



*A web-based database
for nuclear EM
moments:
status and perspectives*

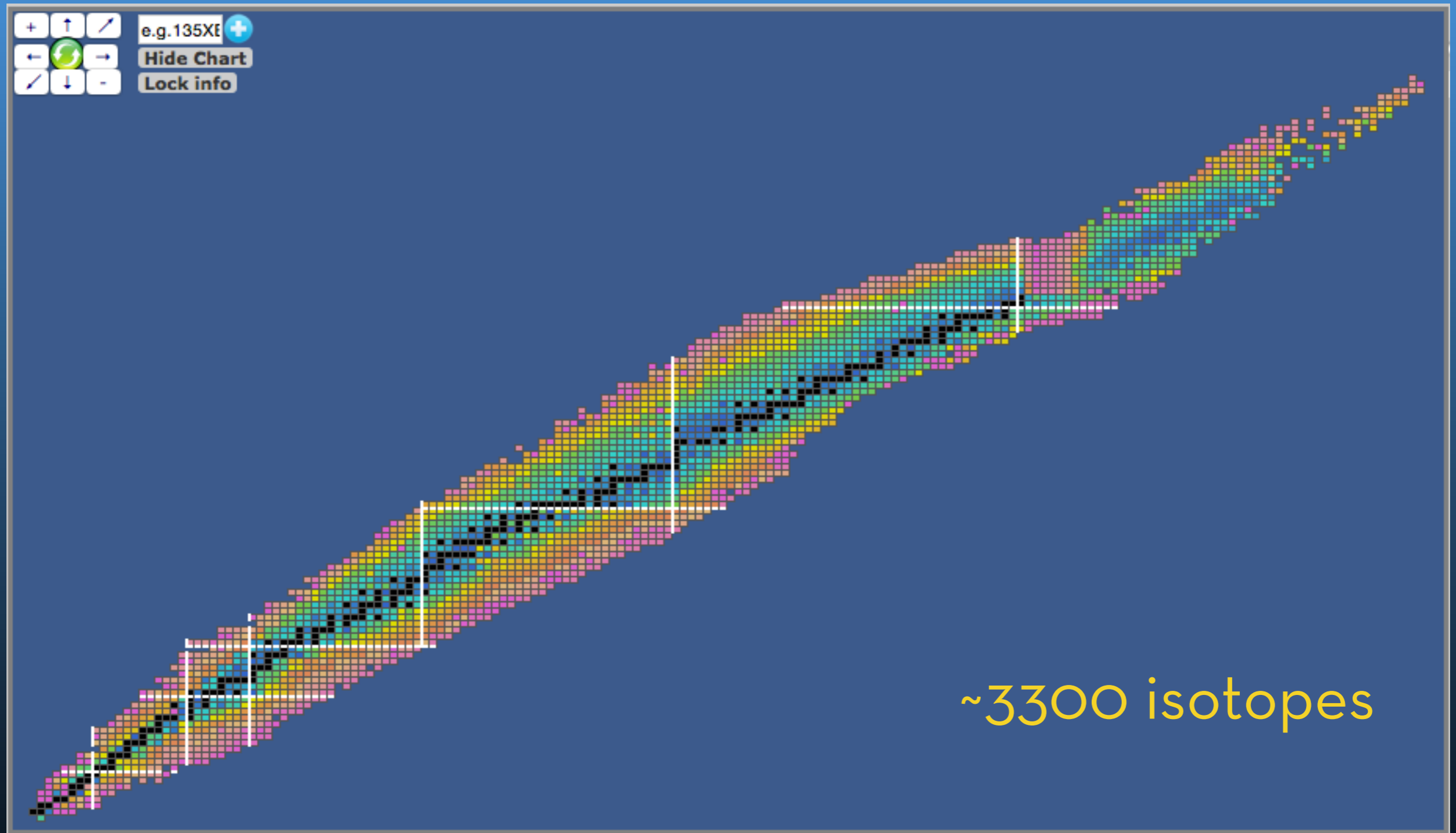
Theo J. Mertzimekis
University of Athens

OUTLINE

- Introduction
- The nuclear EM moments DB
- Layout and technical aspects
- Serve - Integrate - Upscale
- The vision for the future



THE NUCLEAR CHART



RIB: THE ONGOING REVOLUTION

- Extensive use during the last 10-15 years
- Opened broad new horizons
- New limits and magic numbers
- Newly observed isotopes
- New phenomena on shell closures, interactions, shapes, ...



