



*60 Years*

**IAEA**

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# IAEA – NDS data retrieval tools

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**ICTP workshop on Nuclear Structure and Decay Data**

**Trieste**

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# On [www-nds.iaea.org](http://www-nds.iaea.org)

- Livechart  
**[/livechart](#)**
- Query tool  
**[/queryensdf](#)**
- Mass chains  
**[/relnsd/NdsEnsdf/masschain.html](#)**
- Actinides decay data  
**[/act\\_ddl](#)**
- Decay data portal (still under development)  
**[/relnsd/vcharhtml/VChartHTML\\_libs.html](#)**
- Mobile devices : Isotope Browser  
**Google Play and iTunes app store**

# Query Tool exercises with solution

[www-nds.iaea.org/queryensdf](http://www-nds.iaea.org/queryensdf)

## NUCLIDE ground state

NUCLIDE ground state

Input fields: Nuclide, Symbol, Z, N, A, Z range, N range

More fields : Q-values, separation energies, atomic masses

## LEVELS

Energy [ ] ≤ keV ≤ [ ]

Decays B.R. [ ] ≤ % ≤ [ ]  Only Ground State

$\beta^-$    $\beta^- n$    $\beta^- 2n$    $2\beta^-$    $\beta^- 3n$    $\beta^- 4n$    $\beta^- \alpha$    $\beta^- F$    $\beta^- p$

## Order by : T<sub>1/2</sub>

Order by : T<sub>1/2</sub>

Z  A  N  Q( $\beta$ )  Q( $\alpha$ )  Q(EC)  Q( $\beta^- n$ )  Sn  Sp  R  AM  E  T<sub>1/2</sub>  BR   $\mu$   Q  E<sub>rad</sub>  I<sub>rad</sub>

Log ft  HF  E<sub>γ</sub>   $\alpha$   B(E)  B(M)   $\delta$

## PLOTTING

X axis: None Y axis: None

List nuclides having an evaluated  $\beta^-$  decay, order by half-life, and display on nuclear chart



List nuclides that can theoretically  $\beta$  decay. Compare with the results before

**NUCLIDE ground state**

Nuclide	Symbol	Z	N	A	Z r
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="checkbox"/>

More fields : Q-values, separation energies, atom

$Q(\beta)$   ≤ keV ≤

$Q(\beta-n)$   ≤ keV ≤

# Plot $Q_{\beta}$ against $Q_{\beta-n}$ for those nuclides with evaluated $\beta$ - and $\beta-n$ decay

**NUCLIDE ground state**

Nuclide:  Symbol:  Z:  N:  A:

More fields : Q-values, separation energies

**LEVELS**

Energy  ≤ keV ≤

Decays B.R.  ≤ % ≤

$\beta$ -  $\beta$ -n  $\beta$ - 2n  $2\beta$ -  $\beta$ - 3n  $\beta$ - 4n  $\beta$ -  $\alpha$

$\beta$ +  $2\beta$ +  $\beta$ + 2p  $\beta$ +  $\alpha$   $\beta$ + p  $\beta$  fission

ec 2ec ec  $\beta$ + ec p ec 2p ec 3p ec  $\alpha$

$\alpha$   $\alpha$ ? IT IT? SF SF  $\beta$ -

$^3\text{H}$   $^3\text{He}$   $^8\text{Be}$   $^{12}\text{C}$   $^{14}\text{C}$   $^{20}\text{O}$   $^{20}\text{Ne}$

