

IAEA – NDS data retrieval tools

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IAEA Nuclear Data Section

Trieste
ICTP workshop on Nuclear Structure and Decay Data
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www-nds.iaea.org

International Atomic Energy Agency
Nuclear Data Services
提供核数据组，原子能机构

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NEW TENDL-2017 TALYS-based Evaluated Nuclear Data Library, 2017: [page] [list] [retrieve]
JENDL/AD-2017 JAEA Activation Cross Section File for Nuclear Decommissioning 2017: [page] [list] [retrieve]
ENDF/B-VIII.0 U.S. Evaluated Nuclear Data Library, issued in 2018: [page] [list] [retrieve]

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Download data, codes, packages

Quick Links
ADS-Lib
Atomic Mass Data Centre
CINDA
Charged particle reference cross section
DROSG-2000
DXS
Decay Data Library for Actinides
EMPIRE-3.2
ENDF Archive
ENDF Retrieval
ENDF-6 Codes
ENDF-6 Format
ENDFVER
ENSDF
ENSDF ASCII Files
ENSDF programs
EPICS Electron & photon interaction data
EXFOR
FENDL
Fission Yields

Main All Reaction Data Structure & Decay by Applications Doc & Codes Index Events Links News

EXFOR
Experimental nuclear reaction data

LiveChart of Nuclides
Interactive Chart of Nuclides

CINDA
Nuclear reaction bibliography

ENDF
Evaluated nuclear reaction libraries

ENSDF
evaluated nuclear structure and decay data (+XUNDL)

NSR
Nuclear Science References

NuDat-2
selected evaluated nuclear structure data **

RIPL
reference parameters for nuclear model calculations

IBANDL
Ion Beam Analysis Nuclear Data Library

Charged particle reference cross section
Beam monitor reactions

PGAA
Prompt gamma rays from neutron capture

FENDL
Fusion Evaluated Nuclear Data Library

Photonuclear
- IAEA Photonuclear Data Library, 1999
- EPICS Electron & Photon Interaction Data, 2017

IRDFF
International Reactor Dosimetry and Fusion File

NAA
Neutron Activation Analysis Portal

Safeguards Data
recommendations, August 2008

Medical Portal
Data for Medical Applications

Standards
- Neutron cross-sections, 2006
- Decay data, 2005

*Database at the IAEA, Vienna **Database at the US NNDC

IAEA Nuclear Data Section

IAEA-NDS Mission, Staff and more
A+M Atomic and Molecular Data
Meetings Workshops
Newsletters
Coordinated Research Projects
NRDC Nuclear Reaction Data Center Network
NSDD Nuclear Structure & Decay Data Network
Technical Documents INDC Reports Publications
Computer Codes
IAEA-NA Department of Nuclear Sciences and Applications

Links – quick reference

- **Atomic Mass Data Centre + Nubase** <https://www-nds.iaea.org/amdc/>
- **ENSDF codes** https://www-nds.iaea.org/public/ensdf_pgm/
- **Nuclear Moments** <https://www-nds.iaea.org/nuclearmoments/>
- **Decay data portal** https://www-nds.iaea.org/relnsd/vcharthtml/VChartHTML_libs.html
- **Pocket Nuclear Database** <https://www-nds.iaea.org/relnsd/pndb/pndb.html>
- **Isotope Browser** for mobile devices [Google Play](#) **or** [App Store](#)
- **Livechart** <https://www-nds.iaea.org/relnsd/vcharthtml/VChartHTML.html>

Query tool & Plot3D links are inside Livechart

Isotope Browser
IAEA Nuclear Data Section

CHART ELEMENT 9C - C - 6

GO CLEAR EXPERT

N A Jπ ☐ Stable

s <T½< Y

Decay and Main Radiations

Decay mode 0 <%< 100

Decay Rad. 0 <keV< 100

[Guide](#)

[Change language](#) going to **Preferences**

Pick an Element (or enter a **Symbol**, e.g. xe, or an **Atomic Number**, e.g. 54, or a **Nuclide**, e.g. 135xe), the search starts automatically

Tap an item in the result list to get detailed information

The Database includes ground states and isomers having half-life > 0.1 s

Chart

Shows the selected nuclides on the Nuclides Chart. All nuclides are shown when no query is active