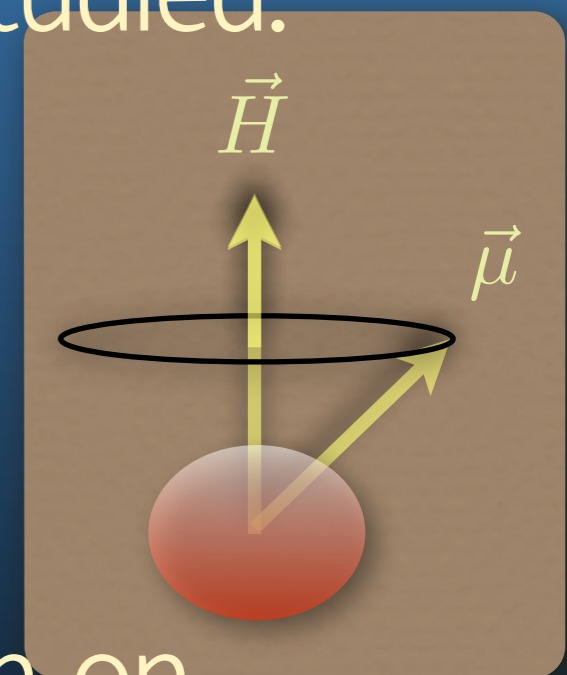
WHAT DOES THIS MEAN?

LOTS
of
DATA



FOCUS ON MOMENTS

- How do electromagnetic moments fit in this new playground?
- Two types of moments are typically studied:
 - ▶ Magnetic Dipole Moment, μ
 - ▶ Electric Quadrupole Moment, Q
- EM moments offer unique information on nuclear structure



NUCLEAR μ & Q DATA

Lots of work on tabulating such data:

- J. Mack, Rev. Mod. Phys. 22, 64 (1950)
- G. Fuller, J. Phys. Chem. Ref. Data 5, 836 (1976)
- P. Raghavan, At. Data Nucl. Data Tables 42, 189 (1989)
- N.J. Stone, At. Data Nucl. Data Tables 90, 75 (2005)
- P. Pyykkö, Mol. Phys. 106, 1965 (2008)
- N.J. Stone, INDC(NDS) 0594 (2011)
- N.J. Stone, INDC(NDS) 0658 (2014)

just a few



DO WE NEED A NEW DATABASE?

YES



BECAUSE WE NOW CAN:

- Take advantage of the WWW
- Build on top of existing print compilations
- Point researchers directly to digital sources
- Invest on synergies with experts (IT, Phys)
- Provide data systematics and visual info



http://magneticmoments.info

Welcome to the Electromagnetic Moment Resources on the Web
A compilation of unevaluated experimental data

