

The image shows a portion of a periodic table where each cell represents an isotope. The cells are color-coded: green for stable or long-lived isotopes, red for short-lived ones, and yellow for others. A magnifying glass is positioned over the Nb-89 isotope, which is in a green cell. The text in the magnified cell reads: Nb-89, (2.03h), ECB+. Other visible isotopes include Nb-87, Nb-90, Nb-91, Nb-92, Nb-93, Zr-85, Zr-86, Zr-87, Zr-89, Zr-90, Zr-91, and Zr-92.

NIOBIUM-89

SUMMARY DATA

GENERAL

CLASSIFICATION

Isotope: Nb-89

Atomic number (Z): 41

Mass number (A): 89

Neutron number (N): 48

RADIOACTIVE DECAY

Decay modes: β^+ , Electron capture

Half-life: 2.03 [h]

Decay constant: 9.4848e-05 [1/s]

Daughters: Zr-89 (98.8%), Zr-89m (1.23%)

Radioactive daughters: Zr-89, Zr-89m

DOSIMETRIC CONSTANTS

Mean alpha energy: 0.0 [MeV]

Mean electron energy: 1.08593 [MeV]

Mean photon energy: 1.36679 [MeV]

Air kerma rate constant, Γ_{10} : $2.111\text{e-}17$ [$\text{Gy}\cdot\text{m}^2/\text{Bq}\cdot\text{s}$]

Air kerma coefficient, K_{air} : $5.037\text{e-}17$ [$\text{Gy} \cdot \text{m}^2/\text{Bq} \cdot \text{s}$]

Equilibrium dose constant for weakly-penetrating radiations (α and/or electrons), Δ_{wp} : 1.740e-13 [Gy·kg/Bq·s]

Equilibrium dose constant for alphas, Δ_a : 0.000e+00 [Gy·kg/Bq·s]

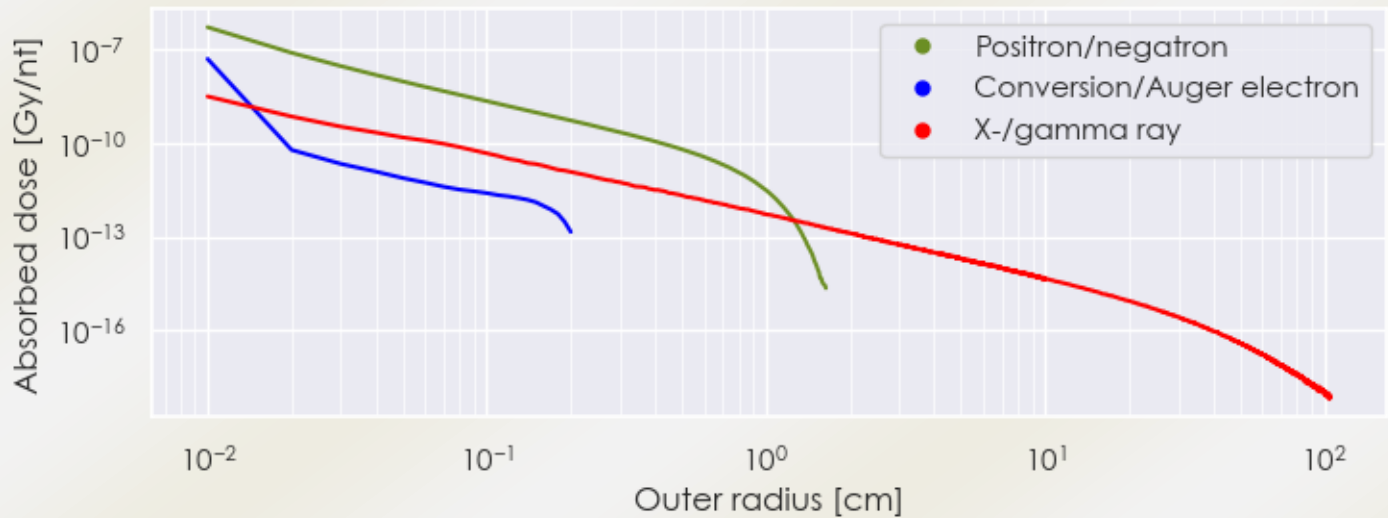
Equilibrium dose constant for betas/electrons, $\Delta_{\beta,\beta^+,e^-}$: 1.740×10^{-13} [Gy·kg/Bq·s]

Equilibrium dose constant for photons, Δ_p : 2.190×10^{-13} [Gy·kg/Bq·s]

DOSE POINT KERNELS (PLOT)

