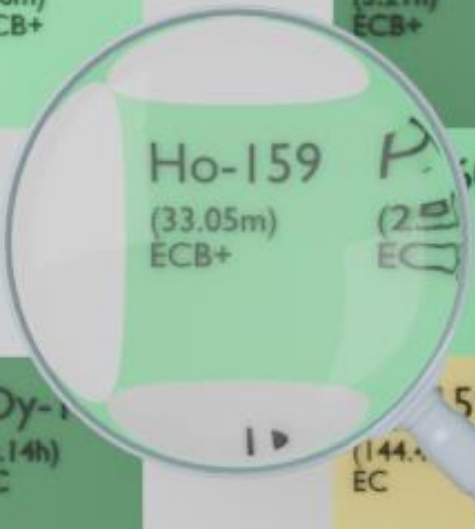




|                           |                          |                           |                            |                          |                           |                           |
|---------------------------|--------------------------|---------------------------|----------------------------|--------------------------|---------------------------|---------------------------|
| Er-158<br>(9.5m)<br>EC    |                          | Er-159<br>(36m)<br>ECB+   | Er-160<br>(3.21h)<br>ECB+  | Er-162<br>(STABLE)       | Er-163<br>(75.0m)<br>ECB+ | Er-164<br>(STABLE)        |
| Ho-155<br>(18m)<br>CB+    | Ho-156<br>(56m)<br>ECB+  | Ho-157<br>(12.6m)<br>ECB+ | Ho-159<br>(33.05m)<br>ECB+ | Ho-160<br>(2.8h)<br>EC   | Ho-161<br>(2.48h)<br>EC   | Ho-162<br>(15.0m)<br>ECB+ |
| Dy-154<br>(1.0E+6y)<br>EC | Dy-155<br>(9.9h)<br>ECB+ | Dy-156<br>(STABLE)        | Dy-157<br>(8.14h)<br>EC    | Dy-159<br>(144.4h)<br>EC | Dy-160<br>(STABLE)        | Dy-161<br>(STABLE)        |
|                           |                          |                           |                            |                          | Dy-162<br>(STABLE)        |                           |

# HOLMIUM-159

## SUMMARY DATA

### GENERAL

#### CLASSIFICATION

Isotope: Ho-159  
Atomic number (Z): 67  
Mass number (A): 159  
Neutron number (N): 92

#### RADIOACTIVE DECAY

Decay modes:  $\beta^+$ , Electron capture  
Half-life: 33.05 [m]  
Decay constant:  $3.4954 \times 10^{-4}$  [1/s]  
Daughters: Dy-159 (100.0%)  
Radioactive daughters: Dy-159

#### DOSIMETRIC CONSTANTS

Mean alpha energy: 0.0 [MeV]  
Mean electron energy: 0.05759 [MeV]  
Mean photon energy: 0.38572 [MeV]  
Air kerma rate constant,  $\Gamma_{10}$ :  $1.498 \times 10^{-17}$  [Gy  $\cdot$  m<sup>2</sup>/Bq  $\cdot$  s]  
Air kerma coefficient,  $K_{air}$ :  $1.507 \times 10^{-17}$  [Gy  $\cdot$  m<sup>2</sup>/Bq  $\cdot$  s]  
Equilibrium dose constant for weakly-penetrating radiations ( $\alpha$  and/or electrons),  $\Delta_{wp}$ :  $9.227 \times 10^{-15}$  [Gy  $\cdot$  kg/Bq  $\cdot$  s]  
Equilibrium dose constant for alphas,  $\Delta_{\alpha}$ : 0.000e+00 [Gy  $\cdot$  kg/Bq  $\cdot$  s]

Equilibrium dose constant for betas/electrons,  $\Delta_{\beta-\beta+,e-}$ :  $9.227\text{e-}15$  [Gy·kg/Bq·s]

Equilibrium dose constant for photons,  $\Delta_p$ :  $6.180\text{e-}14$  [Gy·kg/Bq·s]

