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Cross Sections and Differential
Spectra for Reactions of 2-20 MeV
Neutrons on ^{nat}Ni

M. Blann
T. T. Komoto

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CROSS SECTIONS AND DIFFERENTIAL SPECTRA FOR REACTIONS
OF 2-20 MeV NEUTRONS ON ^{nat}Ni

M. Blann and T. T. Komoto
E-Division, Physics Department
Lawrence Livermore National Laboratory
P. O. Box 608
Livermore, California 94550

UCID--21311

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This report summarizes product yields, secondary n,p and α spectra, and γ -ray spectra calculated for incident neutrons of 2-20 MeV on ^{nat}Ni targets.

Results are all from the code ALICE, using the version ALISO which does weighting of results for targets which are a mix of isotopes. Where natural isotopic targets are involved, yields and n,p, α spectra will be reported weighted over isotopic yields. Gamma-ray spectra, however, will be reported for the most abundant isotope.

In Section I, we present product yields versus incident neutron energy. In Section II, we present n,p, α spectra versus incident neutron energy, and in Section III, we present calculated γ -ray spectra.

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SECTION 1

yields from $^{nat}\text{Ni}(n,x)$ Reactions
for 2-20 MeV Incident Neutrons

isotopically weighted results for incident energy 2.00 mev(lab)

Atomic number	28	28	28	28	28	28	28	28	28	28
mass number	65	64	63	62	61	60	59	58	57	56
er xsect s(j)	1.896e+03	1.896e+03	0.	0.	0.	0.	0.	0.	0.	0.
Atomic number	27	27	27	27	27	27	27	27	27	27
mass number	64	63	62	61	60	59	58	57	56	55
er xsect s(j)	9.879e+00	0.	0.	0.	0.	0.	0.	0.	0.	0.
Atomic number	26	26	26	26	26	26	26	26	26	26
mass number	63	62	61	60	59	58	57	56	55	54
er xsect s(j)	0.	0.	9.670e-02	0.	0.	0.	0.	0.	0.	0.

isotopically weighted results for incident energy 3.00 mev(lab)

Atomic number	28	28	28	28	28	28	28	28	28	28
mass number	65	64	63	62	61	60	59	58	57	56
er xsect s(j)	1.714e+03	1.668e+03	0.	0.	0.	0.	0.	0.	0.	0.
Atomic number	27	27	27	27	27	27	27	27	27	27
mass number	64	63	62	61	60	59	58	57	56	55
er xsect s(j)	6.731e+01	0.	0.	0.	0.	0.	0.	0.	0.	0.
Atomic number	26	26	26	26	26	26	26	26	26	26
mass number	63	62	61	60	59	58	57	56	55	54
er xsect s(j)	0.	0.	1.256e+00	0.	0.	0.	0.	0.	0.	0.

isotopically weighted results for incident energy 4.00 mev(lab)

Atomic number	28	28	28	28	28	28	28	28	28	28
mass number	65	64	63	62	61	60	59	58	57	56
er xsect s(j)	1.695e+03	1.551e+03	0.	0.	0.	0.	0.	0.	0.	0.
Atomic number	27	27	27	27	27	27	27	27	27	27
mass number	64	63	62	61	60	59	58	57	56	55
er xsect s(j)	1.698e+02	0.	0.	0.	0.	0.	0.	0.	0.	0.
Atomic number	26	26	26	26	26	26	26	26	26	26
mass number	63	62	61	60	59	58	57	56	55	54
er xsect s(j)	0.	0.	6.622e+00	0.	0.	0.	0.	0.	0.	0.

isotopically weighted results for incident energy 5.00 mev(lab)

Atomic number	28	28	28	28	28	28	28	28	28	28
mass number	65	64	63	62	61	60	59	58	57	56
er xsect s(j)	1.669e+03	1.441e+03	0.	0.	0.	0.	0.	0.	0.	0.
Atomic number	27	27	27	27	27	27	27	27	27	27
mass number	64	63	62	61	60	59	58	57	56	55
er xsect s(j)	2.616e+02	0.	0.	0.	0.	0.	0.	0.	0.	0.
Atomic number	26	26	26	26	26	26	26	26	26	26
mass number	63	62	61	60	59	58	57	56	55	54
er xsect s(j)	0.	0.	1.971e+01	0.	0.	0.	0.	0.	0.	0.

isotopically weighted results for incident energy				6.00 mev(lab)							
Atomic number	28	28	28	28	28	28	28	28	28	28	
mass number	65	64	63	62	61	60	59	58	57	56	
er xsect s(j)	1.600e+03	1.325e+03	0.	0.	0.	0.	0.	0.	0.	0.	
Atomic number	27	27	27	27	27	27	27	27	27	27	
mass number	64	63	62	61	60	59	58	57	56	55	
er xsect s(j)	3.141e+02	0.	0.	0.	0.	0.	0.	0.	0.	0.	
Atomic number	26	26	26	26	26	26	26	26	26	26	
mass number	63	62	61	60	59	58	57	56	55	54	
er xsect s(j)	0.	0.	3.723e+01	0.	0.	0.	0.	0.	0.	0.	

isotopically weighted results for incident energy				7.00 mev(lab)							
Atomic number	28	28	28	28	28	28	28	28	28	28	
mass number	65	64	63	62	61	60	59	58	57	56	
er xsect s(j)	1.521e+03	1.223e+03	0.	0.	0.	0.	0.	0.	0.	0.	
Atomic number	27	27	27	27	27	27	27	27	27	27	
mass number	64	63	62	61	60	59	58	57	56	55	
er xsect s(j)	3.368e+02	0.	0.	0.	0.	0.	0.	0.	0.	0.	
Atomic number	26	26	26	26	26	26	26	26	26	26	
mass number	63	62	61	60	59	58	57	56	55	54	
er xsect s(j)	0.	0.	5.088e+01	0.	0.	0.	0.	0.	0.	0.	

isotopically weighted results for incident energy				8.00 mev(lab)							
Atomic number	28	28	28	28	28	28	28	28	28	28	
mass number	65	64	63	62	61	60	59	58	57	56	
er xsect s(j)	1.438e+03	1.166e+03	0.	0.	0.	0.	0.	0.	0.	0.	
Atomic number	27	27	27	27	27	27	27	27	27	27	
mass number	64	63	62	61	60	59	58	57	56	55	
er xsect s(j)	3.287e+02	0.	0.	0.	0.	0.	0.	0.	0.	0.	
Atomic number	26	26	26	26	26	26	26	26	26	26	
mass number	63	62	61	60	59	58	57	56	55	54	
er xsect s(j)	0.	0.	3.710e+01	0.	0.	0.	0.	0.	0.	0.	

isotopically weighted results for incident energy				9.00 mev(lab)							
Atomic number	28	28	28	28	28	28	28	28	28	28	
mass number	65	64	63	62	61	60	59	58	57	56	
er xsect s(j)	1.370e+03	1.102e+03	3.528e+00	0.	0.	0.	0.	0.	0.	0.	
Atomic number	27	27	27	27	27	27	27	27	27	27	
mass number	64	63	62	61	60	59	58	57	56	55	
er xsect s(j)	3.397e+02	0.	0.	0.	0.	0.	0.	0.	0.	0.	
Atomic number	26	26	26	26	26	26	26	26	26	26	
mass number	63	62	61	60	59	58	57	56	55	54	
er xsect s(j)	0.	0.	6.122e+01	0.	0.	0.	0.	0.	0.	0.	

isotopically weighted results for incident energy 10.00 mev(lab)

Atomic number	28	28	28	28	28	28	28	28	28	28
mass number	65	64	63	62	61	60	59	58	57	56
er xsect s(j)	1.315e+03	1.017e+03	7.626e+00	0.	0.	0.	0.	0.	0.	0.
Atomic number	27	27	27	27	27	27	27	27	27	27
mass number	64	63	62	61	60	59	58	57	56	55
er xsect s(j)	3.410e+02	0.	0.	0.	0.	0.	0.	0.	0.	0.
Atomic number	26	26	26	26	26	26	26	26	26	26
mass number	63	62	61	60	59	58	57	56	55	54
er xsect s(j)	5.524e-02	0.	6.355e+01	0.	0.	0.	0.	0.	0.	0.

isotopically weighted results for incident energy 11.00 mev(lab)

Atomic number	28	28	28	28	28	28	28	28	28	28
mass number	65	64	63	62	61	60	59	58	57	56
er xsect s(j)	1.269e+03	8.297e+02	1.300e+01	0.	0.	0.	0.	0.	0.	0.
Atomic number	27	27	27	27	27	27	27	27	27	27
mass number	64	63	62	61	60	59	58	57	56	55
er xsect s(j)	3.400e+02	1.304e+02	0.	0.	0.	0.	0.	0.	0.	0.
Atomic number	26	26	26	26	26	26	26	26	26	26
mass number	63	62	61	60	59	58	57	56	55	54
er xsect s(j)	1.519e+00	0.	6.415e+01	0.	0.	0.	0.	0.	0.	0.

