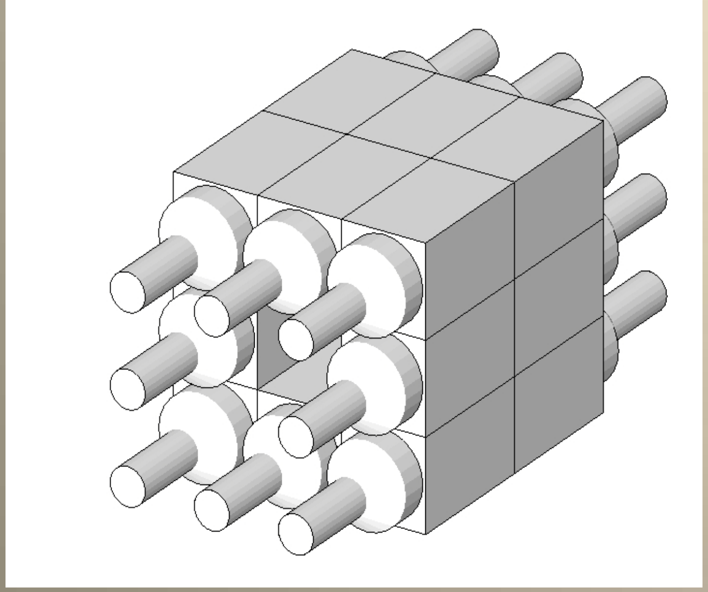
This not (yet) a proposal

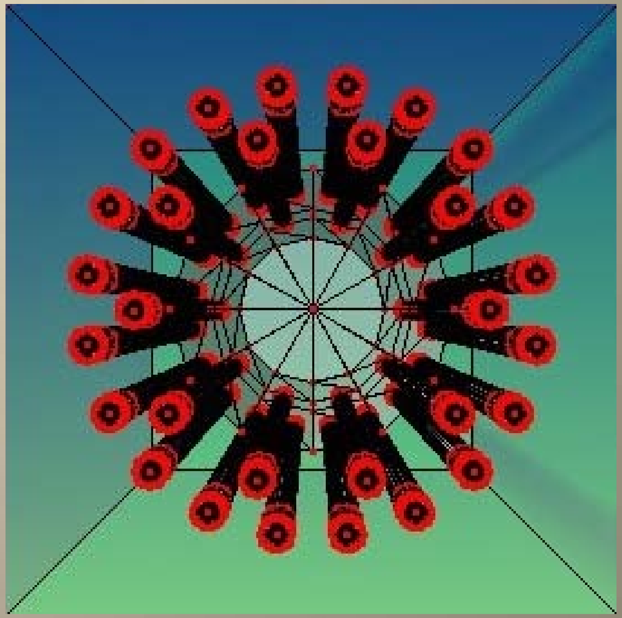
Complementarities between the Total Absorption experiments
And the beta delayed neutron experiments

Beta Decay and the N = 82 Waiting Point nuclei
and nearby nuclei

B. Rubio, A. Algora, J.L. Taín, J. Agramunt, C. Domingo, S. Orrigo….
IFIC-CSIC Valencia, Spain



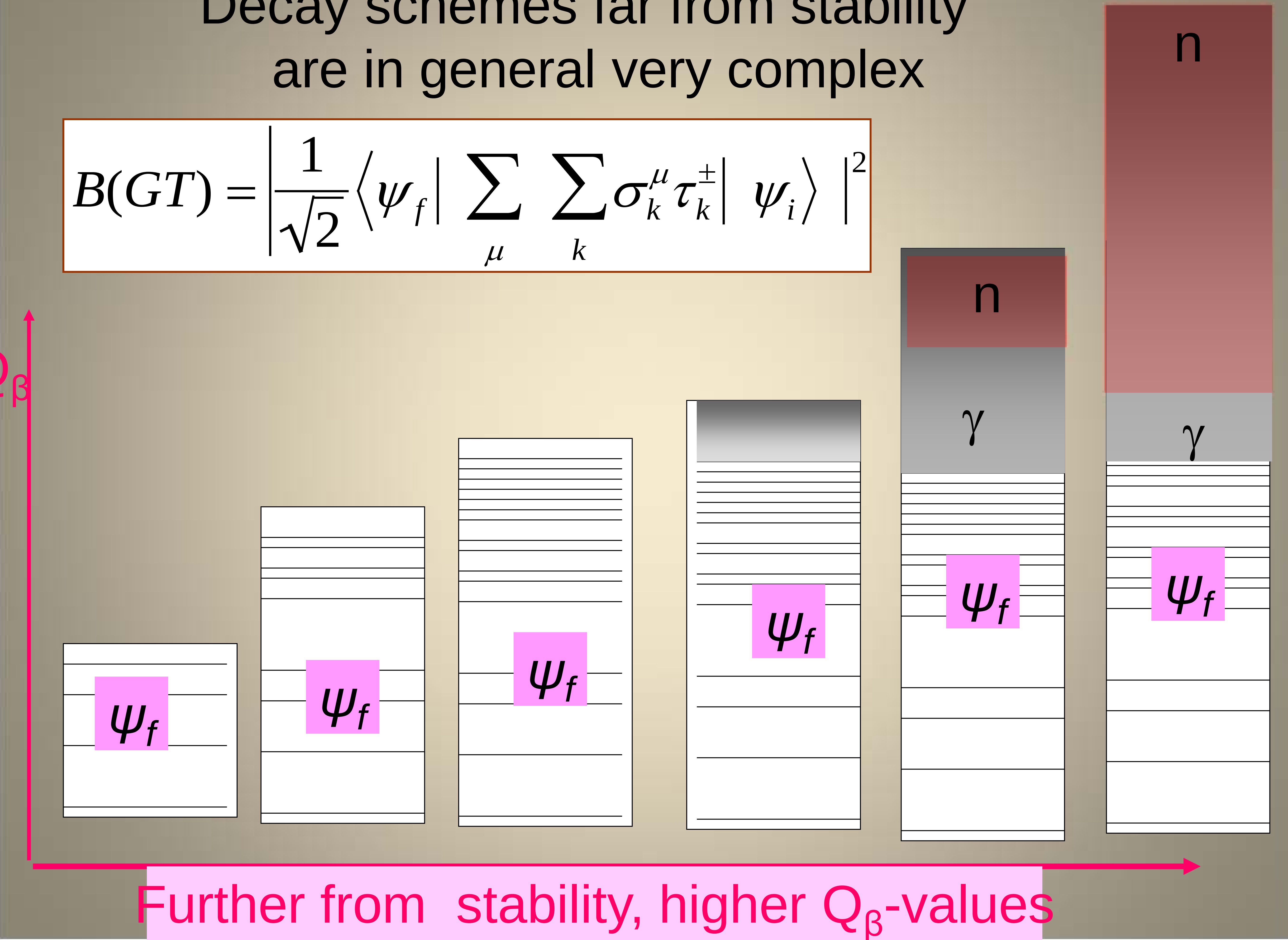
…………



BRIKEN 31-jul-2013

Decay schemes far from stability are in general very complex

$$B(GT) = \left| \frac{1}{\sqrt{2}} \left\langle \psi_f \right| \sum_{\mu} \sum_{k} \sigma_k^{\mu} \tau_k^{\pm} \left| \; \psi_i \right\rangle \right|^2$$

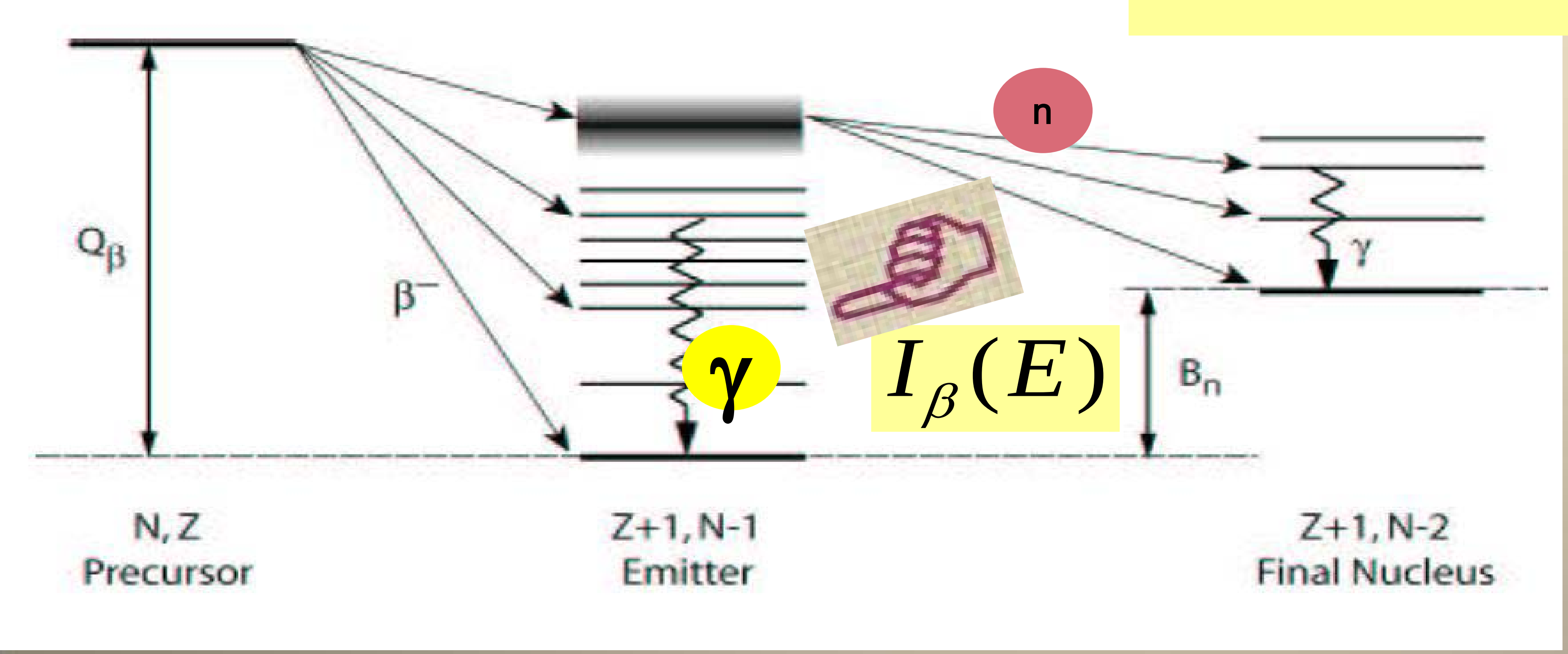


Calculation

$$B(GT) = \left| \frac{1}{\sqrt{2}} \left\langle \psi_f \right| \sum_{\mu} \sum_{k} \sigma_k^{\mu} \tau_k^{\pm} \left| \; \psi_i \right\rangle \right|^2$$

