

Saturday

Sunday

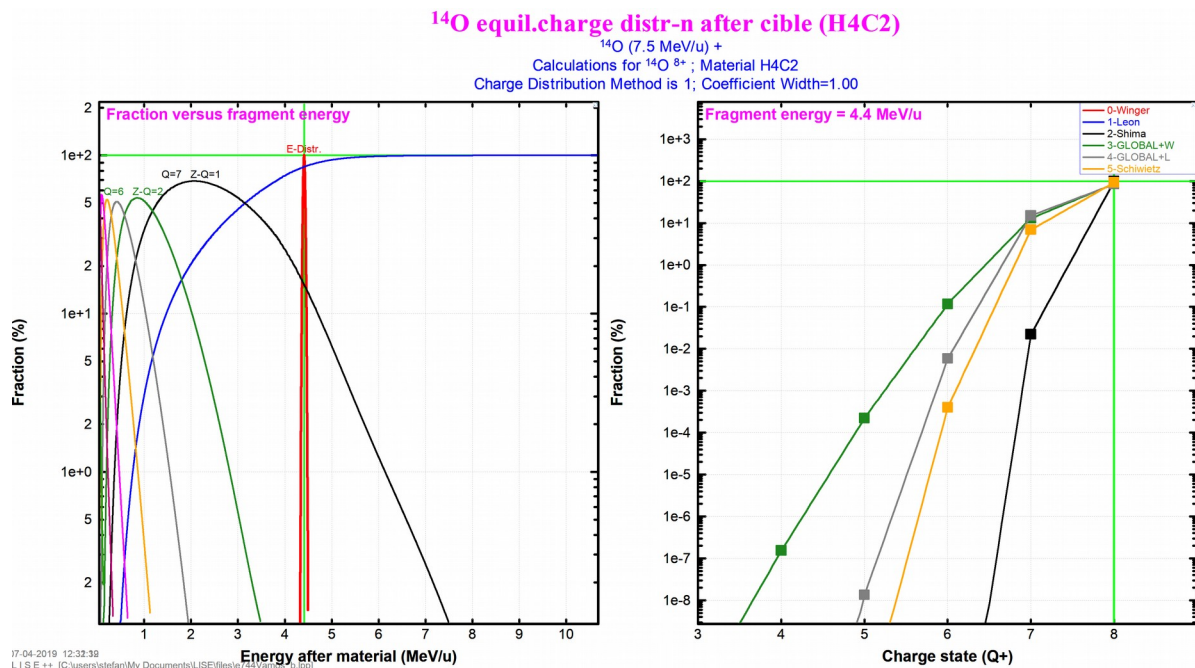
- start a RUN with target holder off (to see if the 3 alpha pics are from the holder) evening
- check kinematic calculations
- heat the Mugast cooling system
- add a TAC T_Agata_hf for beam intensity monitoring
- Straggling into the target (E & Theta)

start run with holder on (under way)

Monday

- change beam energy ($E=7.50$ MeV/u)
- make a hole target, diameter = 7 mm, foil quite thick
- dismount targets with gloves
- mount targets (list + hole target)
Target list (Hole Target, 200 um CH2, 100 um CH2, C target, 100 um CH2, 70 um CH2)
- remove the small DCs
- install the VAMOS finger, larger one
- to mount / or not a MCP
- Prepare *Agata Or - HFpropre* and *Agata 52 – HFpropre* for beam intensity monitoring.
- Solve the MM3 EY problems

Charge distribution after the target :



90% 8+

15% 7+

Brho Beam after the target 0.5408 Tm

Beam energy straggling $d\text{Brho}/\text{Brho}=0.44\%$ (FWHM), angular straggling 0.4°

14O relevants Brho 0.45-0.51

14N relevant Brho 0.45-0.59

Fragments inside Vamos:

Pressure 50 mb

Beam Brho 0.5406 Tm

Beam stops in 5th IC 49 MeV/64MeV

Lowest 14O stops in 3rd IC 26 MeV/46 mev

Lowest 14N stops in 3rd IC 17 MeV / 35 MeV

Highest 14N stops in 7th IC 47 MeV / 58 MeV

Table of Nuclides

A: 14, Element: O, Z: 8, Q: 8

Beta+ decay

Ion mass = 14.0042 amu

Energy: 4.58963 MeV/u, Brho: 0.5406 Tm, Erho: 16.051 MJ/C, P: 1296.54 MeV/c, p_trnspt: 0.162068 GeV/c

Energy: 4.591 AMeV, TKE: 64.2741 MeV, Velocity: 2.96506 cm/hs, Beta: 0.0989039, Gamma: 1.004927

After: ☐ Energy Remain. ☐ E-Loss

Block	Z\Thickness	MeV/u	MeV	MeV	<Q>
CD2target					
DCEntrance	H8C1004 0.9 micron	4.5482	63.694	0.58046	7.83
MWPPAC	H10C4 120 mm	4.4797	62.734	0.95969	7.85
PPAC FOI...	H8C1004 3 micron	4.3391	60.765	1.9689	7.81
DC1gas2	H10C4 160 mm	4.2446	59.442	1.3234	7.83
SpacerDC	H10C4 120 mm	4.1726	58.434	1.0073	7.82
DC2gas2	H10C4 160 mm	4.0753	57.072	1.8627	7.81
DCExit	H8C1004 6 micron	3.7716	52.818	4.2533	7.72
Spacer	CF4 45 mm	3.5022	49.046	3.7723	7.62
IC 4	CF4 60 mm	3.125	43.763	5.2829	7.52
IC5	CF4 60 mm	2.7198	38.088	5.6747	7.40
IC6	CF4 120 mm	1.7965	25.159	12.93	6.97
IC7	CF4 120 mm	0.64884	9.0864	16.072	5.84
IC8	CF4 120 mm	0	0	9.0864	0.00
IC9	CF4 100 mm	0	0	0	0
IC10	CF4 20 mm	0	0	0	0

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Beam 14O

Table of Nuclides

A: 14, Element: O, Z: 8, Q: 8

Beta+ decay

Ion mass = 14.0042 amu

Energy: 3.32583 MeV/u, Brho: 0.46 Tm, Erho: 11.6373 MJ/C, P: 1103.24 MeV/c, p_trnspt: 0.137905 GeV/c

Energy: 3.3263 AMeV, TKE: 46.5687 MeV, Velocity: 2.5264 cm/hs, Beta: 0.0842718, Gamma: 1.00357

After: ☐ Energy Remain. ☐ E-Loss

Block	Z\Thickness	MeV/u	MeV	MeV	<Q>
CD2target					
DCEntrance	H8C1004 0.9 micron	3.2745	45.857	0.71137	7.63
MWPPAC	H10C4 120 mm	3.1894	44.665	1.1928	7.67
PPAC FOI...	H8C1004 3 micron	3.0127	42.191	2.4734	7.67
DC1gas2	H10C4 160 mm	2.8934	40.62	1.6708	7.61
SpacerDC	H10C4 120 mm	2.8017	39.236	1.2845	7.58
DC2gas2	H10C4 160 mm	2.6762	37.478	1.7573	7.55
DCExit	H8C1004 6 micron	2.276	31.874	5.6045	7.32
Spacer	CF4 45 mm	1.918	26.861	5.0133	7.04
IC 4	CF4 60 mm	1.3931	19.509	7.3512	6.68
IC5	CF4 60 mm	0.80217	11.234	8.2757	6.07
IC6	CF4 120 mm	0	0	11.234	0.00
IC7	CF4 120 mm	0	0	0	0
IC8	CF4 120 mm	0	0	0	0
IC9	CF4 100 mm	0	0	0	0
IC10	CF4 20 mm	0	0	0	0

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14O Low Brho

Table of Nuclides

A: 14, Element: N, Z: 7, Q: 7

Stable

Ion mass = 13.9992 amu

Energy: 2.49379 MeV/u, Brho: 0.455 Tm, Erho: 9.9749 MJ/C, P: 954.839 MeV/c, p_trnspt: 0.136406 GeV/c