The color represents the main decay mode

Zoom to get nuclide names, more to get summary data

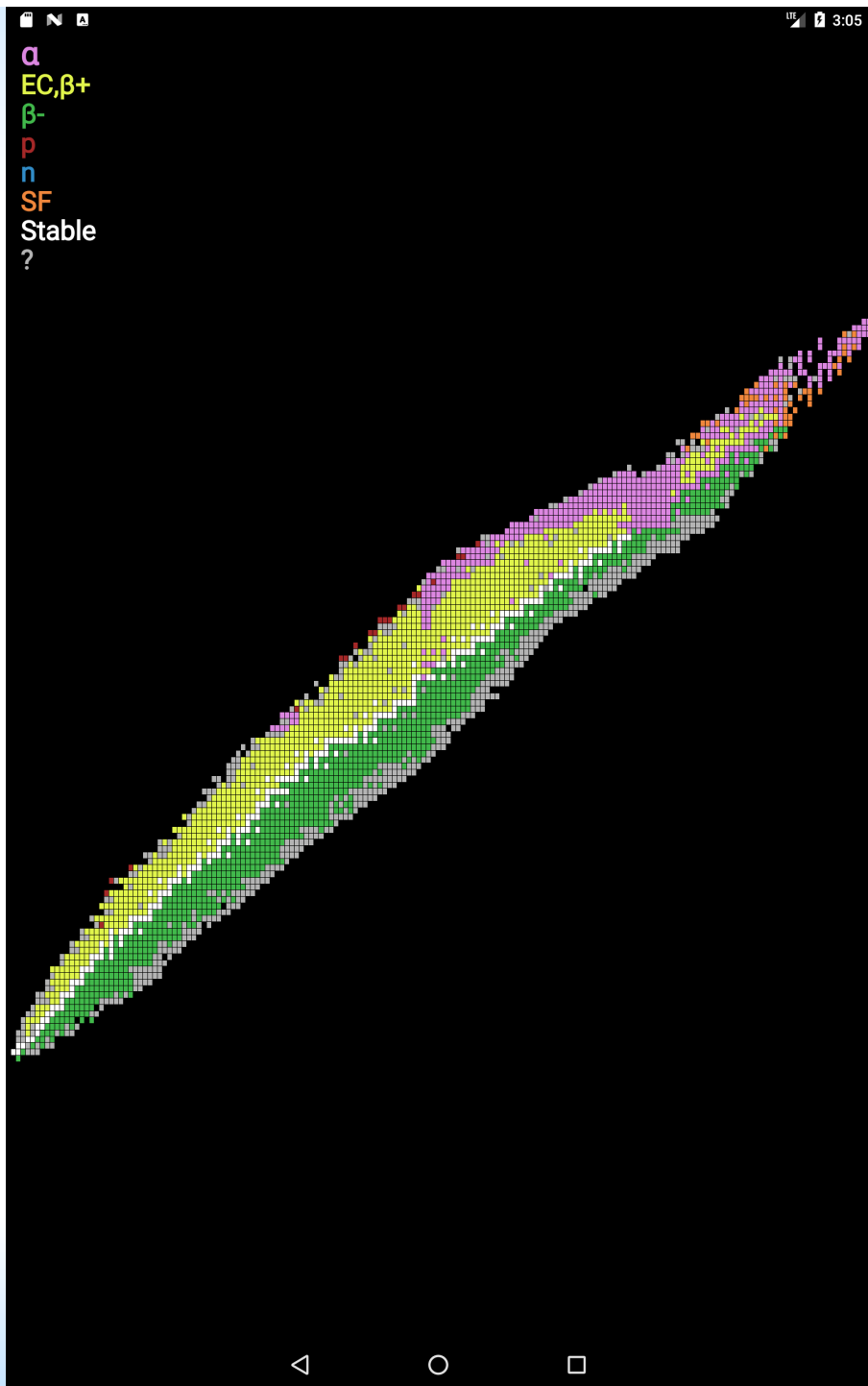
Tap to go to the detail page

The Decay chain is shown by a **long press** on a nuclide. It includes all ground state decay modes having a branching ratio value, and all the possible parents. Use the Preferences to change this

Spontaneous fission and branching ratios marked as ? are not drawn

Long press on the same nuclide to reset the chart

Dashed lines represent secondary decay modes



- More about this nuclide on [NDS web](#)
- Uncertainty example: 12.3 (11) means 12.3 ± 1.1
- Refer to the Guide for the meaning of the data


Z 93 **N** 143 **J π** (6-)


Half-life 153 10³ (5) Y


Parents

 **240-Am** α 1.9 10⁻⁴ %7

Decays see the [decay chain](#)

 ec 86.3(8)% \rightarrow **236-U**

 β^- 13.5(8)% \rightarrow **236-Pu**

 α 0.16(4)% \rightarrow **232-Pa**

Q α 5010 (50) keV

Q β 480 (50) keV

Qec 930 (50) keV

Sn 5740 (50) keV

Sp 4830 (50) keV

Binding energy/A

7579.21 (21) keV


Mass

236.04657 (50) AMU

Thermal neutron capture

142 barns

Decay radiations [ordering](#)

 From β^- decay

Y

| En [keV] | Int [%] |
|------------|-------------|
| 158.35 (2) | 4.2 (3) |
| 102.82 (2) | 0.91 (7) |
| 44.6 (1) | 0.0182 (14) |

