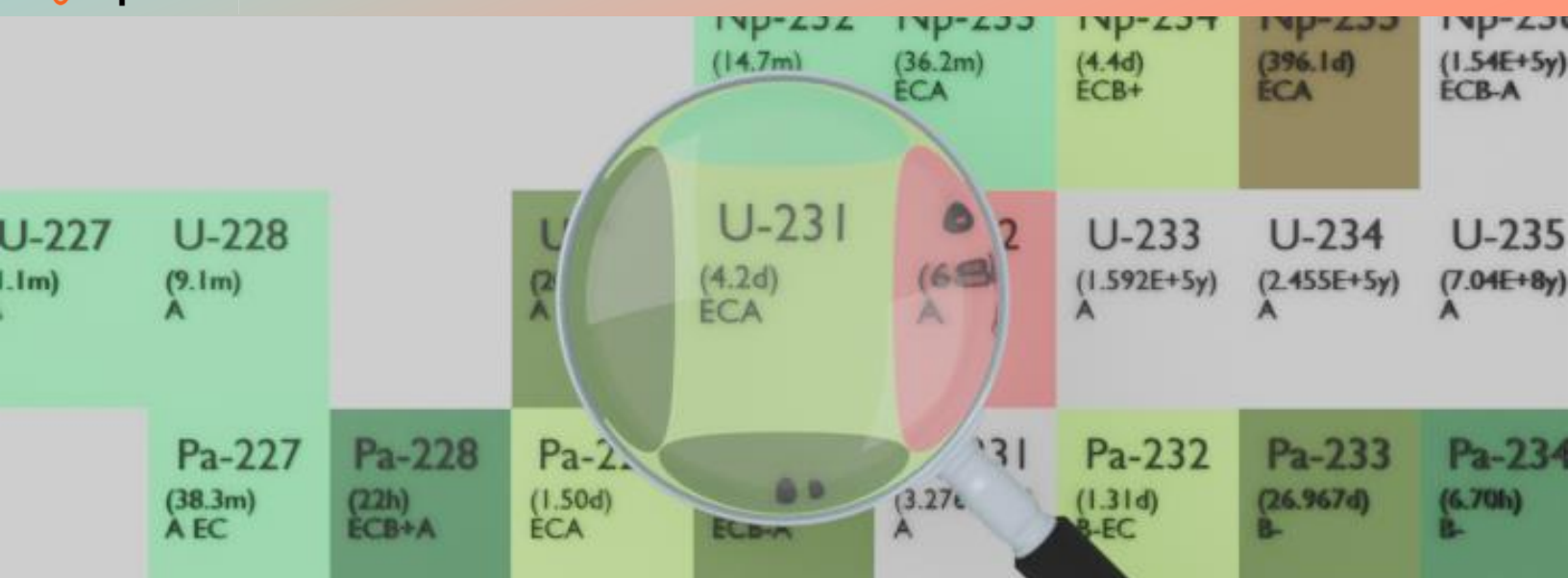




# URANIUM-231

## SUMMARY DATA

### GENERAL

#### CLASSIFICATION

Isotope: U-231  
Atomic number (Z): 92  
Mass number (A): 231  
Neutron number (N): 139

#### RADIOACTIVE DECAY

Decay modes:  $\alpha$ , Electron capture  
Half-life: 4.2 [d]  
Decay constant:  $1.9101 \times 10^{-6}$  [1/s]  
Daughters: Pa-231 (100.0%), Th-227 (0.004%)  
Radioactive daughters: Pa-231, Th-227

