



Introduction

The calculations for the ITER Neutron Streaming Experiment of the Shielding Integral Benchmark Archive and Database (SINBAD 2000), maintained by the Radiation Safety Information Computational Center (RSICC), were performed with Attila. This calculation is a reproduction of a neutronics experiment of the International Thermonuclear Experimental Reactor (ITER) shielding system irradiated with an anisotropic neutron source. Various reaction rates were measured by foils embedded in the shield and along a streaming path.

Problem Summary

Figure 1 shows the quarter symmetric geometry of the neutron streaming experiment assembly. The neutron source is located at (-5.31 cm, 0 cm, 0 cm), shown as the red dot below (on-axis case). Calculations were also performed with an off-axis neutron source (see Ref. [2] for complete source specification).

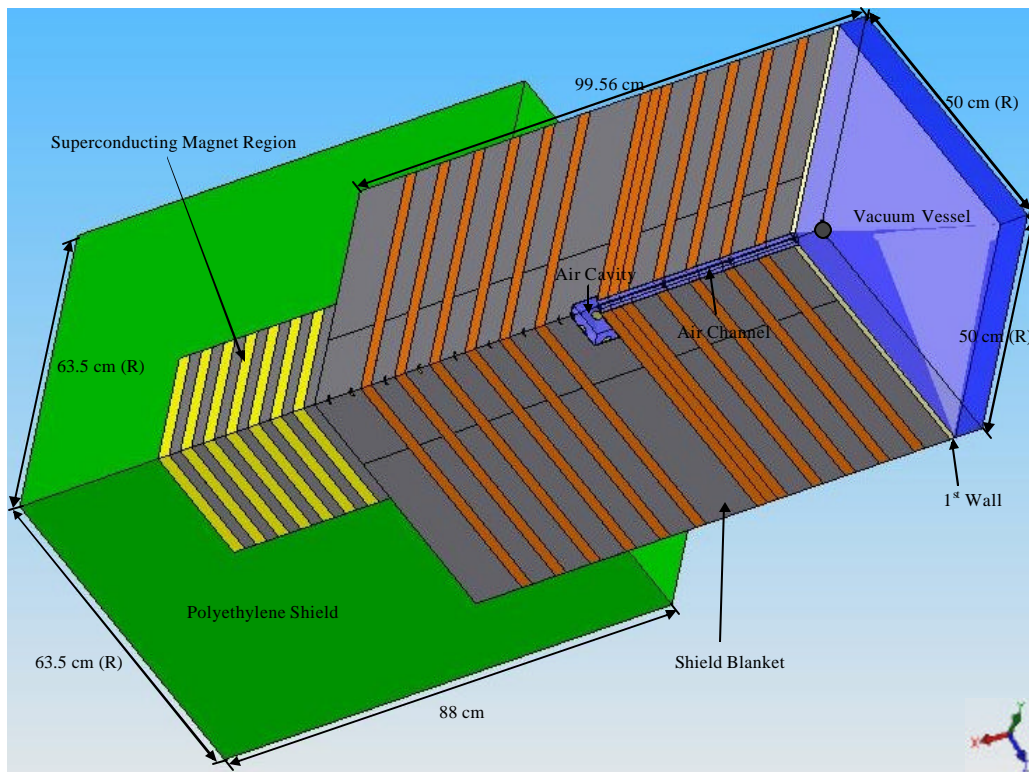


Figure 1: ITER mock-up geometry

The base of the model containing the point source is representative of the ITER vacuum vessel (air - blue) with 1 cm thick copper layer (yellow). This is followed by alternating slabs of AISI-316 stainless steel (grey) and the water equivalent Perspex material (red) representative of the ITER shielding blanket. A high aspect ratio rectangular streaming channel is present, the end of which opens to a rectangular cavity, representative of streaming paths between ITER blanket modules. This is followed by alternating slabs of AISI-316 stainless steel and copper representing the superconducting magnet region. The end of the mock-up is encased by a polyethylene block (green). The material compositions are listed in Ref. [2] and in the Attila input files. For the benchmark problem with the source on the x-axis, a $\frac{1}{4}$ symmetry model was used (as shown in Figure 1) in the calculation. When the source was placed off axis, a $\frac{1}{2}$ symmetry model was used. The reflected size of the vacuum vessel / shield blanket assembly is 99.56 cm x 100 cm x 100 cm and the reflected size of the polyethylene shield is 88 cm x 127 cm x 127 cm. The channel is 2.8 cm in diameter and 39.07 cm long ($l/d = 13.95$) and the cavity is 4.8 cm x 5.2 cm x 14.8 cm.