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

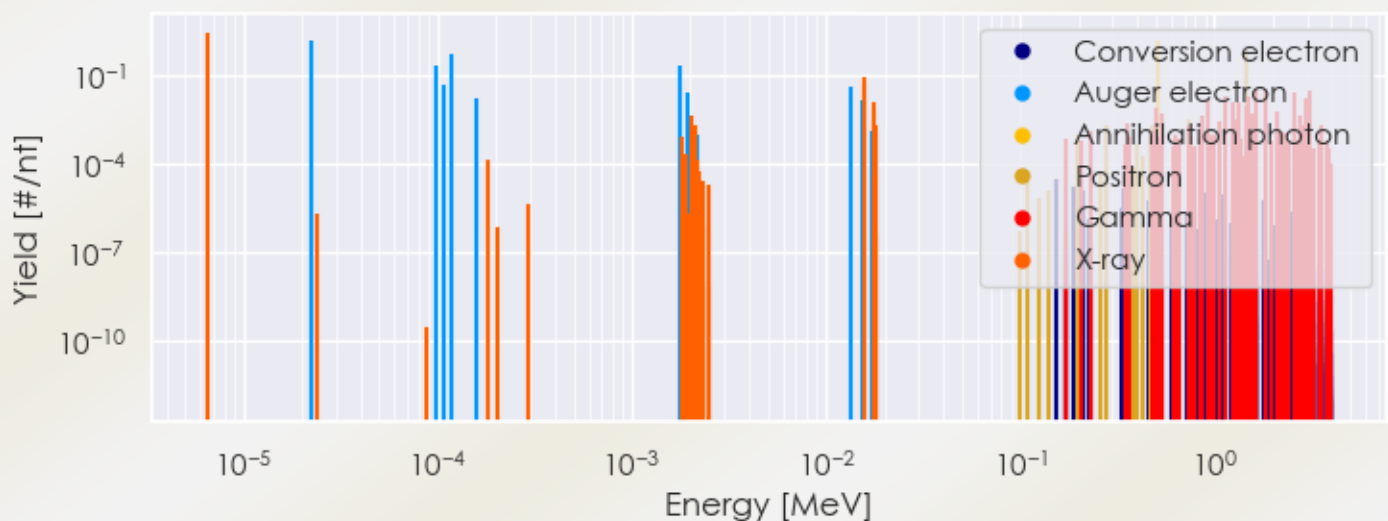
Note: Bins are spaced every 0.1 mm until a radius of 10 cm, and every 1 mm until a radius of 2 m.



Download tabulated dose point kernel file here: www.mirdsoft.org/products/MIRDspecs/Nb-89 DPK.csv

SUMMARY SPECTRA (PLOT)

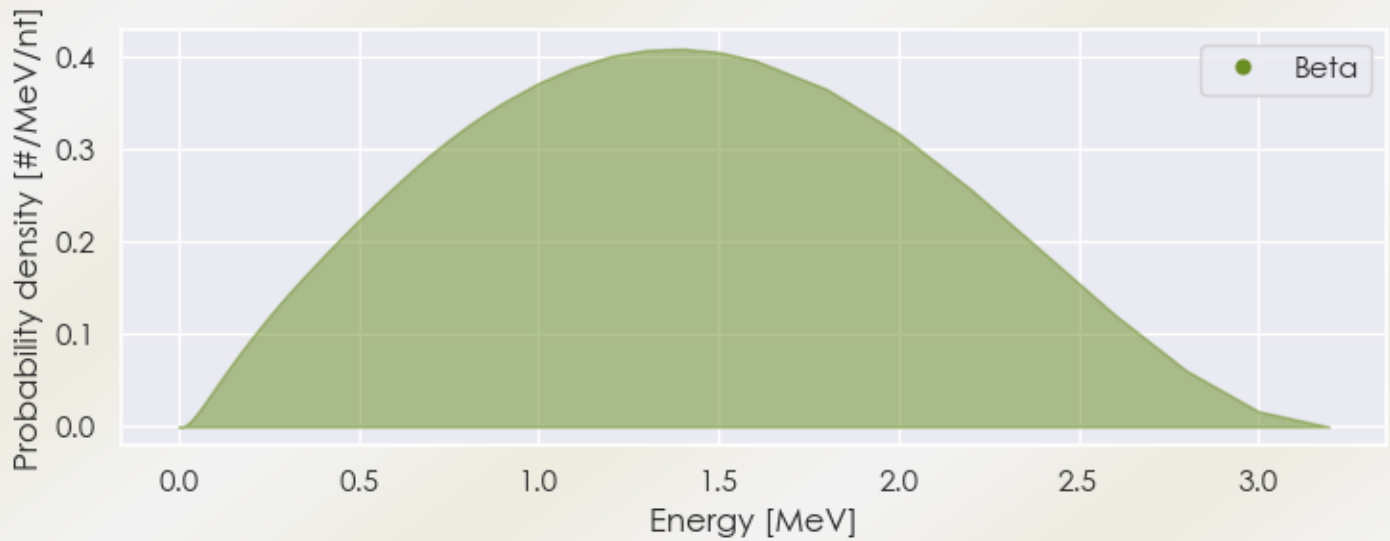
Spectra source: **ICRP Publication 107: Nuclear Decay Data for Dosimetric Calculations. Ann. ICRP 2008, 38 (3).**



Download tabulated summary spectra file here: www.mirdsoft.org/products/MIRDspecs/Nb-89 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/Nb-89 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/Nb-89 Summary Spectrum.csv

Energy [MeV]	Yield [# / nt] if > 0.01	Radiation type
6.52412e-06	2.947e+00	X-ray
1.56498e-02	4.509e-02	X-ray
1.57372e-02	8.628e-02	X-ray
1.76312e-02	1.325e-02	X-ray
5.11000e-01	1.511e+00	Annihilation photon
9.20500e-01	1.435e-02	Gamma
1.12700e+00	2.100e-02	Gamma
1.25900e+00	1.225e-02	Gamma
1.33230e+00	1.225e-02	Gamma
1.51140e+00	1.925e-02	Gamma

1.62720e+00	3.500e-02	Gamma
1.83340e+00	3.255e-02	Gamma
2.57230e+00	2.660e-02	Gamma
2.96010e+00	1.750e-02	Gamma
3.09270e+00	3.045e-02	Gamma
1.44860e+00	7.449e-01	Positron
2.22355e-05	1.563e+00	Auger electron
9.83371e-05	2.338e-01	Auger electron
1.06598e-04	4.976e-02	Auger electron
1.17895e-04	5.352e-01	Auger electron
1.58205e-04	1.580e-02	Auger electron
1.75390e-03	2.217e-01	Auger electron
1.94480e-03	2.486e-02	Auger electron
1.33271e-02	4.187e-02	Auger electron
1.53342e-02	1.491e-02	Auger 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