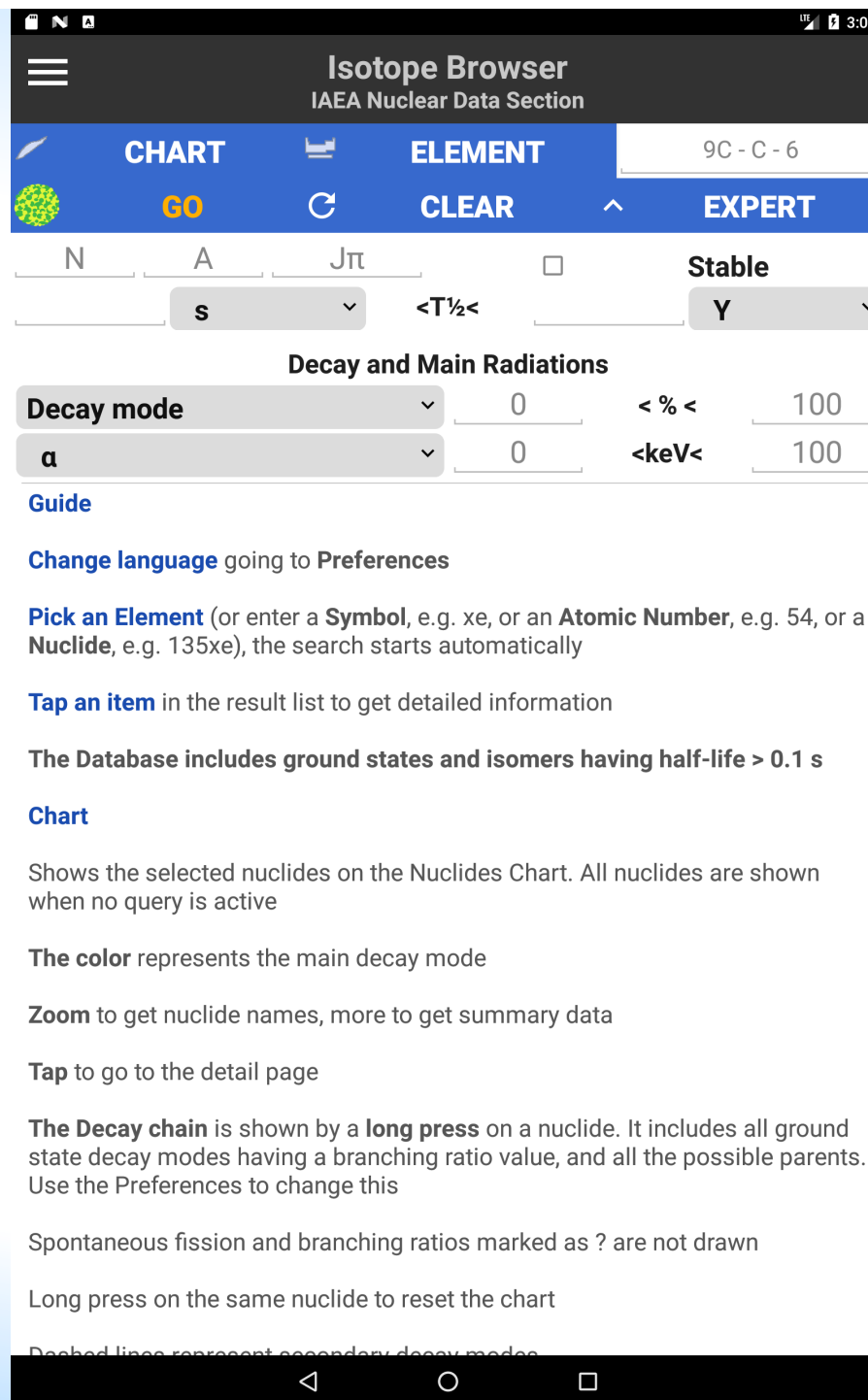
X

| En [keV] | Transition | Int [%] |
|-------------------|--------------|------------|
| 117.800 - 121.556 | K β | 0.186 (14) |
| 104.279 | K α 1 | 0.38 (3) |
| 99.979 | K α 2 | 0.237 (17) |
| 12.169 - 22.841 | L | 13.4 (8) |