Energy: 2.4937 AMeV, TKE: 34.9112 MeV, Velocity: 2.1893 cm/hs, Beta: 0.0730272, Gamma: 1.002677

After: ☐ Energy Remain. ☐ E-Loss

Block	Z\Thickness	MeV/u	MeV	MeV	<Q>
CD2target					
DCEntrance	H8C1004 0.9 micron	2.4459	34.241	0.66983	6.53
MWPPAC	H10C4 120 mm	2.3652	33.11	1.131	6.58
PPAC FOI...	H8C1004 3 micron	2.1977	30.766	2.3448	6.45
DC1gas2	H10C4 160 mm	2.0823	29.151	1.615	6.49
SpacerDC	H10C4 120 mm	1.9934	27.907	1.2441	6.46
DC2gas2	H10C4 160 mm	1.872	26.207	1.6998	6.41
DCExit	H8C1004 6 micron	1.4829	20.759	5.4474	6.10
Spacer	CF4 45 mm	1.1289	15.803	4.9563	5.71
IC 4	CF4 60 mm	0.59026	8.2632	7.5398	5.08
IC5	CF4 60 mm	0.068475	0.9586	7.3046	3.63
IC6	CF4 120 mm	0	0	0.9586	0.00
IC7	CF4 120 mm	0	0	0	0
IC8	CF4 120 mm	0	0	0	0
IC9	CF4 100 mm	0	0	0	0
IC10	CF4 20 mm	0	0	0	0

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14N lowest Brho

Table of Nuclides

A: 14, Element: N, Z: 7, Q: 7

Stable

Ion mass = 13.9992 amu

Energy: 4.18936 MeV/u, Brho: 0.59 Tm, Erho: 16.7418 MJ/C, P: 1238.14 MeV/c, p_trnspt: 0.176878 GeV/c

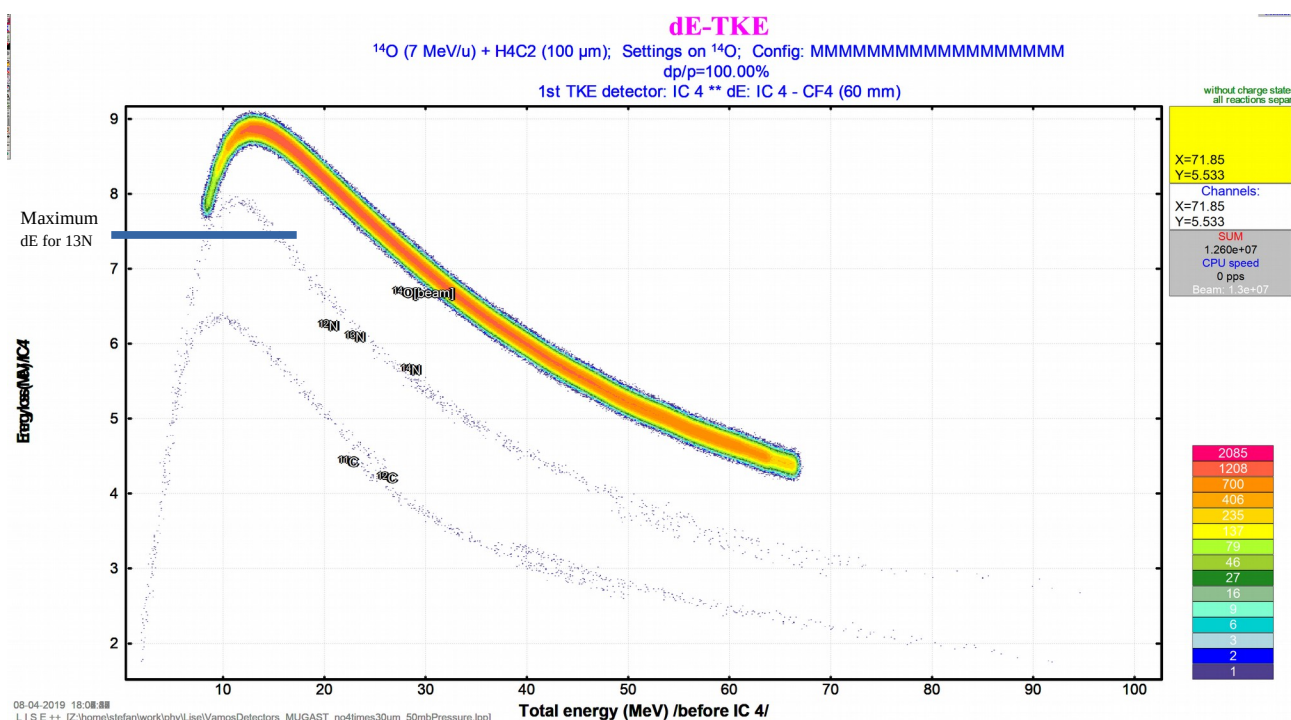
Energy: 4.1891 AMeV, TKE: 58.6478 MeV, Velocity: 2.83373 cm/hs, Beta: 0.094523, Gamma: 1.004497

