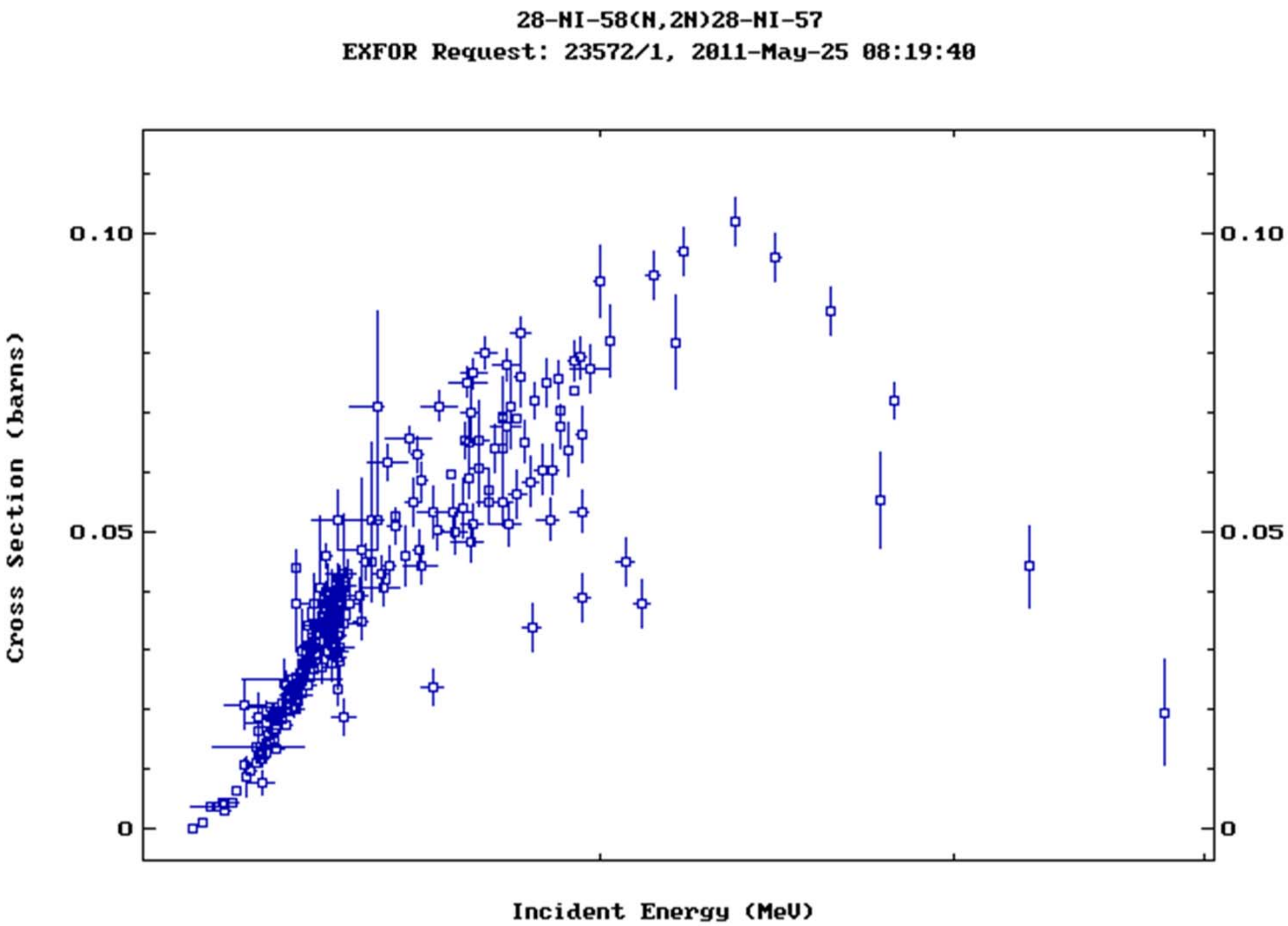
International Atomic Energy Agency

Experience of activation cross sections in EXFOR

V. M. Semkova


28-NI-58(N,2N)28-NI-57
EXFOR Request: 23572/1, 2011-May-25 08:19:40
0.10
0.05
0
0.10
0.05
0
Cross Section (barns)
Incident Energy (MeV)

