IAEA – NDS data retrieval tools

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IAEA Nuclear Data Section

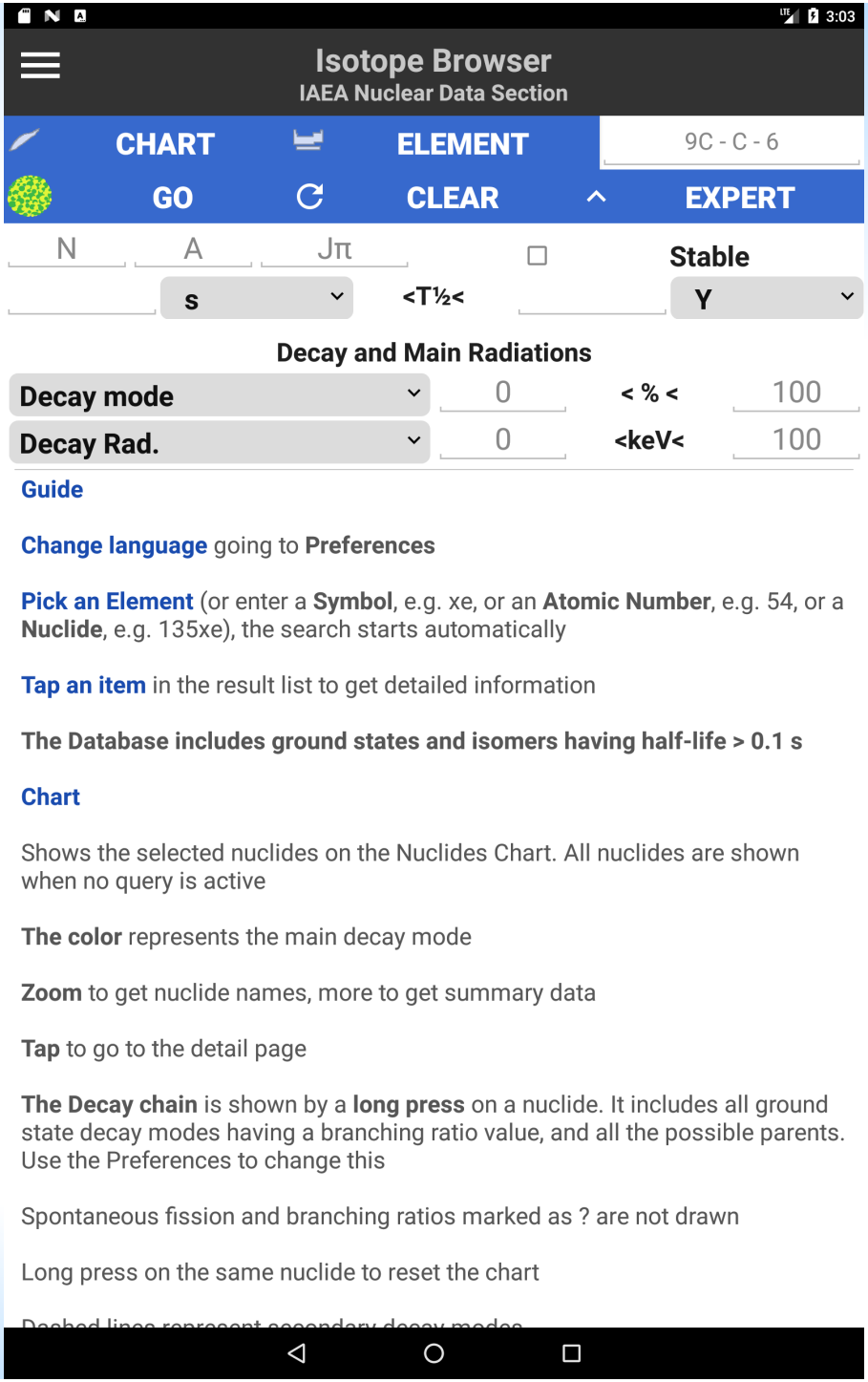
Trieste
ICTP workshop on Nuclear Structure and Decay Data
October 2018

