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Activation calculation of the EURISOL mercury target

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1. Introduction

The MCNPX Monte-Carlo particle transport code [1] coupled to the CINDER'90 depletion code [2] has been used to compute the radioactive inventory of the EURISOL 4 MW power target [3]. At the very beginning, a benchmark study of the MCNPX code allowed us to choose the "best" spallation and fission-evaporation model parameters for simulation. In this way some uncertainty estimates of the presented results could be obtained. In this work we report an extensive list of nuclides (given in Appendix) produced in the liquid mercury converter, for which detailed simulation were done taking into account the realistic target geometry and material configurations.

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2. Benchmark

In order to check the liability of models available in MCNPX code, some benchmark calculations on gas and residual nuclei production have been done. The code MCNPX allows the user to choose between different intra-nuclear cascade and fission-evaporation model combinations among ISABEL, BERTINI and INCL4 for cascade and DRESNER (associated with RAL or ORNL fission models) and ABLA for de-excitation [1]. Another possibility with MCNPX is to use the package CEM2k (cascade and deexcitation). For both ISABEL and BERTINI models, pre-equilibrium option has been used. For microscopic cross section predictions the code MCNPX has been used without the full particle transport.

2.1 Gas production

Some various data on tritium production cross sections have been compiled [4, 5, 6, 7, 8] for a natural lead target, and are compared in Fig. 1 to the results given by MCNPX code using model combinations resulting in non-zero triton emission. The ISABEL-ABLA and INCL4-ABLA models combination are then excluded and only CEM2k, BERTINI-RAL and ISABEL-RAL can be used for this particular observable. The first and the second model combinations seem to overestimate the data, only ISABEL-RAL shows the saturation visible in the data occurring around 1-2 GeV incident proton energy. The value of tritium production cross section given by CEM2k and BERTINI-RAL is about 700 mb for 1 GeV protons, which is by a factor 2 larger than the value given by ISABEL-RAL (360 mb) (see Fig. 1).

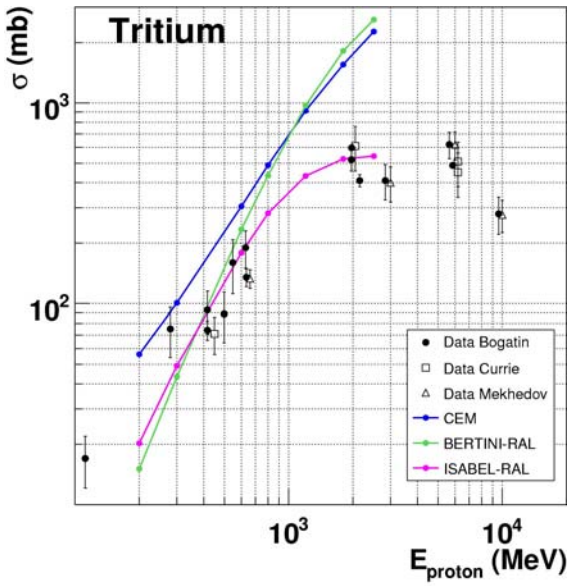

Figure 1: Tritium production cross section in a thin lead target as a function of proton incident energy.

2.2 Residual nuclei production

A comparison of fission yields from thick targets between MCNPX models and ISOLDE data [9] has also been performed. ISOLDE experiment at CERN collected data of yields and release of noble-gas isotopes from UCx/graphite and ThCx/graphite targets. Proton beams of 1.0 and 1.4 GeV were used. Fig. 2 presents the in-target production yield of Krypton isotopes for CEM2k, INCL4-ABLA, ISABEL-ABLA and ISABEL-RAL models with 1.4 GeV protons impinging directly on the thick uranium carbide target. More details on the target geometry and primary beam characteristics can be found in Ref. [9].

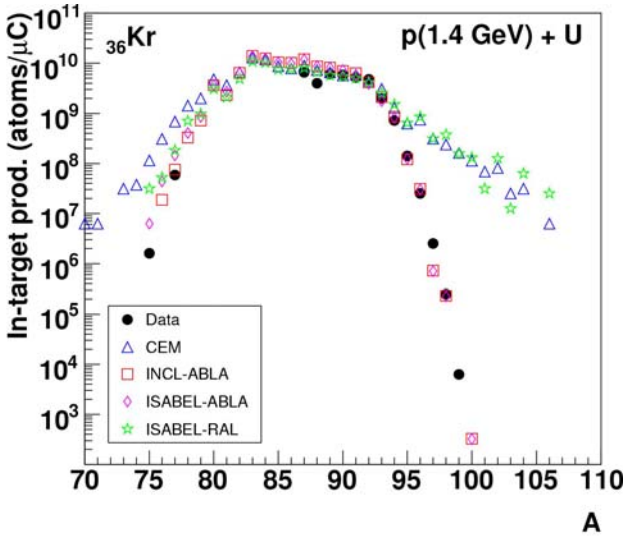

Figure 2: Mass distribution of Krypton isotopes predicted by different models in MCNPX compared to ISOLDE data (see the legend).

Note that in these simulations all secondary reactions, including low energy neutrons, are taken into account. In brief, we can see that only the combinations using ABLA fission-evaporation model are able to reproduce the shape of the mass distribution. The CEM2k and ISABEL-RAL models predict too broad distribution and therefore overestimate the production of isotopes on the neutron rich side in particular. Similar conclusions are drawn also for the isotopic distribution of Xenon (not shown in the figure).

3. EURISOL 4 MW target

The simulation of the EURISOL 4 MW power target [3] has been done using the MCNPX code. A schematic view of the geometry implemented in MCNPX is shown in Fig. 3. It consists of a two-stage target, in which most of the primary beam power is dissipated in the liquid Hg (target-converter), whereas the produced neutron flux is used to induce fissions in the uranium carbide material (production target), which in principle should not be overheated by the primary beam.

The target-converter (liquid Hg) is of 16 cm diameter and of the stopping length (~45 cm long for 1 GeV protons). The mercury is surrounded by 8 production targets that contain the fissile material (uranium or thorium carbide tablets), which will be heated up to ~2000^{o}C in order to increase the effusion-diffusion process (extraction efficiency) of the fission products. Extracted fission products are driven to a single or multiple ion sources by 8 beam tubes. The entire target assembly is maintained by a stainless steel structure isolated electrically and surrounded by a moderator (thick graphite layers). The incident beam is 1 GeV protons (up to 4 mA primary beam intensity) with a Gaussian profile.

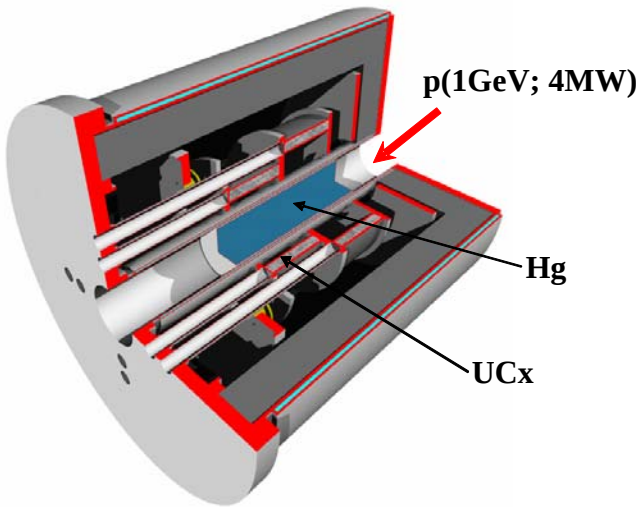

Figure 3: Schematic view of the realistic EURISOL 4 MW power target geometry implemented in MCNPX.

For the target-converter material natural mercury has been used. The composition, following the natural abundance of mercury isotopes is given in Table 1. In MCNPX, the neutron cross section library LA150N from LANL (1998) has been used, where all naturally occurring isotopes of mercury are available for neutron energy up to 150 MeV.

^{196}Hg	0.0015
^{198}Hg	0.0997
^{199}Hg	0.1687
^{200}Hg	0.2310
^{201}Hg	0.1318
^{202}Hg	0.2986
^{204}Hg	0.0687

Table 1: Isotopic composition (in atomic fraction) of mercury target (density ρ = 13.55 g/cm^3).

4. Spallation residues in mercury converter

Using the target geometry presented in Fig. 3 we calculated the residual nuclei charge and mass distributions in the mercury target using ISABEL-ABLA, INCL4-ABLA and CEM2k model combinations.

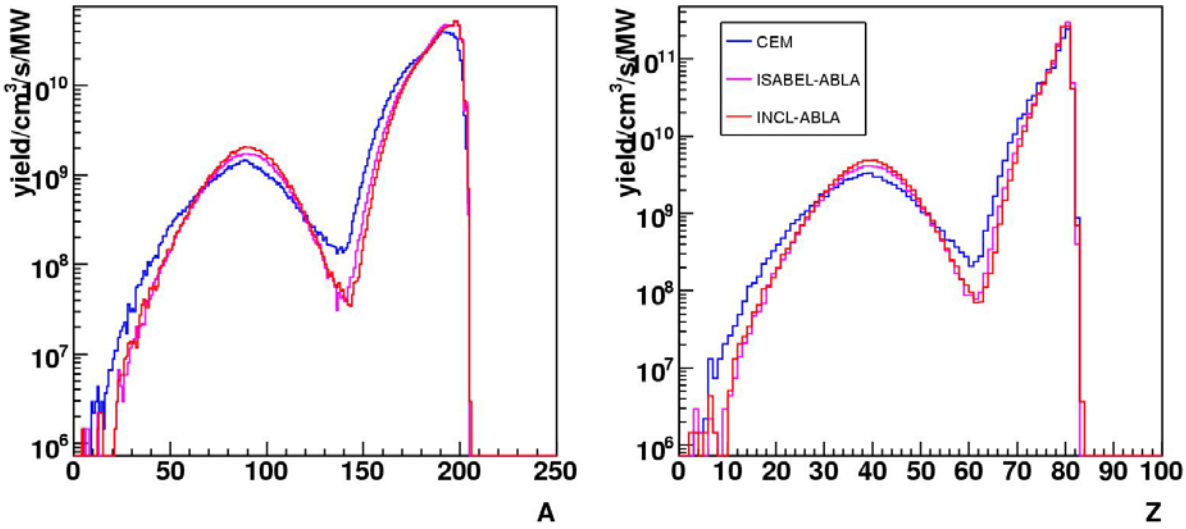

Figure 4: Mass (left) and charge (right) distributions of spallation residues in thick mercury target using a 1 GeV proton beam. The following model combinations were used: ISABEL-ABLA (magenta), INCL4-ABLA (red) and CEM2k (blue).

The results are shown in Fig. 4, where important discrepancies are observed among the different model predictions. Note that the absolute values of the differences between production yields given by different models will increase with the irradiation time of the target. We note that this observable is an averaged value on the whole mercury volume under irradiation (~ 8567 cm^3). The local values are higher near the impact point of the beam and lower in the periphery of the target. The yields are provided in atoms per (s·MW·cm^3) in Fig. 4.