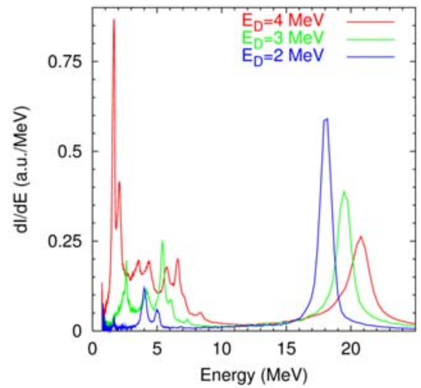
- ENTRY 22976 20090220 20090508 20090507 2209
- TITLE .Measurement of Neutron Activation Cross Sections in
- the Energy Range from 8 MeV to 15 MeV
- AUTHOR (W.MANNHART, D.SCHMIDT)
- REFERENCE (R,PTB-N-53,200701) Report of the Physikalisch-
- Technischen Bundesanstalt, Braunschweig, Germany.
- ....
- CORRECTION .After subtraction of the GAS-OUT measurements from
- the measured data, corrections were applied for the
- breakup neutrons. The magnitude of the correction
- depends on the reaction cross section and on the
- neutron energy. The error of the correction is 3% of
- the experimental value (R) describing the actual
- ratio of breakup-to-monoenergetic neutrons
- .Corrections were made also:
- For summing losses in the photon counting
- For the variation of the photon efficiency over the
- finite size of samples
- For photon attenuation in the sample
- For positron annihilation in flight
- For dead time effects
- For variation of neutron fluence in time
- For fission fragment losses
- For zero extrapolation of the fission events
- For neutron scattering from the gas target, fission
- chamber and support structures

Keywords	Selected	# Entries	% of total
METOD	ACTIV	3900	20
INC-SOURCE	D-D	4000	20
ENERGY	6 to 12 MeV		
DETECTOR	GE, GE-IN,		
	GELI, HPGE	2200	~10
	NAICR	1800	~10

- **Neutron spectrum unfolding:** Mean neutron energy and energy distribution for the irradiation geometry were determined by Monte Carlo program TARGET, spectrum unfolding by time-of-flight measurements in combination with threshold activation unfolding procedure were used in order to determine contribution of the breakup neutrons.

TOF measurement

- Liquid scintillator (NE213): 4” diameter 1” thick, Δt=0.5 ns fwhm, 0.35 ns/channel, Efficiency: C. Goddio thesis work (E_n > 1 MeV)
- Pulsed VdG: 1.5 ns fwhm, long tails, 400 ns rep. period
- 3 m flight-path
- Collimator to avoid scattered neutron contributions



Divide the flux in components: Φ'$_k$

$$\Phi' = \sum_{k=1}^{n} g_k \Phi'_k$$

Fix group cross sections for standards: G

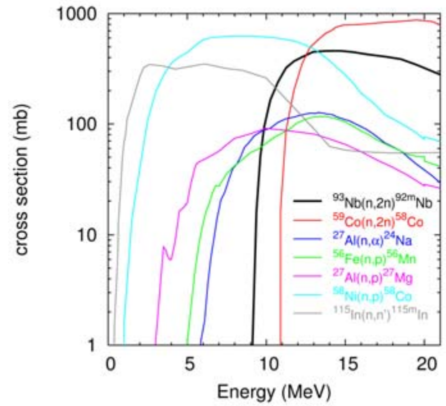
$$F_{t,i} = N_A \sum_{k=1}^{n} g_k \int_0^\infty \sigma_i \Phi'_k dE.$$

