Exotic Nuclear Geometries, Symmetries and Quantum Numbers

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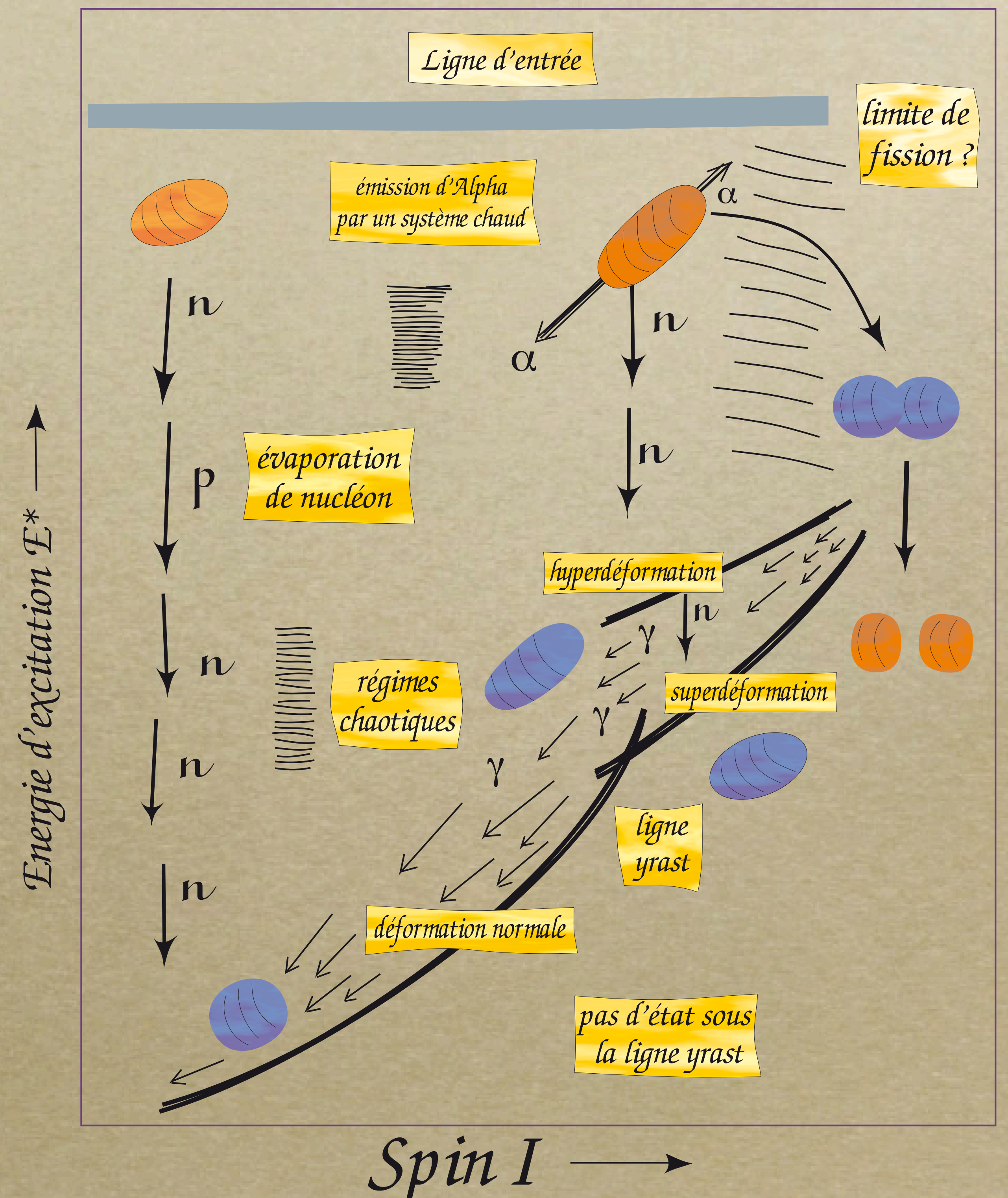
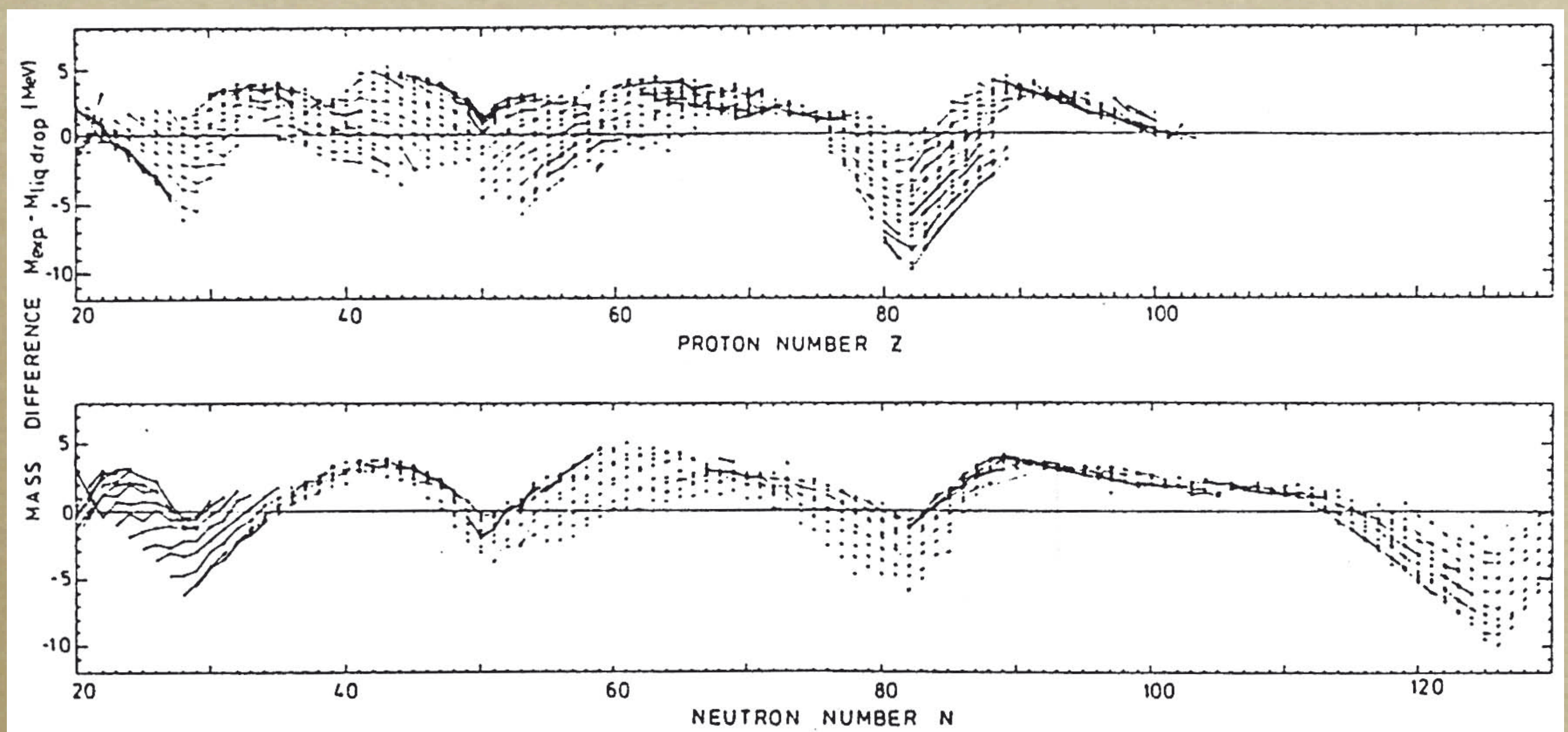
