The Abdus Salam International Centre for Theoretical Physics

2484-21

ICTP-IAEA Joint Workshop on Nuclear Data for Science and Technology: Medical Applications

30 September - 4 October, 2013

Nuclear Data Retrieval and Dissemination

R. Capote
Nuclear Data Section
IAEA
Vienna
Austria

A.L. Nichols
Department of Physics
University of Surrey Guildford
UK

Strada Costiera, 11 - 34151 - Trieste - Italy • Tel. +39 0402240111 • Fax. +39 040224163 • sci_info@ictp.it • www.ictp.it
ICTP is governed by UNESCO, IAEA, and Italy, and it is a UNESCO Category 1 Institute

Nuclear Data Retrieval and Dissemination

Roberto Capote

Nuclear Data Section, IAEA, Vienna, Austria

Alan Nichols

Department of Physics, University of Surrey

Guildford, UK

3 October 2013

Workshop on Nuclear Data for Science and Technology: Medical Applications
ICTP, Trieste, Italy, 30 September – 4 October 2013

Where to get the data

National Nuclear Data Center
BROOKHAVEN NATIONAL LABORATORY

www.nndc.bnl.gov

NUCLEAR SCIENCE DIVISION
LBNL

ie.lbl.gov

TUNL Nuclear Data Evaluation Project

www.tunl.duke.edu/nucldata

data for A < 20

Nuclear Data Services

www-nds.iaea.org

IAEA Nuclear Data Section: Medical Portal

www-nds.iaea.org

www-nds.iaea.org/medportal/

ENSDF

ENSDF:

www.nndc.bnl.gov/ensdf/

NUDAT:

www.nndc.bnl.gov/nudat2/

NSR:

www-nds.iaea.org/nsr/index.jsp

MIRD:

www.nndc.bnl.gov/mird/

Decay Data Evaluation Project (DDEP)

DDEP:

www.nucleide.org/DDEP_WG/DDEPdata.htm

Introductory text:

www.nucleide.org/DDEP_WG/Introduction_2011.pdf

JANIS, NEA-OECD, Nuclear Data Bank, Paris

JANIS:

www.oecd-nea.org/janis/

INL: X-ray and γ-ray spectra

www.inl.gov/gammaray/catalogs/catalogs.shtml

Specific catalogues:

- **NaI(Tl) scintillator**
  www.inl.gov/gammaray/catalogs/pdf/naicat.pdf
- **Ge and Si(Li) detectors**
  www.inl.gov/gammaray/catalogs/pdf/gecat.pdf

IAEA LiveChart

Marco Verpelli

Nuclear Data Section
Department of Nuclear Sciences and Applications

ICTP, Trieste, Italy, 30 September – 4 October 2013

LiveChart

LiveChart:

www-nds.iaea.org/relnsd/vcharthtml/VChartHTML.html

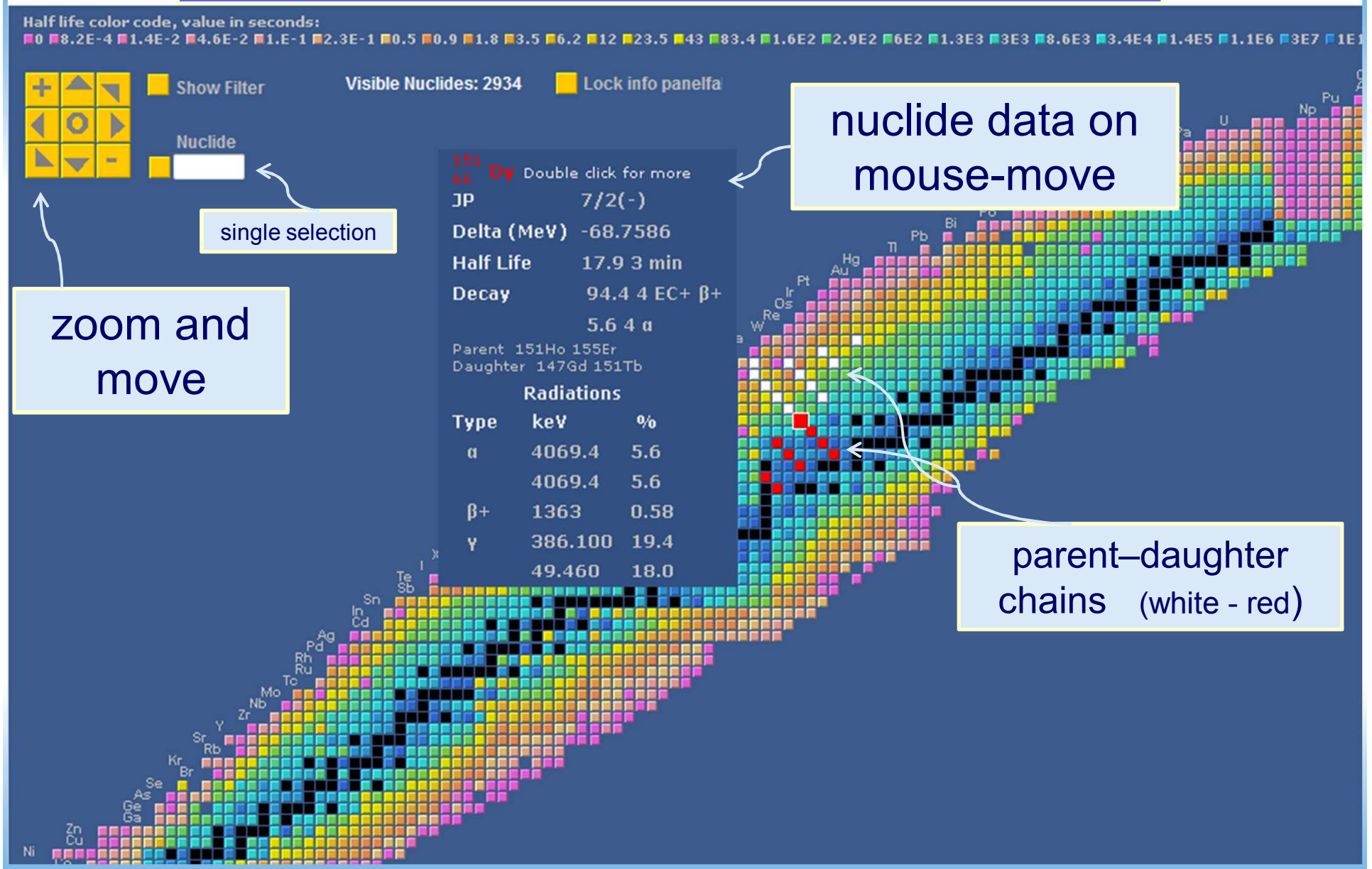
LiveChart: a Relational Database for Structure and Decay Data

All fields from
- adopted levels & gammas
- decay datasets
etc..

More than 130 fields

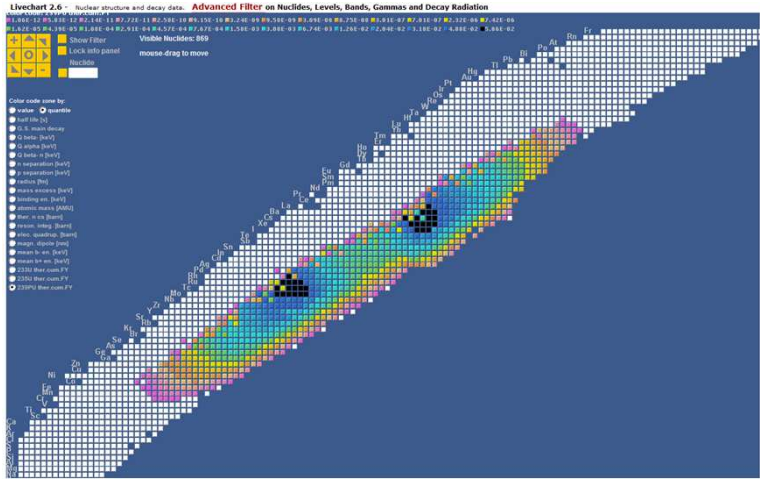
A relational database enables
very powerful retrieval and presentation of data