After: ☐ Energy Remain. ☐ E-Loss

Block	Z\Thickness	MeV/u	MeV	MeV	<Q>
CD2target					
DCEntrance	H8C1004 0.9 micron	4.1548	58.164	0.48422	6.85
MWPPAC	H10C4 120 mm	4.0974	57.36	0.8037	6.87
PPAC FOI...	H8C1004 3 micron	3.9796	55.712	1.6483	6.84
DC1gas2	H10C4 160 mm	3.9013	54.616	1.0958	6.86
SpacerDC	H10C4 120 mm	3.8417	53.782	0.8343	6.85
DC2gas2	H10C4 160 mm	3.7611	52.652	1.129	6.84
DCExit	H8C1004 6 micron	3.5083	49.113	3.5392	6.77
Spacer	CF4 45 mm	3.2884	46.034	3.0768	6.69
IC 4	CF4 60 mm	2.9758	41.701	4.3338	6.62
IC5	CF4 60 mm	2.6508	37.109	4.5918	6.53
IC6	CF4 120 mm	1.9131	26.782	10.326	6.24
IC7	CF4 120 mm	1.0087	14.122	12.661	5.60
IC8	CF4 120 mm	0.013196	0.18474	13.937	3.09
IC9	CF4 100 mm	0	0	0.18474	0.00
IC10	CF4 20 mm	0	0	0	0

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14N highest Brho



Identification with Vamos (dE vs total energy). Blue line shows the maximum dE possible for E744 experiment.

Vamos simulation (this changed a bit with final beam energy but in relativ is ok)

Kinematics of $1\text{H}(^{14}\text{O},\gamma\text{p})^{14}\text{O}$ (left) and vamos selection