#### DOSIMETRIC CONSTANTS

Mean alpha energy: 0.0002 [MeV]  
Mean electron energy: 0.08467 [MeV]  
Mean photon energy: 0.08964 [MeV]  
Air kerma rate constant,  $\Gamma_{10}$ :  $3.172 \times 10^{-17}$  [Gy  $\cdot$  m<sup>2</sup>/Bq  $\cdot$  s]  
Air kerma coefficient,  $K_{\text{air}}$ :  $3.172 \times 10^{-17}$  [Gy  $\cdot$  m<sup>2</sup>/Bq  $\cdot$  s]  
Equilibrium dose constant for weakly-penetrating radiations ( $\alpha$  and/or electrons),  $\Delta_{\text{wp}}$ :  $1.360 \times 10^{-14}$  [Gy  $\cdot$  kg/Bq  $\cdot$  s]  
Equilibrium dose constant for alphas,  $\Delta_{\alpha}$ :  $3.204 \times 10^{-17}$  [Gy  $\cdot$  kg/Bq  $\cdot$  s]

Equilibrium dose constant for betas/electrons,  $\Delta_{\beta,\beta^+,e^-}$ :  $1.357 \times 10^{-14}$  [Gy·kg/Bq·s]

Equilibrium dose constant for photons,  $\Delta_p$ :  $1.436 \times 10^{-14}$  [Gy·kg/Bq·s]

### DOSE POINT KERNELS (PLOT)

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

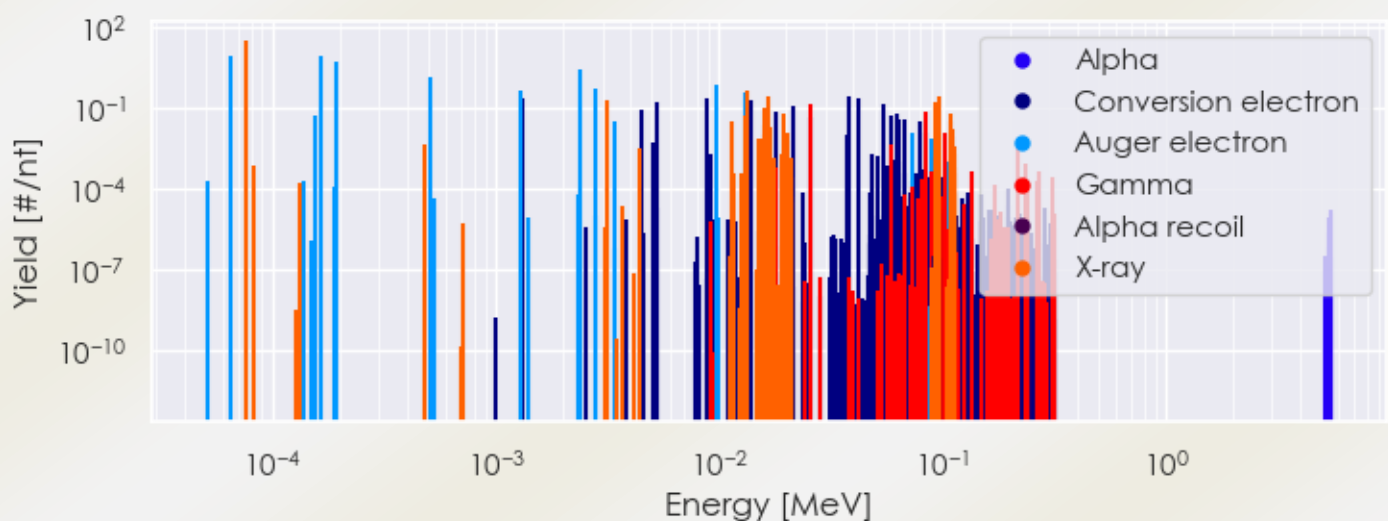
Note: Bins are spaced every 0.1 mm until a radius of 10 cm, and every 1 mm until a radius of 2 m.