 From ec decay

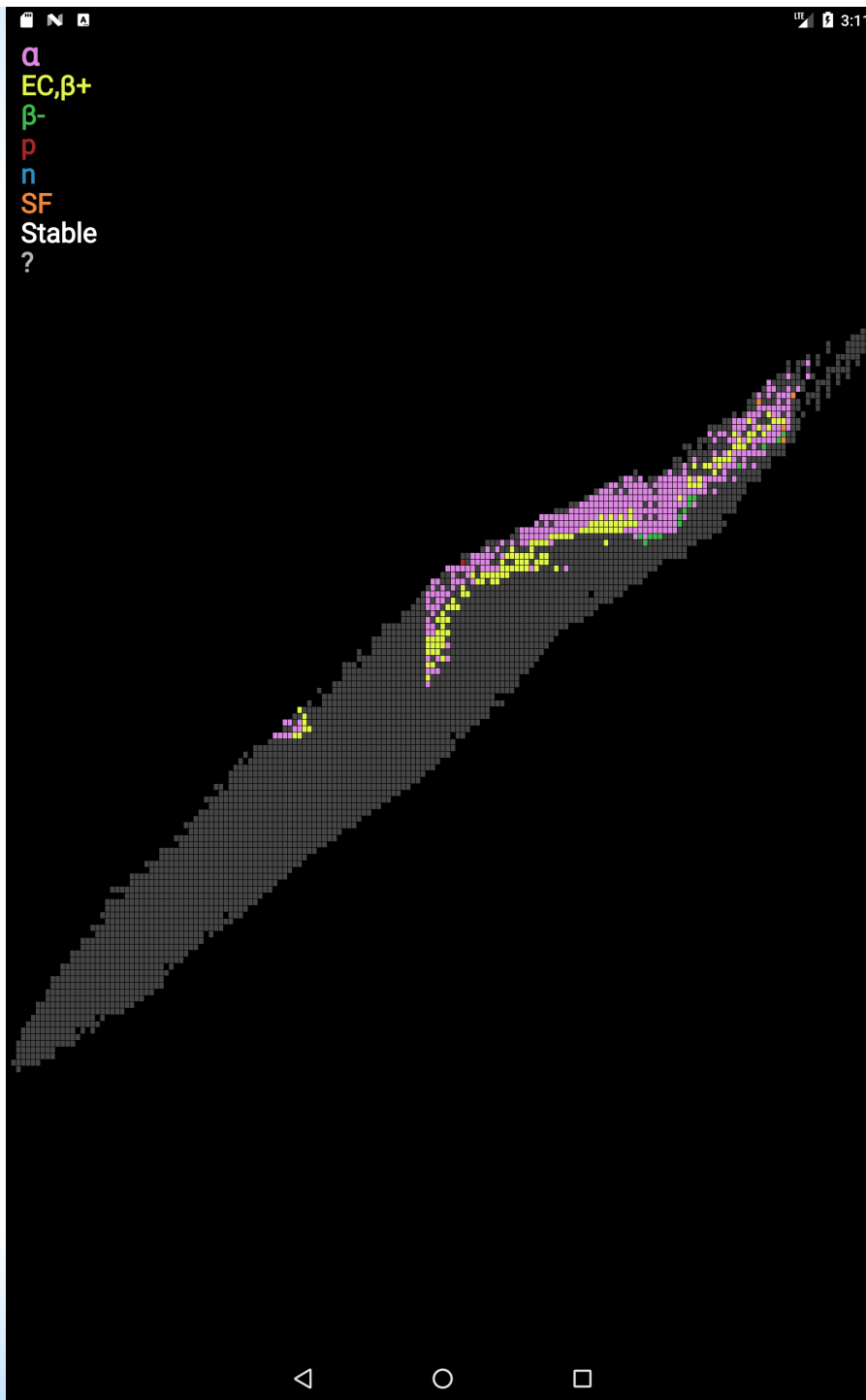
Y

| En [keV] | Int [%] |
|------------|-----------|
| 160.33 (2) | 31.3 (17) |
| 104.23 (2) | 7.2 (4) |



| 595 nuclides for " Decay radiations α order by Half-life ": ≡ | | | |
|--|-------------------------------|--------|-------------|
| CHART | T ½ | I % | |
| 105Te 52 | 0.62 (7) us | α 100% | 4703 keV |
| 106Te 52 | 70 (17) us | α 100% | 4128 keV |
| 110Xe 54 | 93 (3) ms | α 100% | 3745 keV |
| 144Nd 60 | 2.29 10 ¹⁵ (16) Y | α 100% | 1905.2 keV |
| 146Sm 62 | 6.8 10 ⁷ (7) Y | α 100% | 2460 keV |
| 147Sm 62 | 1.060 10 ¹¹ (11) Y | α 100% | 2248 keV |
| 148Gd 64 | 71.1 (12) Y | α 100% | 3182.69 keV |
| 148Sm 62 | 7 10 ¹⁵ (3) Y | α 100% | 1932.3 keV |
| 150Gd 64 | 1.79 10 ⁶ (8) Y | α 100% | 2726 keV |
| 152Gd 64 | 1.08 10 ¹⁴ (8) Y | α 100% | 2146.9 keV |
| 154Dy 66 | 3.0 10 ⁶ (15) Y | α 100% | 2870 keV |
| 156Hf 72 | 23 (1) ms | α 100% | 5873 keV |
| 156mHf 72 | 0.52 (1) ms | α 100% | 7782 keV |
| 156mLu 71 | 198 (2) ms | α 100% | 5565 keV |
| 157mTa 73 | 4.3 (1) ms | α 100% | 6214 keV |
| 157mTa 73 | 1.7 (1) ms | α 100% | 7744 keV |
| 158W 74 | 1.25 (21) ms | α 100% | 6445 keV |
| 162Os 76 | 2.1 (1) ms | α 100% | 6602 keV |

| 595 nuclides for " Decay radiations α order by Half-life ": CHART | | | | ↻ T ½ | ↻ I % |
|--|--------------|---------|-----------|-------|-------|
| 214m Rn 86 | 6.5 (30) ns | 8+ | IT ≈90% | | |
| 219 Pa 91 | 53 (10) ns | 9/2- | α 100% | | |
| 217 Ac 89 | 69 (4) ns | 9/2- | α ≈100% | | |
| 216m Fr 87 | 71 (5) ns | (3-) | Uncertain | | |
| 215 Fr 87 | 86 (5) ns | 9/2- | α 100% | | |
| 218 Th 90 | 117 (9) ns | 0+ | α 100% | | |
| 213 At 85 | 125 (6) ns | 9/2- | α 100% | | |
| 212 Po 84 | 0.299 (2) us | 0+ | α 100% | | |
| 214 At 85 | 558 (10) ns | 1- | α 100% | | |
| 105 Te 52 | 0.62 (7) us | (5/2+) | α ≈100% | | |
| 216 Fr 87 | 0.70 (2) us | (1-) | α 100% | | |
| 217m Ac 89 | 740 (40) ns | (29/2)+ | IT 95.7% | | |
| 214m At 85 | 760 (15) ns | 9- | α ≤100% | | |
| 219 Th 90 | 1.05 (3) us | (9/2+) | α 100% | | |
| 218 Ac 89 | 1.08 (9) us | (1-) | α 100% | | |
| 217 Ra 88 | 1.6 (2) us | (9/2+) | α ≈100% | | |
| 215 Rn 86 | 2.30 (10) us | 9/2+ | α 100% | | |
| 213 Po 84 | 3.72 (2) us | 9/2+ | α 100% | | |



Nuclides list ordering

- ☐ Z and N
- ☐ N and Z
- ☒ Half-life

Decay Radiation ordering

- ☐ Intensity
- ☒ Energy

Decay chain display

- ☐ Show all parents

Languages

- ☒ English
- ☐ العربية
- ☐ Español
- ☐ Français
- ☐ Italiano
- ☐ 日本語
- ☐ Русский
- ☐ Slovenščina
- ☐ 简体中文
- ☐ 繁体中文

App Version Code 88 Version Name 4.2.42



Provided by the
IAEA Nuclear Data Section

a
 EC,β+
 β-
 p
 n
 SF
 Stable
 ?