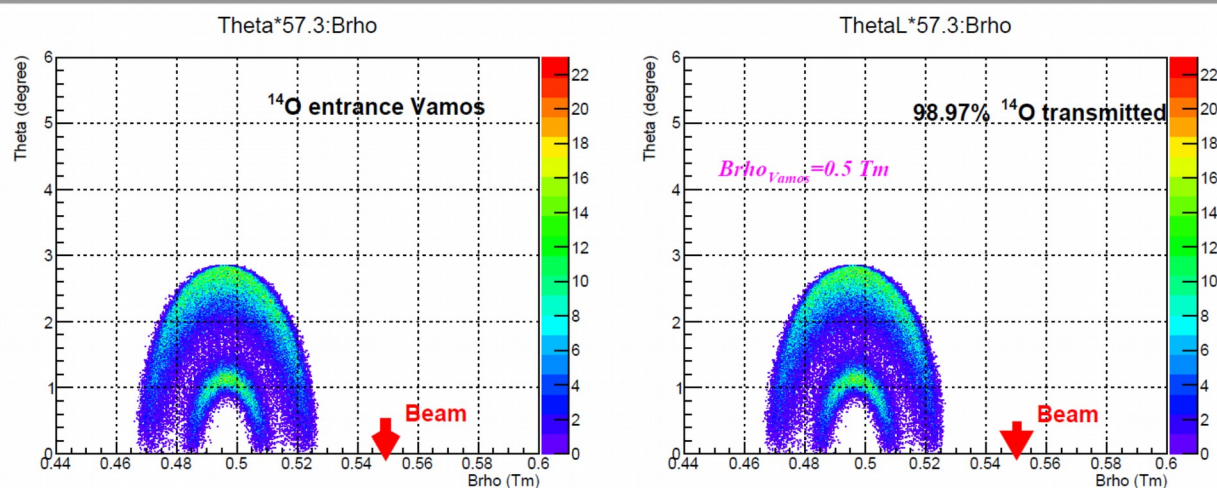


Figure 2 Transmission of the ^{14}O trough VAMOS. Brho for the ^{14}O beam is 0.55 Tm and the ^{14}O of interest is found between (0.46 to 0.53 Tm). Brho of reference for VAMOS used in the simulation ~ 0.5 Tm

Kinematics of $1\text{H}(14\text{O}, p p)13\text{N}$ (left) and vamos selection

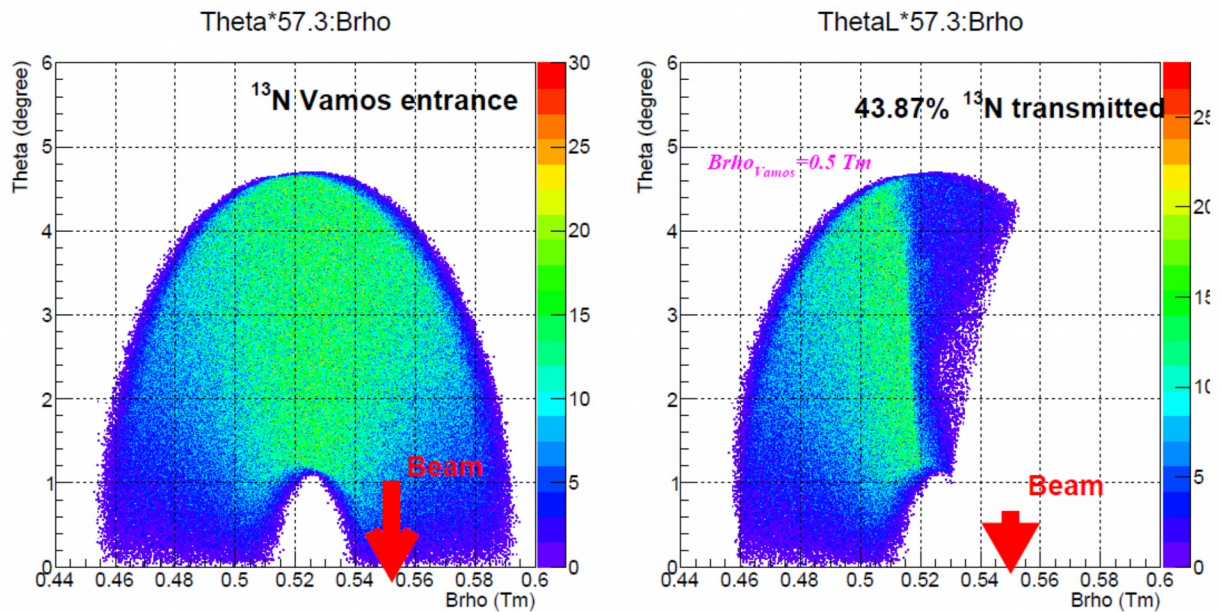


Figure 3 Transmission of ^{13}N trough Vamos. Brho for the ^{13}N of interest if between 0.45 to 0.58 Tm. Brho of reference for Vamos ~ 0.5 Tm

Peace 4 simulation of fusion evaporation for 14O beam on 12C :

All heavy fragments have low energy
 Protons are produced with 1.5 barn cross-section
 Alfa with 1 barn
 gammas with 4.5 barns