p n D G 2p Mg Ne

Half Life **3.68E-8** fs ≤  $T_{1/2}$  ≤ **7.71**

More fields : nuclear moments

**GAMMA transitions**

Energy  ≤ keV ≤

Final level  ≤ keV ≤  J

More fields : conversion coefficients, multi

Order by : Z , A

Z  A  N   $Q(\beta)$    $Q(\alpha)$    $Q(\beta-n)$

Log ft  HF   $E_{\gamma}$    $\alpha$   B(E)  B

**PLOTTING**

X axis:  $Q(\beta)$  Y axis:  $Q(\beta-n)$

Relational ENSDF  
December 2015 snapshot of

Drag here to move the panel - right click on the image to save

Draw **Title**  Labels: x  y

**Title**

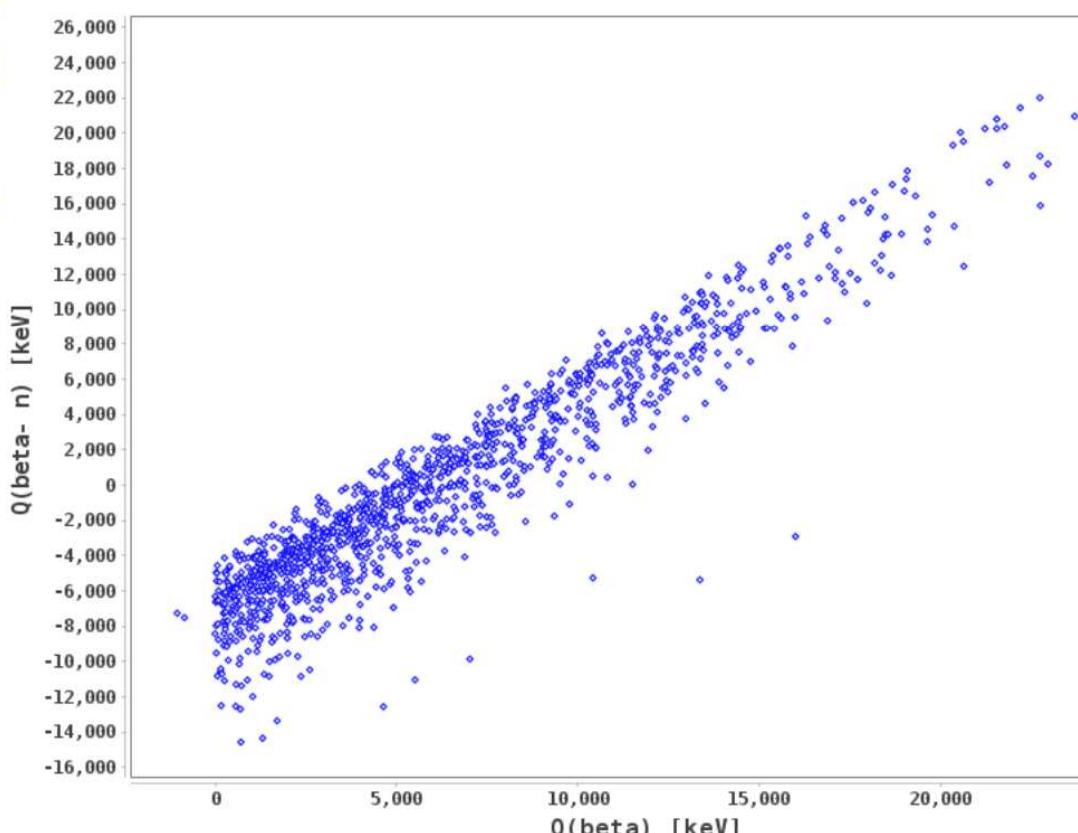
Type  line  scatter

Size w:  h:

Log Scale  x  y

Grids  x  y

[Show data](#)



The plot shows a scatter of blue data points representing nuclides with both  $\beta$ - and  $\beta-n$  decays. The x-axis is  $Q(\beta)$  [keV] ranging from 0 to 20,000. The y-axis is  $Q(\beta-n)$  [keV] ranging from -16,000 to 26,000. The data points show a clear positive linear trend, indicating that as the  $\beta$  decay energy increases, the  $\beta-n$  decay energy also tends to increase.

# Find $\beta^-$ -decaying nuclides which have $\beta$ transitions with $9 \leq \log ft \leq 10$ . Check $\Delta J$ and $\Delta \pi$ values.

Metastables  
 J $\pi$   weak order   $\pi$  any  Isospin  P 1

**DECAY radiation** emitted by the daughter  
 Type  any   $\alpha$    $\beta^-$    $\beta^+$    $\gamma$   e  
 delayed  n  p   $\alpha$   
 Energy   $\leq$  keV  $\leq$    only  most intense lines  
 Intensity   $\leq$  %  $\leq$    
 Max En.   $\leq$  keV  $\leq$     $9 \leq \log FT \leq$    10

In the "Decay Radiation" tab check J $\pi$  of parent and daughter, or download the CSV for further analysis

You requested: Radiation type  $\beta^-$   $9 \leq \log FT \leq 10$

Ground State | Levels | Gammas | **Decay Radiation**

510 rows retrieved

Click on a column header to open the guide  
 Comments  **Uncertainty** for numeric values refers to the last digits of the value: 12.123 means  $12.1 \pm 2.3$

Data from: ENSDF apart Q from AME2012 [Definitions and Sources](#) ?