Neutron Source

The neutron source was produced by a 230 keV deuteron beam incident on a T-Ti target as produced by the Frascati Neutron Generator. This source was simulated as an angular dependent anisotropic point source. The energy and angle distribution can be found in Ref [2] and in the Attila anisotropic point source file (eighteen_srcs.ptsrc.inp).

Measurement Locations

Reaction rate measurements were obtained by activation of foils in the channel and shield blanket. These foils were explicitly modeled in the Attila calculation. Ref. [2] gives the coordinates of the foils. Figure 2 shows the relative locations of the foils (yellow) in the mock-up geometry (some of the shield blanket has been made transparent to reveal the foils), of which 13 reside along the air channel (on axis foils) and 11 in the air cavity (off axis foils).

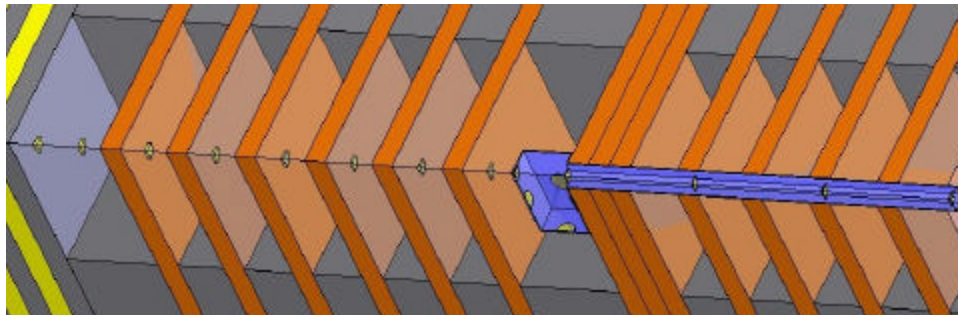


Figure 2: Foil locations in ITER mock-up assembly

Attila Calculation

The following specifies some parameters of the Attila calculation:

- ⇒ Source: Anisotropic Point
- ⇒ Geometry:
 - ⇒ ½ Symmetry: 48,000 tetrahedral cells
 - ⇒ ¼ Symmetry: 34,000 tetrahedral cells
- ⇒ Cross Section Library:
 - ⇒ FENDL2.1: 171 neutron groups (15.683 MeV – 1E-11 MeV)
- ⇒ Quadrature: Triangular Chebychev Legendre, S₁₆, S₁₈
- ⇒ Scattering Expansion: Galerkin, P₅
- ⇒ Response Functions : IRDF-90

Results

Four different reaction rates were calculated with Attila using the IRDF-90 response function: $^{93}\text{Nb}(n,2n)$, $^{27}\text{Al}(n,\alpha)$, $^{58}\text{Ni}(n,p)$, and $^{197}\text{Au}(n,?)$. Tables 1 through 4 give the results with the source on axis. The experimentally measured reaction rate values, percent experimental uncertainty (E.U. %), and calculated reaction rate values using MCNP were taken from Ref [2]. The calculated reaction rate values using Attila are given along with the Attila calculated to experimentally measured ratio (Attila C/E) and the Attila / MCNP ratio. The reported MCNP results are those calculated with FENDL-2 cross sections, except those indicated by a (*) where the only available results were those using FENDL-1 cross section data.