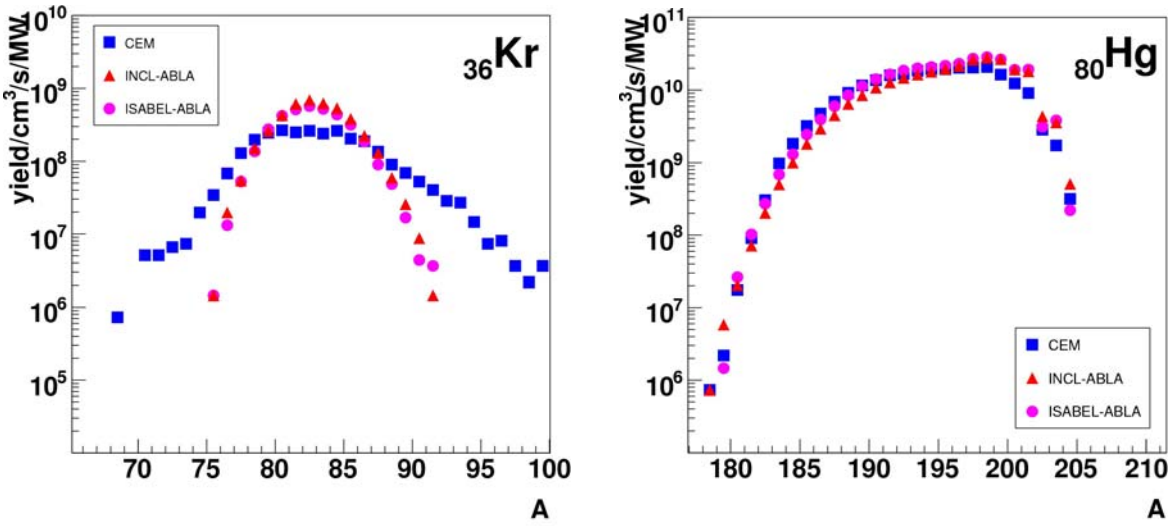

Figure 5: Same as Fig. 4 but for mass distribution of Krypton isotopes (on the left) and Mercury isotopes (on the right).

A more detailed examination of the mass distribution for particular isotopes as Krypton, being fission product, and Mercury, being spallation residue, is presented in Fig. 5. This model comparison confirms, as stated earlier in this work, that CEM2k gives un-physically broad isotopic distributions for fission products.

5. Activation calculations

The activation of the mercury target was calculated using CINDER'90 transmutation code [2], which can be used to obtain the radionuclide inventory in accelerator targets. This code uses neutron cross section and nuclei decay data library in combination with spallation yields and neutron flux tables calculated by an external code (MCNPX in this case). In this way both high energy and low energy reactions, including thermal neutrons, are taken into account.

Within CINDER'90 the concentration of nuclides depleted and produced in irradiated materials are described by a set of coupled differential equations, the concentration of nuclides being calculated from the history of gains from neutron absorption reactions (spallation, fission, (n,γ), (n,2n), etc ...) and radioactive decay [2].

In this work calculations were done considering a continuous irradiation time of 40 years with the proton beam intensity of 2.28 mA, which represents average operating conditions of the facility. Fig. 6 shows the "most probable" radionuclide inventory obtained with ISABEL-ABLA model combination. The contribution to the total activity of high volatility nuclides as tritium and iodine, mercury isotopes with an intermediate volatility, and less volatile but long lived nuclides as ^{148}Gd, ^{172}Hf, and ^{195}Au are shown explicitly.

Appendix 1 gives much more detailed inventory of the main contributing nuclides (> 1%) to the total activity for different cooling time after shutdown (1 day, 1 year, 10 years and 100 years). In addition, an extensive list of nuclides produced in the target is also available in Appendix 2, where only the nuclides with an activity larger than 1 MBq/g are presented. The total activity is found to be about 10^3 GBq/cm^3 1 year after the end of irradiation time.

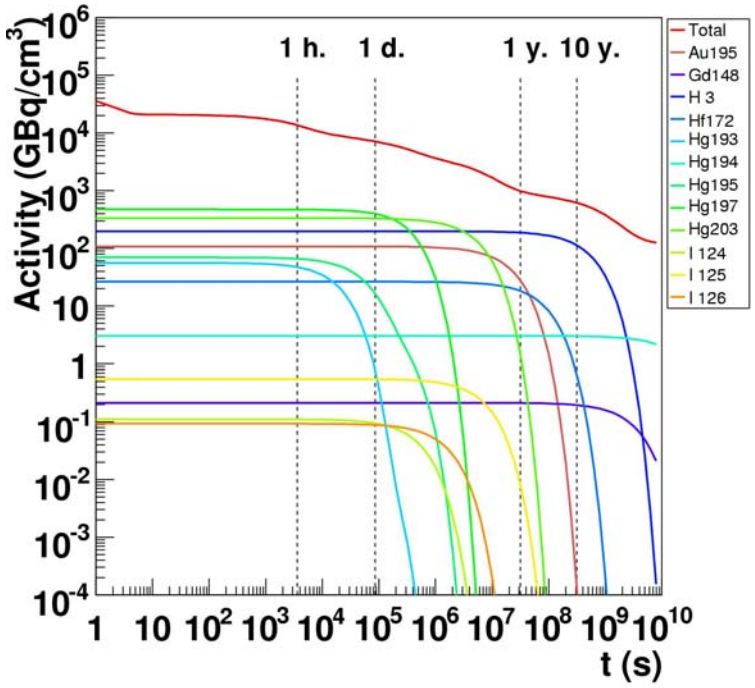

Figure 6: Total radioactivity estimate of EURISOL 4MW Hg target as a function of cooling time using ISABEL-ABLA models. The main contributions of different radioisotopes are shown separately.

Calculations were also performed using three other model combinations (INCL4-ABLA, ISABEL-ABLA and CEM2k) resulting in three different distributions of spallation residues and gas production in target. The results are summarized in Fig. 7 and Table 2.

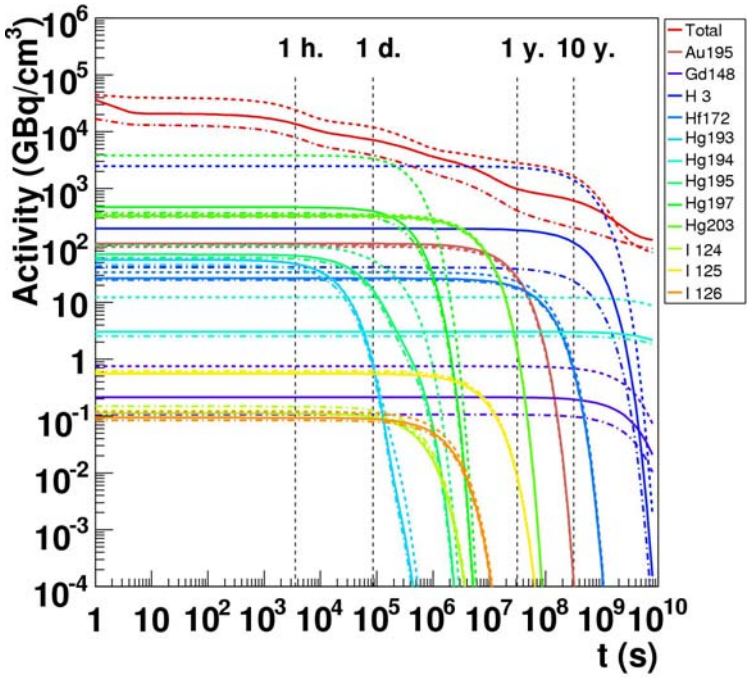

Figure 7: Radioactivity estimates as a function of cooling time using ISABEL-ABLA (solid line), CEM2k (dashed line) and INCL4-ABLA (dashed-dotted line) models. Irradiation conditions are the same as in Fig. 6.

As one could expect, we can see that the different microscopic models are giving significant

differences in radioisotope activity, particularly for the important α emitter as ^{148}Gd (see Table 2), and also for tritium gas emission (see Fig. 7) for the decay period between 1 and 10 years. We note separately that the use of CEM2k model for tritium activity estimation would give the most conservative case as shown in a previous section, i.e. lowering this value by a factor of 2 for 1 GeV incident protons would be a more reasonable estimate.

		1 year after irradiation			10 years after irradiation		
		ISABEL-ABLA	CEM2k	INCL4-ABLA	ISABEL-ABLA	CEM2k	INCL4-ABLA
Total activity	Half life	9.810^{2}	$2.8\ 10^{3}$	$4.1\ 10^{2}$	$6.1\ 10^{2}$	$1.6\ 10^{3}$	$2.0\ 10^{2}$
^{195}Au	186.1 d	$2.8\ 10^{1}$	2.410^{1}	$2.6\ 10^{1}$	$2.1\ 10^{-4}$	$1.8\ 10^{-4}$	$2.0\ 10^{-4}$
^{148}Gd	74.6 y	2.110^{-1}	$7.4\ 10^{-1}$	$1.1\ 10^{-1}$	$2.0\ 10^{-1}$	$6.8\ 10^{-1}$	$9.7\ 10^{-2}$
^{3}H	12.32 y	$1.9\ 10^{2}$	$2.3\ 10^{3}$	$3.9\ 10^{1}$	$1.1\ 10^{2}$	$1.4\ 10^{3}$	$2.3\ 10^{1}$
^{172}Hf	1.87 y	$1.8\ 10^{2}$	$2.3\ 10^{2}$	$1.7\ 10^{2}$	$6.5\ 10^{-1}$	$8.3\ 10^{-1}$	$6.1\ 10^{-1}$
^{194}Hg	444 y	3.0	$1.2\ 10^{1}$	2.6	3.0	$1.2\ 10^{1}$	2.5

Table 2: Radioactivity (in GBq/cm^3) in the case of some important isotopes for radioprotection in the irradiated mercury target as a function of the ISABEL-ABLA, CEM2k and INCL4-ABLA models within MCNPX.

6. Decay heat and γ emission

The decay heat and gamma emission of the mercury target has been also estimated using CINDER'90 as shown in Fig. 8 for 5000 hours of irradiation (annual operating time of the installation after which maintenance operations around the target can take place) at 4 MW beam power. The averaged decay power will be about 0.4 W/cm^3 one day after shutdown or 3.4 kW for the whole "active" target volume. The nuclides giving the main contribution to the decay heat are also plotted in detail. The number of γ emitted around the energy of 1 MeV one day after shutdown is about $3{\cdot}10^{11}$ s^{-1} cm^{-3} (see Fig. 8).

7. Conclusion

We have used MCNPX coupled to CINDER to estimate the production of radioactive nuclides in the EURISOL 4 MW liquid mercury target during a lifetime of the installation of 40 years. The calculations have been done with different intra-nuclear cascade and fission evaporation model combinations. A benchmark exercise allowed a better understanding of differences seen between theses models, especially for the creation of tritium and fission products.

To obtain a realistic production yield for tritium gas in proton induced spallation reactions, we recommend using the ISABEL-RAL model, while both CEM2k and BERTINI-RAL are overestimating production rate above 1 GeV incident proton. The best combinations of models to calculate the residual nuclei production are those using ABLA fission-evaporation model, CEM2k or combinations using RAL model are giving too broad mass distributions when compared to available data.

In this work an extensive list of the radio-nuclides was obtained and is available on the request in tabular format. It represents a good starting point for further studies on the handling of EURISOL mercury target, radioprotection and safety related issues including storage of the irradiated mercury.