Periodic Table

Z-Helix

Elementary Particles

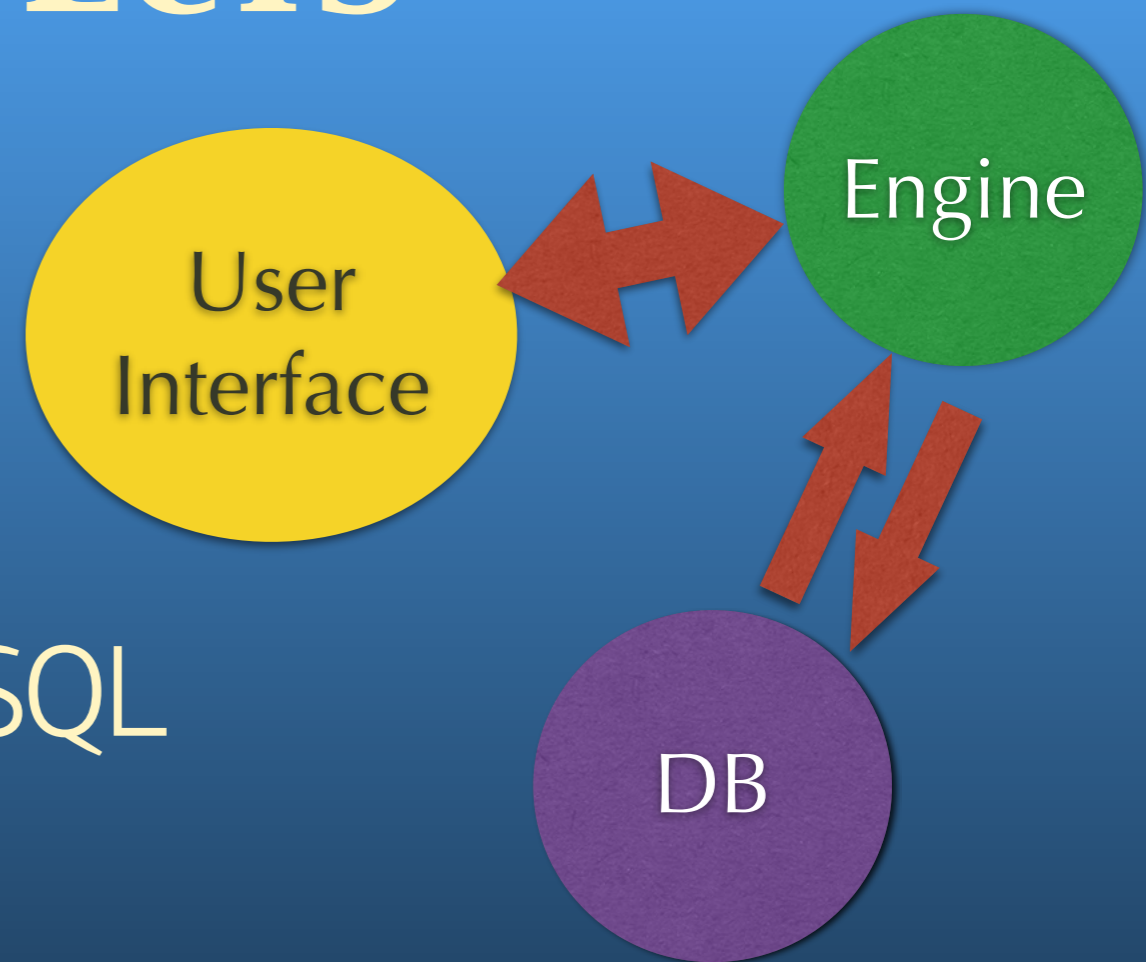
ABOUT

HELP

Group	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	1 n																	
Period 1	1 H																	2 He
2	3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
3	11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
4	19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
5	37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
6	55 Cs	56 Ba	* 71 Lu	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
7	87 Fr	88 Ra	** 103 Lr	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Uut	114 Fl	115 Uup	116 Lv	117 Uus	118 Uuo
*Lanthanides			* 57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb		
**Actinides			** 89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No		



TECH ASPECTS



- User Interface is HTML
- Data are tabulated in MySQL
- Engine is built in PHP
- Small fingerprint; Comfy interaction; Clear Info
- Easy upgrades, easy expansion



EXAMPLE: KR ISOTOPES

Welcome to the Electromagnetic Moment Resources on the Web
A compilation of unevaluated experimental data

Periodic Table | Z-Helix | Elementary Particles | ABOUT | HELP

Group 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

Period 1 1 H 2 He

2 3 Li 4 Be 5 B 6 C 7 N 8 O 9 F 10 Ne

3 11 Na 12 Mg 13 Al 14 Si 15 P 16 S 17 Cl 18 Ar

4 19 K 20 Ca 21 Sc 22 Ti 23 V 24 Cr 25 Mn 26 Fe 27 Co 28 Ni 29 Cu 30 Zn 31 Ga 32 Ge 33 As 34 Se 35 Br 36 Kr

5 37 Rb 38 Sr 39 Y 40 Zr 41 Nb 42 Mo 43 Tc 44 Ru 45 Rh 46 Pd 47 Ag 48 Cd 49 In 50 Sn 51 Sb 52 Te 53 I 54 Xe

6 55 Cs 56 Ba * 71 Lu 72 Hf 73 Ta 74 W 75 Re 76 Os 77 Ir 78 Pt 79 Au 80 Hg 81 Tl 82 Pb 83 Bi 84 Po 85 At 86 Rn

7 87 Fr 88 Ra ** 103 Lr 104 Rf 105 Db 106 Sg 107 Bh 108 Hs 109 Mt 110 Ds 111 Rg 112 Cn 113 Uut 114 Fl 115 Uup 116 Lv 117 Uus 118 Uuo

*Lanthanides 57 La 58 Ce 59 Pr 60 Nd 61 Pm 62 Sm 63 Eu 64 Gd 65 Tb 66 Dy 67 Ho 68 Er 69 Tm 70 Yb

**Actinides 89 Ac 90 Th 91 Pa 92 U 93 Np 94 Pu 95 Am 96 Cm 97 Bk 98 Cf 99 Es 100 Fm 101 Md 102 No

Z: Search

A: Reset

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Periodic Table

Z-Helix

Elementary Particles

ABOUT

HELP

Krypton (Z=36)

