

IND-134 (8.5m) ECB+	IND-135 (12.4m) ECB+	IND-136 (50.65m) ECB+	IND-137 (38.5m) ECB+	IND-138 (5.04h) EC	IND-139 (29.7m) ECB+	IND-140 (3.37d) EC	IND-141 (2.49h) ECB+	
Pr-134 (11m) ECB+	Pr-135 (2.1m) ECB+	Pr-136 (13.1m) ECB+	Pr-137 (1.1m) ECB+	Pr-138 (1.45m) ECB+	Pr-139 (4.41h) ECB+	Pr-140 (3.39m) ECB+	Pr-141 (3.39m) ECB+	
Ce-131 (0.2m) ECB+	Ce-132 (3.51h) EC	Ce-133 (97m) ECB+	Ce-134 (3.16d) EC	Ce-135 (9.0h) ECB+	Ce-136 (STABLE)	Ce-137 (9.0h) ECB+	Ce-138 (STABLE)	Ce-139 (137.641d) EC

PRASEODYMIUM-136

SUMMARY DATA

GENERAL

CLASSIFICATION

Isotope: Pr-136
Atomic number (Z): 59
Mass number (A): 136
Neutron number (N): 77

RADIOACTIVE DECAY

Decay modes: β^+ , Electron capture
Half-life: 13.1 [m]
Decay constant: $8.8187\text{e-}04$ [1/s]
Daughters: Ce-136 (100.0%)
Radioactive daughters: None

DOSIMETRIC CONSTANTS

Mean alpha energy: 0.0 [MeV]
Mean electron energy: 0.75448 [MeV]
Mean photon energy: 2.14584 [MeV]
Air kerma rate constant, Γ_{10} : $5.512\text{e-}17$ [$\text{Gy} \cdot \text{m}^2/\text{Bq} \cdot \text{s}$]
Air kerma coefficient, K_{air} : $7.724\text{e-}17$ [$\text{Gy} \cdot \text{m}^2/\text{Bq} \cdot \text{s}$]
Equilibrium dose constant for weakly-penetrating radiations (α and/or electrons), Δ_{wp} : $1.209\text{e-}13$ [$\text{Gy} \cdot \text{kg}/\text{Bq} \cdot \text{s}$]
Equilibrium dose constant for alphas, Δ_{α} : $0.000\text{e+}00$ [$\text{Gy} \cdot \text{kg}/\text{Bq} \cdot \text{s}$]

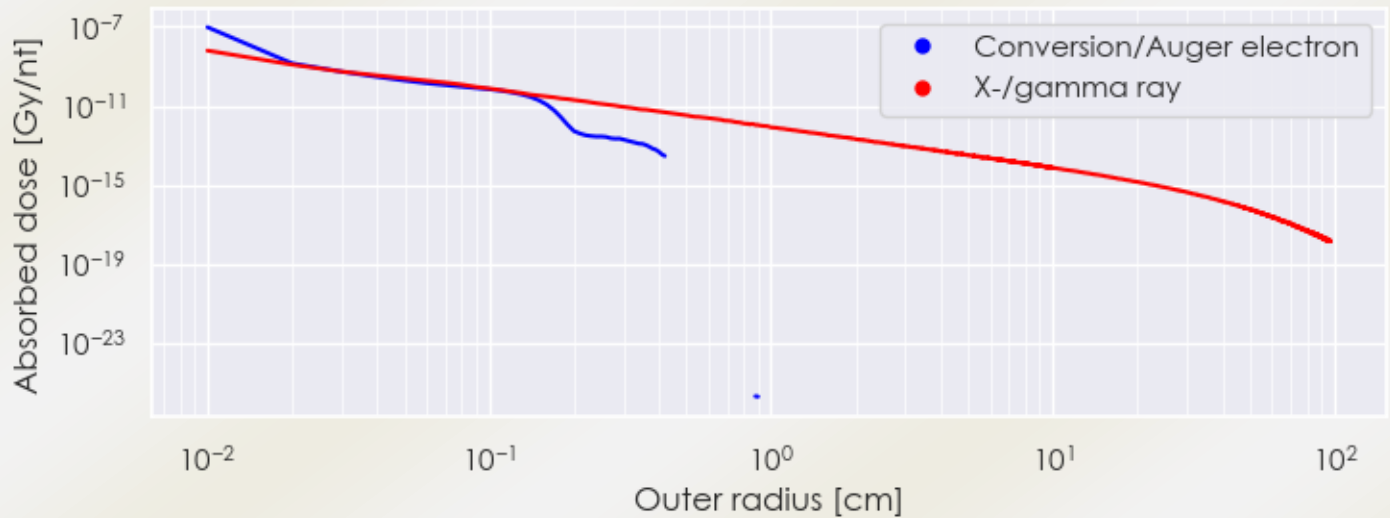
Equilibrium dose constant for betas/electrons, $\Delta_{\beta,\beta^+,e^-}$: 1.209×10^{-13} [Gy·kg/Bq·s]