### DOSE POINT KERNELS (PLOT)

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

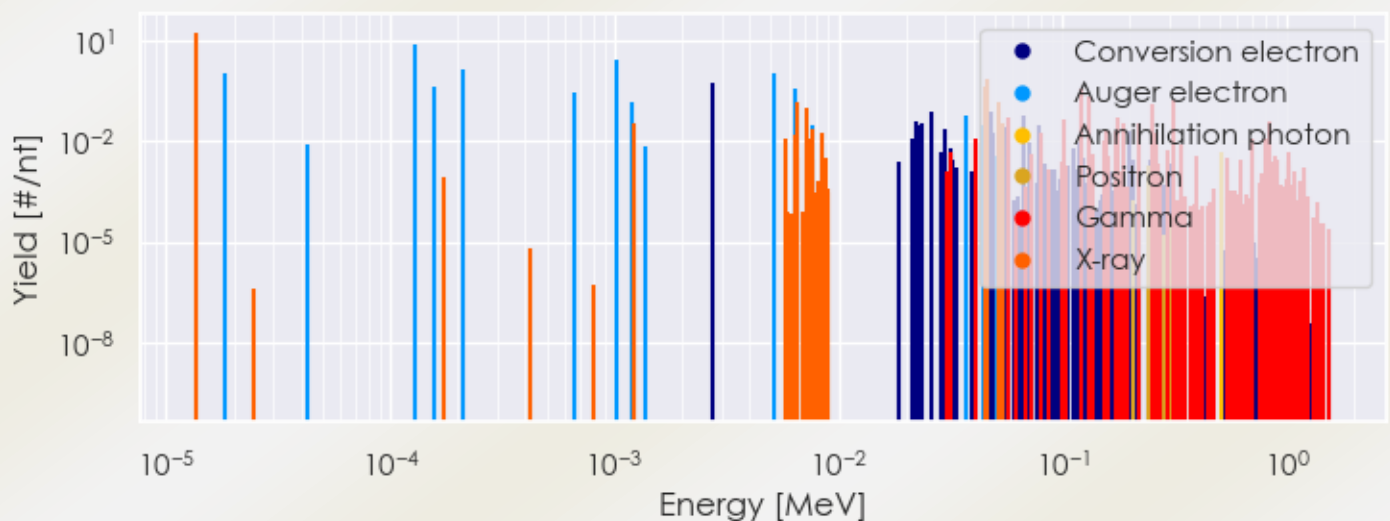
Note: Bins are spaced every 0.1 mm until a radius of 10 cm, and every 1 mm until a radius of 2 m.



Download tabulated dose point kernel file here: [www.mirdsoft.org/products/MIRDspecs/Ho-159 DPK.csv](http://www.mirdsoft.org/products/MIRDspecs/Ho-159 DPK.csv)

### SUMMARY SPECTRA (PLOT)

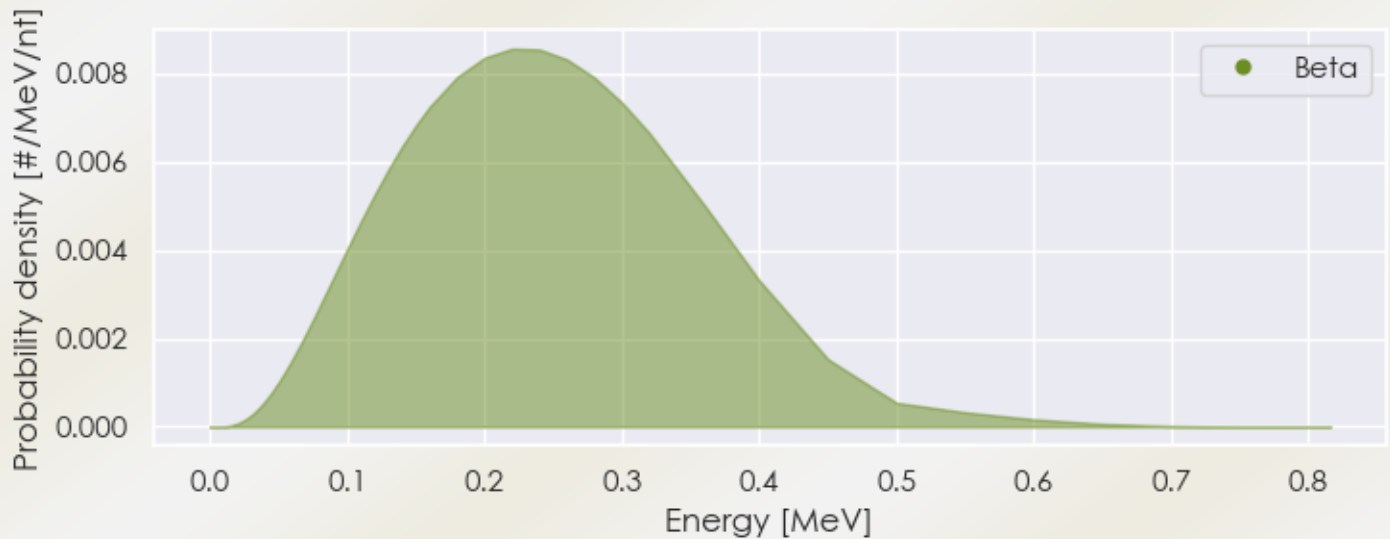
Spectra source: **ICRP Publication 107: Nuclear Decay Data for Dosimetric Calculations. Ann. ICRP 2008, 38 (3).**