$$\mathbf{G}_{i,k} = N_A \int_0^\infty \sigma_i \Phi'_k dE$$

Use prior knowledge from time-of-flight measurements

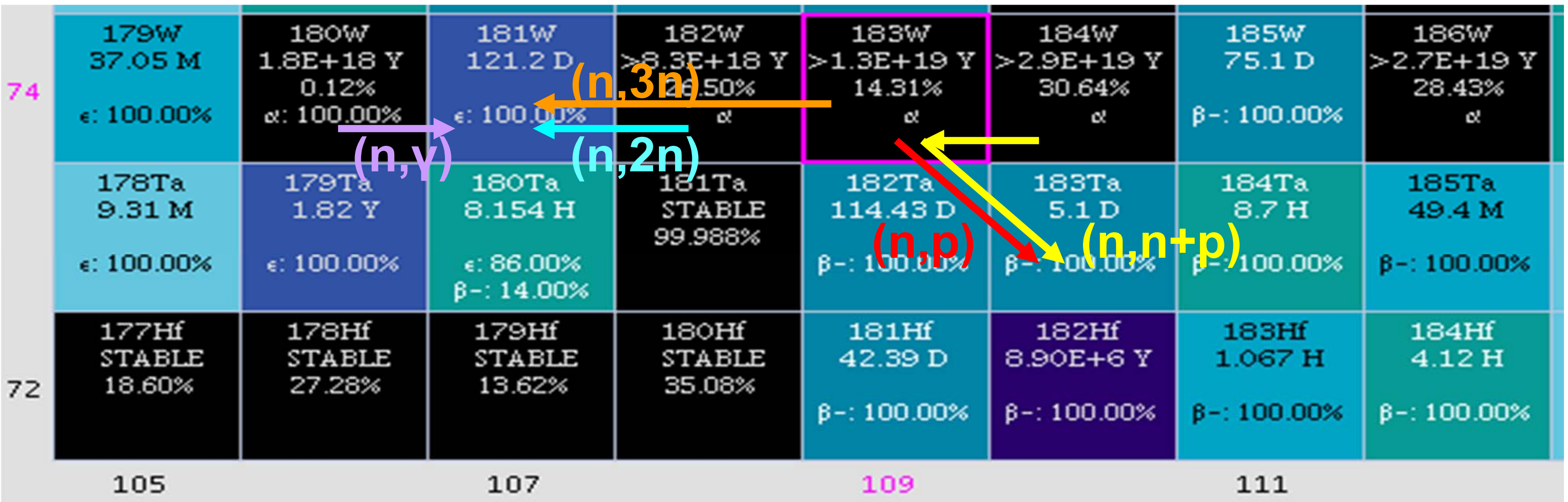
$$\mathbf{F_t} = \mathbf{Gg}.$$

$$\chi^2 = (\mathbf{F_t} - \mathbf{Gg})^T \mathbf{V}_{\mathbf{F_t}}^{-1} (\mathbf{F_t} - \mathbf{Gg}) + (\mathbf{g} - \mathbf{g_0})^T \mathbf{V}_{\mathbf{g_0}}^{-1} (\mathbf{g} - \mathbf{g_0})$$



