Isobaric Analogue States (IAS) in NUBASE

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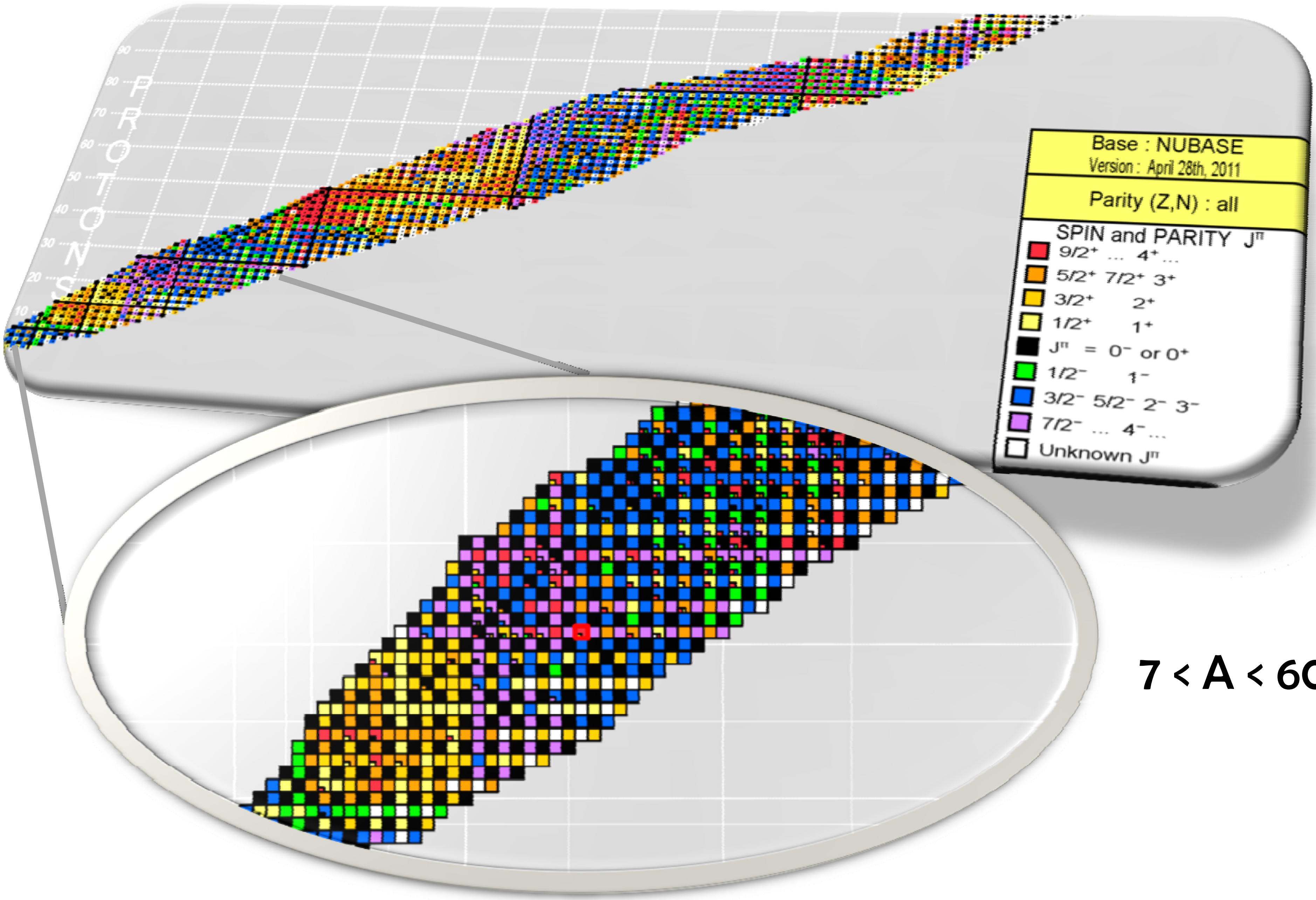