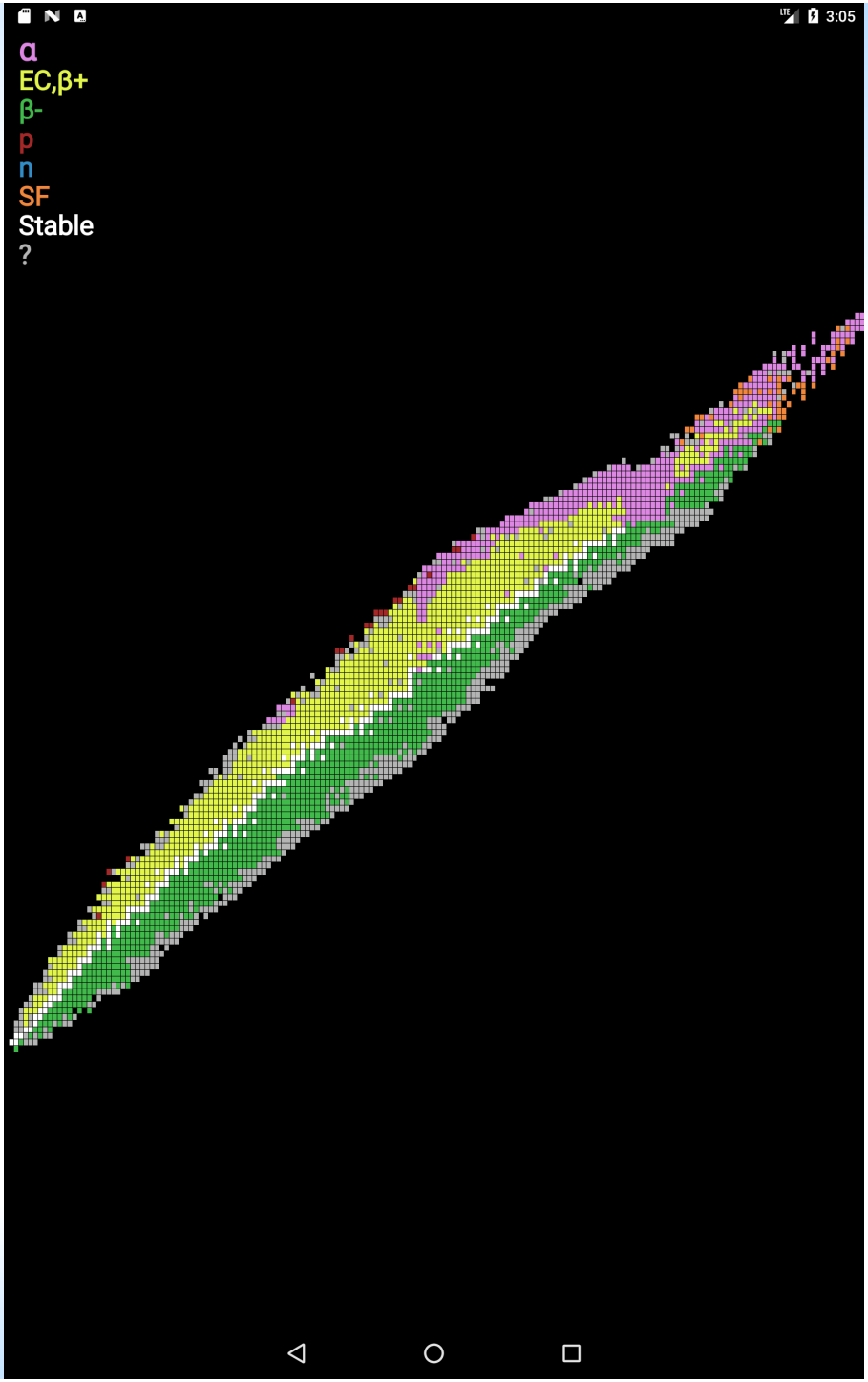
www-nds.iaea.org

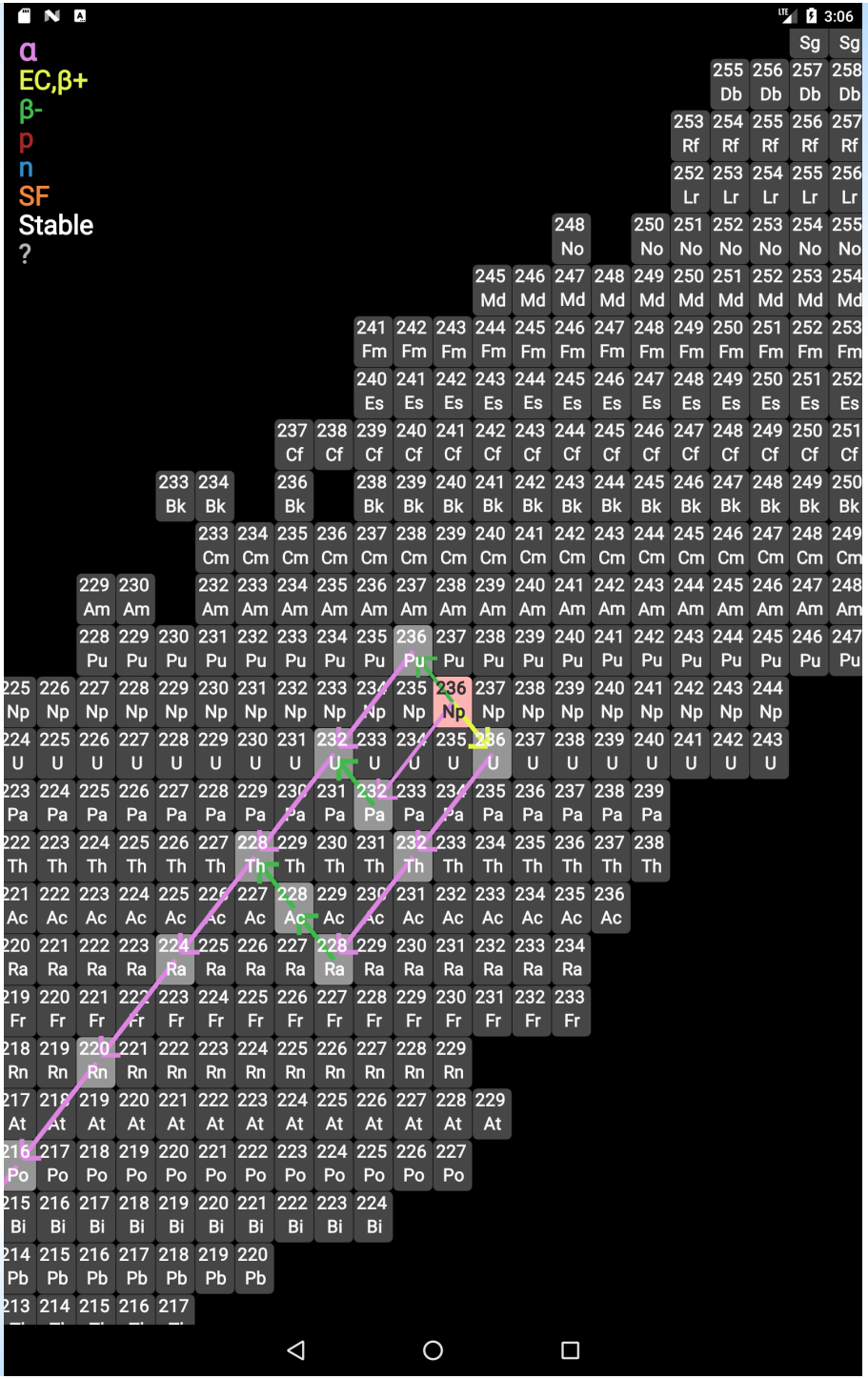
Links – quick reference

- **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


3:03
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


3:05
α
EC,β+
β-
p
n
SF
Stable
?


3:06
α
EC,β+
β-
p
n
SF
Stable
?