LiveChart

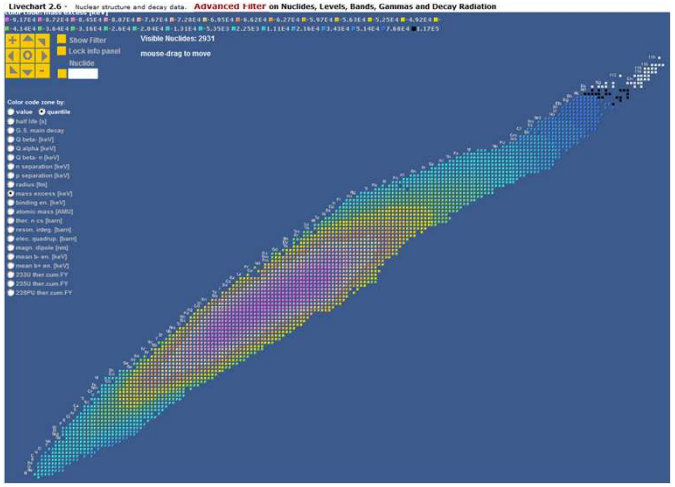

Half life color code, value in seconds:
0 8.2E-4 1.4E-2 4.6E-2 1.E-1 2.3E-1 0.5 0.9 1.8 3.5 6.2 12 23.5 43 83.4 1.6E2 2.9E2 6E2 1.3E3 3E3 8.6E3 3.4E4 1.4E5 1.1E6 3E7 1E1
Show Filter
Visible Nuclides: 2934
Lock info panelfa
Nuclide
151 66 Dy Double click for more
JP 7/2(-)
Delta (MeV) -68.7586
Half Life 17.9 3 min
Decay 94.4 4 EC+ β+
5.6 4 α
Parent 151Ho 155Er
Daughter 147Gd 151Tb
Radiations
Type keV %
α 4069.4 5.6
4069.4 5.6
β+ 1363 0.58
γ 386.100 19.4
49.460 18.0
zoom and move
single selection
nuclide data on mouse-move
parent–daughter chains (white - red)

LiveChart colour code - examples

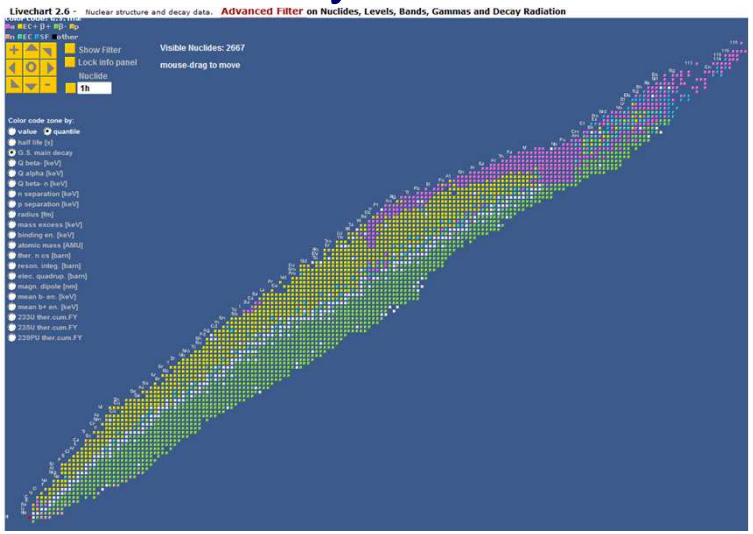
Fission yields



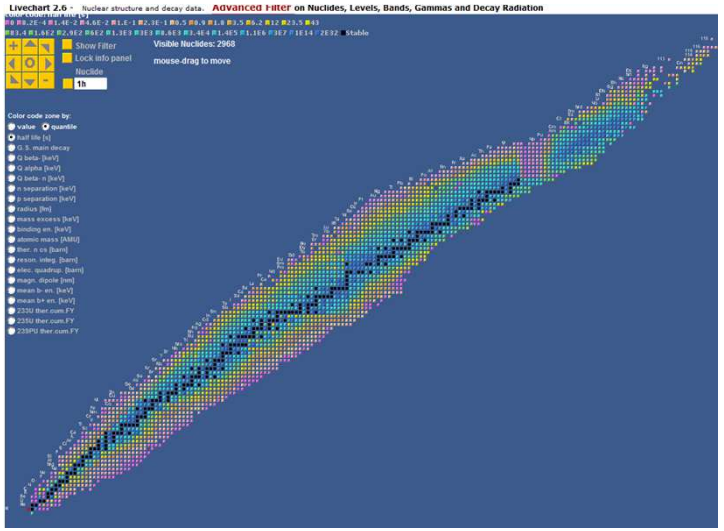
Mass excess



Decay mode



Half-life



LiveChart: nuclide data - detail

Nuclide | Levels | Gammas | Bands | Decay Radiation | Magn. Mom. | El. Mom. | Ther.

