

MPFD Foil Activation Experiment Resource

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For each wand:

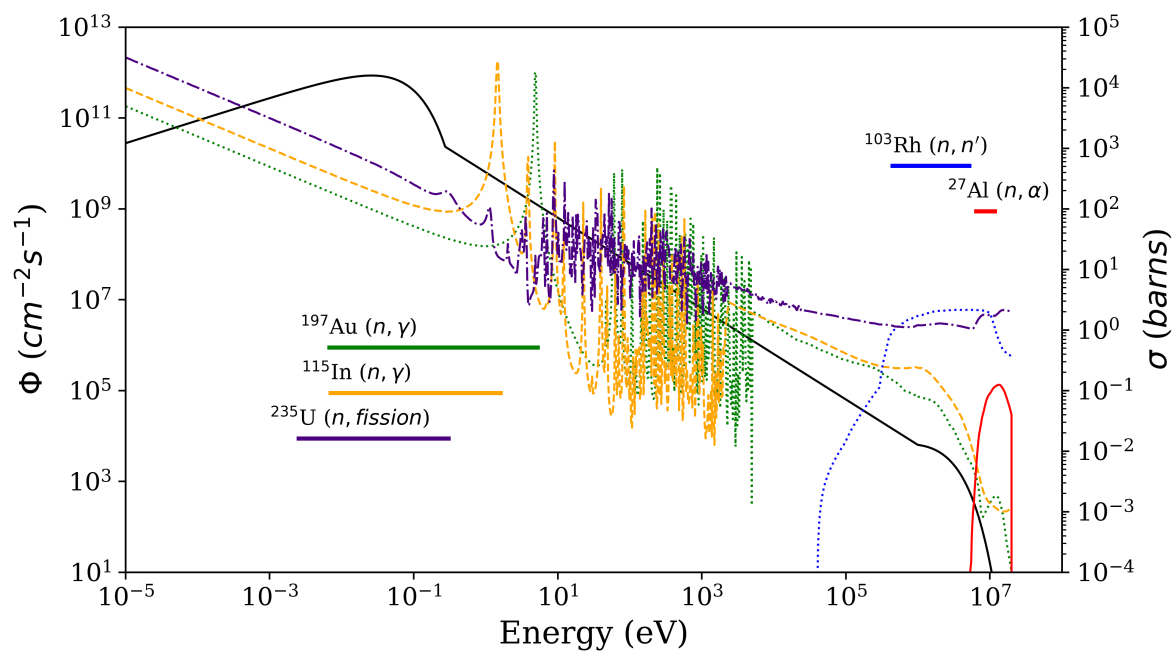
Inventory

1. Loaded wand
2. Stopwatch
3. Gloves
4. Sample Bags (Four plastic bags labeled #1, #2, #3, and #4; #1 corresponds to the highest axial position.)
5. Sample pig for transportation
6. Neutron dose monitor.

Procedures

1. Raise reactor power to P then insert wand into reactor core.
2. Irradiate foil for t_i .
3. Scram reactor and promptly remove wand from reactor core.
4. While dose is above 50 mR/h at 1 ft., keep stored in fuel rod storage.
5. Pull wand to surface and remove internals. Remove foils from internals and place in labeled bags. Place bags in sample pig.
6. Count foils one at a time with HPGe for listed counting time.

Principle Reactions



| Reaction | $T_{1/2}$ | ROI (eV) | Important Gammas (keV) |
|---|-----------|------------------------|----------------------------------|
| $^{115}\text{In}(n,\gamma)^{116}\text{In}$ | 54 m | 7.0021e-03, 1.6130e+00 | 417, 819, 1090, 1293, 1508, 2111 |
| $^{115}\text{In}(n,\gamma)^{116}\text{In Cd}$ | 54 m | 1.1955e+00, 1.9916e+00 | 417, 819, 1090, 1293, 1508, 2111 |
| $^{197}\text{Au}(n,\gamma)^{198}\text{Au}$ | 2.7 d | 6.7266e-03, 5.2684e+00 | 412, 676, 1088 |
| $^{197}\text{Au}(n,\gamma)^{198}\text{Au Cd}$ | 2.7 d | 4.0752e+00, 7.1730e+00 | 412, 676, 1088 |
| $^{103}\text{Rh}(n,n')^{103m}\text{Rh}$ | 56.12 m | 4.4469e+05, 5.1947e+06 | 40 |
| $^{27}\text{Al}(n,\alpha)^{24}\text{Na}$ | 15.03 h | 6.4564e+06, 1.1695e+07 | 1369, 2754 |