PROTONS
Base : NUBASE
Version : April 28th, 2011
Parity (Z,N) : all
SPIN and PARITY J^π
9/2+ ... 4+ ...
5/2+ 7/2+ 3+
3/2+ 2+
1/2+ 1+
J^π = 0− or 0+
1/2− 1−
3/2− 5/2− 2− 3−
7/2− ... 4− ...
Unknown J^π

7 < A < 60

Isospin projection

$$T_Z = \frac{N-Z}{2}$$

ground states

Isospin

$$\left|\frac{N-Z}{2}\right| \leq T \leq \frac{N+Z}{2}$$

and $T \geq T_Z$

ground and excited states

Isobaric Analogue States for mass modelling and mass predictions

Mass, M of each nuclear configuration is fully defined by

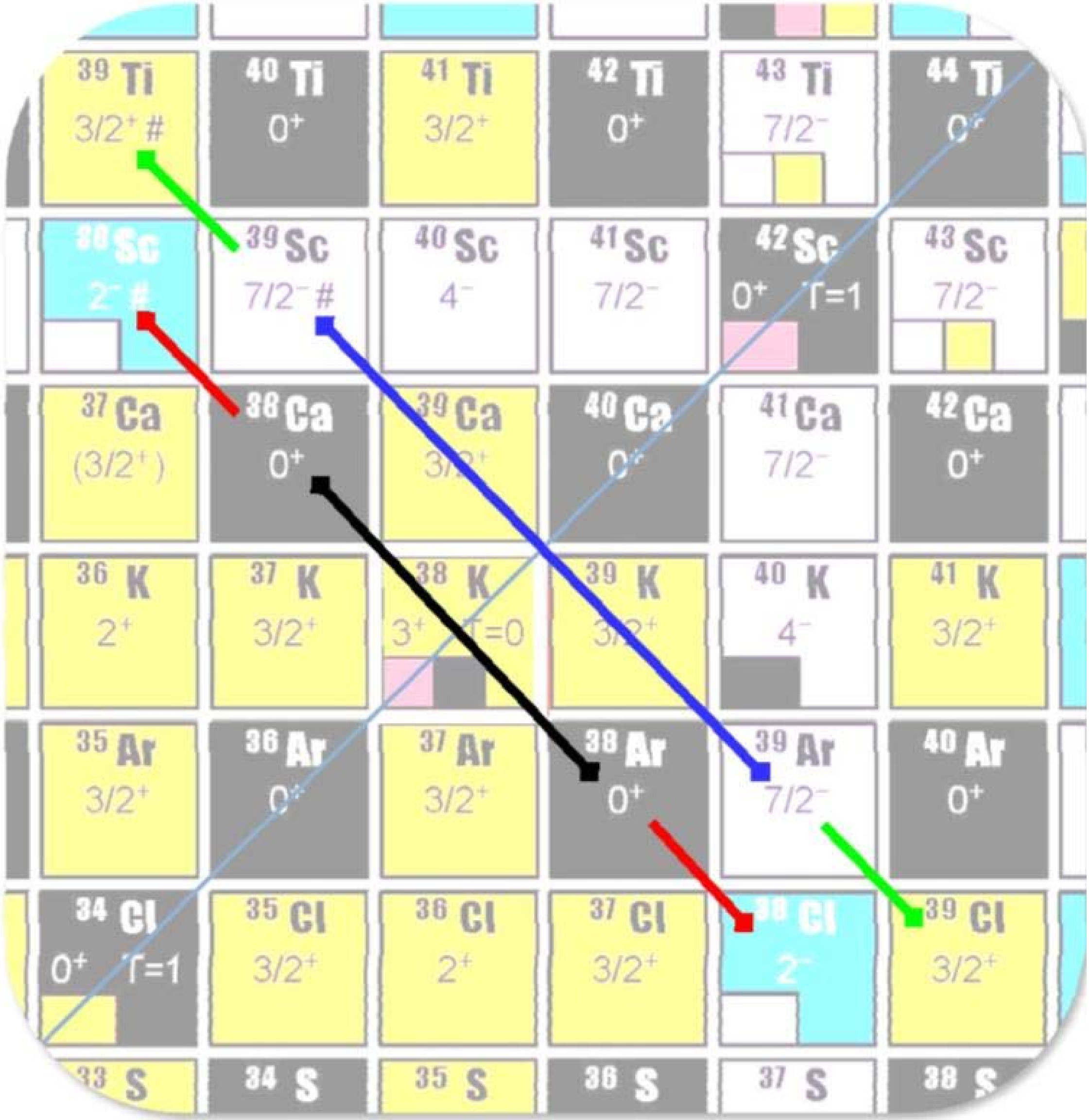
$M(\text{space}, \text{spin}, \text{isospin}) = M\left(A^{1/3}, J^{\pi}, T\right)$ **experimental**