PAGE

isotopically weighted results for incident energy 12.00 mev(lab)

Atomic number	28	28	28	28	28	28	28	28	28	28
mass number	65	64	63	62	61	60	59	58	57	56
er xsect s(j)	1.232e+03	6.264e+02	4.419e+01	0.	0.	0.	0.	0.	0.	0.
Atomic number	27	27	27	27	27	27	27	27	27	27
mass number	64	63	62	61	60	59	58	57	56	55
er xsect s(j)	3.308e+02	3.190e+02	0.	0.	0.	0.	0.	0.	0.	0.
Atomic number	26	26	26	26	26	26	26	26	26	26
mass number	63	62	61	60	59	58	57	56	55	54
er xsect s(j)	2.777e-01	0.	6.634e+01	4.538e+00	0.	0.	0.	0.	0.	0.

isotopically weighted results for incident energy 14.00 mev(lab)

Atomic number	28	28	28	28	28	28	28	28	28	28
mass number	65	64	63	62	61	60	59	58	57	56
er xsect s(j)	1.163e+03	3.473e+02	2.420e+02	0.	0.	0.	0.	0.	0.	0.
Atomic number	27	27	27	27	27	27	27	27	27	27
mass number	64	63	62	61	60	59	58	57	56	55
er xsect s(j)	2.450e+02	4.416e+02	0.	0.	0.	0.	0.	0.	0.	0.
Atomic number	26	26	26	26	26	26	26	26	26	26
mass number	63	62	61	60	59	58	57	56	55	54
er xsect s(j)	1.282e+00	0.	7.288e+01	3.527e+01	0.	0.	0.	0.	0.	0.

isotopically weighted results for incident energy 16.00 mev(lab)

Atomic number	28	28	28	28	28	28	28	28	28	28
mass number	65	64	63	62	61	60	59	58	57	56
er xsct s(j)	1.076e+03	2.437e+02	3.490e+02	0.	0.	0.	0.	0.	0.	0.
Atomic number	27	27	27	27	27	27	27	27	27	27
mass number	64	63	62	61	60	59	58	57	56	55
er xsct s(j)	1.586e+02	4.960e+02	0.	0.	0.	0.	0.	0.	0.	0.
Atomic number	26	26	26	26	26	26	26	26	26	26
mass number	63	62	61	60	59	58	57	56	55	54
er xsct s(j)	5.069e+00	0.	6.472e+01	5.157e+01	0.	0.	0.	0.	0.	0.

isotopically weighted results for incident energy 18.00 mev(lab)

Atomic number	28	28	28	28	28	28	28	28	28	28
mass number	65	64	63	62	61	60	59	58	57	56
er xsct s(j)	9.796e+02	1.667e+02	4.121e+02	0.	0.	0.	0.	0.	0.	0.
Atomic number	27	27	27	27	27	27	27	27	27	27
mass number	64	63	62	61	60	59	58	57	56	55
er xsct s(j)	1.060e+02	5.199e+02	0.	0.	0.	0.	0.	0.	0.	0.
Atomic number	26	26	26	26	26	26	26	26	26	26
mass number	63	62	61	60	59	58	57	56	55	54
er xsct s(j)	1.184e+01	0.	3.716e+01	8.378e+01	0.	0.	0.	0.	0.	0.

isotopically weighted results for incident energy 20.00 mev(lab)

Atomic number	28	28	28	28	28	28	28	28	28	28
mass number	65	64	63	62	61	60	59	58	57	56
er xsct s(j)	8.795e+02	1.354e+02	4.436e+02	9.314e-01	0.	0.	0.	0.	0.	0.
Atomic number	27	27	27	27	27	27	27	27	27	27
mass number	64	63	62	61	60	59	58	57	56	55
er xsct s(j)	8.034e+01	5.088e+02	1.909e-02	0.	0.	0.	0.	0.	0.	0.
Atomic number	26	26	26	26	26	26	26	26	26	26
mass number	63	62	61	60	59	58	57	56	55	54
er xsct s(j)	1.923e+01	1.921e+00	1.710e+01	1.013e+02	0.	0.	0.	0.	0.	0.

SECTION 2

Particle Spectra from $^{nat}\text{Ni}(n,x)$ Reactions
for 2-20 MeV Incident Neutrons

isotopically weighted results for incident energy 2.00 mev(lab)

ke	ds/de(mb/mev)=	neutrons	protons	alphas	deuterons
0.250		6.3137e+02	0.	0.	0.
0.750		1.0609e+03	0.	0.	0.
1.250		1.1276e+03	0.	0.	0.
1.750		9.7161e+02	2.6075e+00	0.	0.
2.250		0.	1.7150e+01	0.	0.
4.750		0.	0.	1.9059e-01	0.
5.250		0.	0.	2.8119e-03	0.

isotopically weighted results for incident energy 3.00 mev(lab)

ke	ds/de(mb/mev)=	neutrons	protons	alphas	deuterons
0.250		4.0627e+02	0.	0.	0.
0.750		6.8533e+02	0.	0.	0.
1.250		7.2661e+02	0.	0.	0.
1.750		6.2727e+02	1.7366e+00	0.	0.
2.250		5.0201e+02	1.1465e+01	0.	0.
2.750		5.9147e+02	3.8105e+01	0.	0.
3.250		0.	3.321e+01	0.	0.
4.750		0.	0.	1.2458e-01	0.
5.250		0.	0.	5.4994e-01	0.
5.750		0.	0.	1.8228e+00	0.
6.250		0.	0.	1.5555e-02	0.

isotopically weighted results for incident energy 4.00 mev(lab)

ke	ds/de(mb/mev)=	neutrons	protons	alphas	deuterons
0.250		3.2432e+02	0.	0.	0.
0.750		5.4574e+02	0.	0.	0.
1.250		5.8029e+02	0.	0.	0.
1.750		5.0141e+02	1.4158e+00	0.	0.
2.250		4.0274e+02	6.6652e+00	0.	0.
2.750		3.1512e+02	2.8947e+01	0.	0.
3.250		2.4495e+02	6.3316e+01	0.	0.
3.750		1.8770e+02	1.0291e+02	0.	0.
4.250		0.	1.3445e+02	0.	0.
4.750		0.	0.	1.0702e-01	0.
5.250		0.	0.	4.7078e-01	0.
5.750		0.	0.	1.3532e+00	0.
6.250		0.	0.	3.5596e+00	0.
6.750		0.	0.	7.7026e+00	0.
7.250		0.	0.	5.0911e-02	0.

isotopically weighted results for incident energy 5.00 mev(lab)

ke	ds/de(mb/mev)=	neutrons	protons	alphas	deuterons
0.250		2.7703e+02	0.	0.	0.
0.750		4.6673e+02	0.	0.	0.
1.250		4.9643e+02	0.	0.	0.
1.750		4.2255e+02	1.1569e+00	0.	0.
2.250		3.4529e+02	7.6600e+00	0.	0.
2.750		2.7191e+02	2.5640e+01	0.	0.
3.250		2.1291e+02	5.1563e+01	0.	0.
3.750		1.6506e+02	8.4078e+01	0.	0.
4.250		1.2555e+02	1.1000e+02	0.	0.
4.750		9.1953e+01	1.2223e+02	8.6577e-02	0.
5.250		0.	1.2101e+02	3.8072e-01	0.
5.750		0.	0.	1.2567e+00	0.
6.250		0.	0.	3.2927e+00	0.
6.750		0.	0.	6.1353e+00	0.
7.250		0.	0.	1.1126e+01	0.
7.750		0.	0.	1.7065e+01	0.
8.250		0.	0.	8.1213e-02	0.

isotopically weighted results for incident energy 6.00 mev(lab)

ke	ds/de(mb/mev)=	neutrons	protons	alphas	deuterons
0.250		2.4191e+02	0.	0.	0.
0.750		4.0829e+02	0.	0.	0.
1.250		4.3479e+02	0.	0.	0.
1.750		3.7687e+02	9.8161e-01	0.	0.
2.250		3.0353e+02	6.5022e+00	0.	0.
2.750		2.4004e+02	2.1717e+01	0.	0.
3.250		1.8913e+02	4.7512e+01	0.	0.
3.750		1.4798e+02	7.7321e+01	0.	0.
4.250		1.1416e+02	9.5207e+01	0.	0.
4.750		8.6471e+01	1.0309e+02	7.2774e-02	0.
5.250		6.4230e+01	1.0303e+02	3.1986e-01	0.
5.750		4.2972e+01	9.3754e+01	1.0503e+00	0.
6.250		0.	8.0353e+01	2.7511e+00	0.
6.750		0.	0.	5.9249e+00	0.
7.250		0.	0.	1.0703e+01	0.
7.750		0.	0.	1.4116e+01	0.
8.250		0.	0.	1.8465e+01	0.
8.750		0.	0.	2.0990e+01	0.
9.250		0.	0.	7.4907e-02	0.

isotopically weighted results for incident energy 7.00 mev(lab)

ke	ds/de(mb/mev)=	neutrons	protons	alphas	deuterons
0.250		2.1688e+02	0.	0.	0.
0.750		3.6632e+02	0.	0.	0.
1.250		3.9027e+02	0.	0.	0.
1.750		3.3843e+02	8.6711e-02	0.	0.
2.250		2.7296e+02	5.7451e+00	0.	0.
2.750		2.1635e+02	1.9153e+01	0.	0.
3.250		1.7105e+02	4.1912e+01	0.	0.
3.750		1.3453e+02	6.8206e+01	0.	0.
4.250		1.0461e+02	8.9094e+01	0.	0.
4.750		8.0221e+01	9.9042e+01	6.3085e-02	0.
5.250		6.0738e+01	9.0719e+01	2.7724e-01	0.
5.750		4.4057e+01	8.2755e+01	9.1455e-01	0.
6.250		3.0671e+01	7.1054e+01	2.3946e+00	0.
6.750		1.9890e+01	5.8374e+01	5.1339e+00	0.
7.250		0.	4.6674e+01	9.2697e+00	0.
7.750		0.	0.	1.4148e+01	0.
8.250		0.	0.	1.5911e+01	0.
8.750		0.	0.	1.8086e+01	0.
9.250		0.	0.	1.8365e+01	0.
9.750		0.	0.	1.7139e+01	0.
10.250		0.	0.	5.0331e-02	0.