Indium

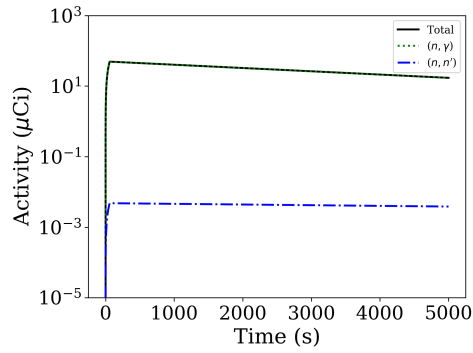
Power Level: 1.0 kW(th)

Time at Power: 60 s

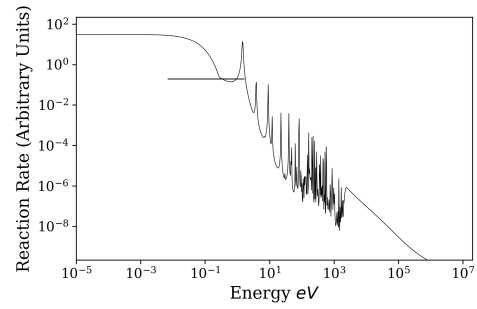
Wait Time: 400 s

Total Activity at Removal: 1.79e+02 μCi

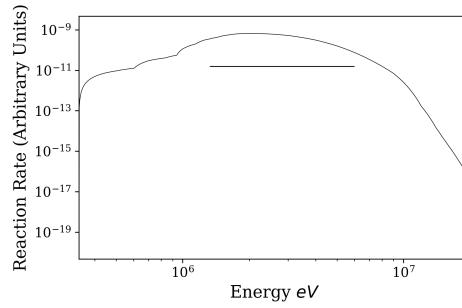
| Position | Mass mg | Start Counting s | Counting Time s | Counting Activity μCi |
|----------|-----------|--------------------|-------------------|----------------------------|
| 1 | 1.7 | 460 | 300 | 4.51e+01 |
| 2 | 1.5 | 760 | 300 | 3.73e+01 |
| 3 | 1.4 | 1060 | 300 | 3.27e+01 |
| 4 | 1.6 | 1360 | 300 | 3.50e+01 |



(a) Position #1



(b) (n, γ) Reaction Rate



(c) (n, n') Reaction Rate

| Reaction | $T_{1/2}$ | ROI (eV) | Important Gammas (keV) |
|---------------|-----------|--------------------|---|
| (n, γ) | 54.0 m | 7.00e-03, 1.61e+00 | 138(0.03), 417(0.36), 819(0.17), 1090(0.53), 1293(0.8), 1508(0.11), |
| (n, n') | 4.4 h | 1.33e+06, 5.96e+06 | 335(0.5) |

Indium (Cd)

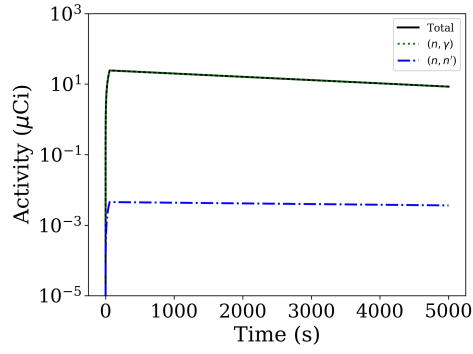
Power Level: 1.0 kW(th)

Time at Power: 60 s

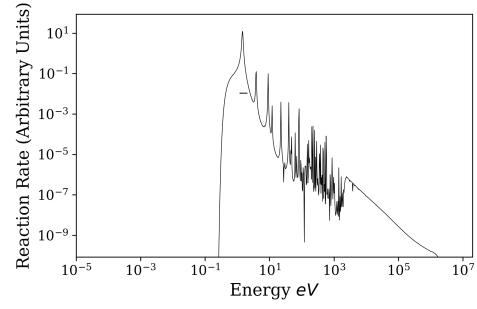
Wait Time: 400 s

Total Activity at Removal: 8.85e+01 μCi

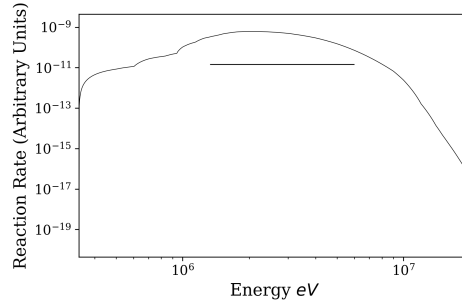
| Position | Mass mg | Start Counting s | Counting Time s | Counting Activity μCi |
|----------|-----------|--------------------|-------------------|----------------------------|
| 1 | 1.7 | 460 | 300 | 2.23e+01 |
| 2 | 1.5 | 760 | 300 | 1.84e+01 |
| 3 | 1.4 | 1060 | 300 | 1.61e+01 |
| 4 | 1.6 | 1360 | 300 | 1.73e+01 |