Isobaric Multiplet Mass Equation, IMME (Wigner, 1958)

theoretical

$$M\,(T, T_Z) = a + bT_Z + cT_Z^2$$

Isobaric multplets, Isospin and Notation



T=1 triplets

T=2 quintuplets

T=3/2 quadruplets

T=5/2 sextuplets

In general, in NUBASE

Excited states are labelled "*i, j, k*", depending on T_Z and T

T=1 triplets; two ground states and one excited state labelled "i" : ${}^{A}_{Z}X^{i}$

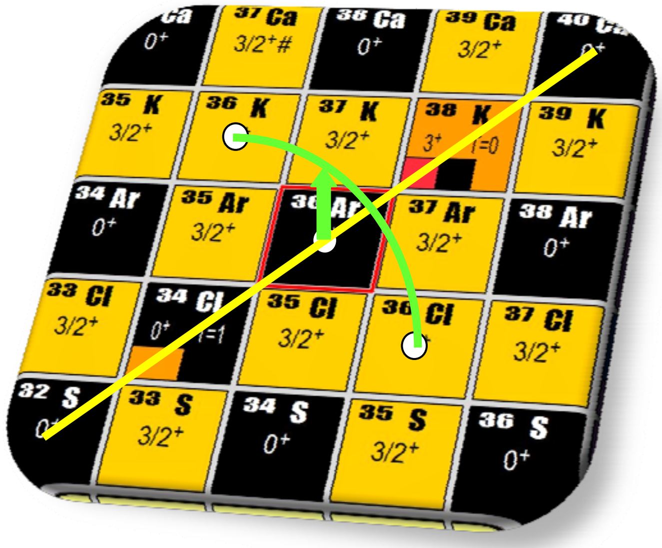
T = 1

$^{36}Ar^{\,i}$

g.s. ^{36}K $T_z = -1$

^{36}Ar $T_z = 0$

^{36}Cl $T_z = +1$ g.s.



T=3/2 quadruplets; two ground states and two excited states labelled "i" : ${}^{A}_{Z}X^{i}$