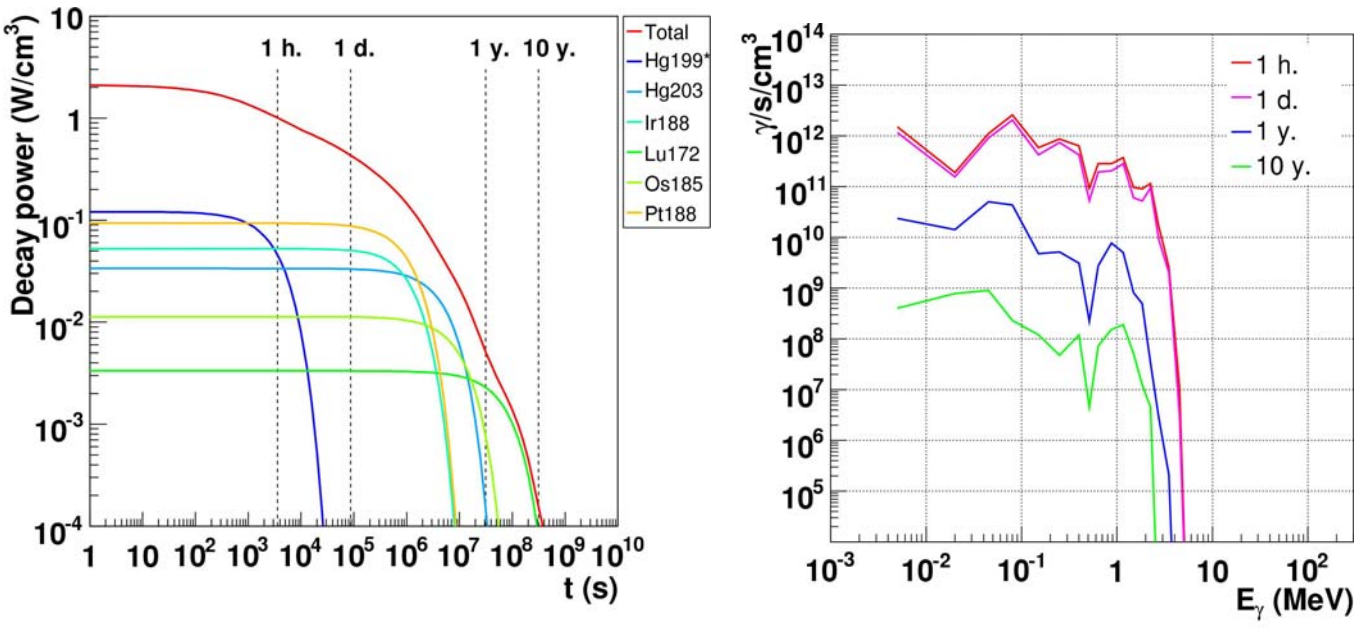

Figure 8: on the left - decay heat of the mercury target as a function of cooling time; on the right - energy spectra of decay gammas emitted by the mercury target for 4 cooling times. The irradiation time was 5000 h at 4 MW primary beam power in both cases.

References

[1] MCNPX - Monte Carlo N-Particle Transport Code System for Multiparticle and High Energy Applications; http://mcnpx.lanl.gov/ (August 2006).

[2] W.B. Wilson and T.R. England, "A Manual for CINDER'90 Version C00D and Associated Codes and Data", LA-UR-00-Draft, April 2001.

[3] For more information the reader is asked to check the information available the EURISOL Design Study web page at http://www.eurisol.org (August 2006).

[4] EXFOR: Experimental Nuclear Reaction Data (EXFOR / CSISRS), http://www.nndc.bnl.gov/exfor3/exfor00.htm

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Appendix 1

Summary of the nuclide inventory of irradiated mercury target

The following tables contain the main contributors (> 1%) to the total activity of mercury target, for 40 years irradiation and at different cooling times. Calculations were done with the ISABEL-ABLA model within MCNPX coupled to CINDER'90. Long lived excited states are denoted by a "*" after element symbol.

1 day after shutdown

Nuclide	$t_{1/2}$(s)	Activity(GBq/cm^3)	Activity(GBq/g)	Activity (%)
91Y	5,06E+06	1,02E+03	7,54E+01	15%
90Y	2,31E+05	8,93E+02	6,59E+01	13%
197Hg	2,31E+05	3,85E+02	2,84E+01	6%
89Sr	4,37E+06	3,32E+02	2,45E+01	5%
203Hg	4,03E+06	3,27E+02	2,42E+01	5%
47Sc	2,89E+05	2,81E+02	2,07E+01	4%
198Au	2,33E+05	2,11E+02	1,56E+01	3%
3H	3,89E+08	1,97E+02	1,46E+01	3%
90Sr	8,88E+08	1,75E+02	1,29E+01	3%
199Au	2,71E+05	1,69E+02	1,25E+01	2%
89Zr	2,82E+05	1,53E+02	1,13E+01	2%
89Y*	1,61E+01	1,53E+02	1,13E+01	2%
185Os	8,09E+06	1,12E+02	8,27E+00	2%
195Au	1,61E+07	1,07E+02	7,92E+00	2%
93Nb*	5,09E+08	1,02E+02	7,55E+00	1%
191Pt	2,51E+05	9,86E+01	7,27E+00	1%
197Hg*	8,57E+04	9,64E+01	7,12E+00	1%
192Ir	6,38E+06	9,60E+01	7,09E+00	1%
189Ir	1,14E+06	9,54E+01	7,04E+00	1%
188Ir	1,49E+05	8,42E+01	6,21E+00	1%
181W	1,05E+07	8,02E+01	5,92E+00	1%
188Pt	8,80E+05	7,44E+01	5,49E+00	1%

1 year after shutdown

Nuclide	$t_{1/2}$(s)	Activity(GBq/cm^3)	Activity(GBq/g)	Activity (%)
3H	3,89E+08	1,86E+02	1,38E+01	19%
90Y	2,31E+05	1,71E+02	1,26E+01	17%
90Sr	8,88E+08	1,71E+02	1,26E+01	17%
93Nb*	5,09E+08	1,00E+02	7,40E+00	10%
193Pt	1,58E+09	6,32E+01	4,67E+00	6%
93Mo	1,10E+11	6,09E+01	4,49E+00	6%
179Ta	5,74E+07	3,02E+01	2,23E+00	3%
195Au	1,61E+07	2,71E+01	2,00E+00	3%
204Tl	1,19E+08	2,01E+01	1,48E+00	2%
172Lu	5,79E+05	1,83E+01	1,35E+00	2%

172Hf	5,90E+07	1,81E+01	1,34E+00	2%
173Lu	4,32E+07	1,79E+01	1,32E+00	2%
91Y	5,06E+06	1,29E+01	9,51E-01	1%
45Ca	1,42E+07	1,21E+01	8,92E-01	1%

10 years after shutdown

Nuclide	**$t_{1/2}$(s)**	**Activity(GBq/cm^3)**	**Activity(GBq/g)**	**Activity (%)**
90Y	2,31E+05	1,37E+02	1,01E+01	22%
90Sr	8,88E+08	1,36E+02	1,01E+01	22%
3H	3,89E+08	1,12E+02	8,23E+00	18%
93Nb*	5,09E+08	8,57E+01	6,33E+00	14%
93Mo	1,10E+11	6,08E+01	4,49E+00	10%
193Pt	1,58E+09	5,57E+01	4,11E+00	9%

100 years after shutdown

Nuclide	**$t_{1/2}$(s)**	**Activity(GBq/cm^3)**	**Activity(GBq/g)**	**Activity (%)**
93Mo	1,10E+11	5,97E+01	4,41E+00	34%
93Nb*	5,09E+08	5,54E+01	4,09E+00	32%
193Pt	1,58E+09	1,57E+01	1,16E+00	9%
90Y	2,31E+05	1,44E+01	1,06E+00	8%
90Sr	8,88E+08	1,44E+01	1,06E+00	8%
93Zr	4,83E+13	5,60E+00	4,13E-01	3%
194Au	1,42E+05	2,65E+00	1,96E-01	2%
194Hg	1,64E+10	2,65E+00	1,96E-01	2%

Appendix 2

Nuclide inventory of mercury target

The following table contains the calculated inventory (with MCNPX coupled to CINDER'90) in mercury target for 40 years irradiation and immediately after shutdown. The model used for these calculations was ISABEL-ABLA, except for tritium production for which CEM2k has been used (see discussion in section 2.1). Only nuclides with activity larger than 1 MBq/g are given. Long lived excited states are denoted by a "*" (first excited state) or by a "#" (second excited state) after element symbol.

Nuclide	**$t_{1/2}$(s)**	**Activity(GBq/cm^3)**	**Activity(GBq/g)**
Total		3,61E+04	2,66E+03
3H	3,89E+08	2,48E+03	1.83E+02
28Al	1,34E+02	2,17E-02	1,60E-03
29Al	3,94E+02	2,03E-02	1,50E-03
31Si	9,44E+03	2,13E-02	1,57E-03
32P	1,23E+06	1,69E-01	1,25E-02
33P	2,19E+06	1,34E-01	9,90E-03
34P	1,24E+01	2,99E-02	2,21E-03
35S	7,56E+06	5,87E-01	4,33E-02
37S	2,99E+02	3,67E-02	2,71E-03
38Cl	2,23E+03	2,02E-01	1,49E-02
38Cl*	7,70E-01	6,10E-02	4,50E-03
39Cl	3,34E+03	6,52E-02	4,81E-03
40Cl	8,10E+01	3,53E-02	2,60E-03
37Ar	3,03E+06	6,99E-01	5,16E-02
39Ar	8,49E+09	3,55E-01	2,62E-02
41Ar	6,58E+03	3,64E-01	2,69E-02
42Ar	1,04E+09	1,37E-02	1,01E-03
43Ar	3,22E+02	2,00E-02	1,48E-03
42K	4,45E+04	5,92E-01	4,37E-02
43K	7,99E+04	7,61E-01	5,62E-02
44K	1,33E+03	3,49E-01	2,57E-02
45K	1,04E+03	4,15E-02	3,06E-03
46K	9,50E+01	2,15E-02	1,59E-03
45Ca	1,42E+07	5,80E+01	4,28E+00
47Ca	3,92E+05	2,26E+00	1,67E-01
49Ca	5,23E+02	1,39E-02	1,03E-03
43Sc	1,40E+04	1,54E-02	1,14E-03
44Sc	1,41E+04	3,15E-01	2,32E-02
44Sc*	2,11E+05	1,74E-02	1,28E-03
45Sc*	3,16E-01	2,16E-01	1,59E-02
46Sc	7,24E+06	2,90E+01	2,14E+00
46Sc*	1,87E+01	1,13E+01	8,33E-01
47Sc	2,89E+05	3,57E+02	2,63E+01
48Sc	1,57E+05	8,52E+01	6,29E+00
49Sc	3,43E+03	2,71E-01	2,00E-02