(a) Position #1



(b) (n, γ) Reaction Rate



(c) (n, n') Reaction Rate

| Reaction | $T_{1/2}$ | ROI (eV) | Important Gammas (keV) |
|---------------|-----------|--------------------|---|
| (n, γ) | 54.0 m | 1.20e+00, 1.99e+00 | 138(0.03), 417(0.36), 819(0.17), 1090(0.53), 1293(0.8), 1508(0.11), |
| (n, n') | 4.4 h | 1.34e+06, 5.97e+06 | 335(0.5) |

Gold

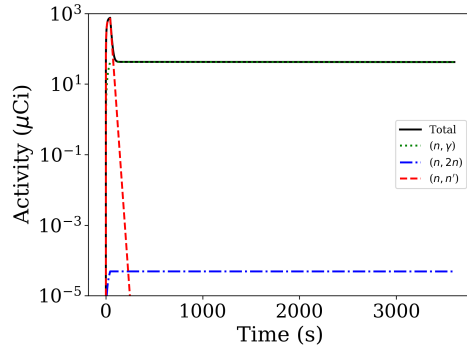
Power Level: 100 kW(th)

Time at Power: 45 s

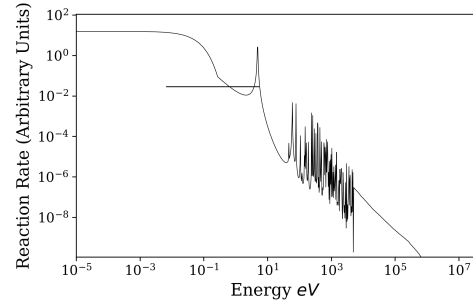
Wait Time: 300 s

Total Activity at Removal: 2.73e+03 μCi

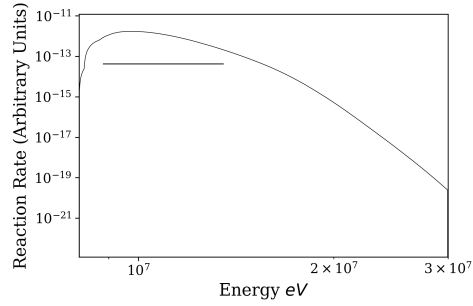
| Position | Mass mg | Start Counting s | Counting Time s | Counting Activity μCi |
|----------|-----------|--------------------|-------------------|----------------------------|
| 1 | 5.0 | 345 | 300 | 4.24e+01 |
| 2 | 4.35 | 645 | 300 | 3.69e+01 |
| 3 | 4.3 | 945 | 300 | 3.64e+01 |
| 4 | 4.37 | 1245 | 300 | 3.70e+01 |



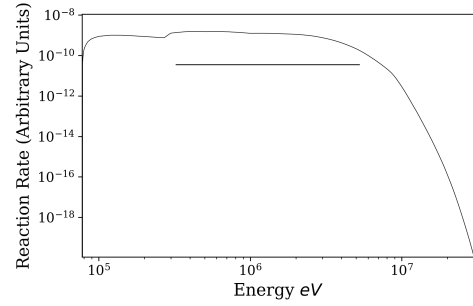
(a) Position #1



(b) (n, γ) Reaction Rate



(c) $(n, 2n)$ Reaction Rate



(d) (n, n') Reaction Rate

| Reaction | $T_{1/2}$ | ROI (eV) | Important Gammas (keV) |
|---------------|-----------|--------------------|--|
| (n, γ) | 2.7 d | 6.73e-03, 5.27e+00 | 412(0.95), 676(0.01), 1088(0.002) |
| $(n, 2n)$ | 6.2 d | 8.83e+06, 1.35e+07 | 333(0.25), 356(0.94), 426(0.06), 1091(0.002) |
| (n, n') | 7.8 s | 3.24e+05, 5.25e+06 | 130(0.08), 279(0.75) |

Gold (Cd)

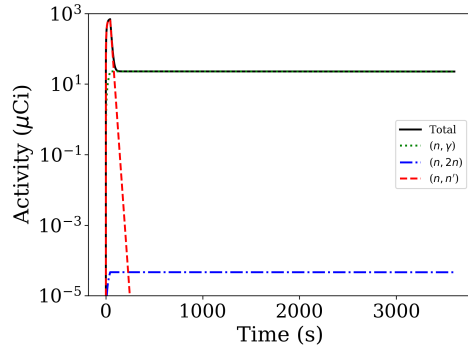
Power Level: 100 kW(th)