$^{41}Ca^{\,i}$ $^{41}Sc^{\,i}$

T = 3/2

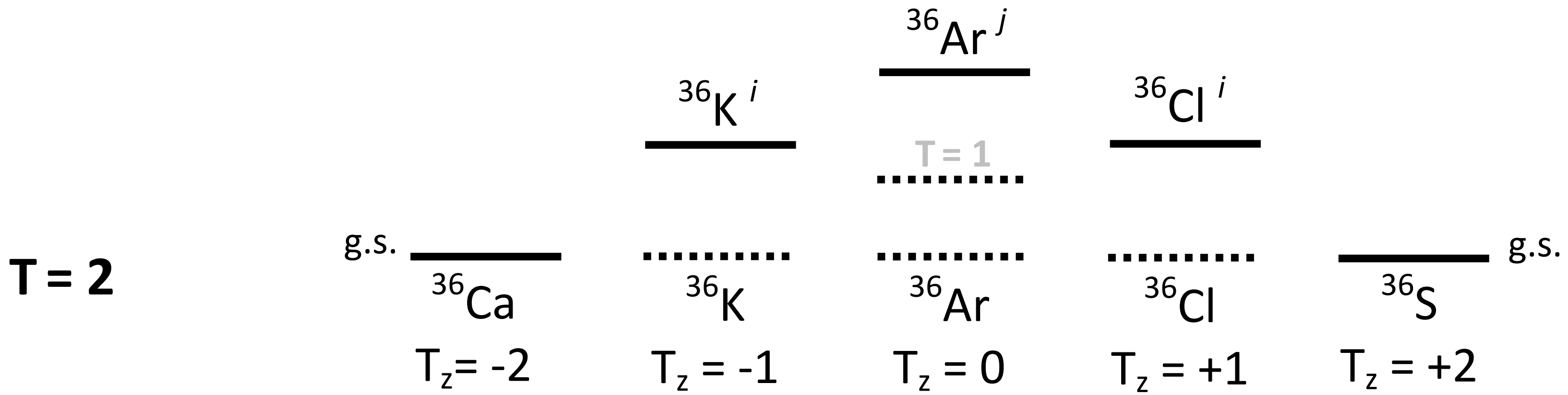
g.s. ^{41}K $T_z = -3/2$

^{41}Ca $T_z = -1/2$

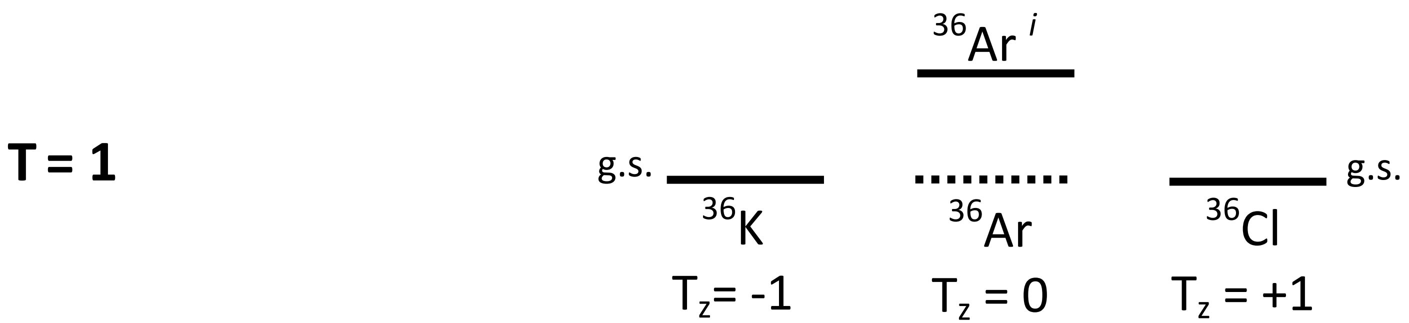
^{41}Sc $T_z = +1/2$

^{41}Ti $T_z = +3/2$ g.s.

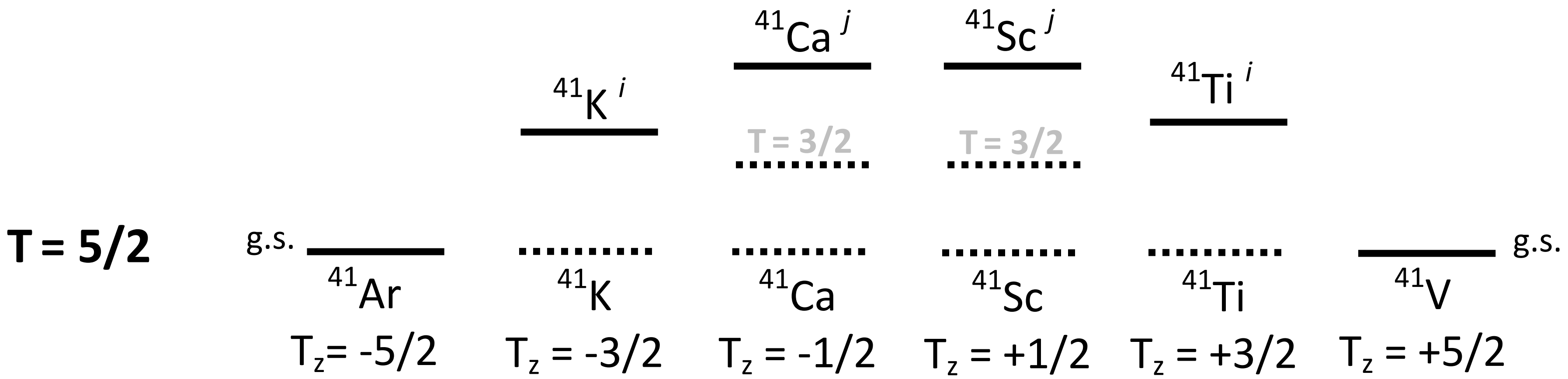
T=2 quintuplets; two ground states and three excited states labelled "*i*" then "*j*" : ${}^{A}_{Z}X^{i}, {}^{A}_{Z}X^{j}$