Attila Benchmark Calculations ITER Neutron Streaming Experiment (SINBAD 2000)

⁹³ Nb(n,2n) Reaction Rate							
Channel Foils							
Foil Position	Experiment	E.U. (%)	Attila	MCNP	MCNP % Uncertainty	Attila C/E	Attila / MCNP
0.25	1.17E-03	3	1.17E-03	1.21E-03	0.3	1.003	0.969
12.95	1.45E-04	3	1.32E-04	1.36E-04	0.9	0.909	0.969
25.95	5.05E-05	3	4.40E-05	4.73E-05	1.4	0.872	0.930
38.65	2.36E-05	3	1.97E-05	2.27E-05	2.2	0.834	0.867
43.82	1.75E-05	4	1.50E-05	1.73E-05	2.4	0.856	0.866
46.35	1.39E-05	4	9.86E-06	1.33E-05	2.1	0.710	0.742
53.3	3.89E-06	4	2.89E-06	3.78E-06	2	0.744	0.765
60.05	1.05E-06	4	8.49E-07	1.03E-06	2	0.809	0.825
66.9	2.85E-07	4	2.47E-07	2.79E-07	1.9	0.865	0.884
73.9	8.20E-08	5	7.08E-08	7.50E-08	1.9	0.863	0.944
80.6	2.46E-08	6	2.19E-08	2.22E-08	1.8	0.892	0.988
87.25	7.24E-09	7	7.00E-09	6.81E-09	1.7	0.967	1.028
91.65	3.02E-09	11	3.07E-09	2.83E-09	1.6	1.015	1.083
Cavity Foils							
5 / 39.12	1.30E-06	4	1.16E-06	1.28E-06	2.1	0.895	0.909
4 / 39.12	1.33E-06	4	1.16E-06	1.31E-06	1.8	0.874	0.888
6 / 41.47	5.36E-07	4	4.70E-07	5.39E-07	2.8	0.877	0.872
3 / 41.47	5.47E-07	4	4.70E-07	4.88E-07	2.7	0.859	0.963
8 / 41.47	9.06E-07	4	8.53E-07	8.89E-07	3.6	0.942	0.960
10 / 41.47	8.69E-07	4	8.53E-07	8.38E-07	4.4	0.982	1.018
9 / 41.47	9.18E-07	4	8.53E-07	9.54E-07	5	0.929	0.894
11 / 41.47	8.90E-07	4	8.53E-07	9.43E-07	4.2	0.959	0.905
1 / 43.82	1.75E-05	4	1.50E-05	1.73E-05	2.4	0.856	0.866
7 / 43.82	1.15E-06	4	1.02E-06	1.13E-06	2.3	0.889	0.905
2 / 43.82	1.24E-06	4	1.02E-06	1.25E-06	2.3	0.824	0.818

Table 1: ⁹³Nb(n,2n) Reaction Rate (Source on Axis)

