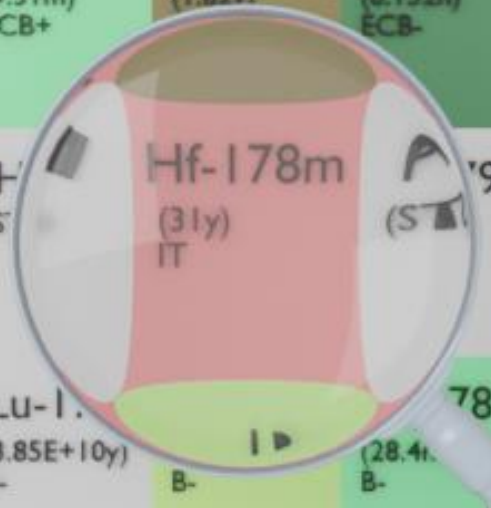




|                            |                           |                          |                             |                                 |                            |                         |                           |                         |
|----------------------------|---------------------------|--------------------------|-----------------------------|---------------------------------|----------------------------|-------------------------|---------------------------|-------------------------|
| Ta-175<br>(0.5h)<br>CB+    | Ta-176<br>(8.09h)<br>ECB+ | Ta-177<br>(56.56h)<br>EC | Ta-178<br>(9.31m)<br>ECB+   | Ta-179<br>(1.82v)<br>ECB-       | Ta-180<br>(8.152h)<br>ECB- | Ta-181<br>(STABLE)      | Ta-182<br>(114.43d)<br>B- | Ta-183<br>(5.1d)<br>B-  |
| Hf-174<br>(2.0E+15y)<br>EC | Hf-175<br>(70d)<br>EC     | Hf-176<br>(STABLE)       | Hf-177<br>(STABLE)          | <b>Hf-178m<br/>(31y)<br/>IT</b> | Hf-179<br>(STABLE)         | Hf-180<br>(STABLE)      | Hf-181<br>(42.39d)<br>B-  | Hf-182<br>(9E+6y)<br>B- |
| Lu-173<br>(1.37y)<br>C     | Lu-174<br>(3.31y)<br>ECB+ | Lu-175<br>(STABLE)       | Lu-176<br>(3.85E+10y)<br>B- | Lu-177<br>(STABLE)              | Lu-178<br>(28.4d)<br>B-    | Lu-179<br>(4.59h)<br>B- | Lu-180<br>(5.7m)<br>B-    | Lu-181<br>(3.5m)<br>B-  |

# HAFNIUM-178M

## SUMMARY DATA

### GENERAL

### CLASSIFICATION

Isotope: Hf-178m  
Atomic number (Z): 72  
Mass number (A): 178  
Neutron number (N): 106

### RADIOACTIVE DECAY

Decay modes: Internal transition  
Half-life: 31.0 [y]  
Decay constant:  $7.0855\text{e-}10$  [1/s]  
Daughters: Hf-178 (100.0%)  
Radioactive daughters: None