Click on a nuclide symbol to show the decay schema

Beta - [CSV](#)

$\langle E_{\beta} \rangle$ [keV]	$I_{\beta}(\text{abs})$ [%]	Daughter level [keV]	J $\pi$	$E_{\beta, \text{max}}$ [keV]	log ft	Transition type	Comments	Parent	$T_{1/2}$	$E_x$ [keV]	J $\pi$ order	Decay
49.47	100	0	1+	156.475 4	9.040 3			<sup>14</sup> <sub>6</sub> C <sub>8</sub>	5700 y 30	0.0	0+	$\beta^-$ 100 %
1000 0.12	0.012 4	6040 4.10	0+	1270 2	9.06 15	1st $\beta^-$ transition		16	7.12 e 2	0.0	?	$\beta^-$ 100 %

# List nuclides with evaluated $\alpha$ decay and display on nuclear chart

**NUCLIDE ground state**

Nuclide	Symbol	Z	N	A
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

More fields : Q-values, separation energies,

---

**LEVELS**

Energy  ≤ keV ≤

Decays B.R.  ≤ % ≤   On

<b><math>\beta^-</math></b>	$\beta^- n$	$\beta^- 2n$	$2\beta^-$	$\beta^- 3n$	$\beta^- 4n$	$\beta^- \alpha$
<b><math>\beta^+</math></b>	$2\beta^+$	$\beta^+ 2p$	$\beta^+ \alpha$	$\beta^+ p$	$\beta$ fission	
<b>ec</b>	2ec	ec $\beta^+$	ec p	ec 2p	ec 3p	ec $\alpha$
<b><math>\alpha</math></b>	$\alpha?$	IT	IT?	SF	SF $\beta^-$	
$^3\text{H}$	$^3\text{He}$	$^8\text{Be}$	$^{12}\text{C}$	$^{14}\text{C}$	$^{20}\text{O}$	$^{20}\text{Ne}$
p	n	D	G	2p	Mg	Ne

# List nuclides that can theoretically $\alpha$ decay and compare with the retrieval before

**NUCLIDE ground state**

Nuclide	Symbol	Z	N	A	Z range	N range	A range	Z	N	A	Z	N	A			
					<input type="checkbox"/>				even	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	odd	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**More fields : Q-values, separation energies, atomic masses, radius**

Q( $\beta$ )  ≤ keV ≤ 
 Q(EC)  ≤ keV ≤ 
 Q( $\alpha$ )  **0** ≤ keV ≤

Q( $\beta$ - n)  ≤ keV ≤ 
 S(n)  ≤ keV ≤ 
 S(p)  ≤ keV ≤



# Plot $Q_\alpha$ vs A for even-even,

**NUCLIDE ground state**

Nuclide Symbol Z N A Z range N range A range Z N A Z N A

even    odd

More fields : Q-values, separation energies, atomic masses, radius

$Q(\beta)$   ≤ keV ≤    $Q(\text{EC})$   ≤ keV ≤    $Q(\alpha)$   ≤ keV ≤

$Q(\beta-n)$   ≤ keV ≤    $S(n)$   ≤ keV ≤    $S(p)$   ≤ keV ≤

R  ≤ fm ≤   Atomic mass AM  ≤ μ AMU ≤

**LEVELS**

Energy  ≤ keV ≤

Decays B.R.  ≤ % ≤   Only Ground State and Metastables  Isospin

Half Life  fs ≤  $T_{1/2}$  ≤  y  Stable   $J^\pi$    weak order   $\pi$

More fields : nuclear moments

**GAMMA transitions**

Energy  ≤ keV ≤

Final level  ≤ keV ≤  J  order   $\pi$

More fields : conversion coefficients, multipolarity, mixing ratio

**DECAY radiation emitted by the daughter**

Type  any   $\alpha$    $\beta^-$    $\beta^+$    $\gamma$   e

delayed  n  p   $\alpha$

Energy  ≤ keV ≤   only  most Intense lines

Intensity  ≤ % ≤

Max En.  ≤ keV ≤   ≤ log FT ≤

Order by : Z, A

Z  A  N   $Q(\beta)$    $Q(\alpha)$    $Q(\text{EC})$    $Q(\beta-n)$   Sn  Sp  R  AM  E   $T_{1/2}$   BR   $\mu$   Q  Erad

Log ft  HF   $E_\gamma$    $\alpha$   B(E)  B(M)   $\delta$

**PLOTTING**

X axis: A Y axis:  $Q(\alpha)$

- Find  $\alpha$  decaying nuclides with Hindrance Factor  $HF=1$ . Plot  $Q_\alpha$  vs  $A$ .