50Sc	1,02E+02	3,50E-02	2,58E-03
45Ti	1,11E+04	3,52E-01	2,60E-02
51Ti	3,46E+02	1,12E-01	8,29E-03
52Ti	1,02E+02	7,59E-02	5,60E-03
53Ti	3,27E+01	1,63E-02	1,20E-03
48V	1,38E+06	4,49E-02	3,31E-03
49V	2,92E+07	1,09E-01	8,08E-03
52V	2,25E+02	2,69E-01	1,99E-02
53V	9,66E+01	1,60E-01	1,18E-02
54V	4,98E+01	9,38E-02	6,92E-03
55V	6,54E+00	5,38E-02	3,97E-03
51Cr	2,39E+06	1,23E-01	9,10E-03
55Cr	2,13E+02	2,37E-01	1,75E-02
56Cr	3,56E+02	1,57E-01	1,16E-02
57Cr	2,11E+01	7,07E-02	5,22E-03
58Cr	7,00E+00	3,31E-02	2,44E-03
52Mn	4,83E+05	3,86E-02	2,85E-03
54Mn	2,70E+07	2,15E-01	1,58E-02
56Mn	9,28E+03	4,80E-01	3,55E-02
57Mn	9,66E+01	3,49E-01	2,58E-02
58Mn	6,53E+01	2,09E-01	1,54E-02
59Mn	4,60E+00	1,37E-01	1,01E-02
60Mn	1,79E+00	5,25E-02	3,88E-03
55Fe	8,62E+07	1,06E-01	7,80E-03
59Fe	3,84E+06	5,24E-01	3,87E-02
61Fe	3,59E+02	1,80E-01	1,33E-02
62Fe	6,80E+01	1,28E-01	9,47E-03
63Fe	6,10E+00	3,71E-02	2,74E-03
56Co	6,80E+06	2,49E-02	1,84E-03
57Co	2,35E+07	9,03E-02	6,67E-03
58Co	6,13E+06	1,74E-01	1,29E-02
60Co	1,66E+08	5,51E-01	4,07E-02
60Co*	6,28E+02	1,18E-01	8,69E-03
61Co	5,94E+03	6,62E-01	4,89E-02
62Co	9,00E+01	5,00E-01	3,69E-02
63Co	2,74E+01	3,20E-01	2,36E-02
64Co	3,00E-01	2,49E-02	1,84E-03
65Co	1,25E+00	4,58E-02	3,38E-03
63Ni	3,16E+09	5,45E-01	4,02E-02
65Ni	9,07E+03	5,10E-01	3,76E-02
66Ni	1,97E+05	2,44E-01	1,80E-02
67Ni	1,80E+01	1,63E-01	1,21E-02
68Ni	7,60E+00	6,68E-02	4,93E-03
69Ni	1,14E+01	2,04E-02	1,50E-03
60Cu	1,46E+03	1,49E-02	1,10E-03
61Cu	1,23E+04	6,88E-02	5,08E-03
62Cu	5,84E+02	2,66E-01	1,96E-02
64Cu	4,57E+04	8,66E-01	6,39E-02
66Cu	3,06E+02	8,96E-01	6,62E-02

67Cu	2,23E+05	7,26E-01	5,36E-02
68Cu	3,11E+01	3,89E-01	2,87E-02
68Cu*	2,25E+02	2,71E-02	2,00E-03
69Cu	1,80E+02	2,12E-01	1,56E-02
70Cu	4,50E+00	1,06E-01	7,83E-03
71Cu	1,95E+01	5,46E-02	4,03E-03
72Cu	6,49E+00	1,81E-02	1,33E-03
63Zn	2,29E+03	6,24E-02	4,61E-03
65Zn	2,11E+07	4,56E-01	3,36E-02
69Zn	3,42E+03	1,60E+00	1,18E-01
69Zn*	4,95E+04	1,64E-01	1,21E-02
71Zn	1,47E+02	3,56E-01	2,63E-02
72Zn	1,67E+05	2,04E-01	1,51E-02
73Zn	2,35E+01	8,41E-02	6,20E-03
74Zn	9,60E+01	3,30E-02	2,43E-03
65Ga	9,12E+02	3,98E-02	2,94E-03
66Ga	3,42E+04	1,44E-01	1,07E-02
67Ga	2,82E+05	3,48E-01	2,57E-02
68Ga	4,06E+03	6,56E-01	4,84E-02
70Ga	1,27E+03	1,03E+00	7,58E-02
72Ga	5,08E+04	1,08E+00	7,94E-02
73Ga	1,75E+04	5,14E-01	3,80E-02
74Ga	4,87E+02	3,08E-01	2,27E-02
74Ga*	9,50E+00	2,69E-02	1,98E-03
75Ga	1,26E+02	1,44E-01	1,06E-02
76Ga	3,26E+01	4,23E-02	3,12E-03
77Ga	1,32E+01	1,58E-02	1,16E-03
67Ge	1,12E+03	2,99E-02	2,21E-03
68Ge	2,34E+07	1,08E-01	7,94E-03
69Ge	1,41E+05	3,64E-01	2,69E-02
71Ge	9,88E+05	1,12E+00	8,27E-02
73Ge*	4,99E-01	6,38E-01	4,71E-02
75Ge	4,97E+03	1,04E+00	7,66E-02
75Ge*	4,77E+01	4,47E-01	3,30E-02
77Ge	4,07E+04	1,70E-01	1,25E-02
77Ge*	5,29E+01	1,76E-02	1,30E-03
78Ge	5,28E+03	9,63E-02	7,11E-03
79Ge	1,91E+01	2,40E-02	1,77E-03
69As	9,14E+02	1,99E-02	1,47E-03
70As	3,16E+03	1,03E-01	7,60E-03
71As	2,35E+05	2,56E-01	1,89E-02
72As	9,36E+04	5,22E-01	3,85E-02
73As	6,94E+06	9,61E-01	7,09E-02
74As	1,54E+06	1,03E+00	7,59E-02
76As	9,48E+04	1,79E+00	1,32E-01
77As	1,40E+05	9,54E-01	7,04E-02
78As	5,44E+03	6,13E-01	4,53E-02
79As	5,41E+02	3,09E-01	2,28E-02
80As	1,52E+01	1,52E-01	1,12E-02

81As	3,33E+01	7,81E-02	5,77E-03
82As	1,91E+01	1,45E-02	1,07E-03
71Se	2,84E+02	1,49E-02	1,10E-03
72Se	7,26E+05	6,33E-02	4,67E-03
73Se	2,57E+04	2,31E-01	1,71E-02
75Se	1,03E+07	1,52E+00	1,12E-01
77Se*	1,75E+01	8,14E-01	6,01E-02
79Se*	2,35E+02	5,47E-01	4,04E-02
81Se	1,11E+03	5,71E-01	4,21E-02
81Se*	3,44E+03	2,81E-02	2,07E-03
83Se	1,34E+03	1,13E-01	8,33E-03
84Se	1,92E+02	3,71E-02	2,74E-03
85Se	3,17E+01	1,56E-02	1,15E-03
74Br	1,52E+03	5,48E-02	4,04E-03
75Br	5,82E+03	1,76E-01	1,30E-02
76Br	5,83E+04	4,14E-01	3,05E-02
77Br	2,05E+05	8,23E-01	6,07E-02
78Br	3,88E+02	1,05E+00	7,77E-02
79Br*	4,86E+00	2,31E-01	1,70E-02
80Br	1,06E+03	1,90E+00	1,40E-01
80Br*	1,59E+04	1,92E-01	1,42E-02
82Br	1,27E+05	1,27E+00	9,34E-02
82Br*	3,68E+02	3,70E-01	2,73E-02
83Br	8,64E+03	6,99E-01	5,16E-02
84Br	1,91E+03	3,71E-01	2,74E-02
85Br	1,72E+02	1,81E-01	1,34E-02
86Br	5,51E+01	7,06E-02	5,21E-03
87Br	5,57E+01	1,48E-02	1,09E-03
76Kr	5,33E+04	3,00E-02	2,21E-03
77Kr	4,46E+03	1,22E-01	8,98E-03
79Kr	1,26E+05	8,22E-01	6,07E-02
79Kr*	5,00E+01	3,02E-02	2,23E-03
81Kr*	1,30E+01	4,43E-01	3,27E-02
83Kr*	6,59E+03	3,46E+00	2,56E-01
85Kr	3,38E+08	7,68E-01	5,67E-02
85Kr*	1,61E+04	2,95E-01	2,18E-02
87Kr	4,58E+03	2,31E-01	1,70E-02
88Kr	1,02E+04	1,13E-01	8,32E-03
89Kr	1,90E+02	3,81E-02	2,81E-03
78Rb	1,06E+03	2,82E-02	2,08E-03
79Rb	1,37E+03	1,01E-01	7,47E-03
80Rb	3,40E+01	2,93E-01	2,16E-02
81Rb	1,65E+04	6,06E-01	4,47E-02
82Rb	7,64E+01	1,13E+00	8,36E-02
83Rb	7,45E+06	1,73E+00	1,28E-01
84Rb	2,84E+06	1,54E+00	1,14E-01
84Rb*	1,23E+03	9,66E-02	7,13E-03
86Rb	1,61E+06	2,66E+00	1,96E-01
86Rb*	6,10E+01	6,85E-01	5,06E-02

88Rb	1,07E+03	1,29E+00	9,52E-02
89Rb	9,12E+02	3,45E-01	2,55E-02
90Rb	1,53E+02	1,56E-01	1,15E-02
91Rb	5,84E+01	6,25E-02	4,61E-03
92Rb	4,50E+00	2,14E-02	1,58E-03
80Sr	6,38E+03	1,49E-02	1,10E-03
81Sr	1,34E+03	7,30E-02	5,39E-03
82Sr	2,21E+06	2,01E-01	1,48E-02
83Sr	1,17E+05	5,45E-01	4,02E-02
85Sr	5,60E+06	2,52E+00	1,86E-01
85Sr*	4,06E+03	3,14E-01	2,32E-02
87Sr*	1,01E+04	2,34E+01	1,73E+00
89Sr	4,37E+06	3,38E+02	2,49E+01
90Sr	8,88E+08	1,75E+02	1,29E+01
91Sr	3,43E+04	7,27E-01	5,37E-02
92Sr	9,76E+03	3,17E+00	2,34E-01
93Sr	4,45E+02	9,13E-02	6,74E-03
94Sr	7,52E+01	4,44E-02	3,28E-03
95Sr	2,51E+01	1,45E-02	1,07E-03
83Y	4,25E+02	5,31E-02	3,92E-03
84Y	4,60E+00	1,24E-01	9,12E-03
85Y	9,65E+03	4,08E-01	3,01E-02
86Y	5,31E+04	7,90E-01	5,83E-02
87Y	2,89E+05	1,47E+00	1,09E-01
88Y	9,21E+06	7,37E+00	5,44E-01
89Y*	1,61E+01	8,58E+01	6,33E+00
90Y	2,31E+05	1,13E+03	8,35E+01
90Y*	1,15E+04	2,57E+02	1,89E+01
91Y	5,06E+06	1,04E+03	7,64E+01
91Y*	2,98E+03	9,33E+02	6,88E+01
92Y	1,27E+04	8,68E+02	6,41E+01
93Y	3,64E+04	1,18E+02	8,68E+00
93Y*	8,20E-01	2,24E+01	1,65E+00
94Y	1,12E+03	3,52E-01	2,60E-02
95Y	6,30E+02	1,44E-01	1,07E-02
96Y	5,90E+00	3,87E-02	2,85E-03
85Zr	4,72E+02	3,32E-02	2,45E-03
86Zr	5,94E+04	9,13E-02	6,74E-03
87Zr	6,24E+03	3,24E-01	2,39E-02
88Zr	7,21E+06	3,69E+00	2,73E-01
89Zr	2,82E+05	1,96E+02	1,45E+01
89Zr*	2,51E+02	3,91E+01	2,89E+00
90Zr*	8,09E-01	1,50E+04	1,11E+03
93Zr	4,83E+13	5,60E+00	4,13E-01
95Zr	5,53E+06	1,05E+00	7,76E-02
97Zr	6,08E+04	1,90E-01	1,40E-02
98Zr	3,07E+01	7,63E-02	5,63E-03
99Zr	2,10E+00	1,91E-02	1,41E-03
87Nb	1,56E+02	1,49E-02	1,10E-03

