



# BISMUTH-213

## SUMMARY DATA

### GENERAL

#### CLASSIFICATION

Isotope: Bi-213  
Atomic number (Z): 83  
Mass number (A): 213  
Neutron number (N): 130

#### RADIOACTIVE DECAY

Decay modes:  $\alpha$ ,  $\beta^-$   
Half-life: 45.59 [m]  
Decay constant:  $2.5340 \times 10^{-4}$  [1/s]  
Daughters: Po-213 (97.9%), Tl-209 (2.09%)  
Radioactive daughters: Po-213, Tl-209

#### DOSIMETRIC CONSTANTS

Mean alpha energy: 0.1245 [MeV]  
Mean electron energy: 0.44404 [MeV]  
Mean photon energy: 0.12773 [MeV]  
Air kerma rate constant,  $\Gamma_{10}$ :  $5.441 \times 10^{-18}$  [Gy  $\cdot$  m<sup>2</sup>/Bq  $\cdot$  s]  
Air kerma coefficient,  $K_{\text{air}}$ :  $5.441 \times 10^{-18}$  [Gy  $\cdot$  m<sup>2</sup>/Bq  $\cdot$  s]  
Equilibrium dose constant for weakly-penetrating radiations ( $\alpha$  and/or electrons),  $\Delta_{\text{wp}}$ :  $9.109 \times 10^{-14}$  [Gy  $\cdot$  kg/Bq  $\cdot$  s]  
Equilibrium dose constant for alphas,  $\Delta_{\alpha}$ :  $1.995 \times 10^{-14}$  [Gy  $\cdot$  kg/Bq  $\cdot$  s]

Equilibrium dose constant for betas/electrons,  $\Delta_{\beta-, \beta+, e-}$ :  $7.114 \times 10^{-14}$  [Gy·kg/Bq·s]

Equilibrium dose constant for photons,  $\Delta_p$ :  $2.046 \times 10^{-14}$  [Gy·kg/Bq·s]

## DOSE POINT KERNELS (PLOT)

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

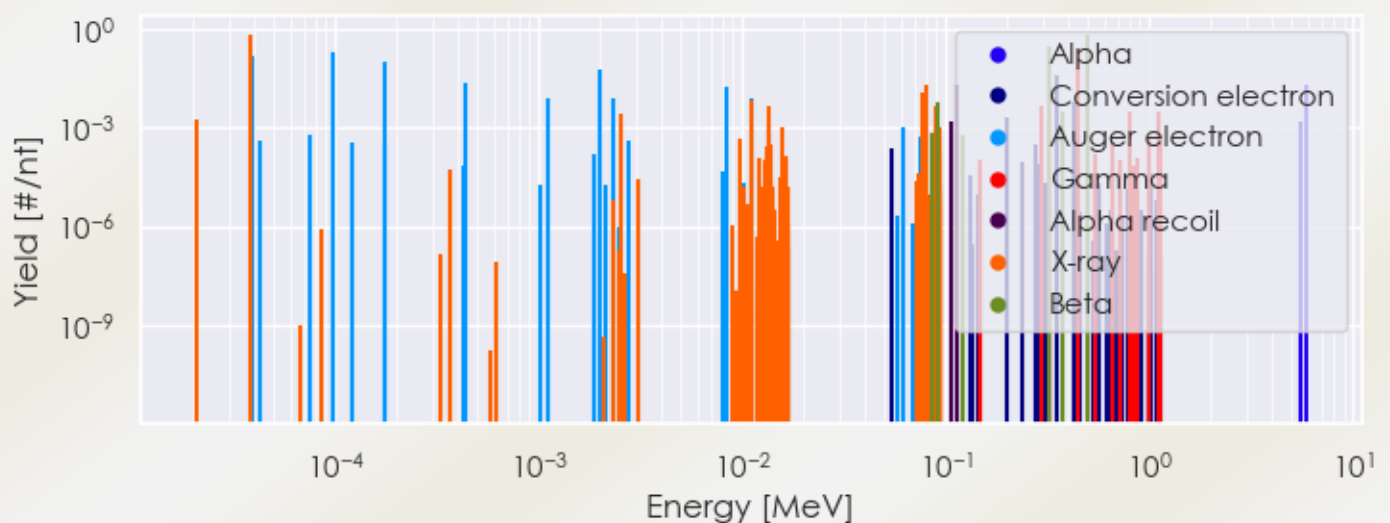
Note: Bins are spaced every 0.1 mm until a radius of 10 cm, and every 1 mm until a radius of 2 m.