Equilibrium dose constant for photons, Δ_p : 3.438×10^{-13} [Gy·kg/Bq·s]

DOSE POINT KERNELS (PLOT)

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

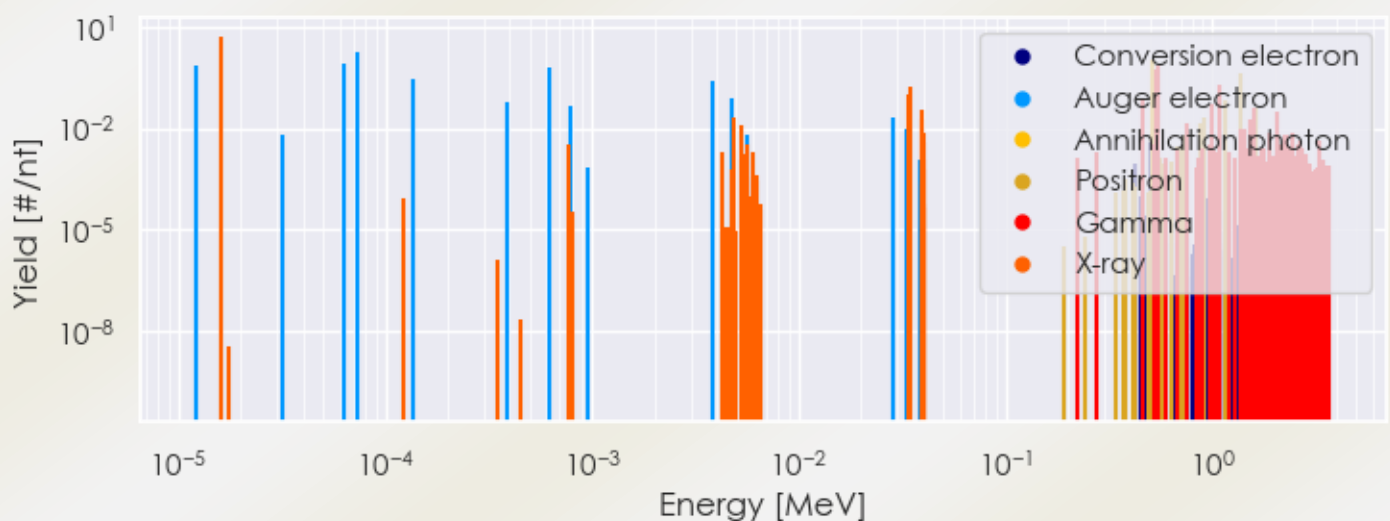
Note: Bins are spaced every 0.1 mm until a radius of 10 cm, and every 1 mm until a radius of 2 m.