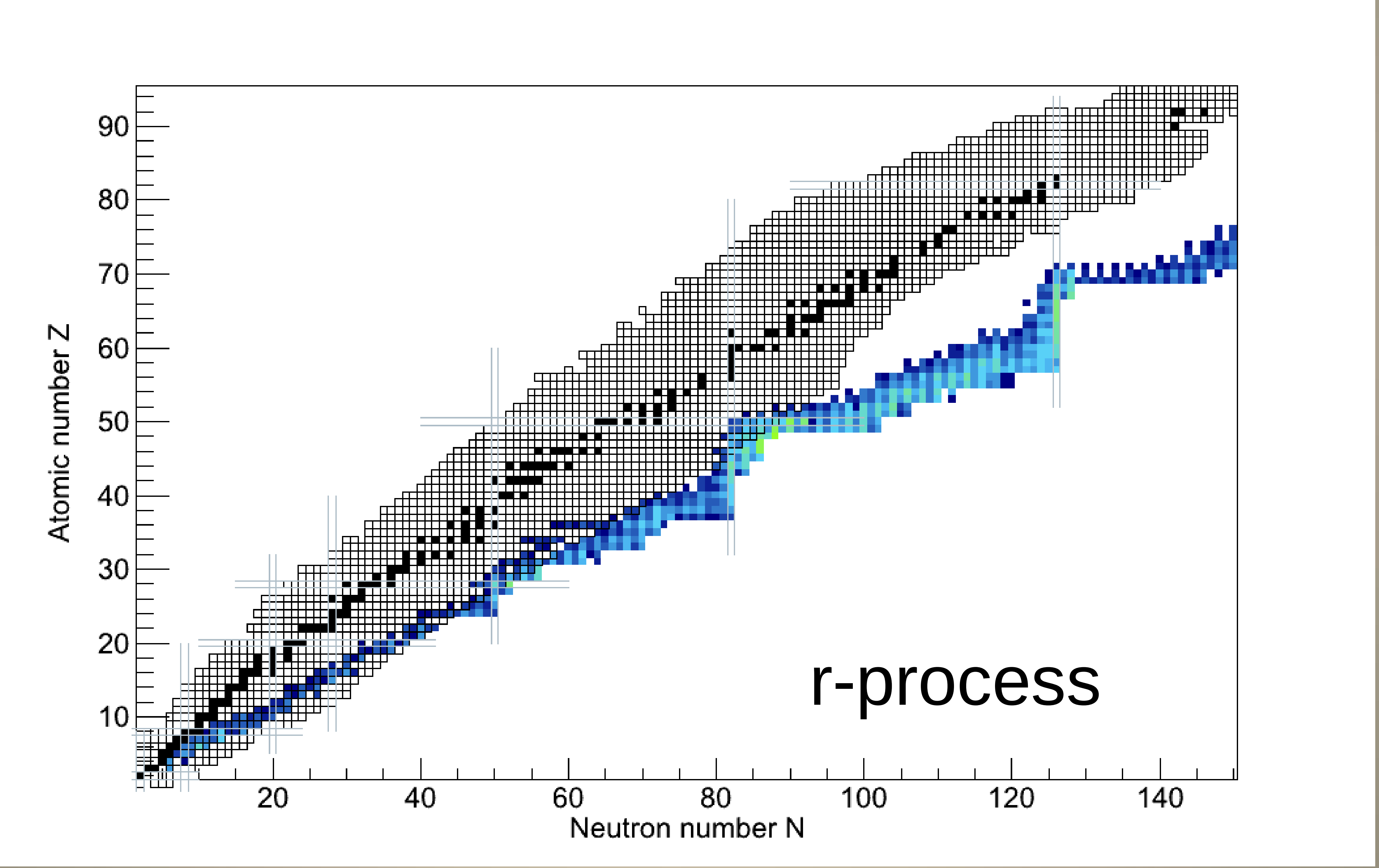
Experiment

$$B(GT) = k \frac{I_\beta(E)}{f(Q_\beta - E, Z) T_{1/2}}$$

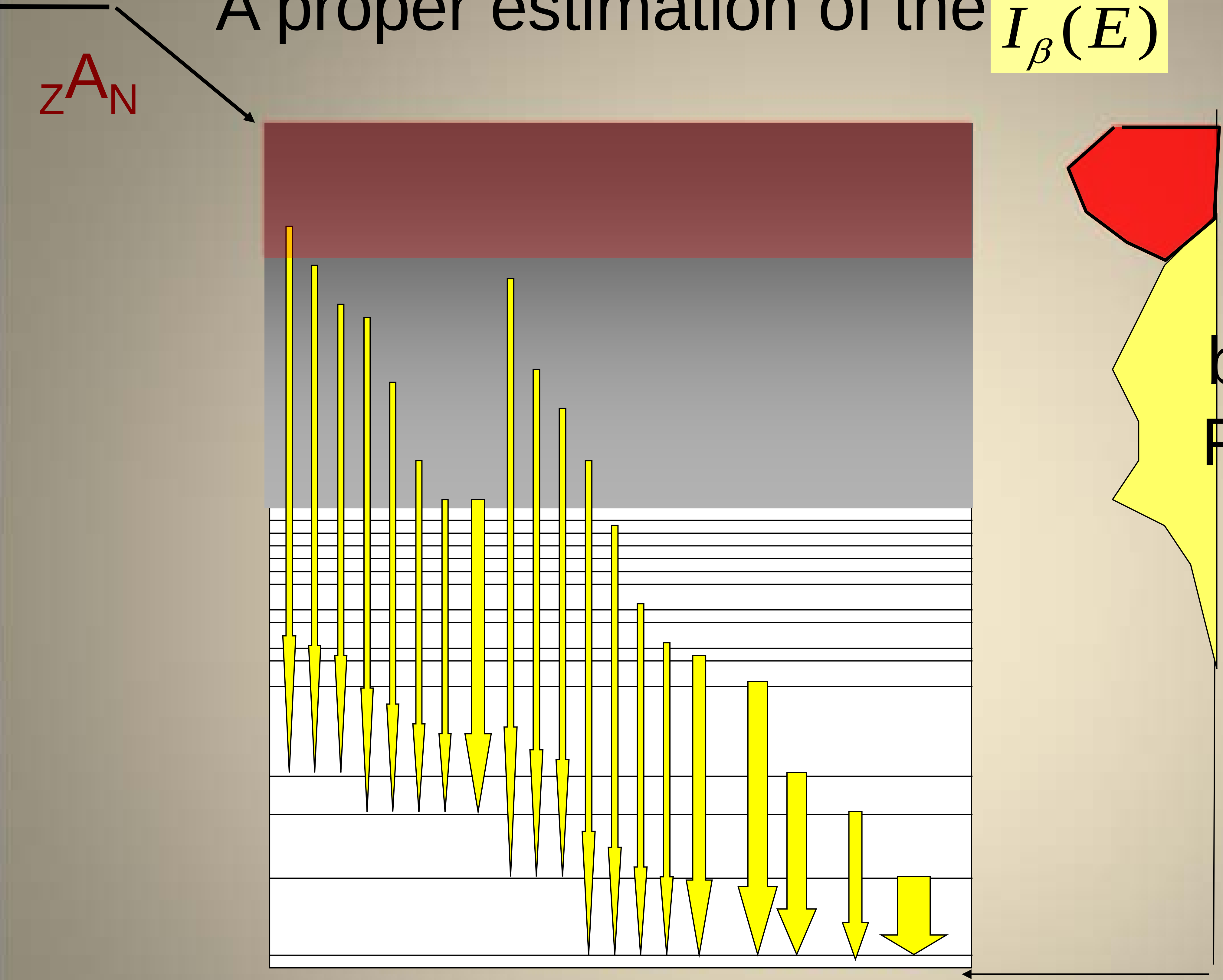


$$S_\beta(E_x) = \frac{I_\beta(E_x)}{f(Q_\beta - E_x) T_{1/2}}$$

It also means we need solid data in order to guide our models towards a proper prediction of T1/2 or Pn values far from the stability

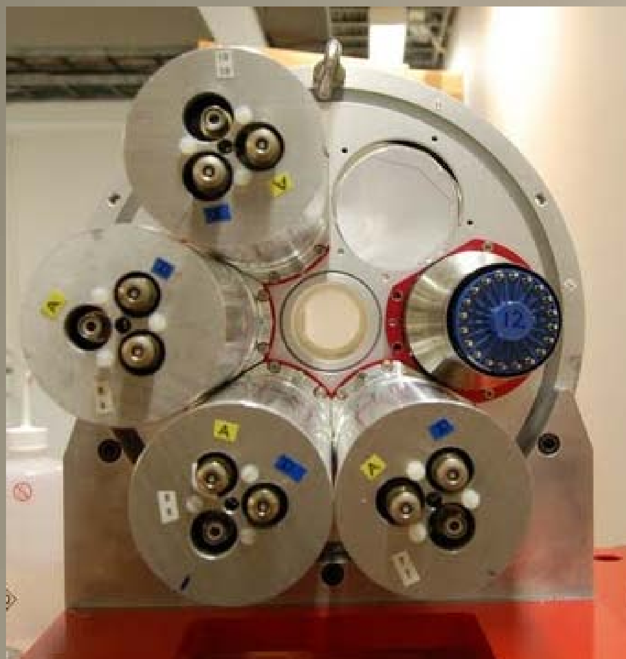


A proper estimation of the $I_\beta(E)$ for nuclei far from the stability is difficult because of the Pandemonium effect



apparent-feeding

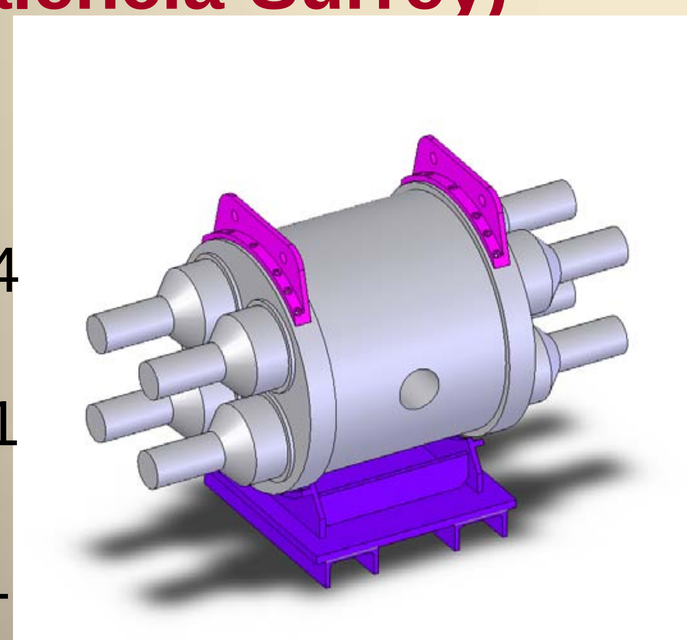
We have a long standing experience working at several Isol facilities