Click on nuclide symbol to show the **level schema** and **ENSDF** dataset

Nuclide	Q_{β^-} [keV]	Q_α [keV]	Q_{EC} [keV]	$Q_{\beta^- n}$ [keV]	S_n [keV]	S_p [keV]
$^{135}_{54}Xe_{81}$	1164.218 *4456*	-3631.54 *457*	-2626.312 *8758*	-7597.80 *457*	6364.46 *463*	9634

Metastable states

Nuclide	Energy (keV)	J^{π}_{order}	Band	$T_{1/2}$	$T_{1/2}$ [s]	Decays	Isospin
$^{135}_{54}Xe_{81}$	526.551 *13* m	11/2-		15.29 min *5*	9.17 x 10^2	IT > 99.4 β- < 0.6	

Ground and metastable states

ENSDF data:

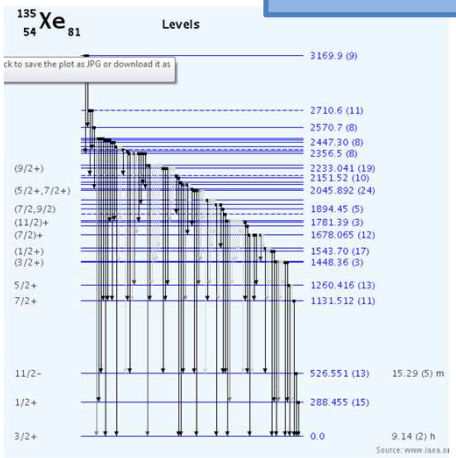
- levels and bands
- Gamma transitions and emissions
- decay radiation

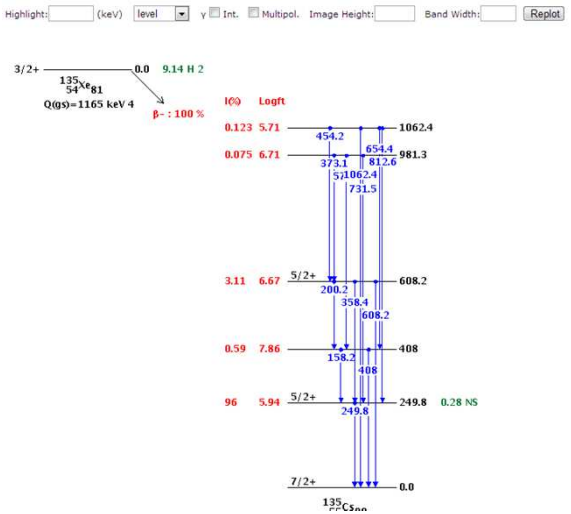
+

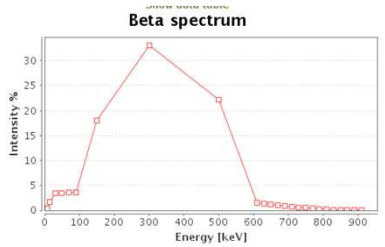
- AMDC data
- nuclear radii → Angeli
- nuclear moments → Stone
- fission yields
- thermal-neutron cross sections

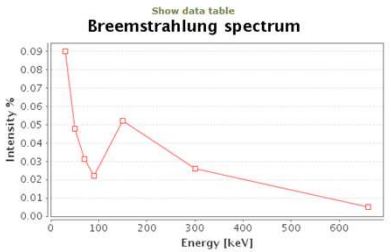
Plots:

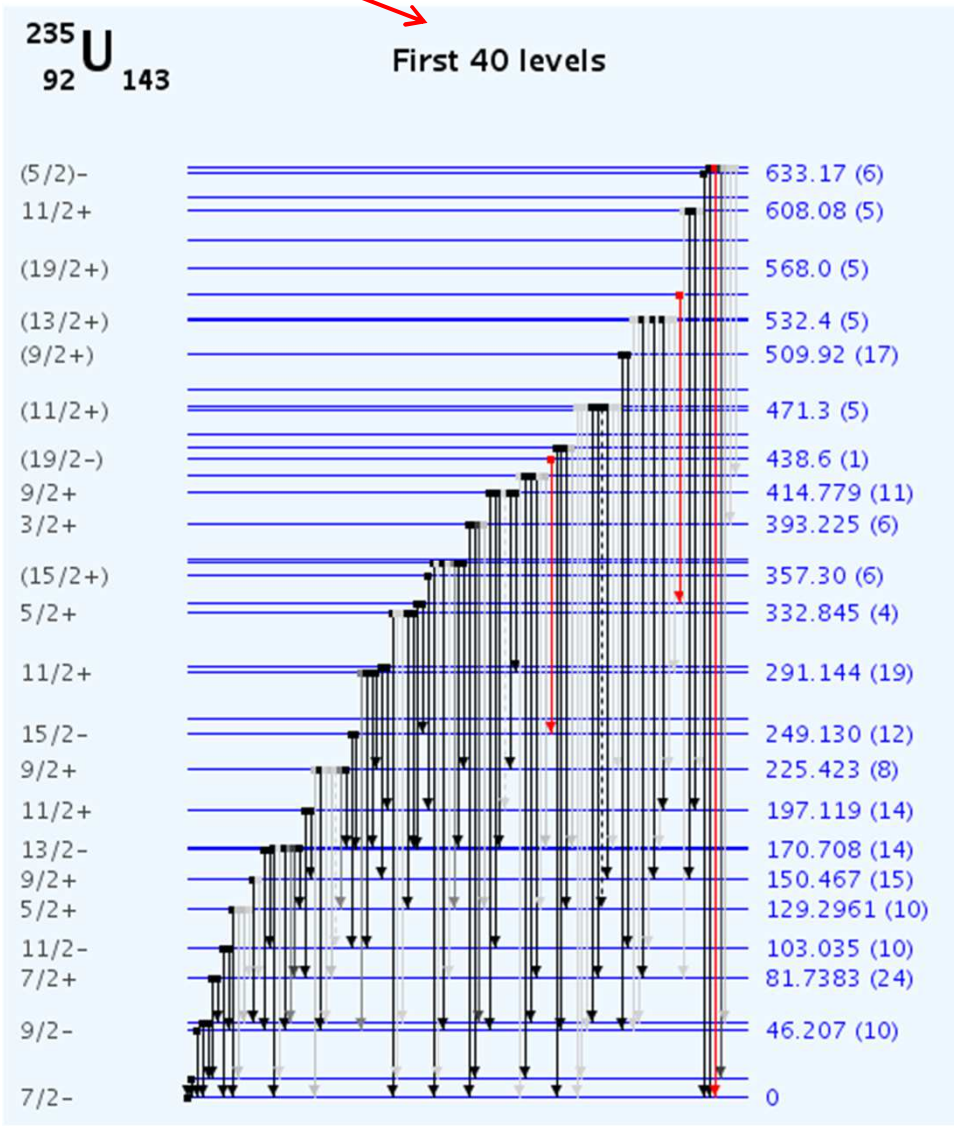
- level schemes and γ
- decay schemes
- beta spectra
- Bremsstrahlung spectra