²⁷ Al(n,a) Reaction Rate							
Channel Foils							
Foil Position	Experiment	E.U. (%)	Attila	MCNP	MCNP % Uncertainty	Attila C/E	Attila / MCNP
0.25	2.87E-04	3.5	2.86E-04	2.94E-04	0.3	0.995	0.971
12.95	3.54E-05	3.5	3.27E-05	3.42E-05	0.9	0.925	0.958
25.95	1.23E-05	4	1.09E-05	1.23E-05	1.4	0.883	0.883
38.65	6.06E-06	4	4.82E-06	5.98E-06	2.1	0.795	0.806
43.82	4.65E-06	4	3.66E-06	4.64E-06	2.5	0.788	0.790
46.35	3.28E-06	5.8	2.44E-06	3.07E-06	2.5	0.743	0.793
53.3	1.02E-06	6.4	7.24E-07	9.10E-07	2.3	0.710	0.796
60.05	3.02E-07	6.5	2.15E-07	2.54E-07	2.3	0.711	0.845
66.9	7.98E-08	7.1	6.28E-08	6.94E-08	2.2	0.787	0.905
73.9	2.46E-08	7.8	1.82E-08	1.93E-08	2.2	0.740	0.943
80.6	7.31E-09	9.4	5.70E-09	5.85E-09	2.1	0.780	0.974
87.25	2.14E-09	11.2	1.84E-09	1.82E-09	2	0.859	1.010
91.65	1.07E-09	12.5	8.03E-10	7.69E-10	1.9	0.751	1.045
Cavity Foils							
5 / 39.12	3.65E-07	5	3.23E-07	3.52E-07	1.6	0.886	0.919
4 / 39.12	3.89E-07	5	3.23E-07	3.59E-07	1.6	0.832	0.901
6 / 41.47	1.50E-07	5	1.37E-07	1.54E-07	2.1	0.914	0.890
3 / 41.47	1.54E-07	5	1.37E-07	1.43E-07	2.1	0.890	0.958
8 / 41.47	2.44E-07	5	2.38E-07	2.56E-07	3.3	0.975	0.929
10 / 41.47	2.32E-07	5	2.38E-07	2.47E-07	3.6	1.025	0.963
9 / 41.47	2.71E-07	5	2.38E-07	2.52E-07	4.2	0.878	0.944
11 / 41.47	2.55E-07	5	2.38E-07	2.48E-07	3.7	0.933	0.959
1 / 43.82	4.65E-06	5	3.66E-06	4.42E-06	2.3	0.788	0.829
7 / 43.82	3.20E-07	5	2.78E-07	3.10E-07	2.1	0.869	0.897
2 / 43.82	3.57E-07	5	2.78E-07	3.32E-07	2.1	0.779	0.838

Table 2: ²⁷Al(n,a) Reaction Rate (Source on Axis)



Attila Benchmark Calculations ITER Neutron Streaming Experiment (SINBAD 2000)

⁵⁸ Ni(n,p) Reaction Rate							
Channel Foils							
Foil Position	Experiment	E.U. (%)	Attila	MCNP	MCNP % Uncertainty	Attila C/E	Attila / MCNP
0.25	7.73E-04	3.5	8.21E-04	8.63E-04	0.3	1.062	0.951
12.95	1.07E-04	3.5	1.08E-04	1.18E-04	0.8	1.013	0.918
25.95	3.41E-05	3.5	3.33E-05	3.83E-05	1.2	0.977	0.870
38.65	1.54E-05	4	1.38E-05	1.73E-05	1.5	0.899	0.800
43.82	1.27E-05	4	1.07E-05	1.32E-05	2.1	0.841	0.810
46.35	1.02E-05	4.5	7.69E-06	9.95E-06	1.8	0.754	0.773
53.3	3.11E-06	5	2.45E-06	3.04E-06	1.7	0.786	0.804
60.05	8.90E-07	5	7.61E-07	8.81E-07	1.6	0.855	0.864
66.9	2.40E-07	5.5	2.34E-07	2.52E-07	1.5	0.973	0.927
73.9	7.34E-08	7	7.11E-08	7.26E-08	1.4	0.969	0.979
80.6	2.36E-08	5.5	2.34E-08	2.30E-08	1.3	0.991	1.017
87.25	7.56E-09	6.5	7.96E-09	7.55E-09	1.2	1.053	1.054
91.65	3.27E-09	6.5	3.59E-09	3.31E-09	1.1	1.097	1.084
Cavity Foils							
5 / 39.12	1.62E-06	5	1.65E-06	1.77E-06	1.6	1.017	0.930
4 / 39.12	1.65E-06	5	1.65E-06	1.86E-06	1.6	0.998	0.885
6 / 41.47	8.64E-07	5	8.53E-07	9.37E-07	1.7	0.987	0.910
3 / 41.47	9.25E-07	5	8.53E-07	8.72E-07	1.6	0.922	0.978
8 / 41.47	1.20E-06	5	1.26E-06	1.30E-06	2.2	1.047	0.967
10 / 41.47	N/A	N/A	1.26E-06	N/A	N/A	N/A	N/A
9 / 41.47	1.28E-06	5	1.26E-06	1.37E-06	3.3	0.982	0.917
11 / 41.47	N/A	N/A	1.26E-06	N/A	N/A	N/A	N/A
1 / 43.82	1.27E-05	5	1.07E-05	1.32E-05	2.1	0.841	0.810
7 / 43.82	1.42E-06	5	1.37E-06	1.48E-06	1.5	0.967	0.927
2 / 43.82	1.47E-06	5	1.37E-06	1.50E-06	1.5	0.934	0.915