• 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 **Jπ** (6-)
Half-life 153 10^{3} (5) Y

Parents
240-Am α 1.9 10^{-4} %7

Decays see the decay chain
ec 86.3(8)% → 236-U
β- 13.5(8)% → 236-Pu
α 0.16(4)% → 232-Pa

Qα 5010 (50) keV
Qβ 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
γ

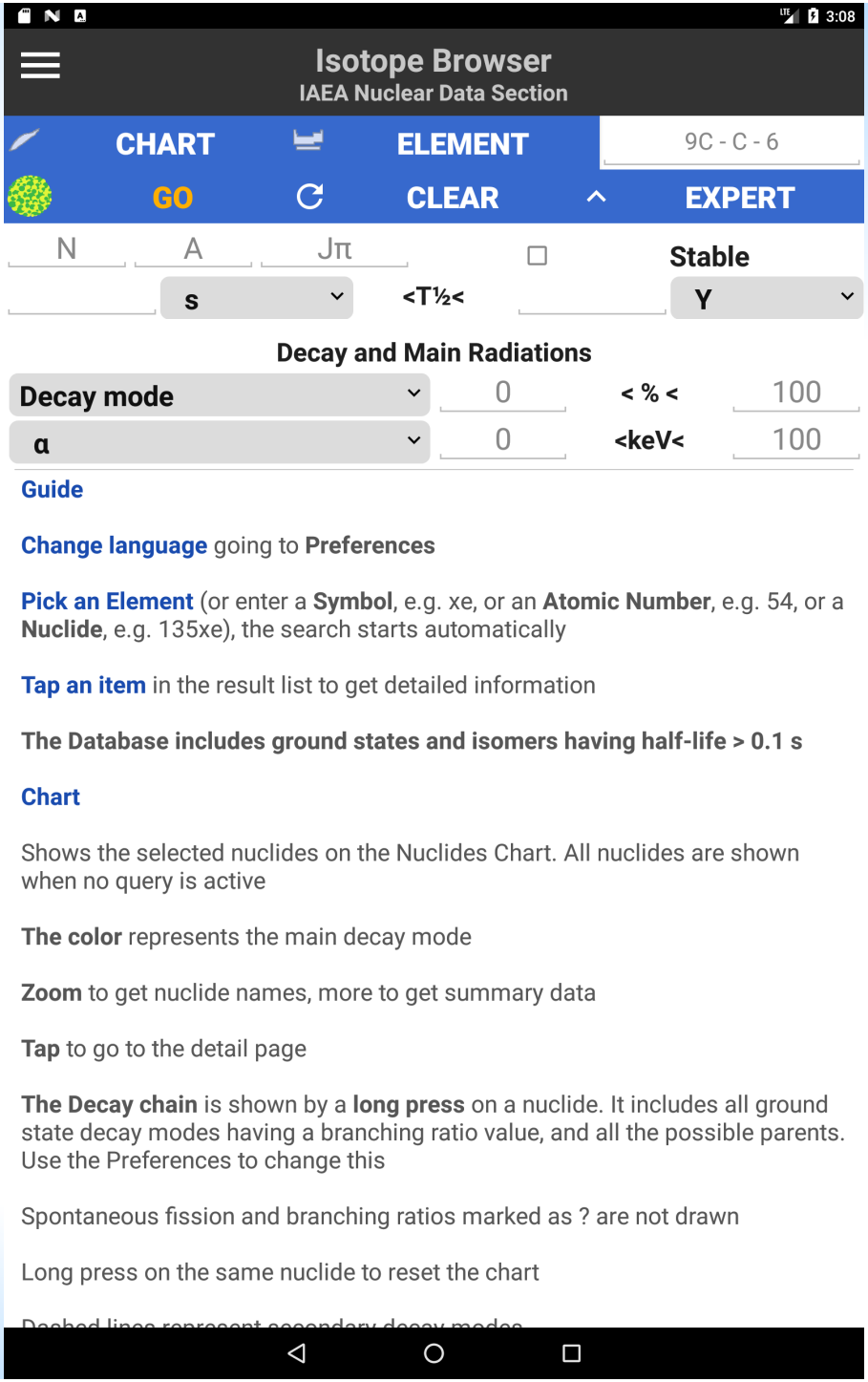
En [keV]	Int [%]
158.35 (2)	4.2 (3)
102.82 (2)	0.91 (7)
44.6 (1)	0.0182 (14)

X

En [keV]	Transition	Int [%]
117.800 - 121.556	Kβ	0.186 (14)
104.279	Kα1	0.38 (3)
99.979	Kα2	0.237 (17)
12.169 - 22.841	L	13.4 (8)