88Nb	8,70E+02	7,47E-02	5,51E-03
89Nb	7,32E+03	2,33E-01	1,72E-02
90Nb	5,26E+04	6,85E-01	5,06E-02
90Nb*	1,88E+01	1,37E-01	1,01E-02
91Nb	2,15E+10	5,83E-01	4,30E-02
91Nb*	5,36E+06	6,96E-01	5,14E-02
92Nb*	8,77E+05	1,80E+01	1,33E+00
93Nb*	5,09E+08	1,02E+02	7,55E+00
94Nb	6,41E+11	3,71E-02	2,74E-03
94Nb*	3,76E+02	1,60E+01	1,18E+00
95Nb	3,02E+06	7,47E+00	5,51E-01
95Nb*	3,12E+05	5,43E-01	4,01E-02
96Nb	8,41E+04	2,70E+00	2,00E-01
97Nb	4,33E+03	1,49E+00	1,10E-01
97Nb*	6,00E+01	3,44E-01	2,54E-02
98Nb	2,86E+00	4,26E-01	3,15E-02
99Nb	1,50E+01	2,45E-01	1,81E-02
100Nb	1,50E+00	5,99E-02	4,42E-03
101Nb	7,10E+00	2,87E-02	2,12E-03
90Mo	2,04E+04	4,17E-02	3,08E-03
91Mo	9,29E+02	9,01E+00	6,65E-01
93Mo	1,10E+11	6,09E+01	4,49E+00
93Mo*	2,50E+04	2,48E+01	1,83E+00
99Mo	2,37E+05	3,11E+00	2,30E-01
101Mo	8,76E+02	3,83E-01	2,82E-02
102Mo	6,78E+02	1,53E-01	1,13E-02
103Mo	6,75E+01	8,06E-02	5,95E-03
104Mo	6,00E+01	2,46E-02	1,82E-03
92Tc	2,64E+02	2,98E-02	2,20E-03
93Tc	9,90E+03	9,47E-02	6,99E-03
94Tc	1,76E+04	2,43E-01	1,79E-02
95Tc	7,20E+04	6,06E-01	4,47E-02
96Tc	3,70E+05	8,36E-01	6,17E-02
96Tc*	3,09E+03	3,42E-02	2,52E-03
97Tc*	7,82E+06	1,14E-01	8,42E-03
99Tc*	2,16E+04	2,44E+00	1,80E-01
100Tc	1,58E+01	7,65E+00	5,65E-01
101Tc	8,52E+02	1,13E+00	8,32E-02
102Tc	5,28E+00	6,65E-01	4,91E-02
103Tc	5,42E+01	3,93E-01	2,90E-02
104Tc	1,10E+03	1,53E-01	1,13E-02
105Tc	4,56E+02	9,29E-02	6,85E-03
106Tc	3,60E+01	4,08E-02	3,01E-03
94Ru	3,11E+03	1,84E-02	1,36E-03
95Ru	5,90E+03	9,76E-02	7,20E-03
97Ru	2,51E+05	4,66E-01	3,44E-02
103Ru	3,39E+06	1,54E+00	1,14E-01
105Ru	1,60E+04	5,19E-01	3,83E-02
106Ru	3,21E+07	2,53E-01	1,87E-02

107Ru	2,25E+02	1,11E-01	8,21E-03
108Ru	2,73E+02	4,31E-02	3,18E-03
96Rh	5,94E+02	1,66E-02	1,22E-03
97Rh	1,87E+03	3,15E-02	2,33E-03
98Rh	5,22E+02	1,36E-01	1,00E-02
99Rh	1,39E+06	3,12E-01	2,30E-02
100Rh	7,49E+04	5,27E-01	3,89E-02
101Rh	1,04E+08	8,03E-01	5,93E-02
101Rh*	3,75E+05	2,80E-02	2,07E-03
102Rh	9,15E+07	8,59E-01	6,34E-02
102Rh*	1,79E+07	6,35E-02	4,69E-03
103Rh*	3,37E+03	2,93E+00	2,16E-01
104Rh	4,23E+01	1,96E+00	1,45E-01
104Rh*	2,60E+02	8,84E-02	6,52E-03
105Rh	1,27E+05	1,28E+00	9,47E-02
105Rh*	4,50E+01	1,49E-01	1,10E-02
106Rh	2,98E+01	8,51E-01	6,28E-02
107Rh	1,30E+03	4,98E-01	3,67E-02
108Rh	1,68E+01	2,54E-01	1,87E-02
109Rh	8,00E+01	1,20E-01	8,88E-03
110Rh	3,16E+00	2,94E-02	2,17E-03
111Rh	1,10E+01	2,51E-02	1,85E-03
99Pd	1,28E+03	2,82E-02	2,08E-03
100Pd	3,14E+05	9,68E-02	7,15E-03
101Pd	3,05E+04	2,01E-01	1,49E-02
103Pd	1,47E+06	7,39E-01	5,45E-02
107Pd*	2,13E+01	2,15E-01	1,59E-02
109Pd	4,93E+04	1,06E+00	7,83E-02
109Pd*	2,81E+02	1,62E-02	1,20E-03
111Pd	1,40E+03	1,69E-01	1,25E-02
112Pd	7,58E+04	7,64E-02	5,64E-03
113Pd	9,30E+01	2,80E-02	2,07E-03
102Ag	7,74E+02	3,48E-02	2,57E-03
103Ag	3,94E+03	1,31E-01	9,68E-03
104Ag	4,15E+03	2,59E-01	1,91E-02
105Ag	3,57E+06	4,16E-01	3,07E-02
106Ag	1,44E+03	5,26E-01	3,88E-02
107Ag*	4,43E+01	5,56E-01	4,10E-02
108Ag	1,42E+02	1,02E+00	7,54E-02
109Ag*	3,96E+01	2,02E+00	1,49E-01
110Ag	2,46E+01	2,20E+00	1,62E-01
110Ag*	2,16E+07	1,01E-01	7,42E-03
111Ag	6,44E+05	5,73E-01	4,23E-02
111Ag*	6,48E+01	1,71E-01	1,26E-02
112Ag	1,13E+04	3,11E-01	2,30E-02
113Ag	1,93E+04	1,59E-01	1,17E-02
114Ag	4,60E+00	7,61E-02	5,62E-03
115Ag	1,20E+03	3,94E-02	2,91E-03
104Cd	3,46E+03	4,34E-02	3,20E-03

105Cd	3,33E+03	6,35E-02	4,68E-03
107Cd	2,34E+04	3,73E-01	2,75E-02
109Cd	4,00E+07	9,28E-01	6,85E-02
111Cd*	2,92E+03	5,70E-01	4,21E-02
113Cd*	4,45E+08	9,77E-02	7,21E-03
115Cd	1,92E+05	6,05E-01	4,46E-02
115Cd*	3,85E+06	6,54E-02	4,83E-03
117Cd	8,96E+03	4,30E-02	3,17E-03
118Cd	3,02E+03	2,53E-02	1,87E-03
106In	3,72E+02	2,15E-02	1,59E-03
107In	1,94E+03	4,98E-02	3,68E-03
108In	3,48E+03	1,26E-01	9,31E-03
109In	1,51E+04	2,51E-01	1,85E-02
110In	1,76E+04	3,93E-01	2,90E-02
111In	2,45E+05	5,96E-01	4,40E-02
112In	8,64E+02	4,47E-01	3,30E-02
112In*	1,23E+03	1,79E-02	1,32E-03
113In*	5,97E+03	5,46E-01	4,03E-02
114In	7,19E+01	7,60E-01	5,61E-02
114In*	4,28E+06	3,11E-01	2,30E-02
115In*	1,62E+04	3,14E-01	2,31E-02
116In	1,41E+01	2,80E-01	2,07E-02
116In*	3,25E+03	2,53E-01	1,86E-02
116In#	2,18E+00	1,03E-01	7,57E-03
117In	2,63E+03	2,19E-01	1,61E-02
117In*	6,99E+03	5,05E-02	3,72E-03
118In	5,00E+00	1,32E-01	9,76E-03
118In*	2,67E+02	1,63E-02	1,20E-03
119In	1,44E+02	5,67E-02	4,18E-03
120In	3,08E+00	2,99E-02	2,20E-03
109Sn	1,08E+03	3,49E-02	2,57E-03
110Sn	1,48E+04	8,89E-02	6,56E-03
111Sn	2,12E+03	1,70E-01	1,25E-02
113Sn	9,94E+06	4,88E-01	3,60E-02
113Sn*	1,28E+03	7,94E-02	5,86E-03
117Sn*	1,18E+06	4,04E+00	2,98E-01
119Sn*	2,53E+07	9,40E+00	6,94E-01
121Sn	9,74E+04	6,41E-02	4,73E-03
123Sn	1,12E+07	1,50E-02	1,11E-03
111Sb	7,50E+01	1,81E-02	1,34E-03
112Sb	5,14E+01	5,74E-02	4,24E-03
113Sb	4,00E+02	1,08E-01	7,95E-03
114Sb	2,09E+02	1,94E-01	1,43E-02
115Sb	1,93E+03	3,12E-01	2,30E-02
116Sb	9,50E+02	4,05E-01	2,99E-02
117Sb	1,01E+04	5,48E-01	4,04E-02
118Sb	2,16E+02	5,51E-01	4,07E-02
119Sb	1,37E+05	5,77E-01	4,26E-02
120Sb	9,53E+02	2,05E-01	1,51E-02