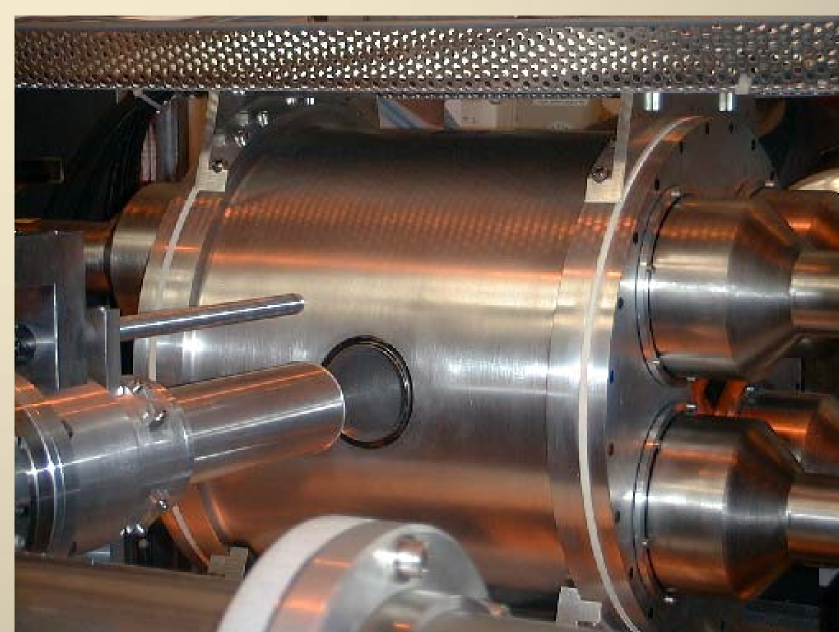


Approved experiments at Jyväskylä

Segmented BaF2 Total Absorption Spectrometer “Rocinante” (Valencia-Surrey)

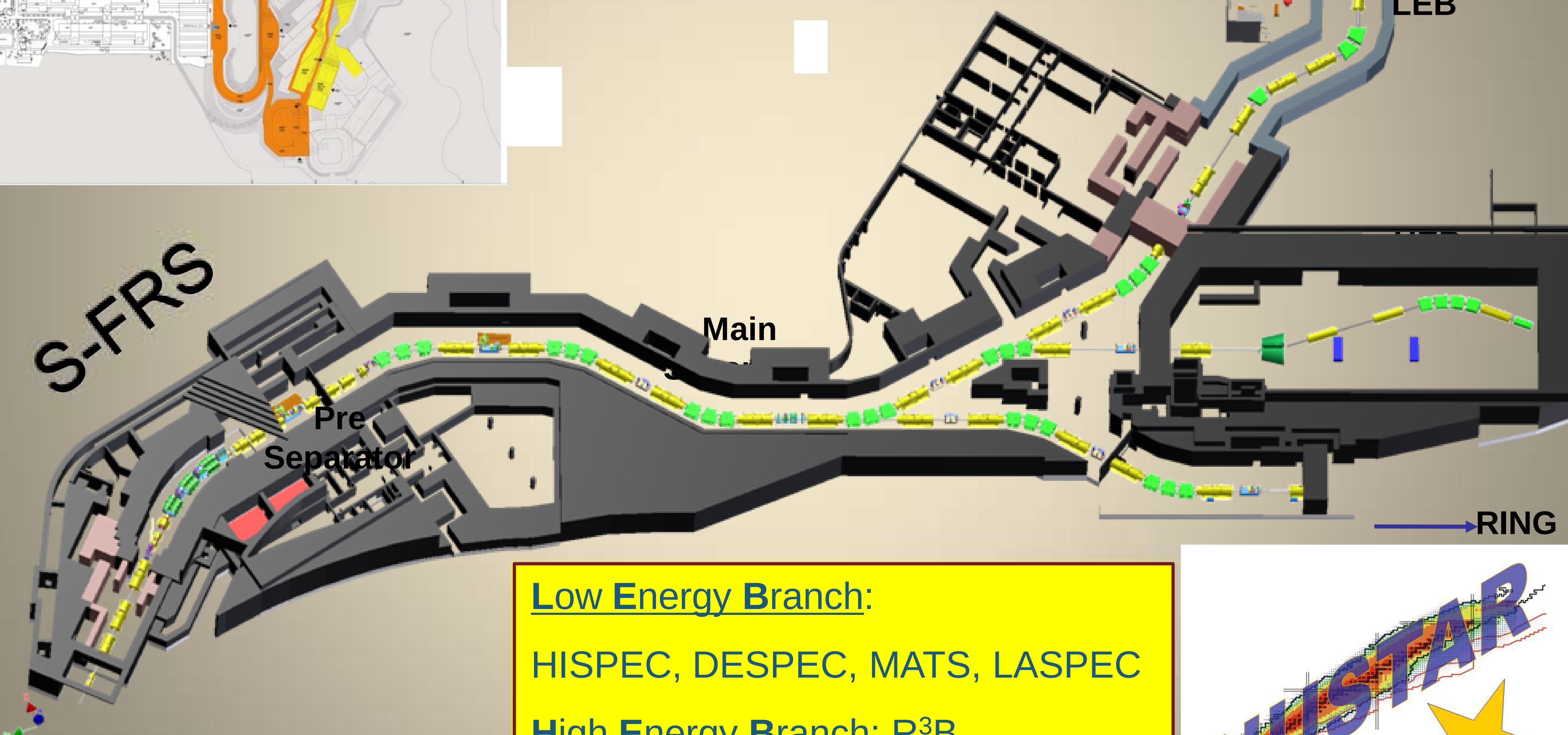
Fallot et al
PRL 109 (2012)202504
Algora etal.
PRL 105 (2010)202501
Nacher et al.
PRL 92 (2004) 232501





Lucrecia: large NaI crytal, the Total Absorption Spectrometer at Isolde (permanent set-up) (Valencia-Surrey-Strasbourg-Madrid)

A new TAS instrument was designed for decay experiments at FAIR NUSTAR fragmentation facility



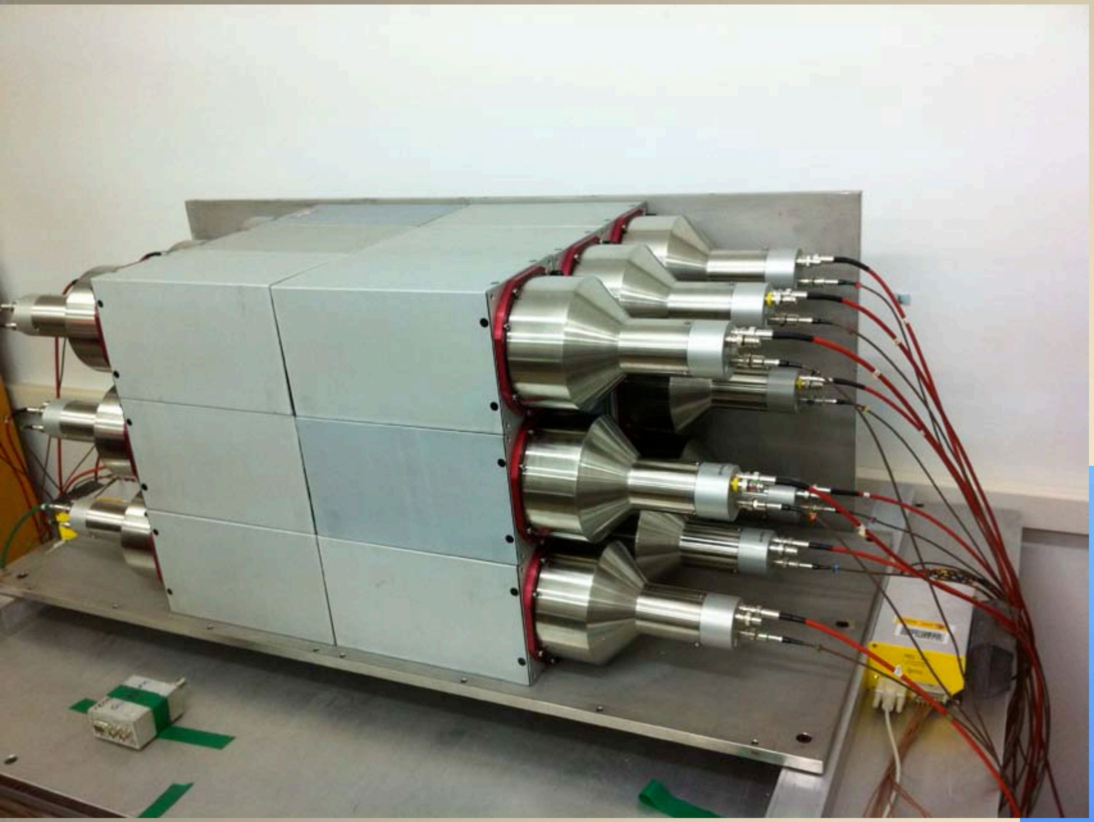
<u>**L**ow **E**nergy **B**ranch</u>:

HISPEC, DESPEC, MATS, LASPEC

<u>**H**igh **E**nergy **B**ranch</u>: R^3B

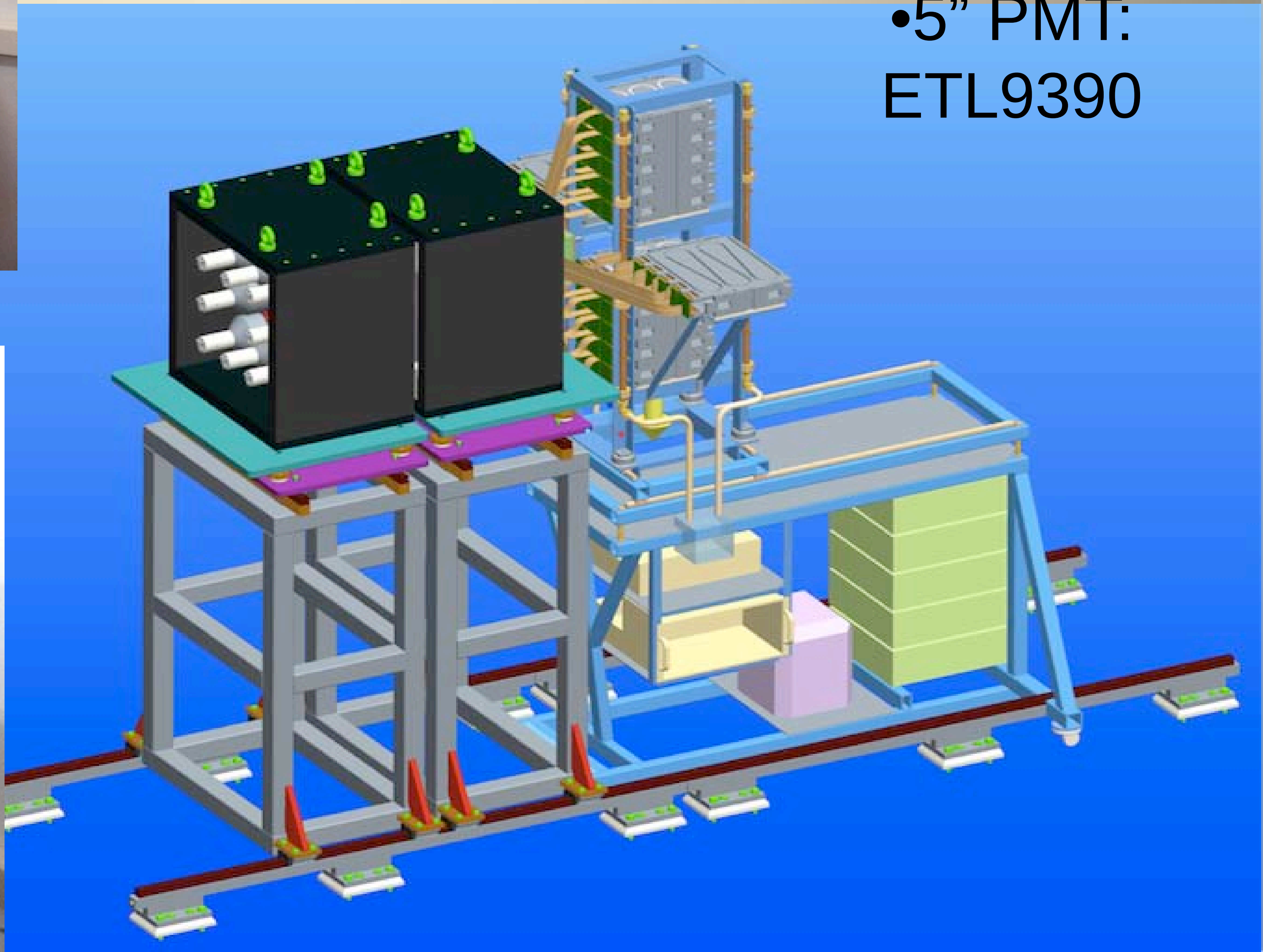
<u>**Ring** Branch</u>: EXL, ILIMA, ELISE