Sg Sg
 255 Db 256 Db 257 Db 258 Db
 253 Rf 254 Rf 255 Rf 256 Rf 257 Rf
 252 Lr 253 Lr 254 Lr 255 Lr 256 Lr
 248 No 250 No 251 No 252 No 253 No 254 No
 245 Md 246 Md 247 Md 248 Md 249 Md 250 Md 251 Md 252 Md 253 Md 254 Md
 241 Fm 242 Fm 243 Fm 244 Fm 245 Fm 246 Fm 247 Fm 248 Fm 249 Fm 250 Fm 251 Fm 252 Fm 253 Fm
 240 Es 241 Es 242 Es 243 Es 244 Es 245 Es 246 Es 247 Es 248 Es 249 Es 250 Es 251 Es 252 Es
 237 Cf 238 Cf 239 Cf 240 Cf 241 Cf 242 Cf 243 Cf 244 Cf 245 Cf 246 Cf 247 Cf 248 Cf 249 Cf 250 Cf
 233 Bk 234 Bk 236 Bk 238 Bk 239 Bk 240 Bk 241 Bk 242 Bk 243 Bk 244 Bk 245 Bk 246 Bk 247 Bk 248 Bk 249 Bk 250 Bk
 233 Cm 234 Cm 235 Cm 236 Cm 237 Cm 238 Cm 239 Cm 240 Cm 241 Cm 242 Cm 243 Cm 244 Cm 245 Cm 246 Cm 247 Cm 248 Cm 249 Cm
 229 Am 230 Am 232 Am 233 Am 234 Am 235 Am 236 Am 237 Am 238 Am 239 Am 240 Am 241 Am 242 Am 243 Am 244 Am 245 Am 246 Am 247 Am 248 Am
 228 Pu 229 Pu 230 Pu 231 Pu 232 Pu 233 Pu 234 Pu 235 Pu 236 Pu 237 Pu 238 Pu 239 Pu 240 Pu 241 Pu 242 Pu 243 Pu 244 Pu 245 Pu 246 Pu 247 Pu
 225 Np 226 Np 227 Np 228 Np 229 Np 230 Np 231 Np 232 Np 233 Np 234 Np 235 Np 236 Np 237 Np 238 Np 239 Np 240 Np 241 Np 242 Np 243 Np 244 Np
 224 U 225 U 226 U 227 U 228 U 229 U 230 U 231 U 232 U 233 U 234 U 235 U 236 U 237 U 238 U 239 U 240 U 241 U 242 U 243 U 244 U
 223 Pa 224 Pa 225 Pa 226 Pa 227 Pa 228 Pa 229 Pa 230 Pa 231 Pa 232 Pa 233 Pa 234 Pa 235 Pa 236 Pa 237 Pa 238 Pa 239 Pa
 222 Th 223 Th 224 Th 225 Th 226 Th 227 Th 228 Th 229 Th 230 Th 231 Th 232 Th 233 Th 234 Th 235 Th 236 Th 237 Th 238 Th
 221 Ac 222 Ac 223 Ac 224 Ac 225 Ac 226 Ac 227 Ac 228 Ac 229 Ac 230 Ac 231 Ac 232 Ac 233 Ac 234 Ac 235 Ac 236 Ac
 220 Ra 221 Ra 222 Ra 223 Ra 224 Ra 225 Ra 226 Ra 227 Ra 228 Ra 229 Ra 230 Ra 231 Ra 232 Ra 233 Ra 234 Ra
 219 Fr 220 Fr 221 Fr 222 Fr 223 Fr 224 Fr 225 Fr 226 Fr 227 Fr 228 Fr 229 Fr 230 Fr 231 Fr 232 Fr 233 Fr
 218 Rn 219 Rn 220 Rn 221 Rn 222 Rn 223 Rn 224 Rn 225 Rn 226 Rn 227 Rn 228 Rn 229 Rn
 217 At 218 At 219 At 220 At 221 At 222 At 223 At 224 At 225 At 226 At 227 At 228 At 229 At
 216 Po 217 Po 218 Po 219 Po 220 Po 221 Po 222 Po 223 Po 224 Po 225 Po 226 Po 227 Po
 215 Bi 216 Bi 217 Bi 218 Bi 219 Bi 220 Bi 221 Bi 222 Bi 223 Bi 224 Bi
 214 Pb 215 Pb 216 Pb 217 Pb 218 Pb 219 Pb 220 Pb
 213 Bi 214 Bi 215 Bi 216 Bi 217 Bi

Querytool exercises

- **β decay**

1. List nuclides having an evaluated β - decay branching ratio and display on nuclear chart
2. List nuclides that can theoretically β decay. Compare with results of 1.
3. Plot Q_{β} against $Q_{\beta-n}$ for those nuclides with evaluated β - and β - n decay
4. Find β - decaying nuclides which have β transitions with $9 \leq \log ft \leq 10$. Check ΔJ and $\Delta \pi$ values.