⁷⁵Kr

⁷⁶Kr

⁷⁷Kr

⁷⁸Kr

⁷⁹Kr

⁸⁰Kr

⁸¹Kr

⁸²Kr

⁸³Kr

⁸⁴Kr

⁸⁵Kr

⁸⁶Kr

⁸⁷Kr

⁸⁹Kr

⁹¹Kr

⁹³Kr

⁹⁵Kr

Isotope	Energy [keV]	t _{1/2}	Spin/Parity	μ [nm]	Q [b]	Ref. Std	Method	NSR keyword	doi
⁸⁰ Kr	617.	8.7 ps	2 ⁺	+0.76(10)			TF	2001Me20	10.1103/PhysRevC.64.024314
	1257.	1.0 ps	4 ⁺	+1.8(6)			TF	2001Me20	10.1103/PhysRevC.64.024314
	1436.	7.6 ps	2 ⁺	+1.3(7)			TF	2001Me20	10.1103/PhysRevC.64.024314

Transient Field integral perturbed angular correlation



EXAMPLE: A=9 ISOBARS

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[Periodic Table](#)

[Z-Helix](#)

[Elementary Particles](#)

[ABOUT](#)

[HELP](#)

Lithium (Z=3)

[⁶Li](#) [⁷Li](#) [⁸Li](#) [⁹Li](#) [¹¹Li](#)

Isotope	Energy [keV]	t _{1/2}	Spin/Parity	μ [nm]	Q [b]	Ref. Std	Method	NSR keyword	doi
⁹ Li	0.	178 ms	3/2 ⁻	3.4391(16)		[¹ H]	β-NMR	1983Co11	10.1103/PhysRevC.28.862
				3.434(5)		[⁸ Li]	CFBLS/β-NMR	1988Ar17	
					0.0253(9)	[⁷ Li]	CFBLS/β-NMR	1988Ar17	
					0.036(7) st	[⁷ Li]	β-NMR	1983Co11	10.1103/PhysRevC.28.862

Beryllium (Z=4)

[⁷Be](#) [⁹Be](#) [¹¹Be](#)

Isotope	Energy [keV]	t _{1/2}	Spin/Parity	μ [nm]	Q [b]	Ref. Std	Method	NSR keyword	doi
⁹ Be	0.	stable	3/2 ⁻	-1.177432(3) d			R	1983It03	10.1103/PhysRevB.27.1906
				-1.1778(9)			N, OP/RD	1976We17	10.1016/0375-9601(76)90722-2
				-1.17749(2)		[¹ H]	N	1949Di25 1951Al11	10.1103/PhysRev.75.1769 10.1103/PhysRev.82.105
					+0.0529(4)		R	1991Su05	10.1016/0009-2614(91)90181-8
					+0.053(3) st		AB	1967Bl09	10.1103/PhysRev.153.164

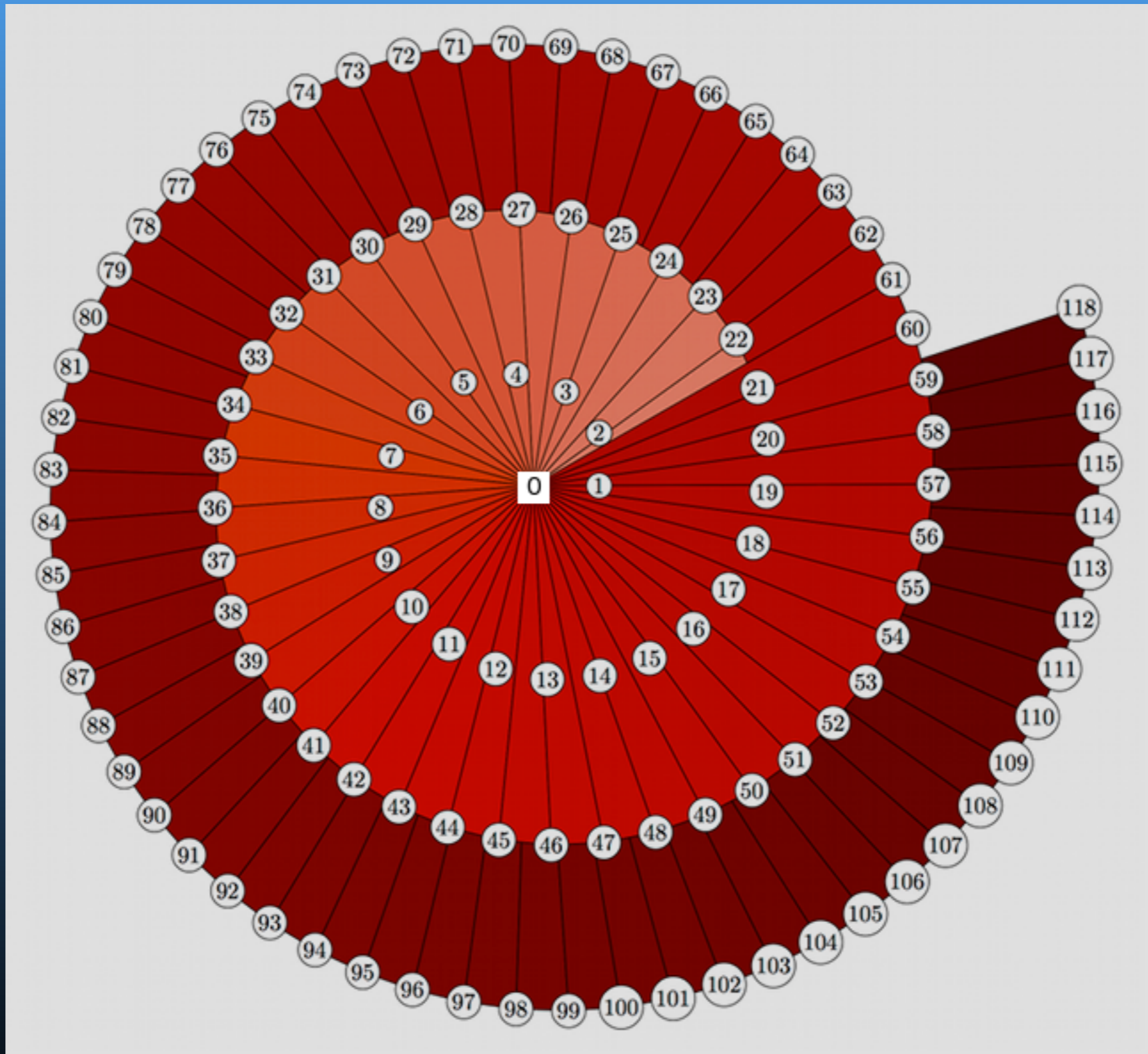
Carbon (Z=6)