isotopically weighted results for incident energy 8.00 mev(lab)

ke	ds/de(mb/mev)=	neutrons	protons	alphas	deuterons
0.250		2.0150e+02	0.	0.	0.
0.750		3.4059e+02	0.	0.	0.
1.250		3.6319e+02	0.	0.	0.
1.750		3.1544e+02	7.5056e-01	0.	0.
2.250		2.5497e+02	4.9756e+00	0.	0.
2.750		2.0269e+02	1.6630e+01	0.	0.
3.250		1.6089e+02	3.6419e+01	0.	0.
3.750		1.2723e+02	5.9216e+01	0.	0.
4.250		9.9696e+01	7.7432e+01	0.	0.
4.750		7.7291e+01	8.6190e+01	5.3818e-02	0.
5.250		5.9451e+01	8.5490e+01	2.5645e-01	0.
5.750		4.5470e+01	7.8078e+01	7.7960e-01	0.
6.250		3.3542e+01	6.1887e+01	2.0408e+00	0.
6.750		2.4103e+01	5.1126e+01	4.3937e+00	0.
7.250		1.6513e+01	4.1109e+01	7.9290e+00	0.
7.750		8.9143e+00	3.2499e+01	1.2044e+01	0.
8.250		0.	2.5579e+01	1.5671e+01	0.
8.750		0.	0.	1.7722e+01	0.
9.250		0.	0.	1.5497e+01	0.
9.750		0.	0.	1.4461e+01	0.
10.250		0.	0.	1.2692e+01	0.
10.750		0.	0.	1.0656e+01	0.
11.250		0.	0.	2.6369e-02	0.

isotopically weighted results for incident energy 9.00 mev (lab)

ke ds/de(mb/mev)=	neutrons	protons	alphas	deuterons
0.250	1.9060e+02	0.	0.	0.
0.750	1.1646e+02	0.	0.	0.
1.250	1.3749e+02	0.	0.	0.
1.750	2.9356e+02	7.3549e-01	0.	0.
2.250	2.3780e+02	4.8778e+00	0.	0.
2.750	1.8960e+02	1.6307e+01	0.	0.
3.250	1.5107e+02	5.372e+01	0.	0.
3.750	1.2007e+02	5.8249e+01	0.	0.
4.250	9.4727e+01	7.6242e+01	0.	0.
4.750	7.4111e+01	8.4801e+01	2.1463e-02	0.
5.250	5.7711e+01	8.4225e+01	2.2615e-01	0.
5.750	4.5005e+01	7.7050e+01	7.4598e-01	0.
6.250	3.4840e+01	6.6494e+01	1.9531e+00	0.
6.750	2.6480e+01	5.141e+01	4.2501e+01	0.
7.250	1.9870e+01	4.0926e+01	5.904e+00	0.
7.750	1.4518e+01	3.2542e+01	1.1581e+01	0.
8.250	1.0053e+01	2.8756e+01	1.8065e+01	0.
8.750	3.9179e+00	2.0383e+01	1.6979e+01	0.
9.250	0.	0.	1.7163e+01	0.
9.750	0.	0.	1.5950e+01	0.
10.250	0.	0.	1.2250e+01	0.
10.750	0.	0.	1.0284e+01	0.
11.250	0.	0.	8.3557e+00	0.
11.750	0.	0.	1.9477e-02	0.
12.250	0.	0.	1.4539e-02	0.

isotopically weighted results for incident energy 10.00 mev (lab)

ke ds/de(mb/mev)=	neutrons	protons	alphas	deuterons
0.250	1.7873e+02	0.	0.	0.
0.750	3.0192e+02	0.	0.	0.
1.250	3.2515e+02	0.	0.	0.
1.750	2.8141e+02	5.6694e-01	0.	0.
2.250	2.2868e+02	4.1810e+00	0.	0.
2.750	1.8278e+02	1.3503e+01	0.	0.
3.250	1.4612e+02	5.366e+01	0.	0.
3.750	1.1662e+02	5.5066e+01	0.	0.
4.250	9.2512e+01	7.2137e+01	0.	0.
4.750	7.2908e+01	8.0484e+01	4.7672e-02	0.
5.250	5.7320e+01	8.0068e+01	2.0947e-01	0.
5.750	4.5253e+01	7.3226e+01	6.9087e-01	0.
6.250	3.6028e+01	6.3364e+01	1.8086e+00	0.
6.750	2.8352e+01	5.2736e+01	3.8942e+00	0.
7.250	2.2362e+01	4.2814e+01	7.0283e+00	0.
7.750	1.7611e+01	3.4319e+01	1.0720e+01	0.
8.250	1.3742e+01	2.4923e+01	1.3946e+01	0.
8.750	1.0473e+01	1.9936e+01	1.5769e+01	0.
9.250	6.8928e+00	1.6089e+01	1.5934e+01	0.
9.750	1.8730e+00	1.2975e+01	1.4754e+01	0.
10.250	0.	0.	1.2898e+01	0.
10.750	0.	0.	1.0789e+01	0.
11.250	0.	0.	7.7147e+00	0.
11.750	0.	0.	6.1154e+00	0.
12.250	0.	0.	4.7566e+00	0.
12.750	0.	0.	1.2171e-02	0.
13.250	0.	0.	8.8514e-03	0.

isotopically weighted results for incident energy 11.00 mev(lab)

ke	ds/de(mb/mev)*	neutrons	protons	alphas	deuterons
0.250		1.6234e+02	0.	0.	0.
0.750		2.8196e+02	0.	0.	0.
1.250		3.1384e+02	0.	0.	0.
1.750		2.7873e+02	1.7936e+02	0.	0.
2.250		2.2827e+02	8.4436e+01	0.	0.
2.750		1.8308e+02	1.2238e+01	0.	0.
3.250		1.4684e+02	2.9791e+01	0.	0.
3.750		1.1735e+02	5.3465e+01	0.	0.
4.250		9.3258e+01	7.0065e+01	0.	0.
4.750		7.3694e+01	7.8185e+01	4.5271e-02	0.
5.250		5.8166e+01	7.7832e+01	1.9903e-01	0.
5.750		4.6170e+01	7.1423e+01	6.5643e-01	0.
6.250		3.7080e+01	6.1896e+01	1.7180e+00	0.
6.750		2.9803e+01	5.1446e+01	3.6981e+00	0.
7.250		2.4123e+01	4.1883e+01	6.6724e+00	0.
7.750		1.9708e+01	3.3704e+01	1.0176e+01	0.
8.250		1.6201e+01	2.7086e+01	1.3234e+01	0.
8.750		1.3336e+01	2.1889e+01	1.4956e+01	0.
9.250		1.0795e+01	1.5938e+01	1.5109e+01	0.
9.750		7.6337e+00	1.3090e+01	1.4053e+01	0.
10.250		4.6035e+00	1.0703e+01	1.2263e+01	0.
10.750		9.5194e-01	8.7625e+00	1.0218e+01	0.
11.250		0.	0.	8.2720e+00	0.
11.750		0.	0.	6.5346e+00	0.
12.250		0.	0.	4.4789e+00	0.
12.750		0.	0.	3.4319e+00	0.
13.250		0.	0.	2.5981e+00	0.
13.750		0.	0.	7.2115e-03	0.
14.250		0.	0.	5.1538e-03	0.

isotopically weighted results for incident energy 12.00 mev(lab)

ke	ds/de(mb/mev)=	neutrons	protons	alphas	deuterons
0.250		1.9404e+02	0.	0.	0.
0.750		2.5280e+02	0.	0.	0.
1.250		2.5348e+02	0.	0.	0.
1.750		2.5302e+02	0.	0.	0.
2.250		2.3295e+02	1.5606e+02	0.	0.
2.750		1.9287e+02	1.9287e+02	0.	0.
3.250		1.9066e+02	1.5781e+02	0.	0.
3.750		1.5431e+02	7.1314e+01	0.	0.
4.250		1.2389e+02	4.4721e+01	0.	0.
4.750		9.8808e+01	6.4982e+01	0.	0.
5.250		7.8175e+01	7.9697e+01	8.8541e+00	0.
5.750		6.1819e+01	7.9398e+01	4.0183e+01	0.
6.250		4.9201e+01	7.2907e+01	6.5778e+01	0.
6.750		3.9672e+01	6.3270e+01	1.7225e+00	0.
7.250		3.2244e+01	5.2862e+01	3.7072e+00	0.
7.750		2.6509e+01	4.3171e+01	6.6860e+00	0.
8.250		2.2130e+01	3.4710e+01	1.0192e+01	0.
8.750		1.8734e+01	2.8026e+01	1.3249e+01	0.
9.250		1.6041e+01	2.2789e+01	1.4970e+01	0.
9.750		1.3840e+01	1.6745e+01	1.5117e+01	0.
10.250		1.1966e+01	1.5648e+01	1.4033e+01	0.
10.750		9.3613e+00	1.1335e+01	1.2259e+01	0.
11.250		6.6645e+00	9.4997e+00	1.0247e+01	0.
11.750		5.9821e+00	8.0344e+00	8.2909e+00	0.
12.250		5.3141e-01	6.8162e+00	6.5237e+00	0.
12.750		0.	0.	5.0562e+00	0.
13.250		0.	0.	3.8610e+00	0.
13.750		0.	0.	2.5707e+00	0.
14.250		0.	0.	1.9271e+00	0.
14.750		0.	0.	1.4329e+00	0.
15.250		0.	0.	4.3145e-03	0.
				3.6452e-03	0.