DTAS: segmented NaI Total Absorption Spectrometer Designed to work at Fragmentation Facilities in combination with AIDA Implentation detector

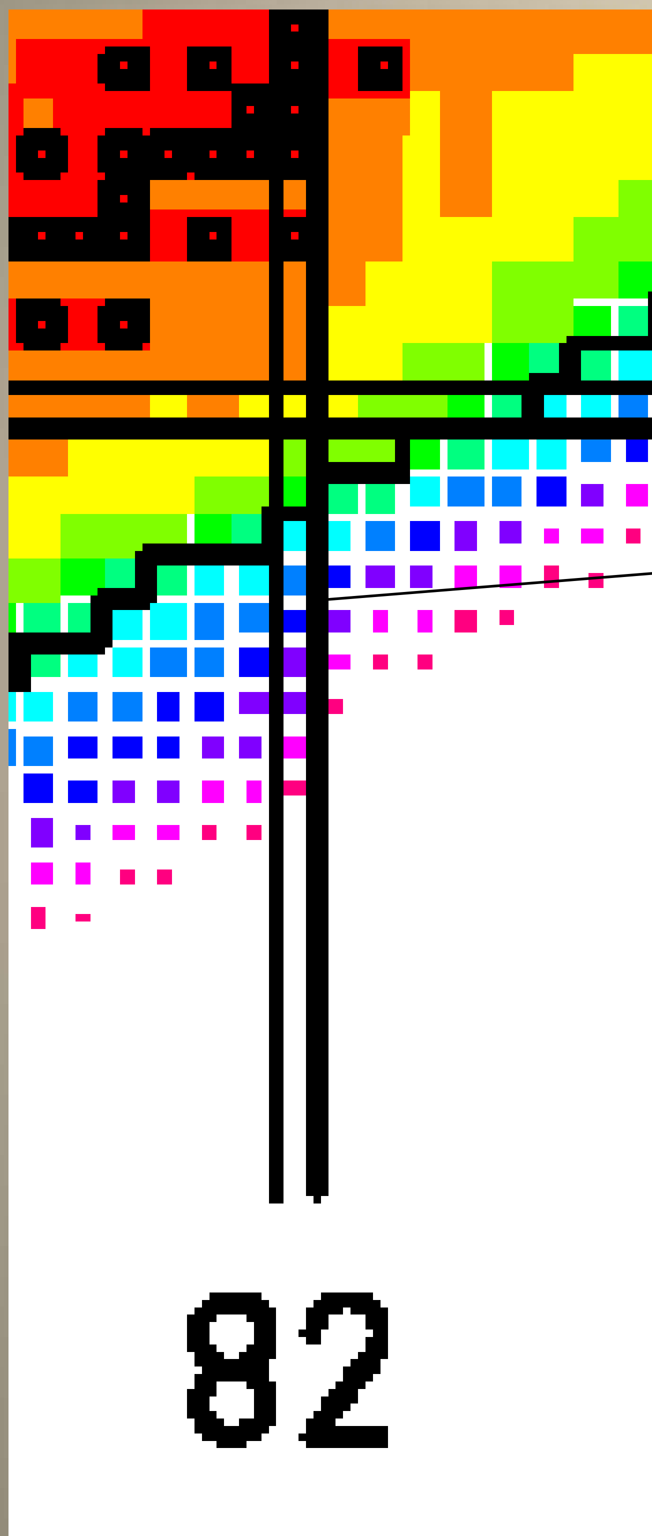


16 × NaI(Tl) crystals:

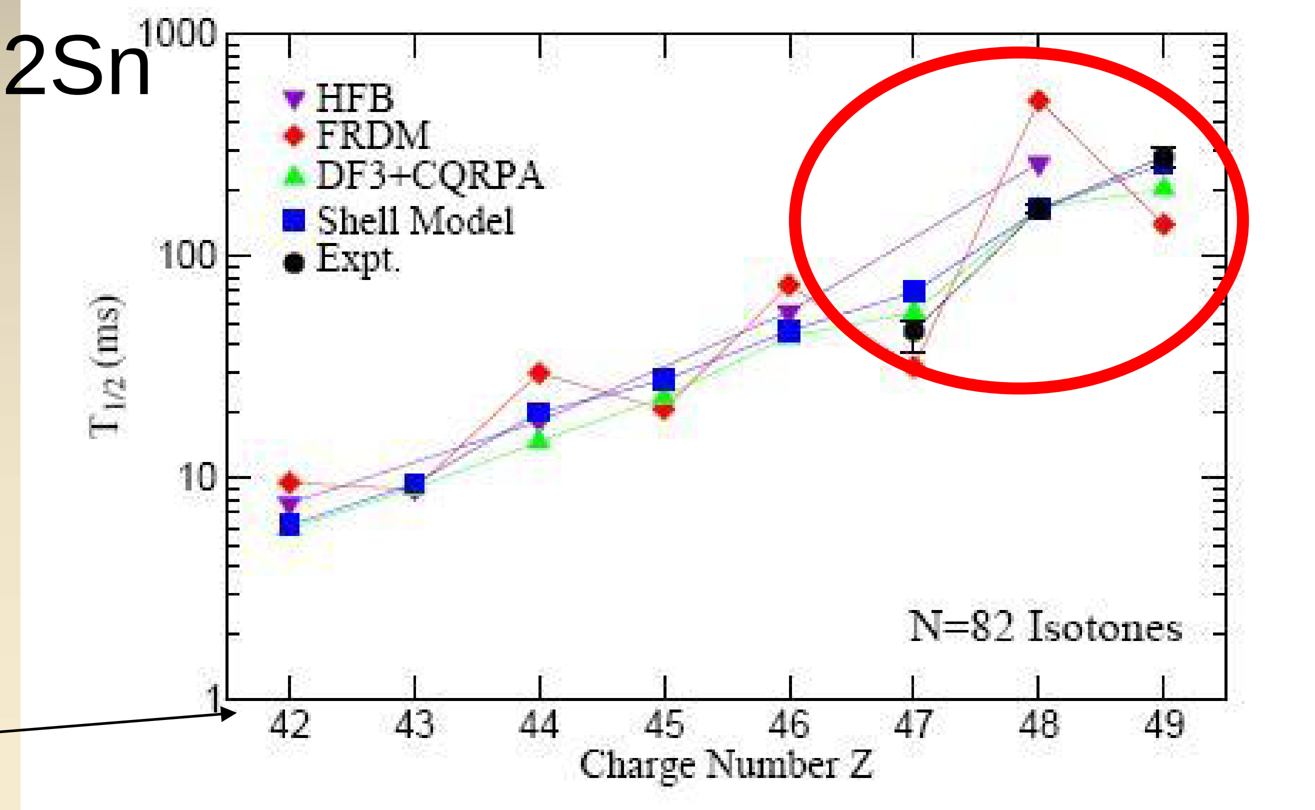
- $15 \times 15 \times 25$ cm^3
- Minimum dead-material
- 5” PMT: ETL9390



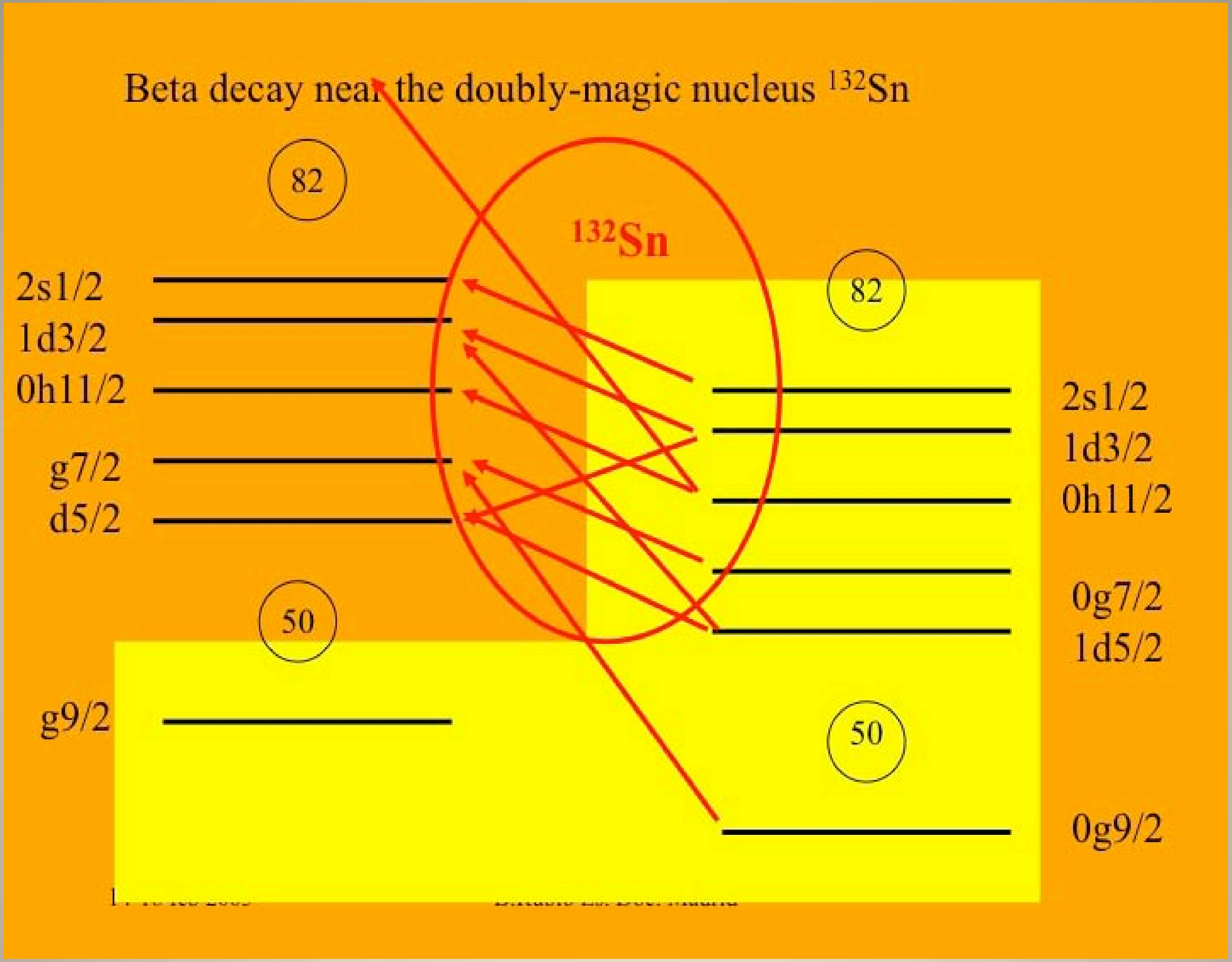
One clear example where
Both kind of data are needed
Are nuclei south and south-west of 132Sn