From ec decay
γ

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


3:08
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
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100
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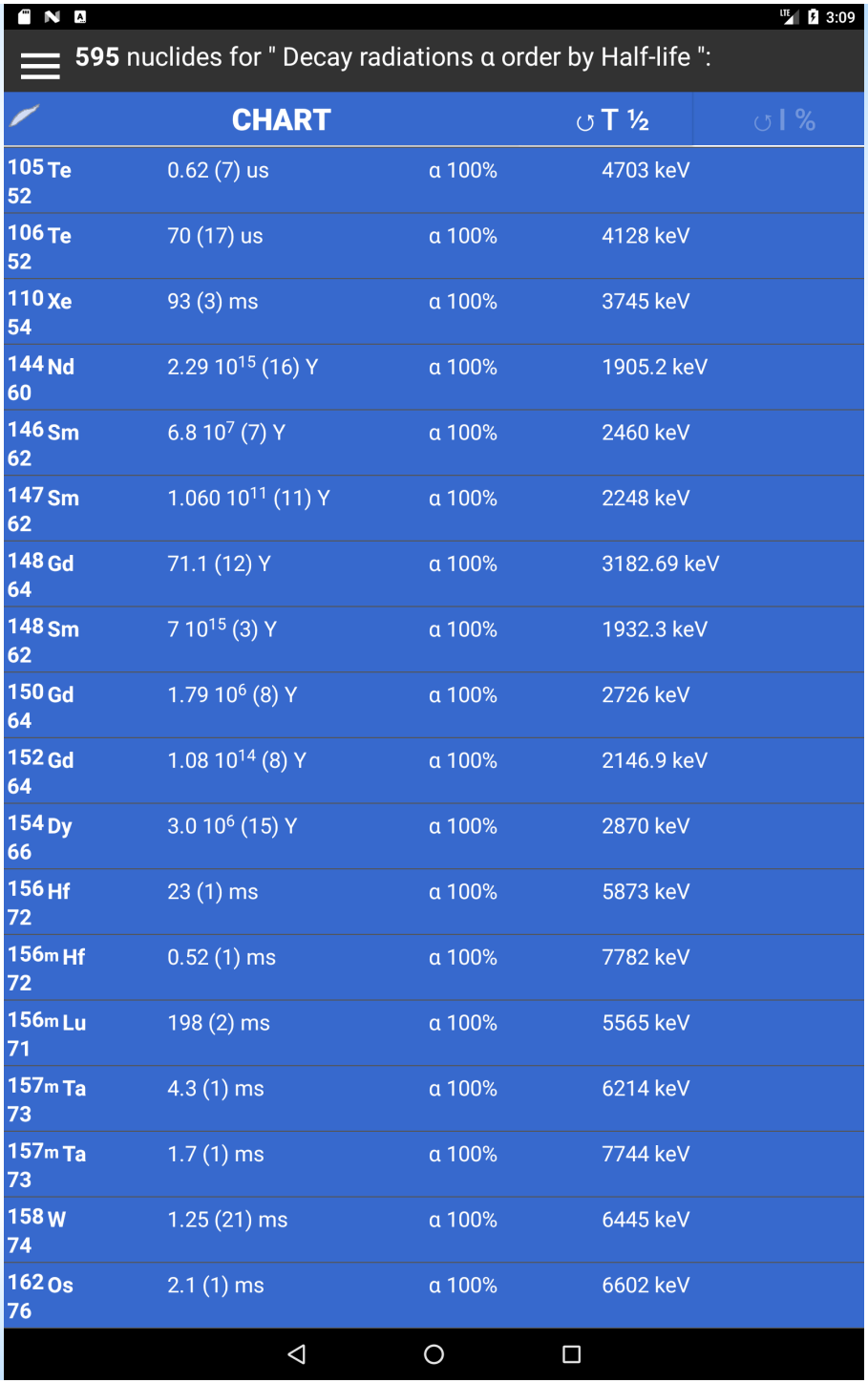
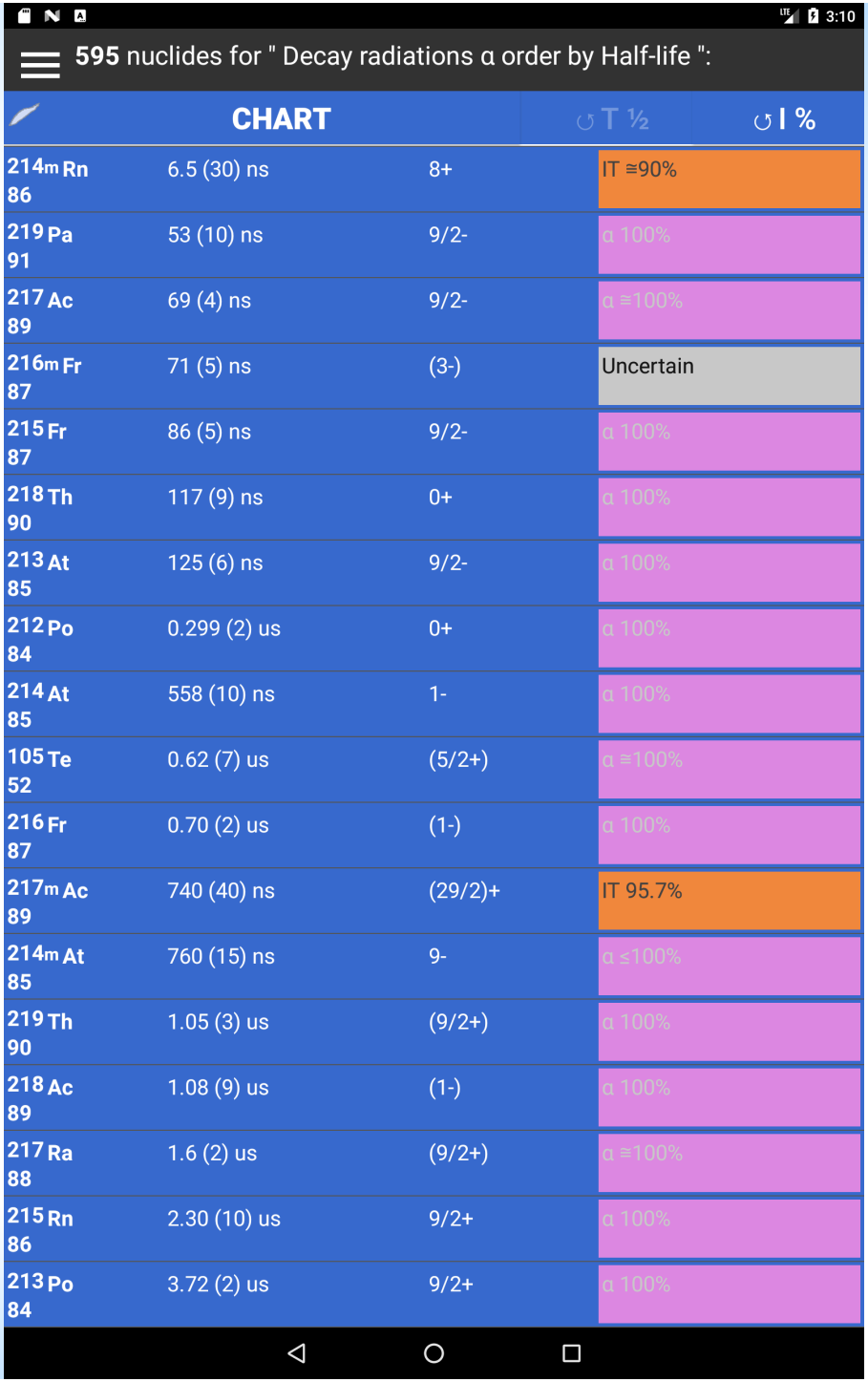
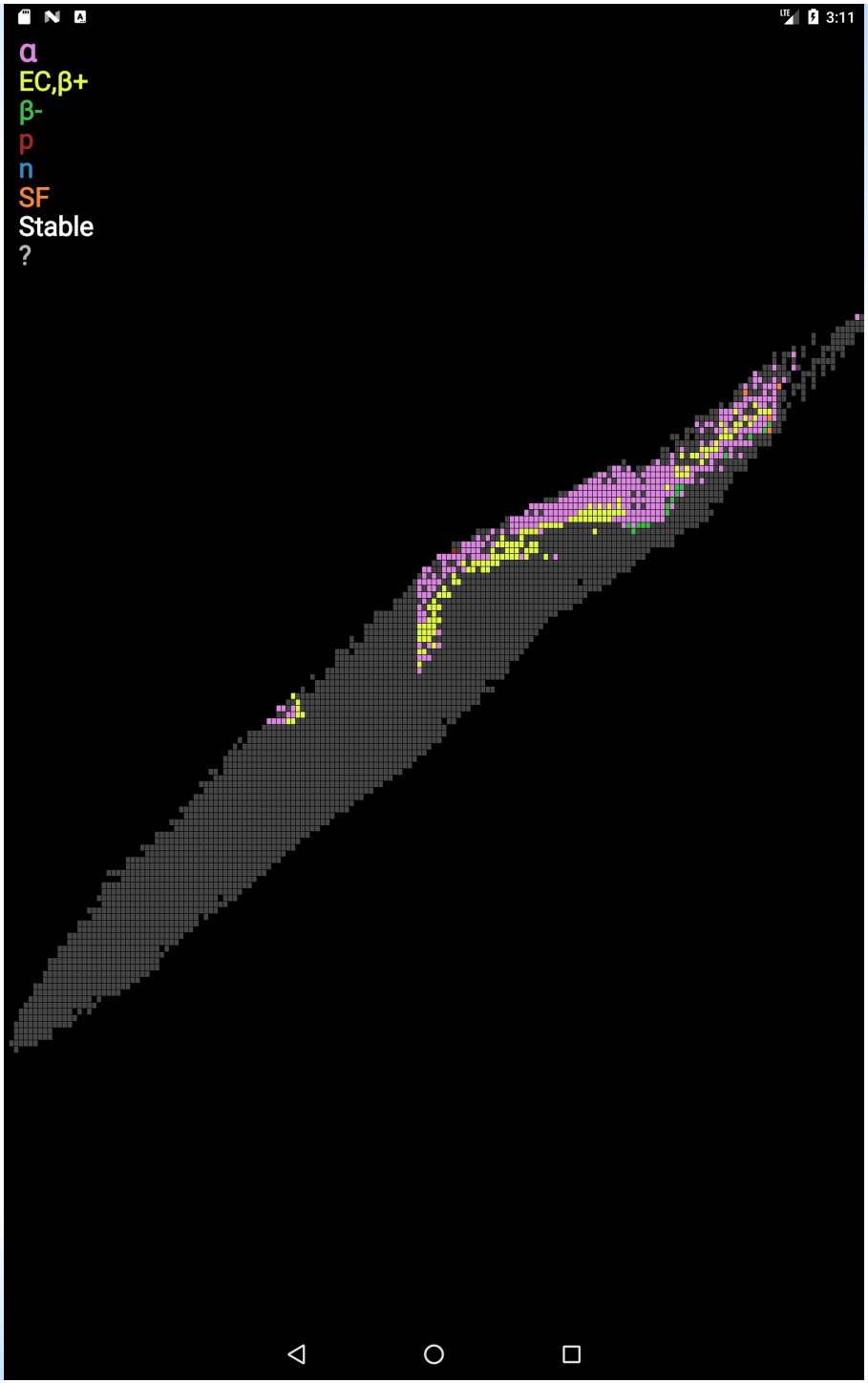
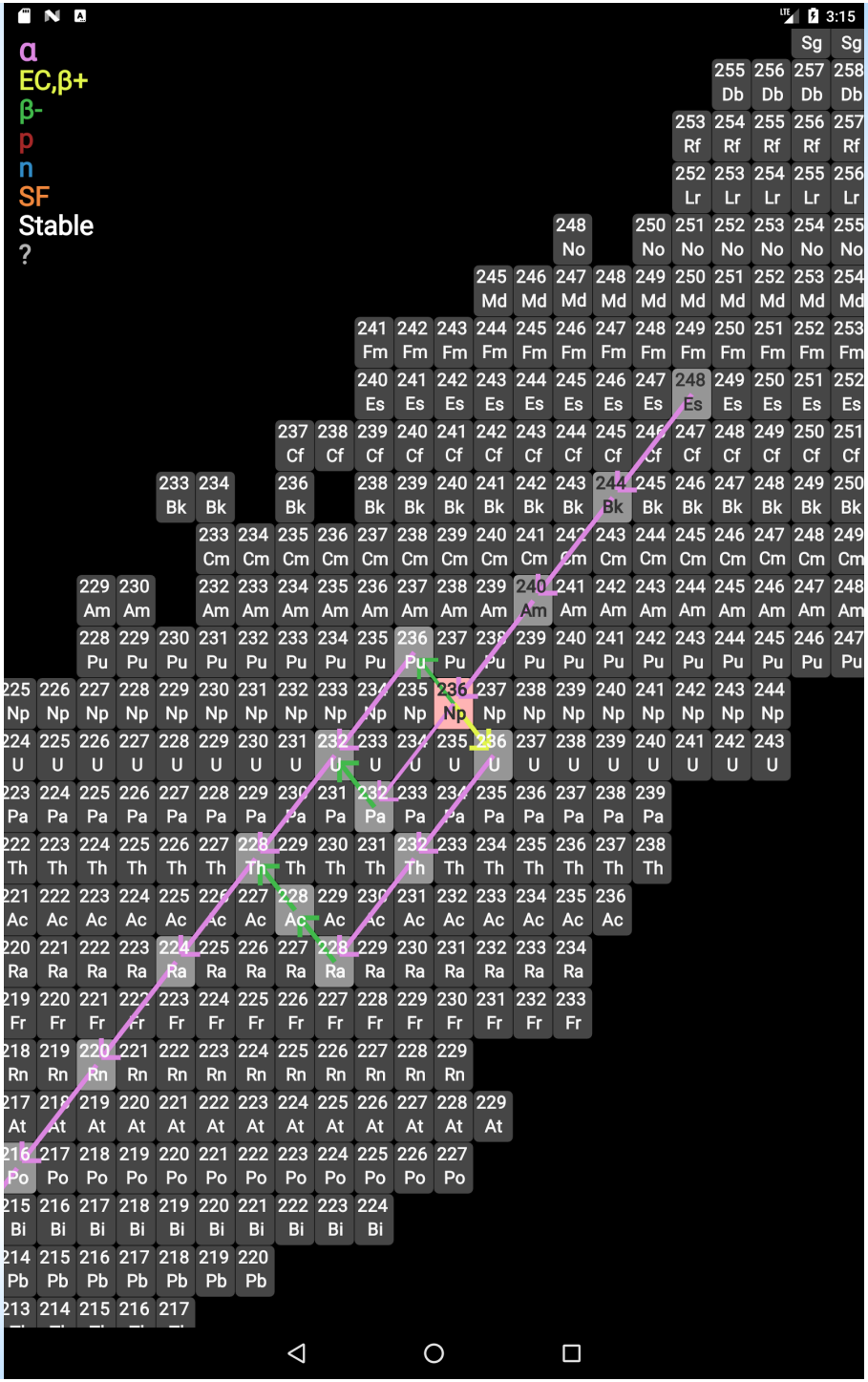