isotopically weighted results for incident energy 14.00 mev(lab)

ka	ds/de(mb/mev)=	neutrons	protons	alphas	deuterons
0.250		3.7094e+02	0.	0.	0.
0.750		3.7607e+02	0.	0.	0.
1.250		3.1974e+02	0.	0.	0.
1.750		2.5987e+02	1.0430e+02	0.	0.
2.250		2.1848e+02	1.3443e+02	0.	0.
2.750		1.9008e+02	1.5714e+02	0.	0.
3.250		1.6940e+02	1.6211e+02	0.	0.
3.750		1.4482e+02	1.4118e+02	0.	0.
4.250		1.2059e+02	1.0884e+02	0.	0.
4.750		9.7010e+01	8.7845e+01	6.0430e+01	0.
5.250		7.6960e+01	7.6580e+01	8.5510e+01	0.
5.750		6.0952e+01	7.1145e+01	1.5729e+00	0.
6.250		4.8771e+01	6.8089e+01	2.6790e+00	0.
6.750		3.9500e+01	6.0513e+01	4.5130e+00	0.
7.250		3.2526e+01	4.9745e+01	7.4543e+00	0.
7.750		2.7350e+01	4.0177e+01	1.1494e+01	0.
8.250		2.3487e+01	3.2493e+01	1.4942e+01	0.
8.750		2.0572e+01	2.6484e+01	1.6365e+01	0.
9.250		1.8336e+01	2.1860e+01	1.7915e+01	0.
9.750		1.6581e+01	1.8138e+01	1.5783e+01	0.
10.250		1.5163e+01	1.5558e+01	1.3777e+01	0.
10.750		1.3972e+01	1.3202e+01	1.1506e+01	0.
11.250		1.2251e+01	1.1523e+01	9.3034e+00	0.
11.750		1.0120e+01	8.3618e+00	7.3395e+00	0.
12.250		7.9853e+00	7.4168e+00	5.6037e+00	0.
12.750		5.8026e+00	6.6565e+00	4.3360e+00	0.
13.250		5.3139e+00	5.9886e+00	3.2699e+00	0.
13.750		2.2026e-01	9.4735e+00	2.4525e+00	0.
14.250		0.	0.	1.8023e+00	0.
14.750		0.	0.	1.3263e+00	0.
15.250		0.	0.	8.5005e-01	0.
15.750		0.	0.	6.2089e-01	0.
16.250		0.	0.	4.9153e-01	0.
16.750		0.	0.	1.4501e-03	0.
17.250		0.	0.	1.0069e-03	0.

isotopically weighted results for incident energy 16.00 mev(lab)

ke	ds/de(mb/mev)=	neutrons	protons	alphas	deuterons
0.250		3.9388e+02	0.	0.	0.
0.750		4.4632e+02	0.	0.	0.
1.250		3.9261e+02	0.	0.	0.
1.750		5.0609e+02	6.6793e+01	0.	0.
2.250		2.3599e+02	8.5733e+01	0.	0.
2.750		1.8795e+02	1.0843e+02	0.	0.
3.250		1.5649e+02	1.2463e+02	0.	0.
3.750		1.3527e+02	1.2625e+02	0.	0.
4.250		1.1802e+02	1.1652e+02	0.	0.
4.750		1.0283e+02	1.0585e+02	3.8059e+01	0.
5.250		8.9142e+01	9.3541e+01	6.1344e+01	0.
5.750		8.2657e+01	8.0777e+01	1.3077e+00	0.
6.250		5.9656e+01	6.9133e+01	2.6078e+00	0.
6.750		4.7895e+01	5.9662e+01	4.8840e+00	0.
7.250		3.9050e+01	5.2339e+01	8.2591e+00	0.
7.750		3.2414e+01	4.6209e+01	1.2277e+01	0.
8.250		2.7510e+01	4.0432e+01	1.6175e+01	0.
8.750		2.3663e+01	3.4509e+01	1.9256e+01	0.
9.250		2.1162e+01	2.7996e+01	2.1145e+01	0.
9.750		1.9137e+01	2.2987e+01	2.1414e+01	0.
10.250		1.7593e+01	1.9156e+01	1.8706e+01	0.
10.750		1.6383e+01	1.6210e+01	1.5619e+01	0.
11.250		1.5424e+01	1.3959e+01	1.2626e+01	0.
11.750		1.4611e+01	1.2063e+01	9.9606e+00	0.
12.250		1.3304e+01	1.0745e+01	7.7118e+00	0.
12.750		1.1737e+01	9.6841e+00	5.8830e+00	0.
13.250		1.0162e+01	8.7491e+00	4.4548e+00	0.
13.750		8.5555e+00	6.4953e+00	3.3104e+00	0.
14.250		6.7604e+00	6.0284e+00	2.4518e+00	0.
14.750		4.6397e+00	5.6451e+00	1.8036e+00	0.
15.250		2.4693e+00	5.2821e+00	1.3192e+00	0.
15.750		2.7495e-04	4.6607e+00	9.5672e-01	0.
16.250		0.	0.	6.9344e-01	0.
16.750		0.	0.	5.0073e-01	0.
17.250		0.	0.	3.1837e-01	0.
17.750		0.	0.	2.2915e-01	0.
18.250		0.	0.	1.6449e-01	0.
18.750		0.	0.	5.3194e-04	0.
19.250		0.	0.	3.6560e-04	0.

isotopically weighted results for incident energy 18.00 mev(lab)

ke	ds/de(mb/mev):	neutrons	protons	alphas	deuterons
0.250		3.5743e+02	0.	0.	0.
0.750		4.4037e+02	0.	0.	0.
1.250		4.2023e+02	0.	0.	0.
1.750		3.4491e+02	3.6532e+01	0.	0.
2.250		2.7211e+02	4.9932e+01	0.	0.
2.750		2.1649e+02	7.0363e+01	0.	0.
3.250		1.7580e+02	9.2082e+01	0.	0.
3.750		1.4508e+02	1.0683e+02	0.	0.
4.250		1.2086e+02	1.1259e+02	0.	0.
4.750		1.0139e+02	1.1185e+02	1.9501e+01	0.
5.250		8.5705e+01	1.0474e+02	4.5843e-01	0.
5.750		7.3019e+01	9.3459e+01	1.1097e+00	0.
6.250		6.2494e+01	8.0582e+01	2.4451e+00	0.
6.750		5.3720e+01	6.8064e+01	4.8529e+00	0.
7.250		4.6471e+01	5.7018e+01	8.4887e+00	0.
7.750		3.8866e+01	4.7897e+01	1.2956e+01	0.
8.250		3.3119e+01	4.0542e+01	1.7255e+01	0.
8.750		2.8190e+01	3.4885e+01	2.0323e+01	0.
9.250		2.4553e+01	3.0456e+01	2.1677e+01	0.
9.750		2.1850e+01	2.6767e+01	2.1494e+01	0.
10.250		1.9795e+01	2.3560e+01	2.0278e+01	0.
10.750		1.8261e+01	2.0436e+01	1.8556e+01	0.
11.250		1.7093e+01	1.7176e+01	1.6574e+01	0.
11.750		1.6183e+01	1.4655e+01	1.4281e+01	0.
12.250		1.5451e+01	1.2780e+01	1.1064e+01	0.
12.750		1.4770e+01	1.1350e+01	8.4368e+00	0.
13.250		1.3644e+01	1.0252e+01	6.3574e+00	0.
13.750		1.2495e+01	9.1850e+00	4.7445e+00	0.
14.250		1.1343e+01	8.4470e+00	3.5126e+00	0.
14.750		1.0182e+01	7.8430e+00	2.5830e+00	0.
15.250		9.0080e+00	7.3387e+00	1.8885e+00	0.
15.750		7.5714e+00	5.5936e+00	1.3737e+00	0.
16.250		5.7956e+00	5.2775e+00	9.9519e-01	0.
16.750		3.9895e+00	4.8267e+00	7.1827e-01	0.
17.250		2.0749e+00	4.3102e+00	5.1668e-01	0.
17.750		0.	3.9460e+00	3.6931e-01	0.
18.250		0.	0.	2.6423e-01	0.
18.750		0.	0.	1.8861e-01	0.
19.250		0.	0.	1.1899e-01	0.
19.750		0.	0.	8.4847e-02	0.
20.250		0.	0.	6.0583e-02	0.
20.750		0.	0.	2.0784e-04	0.
21.250		0.	0.	1.4185e-04	0.