N=82

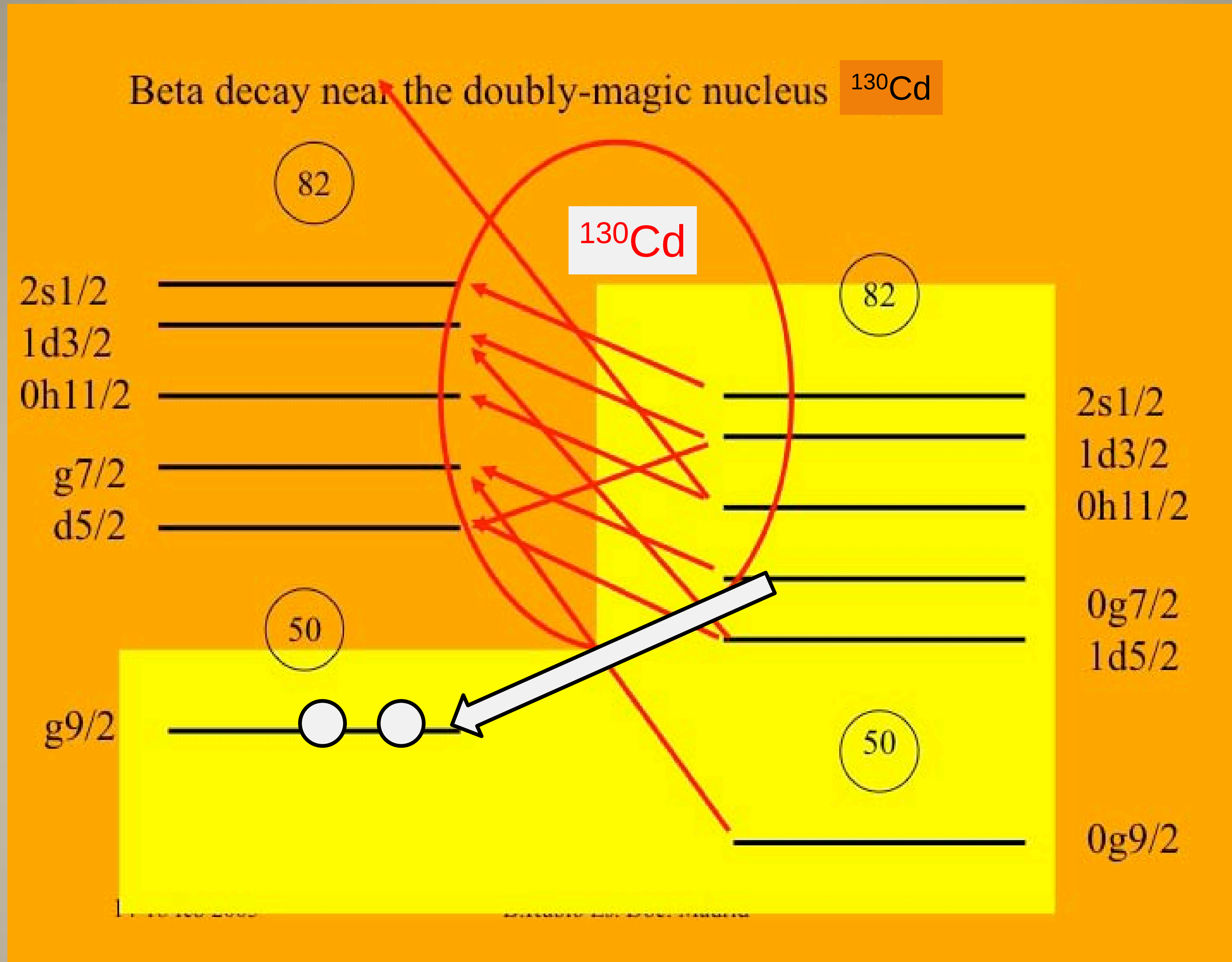


H. Grawe, K. Langanke and
G. Martínez-Pinedo
Rep. Prog. Phys. **70**
No 9 (September 2007)
1525-1582

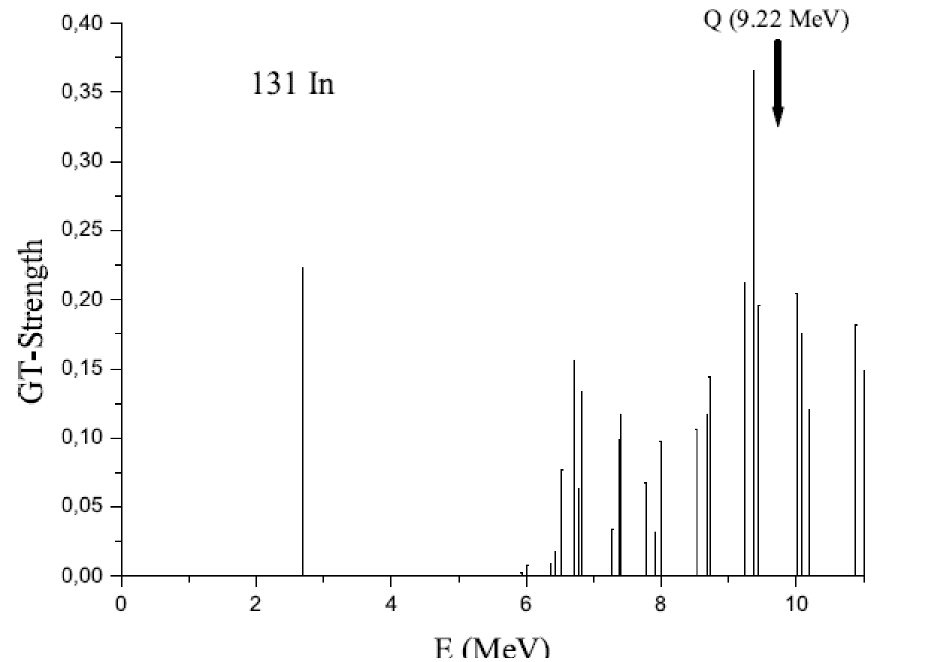


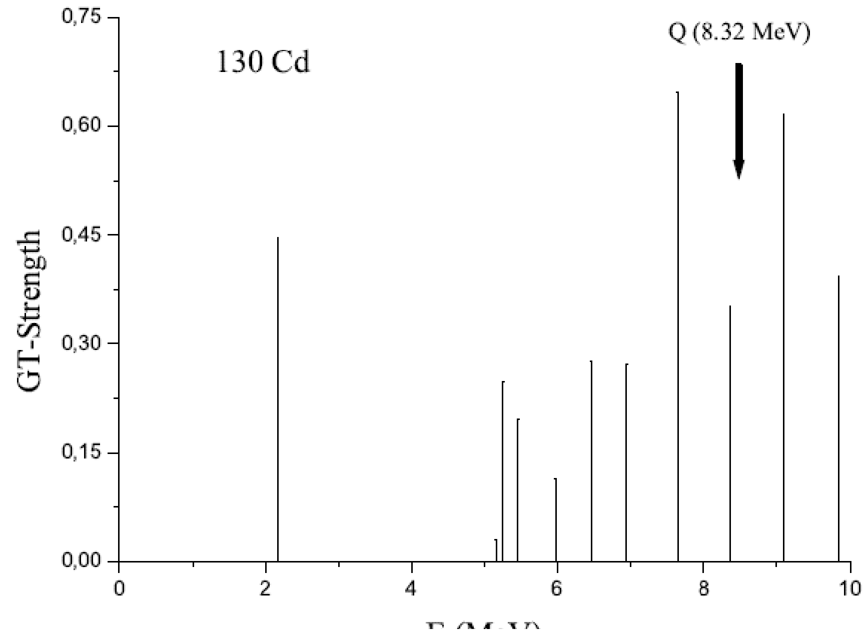
$$B_{GT}^{SP}=S^{-}=3(N-Z)=3(82-50)=96$$

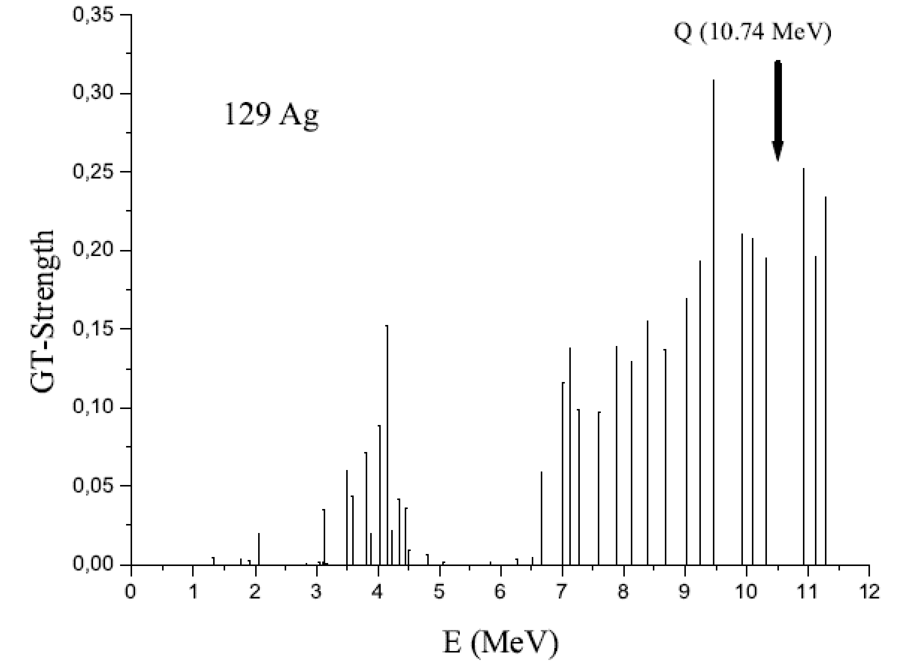
$$B_{GT}^{exp}\text{ (in 132Sn decay)}= 0.26$$