Target will contain 1.2×10^{21} nucleons (1/3 carbon)
 for 1×10^5 pps 14O

at forward angles (10-40 degrees) :

protons have $158+195+228$ mb cross-sec $\rightarrow$ 32 counts/s (mainly between 1-9 MeV)

alfas have $214+267+293$ mb cross-section $\rightarrow$ 43 counts/s (mainly between 1-12 MeV)

1.Yields of residual nuclei

Z	N	A	events	percent	x-section(mb)
14	12	26 Si	1	0.1%	0.783
12	12	24 Mg	4	0.4%	3.13
13	10	23 Al	4	0.4%	3.13
12	11	23 Mg	62	6.2%	48.5
11	12	23 Na	33	3.3%	25.8
11	11	22 Na	36	3.6%	28.2
10	12	22 Ne	3	0.3%	2.35
11	10	21 Na	35	3.5%	27.4
10	11	21 Ne	4	0.4%	3.13
11	9	20 Na	2	0.2%	1.57
10	10	20 Ne	270	27%	211
10	9	19 Ne	14	1.4%	11
9	10	19 F	30	3%	23.5

10	8	18 Ne	5	0.5%	3.91
10	7	17 Ne	1	0.1%	0.783
9	8	17 F	47	4.7%	36.8
8	8	16 O	377	37.7%	295
8	7	15 O	2	0.2%	1.57
7	8	15 N	32	3.2%	25
8	6	14 O	1	0.1%	0.783
7	6	13 N	19	1.9%	14.9
6	6	12 C	13	1.3%	10.2
5	4	9 B	5	0.5%	3.91
TOTAL			1000	100%	783

Proton spectra in laboratory coordinates 2017 events

Energy range (MeV)	Angular range (deg)																	
	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0.0-1.0		1		2	3	1	3	2	4	7	6	7	8	7	5	2	1	1
1.0-2.0			1	1	3	4	10	14	19	13	15	5	11	3	4	2		1
2.0-3.0				1	9	10	14	16	18	11	14	11	5	6	5	7	3	
3.0-4.0				9	8	11	15	25	14	12	12	9	5	7	3	3	1	
4.0-5.0			2	7	8	14	22	16	16	12	8	11	6	8	5	1	2	
5.0-6.0		3	1	11	13	19	16	13	7	8	7	9	7	5		1	2	1
6.0-7.0		4	9	17	15	15	12	14	8	10	5	4	3	3	1	3		
7.0-8.0	1	6	13	11	23	25	21	13	6	5	7	3	3	2		2	3	1
8.0-9.0	4	15	14	21	15	22	16	15	4	5	4	1	1	1	4		1	
9.0-10.0		8	19	16	15	14	8	8	7	6	6		3		2			
10.0-11.0	5	8	17	16	11	13	7	9	5	9	4		1					
11.0-12.0	5	7	14	19	10	7	14	14	4	5	1	2						
12.0-13.0	1	11	9	18	19	9	9	4	3	3	2	1	1		1			
13.0-14.0	3	14	9	3	15	6	10	8	2	1	1			1				
14.0-15.0	6	4	10	6	11	9	5	1	4									
15.0-16.0	4	8	14	6	10	4	5	4	2	1		1						
16.0-17.0		12	7	9	8	5	4	3	1	2								
17.0-18.0	1	8	8	9	4	5	2		2									
18.0-19.0	3	10	9	10	4	2	3	1	2	3								
19.0-20.0		2	10	7	3	5	2	1	1									
20.0-21.0	2	7	3	5	7	2		1										
21.0-22.0		4	6	3	2	2	3											
22.0-23.0		3	4	2		5			1									
23.0-24.0	2	3	3	3	1	3	1											
24.0-25.0	2	4	4	5	1	1		1										
25.0-26.0	2	7	1	2	1	1												
26.0-27.0	1	2	3	1	2	1												
27.0-28.0	2	1	1	3	1													
28.0-29.0		1		1	1													
29.0-30.0	1	2	1	1														
Above 30.0	1	3	3	3	1	1												
Total	46	158	195	228	224	216	202	183	130	113	92	64	54	43	30	21	13	5
dSig/dOmega	4e+02	4e+02	3e+02	3e+02	2e+02	2e+02	2e+02	1e+02	9e+01	8e+01	7e+01	5e+01	5e+01	4e+01	4e+01	4e+01	4e+01	3e+01
0.0 - 5.0		1	3	20	31	40	64	73	71	55	55	43	35	31	22	15	7	3
5.0 - 10.0	5	36	56	76	81	95	73	63	32	34	29	17	17	11	7	6		2
10.0 - 20.0	28	84	107	103	95	65	61	45	26	24	8	4	2	1	1			
Above 20.0	13	37	29	29	17	16	4	2	1									