Table 3: ⁵⁸Ni(n,p) Reaction Rate (Source on Axis)

¹⁹⁷ Au(n,?) Reaction Rate							
Channel Foils							
Foil Position	Experiment	E.U. (%)	Attila	MCNP*	MCNP % Uncertainty	Attila C/E	Attila / MCNP
0.25	N/A	N/A	N/A	N/A	N/A	N/A	N/A
12.95	N/A	N/A	N/A	N/A	N/A	N/A	N/A
25.95	N/A	N/A	N/A	N/A	N/A	N/A	N/A
38.65	N/A	N/A	N/A	N/A	N/A	N/A	N/A
43.82	4.72E-04	4	5.03E-04	3.99E-04	8.9	1.065	1.260
46.35	2.14E-04	4.5	2.05E-04	1.83E-04	9.1	0.959	1.121
53.3	9.92E-05	4.5	1.09E-04	1.00E-04	6.9	1.097	1.088
60.05	4.99E-05	4.5	5.52E-05	4.53E-05	9.4	1.107	1.219
66.9	2.11E-05	4.5	2.42E-05	2.31E-05	9.5	1.147	1.047
73.9	9.30E-06	4.5	1.04E-05	8.85E-06	7.6	1.116	1.173
80.6	4.25E-06	4.5	4.69E-06	4.15E-06	8.5	1.104	1.131
87.25	1.79E-06	4.5	1.99E-06	1.63E-06	6.6	1.112	1.221
91.65	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cavity Foils							
5 / 39.12	6.14E-04	4.5	6.86E-04	6.00E-04	6.2	1.118	1.144
4 / 39.12	6.08E-04	4.5	6.86E-04	6.00E-04	6.2	1.129	1.144
6 / 41.47	4.06E-04	4.5	4.34E-04	4.35E-04	7.6	1.070	0.999
3 / 41.47	3.96E-04	4.5	4.34E-04	4.35E-04	7.6	1.097	0.999
8 / 41.47	N/A	N/A	4.57E-04	N/A	N/A	N/A	N/A
10 / 41.47	N/A	N/A	4.57E-04	N/A	N/A	N/A	N/A
9 / 41.47	4.30E-04	4.5	4.57E-04	4.26E-04	5.9	1.062	1.072
11 / 41.47	4.17E-04	4.5	4.57E-04	4.26E-04	5.9	1.095	1.072
1 / 43.82	4.72E-04	4.5	5.23E-04	3.99E-04	6.6	1.108	1.311
7 / 43.82	4.22E-04	4.5	4.71E-04	4.24E-04	6.1	1.116	1.110
2 / 43.82	4.23E-04	4.5	4.71E-04	4.24E-04	6.1	1.113	1.110

Table 4: ¹⁹⁷Au(n,?) Reaction Rate (Source on Axis)



Attila Benchmark Calculations ITER Neutron Streaming Experiment (SINBAD 2000)

Tables 5-8 give the ratio of the solution with the source off axis obtained by Attila to experimental measurements (C/E) for each of the response functions at each detector location.