Querytool exercises

- **α decay**

5. List nuclides with evaluated α decay and display on nuclear chart
6. List nuclides that can theoretically α decay and compare with 5.
7. Plot Q_α vs A . Plot the same for even-even, even-odd (odd-even), and odd-odd nuclei
8. Find α decaying nuclides with Hindrance Factor $HF=1$. Plot Q_α vs A . Compare with plots from 7.

Querytool exercises

9. Plot $B(E_2)$ strengths of transitions from first excited 2^+ states to the ground state vs A , then Z (for e-e, e-o/o-e, o-o nuclides).
10. Plot dipole magnetic moments of e-e, e-o, o-o nuclei vs A and for $Z = 19$ isotopic chain vs A .
11. Find nuclides which emit γ rays of energy 197 keV through internal transitions and induced reactions.

In this section we consider the excited states as members of quasirotational bands. Figure 3 illustrates how the multiple-phonon levels may be decomposed into various intrinsic excitations

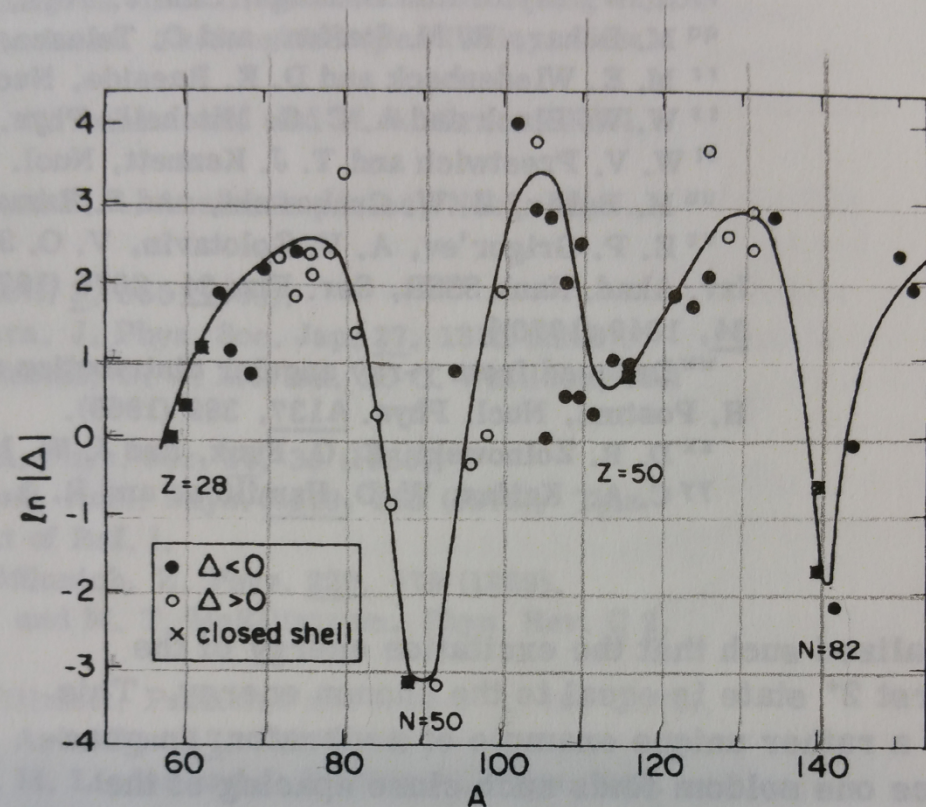


FIG. 2. $E2/M1$ mixing ratios of $2' \rightarrow 2$ transitions in even-even nuclei $60 \leq A \leq 150$. The solid curve indicates the trend of the measured values and shows pronounced minima in the vicinity of closed shells.

vs A , then S_n vs $T_{1/2}$

00 levels decaying via
an evaluated n emission

K.S. Krane, Phys.Rev. C 10 (1974) 1197
(Δ is a function of δ)

15. Plot A vs δ for E_2/M_1 transitions from $J^\pi 2^+_{\text{red}}$ to 2^+ for e-e nuclides having $60 \leq A \leq 150$.

Querytool exercises

- 16 Plot Z vs Atomic Mass for $A = 212$
- 17 Plot Q_{β} versus Q_{EC} for the entire set