Alpha spectra in laboratory coordinates 1398 events

Energy range (MeV)	Angular range (deg)																	
	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0.0-1.0		1		3	5	5	5	3	1		3	1			1	1		
1.0-2.0		4	8	3	5	7	8	2	4	1	3	3	2		1			
2.0-3.0		4	4	9	9	10	9	4	6	1	6	4	1	2				
3.0-4.0	1	3	4	10	7	8	8	3	5	2	1	1			1			
4.0-5.0		2	7	10	12	9	6	6	2	4	2	1						
5.0-6.0		3	9	13	15	6	8	4	5	2	1	1			1			
6.0-7.0			5	13	16	13	5	4	1	1	1							
7.0-8.0		1	10	19	11	9	4	5	2	1		1						
8.0-9.0		1	9	8	14	11	4	3	1									
9.0-10.0	1	4	7	23	11	6	4		2									
10.0-11.0	2	3	5	19	12	5	4	1	1	3								
11.0-12.0		1	11	17	6	4	2		2		2							
12.0-13.0	2	4	18	15	3	6	2	2										
13.0-14.0	1	5	8	10	5	3	2	1	1	1								
14.0-15.0	2	7	14	12	6	3	2	2	1									
15.0-16.0		11	12	8	1	6	2	1										
16.0-17.0	2	7	16	12		5												
17.0-18.0	4	7	11	13	5	1	5											
18.0-19.0	3	11	9	6	1	4	1											
19.0-20.0	4	12	10	7	3	2												
20.0-21.0	5	6	7	8	4	4												
21.0-22.0	7	7	3	5	1	3	1	1										
22.0-23.0	2	9	13	4	3	1												
23.0-24.0	4	13	6	5	2	3		1										
24.0-25.0	4	8	8	8		1												
25.0-26.0	3	8	3	2	1													
26.0-27.0	2	9	3	6	3	3												
27.0-28.0	6	6	2	4	2	1	1											
28.0-29.0	2	5	4	7	2		2											
29.0-30.0	3	8	4		1													
Above 30.0	29	44	37	14	9	1												
Total	89	214	267	293	175	140	85	43	34	16	19	12	3	2	5	1		
dSig/dOmega	7e+02	6e+02	5e+02	4e+02	2e+02	1e+02	7e+01	3e+01	3e+01	1e+01	1e+01	9	3	2	6	2	0	0
0.0 - 5.0	1	14	23	35	38	39	36	18	8	15	10	3	2	4	1			
5.0 - 10.0	1	9	40	76	67	45	25	16	11	4	2	2		1				
10.0 - 20.0	20	68	114	119	42	39	20	7	5	4	2							
Above 20.0	67	123	90	63	28	17	4	2										

Gamma ray spectrum 7425 events

Emission from unbound and bound states(*), and total gamma ray spectrum

(*) note that emission of a particle from an unbound state is not allowed in the code if Ecm is less than Emin

Energy range (MeV)	Unbound	Bound	TOTAL
0.0 - 1.0	4	422	426
1.0 - 2.0	2535	4457	6992
3.0 - 4.0	1	0	1
5.0 - 6.0	1	0	1
6.0 - 7.0	1	0	1
8.0 - 9.0	1	0	1
9.0 - 10.0	1	0	1
11.0 - 12.0	1	0	1
12.0 - 13.0	1	0	1
Total	2546	4879	7425