Download tabulated dose point kernel file here: www.mirdsoft.org/products/MIRDspecs/Pr-136 DPK.csv

SUMMARY SPECTRA (PLOT)

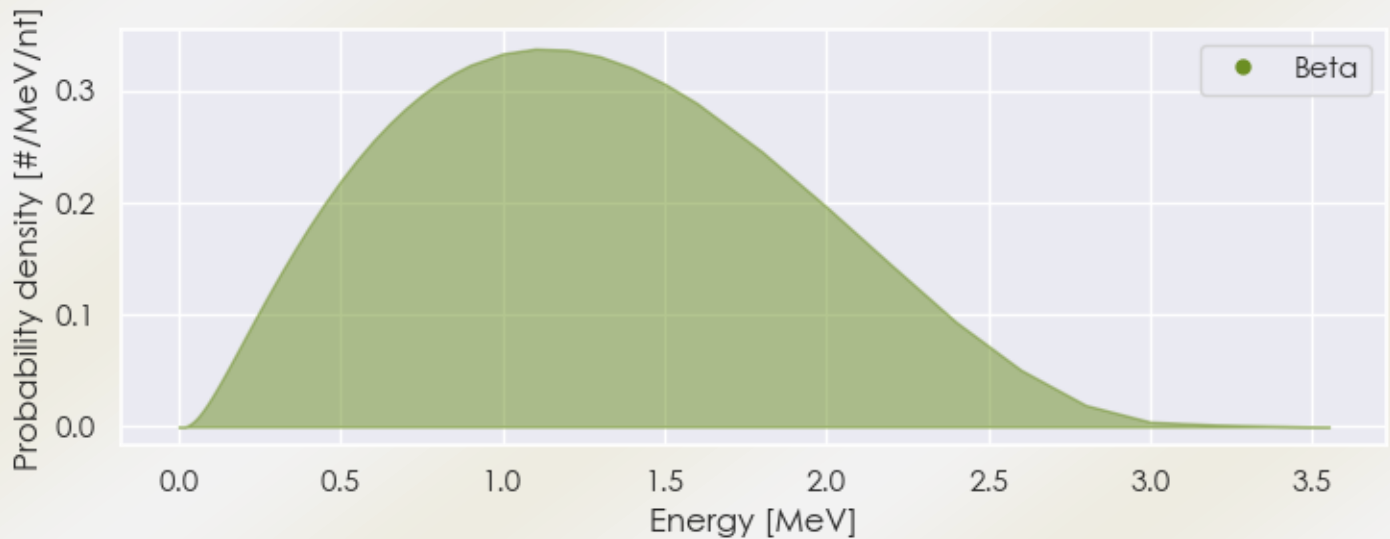
Spectra source: **ICRP Publication 107: Nuclear Decay Data for Dosimetric Calculations. Ann. ICRP 2008, 38 (3).**



Download tabulated summary spectra file here: www.mirdsoft.org/products/MIRDspecs/Pr-136 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/Pr-136 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/Pr-136 Summary Spectrum.csv

Energy [MeV]	Yield [# / nt] if > 0.01	Radiation type
1.61262e-05	5.171e+00	X-ray
4.82666e-03	2.069e-02	X-ray
5.25981e-03	1.244e-02	X-ray
3.42907e-02	9.802e-02	X-ray
3.47432e-02	1.795e-01	X-ray
3.91962e-02	1.745e-02	X-ray
3.92855e-02	3.380e-02	X-ray
4.61000e-01	7.650e-02	Gamma
5.11000e-01	1.143e+00	Annihilation photon
5.39750e-01	5.240e-01	Gamma

5.52160e-01	7.598e-01	Gamma
7.61000e-01	1.467e-02	Gamma
1.00070e+00	5.030e-02	Gamma
1.09230e+00	1.855e-01	Gamma
1.51500e+00	1.939e-02	Gamma
1.60270e+00	3.930e-02	Gamma
2.06720e+00	2.987e-02	Gamma
8.77245e-01	1.499e-02	Positron
9.17019e-01	2.199e-02	Positron
1.15182e+00	7.096e-02	Positron
1.36461e+00	4.038e-01	Positron
1.61612e+00	4.098e-02	Positron
1.22653e-05	7.347e-01	Auger electron
6.25448e-05	7.982e-01	Auger electron
7.40114e-05	1.737e+00	Auger electron
1.35108e-04	2.714e-01	Auger electron
3.89069e-04	5.798e-02	Auger electron
6.26813e-04	6.382e-01	Auger electron
7.79419e-04	4.627e-02	Auger electron
3.85076e-03	2.465e-01	Auger electron
4.70733e-03	8.118e-02	Auger electron
2.83189e-02	2.119e-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