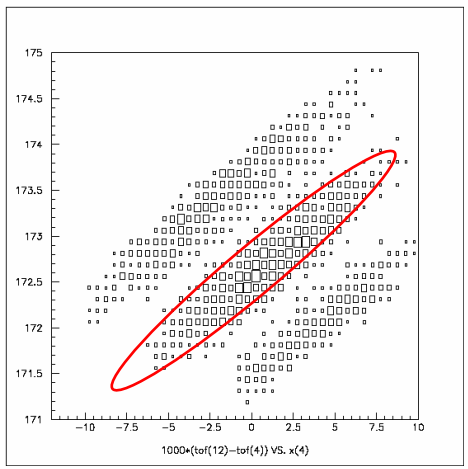
7 g @ S2

98.6% f. s.

461 MeV/u

414 MeV/u





8 g @ S2

98.3% f. s.

415 MeV/u

366 MeV/u

Selecting the right degrader thickness III

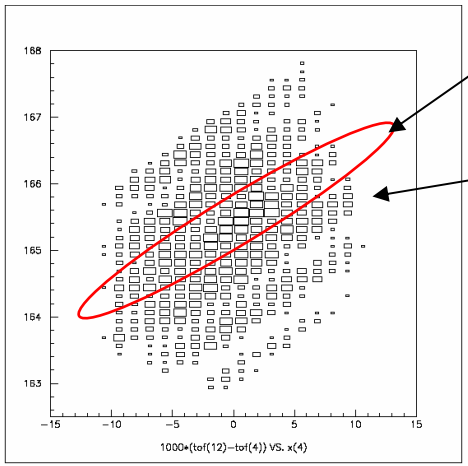
Comparing the Z-AoQ resolution for the 1023 + 221 Be/Nb target for ^{135}Te

5 g @ S2

98.3% f. s.

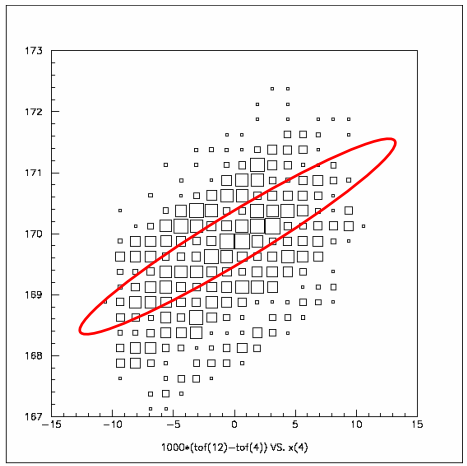
489 MeV/u

440 MeV/u



^{135}Te

^{134}Te



6 g @ S2

97.9% f. s.

442 MeV/u

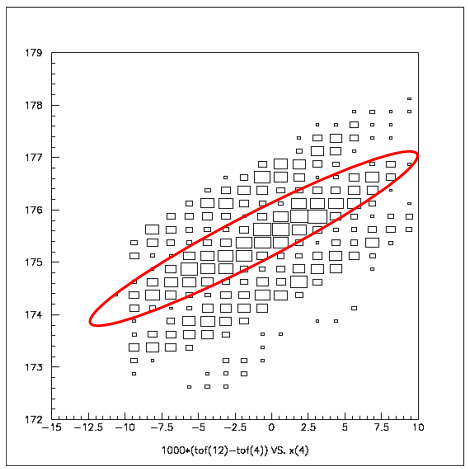
392 MeV/u

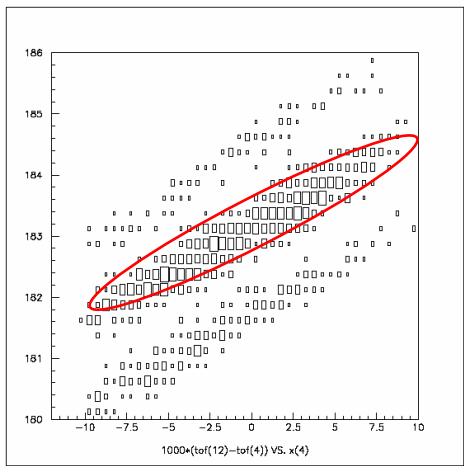
7 g @ S2

97.3% f. s.

394 MeV/u

340 MeV/u





8 g @ S2

96.3% f. s.

341 MeV/u

283 MeV/u

Selecting the right degrader thickness IV

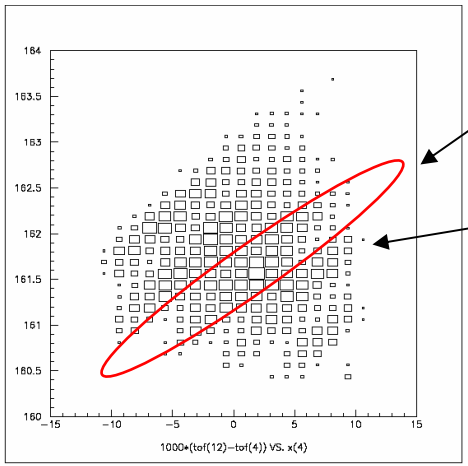
Comparing the Z-AoQ resolution for the 418 + 221 Be/Nb target for ^{135}Te

5 g @ S2

98.6% f. s.