Time at Power: 45 s

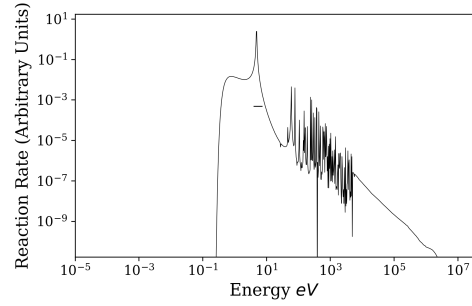
Wait Time: 300 s

Total Activity at Removal: 2.49e+03 μCi

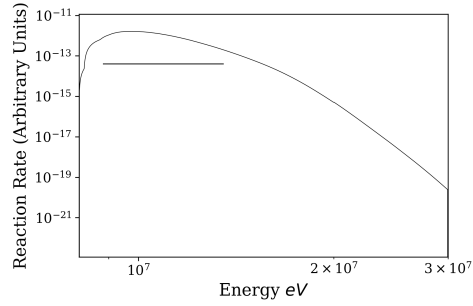
| Position | Mass mg | Start Counting s | Counting Time s | Counting Activity μCi |
|----------|-----------|--------------------|-------------------|----------------------------|
| 1 | 5.0 | 345 | 300 | 2.28e+01 |
| 2 | 4.35 | 645 | 300 | 1.98e+01 |
| 3 | 4.3 | 945 | 300 | 1.96e+01 |
| 4 | 4.37 | 1245 | 300 | 1.99e+01 |



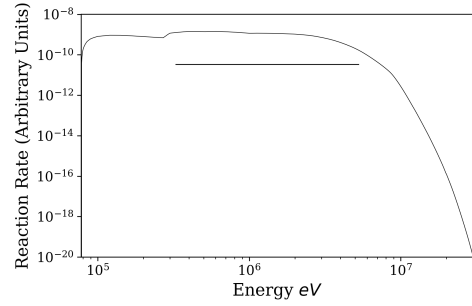
(a) Position #1



(b) (n, γ) Reaction Rate



(c) $(n, 2n)$ Reaction Rate



(d) (n, n') Reaction Rate

| Reaction | $T_{1/2}$ | ROI (eV) | Important Gammas (keV) |
|---------------|-----------|--------------------|--|
| (n, γ) | 2.7 d | 4.08e+00, 7.17e+00 | 412(0.95), 676(0.01), 1088(0.002) |
| $(n, 2n)$ | 6.2 d | 8.83e+06, 1.35e+07 | 333(0.25), 356(0.94), 426(0.06), 1091(0.002) |
| (n, n') | 7.8 s | 3.28e+05, 5.28e+06 | 130(0.08), 279(0.75) |

Rhodium

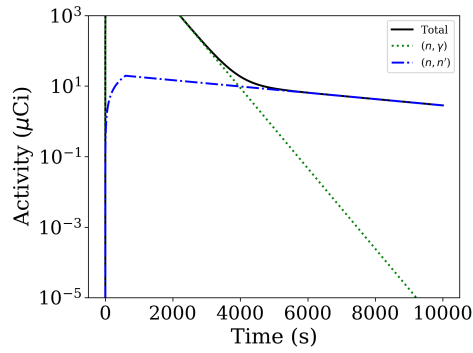
Power Level: 100 kW(th)

Time at Power: 600 s

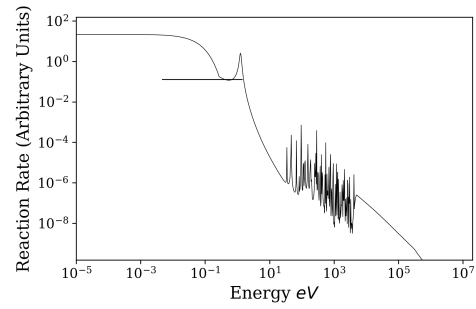
Wait Time: 5000 s

Total Activity at Removal: 2.20e+05 μCi

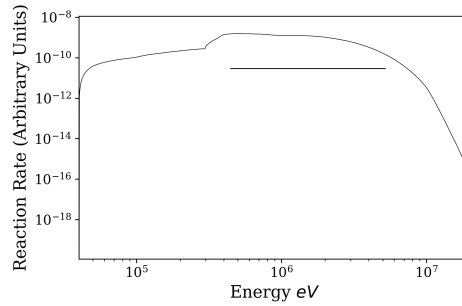
| Position | Mass mg | Start Counting s | Counting Time s | Counting Activity μCi |
|----------|-----------|--------------------|-------------------|----------------------------|
| 1 | 0.7 | 5600 | 600 | 7.13e+00 |
| 2 | 0.55 | 6200 | 600 | 4.88e+00 |
| 3 | 0.5 | 6800 | 600 | 3.91e+00 |
| 4 | 0.55 | 7400 | 600 | 3.79e+00 |