**NUCLIDE ground state**

Nuclide	Symbol	Z	N	A	Z range	N range	A range	Z	N	A	Z	
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	
											even <input type="checkbox"/>	odd <input type="checkbox"/>

More fields : Q-values, separation energies, atomic masses, radius

---

**LEVELS**

Energy  ≤ keV ≤   
 Decays B.R.  ≤ % ≤   Only Ground State and Metastables  
 Half Life **3.68E-8** fs ≤  $T_{1/2}$  ≤ **7.7E24** y  Stable   $J^\pi$   weak or

More fields : nuclear moments

---

**GAMMA transitions**

Energy  ≤ keV ≤   
 Final level  ≤ keV ≤  J  order   $\pi$   any  
 More fields : conversion coefficients, multipolarity, mixing ratio

**DECAY radiation emit**

Type  any   $\alpha$    $\beta^-$   
 delayed  n  p  c  
 Energy  ≤ keV ≤   
 Intensity  ≤ % ≤   
 Hindrance  **1** ≤ HF ≤  **1**

---

**Order by : Z , A**

<input checked="" type="checkbox"/> Z	<input checked="" type="checkbox"/> A	<input type="checkbox"/> N	<input type="checkbox"/> Q( $\beta$ )	<input type="checkbox"/> Q( $\alpha$ )	<input type="checkbox"/> Q(EC)	<input type="checkbox"/> Q( $\beta$ -n)	<input type="checkbox"/> Sn	<input type="checkbox"/> Sp	<input type="checkbox"/> R	<input type="checkbox"/> AM	<input type="checkbox"/> E	<input type="checkbox"/> T <sub>1/2</sub>	<input type="checkbox"/> BR
<input type="checkbox"/> Log ft	<input type="checkbox"/> HF	<input type="checkbox"/> E $\gamma$	<input type="checkbox"/> $\alpha$	<input type="checkbox"/> B(E)	<input type="checkbox"/> B(M)	<input type="checkbox"/> $\delta$							

---

**PLOTTING**

X axis:  A    Y axis:  Q( $\alpha$ )

# Plot $B(E_2)$ strengths of transitions from first excited $2^+$ states to the ground state vs A

More fields : Q-values, separation energies, atomic masses, radius

---

### LEVELS

Energy  ≤ keV ≤

Decays B.R.  ≤ % ≤   Only Ground State and Metastables

Half Life  3.68E-8 fs ≤  $T_{1/2}$  ≤  7.7E24 y  Stable

More fields : nuclear moments

$J^\pi$  2  weak order 2  Isospin   $\pi$  +

---

### GAMMA transitions

Energy  ≤ keV ≤

Final level  ≤ keV  0 J  order   $\pi$  any

level  0 ≤  0 J  order   $\pi$  any

More fields : conversion coefficients, multipolarity, mixing ratio

Conv. Coef.  ≤  $\alpha$  ≤  Total

Multipolarity  E2  weak No mix

w.u.  B(E2)

Mixing  ≤  $\delta$  ≤

---

### DECAY radiation emitted by the daughter

Type  any   $\alpha$    $\beta^-$    $\beta^+$    $\gamma$   e

delayed  n  p   $\alpha$

Energy  ≤ keV ≤   only 2 most intense lines

Intensity  ≤ % ≤

---

### Order by : Z , A

Z  A  N  Q( $\beta$ )  Q( $\alpha$ )  Q(EC)  Q( $\beta$ -n)  Sn  Sp  R  AM  E   $T_{1/2}$   BR   $\mu$   Q  E<sub>rad</sub>

Log ft  HF  E<sub>y</sub>   $\alpha$   B(E)  B(M)   $\delta$

---

### PLOTTING

X axis:  A Y axis:  B(E)