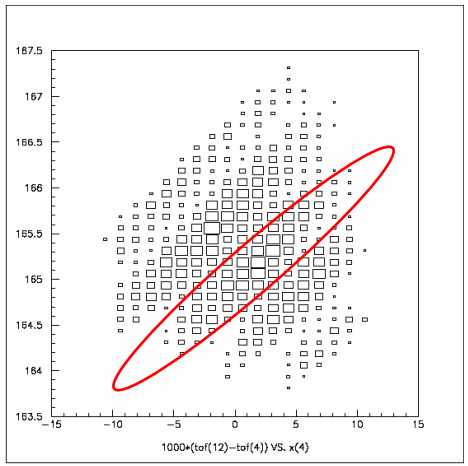
535 MeV/u

489 MeV/u



^{135}Te

^{134}Te



6 g @ S2

98.3% f. s.

490 MeV/u

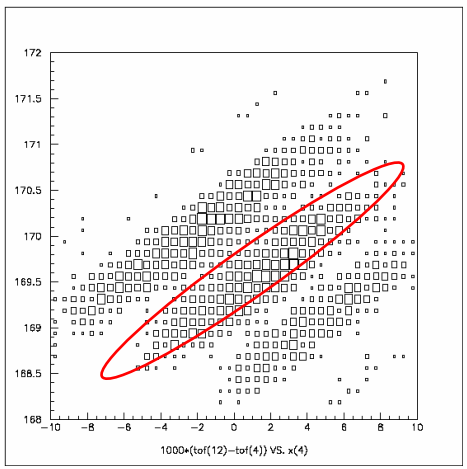
442 MeV/u

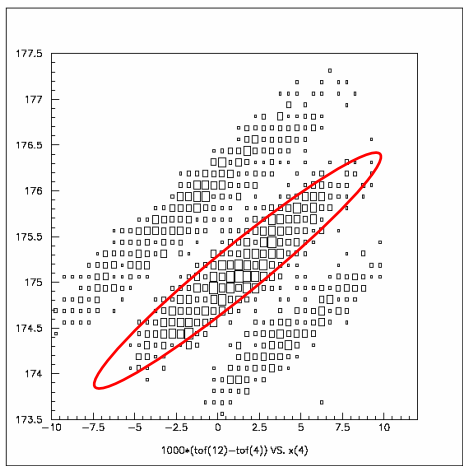
7 g @ S2

97.9% f. s.

444 MeV/u

393 MeV/u





8 g @ S2

97.3% f. s.

396 MeV/u

342 MeV/u

Selecting the right degrader thickness V

How do different degrader thicknesses affect the transmission ?

Isotope	0.4 + 5*	0.4 + 6	0.4 + 7	0.4 + 8	1.0 + 5	1.0 + 6	1.0 + 7	1.0 + 8
^{128}Sn	1.034+	0.637	0.157	0.0	1.862	0.934	0.202	0.005
^{129}Sn	3.631	3.275	2.442	1.648	4.370	3.600	2.422	1.341
^{130}Sn	5.445	5.099	4.558	4.121	3.991	3.656	3.268	3.091
^{132}Sn	3.357	1.648	0.126	0.0	1.284	0.247	0.0	0.0
^{133}Sb	3.493	1.615	0.389	0.014	1.685	0.509	0.068	0.0
^{134}Te	3.420	3.099	2.342	1.377	4.203	3.422	2.383	0.944
^{135}Te	5.905	5.366	4.759	4.223	4.571	4.291	3.747	3.322

+Transmission calculated in front of S4 degrader and given in %. *1st number gives the target thickness, the 2nd the degrader thickness. Both given in g/cm^2.

Selecting the right degrader thickness VI

Where do we lose the ions ?

Isotope	0.4 + 5*	0.4 + 6	0.4 + 7	0.4 + 8	1.0 + 5	1.0 + 6	1.0 + 7	1.0 + 8
^{128}Sn	-3.0;1.0+	-3.8;1.1	-5.1;1.1	-6.6;1.1	-3.2;1.3	-4.2;1.4	-5.7;1.4	-7.7;1.5
^{129}Sn	-1.6;1.1	-2.0;1.1	-2.6;1.2	-3.4;1.3	-1.5;1.3	-2.1;1.2	-2.9;1.3	-3.9;1.5
^{130}Sn	0.0;1.2	0.0;1.2	0.0;1.2	0.0;1.3	0.0;1.2	0.0;1.2	0.0;1.2	0.0;1.3
^{132}Sn	+2.8;0.8	+3.8;0.8	+5.0;0.8	6.7;0.7	+3.4;0.8	+4.6;0.7	+6.3;0.8	+8.8;0.8
^{133}Sb	-3.4;1.4	-4.5;1.5	-6.6;1.6	-7.3;1.6	-3.7;1.4	-5.14;1.4	-6.6;1.6	-8.4;1.4
^{134}Te	-1.5;1.1	-2.2;1.2	-3.1;1.4	-3.7;1.3	-1.7;1.2	-2.21;1.3	-3.12;1.3	-4.4;1.5
^{135}Te	0.0;1.2	0.0;1.2	0.0;1.2	0.0;1.3	0.0;1.1	0.0;1.2	0.0;1.2	0.0;1.3

+X-position and σ-value of distribution before S4-slits in cm. *1st number gives the target thickness, the 2nd the degrader thickness. Both given in g/cm^2.