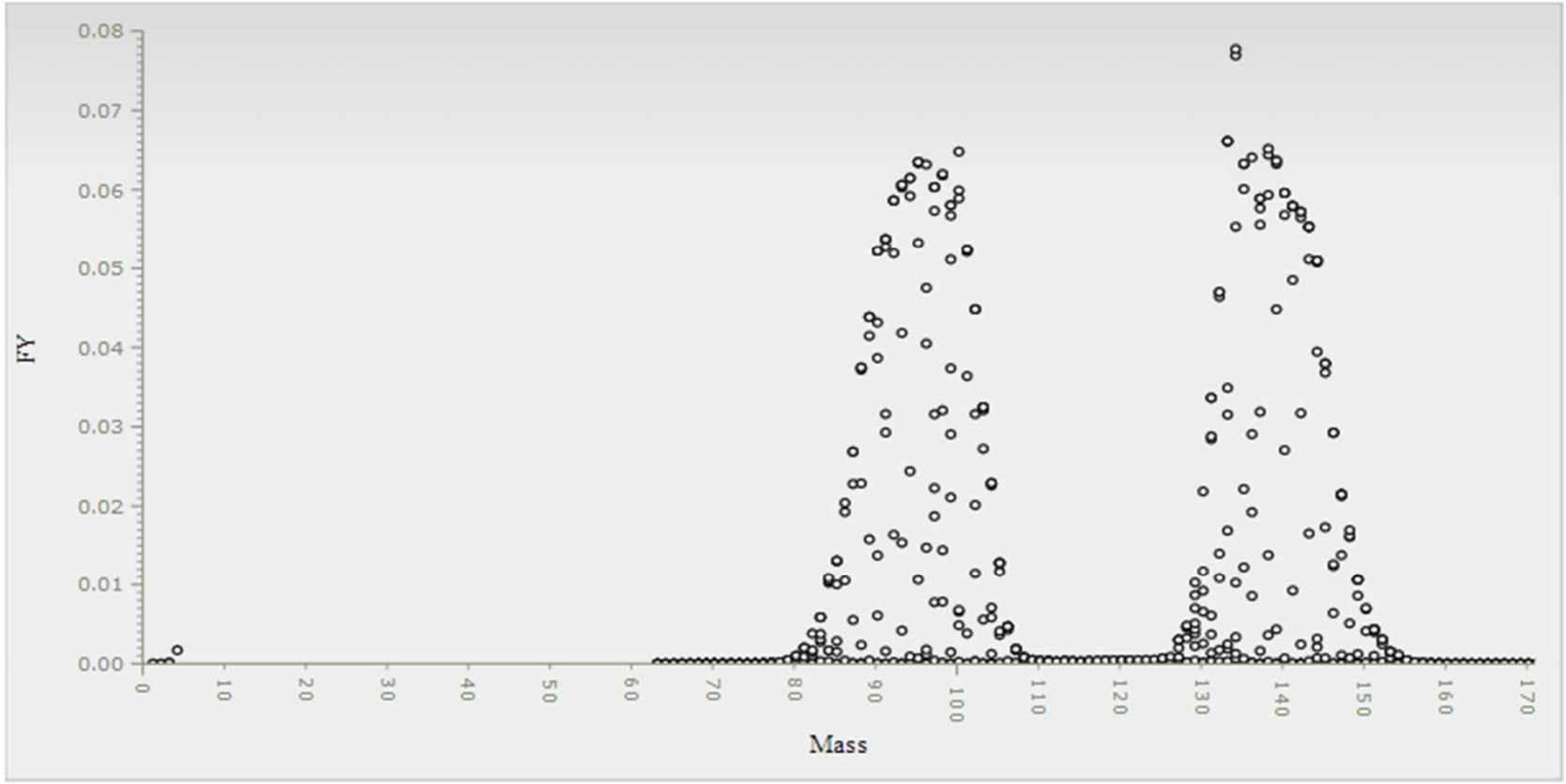




Level scheme plotting options:

- **level number**
- **energies**
- **bands**

Fission yields



235U Cumulative Fast

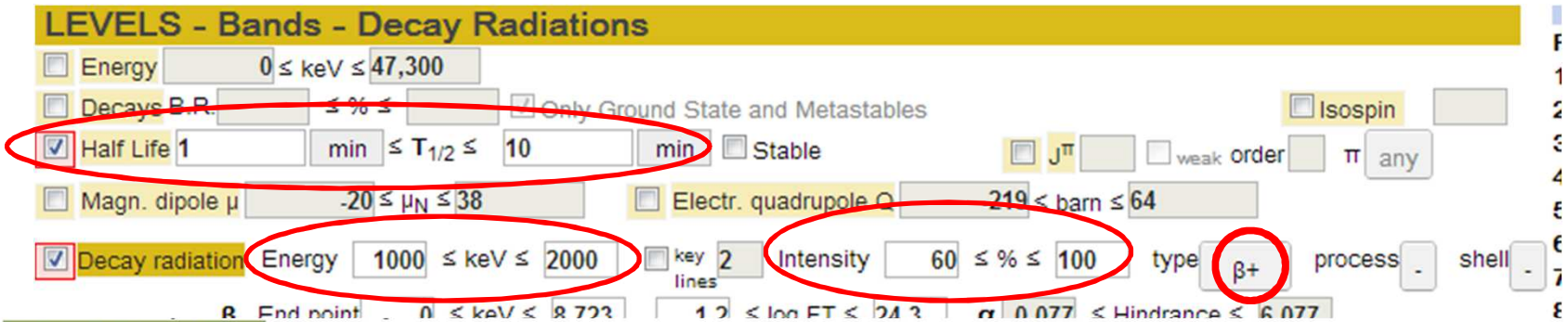
0 < X < 171 0 < Y < 0.08 Indep. Cumul. Ther. Fast 14 MeV Redraw Reset