### DOSIMETRIC CONSTANTS

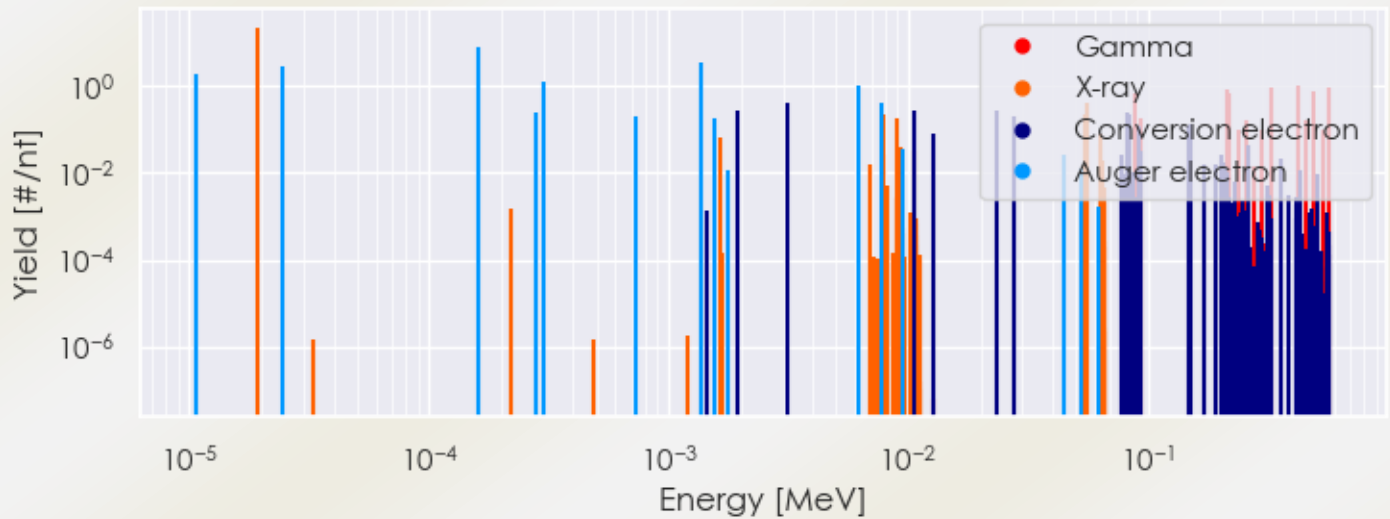
Mean alpha energy: 0.0 [MeV]  
Mean electron energy: 0.21132 [MeV]  
Mean photon energy: 2.23831 [MeV]  
Air kerma rate constant,  $\Gamma_{10}$ :  $8.456\text{e-}17$  [ $\text{Gy} \cdot \text{m}^2/\text{Bq} \cdot \text{s}$ ]  
Air kerma coefficient,  $K_{\text{air}}$ :  $8.456\text{e-}17$  [ $\text{Gy} \cdot \text{m}^2/\text{Bq} \cdot \text{s}$ ]  
Equilibrium dose constant for weakly-penetrating radiations ( $\alpha$  and/or electrons),  $\Delta_{\text{wp}}$ :  $3.386\text{e-}14$  [ $\text{Gy} \cdot \text{kg}/\text{Bq} \cdot \text{s}$ ]  
Equilibrium dose constant for alphas,  $\Delta_{\alpha}$ :  $0.000\text{e+}00$  [ $\text{Gy} \cdot \text{kg}/\text{Bq} \cdot \text{s}$ ]

Equilibrium dose constant for betas/electrons,  $\Delta_{\beta,\beta^+,e^-}$ :  $3.386\text{e-}14$  [Gy·kg/Bq·s]

Equilibrium dose constant for photons,  $\Delta_p$ :  $3.586\text{e-}13$  [Gy·kg/Bq·s]

## SUMMARY SPECTRA (PLOT)

Spectra source: **ICRP Publication 107: Nuclear Decay Data for Dosimetric Calculations. Ann. ICRP 2008, 38 (3).**



Download tabulated summary spectra file here: [www.mirdsoft.org/products/MIRDspecs/Hf-178m Summary Spectrum.csv](http://www.mirdsoft.org/products/MIRDspecs/Hf-178m%20Summary%20Spectrum.csv)

## TABULATED DATA

### SUMMARY SPECTRA (TABLE)

Spectra source: **ICRP Publication 107: Nuclear Decay Data for Dosimetric Calculations. Ann. ICRP 2008, 38 (3).**

Note: Radiations with yield < 0.01 are excluded from the table, but are available in the linked \*.csv data.

Download tabulated summary spectra file here: [www.mirdsoft.org/products/MIRDspecs/Hf-178m Summary Spectrum.csv](http://www.mirdsoft.org/products/MIRDspecs/Hf-178m%20Summary%20Spectrum.csv)

| Energy [MeV] | Yield [# /nt] if > 0.01 | Radiation type |
|--------------|-------------------------|----------------|
| 1.94278e-05  | 2.162e+01               | X-ray          |
| 1.63887e-03  | 6.556e-02               | X-ray          |
| 6.98230e-03  | 1.489e-02               | X-ray          |
| 7.83281e-03  | 2.464e-02               | X-ray          |
| 7.88959e-03  | 2.175e-01               | X-ray          |
| 9.03751e-03  | 1.808e-01               | X-ray          |