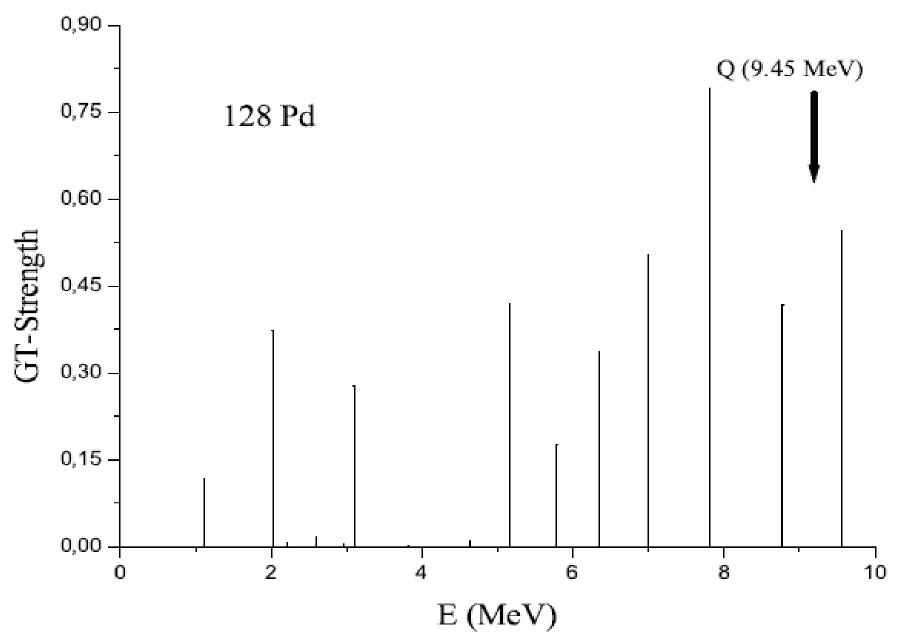


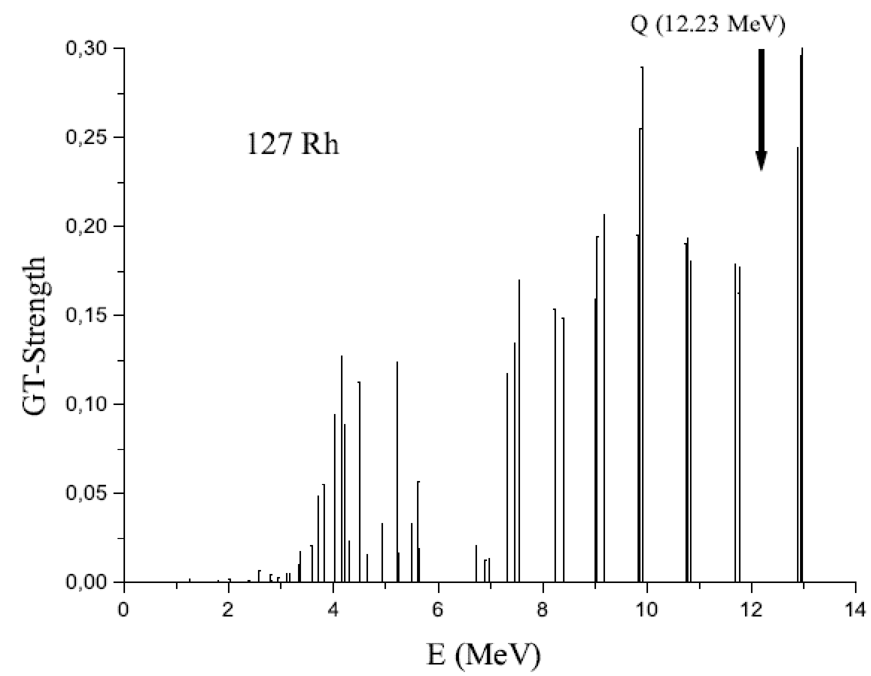
$0^+ \rightarrow 1^+ (\pi g_{9/2} \nu g_{7/2})$