Download tabulated dose point kernel file here: [www.mirdsoft.org/products/MIRDspecs/Bi-213 DPK.csv](http://www.mirdsoft.org/products/MIRDspecs/Bi-213 DPK.csv)

## SUMMARY SPECTRA (PLOT)

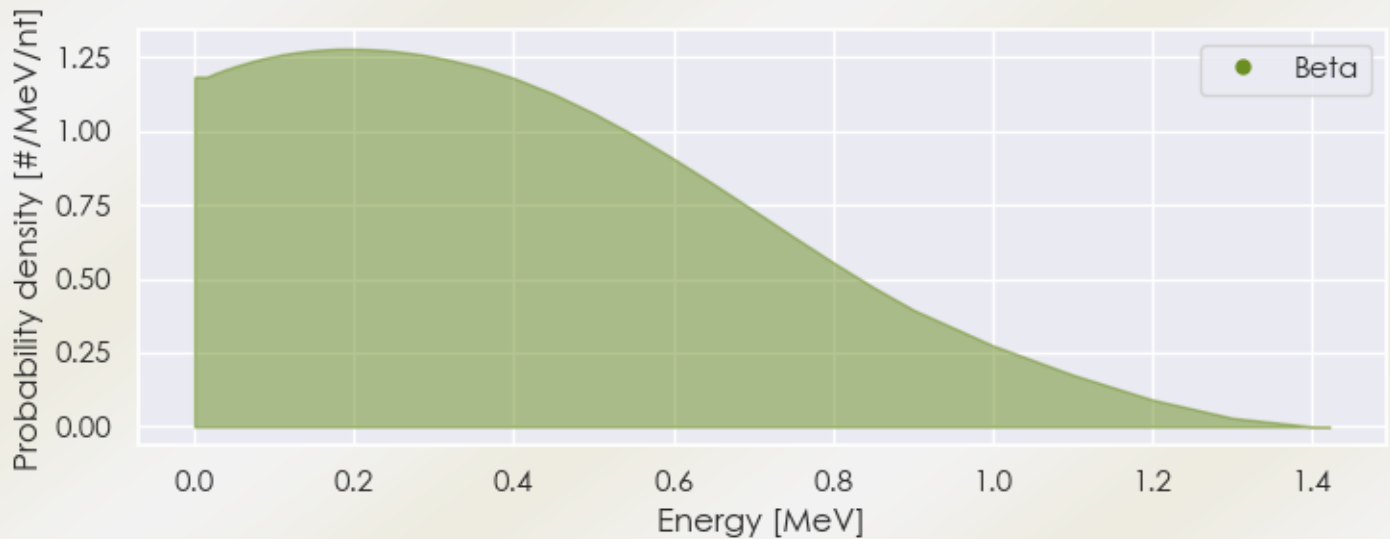
Spectra source: **ICRP Publication 107: Nuclear Decay Data for Dosimetric Calculations. Ann. ICRP 2008, 38 (3).**



Download tabulated summary spectra file here: [www.mirdsoft.org/products/MIRDspecs/Bi-213 Summary Spectrum.csv](http://www.mirdsoft.org/products/MIRDspecs/Bi-213 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/Bi-213 Beta Spectrum.csv](http://www.mirdsoft.org/products/MIRDspecs/Bi-213 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/Bi-213 Summary Spectrum.csv](http://www.mirdsoft.org/products/MIRDspecs/Bi-213 Summary Spectrum.csv)

| Energy [MeV] | Yield [# / nt] if > 0.01 | Radiation type |
|--------------|--------------------------|----------------|
| 3.84109e-05  | 6.243e-01                | X-ray          |
| 7.71271e-02  | 1.214e-02                | X-ray          |
| 7.96070e-02  | 2.021e-02                | X-ray          |
| 4.40460e-01  | 2.610e-01                | Gamma          |
| 3.19976e-01  | 3.098e-01                | Beta           |
| 4.91654e-01  | 6.586e-01                | Beta           |
| 3.94527e-05  | 1.491e-01                | Auger electron |
| 9.70234e-05  | 1.945e-01                | Auger electron |
| 1.74590e-04  | 1.046e-01                | Auger electron |
| 4.31989e-04  | 2.402e-02                | Auger electron |

|                    |           |                                     |
|--------------------|-----------|-------------------------------------|
| <b>2.01388e-03</b> | 5.691e-02 | <a href="#">Auger electron</a>      |
| <b>8.44368e-03</b> | 1.657e-02 | <a href="#">Auger electron</a>      |
| <b>3.47036e-01</b> | 4.043e-02 | <a href="#">Conversion electron</a> |
| <b>5.86959e+00</b> | 1.935e-02 | <a href="#">Alpha</a>               |
| <b>1.12410e-01</b> | 1.935e-02 | <a href="#">Alpha recoil</a>        |

## 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)