3:09
595 nuclides for " Decay radiations α order by Half-life ":
CHART
T ½
105 Te 52
0.62 (7) us
α 100%
4703 keV
106 Te 52
70 (17) us
α 100%
4128 keV
110 Xe 54
93 (3) ms
α 100%
3745 keV
144 Nd 60
2.29 10^15 (16) Y
α 100%
1905.2 keV
146 Sm 62
6.8 10^7 (7) Y
α 100%
2460 keV
147 Sm 62
1.060 10^11 (11) Y
α 100%
2248 keV
148 Gd 64
71.1 (12) Y
α 100%
3182.69 keV
148 Sm 62
7 10^15 (3) Y
α 100%
1932.3 keV
150 Gd 64
1.79 10^6 (8) Y
α 100%
2726 keV
152 Gd 64
1.08 10^14 (8) Y
α 100%
2146.9 keV
154 Dy 66
3.0 10^6 (15) Y
α 100%
2870 keV
156 Hf 72
23 (1) ms
α 100%
5873 keV
156m Hf 72
0.52 (1) ms
α 100%
7782 keV
156m Lu 71
198 (2) ms
α 100%
5565 keV
157m Ta 73
4.3 (1) ms
α 100%
6214 keV
157m Ta 73
1.7 (1) ms
α 100%
7744 keV
158 W 74
1.25 (21) ms
α 100%
6445 keV
162 Os 76
2.1 (1) ms
α 100%
6602 keV


3:10
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%


3:11
α
EC,β+
β-
p
n
SF
Stable
?


3:13
Settings
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


α
EC,β+
β-
p
n
SF
Stable
?

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

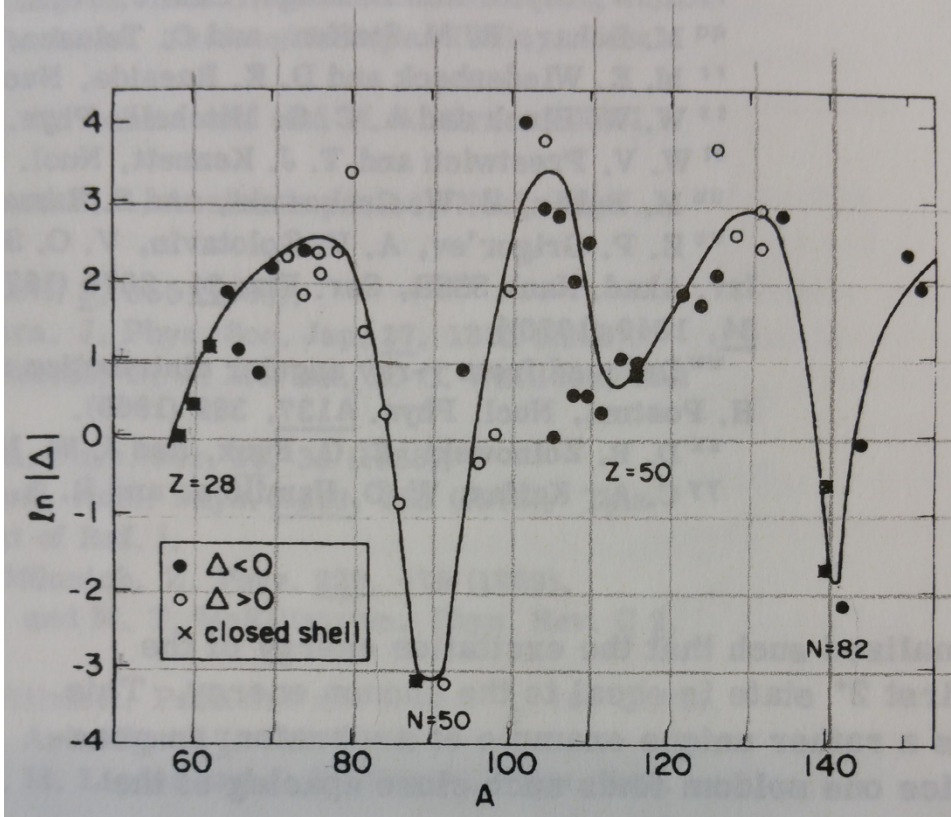


FIG. 2. $E2/M1$ mixing ratios of $2' \rightarrow 2$ transitions in even-even nuclei $60 \lesssim A \lesssim 150$. The solid curve indicates the trend of the measured values and shows pronounced minima in the vicinity of closed shells.