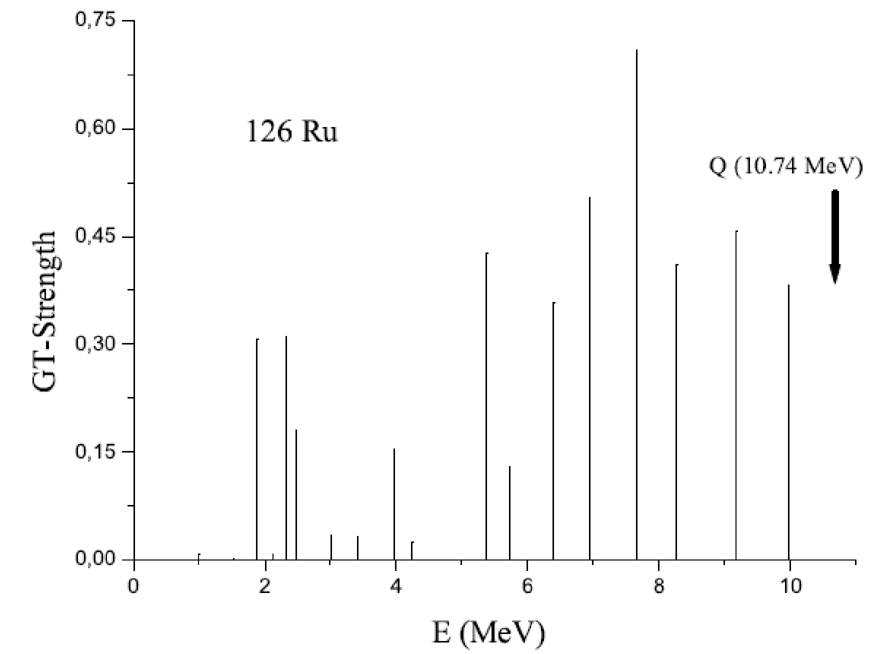


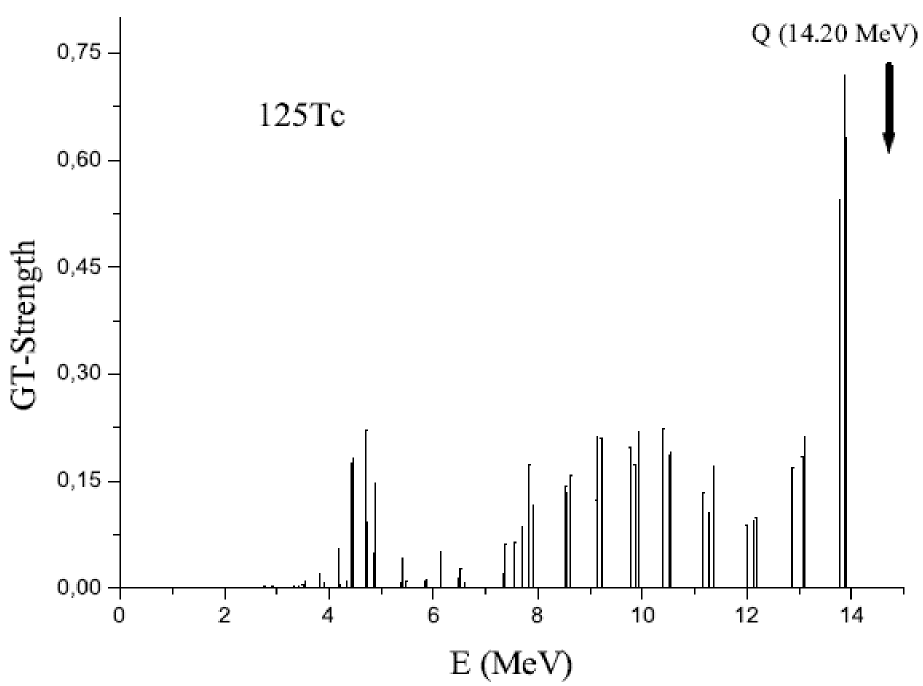


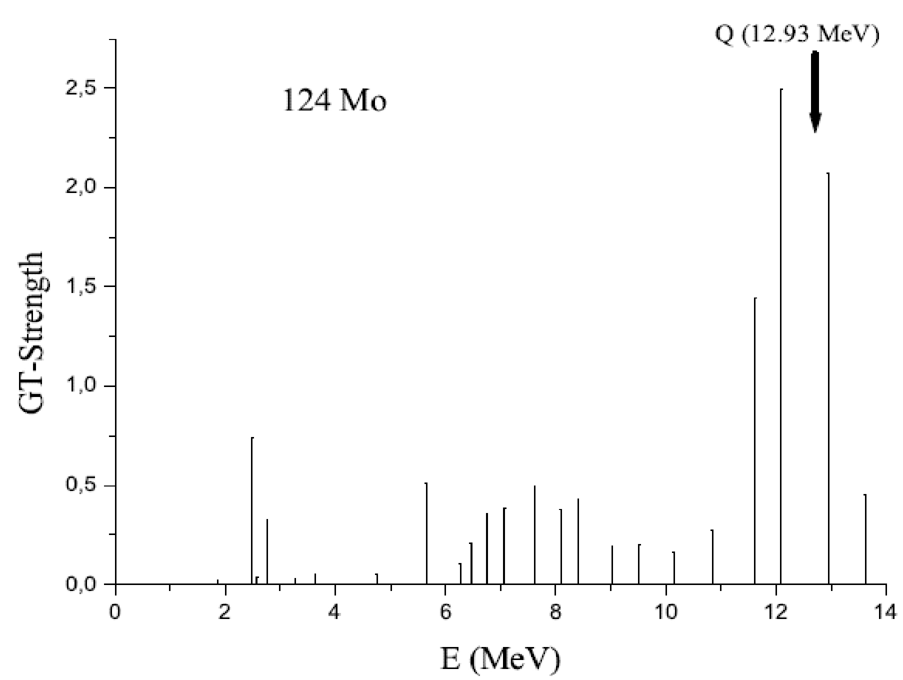












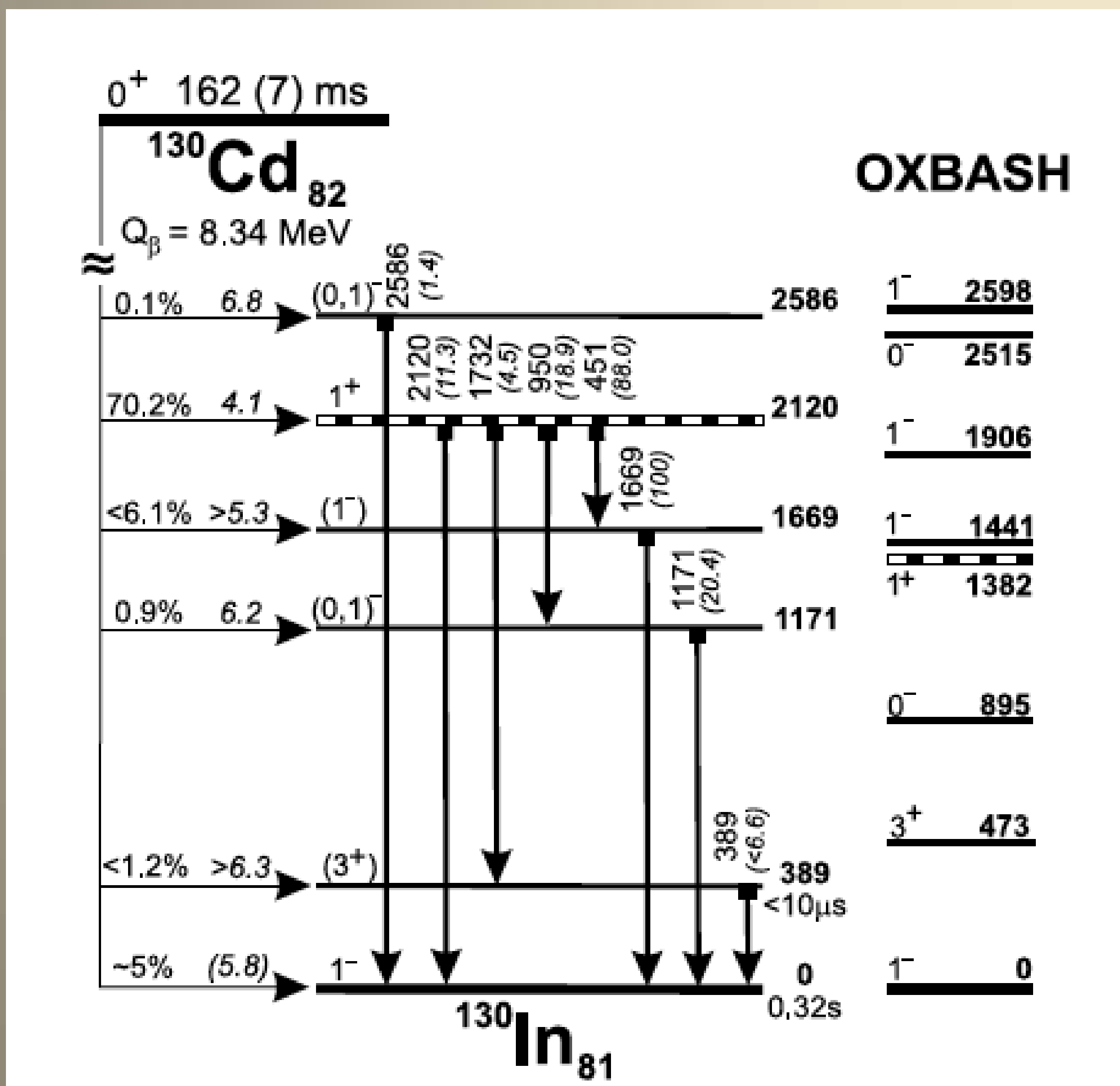
Shell Model Calculations N=82:

Cuenca-Garcia et al. EPJA 34 (2007) 99

VOLUME 91, NUMBER 16 PHYSICAL REVIEW LETTERS week ending 17 OCTOBER 2003

$N = 82$ Shell Quenching of the Classical r-Process "Waiting-Point" Nucleus ^{130}Cd

I. Dillmann,[1,2] K.-L. Kratz,[1,*] A. Wöhr,[3,4] O. Arndt,[1] B. A. Brown,[5] P. Hoff,[6] M. Hjorth-Jensen,[7] U. Köster,[8] A. N. Ostrowski,[1] B. Pfeiffer,[1] D. Seweryniak,[9] J. Shergur,[3,9] W. B. Walters,[3] and the ISOLDE Collaboration[8]



The observed 1+ state exhaust only 11% of the expected 1+ strength.

Last excited state at 2.6 MeV

Some observed gamma strength could not be located in the level schemme

...eory [17]. The log ft values for a cluster of seven levels above 4.4 MeV (not included in Fig. 1) clearly suggest GT feeding. ...

PHYSICAL REVIEW C, VOLUME 62, 054301

Selective laser ionization of very neutron-rich cadmium isotopes: Decay properties of $^{131}Cd_{83}$ and $^{132}Cd_{84}$

M. Hannawald,[1] K.-L. Kratz,[1,*] B. Pfeiffer,[1] W. B. Walters,[2] V. N. Fedoseyev,[3] V. I. Mishin,[3] W. F. Mueller,[4] H. Schatz,[5] J. Van Roosbroeck,[4] U. Köster,[6] V. Sebastian,[7] H. L. Ravn,[8] and the ISOLDE Collaboration[8]
[1]*Institut für Kernchemie, Universität Mainz, D-55128 Mainz, Germany*
[2]*Department of Chemistry, University of Maryland, College Park, Maryland 20742*
[3]*Institute of Spectroscopy, Russian Academy of Sciences, RU-142092 Troitzk, Russia*
[4]*Instituut for Kern- en Stralingsfysica, University of Leuven, B-3001 Leuven, Belgium*
[5]*Gesellschaft für Schwerionenforschung, D-64291 Darmstadt, Germany*
[6]*Physik Department, TU München, D-85748 Garching, Germany*
[7]*Institut für Physik, Universität Mainz, D-55128 Mainz, Germany*
[8]*CERN, CH-1211 Geneva 23, Switzerland*
(Received 4 May 2000; published 25 September 2000)

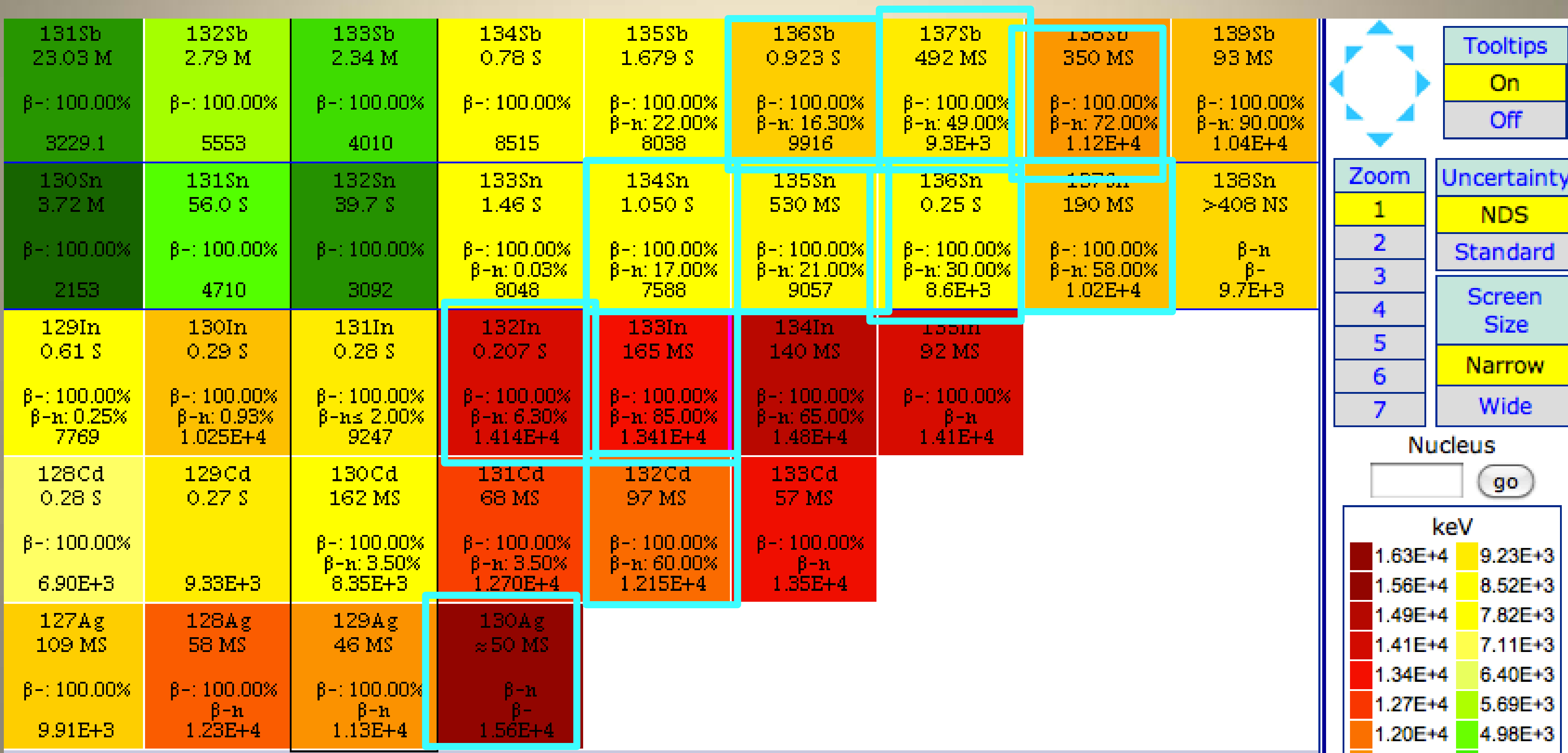
A chemically selective laser ion source has been applied in a decay study of the very neutron-rich isotopes ^{131}Cd and ^{132}Cd at CERN/ISOLDE. For the β^- decay of the $N=83$ nuclide ^{131}Cd a surprisingly short half-life of (68 ± 3) ms and a weak delayed-neutron branch of $P_n=(3.5\pm1.0)\%$ were observed. For the $N=84$ nuclide ^{132}Cd a half-life of (97 ± 10) ms and a P_n value of $(60\pm15)\%$ were obtained. Schematic features of both decay schemes are developed. We find that our new data are not reproduced by current global models used for *ab initio* calculations of β-decay properties without significant changes.

^{131}Cd: 68(3) ms **^{132}Cd 97 (10) ms** **^{133}Cd 57(10)**

The 68 (3) ms half-life and 3.5% P_n values for ^{131}Cd remain somewhat anomalous and deserve more attention.