isotopically weighted results for incident energy 20 00 mev(lab)

ke	ds/de(mb/mev)=	neutrons	protons	alphas	deuterons
0.250		2.7947e+02	0.	0.	0.
0.750		4.0387e+02	0.	0.	0.
1.250		4.0974e+02	0.	0.	0.
1.750		3.5135e+02	6.6064e+01	0.	0.
2.250		2.8435e+02	6.2944e+01	0.	0.
2.750		2.3308e+02	4.8605e+01	0.	0.
3.250		1.9195e+02	6.9443e+01	0.	0.
3.750		1.5940e+02	8.8313e+01	0.	0.
4.250		1.3264e+02	1.0117e+02	0.	0.
4.750		1.1031e+02	1.0646e+02	1.0790e+01	0.
5.250		9.1807e+01	1.0379e+02	3.5666e+01	0.
5.750		7.6705e+01	9.5368e+01	9.3872e+01	0.
6.250		6.4566e+01	8.4004e+01	2.7092e+00	0.
6.750		5.4918e+01	7.2007e+01	4.5736e+00	0.
7.250		4.7253e+01	6.0839e+01	8.2079e+00	0.
7.750		4.1077e+01	5.1198e+01	1.2707e+01	0.
8.250		3.6062e+01	4.3229e+01	1.7037e+01	0.
8.750		3.1972e+01	3.6786e+01	2.0128e+01	0.
9.250		2.8707e+01	3.1608e+01	2.1522e+01	0.
9.750		2.5415e+01	2.7427e+01	2.1399e+01	0.
10.250		2.2930e+01	2.4034e+01	2.0209e+01	0.
10.750		2.0816e+01	2.1255e+01	1.8395e+01	0.
11.250		1.9231e+01	1.8523e+01	1.6294e+01	0.
11.750		1.8016e+01	1.6908e+01	1.4145e+01	0.
12.250		1.7078e+01	1.5188e+01	1.2102e+01	0.
12.750		1.6337e+01	1.3493e+01	1.0255e+01	0.
13.250		1.5725e+01	1.1949e+01	8.3337e+00	0.
13.750		1.4978e+01	1.0721e+01	6.3616e+00	0.
14.250		1.4074e+01	9.8245e+00	5.6329e+00	0.
14.750		1.3192e+01	9.0868e+00	5.7356e+00	0.
15.250		1.2321e+01	8.3214e+00	5.7296e+00	0.
15.750		1.1457e+01	7.8614e+00	5.9848e+00	0.
16.250		1.0596e+01	7.4862e+00	1.4371e+00	0.
16.750		9.7326e+00	7.1739e+00	1.0366e+00	0.
17.250		8.4056e+00	6.7677e+00	7.4530e-01	0.
17.750		6.8636e+00	5.0120e+00	5.3418e-01	0.
18.250		5.2981e+00	4.7074e+00	3.8194e-01	0.
18.750		3.6814e+00	4.4112e+00	2.7247e-01	0.
19.250		1.7774e+00	4.0852e+00	1.9525e-01	0.
19.750		0.	3.7979e+00	1.3732e-01	0.
20.250		0.	0.	9.7405e-02	0.
20.750		0.	0.	6.4976e-02	0.
21.250		0.	0.	4.3054e-02	0.
21.750		0.	0.	3.0497e-02	0.
22.250		0.	0.	2.1574e-02	0.
22.750		0.	0.	8.0244e-03	0.
23.250		0.	0.	5.4494e-03	0.

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SECTION 3

γ -ray Spectra Following $^{nat}\text{Ni}(n, \_)$ Reactions

laboratory bombardment energy = 2.0mev   target mass = 58.0
 compound nucleus mass = 59.0   compound nucleus formation q value = 9.0
 compound nucleus atomic number = 28   mass num= 59
 total reaction cross section = 1917.5
 excitation energy of compound nucleus = 11.0mev   j= 0
 reaction cross section 1917.5

0 gamma (mev)	cross section (mb/mev) (mb/Sr.meV)
5.000e-01	1.968e+03 1.562e+02
1.000e+00	1.053e+03 8.357e+01
1.500e+00	3.571e+02 2.834e+01
2.000e+00	6.055e+00 4.806e-01
2.500e+00	1.260e+01 9.999e-01
3.000e+00	2.160e+01 1.714e+00
3.500e+00	3.230e+01 2.564e+00
4.000e+00	4.555e+01 3.456e+00
4.500e+00	5.394e+01 4.281e+00
5.000e+00	6.209e+01 4.927e+00
5.500e+00	6.683e+01 5.304e+00
6.000e+00	6.741e+01 5.350e+00
6.500e+00	6.364e+01 5.051e+00
7.000e+00	5.594e+01 4.440e+00
7.500e+00	4.532e+01 3.597e+00
8.000e+00	3.324e+01 2.638e+00
8.500e+00	2.143e+01 1.701e+00
9.000e+00	1.151e+01 9.137e-01
9.500e+00	4.631e+00 3.675e-01
1.000e+01	1.066e+00 8.479e-02
1.050e+01	3.908e-02 3.102e-03

laboratory bombardment energy = 3.0mev target mass = 58.0
 compound nucleus mass = 59.0 compound nucleus formation q value = 9.0
 compound nucleus atomic number = 28 mass num= 59
 total reaction cross section = 1725.0
 excitation energy of compound nucleus = 11.9mev j= 0
 reaction cross section 1725.0

e gamma (mev)	cross section	
	(mb/mev)	(mb/Sr.meV)
5.000e-01	1.737e+03	1.379e+02
1.000e+00	1.130e+03	8.966e+01
1.500e+00	7.474e+02	5.932e+01
2.000e+00	4.073e+02	3.233e+01
2.500e+00	1.416e+02	1.124e+01
3.000e+00	1.317e+01	1.046e+00
3.500e+00	2.029e+01	1.611e+00
4.000e+00	2.829e+01	2.245e+00
4.500e+00	3.640e+01	2.889e+00
5.000e+00	4.379e+01	3.476e+00
5.500e+00	4.964e+01	3.939e+00
6.000e+00	5.324e+01	4.225e+00
6.500e+00	5.412e+01	4.295e+00
7.000e+00	5.209e+01	4.134e+00
7.500e+00	4.730e+01	3.754e+00
8.000e+00	4.025e+01	3.195e+00
8.500e+00	3.173e+01	2.518e+00
9.000e+00	2.273e+01	1.804e+00
9.500e+00	1.456e+01	1.139e+00
1.000e+01	7.563e+00	6.002e-01
1.050e+01	2.978e+00	2.363e-01
1.100e+01	6.645e-01	5.274e-02
1.150e+01	2.158e-02	1.712e-03

laboratory bombardment energy = 4.0mev target mass = 58.0
 compound nucleus mass = 59.0 compound nucleus formation q value = 9.0
 compound nucleus atomic number = 28 mass num= 59
 total reaction cross section = .1703.3
 excitation energy of compound nucleus = 12.9mev j= 0
 reaction cross section 1703.3

e gamma (mev)	cross section	
	(mb/mev)	(mb/sr.meV)
5.000e-01	1.713e+03	1.360e+02
1.000e+00	1.079e+03	8.720e+01
1.500e+00	7.855e+02	6.234e+01
2.000e+00	5.703e+02	4.526e+01
2.500e+00	3.803e+02	3.018e+01
3.000e+00	2.035e+02	1.615e+01
3.500e+00	6.743e+01	5.351e+00
4.000e+00	7.235e+01	5.742e+00
4.500e+00	9.590e+01	7.611e+00
5.000e+00	1.193e+00	9.469e-02
5.500e+00	1.405e+00	1.111e-01
6.000e+00	1.576e+00	1.251e-01
6.500e+00	1.687e+00	1.339e-01
7.000e+00	1.727e+00	1.371e-01
7.500e+00	1.690e+00	1.341e-01
8.000e+00	1.576e+00	1.251e-01
8.500e+00	1.394e+00	1.106e-01
9.000e+00	1.160e+00	9.209e-02
9.500e+00	8.982e-01	7.128e-02
1.000e+01	6.340e-01	5.032e-02
1.050e+01	3.956e-01	3.139e-02
1.100e+01	2.065e-01	1.639e-02
1.150e+01	8.113e-02	6.439e-03
1.200e+01	1.924e-02	1.527e-03
1.250e+01	3.026e-03	2.401e-04

laboratory bombardment energy 5.0mev target mass = 58.0
 compound nucleus mass = 59.0 compound nucleus formation q value = 9.0
 compound nucleus atomic number = 28 mass num= 59
 total reaction cross section = 1701.5
 excitation energy of compound nucleus = 13.9mev j= 0
 reaction cross section 1701.5

e gamma (mev)	cross section	
	(mb/mev)	(mb/gr.mev)
5.000e-01	1.755e+03	1.377e+02
1.000e+00	1.131e+03	8.978e+01
1.500e+00	8.113e+02	6.439e+01
2.000e+00	6.050e+02	4.801e+01
2.500e+00	4.547e+02	3.609e+01
3.000e+00	3.313e+02	2.630e+01
3.500e+00	2.192e+02	1.740e+01
4.000e+00	1.176e+02	9.333e+00
4.500e+00	4.121e+01	3.270e+00
5.000e+00	4.500e+00	3.571e-01
5.500e+00	5.459e+00	4.333e-01
6.000e+00	6.331e+00	5.025e-01
6.500e+00	7.046e+00	5.592e-01
7.000e+00	7.542e+00	5.986e-01
7.500e+00	7.774e+00	6.170e-01
8.000e+00	7.713e+00	6.121e-01
8.500e+00	7.352e+00	5.835e-01
9.000e+00	6.710e+00	5.326e-01
9.500e+00	5.833e+00	4.629e-01
1.000e+01	4.788e+00	3.800e-01
1.050e+01	3.464e+00	2.708e-01
1.100e+01	2.563e+00	2.034e-01
1.150e+01	1.586e+00	1.259e-01
1.200e+01	8.202e-01	6.516e-02
1.250e+01	5.168e-01	2.514e-02
1.300e+01	7.004e-02	5.559e-03
1.350e+01	6.197e-03	4.918e-04