# Find nuclides which emit $\gamma$ rays of energy 197.2 keV through internal transitions and induced reactions.

**NUCLIDE ground state**

Nuclide Symbol Z N A Z range N range

More fields : Q-values, separation energies, atomic masses, radius

**LEVELS**

Energy  ≤ keV ≤

Decays B.R.  ≤ % ≤   Only Ground State and Met

Half Life  ≤ T<sub>1/2</sub> ≤   y  Stable

More fields : nuclear moments

**GAMMA transitions**

Energy  197.1 ≤ keV ≤ 197.3

Final  ≤ keV  J  order  π any

level  ≤

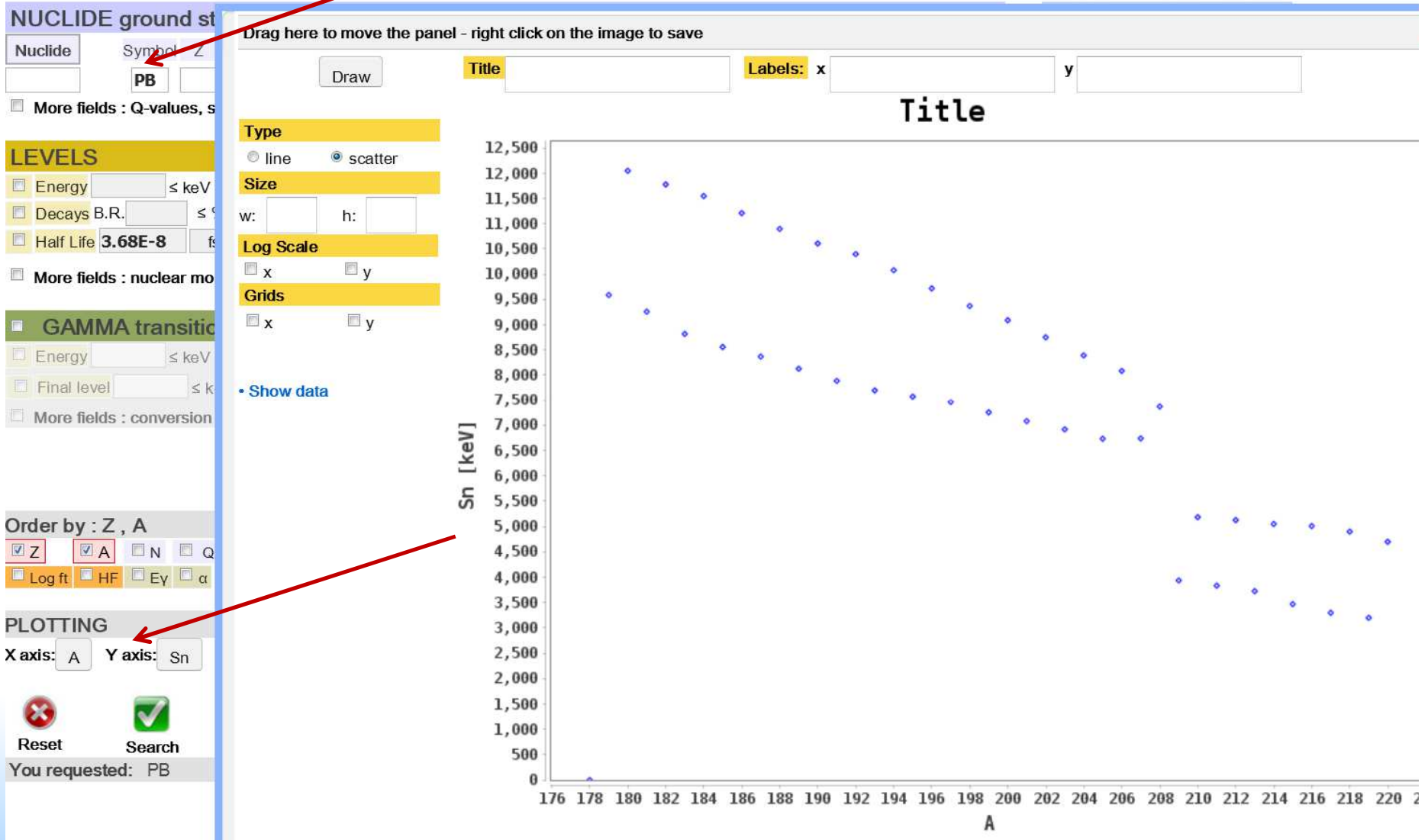
More fields : conversion coefficients, multipolarity, mixing ratio