Pocket Nuclear Database

File Edit View Help

New Database Open Database Write Changes Revert Changes

Database Structure Browse Data Edit Pragmas Execute SQL

Create Table Create Index Modify Table Delete Table

| Name | Type | Schema |
|--------------------|----------------|---|
| ▼ Tables (10) | | |
| > cum_fy | | CREATE TABLE cum_fy (PARENT_NUCID varchar(5) NOT NULL, DAUGHTER_NUCID varchar(5) NOT null, L_SEQNO int(11) NOT N |
| > decay_codes | | CREATE TABLE decay_codes (ensdf_code varchar(10) DEFAULT NULL ,decay_code int(10) NOT NULL ,dataset_code varchar(10) DE |
| > decay_radiations | | CREATE TABLE decay_radiations (parent_nucid varchar(10) NOT NULL ,parent_l_seqno int(10) NOT NULL ,z int(10) NOT NULL ,n i |
| > descriptions | | CREATE TABLE descriptions (item varchar(10) NOT NULL ,short_desc varchar(50) DEFAULT NULL ,long_desc varchar(200) DEFAULT |
| > ensdf | | CREATE TABLE ensdf (file varchar(10) NOT NULL ,identification varchar(60) DEFAULT NULL ,date_ensdf varchar(20) DEFAULT NUL |
| > gammas | | CREATE TABLE gammas (z int(10) NOT NULL ,n int(10) NOT NULL ,nucid varchar(10) NOT NULL ,g_seqno int(10) NOT NULL ,l_sec |
| > ind_fy | | CREATE TABLE ind_fy (PARENT_NUCID varchar(5) NOT NULL , DAUGHTER_NUCID varchar(5) NOT NULL , L_SEQNO int(11) NOT I |
| > l_decays | | CREATE TABLE l_decays (z int(10) NOT NULL ,n int(10) NOT NULL ,nucid varchar(10) NOT NULL ,l_seqno int(10) NOT NULL ,decay |
| ▼ levels | | CREATE TABLE levels (z int(10) NOT NULL ,n int(10) NOT NULL ,nucid varchar(10) NOT NULL ,l_seqno int(10) NOT NULL ,energy v |
| z | int (10) | `z` int (10) NOT NULL |
| n | int (10) | `n` int (10) NOT NULL |
| nucid | varchar (10) | `nucid` varchar (10) NOT NULL |
| l_seqno | int (10) | `l_seqno` int (10) NOT NULL |
| energy | varchar (10) | `energy` varchar (10) DEFAULT NULL |
| energy_unc | varchar (10) | `energy_unc` varchar (10) DEFAULT NULL |
| energy_limit | varchar (10) | `energy_limit` varchar (10) DEFAULT NULL |
| energy_num | double | `energy_num` double DEFAULT NULL |
| energy_unc_num | double | `energy_unc_num` double DEFAULT NULL |
| energy_series | varchar (10) | `energy_series` varchar (10) DEFAULT NULL |
| half_life | varchar (10) | `half_life` varchar (10) DEFAULT NULL |
| half_life_unc | varchar (10) | `half_life_unc` varchar (10) DEFAULT NULL |
| half_life_units | varchar (10) | `half_life_units` varchar (10) DEFAULT NULL |
| half_life_limit | varchar (10) | `half_life_limit` varchar (10) DEFAULT NULL |
| half_life_num | double | `half_life_num` double DEFAULT NULL |
| half_life_unc_num | double | `half_life_unc_num` double DEFAULT NULL |
| half_life_sec | double | `half_life_sec` double DEFAULT NULL |
| half_life_sec_unc | double | `half_life_sec_unc` double DEFAULT NULL |
| jp | varchar (30) | `jp` varchar (30) DEFAULT NULL |
| parity | int (10) | `parity` int (10) DEFAULT NULL |
| jp_order | int (10) | `jp_order` int (10) DEFAULT NULL |
| jp_weak | int (10) | `jp_weak` int (10) DEFAULT NULL |
| quadrupole_em | varchar (10) | `quadrupole_em` varchar (10) DEFAULT NULL |

Pocket Nuclear Database

Database Structure Browse Data Edit Pragmas Execute SQL



```
select (CAST(ROUND(energy_num + 0.5) AS INT) /100)*100 as energy, count(*)
from
levels
where
energy_num is not null/* remove null values*/
and energy_series = ''/* remove values with unknown baseline*/
--and nucid = '238U'/* remove to get all nuclides */
group by 1 order by 1;
```

| | energy | count(*) |
|---|--------|----------|
| 1 | 0 | 5404 |
| 2 | 100 | 2360 |
| 3 | 200 | 2586 |
| 4 | 300 | 2584 |
| 5 | 400 | 2523 |
| 6 | 500 | 2716 |
| 7 | 600 | 2760 |
| 8 | 700 | 2879 |