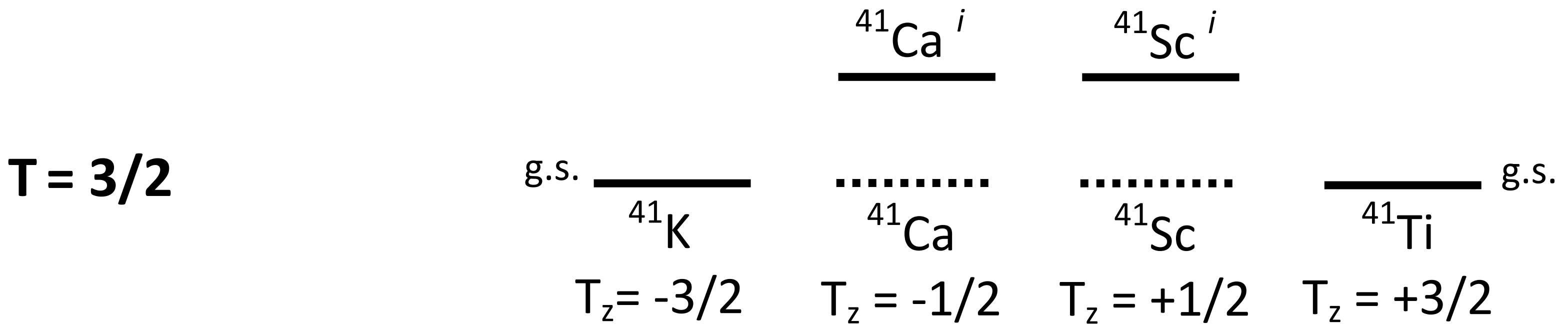
The T=1 triplets lie at lower energies compared to the T=2 quintuplet



T=5/2 quadruplets; two ground states and three excited states labelled "*i*" then "*j*" : $^{A}_{Z}X^{i}$, $^{A}_{Z}X^{j}$



Lower lying T=3/2 states



Exceptions

When the excited IAS state is also an isomer; isomer notation is used preferentially

$^{16}N^{i}, {}^{26}Al^{i}$ and $^{38}K^{i}$ **written** $^{16}N^{m}, {}^{26}Al^{m}$ and $^{38}K^{m}$

When there is an isospin inversion; in these N=Z cases the g.s. is T=1

$^{34}Cl^{i}, {}^{42}Sc^{i}, {}^{46}V^{i}, {}^{50}Mn^{i}, {}^{54}Co^{i}$ and $^{62}Ga^{i}$ **written** $^{34}Cl, {}^{42}Sc, {}^{46}V, Mn, {}^{54}Co$ and ^{62}Ga

In all, 9 exceptions within 109 multiplets from T=1 to T=4

IAS attributes

$$\mathrm{M(space, spin, isospin)} = \mathrm{M}\left(A^{1/3}, J^{\pi}, T\right)$$

some excited states are fragmented

mixing between nearby levels of the same J^{π}

Consequence: discrete IAS state may be isospin mixed and spread over several states.