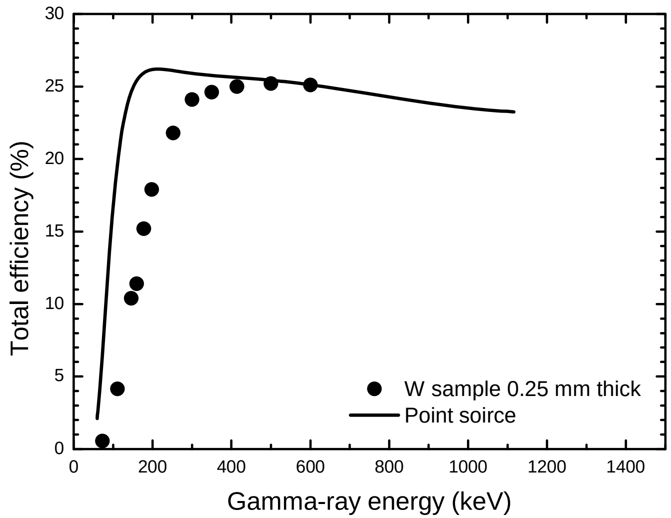
Generalized Least Squares: Based on Bayes’ method, algorithm and derivation in D.L. Smith ‘93
Program: *GLSMOD*, Drivers: *CFLUX* (*CXSEC*)

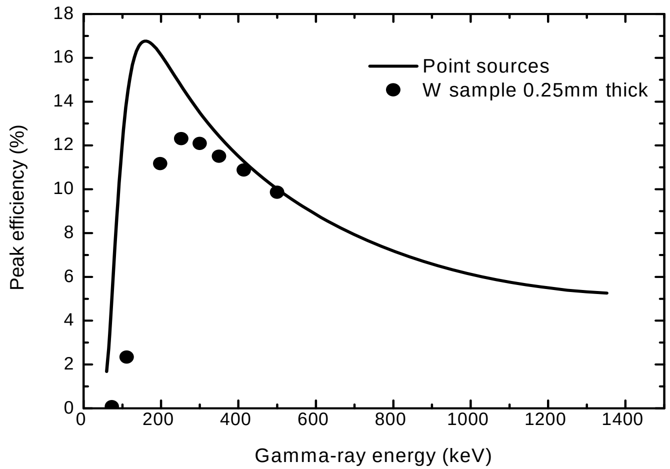
Sample composition



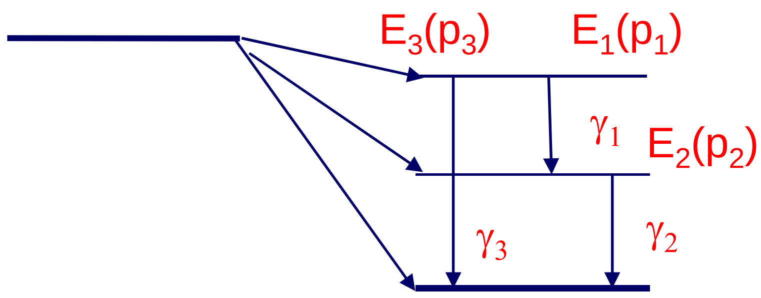
Detector efficiency: analytical function and MCNP detector efficiency simulation

Gamma-ray attenuation: $\overline{T} = \frac{1}{\mu x}\left(1 - e^{-\mu x}\right)$ μ absorption coefficient, x sample thickness