⁹³ Nb(n,2n) Reaction Rate							
Channel Foils							
Foil Position	Experiment	E.U. (%)	Attila	MCNP	MCNP % Uncertainty	Attila C/E	Attila / MCNP
0.25	6.36E-04	4	6.42E-04	6.34E-04	0.4	1.009	1.012
12.95	4.36E-05	4	4.08E-05	4.16E-05	1.4	0.936	0.981
25.95	5.20E-06	4	5.24E-06	5.34E-06	1.9	1.007	0.981
38.65	1.07E-06	5	9.78E-07	1.02E-06	3.4	0.914	0.958
Cavity Foils							
5 / 39.12	4.12E-07	4	3.72E-07	3.88E-07	2.1	0.903	0.959
4 / 39.12	9.03E-07	4	8.01E-07	8.35E-07	2.5	0.887	0.959
6 / 41.47	3.08E-07	5	2.70E-07	2.95E-07	4.2	0.875	0.914
3 / 41.47	4.89E-07	4	4.70E-07	4.99E-07	3.4	0.962	0.942
8 / 41.47	3.29E-07	4	2.94E-07	3.20E-07	5.1	0.893	0.918
10 / 41.47	3.13E-07	5	2.94E-07	3.02E-07	3.9	0.939	0.973
9 / 41.47	4.55E-07	5	3.69E-07	4.00E-07	4.6	0.810	0.922
11 / 41.47	4.57E-07	5	3.69E-07	4.50E-07	4.8	0.807	0.819
1 / 43.82	6.57E-07	5	5.38E-07	6.05E-07	4.1	0.819	0.889
7 / 43.82	3.50E-07	5	3.03E-07	3.18E-07	2.3	0.865	0.952
2 / 43.82	7.46E-07	5	6.97E-07	7.05E-07	3	0.934	0.989

Table 5: ⁹³Nb(n,2n) Reaction Rate (Source off Axis)

²⁷ Al(n,a) Reaction Rate							
Channel Foils							
Foil Position	Experiment	E.U. (%)	Attila	MCNP	MCNP % Uncertainty	Attila C/E	Attila / MCNP
0.25	1.72E-04	5	1.57E-04	1.58E-04	0.4	0.914	0.995
12.95	1.25E-05	5	1.06E-05	1.07E-05	1.3	0.852	0.995
25.95	1.59E-06	5	1.42E-06	1.43E-06	1.7	0.892	0.992
38.65	3.15E-07	5	2.70E-07	2.82E-07	3.2	0.857	0.958
Cavity Foils							
5 / 39.12	1.33E-07	5	1.12E-07	1.15E-07	2	0.841	0.973
4 / 39.12	2.55E-07	5	2.21E-07	2.27E-07	2.3	0.868	0.975
6 / 41.47	1.02E-07	5	8.12E-08	8.63E-08	3.6	0.796	0.940
3 / 41.47	1.45E-07	5	1.31E-07	1.37E-07	3	0.906	0.959
8 / 41.47	9.51E-08	5	8.80E-08	9.39E-08	4.3	0.926	0.938
10 / 41.47	N/A	N/A	8.80E-08	9.32E-08	3.6	N/A	0.945
9 / 41.47	1.34E-07	5	1.08E-07	1.27E-07	4.1	0.803	0.847
11 / 41.47	1.31E-07	5	1.08E-07	1.13E-07	4.3	0.821	0.952
1 / 43.82	1.92E-07	5	1.51E-07	1.66E-07	3.8	0.788	0.911
7 / 43.82	1.06E-07	5	9.02E-08	9.30E-08	2.1	0.851	0.970
2 / 43.82	2.16E-07	5	1.88E-07	1.87E-07	2.8	0.871	1.006

Table 6: ²⁷Al(n,a) Reaction Rate (Source off Axis)