Taken from Bill Walters contribution to Isolde workshop 2010

We are interested in beta Decays with large Q-beta values
nd competing beta delayed gamma and beta delayed neutrons
These cases will need both kind of experiments
if we aim to a full picture of the beta strength



Letter of intent for the use of the
DECAY TOTAL ABSORPTION SPECTROMETER (DTAS) at RIKEN
to study the beta and isomeric decay of exotic nuclei

J. Agramunt, A. Algora, C. Domingo-Pardo, S.E.A. Orrigo, B. Rubio, J.L. Taín
IFIC-(CSIC-Univ. Valencia) Spain

T. Davinson, A. Estrade, P. Woods
University of Edinburgh, U.K

H. Baba, G. Lorusso, S. Nishimura, H. Sakurai , P. Söderström
RIKEN Nishina Center, Japan

W. Gelletly, P. H. Regan, Z. Podolyák
University of Surrey, UK

J. Simpson, M. Labiche
STFC Daresbury Laboratory , UK

D. Joss, R. Page
University of Liverpool, UK

A. Jungclaus, E. Nácher
IEM (CSIC), Madrid, Spain

B. Blank, M. Gerbaux, J. Giovinazzo, S. Grévy, T. Kurtukian Nieto
CEN Bordeaux Gradignan, France

Y. Fuijta, H. Fujita
RCNP and Department of Physics, Osaka Univ, Japan

D. Nishimura
Tokyo University of Science, Noda, Chiba, Japan

May 2013

RIKEN NiSHiNA CENTER

CENTER *for* NUCLEAR STUDY

July 27, 2013

Letter of intent for the use of the
DECAY TOTAL ABSORPTION SPECTROMETER (DTAS) at RIKEN
to study the beta and isomeric decay of exotic nuclei

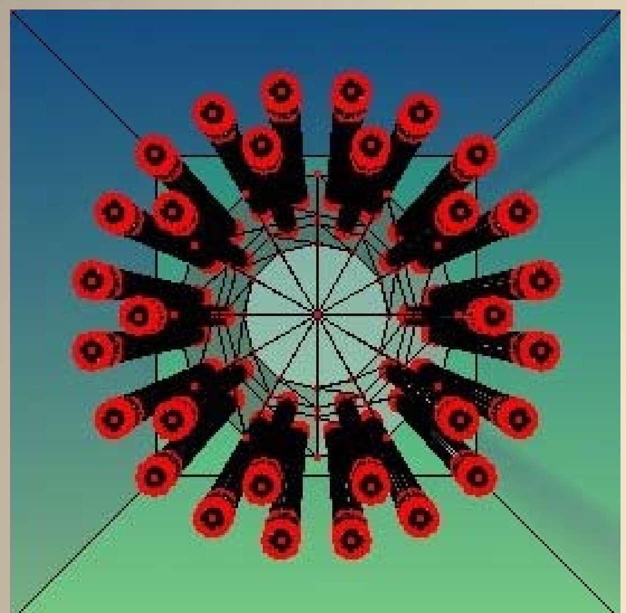
J. Agramunt, A. Algora, C. Domingo-Pardo, S.E.A. Orrigo, B. Rubio, J.L. Taín

RIKEN NiSHiNA CENTER

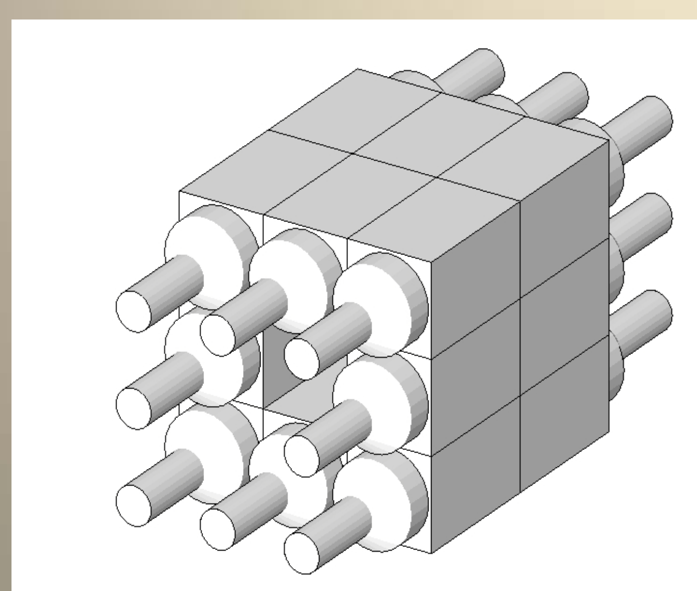
CENTER *for* NUCLEAR STUDY

The authors intend to move a Decay Total Absorption gamma-ray Spectrometer (DTAS) to BigRIPS in order to study beta-decays in three key areas in the chart of nuclei: waiting point nuclei around N=82, the ^{100}Sn region, and "north-east" of ^{78}Ni. The measurements with DTAS at RIBF are complementary to the ongoing EURICA campaigns and will bring new qualitative and quantitative information on the structure of nuclei far from stability. The spectrometer is adapted to the needs of in-flight separated beams, state-of-the-art, and well suited for the intended measurements. The collaboration is expert in experiment and analysis after many campaigns at the FRS of GSI, ISOLDE, Jyväskylä, etc. Many of the nuclei of interest belong to refractory elements and can only be reached with in-flight separation or at an IGISOL facility. The ability to work very far from stability, where beta-decay Q-values are very large is especially interesting. The issue of strength functions is very important, as is the competition between gamma decay and beta-delayed neutrons. Obviously, the key to success will lie in what is proposed. The collaboration should seriously consider which cases are unique for this facility and prepare a dedicated proposal. After positive evaluation, the DTAS equipment can be moved to RIKEN.

One cannot do everything at the same time!!!!!



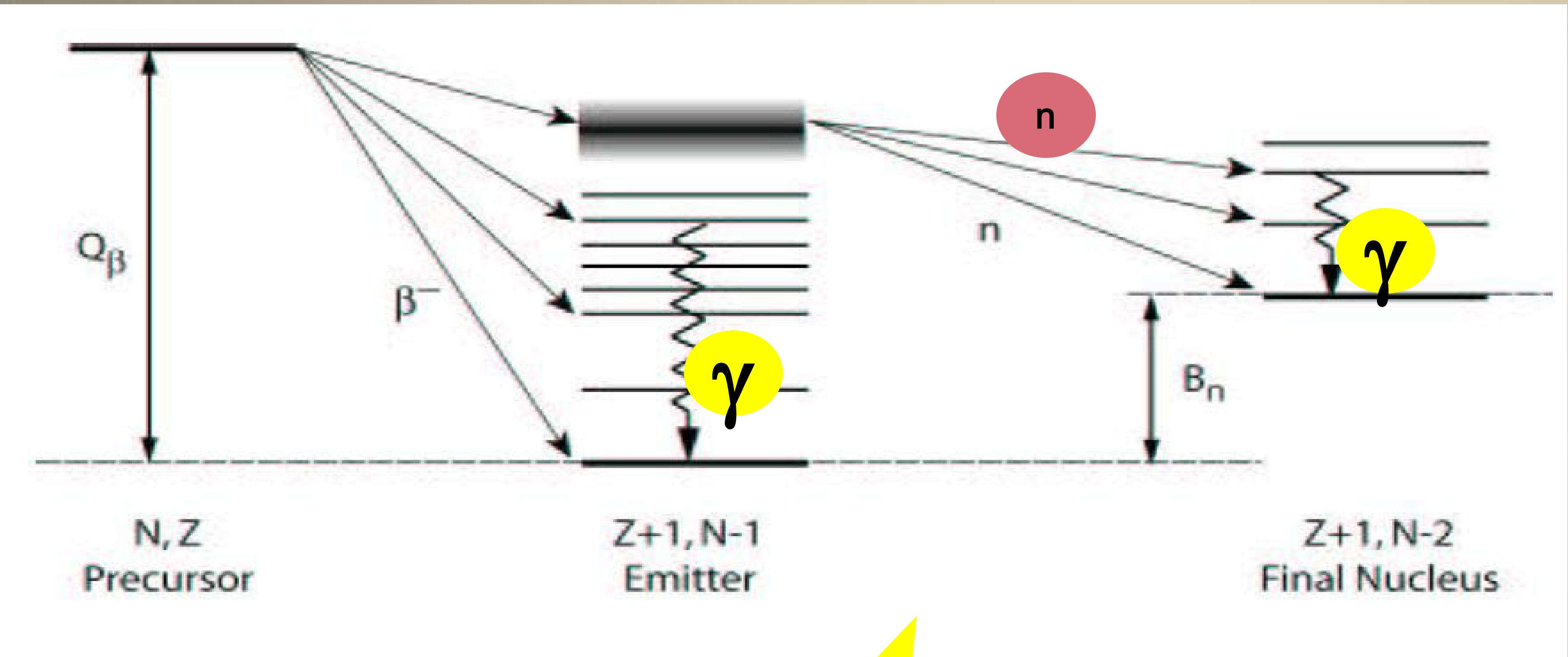
But, planning the BRIKEN Experiments….



One should consider the DTAS experiments….

ISOTOPE	T1/2 [ms]	Iπ	Ex(keV)	Qβ	Sn [keV]	Pn [%]*
130In	278(3)	1(-)	0	10250 (40)	7620(39)	1.01(22)
130Inm1	538(5)	(10-)	50(50)			
130Inm2	550(10)	(5+)	400(60)			1.65(18)
131In	280(30)	(9/2+)	0	9177 18	5247(24)	2.3(3)
131Inm1	350(50)	(1/2-)	302(32)			
131Inm2	320(60)	(21/2+)	3764(88)			
132In	207(6)	(7/2-)	0	14140 60	7311(25)	5.2(12)
133In	180(15)	(9/2+)	[illegible]	13531 SY	2470(40)	87(9)
129Cd	270(40)	[illegible]	[illegible]	[illegible]	[illegible](60)	
129Cdm1?	104(?)	[illegible]	[illegible]	[illegible]		
130Cd	162(7)	0+	[illegible]	[illegible])	5020(60)	3.6(10)
131Cd	68(3)	(7/2-)	[illegible]	12870 SY	6320(60)	3.5(10)
132Cd	97(10)	0+	0	11700 SY	2350(70)	60(15)
128Ag	58(5)			12490 SY		
129Ag	46(9)	(9/2+)	0	10750 SY	3980 SY	

Presence
of beta-decaying
isomers



Beta-delayed Neutron-gamma

IFIC INSTITUT DE FÍSICA CORPUSCULAR

INSTITUTO DE FÍSICA CORPUSCULAR

CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS CSIC

VNIVERSITAT DE VALÈNCIA

TAS Workshop in Valencia January 2014

FIN

ISOTOPE	T1/2 [ms]	Iπ	Ex(keV)	Qβ	Sn [keV]	Pn [%]*
130In	278(3)	1(-)	0	10250 (40)	7620(39)	1.01(22)
130Inm1	538(5)	(10-)	50(50)			
130Inm2	550(10)	(5+)	400(60)			1.65(18)
131In	280(30)	(9/2+)	0	9177 18	5247(24)	2.3(3)
131Inm1	350(50)	(1/2-)	302(32)			
131Inm2	320(60)	(21/2+)	3764(88)			
132In	207(6)	(7/2-)	0	14140 60	7311(25)	5.2(12)
133In	180(15)	(9/2+)	0	13531 SY	2470(40)	87(9)
129Cd	270(40)	(3/2+)	0	9880 SY	6650(60)	
129Cdm1?	104(?)					
130Cd	162(7)	0+	0	8340(160)	5020(60)	3.6(10)
131Cd	68(3)	(7/2-)	0	12870 SY	6320(60)	3.5(10)
132Cd	97(10)	0+	0	11700 SY	2350(70)	60(15)
128Ag	58(5)			12490 SY		
129Ag	46(9)	(9/2+)	0	10750 SY	3980 SY	