Choose mass and value range

Choose type

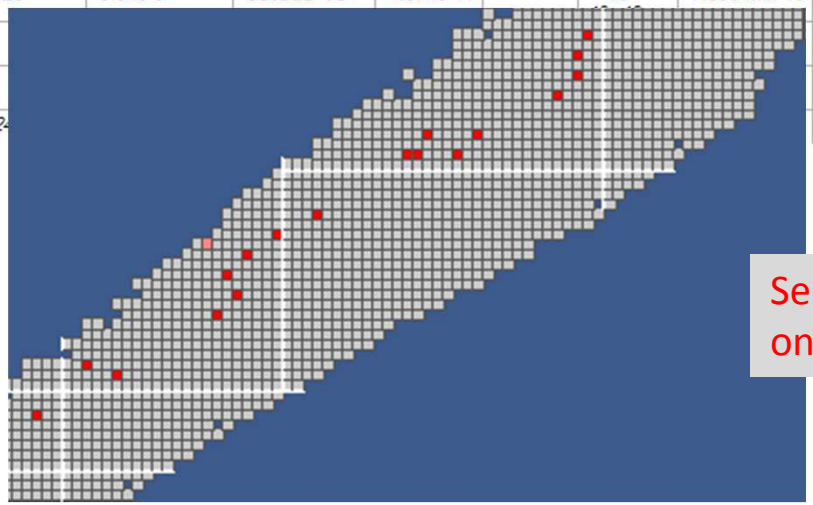
Examples of queries

Selection of nuclides with half-lives between 1 and 10 mins, emitting β^+ with energy between 1 and 2 MeV



Electron Capture and Beta+

Fed level	Jp	Energy EC	Avg Energy β+	Intensity EC	Intensity β+	LogFT	Unforb.	Parent	$T_{1/2}$	E [keV]	Jp order	Decay	$Q_{gs \to gs}$	Daughter
498.01 *5*	3/2+	(3415.285) *17*	1076.7 *79*	26.7 *9*	**60.3** ***19***	4.691 *18*		$^{113}_{51}Sb_{62}$	6.67 min *7*	0.0	5/2+	ec β+ 100 %	3913.295 *17402*	$^{113}_{50}Sn_{63}$
670.1 *3*	1+	(3500.721) *2*	1099 *6*	2.80 *24*	**70** ***6***	4.4 *1*		$^{60}_{30}Zn_{30}$	2.38 min *5*	0.0	0+	ec β+ 100 %	4170.821 *1769*	$^{60}_{29}Cu_{31}$
0.0	0+	(3573.784) *3585*	1142.7 *19*	5.49 *6*	**80.9** ***4***	4.75 *1*		$^{78}_{35}Br_{43}$	6.45 min *4*	0.0	1+	ec β+ ≥ 99.99 %	3573.784 *3585*	$^{78}_{34}Se_{44}$
0.0	0+	(3656.639) *3059*	1188.6 *14*	24.3 *2*	**73.2** ***3***	4.525 *13*		$^{118}_{51}Sb_{67}$	3.6 min *1*	0.0	1+	ec β+ 100 %	3656.639 *3059*	$^{118}_{50}Sn_{68}$
2167.5 *3*	2+	(3746.555) *500*	1212.08 *20*	0.516 *5*	**99.333** ***13***	4.9746 *11*		^{38}K	7.636 min *18*	0	3+	ec β+ 100 %	5914.055 *347*	$^{38}_{18}Ar_{20}$
0.0	0+	(3731.489) *19933*	1224.4							0.0	1+	ec β+ 100 %	3731.489 *19933*	$^{134}_{56}Ba_{78}$
3189.33 *14*	6+	(3853.051) *300*	1264.00							616.28 *6* m	(7)+	ec β+ 100 %	6426.101 *225*	$^{42}_{20}Ca_{22}$
0.0	0+	(3958.896) *872*	1316.0 *24*							0.0	1+	ec β+ 100 %	3958.896 *872*	^{62}Ni

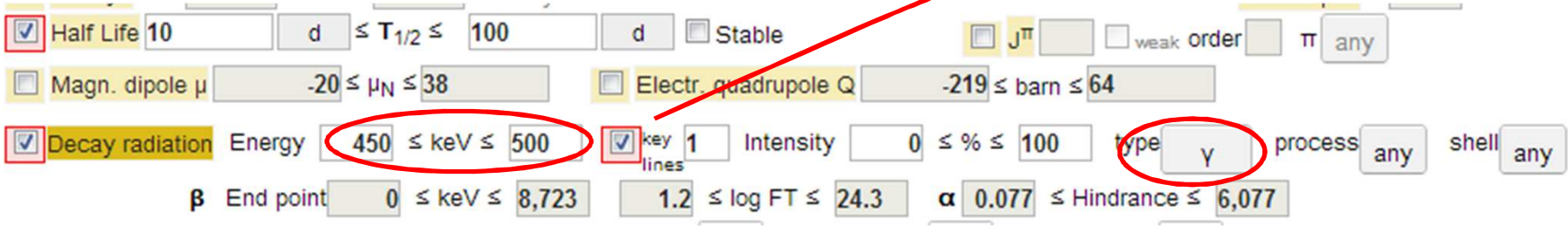


Selected nuclides visualised on Livechart

Gamma spectroscopy : peak identification

Nuclides with half-lives between 10 and 100 days, emitting γ with energy between 450 and 500 keV. The γ must be the most intense line (key-line)