(a) Position #1



(b) (n, γ) Reaction Rate



(c) (n, n') Reaction Rate

| Reaction | $T_{1/2}$ | ROI (eV) | Important Gammas (keV) |
|---------------|-----------|--------------------|--|
| (n, γ) | 4.4 m | 4.67e-03, 1.39e+00 | 51(0.47), 78(0.025), 560(0.026), 770(0.0018) |
| (n, n') | 56.1 m | 4.45e+05, 5.19e+06 | 40(0.004) |

Aluminum

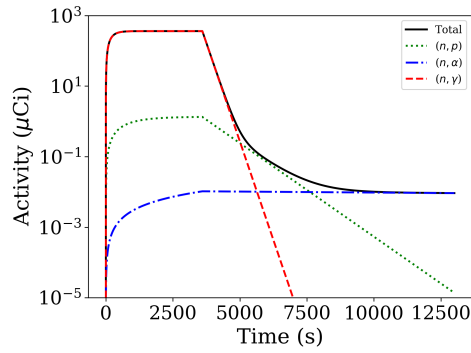
Power Level: 250 kW(th)

Time at Power: 3600 s

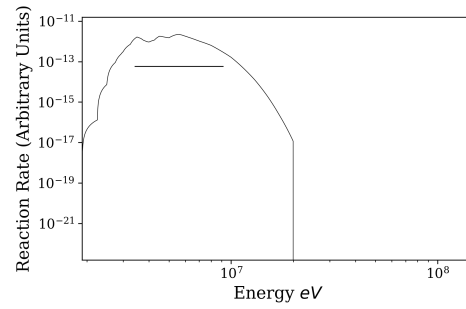
Wait Time: 1800 s

Total Activity at Removal: 9.62e+02 μCi

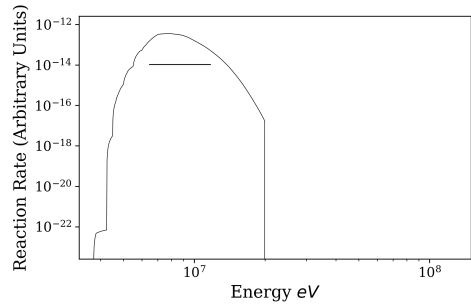
| Position | Mass mg | Start Counting s | Counting Time s | Counting Activity μCi |
|----------|-----------|--------------------|-------------------|----------------------------|
| 1 | 0.3 | 5400 | 1800 | 1.92e-01 |
| 2 | 0.2 | 7200 | 1800 | 1.75e-02 |
| 3 | 0.1 | 9000 | 1800 | 3.83e-03 |
| 4 | 0.2 | 10800 | 1800 | 6.44e-03 |



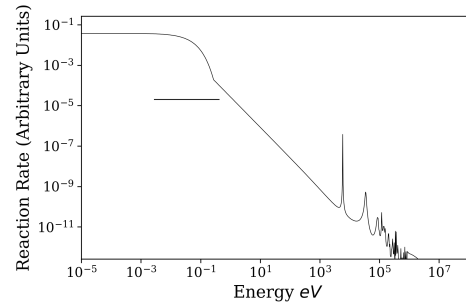
(a) Position #1



(b) (n,p) Reaction Rate



(c) (n,α) Reaction Rate



(d) (n,γ) Reaction Rate

| Reaction | $T_{1/2}$ | ROI (eV) | Important Gammas (keV) |
|--------------|-----------|--------------------|---------------------------------|
| (n,p) | 9.5 m | 3.42e+06, 9.14e+06 | 180(0.007), 840(0.7), 1013(0.3) |
| (n,α) | 15.0 h | 6.46e+06, 1.17e+07 | 1369(1), 2754(1) |
| (n,γ) | 2.2 m | 2.82e-03, 4.15e-01 | 1780(1) |

Useful Links

Activation Calculator

<https://www.ncnr.nist.gov/resources/activation/>

Online Spectrum Catalogs for Ge and Si(Li)

http://www4vip.inl.gov/gammaray/catalogs/ge/catalog_ge.shtml

Decay Radiation Search

https://www.nndc.bnl.gov/nudat2/indx_dec.jsp

Evaluated Nuclear Data File (ENDF) Retrieval & Plotting

<https://www.nndc.bnl.gov/sigma/>