Attila Benchmark Calculations ITER Neutron Streaming Experiment (SINBAD 2000)

⁵⁸ Ni(n,p) Reaction Rate							
Channel Foils							
Foil Position	Experiment	E.U. (%)	Attila	MCNP	MCNP % Uncertainty	Attila C/E	Attila / MCNP
0.25	5.05E-04	4	4.76E-04	4.98E-04	0.4	0.942	0.956
12.95	5.01E-05	4	4.60E-05	4.65E-05	1.2	0.919	0.990
25.95	7.17E-06	4	6.87E-06	7.06E-06	1.5	0.959	0.974
38.65	1.47E-06	5	1.34E-06	1.35E-06	2.7	0.910	0.991
Cavity Foils							
5 / 39.12	7.77E-07	4.5	7.14E-07	7.43E-07	1.7	0.919	0.961
4 / 39.12	1.09E-06	4.5	1.06E-06	1.09E-06	1.7	0.973	0.973
6 / 41.47	5.86E-07	6	5.32E-07	5.54E-07	2.1	0.908	0.960
3 / 41.47	7.64E-07	5	6.83E-07	7.09E-07	1.9	0.894	0.963
8 / 41.47	6.16E-07	5	5.70E-07	6.00E-07	2.7	0.926	0.950
10 / 41.47	N/A	N/A	N/A	5.81E-07	2.4	N/A	N/A
9 / 41.47	8.35E-07	6	6.36E-07	6.96E-07	2.8	0.762	0.914
11 / 41.47	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1 / 43.82	8.94E-07	5	8.06E-07	8.61E-07	2.9	0.901	0.936
7 / 43.82	6.22E-07	5	5.73E-07	5.83E-07	1.6	0.921	0.983
2 / 43.82	8.94E-07	6	8.56E-07	8.68E-07	1.9	0.957	0.986

Table 7: ⁵⁸Ni(n,p) Reaction Rate (Source off Axis)

¹⁹⁷ Au(n,?) Reaction Rate							
Channel Foils							
Foil Position	Experiment	E.U. (%)	Attila	MCNP*	MCNP % Uncertainty	Attila C/E	Attila / MCNP
0.25	N/A	N/A	N/A	N/A	N/A	N/A	N/A
12.95	N/A	N/A	N/A	N/A	N/A	N/A	N/A
25.95	N/A	N/A	N/A	N/A	N/A	N/A	N/A
38.65	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cavity Foils							
5 / 39.12	5.02E-04	4	5.64E-04	5.40E-04	7.6	1.120	1.044
4 / 39.12	4.90E-04	4	5.37E-04	5.12E-04	7	1.100	1.049
6 / 41.47	3.05E-04	4	3.66E-04	2.94E-04	8.9	1.200	1.245
3 / 41.47	2.70E-04	4	3.41E-04	2.46E-04	8.9	1.260	1.386
8 / 41.47	3.23E-04	4	3.77E-04	3.62E-04	9.1	1.170	1.041
10 / 41.47	3.12E-04	4	3.77E-04	3.68E-04	8.4	1.210	1.024
9 / 41.47	2.95E-04	4	3.61E-04	3.00E-04	7	1.220	1.203
11 / 41.47	2.74E-04	4	3.61E-04	3.13E-04	9.5	1.320	1.153
1 / 43.82	3.51E-04	4	4.04E-04	3.39E-04	8.1	1.150	1.192
7 / 43.82	2.95E-04	4	3.86E-04	2.67E-04	7.2	1.310	1.446
2 / 43.82	3.09E-04	4	3.72E-04	2.90E-04	8.3	1.200	1.283

Table 8: ¹⁹⁷Au(n,?) Reaction Rate (Source off Axis)

In the above tables "N/A" indicates that the experimental measured data was not available from Ref [2] at the location for the reaction rate of interest.