Download tabulated dose point kernel file here: [www.mirdsoft.org/products/MIRDspecs/U-231 DPK.csv](http://www.mirdsoft.org/products/MIRDspecs/U-231 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/U-231 Summary Spectrum.csv](http://www.mirdsoft.org/products/MIRDspecs/U-231 Summary 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/U-231 Summary Spectrum.csv](http://www.mirdsoft.org/products/MIRDspecs/U-231%20Summary%20Spectrum.csv)

| Energy [MeV] | Yield [#]/nt] if > 0.01 | Radiation type |
|--------------|-------------------------|----------------|
| 7.65216e-05  | 3.374e+01               | X-ray          |
| 3.15895e-03  | 1.944e-01               | X-ray          |
| 1.14081e-02  | 3.112e-02               | X-ray          |
| 1.31269e-02  | 5.132e-02               | X-ray          |
| 1.32994e-02  | 4.510e-01               | X-ray          |
| 1.59993e-02  | 1.027e-02               | X-ray          |
| 1.60398e-02  | 9.387e-02               | X-ray          |
| 1.61112e-02  | 2.203e-02               | X-ray          |
| 1.66446e-02  | 1.739e-02               | X-ray          |
| 1.67859e-02  | 2.581e-01               | X-ray          |
| 1.69536e-02  | 1.967e-02               | X-ray          |
| 1.96582e-02  | 5.794e-02               | X-ray          |
| 2.02959e-02  | 1.097e-02               | X-ray          |
| 2.56500e-02  | 1.460e-01               | Gamma          |
| 8.42300e-02  | 7.300e-02               | Gamma          |
| 9.26782e-02  | 1.745e-01               | X-ray          |
| 9.63371e-02  | 2.806e-01               | X-ray          |
| 1.02300e-01  | 1.256e-02               | Gamma          |
| 1.08078e-01  | 3.226e-02               | X-ray          |
| 1.08921e-01  | 6.301e-02               | X-ray          |
| 1.12089e-01  | 1.620e-02               | X-ray          |
| 6.46633e-05  | 8.218e+00               | Auger electron |
| 1.56144e-04  | 5.526e-02               | Auger electron |
| 1.65010e-04  | 8.921e+00               | Auger electron |
| 1.93398e-04  | 5.042e+00               | Auger electron |
| 5.14018e-04  | 1.464e+00               | Auger electron |
| 1.29803e-03  | 4.813e-01               | Auger electron |

|                    |           |                     |
|--------------------|-----------|---------------------|
| <b>1.32700e-03</b> | 2.360e-01 | Conversion electron |
| <b>2.37978e-03</b> | 2.914e+00 | Auger electron      |
| <b>2.82493e-03</b> | 5.252e-01 | Auger electron      |
| <b>3.42338e-03</b> | 3.053e-02 | Auger electron      |
| <b>4.53700e-03</b> | 9.041e-02 | Conversion electron |
| <b>5.24800e-03</b> | 1.679e-01 | Conversion electron |
| <b>8.90700e-03</b> | 2.218e-01 | Conversion electron |
| <b>9.82260e-03</b> | 7.114e-01 | Auger electron      |
| <b>1.30363e-02</b> | 3.571e-01 | Auger electron      |
| <b>1.39106e-02</b> | 2.076e-01 | Conversion electron |
| <b>1.62790e-02</b> | 4.223e-02 | Auger electron      |
| <b>1.80700e-02</b> | 7.281e-02 | Conversion electron |
| <b>2.14906e-02</b> | 1.259e-01 | Conversion electron |
| <b>2.56500e-02</b> | 4.184e-02 | Conversion electron |
| <b>3.74370e-02</b> | 1.003e-02 | Conversion electron |
| <b>3.81480e-02</b> | 2.905e-01 | Conversion electron |
| <b>4.18070e-02</b> | 2.422e-01 | Conversion electron |
| <b>5.43906e-02</b> | 1.500e-01 | Conversion electron |
| <b>5.85500e-02</b> | 5.225e-02 | Conversion electron |
| <b>6.31170e-02</b> | 6.091e-02 | Conversion electron |
| <b>6.38280e-02</b> | 3.947e-02 | Conversion electron |
| <b>6.74870e-02</b> | 3.681e-02 | Conversion electron |
| <b>7.36405e-02</b> | 1.227e-02 | Auger electron      |
| <b>8.00706e-02</b> | 3.372e-02 | Conversion electron |
| <b>8.42300e-02</b> | 1.159e-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)