laboratory bombardment energy = 6.0mev target mass = 58.0
 compound nucleus mass = 59.0 compound nucleus formation q value = 9.0
 compound nucleus atomic number = 28 mass num= 59
 total reaction cross section = 1662.4
 excitation energy of compound nucleus = 14.9mev j= 0
 reaction cross section 1662.4

e gamma (mev)	cross section	
	(mb/mev)	(mb/sr.meV)
5.000e-01	1.711e+03	1.358e+02
1.000e+00	1.147e+03	9.108e+01
1.500e+00	8.490e+02	6.738e+01
2.000e+00	6.471e+02	5.136e+01
2.500e+00	4.946e+02	3.925e+01
3.000e+00	3.763e+02	2.987e+01
3.500e+00	2.825e+02	2.242e+01
4.000e+00	2.036e+02	1.616e+01
4.500e+00	1.328e+02	1.054e+01
5.000e+00	7.005e+01	5.560e+00
5.500e+00	2.338e+01	1.856e+00
6.000e+00	8.110e-01	6.436e-02
6.500e+00	9.298e-01	7.379e-02
7.000e+00	1.030e+00	8.172e-02
7.500e+00	1.103e+00	8.756e-02
8.000e+00	1.145e+00	9.086e-02
8.500e+00	1.150e+00	9.129e-02
9.000e+00	1.118e+00	8.870e-02
9.500e+00	1.048e+00	8.315e-02
1.000e+01	9.437e-01	7.490e-02
1.050e+01	8.123e-01	6.447e-02
1.100e+01	6.622e-01	5.256e-02
1.150e+01	5.049e-01	4.007e-02
1.200e+01	3.529e-01	2.801e-02
1.250e+01	2.193e-01	1.741e-02
1.300e+01	1.152e-01	9.142e-03
1.350e+01	4.722e-02	3.748e-03
1.400e+01	1.487e-02	1.180e-03
1.450e+01	8.235e-03	6.536e-04

laboratory bombardment energy = 7.0mev target mass = 58.0
 compound nucleus mass = 59.0 compound nucleus formation q value = 9.0
 compound nucleus atomic number = 28 mass num= 59
 total reaction cross section = 1602.5
 excitation energy of compound nucleus = 15.9mev j= 0
 reaction cross section 1602.5

energy (mev)	cross section (mb/mev) (mb/cr.mev)
5.000e-01	1.655e+03 1.313e+02
1.000e+00	1.132e+03 8.981e+01
1.500e+00	8.665e+02 6.877e+01
2.000e+00	6.857e+02 5.442e+01
2.500e+00	5.422e+02 4.303e+01
3.000e+00	4.236e+02 3.362e+01
3.500e+00	3.265e+02 2.591e+01
4.000e+00	2.487e+02 1.974e+01
4.500e+00	1.863e+02 1.479e+01
5.000e+00	1.342e+02 1.065e+01
5.500e+00	8.837e+01 7.014e+00
6.000e+00	4.843e+01 3.844e+00
6.500e+00	1.910e+01 1.516e+00
7.000e+00	5.188e+00 4.118e-01
7.500e+00	2.728e+00 2.546e-01
8.000e+00	6.149e+00 4.880e-01
8.500e+00	6.423e+00 5.097e-01
9.000e+00	6.528e+00 5.181e-01
9.500e+00	6.460e+00 5.119e-01
1.000e+01	6.186e+00 4.909e-01
1.050e+01	5.741e+00 4.557e-01
1.100e+01	5.134e+00 4.076e-01
1.150e+01	4.402e+00 3.493e-01
1.200e+01	3.581e+00 2.842e-01
1.250e+01	2.730e+00 2.166e-01
1.300e+01	1.909e+00 1.515e-01
1.350e+01	1.185e+00 9.407e-02
1.400e+01	6.160e-01 4.889e-02
1.450e+01	2.395e-01 1.901e-02
1.500e+01	5.597e-02 4.442e-03
1.550e+01	1.227e-02 9.740e-04

laboratory bombardment energy = 8.0mev target mass = 58.0
 compound nucleus mass = 59.0 compound nucleus formation q value = 9.0
 compound nucleus atomic number = 28 mass num= 59
 total reaction cross section = 1542.9
 excitation energy of compound nucleus = 16.9mev j= 0
 reaction cross section 1542.9

e gamma (mev)	cross section (mb/mev)	(mb/gr.mev)
5.000e-01	1.599e+03	1.5269e+02
1.000e+00	1.106e+03	8.781e+01
1.500e+00	8.675e+02	6.885e+01
2.000e+00	7.094e+02	5.630e+01
2.500e+00	5.822e+02	4.621e+01
3.000e+00	4.725e+02	3.750e+01
3.500e+00	3.771e+02	2.993e+01
4.000e+00	2.956e+02	2.346e+01
4.500e+00	2.279e+02	1.809e+01
5.000e+00	1.752e+02	1.374e+01
5.500e+00	1.290e+02	1.024e+01
6.000e+00	9.212e+01	7.311e+00
6.500e+00	5.986e+01	4.751e+00
7.000e+00	3.194e+01	2.535e+00
7.500e+00	1.141e+01	9.056e-01
8.000e+00	1.518e+00	1.204e-01
8.500e+00	1.634e+00	1.296e-01
9.000e+00	1.718e+00	1.363e-01
9.500e+00	1.765e+00	1.401e-01
1.000e+01	1.772e+00	1.406e-01
1.050e+01	1.754e+00	1.376e-01
1.100e+01	1.653e+00	1.312e-01
1.150e+01	1.529e+00	1.214e-01
1.200e+01	1.367e+00	1.085e-01
1.250e+01	1.174e+00	9.321e-02
1.300e+01	9.604e-01	7.622e-02
1.350e+01	7.578e-01	6.166e-02
1.400e+01	5.218e-01	4.132e-02
1.450e+01	3.292e-01	2.613e-02
1.500e+01	1.763e-01	1.399e-02
1.550e+01	5.281e-02	9.749e-03
1.600e+01	2.821e-02	2.259e-03
1.650e+01	2.108e-02	1.673e-03

laboratory bombardment energy = 9.0mev target mass = 58.0
 compound nucleus mass = 59.0 compound nucleus formation q value = 9.0
 compound nucleus atomic number = 28 mass num= 59
 total reaction cross section = 1494.9
 excitation energy of compound nucleus = 17.8mev j= 0
 reaction cross section 1494.9

e gamma (mev)	cross Section (mb/mev) (mb/Sr.mev)	
5.000e-01	1.554e+03	1.233e+02
1.000e+00	1.081e+03	8.576e+01
1.500e+00	8.556e+02	6.790e+01
2.000e+00	7.094e+02	5.630e+01
2.500e+00	5.924e+02	4.702e+01
3.000e+00	4.901e+02	3.970e+01
3.500e+00	3.992e+02	3.169e+01
4.000e+00	3.197e+02	2.537e+01
4.500e+00	2.519e+02	1.999e+01
5.000e+00	1.960e+02	1.555e+01
5.500e+00	1.513e+02	1.201e+01
6.000e+00	1.159e+02	9.201e+00
6.500e+00	8.728e+01	6.927e+00
7.000e+00	6.272e+01	4.978e+00
7.500e+00	4.676e+01	3.235e+00
8.000e+00	2.158e+01	1.713e+00
8.500e+00	7.440e+00	5.905e-01
9.000e+00	5.714e-01	4.535e-02
9.500e+00	6.052e-01	4.803e-02
1.000e+01	6.286e-01	4.989e-02
1.050e+01	6.401e-01	5.080e-02
1.100e+01	6.586e-01	5.069e-02
1.150e+01	6.234e-01	4.948e-02
1.200e+01	5.943e-01	4.717e-02
1.250e+01	5.515e-01	4.377e-02
1.300e+01	4.962e-01	3.938e-02
1.350e+01	4.303e-01	3.415e-02
1.400e+01	3.564e-01	2.829e-02
1.450e+01	2.780e-01	2.211e-02
1.500e+01	2.000e-01	1.633e-02
1.550e+01	1.328e-01	1.054e-02
1.600e+01	7.002e-02	6.192e-03
1.650e+01	4.357e-02	3.458e-03
1.700e+01	3.067e-02	2.434e-03
1.750e+01	3.228e-02	2.562e-03

laboratory bombardment energy = 10.0mev target mass = 58.0
 compound nucleus mass = 59.0 compound nucleus formation q value = 9.0
 compound nucleus atomic number = 28 mass num= 59
 total reaction cross section = 1463.2
 excitation energy of compound nucleus = 18.8mev j= 0
 reaction cross section 1463.2

