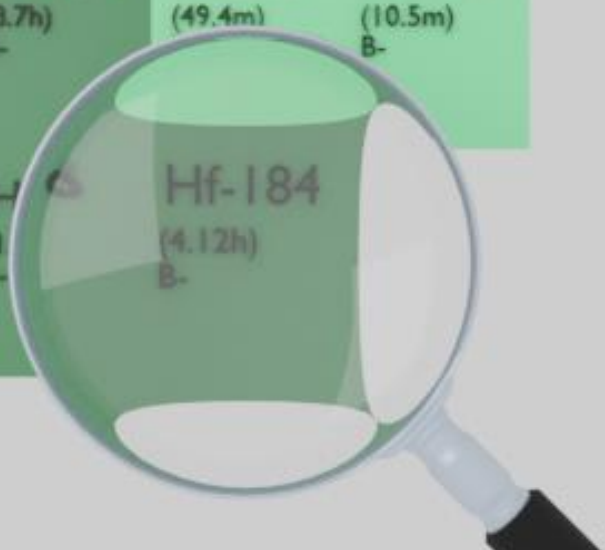




Ta-181 (STABLE)	Ta-182 (114.43d) B-	Ta-183 (5.1d) B-	Ta-184 (8.7h) B-	Ta-185 (49.4m) B-	Ta-186 (10.5m) B-
Hf-180 (STABLE)	Hf-181 (42.39d) B-	Hf-182 (9E+6y) B-	Hf-183 (1.1h) B-	Hf-184 (4.12h) B-	
Lu-179 (4.59h) B-	Lu-180 (5.7m) B-	Lu-181 (3.5m) B-			

HAFNIUM-184

SUMMARY DATA

GENERAL

CLASSIFICATION

Isotope: Hf-184
Atomic number (Z): 72
Mass number (A): 184
Neutron number (N): 112

RADIOACTIVE DECAY

Decay modes: β^-
Half-life: 4.12 [h]
Decay constant: 4.6733e-05 [1/s]
Daughters: Ta-184 (100.0%)
Radioactive daughters: Ta-184

DOSIMETRIC CONSTANTS

Mean alpha energy: 0.0 [MeV]
Mean electron energy: 0.47868 [MeV]
Mean photon energy: 0.23867 [MeV]
Air kerma rate constant, Γ_{10} : 1.096e-17 [Gy·m²/Bq·s]
Air kerma coefficient, K_{air} : 1.096e-17 [Gy·m²/Bq·s]
Equilibrium dose constant for weakly-penetrating radiations (α and/or electrons), Δ_{wp} : 7.669e-14 [Gy·kg/Bq·s]
Equilibrium dose constant for alphas, Δ_{α} : 0.000e+00 [Gy·kg/Bq·s]

Equilibrium dose constant for betas/electrons, $\Delta_{\beta-, \beta+, e-}$: 7.669×10^{-14} [Gy · kg/Bq · s]

Equilibrium dose constant for photons, Δ_p : 3.824×10^{-14} [Gy · kg/Bq · s]

DOSE POINT KERNELS (PLOT)

Dose point kernel source: **Graves, et al. Medical Physics. 2019 Nov.; 46(11):5284-5293.**