In the results, take <sup>19</sup>F and plot its level schema

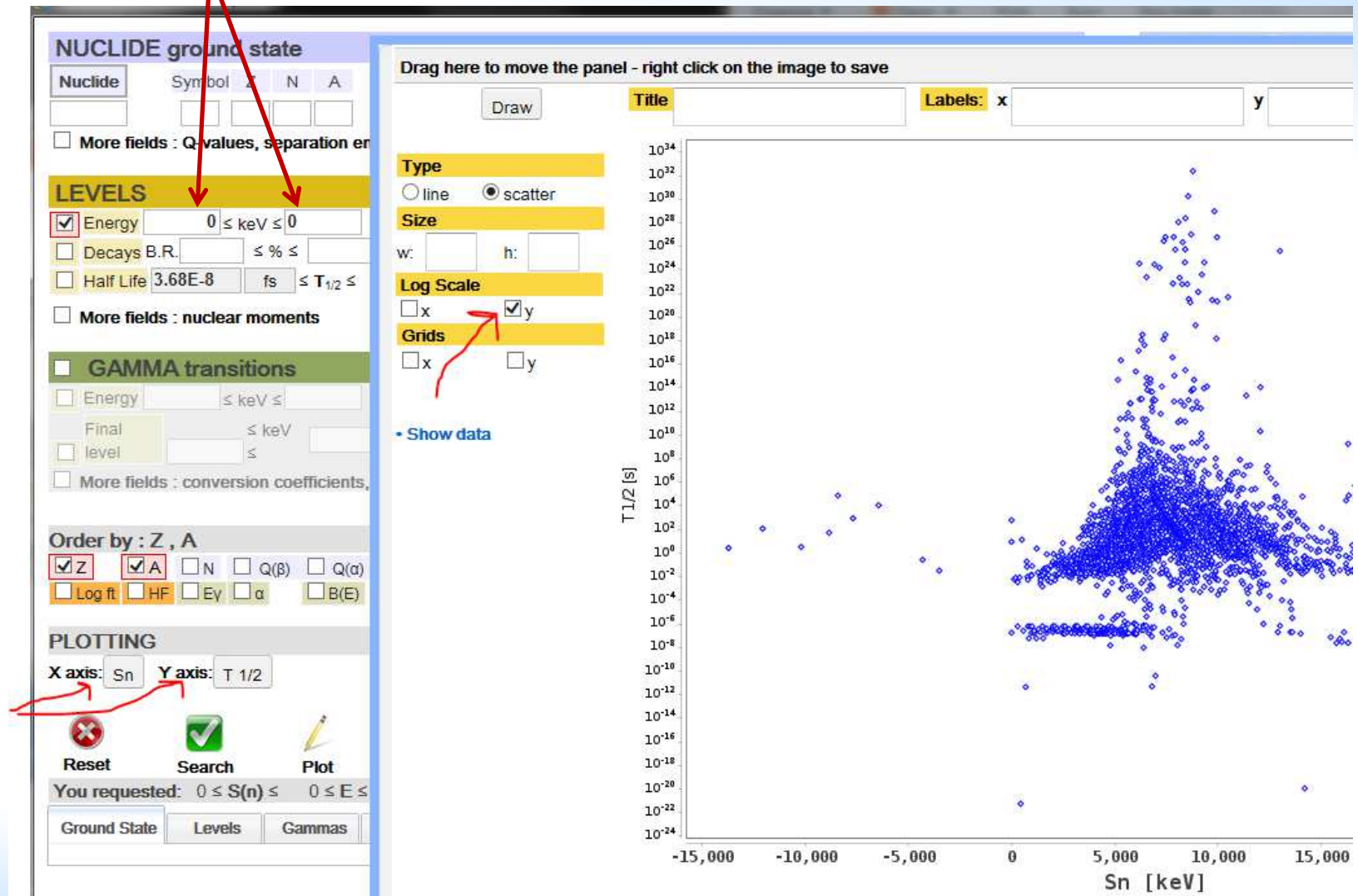
↓ CSV

Nuclide	Energy [keV]	J <sup>π</sup>	T <sub>1/2</sub> Abund. [mole fract.]
<sup>19</sup> <sub>9</sub> F <sub>10</sub>	0.0	1/2+	STABLE 100 %
<sup>36</sup> <sub>18</sub> Ar <sub>18</sub>	0.0	0+	STABLE 0.3336 % 21
<sup>81</sup>	0	3/2-	22 2 6 8 3