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

00 levels decaying via
an evaluated n emission

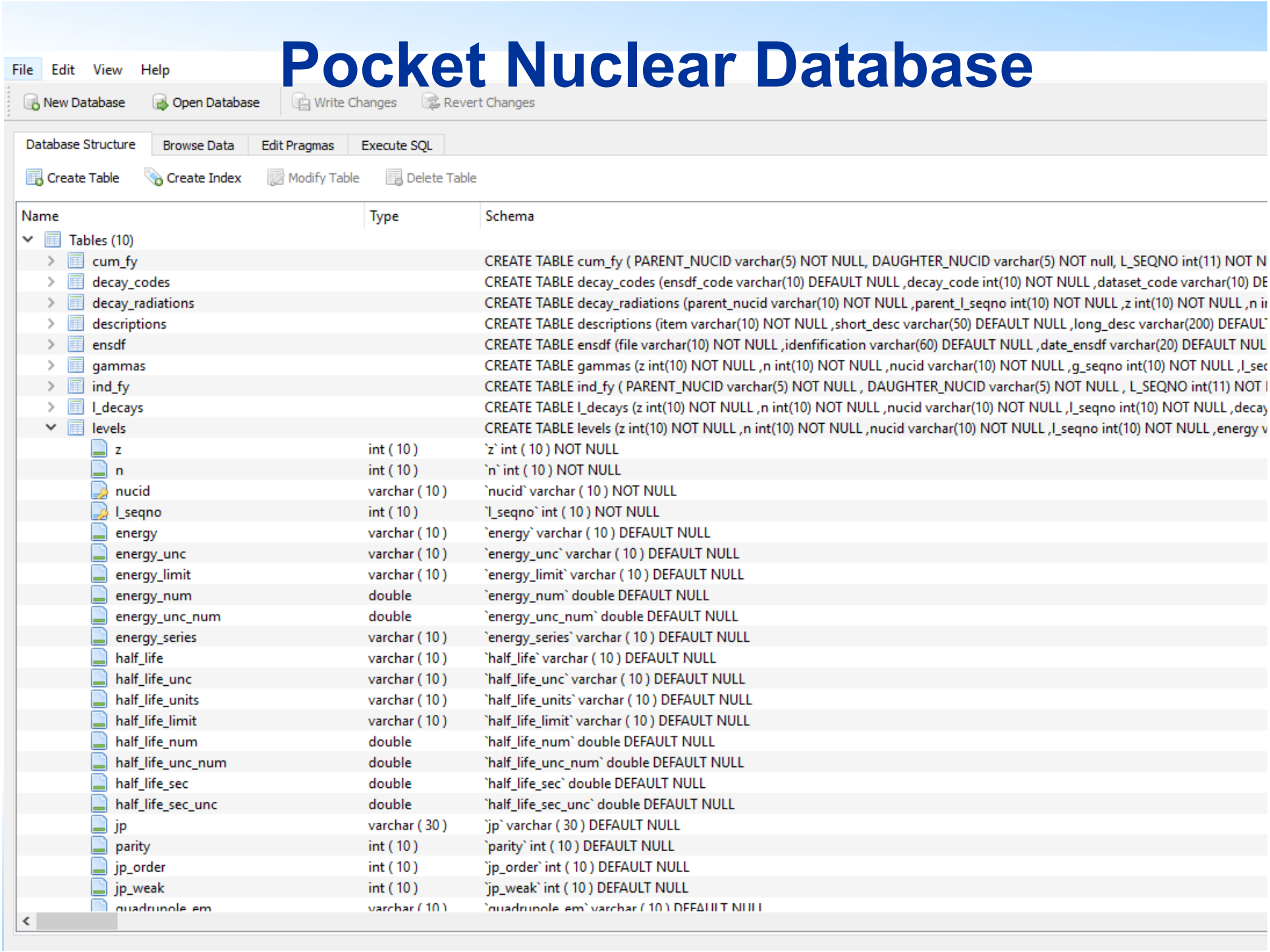
K.S. Krane, Phys.Rev. C 10 (1974) 1197
(Δ is a function of δ)