key-line condition



Gamma

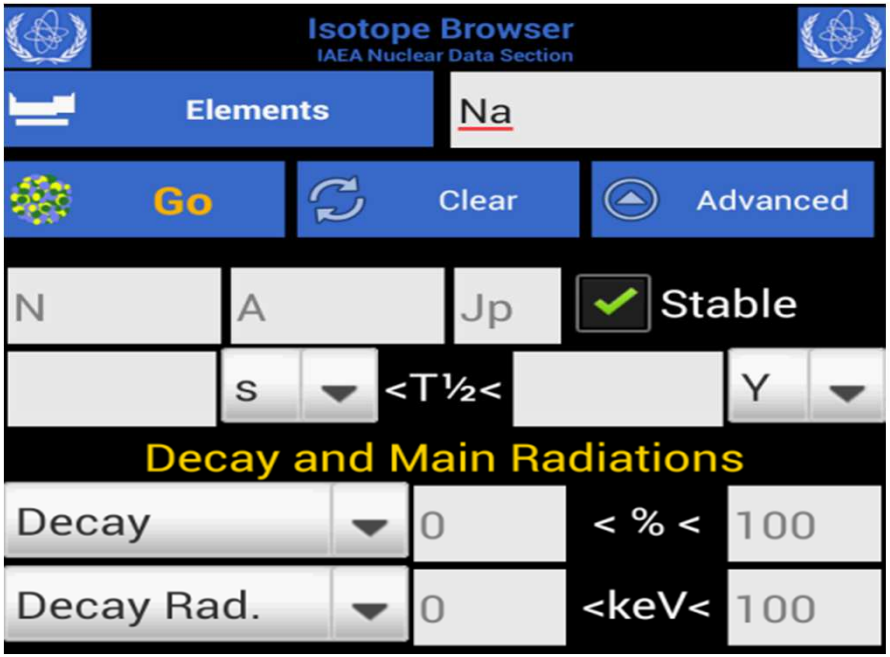
Start level	Jp	Final Level	Jp	Energy	Intensity	Mixing	Multipol.	Tot. Conv. Coeff.	Parent	$T_{1/2}$	E [keV]	Jp order	Decay	$Q_{gs \to gs}$	Daughter
1084.85 *17*	21/2+	631.33	15/2+	453.59 *20*	**68** *3*		E2	0.0248	$^{179}_{72}Hf_{107}$	25.05 d *25*	1105.74 *16* m2	25/2-	IT 100 %	1105.74	$^{179}_{72}Hf_{107}$
477.612 *3*	1/2-	0.0	3/2-	477.6035 *20*	**10.44** *4*	0.20	M1(+E2)	7.3E-7 *11*	$^{7}_{4}Be_{3}$	53.22 d *6*	0.0	3/2-	ec 100 %	861.893 *71*	$^{7}_{3}Li_{4}$

All mass chains on one web-page

With separation energies, intermediate states, and data for metastable and ground states:
Jp, decays, half-lives and Q-values.

Clicking on a nuclide opens a detailed page

Isotope Browser : app for android mobile devices



20 Na 11	447.9 (23) ms	2+	ec 100.0%
21 Na 11	22.49 (4) s	3/2+	ec β+ 100.0%
22 Na 11	2.6027 (10) Y	3+	ec β+ 100.0%
23 Na 11	Stable	3/2+	
24 Na 11	14.997 (12) H	4+	β- 100.0%

^{26}Na Sodium

More about 26NA on on NDS web

Uncertainty applies to the least significant digit(s)

Z 11 N 15 Jπ 3+
Half life 1.077 (5) s
Decays
β- 100.0 %
Qα -12079.07 (1288) MeV
Qβ 9353.766 (3502) MeV
Qec -7340.225 (1852) MeV
Sn 5574.28 (370) MeV
Sp 12089.95 (4486) MeV
Electric Momoment -0.08 5 barn
Magnetic Momement +2.851 2 μN
Binding/A 8004.201 (135) MeV
Mass 25.992634649 (3759) AMU
Charge radius 2.9928 (0.0331) rms fm
Decay radiations
From β- decay
β- 3514 (8) keV 88.1 (4) %
2026 (8) keV 2.7 (2) %
2263 (8) keV 2.7 (3) %