Export data as CSV

Column names in first line ☒

Field separator

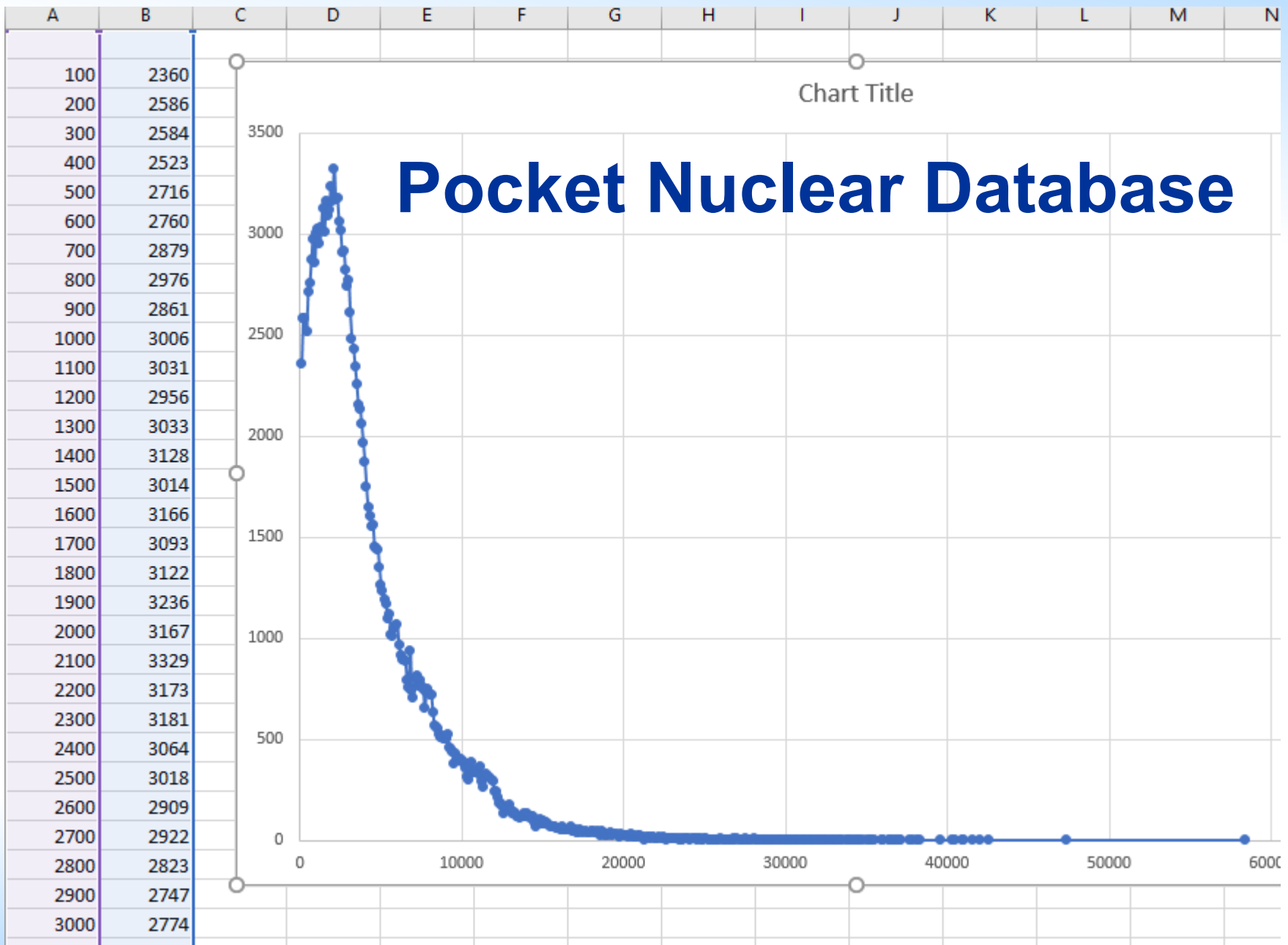
Quote character

New line characters

OK Cancel

367 rows returned in 677ms from: select (CAST(ROUND(energy_num + 0.5) AS INT) /100)*100 as energy, count(*)
from
levels
where
energy_num is not null

Pocket Nuclear Database



Database Structure Browse Data Edit Pragmas Execute SQL



SQL 1

```
1 select distinct l.parent_nucid,l.daughter_nucid as daughter, l.daughter_l_seqno
2 as daughter_level, l.start_l_en_num as daughter_level_energy
3 from decay_radiations l where daughter_l_seqno != -1
4 and l.daughter_nucid = '210AT' /* remove this to get all nuclides*/
5 and not exists (
6 select * from levels ll where l.daughter_nucid = ll.nucid
7 and l.start_l_en_num = ll.energy_num )
8 order by 1, 2, 3;
```


<

| | parent_nucid | daughter | daughter_level | daughter_level_energy |
|---|--------------|----------|----------------|-----------------------|
| 1 | 214FR | 210AT | 1 | 72.77 |
| 2 | 214FR | 210AT | 1 | 70.0 |
| 3 | 214FR | 210AT | 2 | 498.0 |
| 4 | 214FR | 210AT | 3 | 507.38 |
| 5 | 214FR | 210AT | 3 | 597.0 |
| 6 | 214FR | 210AT | 5 | 1039.0 |
| 7 | 214FR | 210AT | 10 | 1228.0 |

210-At adopted dataset

| Nuclide | E_x [keV] | J^π order | B |
|--|----------------|---------------|---|
| ²¹⁰ ₈₅ At ₁₂₅ | 0.0 | (5)+ | |
| ²¹⁰ ₈₅ At ₁₂₅ | 72.65 5 | (4)+ | |
| ²¹⁰ ₈₅ At ₁₂₅ | 496.17 5 | (4)+ 2 | |
| ²¹⁰ ₈₅ At ₁₂₅ | 507.4 1 | (6)+ | |
| ²¹⁰ ₈₅ At ₁₂₅ | 530.88 6 | (3)+ | |
| ²¹⁰ ₈₅ At ₁₂₅ | 576.4 1 | (7)+ | |
| ²¹⁰ ₈₅ At ₁₂₅ | 594 ? 7 | | |
| ²¹⁰ ₈₅ At ₁₂₅ | 603 5 5 | | |

214-Fr α 210-At decay dataset

Alpha 

| E_α [keV] | I_α (abs) [%] | Daughter level [keV] |
|---------------------|-------------------------|-------------------------|
| 7406 8 | 0.3 | 1039 10 |
| 7605 8 | 1.0 | 837 10 |
| 7840 | < 0.1 | 597 |
| 7937 8 | 1.0 | 498 10 |
| 8358 4 | 4.8 2 | 70 7 |
| 8427 4 | 93.0 5 | 0.0 |

Thank you!