122Sb	2,33E+05	3,37E-01	2,49E-02
124Sb	5,20E+06	3,11E-02	2,30E-03
114Te	9,10E+02	2,82E-02	2,08E-03
115Te	3,48E+02	7,62E-02	5,63E-03
116Te	8,96E+03	1,53E-01	1,13E-02
117Te	3,72E+03	2,24E-01	1,65E-02
118Te	5,18E+05	2,63E-01	1,94E-02
119Te	5,78E+04	3,41E-01	2,52E-02
121Te	1,45E+06	5,46E-01	4,03E-02
121Te*	1,33E+07	4,94E-02	3,64E-03
123Te*	1,03E+07	1,25E-01	9,26E-03
125Te*	5,01E+06	3,96E-01	2,92E-02
127Te	3,37E+04	3,99E-02	2,94E-03
116I	2,91E+00	2,75E-02	2,03E-03
117I	1,38E+02	4,63E-02	3,41E-03
118I	8,20E+02	8,13E-02	6,00E-03
119I	1,15E+03	1,29E-01	9,56E-03
120I	4,86E+03	1,89E-01	1,40E-02
121I	7,63E+03	2,67E-01	1,97E-02
122I	2,18E+02	2,93E-01	2,17E-02
123I	4,75E+04	3,61E-01	2,67E-02
124I	3,61E+05	1,11E-01	8,22E-03
125I	5,20E+06	5,50E-01	4,06E-02
126I	1,12E+06	9,32E-02	6,88E-03
128I	1,50E+03	1,84E-01	1,36E-02
119Xe	3,48E+02	2,82E-02	2,08E-03
120Xe	2,40E+03	3,65E-02	2,70E-03
121Xe	2,41E+03	8,47E-02	6,25E-03
122Xe	7,24E+04	1,20E-01	8,82E-03
123Xe	7,49E+03	1,84E-01	1,35E-02
125Xe	6,08E+04	4,66E-01	3,44E-02
125Xe*	5,70E+01	3,79E-02	2,80E-03
127Xe	3,15E+06	3,79E-01	2,79E-02
129Xe*	7,68E+05	5,14E-02	3,80E-03
131Xe*	1,03E+06	2,09E-02	1,54E-03
121Cs	1,26E+02	1,98E-02	1,46E-03
122Cs	2,10E+01	2,42E-02	1,79E-03
123Cs	3,52E+02	5,64E-02	4,16E-03
124Cs	3,08E+01	6,54E-02	4,82E-03
125Cs	2,70E+03	1,03E-01	7,60E-03
126Cs	9,84E+01	1,69E-01	1,24E-02
127Cs	2,25E+04	2,19E-01	1,62E-02
128Cs	2,17E+02	2,06E-01	1,52E-02
129Cs	1,15E+05	1,85E-01	1,36E-02
130Cs	1,79E+03	4,99E-02	3,68E-03
131Cs	8,37E+05	2,13E-01	1,57E-02
132Cs	5,59E+05	3,61E-02	2,67E-03
134Cs	6,51E+07	7,90E-02	5,83E-03
124Ba	7,10E+02	1,83E-02	1,35E-03

125Ba	2,10E+02	3,64E-02	2,69E-03
126Ba	6,00E+03	5,31E-02	3,92E-03
127Ba	7,62E+02	1,05E-01	7,72E-03
128Ba	2,10E+05	1,10E-01	8,12E-03
129Ba	8,00E+03	1,21E-01	8,94E-03
131Ba	1,02E+06	1,87E-01	1,38E-02
133Ba	3,32E+08	1,55E-01	1,14E-02
133Ba*	1,40E+05	1,75E-02	1,29E-03
135Ba*	1,03E+05	1,75E-01	1,29E-02
136Ba*	3,08E-01	5,16E-02	3,81E-03
137Ba*	1,53E+02	1,76E-01	1,30E-02
127La	2,30E+02	2,98E-02	2,20E-03
128La	3,00E+02	4,31E-02	3,18E-03
129La	6,96E+02	4,65E-02	3,43E-03
130La	5,22E+02	6,14E-02	4,53E-03
131La	3,54E+03	7,14E-02	5,27E-03
132La	1,73E+04	9,96E-02	7,35E-03
133La	1,41E+04	1,25E-01	9,19E-03
134La	3,87E+02	1,16E-01	8,59E-03
135La	7,02E+04	1,19E-01	8,75E-03
129Ce	2,10E+02	1,82E-02	1,34E-03
130Ce	1,50E+03	1,83E-02	1,35E-03
131Ce	6,00E+02	2,82E-02	2,08E-03
132Ce	1,26E+04	5,15E-02	3,80E-03
133Ce	1,76E+04	7,64E-02	5,64E-03
134Ce	2,73E+05	8,65E-02	6,39E-03
135Ce	6,37E+04	9,64E-02	7,11E-03
137Ce	3,24E+04	1,03E-01	7,59E-03
139Ce	1,19E+07	1,03E-01	7,61E-03
132Pr	1,08E+02	1,49E-02	1,10E-03
133Pr	3,90E+02	2,32E-02	1,71E-03
134Pr	1,02E+03	3,98E-02	2,94E-03
135Pr	1,44E+03	4,32E-02	3,19E-03
136Pr	7,86E+02	3,49E-02	2,57E-03
137Pr	4,61E+03	6,64E-02	4,90E-03
138Pr	8,70E+01	7,79E-02	5,75E-03
139Pr	1,59E+04	8,82E-02	6,51E-03
140Pr	2,03E+02	8,35E-02	6,16E-03
142Pr	6,88E+04	1,36E-02	1,01E-03
134Nd	5,10E+02	1,49E-02	1,10E-03
136Nd	3,04E+03	2,32E-02	1,72E-03
137Nd	2,31E+03	4,15E-02	3,06E-03
138Nd	1,81E+04	5,65E-02	4,17E-03
139Nd	1,78E+03	7,64E-02	5,64E-03
140Nd	2,91E+05	5,75E-02	4,24E-03
141Nd	8,96E+03	9,20E-02	6,79E-03
147Nd	9,49E+05	1,96E-02	1,45E-03
138Pm	1,00E+01	1,78E-02	1,32E-03
139Pm	2,49E+02	4,97E-02	3,67E-03

140Pm	9,20E+00	4,49E-02	3,32E-03
141Pm	1,25E+03	7,64E-02	5,64E-03
142Pm	4,05E+01	1,10E-01	8,14E-03
143Pm	2,29E+07	1,57E-01	1,16E-02
144Pm	3,14E+07	1,62E-02	1,20E-03
145Pm	5,59E+08	2,21E-01	1,63E-02
146Pm	1,75E+08	9,20E-02	6,79E-03
147Pm	8,28E+07	2,10E-02	1,55E-03
139Sm	1,54E+02	1,66E-02	1,22E-03
140Sm	8,89E+02	2,49E-02	1,84E-03
141Sm	6,12E+02	4,15E-02	3,06E-03
142Sm	4,35E+03	9,02E-02	6,66E-03
143Sm	5,30E+02	1,38E-01	1,02E-02
145Sm	2,94E+07	4,08E-01	3,01E-02
151Sm	2,84E+09	1,85E-02	1,37E-03
153Sm	1,67E+05	3,26E-01	2,41E-02
141Eu	4,00E+01	2,13E-02	1,57E-03
142Eu	2,40E+00	4,15E-02	3,06E-03
143Eu	1,58E+02	8,94E-02	6,60E-03
144Eu	1,02E+01	1,16E-01	8,53E-03
145Eu	5,12E+05	3,30E-01	2,43E-02
146Eu	3,97E+05	6,02E-01	4,44E-02
147Eu	2,07E+06	6,08E-01	4,49E-02
148Eu	4,71E+06	2,74E-02	2,03E-03
149Eu	8,04E+06	9,62E-01	7,10E-02
152Eu	4,21E+08	2,93E-01	2,16E-02
152Eu*	3,36E+04	4,39E-01	3,24E-02
154Eu	2,71E+08	1,06E+00	7,79E-02
154Eu*	2,76E+03	2,80E-01	2,07E-02
155Eu	1,48E+08	3,86E-01	2,85E-02
156Eu	1,31E+06	1,48E-01	1,09E-02
143Gd	3,90E+01	3,10E-02	2,29E-03
144Gd	2,70E+02	5,80E-02	4,28E-03
145Gd	1,38E+03	1,33E-01	9,81E-03
146Gd	4,17E+06	5,18E-01	3,82E-02
147Gd	1,37E+05	5,73E-01	4,23E-02
148Gd	2,35E+09	2,14E-01	1,58E-02
149Gd	8,10E+05	9,67E-01	7,14E-02
151Gd	1,07E+07	1,24E+00	9,12E-02
153Gd	2,09E+07	2,28E+00	1,68E-01
159Gd	6,68E+04	6,98E-02	5,15E-03
145Tb	2,95E+01	4,54E-02	3,35E-03
146Tb	8,00E+00	1,10E-01	8,15E-03
147Tb	5,90E+03	3,62E-01	2,67E-02
148Tb	3,60E+03	6,63E-01	4,90E-02
149Tb	1,49E+04	9,01E-01	6,65E-02
150Tb	1,25E+04	6,90E-01	5,09E-02
151Tb	6,34E+04	1,00E+00	7,40E-02
152Tb	6,30E+04	1,11E+00	8,18E-02

153Tb	2,02E+05	1,43E+00	1,06E-01
154Tb	7,74E+04	4,69E-02	3,46E-03
155Tb	4,60E+05	3,86E+00	2,85E-01
156Tb	4,62E+05	6,77E-02	5,00E-03
156Tb*	1,91E+04	1,63E-02	1,20E-03
156Tb#	8,80E+04	1,92E-02	1,41E-03
157Tb	4,73E+09	5,14E-01	3,79E-02
158Tb	4,73E+09	3,04E-01	2,24E-02
158Tb*	1,05E+01	1,14E+00	8,44E-02
160Tb	6,25E+06	5,53E+00	4,08E-01
161Tb	5,96E+05	4,26E-02	3,14E-03
146Dy	2,90E+01	2,76E-02	2,04E-03
147Dy	7,50E+01	7,25E-02	5,35E-03
148Dy	1,86E+02	4,10E-01	3,02E-02
149Dy	2,54E+02	6,62E-01	4,88E-02
150Dy	4,30E+02	7,31E-01	5,40E-02
151Dy	1,07E+03	8,76E-01	6,46E-02
152Dy	8,53E+03	9,70E-01	7,16E-02
153Dy	2,30E+04	1,32E+00	9,74E-02
155Dy	3,60E+04	3,81E+00	2,81E-01
157Dy	2,93E+04	7,24E+00	5,34E-01
159Dy	1,25E+07	7,90E+00	5,83E-01
165Dy	8,40E+03	1,85E+00	1,37E-01
165Dy*	7,55E+01	1,20E+00	8,84E-02
149Ho	5,80E+01	1,32E-01	9,78E-03
150Ho	8,80E+01	3,57E-01	2,64E-02
151Ho	3,52E+01	5,58E-01	4,12E-02
152Ho	1,62E+02	5,69E-01	4,20E-02
153Ho	1,20E+02	9,34E-01	6,90E-02
154Ho	7,10E+02	1,66E+00	1,22E-01
155Ho	2,88E+03	2,32E+00	1,71E-01
156Ho	3,36E+03	3,11E+00	2,29E-01
157Ho	7,56E+02	4,48E+00	3,30E-01
158Ho	6,60E+02	4,71E+00	3,48E-01
159Ho	1,98E+03	5,48E+00	4,04E-01
160Ho	1,54E+03	6,80E+00	5,02E-01
161Ho	8,93E+03	7,28E+00	5,38E-01
161Ho*	6,73E+00	1,68E-02	1,24E-03
162Ho	9,00E+02	3,09E-01	2,28E-02
162Ho*	4,02E+03	1,79E-01	1,32E-02
163Ho	1,44E+11	5,49E-02	4,05E-03
163Ho*	1,09E+00	5,31E-01	3,92E-02
164Ho	1,74E+03	1,25E+01	9,20E-01
164Ho*	2,25E+03	4,83E+00	3,56E-01
166Ho	9,65E+04	1,36E+01	1,01E+00
166Ho*	3,79E+10	5,00E-03	3,69E-04
167Ho	1,12E+04	2,78E-01	2,05E-02
168Ho	1,80E+02	1,66E-03	1,22E-04
150Er	1,85E+01	4,01E-02	2,96E-03