Download tabulated summary spectra file here: [www.mirdsoft.org/products/MIRDspecs/Ho-159 Summary Spectrum.csv](http://www.mirdsoft.org/products/MIRDspecs/Ho-159 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/Ho-159 Beta Spectrum.csv](http://www.mirdsoft.org/products/MIRDspecs/Ho-159 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/Ho-159 Summary Spectrum.csv](http://www.mirdsoft.org/products/MIRDspecs/Ho-159 Summary Spectrum.csv)

| Energy [MeV] | Yield [# / nt] if > 0.01 | Radiation type |
|--------------|--------------------------|----------------|
| 1.37139e-05  | 1.834e+01                | X-ray          |
| 1.22958e-03  | 3.492e-02                | X-ray          |
| 5.76280e-03  | 1.129e-02                | X-ray          |
| 6.44440e-03  | 1.651e-02                | X-ray          |
| 6.48150e-03  | 1.459e-01                | X-ray          |
| 7.25411e-03  | 9.996e-02                | X-ray          |
| 7.35039e-03  | 1.214e-02                | X-ray          |
| 7.62077e-03  | 2.470e-02                | X-ray          |
| 8.42363e-03  | 1.753e-02                | X-ray          |
| 4.11820e-02  | 1.148e-02                | Gamma          |

|             |           |                     |
|-------------|-----------|---------------------|
| 4.52703e-02 | 4.362e-01 | X-ray               |
| 4.60801e-02 | 7.796e-01 | X-ray               |
| 5.20302e-02 | 8.024e-02 | X-ray               |
| 5.21989e-02 | 1.551e-01 | X-ray               |
| 5.35316e-02 | 1.766e-02 | X-ray               |
| 5.35696e-02 | 3.421e-02 | X-ray               |
| 5.66260e-02 | 5.177e-02 | Gamma               |
| 7.98070e-02 | 1.846e-02 | Gamma               |
| 1.00599e-01 | 4.815e-02 | Gamma               |
| 1.21012e-01 | 3.620e-01 | Gamma               |
| 1.31973e-01 | 2.360e-01 | Gamma               |
| 1.52375e-01 | 1.064e-02 | Gamma               |
| 1.55851e-01 | 1.940e-02 | Gamma               |
| 1.73155e-01 | 2.143e-02 | Gamma               |
| 1.77608e-01 | 5.358e-02 | Gamma               |
| 1.86274e-01 | 3.367e-02 | Gamma               |
| 2.17647e-01 | 3.656e-02 | Gamma               |
| 2.52963e-01 | 1.368e-01 | Gamma               |
| 2.58822e-01 | 1.839e-02 | Gamma               |
| 3.09594e-01 | 1.723e-01 | Gamma               |
| 7.06648e-01 | 1.180e-02 | Gamma               |
| 8.07236e-01 | 1.281e-02 | Gamma               |
| 8.38625e-01 | 3.841e-02 | Gamma               |
| 1.81686e-05 | 1.017e+00 | Auger electron      |
| 1.28541e-04 | 8.370e+00 | Auger electron      |
| 1.55577e-04 | 4.121e-01 | Auger electron      |
| 2.09925e-04 | 1.355e+00 | Auger electron      |
| 6.60787e-04 | 2.834e-01 | Auger electron      |
| 1.01722e-03 | 2.903e+00 | Auger electron      |
| 1.19335e-03 | 1.580e-01 | Auger electron      |
| 2.76500e-03 | 5.441e-01 | Conversion electron |
| 5.12926e-03 | 1.037e+00 | Auger electron      |
| 6.39272e-03 | 3.651e-01 | Auger electron      |
| 7.69037e-03 | 3.236e-02 | Auger electron      |
| 2.14145e-02 | 1.191e-02 | Conversion electron |
| 2.23655e-02 | 4.016e-02 | Conversion electron |
| 2.27873e-02 | 2.889e-02 | Conversion electron |
| 2.35970e-02 | 3.289e-02 | Conversion electron |

|                    |           |                     |
|--------------------|-----------|---------------------|
| <b>2.59460e-02</b> | 7.223e-02 | Conversion electron |
| <b>2.97159e-02</b> | 2.352e-02 | Conversion electron |
| <b>3.70640e-02</b> | 6.206e-02 | Auger electron      |
| <b>4.39727e-02</b> | 3.104e-02 | Auger electron      |
| <b>4.67380e-02</b> | 1.223e-02 | Conversion electron |
| <b>4.76135e-02</b> | 7.359e-02 | Conversion electron |
| <b>4.80353e-02</b> | 2.144e-02 | Conversion electron |
| <b>4.88450e-02</b> | 1.841e-02 | Conversion electron |
| <b>5.49639e-02</b> | 2.558e-02 | Conversion electron |
| <b>6.71510e-02</b> | 5.629e-02 | Conversion electron |
| <b>7.81120e-02</b> | 2.915e-02 | Conversion electron |
| <b>1.99102e-01</b> | 2.126e-02 | Conversion electron |
| <b>2.55733e-01</b> | 1.558e-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/SNMMI-MAIN/iCore/Store/StoreLayouts/Item\\_Detail.aspx?iProductCode=0-932004-80-6](https://sites.snmmi.org/SNMMI-MAIN/iCore/Store/StoreLayouts/Item_Detail.aspx?iProductCode=0-932004-80-6)