# Plot $S_n$ vs A for Led



# Plot ground states $S_n$ vs $T_{1/2}$



# Plot A vs $T_{1/2}$ for $Z \leq 100$ levels decaying via $\beta$ -n for which there is an evaluated n emission

## NUCLIDE ground state

Nuclide	Symbol	Z	N	A	Z range	N
					<input checked="" type="checkbox"/> 100	

More fields : Q-values, separation energies, atomic masses

## LEVELS

Energy  ≤ keV ≤

Decays B.R.  ≤ % ≤   Only Ground State

$\beta^-$    $\beta^- n$    $\beta^- 2n$    $2\beta^-$    $\beta^- 3n$    $\beta^- 4n$    $\beta^- \alpha$    $\beta^- F$    $\beta^- p$   
  $\beta^+$    $2\beta^+$    $\beta^+ 2p$    $\beta^+ \alpha$    $\beta^+ p$    $\beta$  fission

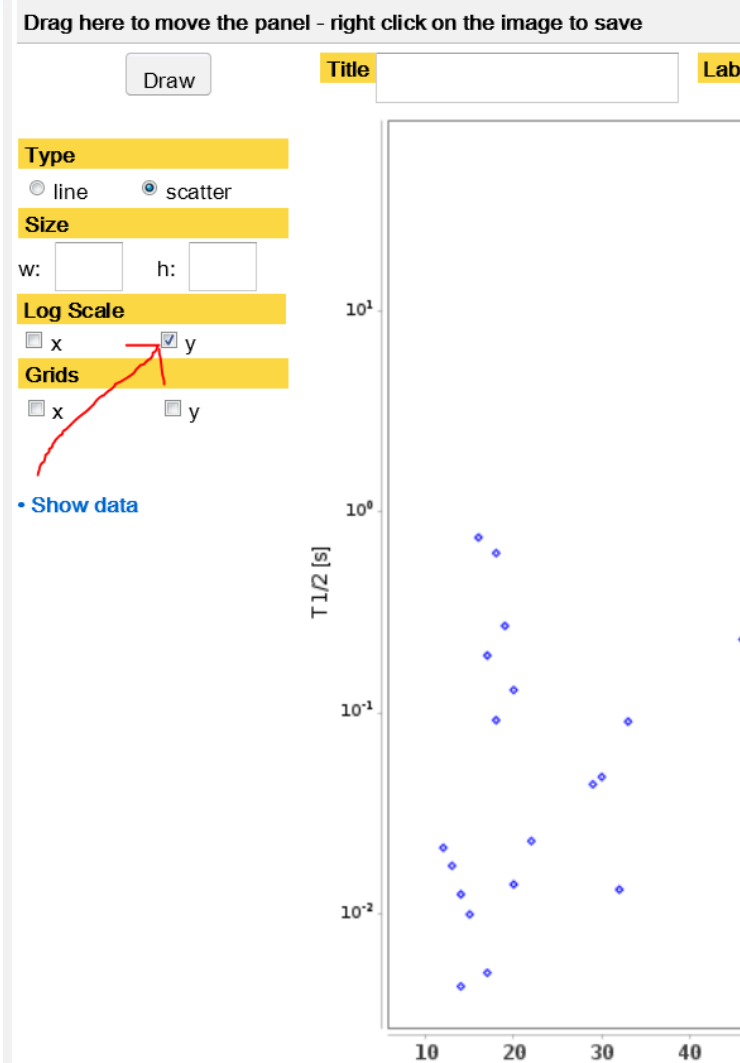
## DECAY radiation emitted by the daughter

Type  any   $\alpha$    $\beta^-$    $\beta^+$    $\gamma$   e

delayed  n  p   $\alpha$

Energy  ≤ keV ≤   only  most intense lines

Intensity  ≤ % ≤



- Plot  $A$  vs  $\delta$  for  $E_2/M_1$  transitions from  $J^\pi 2^+ \rightarrow 2^+$  for even-even nuclides having  $60 \leq A \leq 150$ .