151Er	2,35E+01	1,61E-01	1,19E-02
152Er	1,01E+01	2,59E-01	1,91E-02
153Er	3,71E+01	5,07E-01	3,74E-02
154Er	2,21E+02	9,24E-01	6,82E-02
155Er	3,18E+02	1,69E+00	1,24E-01
156Er	1,17E+03	2,58E+00	1,90E-01
157Er	1,12E+03	4,04E+00	2,98E-01
158Er	8,10E+03	4,43E+00	3,27E-01
159Er	2,16E+03	5,31E+00	3,92E-01
160Er	1,03E+05	6,71E+00	4,95E-01
161Er	1,16E+04	7,17E+00	5,29E-01
163Er	4,50E+03	1,93E+01	1,43E+00
165Er	3,73E+04	2,11E+01	1,56E+00
167Er*	2,28E+00	5,19E+00	3,83E-01
169Er	8,04E+05	1,66E+00	1,22E-01
152Tm	5,20E+00	1,78E-02	1,31E-03
153Tm	1,59E+00	5,41E-02	3,99E-03
154Tm	8,10E+00	2,37E-01	1,75E-02
155Tm	3,40E+01	6,13E-01	4,53E-02
156Tm	8,38E+01	1,32E+00	9,78E-02
157Tm	2,10E+02	2,84E+00	2,09E-01
158Tm	2,41E+02	3,32E+00	2,45E-01
159Tm	5,49E+02	4,54E+00	3,35E-01
160Tm	5,64E+02	6,06E+00	4,47E-01
161Tm	2,28E+03	6,61E+00	4,88E-01
162Tm	1,30E+03	8,65E+00	6,39E-01
163Tm	6,52E+03	1,23E+01	9,05E-01
164Tm	1,20E+02	1,23E+01	9,07E-01
165Tm	1,08E+05	1,46E+01	1,07E+00
166Tm	2,77E+04	1,51E+01	1,11E+00
167Tm	7,98E+05	1,58E+01	1,17E+00
168Tm	8,04E+06	1,02E+00	7,51E-02
170Tm	1,11E+07	3,43E+01	2,53E+00
171Tm	6,06E+07	6,88E-01	5,08E-02
172Tm	2,29E+05	2,08E-02	1,53E-03
155Yb	1,71E+00	6,84E-02	5,05E-03
156Yb	2,61E+01	3,00E-01	2,21E-02
157Yb	3,86E+01	1,25E+00	9,21E-02
158Yb	9,90E+01	1,47E+00	1,09E-01
159Yb	8,40E+01	2,59E+00	1,91E-01
160Yb	2,88E+02	4,19E+00	3,09E-01
161Yb	2,52E+02	5,08E+00	3,75E-01
162Yb	1,13E+03	7,49E+00	5,53E-01
163Yb	6,63E+02	1,15E+01	8,50E-01
164Yb	4,55E+03	1,18E+01	8,75E-01
165Yb	5,94E+02	1,43E+01	1,06E+00
166Yb	2,04E+05	1,49E+01	1,10E+00
167Yb	1,05E+03	1,55E+01	1,14E+00
169Yb	2,77E+06	3,94E+01	2,90E+00

169Yb*	4,60E+01	4,94E+00	3,64E-01
175Yb	3,62E+05	5,93E-01	4,38E-02
157Lu	5,40E+00	5,46E-02	4,03E-03
158Lu	1,04E+01	2,15E-01	1,59E-02
159Lu	1,23E+01	6,57E-01	4,85E-02
160Lu	3,55E+01	1,49E+00	1,10E-01
161Lu	7,20E+01	2,12E+00	1,56E-01
162Lu	8,22E+01	4,54E+00	3,35E-01
163Lu	2,38E+02	8,87E+00	6,55E-01
164Lu	1,88E+02	9,78E+00	7,22E-01
165Lu	6,44E+02	1,29E+01	9,51E-01
166Lu	1,59E+02	1,40E+01	1,03E+00
167Lu	3,09E+03	1,46E+01	1,08E+00
168Lu	3,30E+02	1,79E+01	1,32E+00
169Lu	1,23E+05	1,89E+01	1,40E+00
170Lu	1,73E+05	2,46E+01	1,82E+00
171Lu	7,12E+05	2,81E+01	2,07E+00
172Lu	5,79E+05	2,66E+01	1,97E+00
172Lu*	2,20E+02	3,26E-02	2,41E-03
173Lu	4,32E+07	2,98E+01	2,20E+00
174Lu	1,05E+08	2,12E+00	1,56E-01
174Lu*	1,23E+07	1,09E+00	8,03E-02
176Lu*	1,33E+04	2,16E+01	1,59E+00
177Lu	5,80E+05	5,39E+00	3,98E-01
177Lu*	1,39E+07	2,08E-02	1,53E-03
178Lu	1,70E+03	1,60E-02	1,18E-03
159Hf	5,60E+00	3,80E-02	2,81E-03
160Hf	1,20E+01	1,71E-01	1,26E-02
161Hf	1,70E+01	5,30E-01	3,91E-02
162Hf	3,76E+01	1,35E+00	9,94E-02
163Hf	4,00E+01	4,88E+00	3,60E-01
164Hf	1,68E+02	5,46E+00	4,03E-01
165Hf	1,02E+02	8,89E+00	6,56E-01
166Hf	4,06E+02	1,06E+01	7,79E-01
167Hf	1,23E+02	1,19E+01	8,77E-01
168Hf	1,56E+03	1,62E+01	1,19E+00
169Hf	1,94E+02	1,77E+01	1,31E+00
170Hf	5,76E+04	2,39E+01	1,76E+00
171Hf	4,36E+04	2,77E+01	2,04E+00
172Hf	5,90E+07	2,64E+01	1,95E+00
173Hf	8,64E+04	3,14E+01	2,32E+00
175Hf	6,05E+06	5,16E+01	3,81E+00
177Hf*	1,08E+00	4,98E-02	3,67E-03
177Hf#	3,08E+03	6,43E-02	4,75E-03
178Hf*	4,00E+00	3,67E+00	2,71E-01
179Hf*	1,87E+01	5,70E+01	4,20E+00
179Hf#	2,17E+06	3,15E+00	2,32E-01
180Hf*	1,98E+04	2,02E+00	1,49E-01
181Hf	3,66E+06	3,29E+00	2,43E-01

162Ta	3,52E+00	1,17E-01	8,60E-03
163Ta	1,10E+01	4,09E-01	3,02E-02
164Ta	1,36E+01	1,68E+00	1,24E-01
165Ta	3,10E+01	3,89E+00	2,87E-01
166Ta	3,44E+01	4,61E+00	3,40E-01
167Ta	8,40E+01	5,72E+00	4,22E-01
168Ta	1,46E+02	1,07E+01	7,92E-01
169Ta	2,94E+02	1,33E+01	9,79E-01
170Ta	4,06E+02	2,05E+01	1,51E+00
171Ta	1,40E+03	2,53E+01	1,87E+00
172Ta	2,21E+03	2,56E+01	1,89E+00
173Ta	1,13E+04	2,88E+01	2,12E+00
174Ta	4,25E+03	3,04E+01	2,25E+00
175Ta	3,78E+04	3,15E+01	2,33E+00
176Ta	2,91E+04	3,73E+01	2,75E+00
177Ta	2,04E+05	4,03E+01	2,97E+00
178Ta	5,59E+02	4,38E+01	3,23E+00
178Ta*	8,50E+03	7,42E-02	5,47E-03
179Ta	5,74E+07	4,45E+01	3,28E+00
180Ta	2,93E+04	4,13E+00	3,05E-01
182Ta	9,94E+06	3,61E+01	2,66E+00
182Ta*	2,83E-01	1,37E+00	1,01E-01
182Ta#	9,50E+02	2,76E-02	2,04E-03
183Ta	4,41E+05	3,99E-01	2,95E-02
164W	6,40E+00	5,39E-02	3,98E-03
165W	5,10E+00	3,29E-01	2,43E-02
166W	1,60E+01	7,97E-01	5,88E-02
167W	1,99E+01	2,07E+00	1,53E-01
168W	5,30E+01	3,59E+00	2,65E-01
169W	7,80E+01	5,69E+00	4,20E-01
170W	2,40E+02	1,27E+01	9,35E-01
171W	1,44E+02	1,84E+01	1,36E+00
172W	4,00E+02	2,00E+01	1,47E+00
173W	4,78E+02	2,45E+01	1,81E+00
174W	1,76E+03	2,75E+01	2,03E+00
175W	2,04E+03	2,97E+01	2,19E+00
176W	8,30E+03	3,61E+01	2,66E+00
177W	8,10E+03	3,95E+01	2,92E+00
178W	1,87E+06	4,33E+01	3,20E+00
179W	2,25E+03	4,79E+01	3,54E+00
179W*	3,84E+02	4,13E-01	3,05E-02
181W	1,05E+07	8,05E+01	5,94E+00
183W*	5,20E+00	2,24E+01	1,65E+00
185W	6,49E+06	2,33E+00	1,72E-01
185W*	1,00E+02	4,91E-02	3,62E-03
187W	8,60E+04	1,22E+00	9,00E-02
166Re	2,20E+00	1,85E-02	1,37E-03
167Re	6,10E+00	1,69E-01	1,24E-02
168Re	6,90E+00	5,76E-01	4,25E-02

169Re	1,29E+01	1,26E+00	9,33E-02
170Re	8,00E+00	4,30E+00	3,17E-01
171Re	1,52E+01	8,71E+00	6,43E-01
172Re	1,50E+01	9,37E+00	6,91E-01
173Re	1,19E+02	1,45E+01	1,07E+00
174Re	1,38E+02	1,87E+01	1,38E+00
175Re	3,48E+02	2,24E+01	1,65E+00
176Re	3,40E+02	3,05E+01	2,25E+00
177Re	8,40E+02	3,54E+01	2,61E+00
178Re	7,92E+02	4,04E+01	2,98E+00
179Re	1,17E+03	4,46E+01	3,29E+00
180Re	1,46E+02	4,90E+01	3,61E+00
181Re	7,20E+04	5,33E+01	3,94E+00
182Re	2,30E+05	5,73E+01	4,23E+00
182Re*	4,57E+04	1,78E-02	1,31E-03
183Re	6,05E+06	6,24E+01	4,60E+00
184Re	3,28E+06	3,63E+00	2,68E-01
184Re*	1,43E+07	4,46E-01	3,29E-02
186Re	3,26E+05	7,28E+01	5,37E+00
188Re	6,11E+04	5,92E-01	4,37E-02
188Re*	1,12E+03	6,06E-02	4,47E-03
189Re	8,75E+04	8,08E-02	5,96E-03
190Re	1,86E+02	4,65E-02	3,43E-03
169Os	3,50E+00	6,63E-02	4,89E-03
170Os	7,10E+00	3,04E-01	2,24E-02
171Os	8,00E+00	9,78E-01	7,22E-02
172Os	1,90E+01	2,04E+00	1,51E-01
173Os	1,60E+01	4,54E+00	3,35E-01
174Os	4,40E+01	7,09E+00	5,23E-01
175Os	8,40E+01	9,94E+00	7,34E-01
176Os	1,80E+02	1,84E+01	1,36E+00
177Os	1,68E+02	2,44E+01	1,80E+00
178Os	3,00E+02	3,13E+01	2,31E+00
179Os	3,90E+02	3,75E+01	2,77E+00
180Os	1,29E+03	4,37E+01	3,22E+00
181Os	1,62E+02	4,95E+01	3,65E+00
182Os	7,96E+04	5,49E+01	4,05E+00
183Os	4,68E+04	6,06E+01	4,47E+00
183Os*	3,56E+04	4,15E-01	3,06E-02
185Os	8,09E+06	1,13E+02	8,32E+00
189Os*	1,73E+04	5,50E+01	4,06E+00
190Os*	5,94E+02	6,45E-01	4,76E-02
191Os	1,33E+06	1,56E+01	1,15E+00
191Os*	4,72E+04	1,46E+01	1,08E+00
192Os*	5,90E+00	3,51E-02	2,59E-03
193Os	1,10E+05	2,66E-01	1,96E-02
194Os	1,89E+08	3,90E-02	2,88E-03
195Os	3,90E+02	3,05E-02	2,25E-03
171Ir	1,50E+00	1,88E-02	1,39E-03