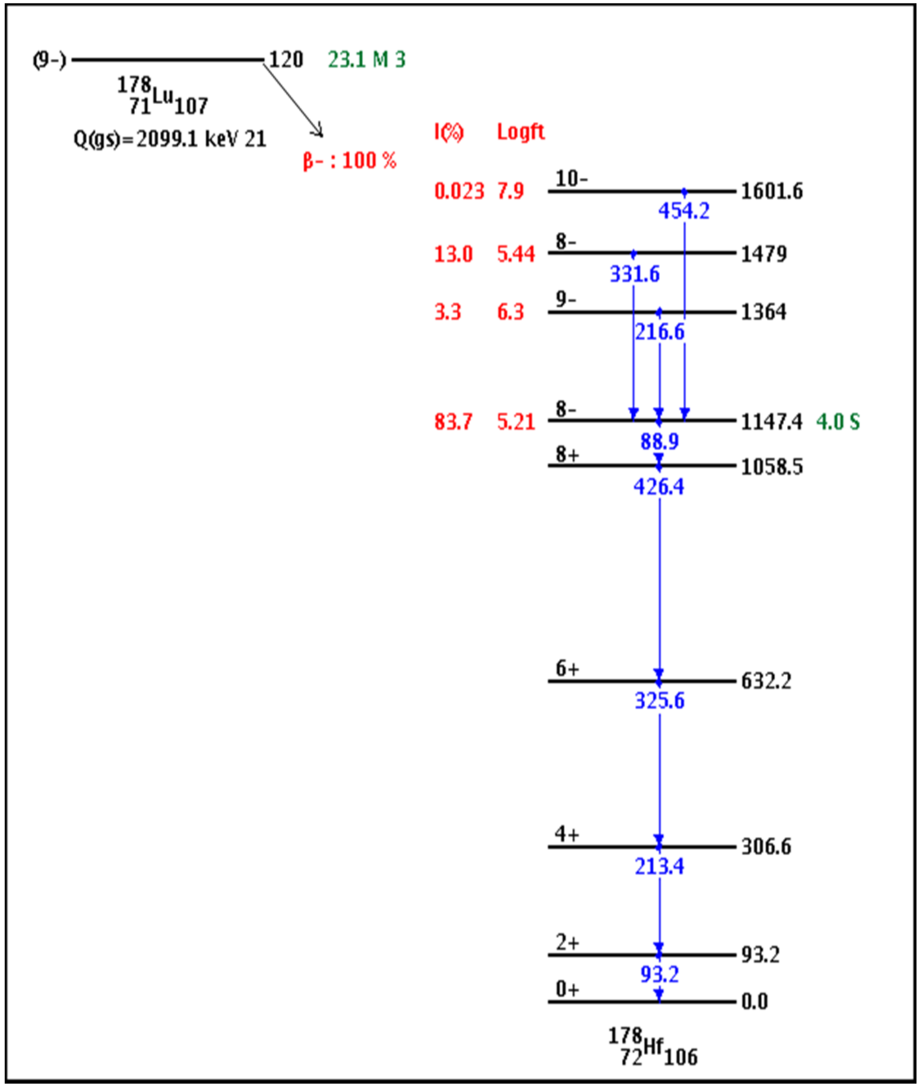
Coincidence summing correction

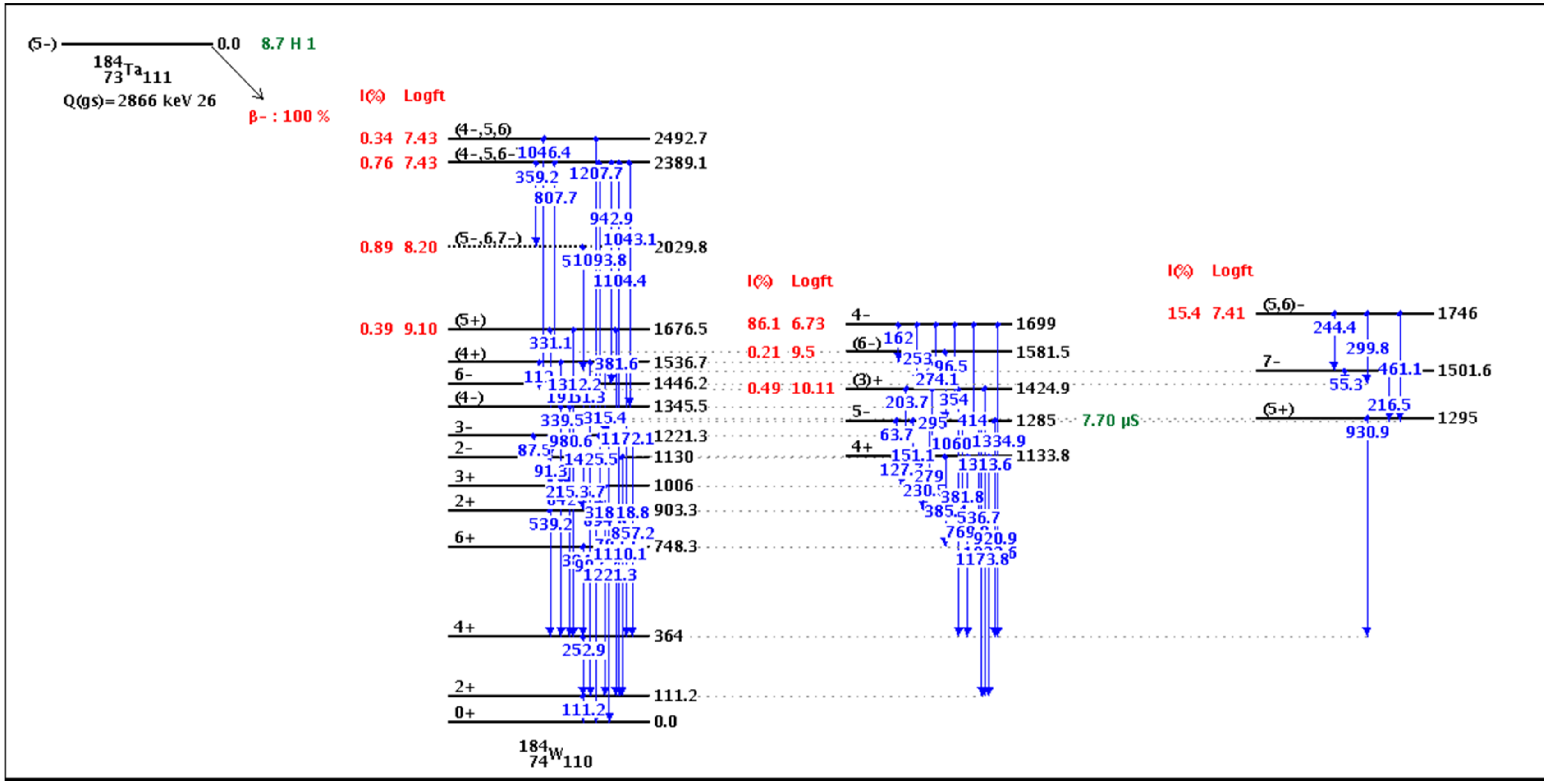


$$c_{coin1} = \frac{1}{1-\varepsilon_{t2}} \qquad c_{coin2} = \frac{1}{1-(p_{\gamma 1}/p_{\gamma 2})\varepsilon_{t1}}$$