|             |           |                     |
|-------------|-----------|---------------------|
| 9.34358e-03 | 3.779e-02 | X-ray               |
| 1.05374e-02 | 3.289e-02 | X-ray               |
| 5.47191e-02 | 2.251e-01 | X-ray               |
| 5.59237e-02 | 3.939e-01 | X-ray               |
| 6.31238e-02 | 4.193e-02 | X-ray               |
| 6.33831e-02 | 8.104e-02 | X-ray               |
| 6.51063e-02 | 1.825e-02 | X-ray               |
| 8.88620e-02 | 6.436e-01 | Gamma               |
| 9.31850e-02 | 1.722e-01 | Gamma               |
| 2.13434e-01 | 8.140e-01 | Gamma               |
| 2.16668e-01 | 6.465e-01 | Gamma               |
| 2.37431e-01 | 9.316e-02 | Gamma               |
| 2.57646e-01 | 1.675e-01 | Gamma               |
| 2.77403e-01 | 1.383e-02 | Gamma               |
| 2.96812e-01 | 9.692e-02 | Gamma               |
| 3.25557e-01 | 9.410e-01 | Gamma               |
| 4.26360e-01 | 9.702e-01 | Gamma               |
| 4.54050e-01 | 1.666e-01 | Gamma               |
| 4.95013e-01 | 7.133e-01 | Gamma               |
| 5.35036e-01 | 9.410e-02 | Gamma               |
| 5.74215e-01 | 8.789e-01 | Gamma               |
| 1.07323e-05 | 1.875e+00 | Auger electron      |
| 2.44605e-05 | 2.664e+00 | Auger electron      |
| 1.59932e-04 | 7.543e+00 | Auger electron      |
| 2.81377e-04 | 2.366e-01 | Auger electron      |
| 3.03245e-04 | 1.278e+00 | Auger electron      |
| 7.24403e-04 | 2.014e-01 | Auger electron      |
| 1.36609e-03 | 3.284e+00 | Auger electron      |
| 1.54545e-03 | 1.736e-01 | Auger electron      |
| 1.76787e-03 | 1.084e-02 | Auger electron      |
| 1.93700e-03 | 2.672e-01 | Conversion electron |
| 3.14170e-03 | 3.806e-01 | Conversion electron |
| 6.17769e-03 | 1.039e+00 | Auger electron      |
| 7.79627e-03 | 3.855e-01 | Auger electron      |
| 9.44430e-03 | 3.605e-02 | Auger electron      |
| 1.06010e-02 | 2.723e-01 | Conversion electron |
| 1.27000e-02 | 7.626e-02 | Conversion electron |
| 2.33800e-02 | 2.567e-01 | Conversion electron |

|                    |           |                     |
|--------------------|-----------|---------------------|
| <b>2.77030e-02</b> | 1.888e-01 | Conversion electron |
| <b>4.45281e-02</b> | 2.496e-02 | Auger electron      |
| <b>5.31026e-02</b> | 1.292e-02 | Auger electron      |
| <b>7.76170e-02</b> | 2.683e-02 | Conversion electron |
| <b>8.19400e-02</b> | 1.925e-02 | Conversion electron |
| <b>8.24220e-02</b> | 2.369e-01 | Conversion electron |
| <b>8.36267e-02</b> | 2.229e-01 | Conversion electron |
| <b>8.67630e-02</b> | 1.025e-02 | Conversion electron |
| <b>9.10860e-02</b> | 1.199e-01 | Conversion electron |
| <b>9.31850e-02</b> | 3.250e-02 | Conversion electron |
| <b>1.47952e-01</b> | 1.133e-01 | Conversion electron |
| <b>1.51186e-01</b> | 1.319e-01 | Conversion electron |
| <b>1.71949e-01</b> | 1.504e-02 | Conversion electron |
| <b>1.92164e-01</b> | 1.525e-02 | Conversion electron |
| <b>2.02189e-01</b> | 1.293e-02 | Conversion electron |
| <b>2.02671e-01</b> | 2.674e-02 | Conversion electron |
| <b>2.03876e-01</b> | 1.862e-02 | Conversion electron |
| <b>2.05423e-01</b> | 1.693e-02 | Conversion electron |
| <b>2.05905e-01</b> | 1.527e-02 | Conversion electron |
| <b>2.07110e-01</b> | 1.010e-02 | Conversion electron |
| <b>2.11335e-01</b> | 1.430e-02 | Conversion electron |
| <b>2.14569e-01</b> | 1.018e-02 | Conversion electron |
| <b>2.60075e-01</b> | 4.172e-02 | Conversion electron |
| <b>3.60878e-01</b> | 2.152e-02 | Conversion electron |
| <b>4.29531e-01</b> | 1.102e-02 | Conversion electron |

## USEFUL LINKS

Isotope decay characteristics are periodically updated as better measurements can be made - changes that may not be reflected on this page. Please see useful links:

National Nuclear Data Center (NNDC): <https://www.nndc.bnl.gov/nudat3/mird/>

International Atomic Energy Agency (IAEA) Livechart: <https://www-nds.iaea.org/relnsd/vcharthtml/VChartHTML.html>

## REFERENCE LINKS

ICRP Report 107: <https://www.icrp.org/publication.asp?id=ICRP%20Publication%20107>

Graves et al. Dose Point Kernels: <https://doi.org/10.1002/mp.13789>

MIRD Decay Schemes 2nd Edition: [https://sites.snmmi.org/SNMML-MAIN/iCore/Store/StoreLayouts/Item\\_Detail.aspx?iProductCode=0-932004-80-6](https://sites.snmmi.org/SNMML-MAIN/iCore/Store/StoreLayouts/Item_Detail.aspx?iProductCode=0-932004-80-6)