15. Plot A vs δ for E_2/M_1 transitions from J^π 2^+ 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



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 ,

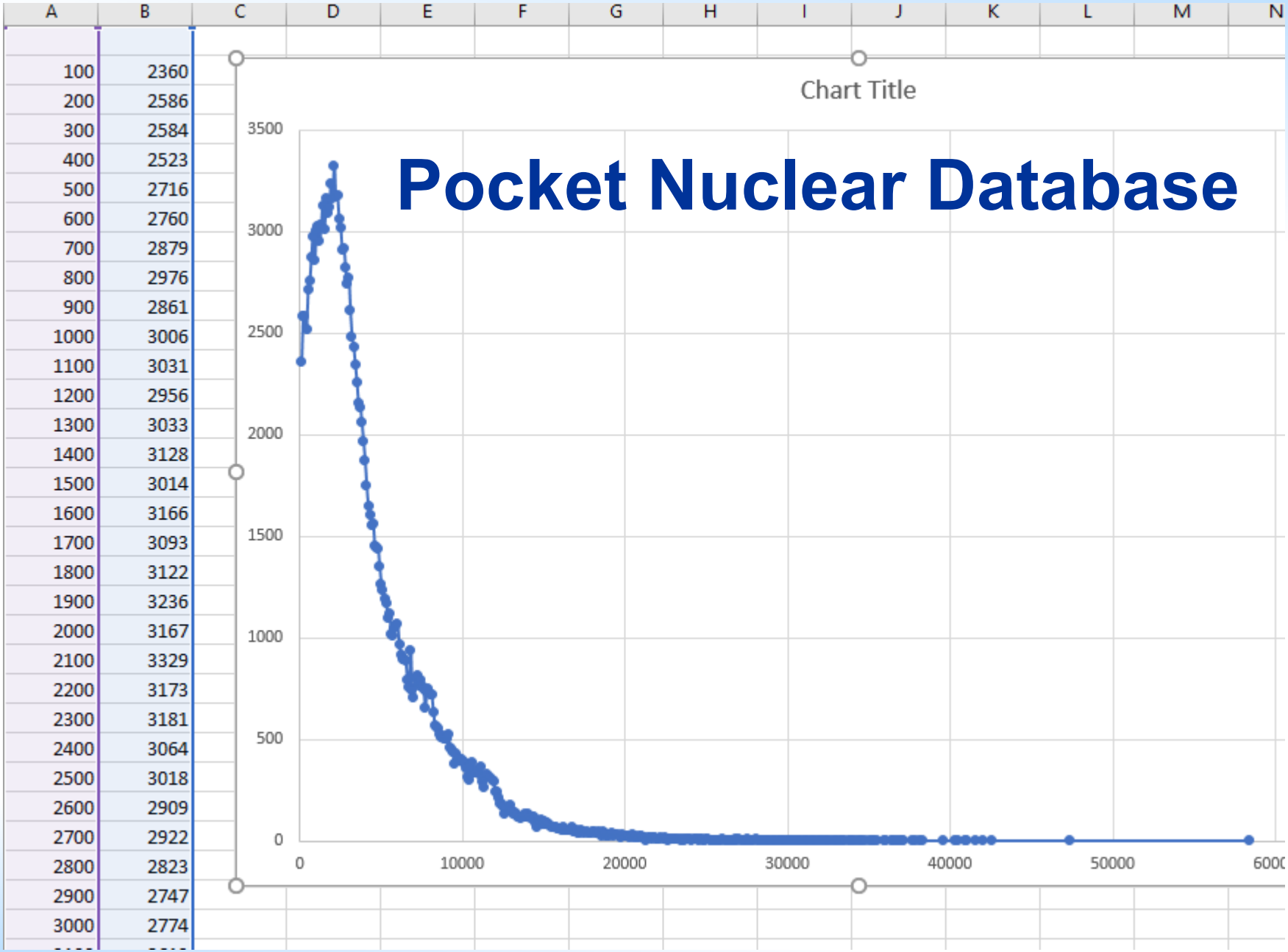
Quote character "

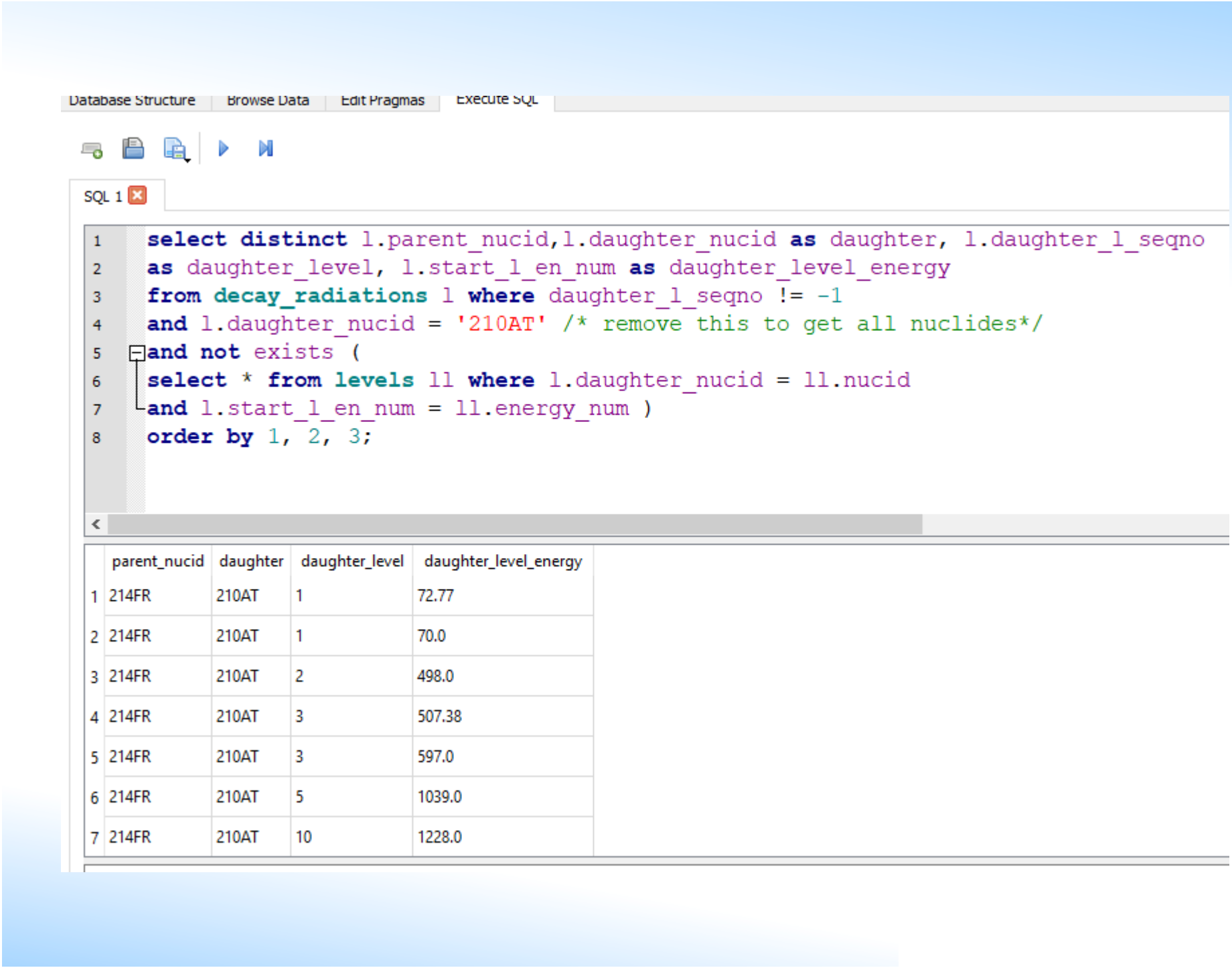
New line characters Windows: CR+LF (\r\n)

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





	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^n_{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 CSV

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!