a gamma (mev)	cross section (mb/mev) (mb/Sr.mev)
5.000e-01	1.450e+03 1.150e+02
1.000e+00	1.014e+03 8.045e+01
1.500e+00	8.099e+02 6.427e+01
2.000e+00	6.807e+02 5.402e+01
2.500e+00	5.787e+02 4.593e+01
3.000e+00	4.894e+02 3.884e+01
3.500e+00	4.086e+02 3.243e+01
4.000e+00	3.356e+02 2.664e+01
4.500e+00	2.709e+02 2.150e+01
5.000e+00	2.148e+02 1.705e+01
5.500e+00	1.677e+02 1.331e+01
6.000e+00	1.293e+02 1.027e+01
6.500e+00	9.905e+01 7.861e+00
7.000e+00	7.536e+01 5.981e+00
7.500e+00	5.633e+01 4.471e+00
8.000e+00	4.014e+01 3.185e+00
8.500e+00	2.559e+01 2.031e+00
9.000e+00	1.283e+01 1.018e+00
9.500e+00	3.449e+00 2.737e-01
1.000e+01	3.679e+00 2.920e-01
1.050e+01	5.861e+00 4.64e-01
1.100e+01	5.985e+00 4.763e-01
1.150e+01	4.045e+00 3.211e-01
1.200e+01	4.034e+00 3.202e-01
1.250e+01	5.947e+00 4.753e-01
1.300e+01	5.780e+00 4.600e-01
1.350e+01	3.532e+00 2.803e-01
1.400e+01	3.205e+00 2.544e-01
1.450e+01	2.803e+00 2.25e-01
1.500e+01	2.337e+00 1.855e-01
1.550e+01	1.826e+00 1.450e-01
1.600e+01	1.501e+00 1.033e-01
1.650e+01	3.086e-01 4.18e-02
1.700e+01	4.102e-01 3.256e-02
1.750e+01	1.581e-01 1.255e-02
1.800e+01	2.422e-02 1.935e-03
1.850e+01	2.580e-02 2.041e-03

laboratory bombardment energy = 11.0mev target mass = 58.0
 compound nucleus mass = 59.0 compound nucleus formation q value = 9.8
 compound nucleus atomic number = 28 mass num= 59
 total reaction cross section = 1447.2
 excitation energy of compound nucleus = 19.8mev j= 0
 reaction cross section 1447.2

# gamma (mev)	cross section	
	(mb/mev)	(mb/sr.mev)
5.000e-01	1.196e+03	9.491e+01
1.000e+00	8.263e+02	6.558e+01
1.500e+00	6.608e+02	5.245e+01
2.000e+00	5.567e+02	4.418e+01
2.500e+00	4.753e+02	3.772e+01
3.000e+00	4.050e+02	3.214e+01
3.500e+00	3.415e+02	2.710e+01
4.000e+00	2.859e+02	2.253e+01
4.500e+00	2.319e+02	1.841e+01
5.000e+00	1.858e+02	1.475e+01
5.500e+00	1.457e+02	1.157e+01
6.000e+00	1.117e+02	8.861e+00
6.500e+00	8.353e+01	6.629e+00
7.000e+00	6.105e+01	4.845e+00
7.500e+00	4.361e+01	3.461e+00
8.000e+00	3.041e+01	2.413e+00
8.500e+00	1.975e+01	1.568e+00
9.000e+00	1.049e+01	8.322e-01
9.500e+00	1.639e+00	1.301e-01
1.000e+01	1.743e+00	1.399e-01
1.050e+01	1.872e+00	1.486e-01
1.100e+01	1.962e+00	1.557e-01
1.150e+01	2.030e+00	1.611e-01
1.200e+01	2.073e+00	1.645e-01
1.250e+01	2.089e+00	1.658e-01
1.300e+01	2.075e+00	1.646e-01
1.350e+01	2.028e+00	1.609e-01
1.400e+01	1.946e+00	1.544e-01
1.450e+01	1.826e+00	1.449e-01
1.500e+01	1.665e+00	1.271e-01
1.550e+01	1.460e+00	1.159e-01
1.600e+01	1.213e+00	9.624e-02
1.650e+01	9.296e-01	7.378e-02
1.700e+01	6.335e-01	5.028e-02
1.750e+01	3.655e-01	2.901e-02
1.800e+01	1.718e-01	1.364e-02
1.850e+01	6.972e-02	5.549e-03
1.900e+01	3.464e-02	2.748e-03
1.950e+01	2.686e-02	2.132e-03

laboratory bombardment energy = 12.0mev   target mass = 58.0
 compound nucleus mass = 59.0   compound nucleus formation q value = 9.0
 compound nucleus atomic number = 28   mass num= 59
 total reaction cross section = 1442.7
 excitation energy of compound nucleus = 20.8mev   j= 0
 reaction cross section 1442.7

• gamma (mev)	cross section (mb/mev) (mb/gr.mev)
5.000e-01	1.090e+03 8.648e+01
1.000e+00	6.940e+02 5.508e+01
1.500e+00	5.438e+02 4.315e+01
2.000e+00	4.580e+02 3.635e+01
2.500e+00	3.914e+02 3.106e+01
3.000e+00	3.344e+02 2.654e+01
3.500e+00	2.834e+02 2.249e+01
4.000e+00	2.373e+02 1.884e+01
4.500e+00	1.959e+02 1.555e+01
5.000e+00	1.589e+02 1.261e+01
5.500e+00	1.261e+02 1.001e+01
6.000e+00	9.754e+01 7.741e+00
6.500e+00	7.300e+01 5.793e+00
7.000e+00	5.236e+01 4.156e+00
7.500e+00	3.547e+01 2.815e+00
8.000e+00	2.260e+01 1.793e+00
8.500e+00	1.294e+01 1.027e+00
9.000e+00	6.728e+00 5.340e-01
9.500e+00	7.664e-01 6.083e-02
1.000e+01	8.396e-01 6.663e-02
1.050e+01	9.091e-01 7.215e-02
1.100e+01	9.736e-01 7.727e-02
1.150e+01	1.032e+00 8.190e-02
1.200e+01	1.083e+00 8.594e-02
1.250e+01	1.129e+00 8.928e-02
1.300e+01	1.157e+00 9.180e-02
1.350e+01	1.177e+00 9.338e-02
1.400e+01	1.182e+00 9.384e-02
1.450e+01	1.171e+00 9.296e-02
1.500e+01	1.139e+00 9.042e-02
1.550e+01	1.081e+00 8.577e-02
1.600e+01	9.886e-01 7.846e-02
1.650e+01	8.561e-01 6.795e-02
1.700e+01	6.827e-01 4.418e-02
1.750e+01	4.835e-01 3.838e-02
1.800e+01	2.943e-01 2.336e-02
1.850e+01	1.522e-01 1.216e-02
1.900e+01	7.257e-02 5.600e-03
1.950e+01	3.723e-02 2.955e-03
2.000e+01	2.497e-02 1.982e-03
2.050e+01	2.072e-02 1.644e-03

laboratory bombardment energy = 14.0mev target mass = 58.0
 compound nucleus mass = 55.0 compound nucleus formation q value = 9.0
 compound nucleus atomic number = 28 mass num= 59
 total reaction cross section = 1441.3
 excitation energy of compound nucleus = 22.8mev j= 0
 reaction cross section 1441.3

e gamma (mev)	cross section (mb/mev)	cross section (mb/gr.mev)
5.000e-01	1.077e+03	8.547e+01
1.000e+00	5.935e+02	4.711e+01
1.500e+00	4.018e+02	3.189e+01
2.000e+00	3.180e+02	2.524e+01
2.500e+00	2.663e+02	2.113e+01
3.000e+00	2.264e+02	1.797e+01
3.500e+00	1.920e+02	1.524e+01
4.000e+00	1.615e+02	1.282e+01
4.500e+00	1.344e+02	1.067e+01
5.000e+00	1.105e+02	8.772e+00
5.500e+00	8.961e+01	7.112e+00
6.000e+00	7.129e+01	5.658e+00
6.500e+00	5.522e+01	4.382e+00
7.000e+00	4.104e+01	3.257e+00
7.500e+00	2.848e+01	2.260e+00
8.000e+00	1.774e+01	1.408e+00
8.500e+00	8.825e+00	7.004e-01
9.000e+00	5.202e+00	4.129e-01
9.500e+00	3.018e+00	2.402e-01
1.000e+01	2.273e+00	1.804e-01
1.050e+01	2.536e+00	2.013e-01
1.100e+01	2.807e+00	2.228e-01
1.150e+01	3.083e+00	2.447e-01
1.200e+01	3.365e+00	2.671e-01
1.250e+01	3.651e+00	2.898e-01
1.300e+01	3.941e+00	3.128e-01
1.350e+01	4.231e+00	3.358e-01
1.400e+01	4.520e+00	3.587e-01
1.450e+01	4.798e+00	3.808e-01
1.500e+01	5.052e+00	4.009e-01
1.550e+01	5.252e+00	4.168e-01
1.600e+01	5.347e+00	4.243e-01
1.650e+01	5.252e+00	4.168e-01
1.700e+01	4.865e+00	3.861e-01
1.750e+01	4.119e+00	3.269e-01
1.800e+01	3.092e+00	2.454e-01
1.850e+01	2.027e+00	1.609e-01
1.900e+01	1.168e+00	9.268e-02
1.950e+01	6.012e-01	4.772e-02
2.000e+01	2.805e-01	2.226e-02
2.050e+01	1.202e-01	9.539e-03
2.100e+01	4.250e-02	3.329e-03
2.150e+01	2.289e-02	1.816e-03
2.200e+01	1.479e-02	1.173e-03
2.250e+01	1.256e-02	9.968e-04