Files

The files necessary to run this calculation are available to current Attila users from www.attilasupport.com as `iter_stream.tar.gz`. All the files are listed in Table 9 below.



Attila Benchmark Calculations ITER Neutron Streaming Experiment (SINBAD 2000)

Attila Files for ITER Neutron Streaming Benchmark	
Main Directory Files	File Description
eighteen_srcs.ptsrc.inp	Anisotropic point source file (source on axis)
fendl.xs_aux.inp	Auxiliary cross section input file for FENDL 2.1
fendl.xs.inp	Cross section input file for FENDL 2.1
rotate_stream_foils.mesh.inp	Mesh file for FSDSFoilsRot directory (see below)
rotate_stream_gold.mesh.inp	Mesh file for FSDSFoilsRotTh directory (see below)
roteigtn.ptsrc.inp	Anisotropic point source file (source off axis)
Stream_Gold.mesh.inp	Mesh file for FSDSFoilsTh directory (see below)
streaming-benchmark.mesh.inp	Mesh file for FSDSFoils directory (see below)
FSDSFoils Directory Files	File Description
FoilsIn-coll.attila.inp	Attila input file for the collided component of the solution
FoilsIn-coll.edit.inp	Edit input file for the collided component of the solution
FoilsIn-uncoll.attila.inp	Attila input file for the uncollided component of the solution
FoilsIn-uncoll.edit.inp	Edit input file for the uncollided component of the solution
FSDSFoils.attila.inp	Attila input file for merged solution (uncollided + collided)
FSDSFoils.edit.inp	Edit input file for the merged solution (uncollided + collided)
run.sh	run script
FSDSFoilsRot Directory Files	File Description
FoilsInRot-coll.attila.inp	Attila input file for the collided component of the solution
FoilsInRot-coll.edit.inp	Edit input file for the collided component of the solution
FoilsInRot-uncoll.attila.inp	Attila input file for the uncollided component of the solution
FoilsInRot-uncoll.edit.inp	Edit input file for the uncollided component of the solution
FSDSFoilsRot.attila.inp	Attila input file for merged solution (uncollided + collided)
FSDSFoilsRot.edit.inp	Edit input file for the merged solution (uncollided + collided)
run.sh	run script
FSDSFoilsRotTh Directory Files	File Description
FoilsInRotTh-coll.attila.inp	Attila input file for the collided component of the solution
FoilsInRotTh-coll.edit.inp	Edit input file for the collided component of the solution
FoilsInRotTh-uncoll.attila.inp	Attila input file for the uncollided component of the solution
FoilsInRotTh-uncoll.edit.inp	Edit input file for the uncollided component of the solution
FSDSFoilsRotTh.attila.inp	Attila input file for merged solution (uncollided + collided)
FSDSFoilsRotTh.edit.inp	Edit input file for the merged solution (uncollided + collided)
run.sh	run script
FSDSFoilsTh Directory Files	File Description
FoilsTherm-coll.attila.inp	Attila input file for the collided component of the solution
FoilsTherm-coll.edit.inp	Edit input file for the collided component of the solution
FoilsTherm-uncoll.attila.inp	Attila input file for the uncollided component of the solution
FoilsTherm-uncoll.edit.inp	Edit input file for the uncollided component of the solution
FSDSFoilsTh.attila.inp	Attila input file for merged solution (uncollided + collided)
FSDSFoilsTh.edit.inp	Edit input file for the merged solution (uncollided + collided)
run.sh	run script

References

- [1] **abs.txt**, P. Batistoni, M. Angelone, M. Pillon, L. Petrizzi, ENEA: Centro Ricerche Energie, Frascati, Italy
 [2] **exp.txt**, P. Batistoni, M. Angelone, M. Pillon, L. Petrizzi, ENEA: Centro Ricerche Energie, Frascati, Italy

Acknowledgements

Transpire, Inc. would like to thank Paola Batistoni at ENEA in Frascati, Italy for providing the details of this benchmark.