[⁹C](#) [¹¹C](#) [¹²C](#) [¹³C](#) [¹⁴C](#) [¹⁵C](#) [¹⁷C](#)

Isotope	Energy [keV]	t _{1/2}	Spin/Parity	μ [nm]	Q [b]	Ref. Std	Method	NSR keyword	doi
⁹ C	0.	126 ms	3/2 ⁻	1.3914(5)			β-NMR	1995Ma48	10.1016/0375-9474(95)00115-H
				1.396(3)			β-NMR	1998Hu08	10.1103/PhysRevC.57.R2790



THE Z-HELIX



PRESENT STATUS

- Over **1100** levels w/ measured moments
- Some **5300** individual measurements
- Elementary **particle data** (from PDG site)
- **DOI** info (a click away). Checked w/ NSR; some corrected; ≈ 200 new found (\leftarrow NSR interested?)
- Real power: **Bi-Monthly updates** (scanning ~ 30 major journals/preprints/RSS etc)



SERVE-INTegrate-UPSCALE

- Isotope / Level energy, spin, parity, halflife
- Magnetic dipole moment
- Electric Quadrupole moment
- Experimental technique / reference nucleus
- Nuclear Structure Reference (NSR) keyword
- DOI - link to original publication



SERVE-**INTEGRATE**-UPSCALE

- DB is stand-alone. However:
 - PHP enables easy integration with all major databases
 - IAEA LiveChart is just a step away



SERVE-INTEGRATE-UPSCALE

- Provide graphical view of systematics

- Enrich secondary information offered

e.g. on experimental techniques

- Start an online forum for colleagues

DB blog: <http://magneticmoments.info/wp>

- Go mobile



NEAR-FUTURE PLANS



NUCLEAR ELECTROMAGNETIC MOMENTS

The present compilation includes experimental information on nuclear magnetic dipole and electric quadrupole moments. The compilation is created, maintained and updated frequently by T.J. Mertzimekis under the IAEA aegis. The compilation includes data found in peer-reviewed journals, international conferences and other resources, such as print compilations (e.g. INDC(NDS)-0594), online nuclear databases (NNDC Nudat2) etc. [Read the full disclaimer here.](#)



Periodic Table

Z-Helix

Elementary Particles

DISCLAIMER

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Z: Search

A: Reset

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VISION FOR THE FUTURE

- UPDATE ! UPDATE ! UPDATE!
- Work closely with the IAEA NDS Group and the Community
- Collaborate with experts on moments evaluation
- Getting DB ready for accommodating high flux of data when times comes (FAIR, FRIB, SPIRAL2 etc)



THANKS TO:

- IAEA Nuclear Data Section
- University of Athens NuSTRAP Group
- Reload Entertainment Ltd