Labelled "frg" in NUBASE:

Strongest fragment given;

Fragment positions and relative strengths provided in comments

NUBASE: isobaric analogues of ground state nuclei 180+

Excited states:

52 Cases which are not completely determined via IT:

Reaction Q-values:	17 cases
Threshold (p,gamma) reaction:	2 cases
1p/2p decay:	33 cases

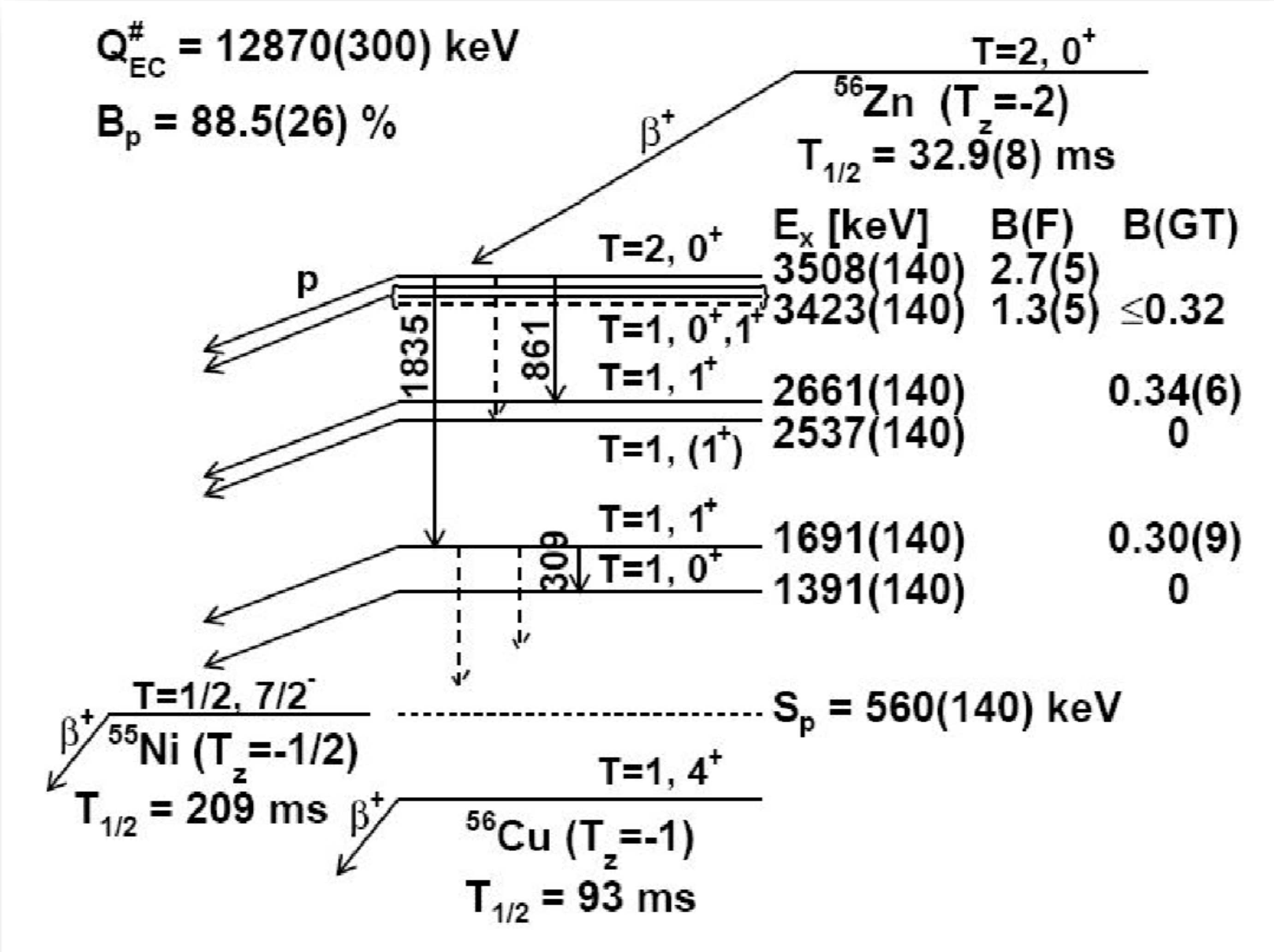
Evolving dataset:

Recent experimental results and techniques indicate the need for further experimental study

2014Or04

First observation of β-delayed γ-proton decay in the T_z = -2, ^{56}Zn nucleus

T=2 fragmented $^{56}Cu^{i}$ IAS repositioned



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Thank you for your attention.

References and further reading

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