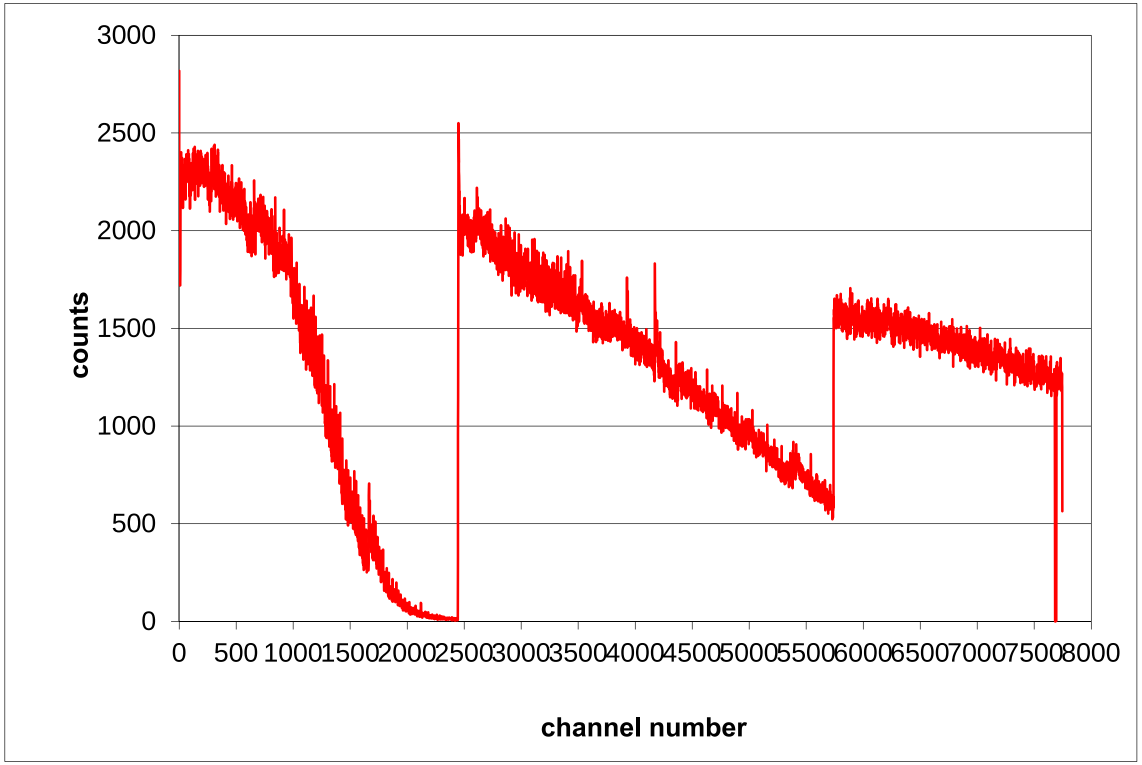
$$c_{coin3} = \frac{1}{1+ p_{\gamma 1}.\varepsilon_{peff\,1}.\varepsilon_{peff\,2}/\left(p_{\gamma 3}.\varepsilon_{peff\,3}\right)}$$

E_γ [&]	E_{level}	I_γ [#&]	α
88.85 *3*	1147.37	68.4[a] *11*	0.487
93.15 *5*	93.15	18.3[a] *3*	4.67
213.41 *5*	306.56	86.5[a] *12*	0.232
216.64 *4*	1364.01	2.64 *17*	0.34 *12*
325.60 *5*	632.16	100.0[a] *12*	0.0621
331.62 *4*	1478.99	12.1 *6*	0.1418
426.36 *5*	1058.52	103.1[a] *14*	0.0292
454.2 *5*	1601.6	0.024 *11*	0.0247





(5-)
0.0
8.7 H 1
184 73 Ta 111
Q(gs)=2866 keV 26
β- : 100 %
I(%) Logft
0.34 7.43
(4-,5,6)
2492.7
0.76 7.43
(4-,5,6-
1046.4
2389.1
359.2
1207.7
807.7
942.9
0.89 8.20
(5-,6,7-)
1043.1
2029.8
1093.8
1104.4
0.39 9.10
(5+)
1676.5
331.1
(4+)
381.6
1536.7
6-
1312.2
1446.2
(4-)
1345.5
339.5
315.4
3-
980.6
1172.1
1221.3
2-
87.5
1425.5
1130
91.3
3+
1006
2+
318
18.8
903.3
539.2
857.2
6+
748.3
1110.1
1221.3
4+
364
252.9
2+
111.2
0+
111.2
0.0
184 74 W 110
I(%) Logft
86.1 6.73
4-
1699
0.21 9.5
(6-)
162
1581.5
253
96.5
274.1
0.49 10.11
(3)+
1424.9
203.7
354
5-
295
414
1285
7.70 μS
63.7
1060
1334.9
4+
151.1
1133.8
1313.6
127
279
230.5
381.8
385
536.7
769
920.9
1173.8
I(%) Logft
15.4 7.41
(5,6)-
1746
244.4
299.8
7-
461.1
1501.6
55.3
216.5
(5+)
1295
930.9



3000
2500
2000
1500
1000
500
0
counts
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
7000
7500
8000
channel number