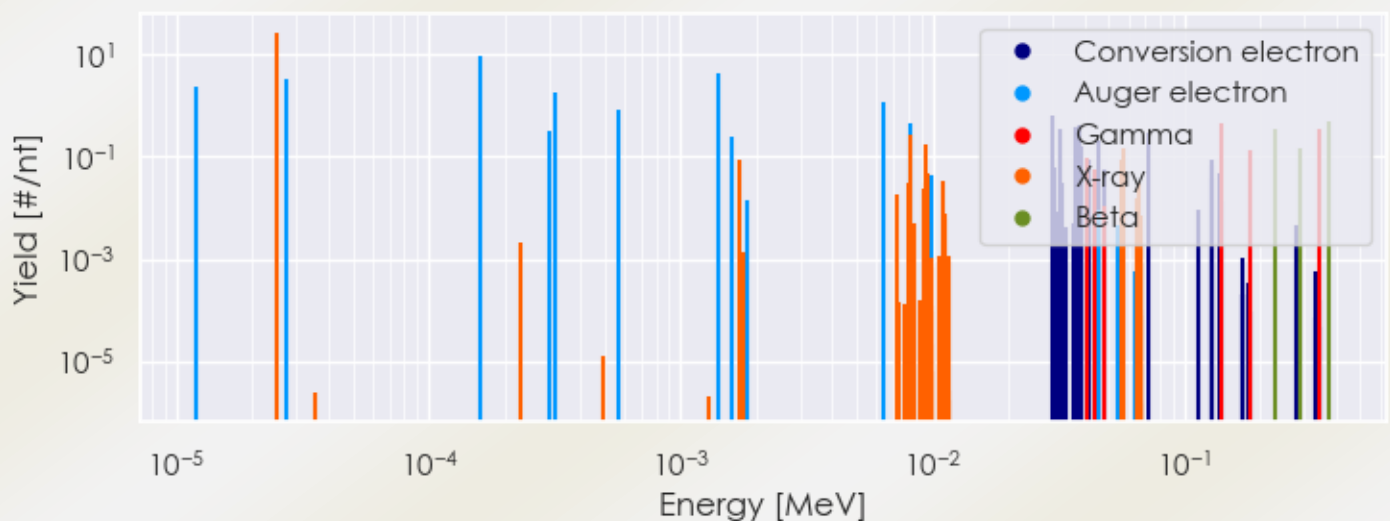
Note: Bins are spaced every 0.1 mm until a radius of 10 cm, and every 1 mm until a radius of 2 m.



Download tabulated dose point kernel file here: www.mirdsoft.org/products/MIRDspecs/Hf-184 DPK.csv

SUMMARY SPECTRA (PLOT)

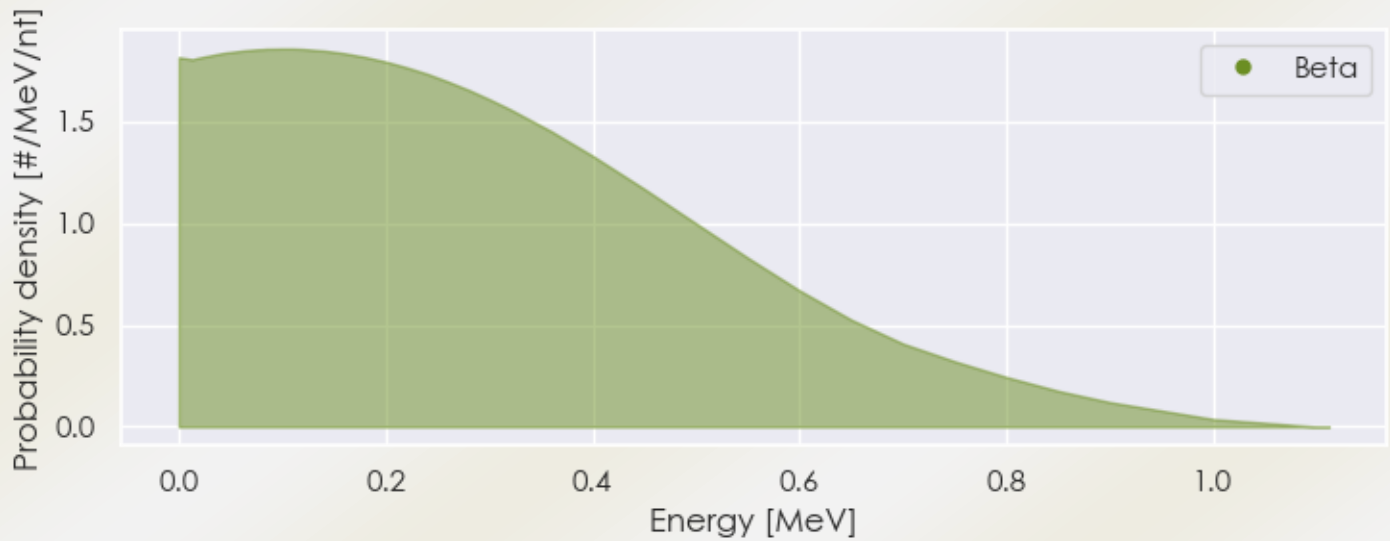
Spectra source: **ICRP Publication 107: Nuclear Decay Data for Dosimetric Calculations. Ann. ICRP 2008, 38 (3).**