How many gammas can we expect per day?

- Primary beam intensity: 10^8 pps
- Isomeric ratios and production cross-sections taken from M. Minevas PhD-thesis
- Total gamma-efficiency: 4%

Table 5.2: Isomeric ratios measured during experiments III.a and III.c with Be and Pb targets, after in-flight fission of ^{238}U at 750 MeV/u and 732 MeV/u, respectively.

Nucleus	Isomeric I^{π}	$E^{\star}, keV$	$T_{1/2}, \mu$s	$R(Be$ target)	$R(Pb$ target)
^{134}Te	6^{+}	1691	0.164	0.11	0.09
^{133}Sb	$> 17/2^{+}$	4526+x	16	0.04	0.03
^{131}Sb	$23/2^{+}$	2166.3	1.1	0.077	0.046
^{131}Sn	$23/2^{-}$	4846.7	0.3	0.026	0.015
^{130}Sn	5^{-}	2085	0.052	0.16	0.12
^{130}Sn	10^{+}	2435	1.6	0.11	0.07
^{129}Sn	$19/2^{+}$	1746	3.7	0.22*	0.09*
^{129}In	$17/2^{-}$	1688	8.5	0.21*	0.11*
^{127}In	–	–	0.09	$0.04 < 0.18$*	$0.05 < 0.25$*

** preliminary result. see Sect. 6.4 for details*

Table 5.4: Production and observed rates measured during experiment III.a with a Be target, after in-flight fission of ^{238}U at 750 MeV/u, setting optimized for ^{130}Sn, $N_{b.p.} = 2.2 * 10^{12}$, the deadtime was 48 %.

Charge	Mass	$N^{tot}(ID)$	$T_{(target-S4)}$	$P_{obs/b.p.}$	$P_{prod/b.p.}$
52	132	100203	1.39E-3	8.7E-8	6.3E-5
52	133	478620	7.7E-3	4.1E-7	5.3E-5
52	134	398742	1.5E-2	3.4E-7	2.3E-5
51	130	324588	6.93E-3	2.8E-7	4.0E-5
51	131	912761	1.47E-2	7.9E-7	5.4E-5
51	132	1170450	2.64E-2	1.0E-6	3.8E-5
51	133	915388	3.57E-2	7.9E-7	2.2E-5
50	128	379274	1.05E-2	3.3E-7	3.1E-5
50	129	646670	2.16E-2	5.6E-7	2.6E-5
50	130	795122	3.29E-2	6.9E-7	2.1E-5
50	131	552511	3.48E-2	4.8E-7	1.4E-5
50	132	273003	3.28E-2	2.4E-7	7.9E-6
49	126	82358	6.6E-3	7.1E-8	1.1E-5
49	127	126177	1.78E-2	1.1E-7	6.1E-6
49	128	82312	2.91E-2	7.1E-8	2.4E-6
49	129	50286	3.07E-2	4.3E-8	1.4E-6

How many gammas can we expect per day?

How many ions reach S4 per second?

Isotope	0.4 + 5*	0.4 + 6	0.4 + 7	0.4 + 8	1.0 + 5	1.0 + 6	1.0 + 7	1.0 + 8
^{128}Sn	13	8	2	0	58	29	6	0.2
^{129}Sn	38	35	26	18	114	94	63	35
^{130}Sn	47	44	39	35	84	77	68	65
^{132}Sn	11	5	0.4	0	10	2	0	0
^{133}Sb	31	15	3.5	0.1	37	11	2	0
^{134}Te	32	29	22	13	96	79	55	22
^{135}Te	??	??	??	??	??	??	??	??

*1st number gives the target thickness, the 2nd the degrader thickness. Both given in g/cm^2.

How many gammas can we expect per day?

Isotope	0.4 + 5*	0.4 + 6	0.4 + 7	0.4 + 8	1.0 + 5	1.0 + 6	1.0 + 7	1.0 + 8
^{128}Sn	??+	??	??	??	??	??	??	??
^{129}Sn	29329	26453	19725	13311	86387	71166	47879	26509
^{130}Sn	17761	16633	14868	13442	31862	29187	26089	24676
^{132}Sn	??	??	??	??	??	??	??	??
^{133}Sb	4340	2006	483	17	5124	1548	206	0
^{134}Te	12218	11071	8367	4920	36750	29921	20836	8254
^{135}Te	??	??	??	??	??	??	??	??

+No lifetime and dead time effects included. *1st number gives the target thickness, the 2nd the degrader thickness. Both given in g/cm^2.