172Ir	2,10E+00	9,96E-02	7,35E-03
173Ir	3,00E+00	4,27E-01	3,15E-02
174Ir	4,00E+00	1,16E+00	8,56E-02
175Ir	4,50E+00	2,55E+00	1,88E-01
176Ir	8,00E+00	5,16E+00	3,81E-01
177Ir	2,10E+01	8,97E+00	6,62E-01
178Ir	1,20E+01	1,42E+01	1,05E+00
179Ir	2,40E+02	2,13E+01	1,57E+00
180Ir	9,00E+01	2,83E+01	2,09E+00
181Ir	2,94E+02	3,59E+01	2,65E+00
182Ir	9,00E+02	4,32E+01	3,19E+00
183Ir	3,30E+03	5,07E+01	3,74E+00
184Ir	1,09E+04	5,86E+01	4,32E+00
185Ir	5,00E+04	6,53E+01	4,82E+00
186Ir	5,99E+04	7,34E+01	5,42E+00
187Ir	3,78E+04	7,93E+01	5,85E+00
188Ir	1,49E+05	8,83E+01	6,52E+00
189Ir	1,14E+06	9,86E+01	7,28E+00
190Ir	1,02E+06	6,67E+00	4,92E-01
190Ir*	4,32E+03	2,43E-01	1,80E-02
190Ir#	1,15E+04	3,30E-02	2,43E-03
191Ir*	4,94E+00	5,39E+00	3,98E-01
191Ir#	6,00E+00	3,70E+00	2,73E-01
192Ir	6,38E+06	9,71E+01	7,16E+00
192Ir*	8,64E+01	6,07E+01	4,48E+00
192Ir#	7,60E+09	1,05E-01	7,78E-03
193Ir*	9,16E+05	1,21E+01	8,92E-01
194Ir	6,89E+04	4,48E+01	3,31E+00
194Ir*	1,48E+07	1,31E+00	9,65E-02
195Ir	9,00E+03	8,26E-01	6,09E-02
195Ir*	1,37E+04	1,05E-01	7,78E-03
196Ir	5,20E+01	5,71E-01	4,21E-02
196Ir*	5,04E+03	5,23E-02	3,86E-03
197Ir	3,48E+02	2,90E-01	2,14E-02
198Ir	8,00E+00	1,49E-01	1,10E-02
199Ir	1,92E+02	6,45E-02	4,76E-03
200Ir	2,69E+01	2,43E-02	1,79E-03
174Pt	9,00E-01	2,23E-02	1,65E-03
175Pt	2,52E+00	1,59E-01	1,18E-02
176Pt	8,30E+00	6,42E-01	4,74E-02
177Pt	1,10E+01	1,52E+00	1,12E-01
178Pt	2,10E+01	3,45E+00	2,55E-01
179Pt	4,30E+01	6,82E+00	5,03E-01
180Pt	5,20E+01	1,12E+01	8,28E-01
181Pt	5,10E+01	1,74E+01	1,29E+00
182Pt	1,56E+02	2,43E+01	1,79E+00
183Pt	3,90E+02	3,23E+01	2,39E+00
184Pt	1,04E+03	4,18E+01	3,09E+00
185Pt	4,26E+03	5,05E+01	3,73E+00

186Pt	7,20E+03	6,07E+01	4,48E+00
187Pt	8,46E+03	6,91E+01	5,10E+00
188Pt	8,80E+05	8,04E+01	5,93E+00
189Pt	3,92E+04	9,18E+01	6,77E+00
191Pt	2,51E+05	1,25E+02	9,25E+00
193Pt	1,58E+09	6,41E+01	4,73E+00
193Pt*	3,74E+05	2,89E+01	2,13E+00
195Pt*	3,47E+05	2,13E+01	1,57E+00
197Pt	6,59E+04	6,53E+01	4,82E+00
197Pt*	5,66E+03	2,17E+01	1,60E+00
199Pt	1,85E+03	4,91E+00	3,63E-01
199Pt*	1,36E+01	4,48E-01	3,30E-02
200Pt	4,50E+04	1,43E+00	1,05E-01
201Pt	1,50E+02	5,98E-01	4,41E-02
202Pt	1,56E+05	2,06E-01	1,52E-02
177Au	1,30E+00	3,90E-02	2,88E-03
178Au	2,60E+00	1,64E-01	1,21E-02
179Au	7,50E+00	5,85E-01	4,31E-02
180Au	8,10E+00	1,43E+00	1,06E-01
181Au	1,14E+01	3,27E+00	2,41E-01
182Au	2,10E+01	5,57E+00	4,11E-01
183Au	4,20E+01	9,49E+00	7,01E-01
184Au	5,30E+01	1,54E+01	1,14E+00
185Au	2,60E+02	2,22E+01	1,64E+00
186Au	6,40E+02	3,09E+01	2,28E+00
187Au	5,04E+02	4,09E+01	3,01E+00
188Au	5,30E+02	5,26E+01	3,88E+00
189Au	1,72E+03	6,37E+01	4,70E+00
190Au	2,57E+03	7,46E+01	5,50E+00
191Au	1,14E+04	8,32E+01	6,14E+00
192Au	1,78E+04	8,98E+01	6,63E+00
193Au	6,35E+04	9,50E+01	7,01E+00
193Au*	3,90E+00	3,43E-02	2,53E-03
194Au	1,42E+05	4,09E+01	3,02E+00
194Au*	6,00E-01	2,56E-02	1,89E-03
195Au	1,61E+07	1,08E+02	7,94E+00
195Au*	3,05E+01	1,61E+00	1,19E-01
196Au	5,34E+05	4,51E+01	3,33E+00
196Au*	8,10E+00	6,08E+00	4,49E-01
196Au#	3,49E+04	2,90E-01	2,14E-02
197Au*	7,80E+00	3,03E+01	2,24E+00
198Au	2,33E+05	2,83E+02	2,09E+01
198Au*	1,99E+05	1,50E+00	1,11E-01
199Au	2,71E+05	2,18E+02	1,61E+01
200Au	2,90E+03	1,99E+02	1,47E+01
200Au*	6,73E+04	5,03E+00	3,71E-01
201Au	1,56E+03	4,03E+01	2,97E+00
202Au	2,88E+01	7,11E+00	5,25E-01
203Au	5,30E+01	6,48E+00	4,79E-01

204Au	3,98E+01	1,10E+00	8,10E-02
180Hg	3,00E+00	4,74E-02	3,50E-03
181Hg	3,60E+00	1,96E-01	1,45E-02
182Hg	1,13E+01	5,84E-01	4,31E-02
183Hg	8,80E+00	1,43E+00	1,06E-01
184Hg	3,06E+01	3,01E+00	2,22E-01
185Hg	4,90E+01	5,48E+00	4,04E-01
186Hg	8,30E+01	9,53E+00	7,03E-01
187Hg	1,44E+02	1,49E+01	1,10E+00
188Hg	1,95E+02	2,15E+01	1,58E+00
189Hg	4,56E+02	2,92E+01	2,16E+00
190Hg	1,20E+03	3,73E+01	2,75E+00
191Hg	2,90E+03	4,41E+01	3,25E+00
192Hg	1,75E+04	5,07E+01	3,74E+00
193Hg	1,37E+04	5,59E+01	4,12E+00
193Hg*	4,25E+04	1,17E+00	8,62E-02
194Hg	1,64E+10	3,04E+00	2,24E-01
195Hg	3,56E+04	6,96E+01	5,13E+00
195Hg*	1,50E+05	9,08E+00	6,70E-01
197Hg	2,31E+05	4,72E+02	3,48E+01
197Hg*	8,57E+04	2,17E+02	1,60E+01
199Hg*	2,56E+03	6,68E+03	4,93E+02
203Hg	4,03E+06	3,33E+02	2,46E+01
205Hg	3,12E+02	4,56E+00	3,37E-01
184Tl	1,10E+01	1,01E-01	7,48E-03
185Tl	1,80E+00	1,94E-01	1,43E-02
186Tl	2,75E+01	6,38E-01	4,71E-02
187Tl	5,00E+01	1,32E+00	9,74E-02
188Tl	7,10E+01	2,23E+00	1,65E-01
189Tl	1,38E+02	3,56E+00	2,63E-01
190Tl	1,56E+02	5,08E+00	3,75E-01
191Tl	3,10E+02	6,73E+00	4,96E-01
192Tl	6,48E+02	8,10E+00	5,98E-01
193Tl	1,30E+03	8,86E+00	6,54E-01
194Tl	1,98E+03	9,58E+00	7,07E-01
195Tl	4,18E+03	1,00E+01	7,38E-01
196Tl	6,62E+03	1,04E+01	7,70E-01
197Tl	1,02E+04	1,10E+01	8,10E-01
198Tl	1,91E+04	1,02E+01	7,52E-01
199Tl	2,67E+04	8,70E+00	6,42E-01
200Tl	9,40E+04	6,58E+00	4,85E-01
201Tl	2,62E+05	1,11E+01	8,17E-01
202Tl	1,06E+06	2,00E+01	1,48E+00
204Tl	1,19E+08	2,42E+01	1,78E+00
188Pb	2,45E+01	1,94E-02	1,43E-03
189Pb	5,10E+01	4,10E-02	3,02E-03
190Pb	7,20E+01	6,91E-02	5,10E-03
191Pb	8,00E+01	8,56E-02	6,32E-03
192Pb	2,10E+02	1,14E-01	8,43E-03

193Pb	3,48E+02	9,61E-02	7,09E-03
194Pb	7,20E+02	1,28E-01	9,43E-03
195Pb	9,00E+02	9,62E-02	7,10E-03
196Pb	2,22E+03	7,80E-02	5,76E-03
197Pb	6,00E+02	6,47E-02	4,77E-03
198Pb	8,60E+03	3,82E-02	2,82E-03
199Pb	5,40E+03	2,82E-02	2,08E-03
200Pb	7,74E+04	1,91E-02	1,41E-03
202Pb*	1,27E+04	3,39E+00	2,50E-01
203Pb	1,87E+05	4,31E+01	3,18E+00
203Pb*	6,30E+00	4,01E+01	2,96E+00
203Pb#	4,80E-01	1,75E-01	1,29E-02
204Pb*	4,01E+03	1,08E+02	7,96E+00
Total		3,61E+04	2,66E+03