Download tabulated summary spectra file here: www.mirdsoft.org/products/MIRDspecs/Hf-184 Summary Spectrum.csv

BETA SPECTRA (PLOT)

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



Download tabulated beta spectra file here: www.mirdsoft.org/products/MIRDspecs/Hf-184 Beta Spectrum.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-184 Summary Spectrum.csv

Energy [MeV]	Yield [# / nt] if > 0.01	Radiation type
2.48902e-05	2.721e+01	X-ray
1.70765e-03	8.903e-02	X-ray
7.19450e-03	1.757e-02	X-ray
8.07690e-03	2.953e-02	X-ray
8.13761e-03	2.607e-01	X-ray
9.19462e-03	2.445e-02	X-ray
9.36071e-03	1.752e-01	X-ray
9.47190e-03	3.108e-02	X-ray
9.64849e-03	4.574e-02	X-ray
1.09205e-02	3.224e-02	X-ray

4.14000e-02	9.207e-02	Gamma
4.39000e-02	5.673e-02	Gamma
4.79000e-02	1.116e-02	Gamma
5.64020e-02	8.321e-02	X-ray
5.76858e-02	1.450e-01	X-ray
6.51037e-02	1.552e-02	X-ray
6.53809e-02	2.999e-02	X-ray
1.39100e-01	4.464e-01	Gamma
1.81000e-01	1.376e-01	Gamma
3.44900e-01	3.515e-01	Gamma
2.28681e-01	3.600e-01	Beta
2.90064e-01	1.500e-01	Beta
3.77799e-01	4.900e-01	Beta
1.20060e-05	2.403e+00	Auger electron
2.73588e-05	3.384e+00	Auger electron
1.60504e-04	9.244e+00	Auger electron
3.04195e-04	3.113e-01	Auger electron
3.16615e-04	1.786e+00	Auger electron
5.66536e-04	7.954e-01	Auger electron
1.41826e-03	4.112e+00	Auger electron
1.60094e-03	2.385e-01	Auger electron
1.84053e-03	1.406e-02	Auger electron
6.40725e-03	1.210e+00	Auger electron
8.10379e-03	4.578e-01	Auger electron
9.83498e-03	4.345e-02	Auger electron
2.97440e-02	6.542e-01	Conversion electron
3.02370e-02	6.098e-02	Conversion electron
3.22440e-02	3.391e-01	Conversion electron
3.27370e-02	3.155e-02	Conversion electron
3.67370e-02	3.878e-01	Conversion electron
3.80208e-02	4.274e-01	Conversion electron
3.92159e-02	1.641e-01	Conversion electron
4.14000e-02	4.817e-02	Conversion electron
4.17159e-02	8.501e-02	Conversion electron
4.39000e-02	2.496e-02	Conversion electron
4.57159e-02	2.065e-01	Conversion electron
4.79000e-02	5.629e-02	Conversion electron
7.15350e-02	2.877e-01	Conversion electron

1.27444e-01	3.534e-02	Conversion electron
1.27937e-01	8.734e-02	Conversion electron
1.29221e-01	6.987e-02	Conversion electron
1.36916e-01	4.778e-02	Conversion electron
1.39100e-01	1.326e-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