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

K.S. Krane, Phys.Rev. C 10 (1974) 1197  
 ( $\Delta$  is a function of  $\delta$ )

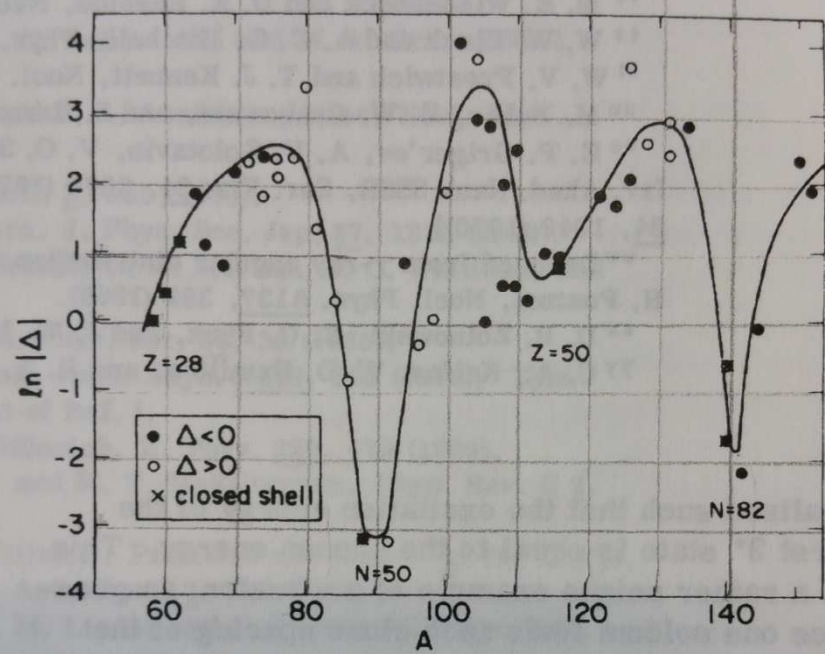


FIG. 2.  $E_2/M_1$  mixing ratios of  $2^+ \rightarrow 2^+$  transitions in even-even nuclei  $60 \leq A \leq 150$ . The solid curve indicates the trend of the measured values and shows pronounced minima in the vicinity of closed shells.

**SEE NEXT PAGE**



- Plot A vs  $\delta$  for  $E_2/M_1$  transitions from  $J^\pi 2^+$  to  $2^+$  for e-e nuclides having  $60 \leq A \leq 150$ .

**NUCLIDE ground state**

Nuclide:  Symbol:  Z:  N:  A:  Z range:  N range:  A range:  60  150

even    odd

More fields : Q-values, separation energies, atomic masses, radius

---

**LEVELS**

Energy   $\leq$  keV  $\leq$

Decays B.R.   $\leq$  %  $\leq$    Only Ground State and Metastables

Half Life  3.68E-8 fs  $\leq$   $T_{1/2} \leq$   7.7E24 y  Stable

More fields : nuclear moments

$J^\pi$  2  weak order 2   $\pi$  +  Isospin

---

**GAMMA transitions**

Energy   $\leq$  keV  $\leq$

Final level   $\leq$  keV  $\leq$   J 2 order 1  $\pi$  +

More fields : conversion coefficients, multipolarity, mixing ratio

Conv. Coef.   $\leq$   $\alpha \leq$   Total

Multipolarity  E2  weak  Yes  mix

w.u.  B(E2)

Mixing   $\leq$   $\delta \leq$

---

**DECAY radiation emitted by the daughter**

Type  any   $\alpha$    $\beta^-$    $\beta^+$    $\gamma$   e

delayed  n  p   $\alpha$

Energy   $\leq$  keV  $\leq$    only 2 most intense

Intensity   $\leq$  %  $\leq$

---

Order by : Z , A

Z  A  N  Q( $\beta$ )  Q( $\alpha$ )  Q(EC)  Q( $\beta$ -n)  S<sub>n</sub>  S<sub>p</sub>  R  AM  E  T<sub>1/2</sub>  BR   $\mu$   Q

Log ft  HF  E<sub>γ</sub>   $\alpha$   B(E)  B(M)   $\delta$

---

**PLOTTING**

X axis:  A  Y axis:   $\delta$



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*Thank you!*