laboratory bombardment energy = 16.0mev target mass = 58.0
 compound nucleus mass = 59.0 compound nucleus formation q value = 9.0
 compound nucleus atomic number = 28 mass num= 59
 total reaction cross section = 1411.9
 excitation energy of compound nucleus = 24.7mev j= 0
 reaction cross section 1411.9

gamma (mev)	cross section (mb/mev)	(mb/sr.meV)
5.000e-01	1.552e+03	1.443e+01
1.000e+00	6.394e+02	5.074e+01
1.500e+00	4.015e+02	3.186e+01
2.000e+00	2.777e+02	2.199e+01
2.500e+00	2.072e+02	1.456e+01
3.000e+00	1.653e+02	1.312e+01
3.500e+00	1.356e+02	1.076e+01
4.000e+00	1.222e+02	8.905e+00
4.500e+00	9.275e+01	7.361e+00
5.000e+00	7.611e+01	6.041e+00
5.500e+00	6.176e+01	4.901e+00
6.000e+00	4.935e+01	3.917e+00
6.500e+00	3.858e+01	3.062e+00
7.000e+00	2.916e+01	2.314e+00
7.500e+00	2.077e+01	1.648e+00
8.000e+00	1.333e+01	1.058e+00
8.500e+00	6.719e+00	5.333e-01
9.000e+00	3.472e+00	2.756e-01
9.500e+00	6.117e-01	4.855e-02
1.000e+01	7.033e-01	5.328e-02
1.050e+01	8.024e-01	6.365e-02
1.100e+01	9.094e-01	7.217e-02
1.150e+01	1.025e+00	8.135e-02
1.200e+01	1.150e+00	9.129e-02
1.250e+01	1.286e+00	1.021e-01
1.300e+01	1.435e+00	1.139e-01
1.350e+01	1.597e+00	1.268e-01
1.400e+01	1.776e+00	1.409e-01
1.450e+01	1.970e+00	1.564e-01
1.500e+01	2.179e+00	1.730e-01
1.550e+01	2.394e+00	1.909e-01
1.600e+01	2.595e+00	2.059e-01
1.650e+01	2.735e+00	2.173e-01
1.700e+01	2.753e+00	2.185e-01
1.750e+01	2.644e+00	2.035e-01
1.800e+01	2.454e+00	1.709e-01
1.850e+01	1.614e+00	1.251e-01
1.900e+01	1.093e+00	8.676e-02
1.950e+01	6.825e-01	5.480e-02
2.000e+01	4.069e-01	3.250e-02
2.050e+01	2.320e-01	1.841e-02
2.100e+01	1.282e-01	1.017e-02
2.150e+01	6.925e-02	4.968e-03
2.200e+01	3.758e-02	2.967e-03
2.250e+01	2.111e-02	1.675e-03
2.300e+01	1.359e-02	1.062e-03
2.350e+01	1.002e-02	8.950e-04
2.400e+01	8.597e-03	6.823e-04

laboratory bombardment energy = 18.0mev target mass = 58.0
 compound nucleus mass = 59.0 compound nucleus formation q value = 9.0
 compound nucleus atomic number = 28 mass num= 59
 total reaction cross section = 1361.5
 excitation energy of compound nucleus = 26.7mev j= 0
 reaction cross section 1361.5

a gamma (mev)	cross section (mb/mev) (mb/cr.mev)
5.000e-01	1.222e+03 9.695e+01
5.400e+00	7.350e+02 3.833e+01
1.500e+00	4.889e+02 3.833e+01
2.000e+00	3.394e+02 2.694e+01
2.500e+00	2.387e+02 1.895e+01
3.000e+00	1.685e+02 1.17e+01
3.500e+00	1.204e+02 9.559e+00
4.000e+00	8.800e+01 6.928e+00
4.500e+00	6.600e+01 5.238e+00
5.000e+00	5.077e+01 4.029e+00
5.500e+00	3.970e+01 3.150e+00
6.000e+00	3.112e+01 2.470e+00
6.500e+00	2.419e+01 1.920e+00
7.000e+00	1.833e+01 1.459e+00
7.500e+00	1.337e+01 1.061e+00
8.000e+00	9.015e+00 7.155e-01
8.500e+00	5.190e+00 4.119e-01
9.000e+00	3.288e+00 2.609e-01
9.500e+00	1.617e+00 1.283e-01
1.000e+01	1.889e+00 1.499e-01
1.050e+01	2.191e+00 1.739e-01
1.100e+01	2.529e+00 2.007e-01
1.150e+01	2.905e+00 2.306e-01
1.200e+01	3.327e+00 2.641e-01
1.250e+01	3.804e+00 3.019e-01
1.300e+01	4.344e+00 3.447e-01
1.350e+01	4.960e+00 3.936e-01
1.400e+01	5.668e+00 4.497e-01
1.450e+01	6.478e+00 5.141e-01
1.500e+01	7.402e+00 5.874e-01
1.550e+01	8.426e+00 6.688e-01
1.600e+01	9.499e+00 7.536e-01
1.650e+01	1.046e+01 8.400e-01
1.700e+01	1.103e+01 8.755e-01
1.750e+01	1.084e+01 8.602e-01
1.800e+01	9.563e+00 7.669e-01
1.850e+01	7.743e+00 6.147e-01
1.900e+01	5.659e+00 4.491e-01
1.950e+01	3.867e+00 3.069e-01
2.000e+01	2.350e+00 2.008e-01
2.050e+01	1.609e+00 1.27e-01
2.100e+01	1.000e+00 7.935e-02
2.150e+01	6.088e-01 4.832e-02
2.200e+01	4.619e-01 3.672e-02
2.250e+01	2.992e-01 2.468e-02
2.300e+01	1.170e-01 9.283e-03
2.350e+01	6.315e-02 5.012e-03
2.400e+01	3.320e-02 2.635e-03
2.450e+01	1.763e-02 1.399e-03
2.500e+01	1.029e-02 8.166e-04
2.550e+01	7.275e-03 5.774e-04
2.600e+01	6.214e-03 4.932e-04

laboratory bombardment energy = 20.0mev target mass = 58.0
 compound nucleus mass = 59.0 compound nucleus formation q value = 9.0
 compound nucleus atomic number = 28 mass num= 59
 total reaction cross section = 1323.4
 excitation energy of compound nucleus = 28.7mev j= 0
 reaction cross section 1323.4

e gamma (mev)	cross section (mb/mev)	(mb/sr mev)
5.000e-01	1.246e+03	9.887e+01
1.000e+00	7.953e+02	6.312e+01
1.500e+00	6.500e+02	5.164e+01
2.000e+00	5.170e+02	4.133e+01
2.500e+00	3.130e+02	2.484e+01
3.000e+00	2.318e+02	1.839e+01
3.500e+00	1.685e+02	1.337e+01
4.000e+00	1.195e+02	9.514e+00
4.500e+00	8.405e+01	6.670e+00
5.000e+00	5.798e+01	4.601e+00
5.500e+00	4.943e+01	3.912e+00
6.000e+00	4.700e+01	3.719e+00
6.500e+00	4.821e+01	3.846e+00
7.000e+00	4.251e+01	3.351e+00
7.500e+00	4.487e+00	3.572e-01
8.000e+00	5.555e+00	4.409e-01
8.500e+00	3.063e+00	2.431e-01
9.000e+00	1.786e+00	1.417e-01
9.500e+00	6.691e-01	5.310e-02
1.000e+01	5.74e-01	4.549e-02
1.050e+01	9.212e-01	7.311e-02
1.100e+01	1.073e+00	8.516e-02
1.150e+01	1.246e+00	9.887e-02
1.200e+01	1.444e+00	1.146e-01
1.250e+01	1.672e+00	1.327e-01
1.300e+01	1.937e+00	1.537e-01
1.350e+01	2.247e+00	1.781e-01
1.400e+01	2.612e+00	2.073e-01
1.450e+01	3.044e+00	2.416e-01
1.500e+01	3.553e+00	2.820e-01
1.550e+01	4.141e+00	3.286e-01
1.600e+01	4.788e+00	3.800e-01
1.650e+01	5.426e+00	4.306e-01
1.700e+01	5.907e+00	4.688e-01
1.750e+01	6.010e+00	4.770e-01
1.800e+01	5.572e+00	4.422e-01
1.850e+01	4.665e+00	3.703e-01
1.900e+01	3.500e+00	2.841e-01
1.950e+01	2.585e+00	2.032e-01
2.000e+01	1.801e+00	1.430e-01
2.050e+01	1.250e+00	9.764e-02
2.100e+01	8.308e-01	6.593e-02
2.150e+01	5.565e-01	4.417e-02
2.200e+01	3.700e-01	2.936e-02
2.250e+01	2.437e-01	1.934e-02
2.300e+01	1.588e-01	1.244e-02
2.350e+01	1.022e-01	8.109e-03
2.400e+01	6.483e-02	5.145e-03
2.450e+01	4.064e-02	3.225e-03
2.500e+01	2.555e-02	2.012e-03
2.550e+01	1.601e-02	1.271e-03
2.600e+01	1.056e-02	8.378e-04
2.650e+01	7.554e-03	5.976e-04
2.700e+01	5.17e-03	4.122e-04
2.750e+01	3.282e-03	2.599e-04
2.800e+01	1.925e-03	1.540e-04