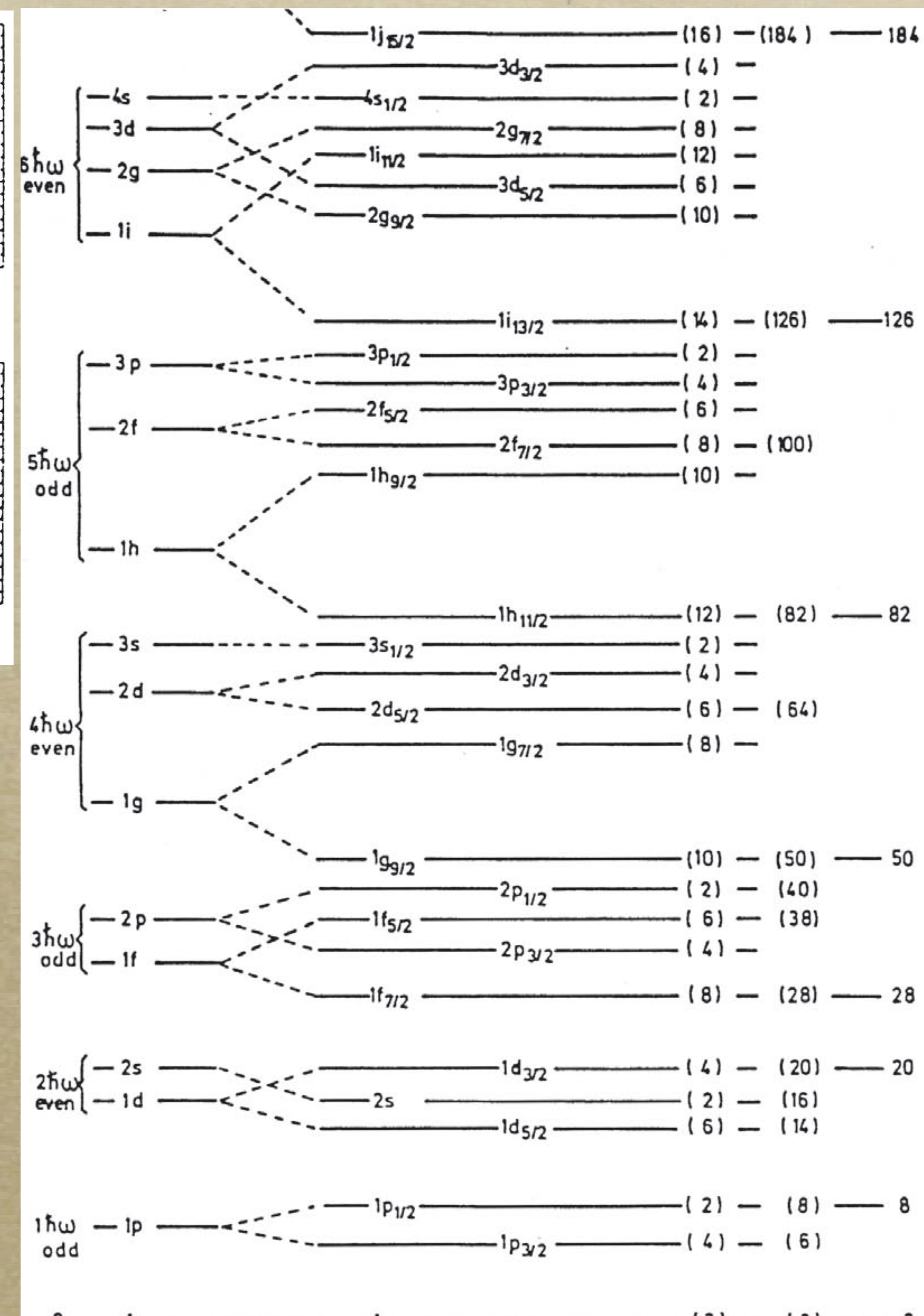
Outline

- Preliminary considerations
- Excitations of the nuclei; case of rotationnal bands
- Effect of Nuclear deformation
- Experimental toolboxes & selected cases



Magic Numbers and Shell Model.





Same Magic numbers for neutrons & protons

=> related to Gaps in a quantum system

… need right orbital ordering in models

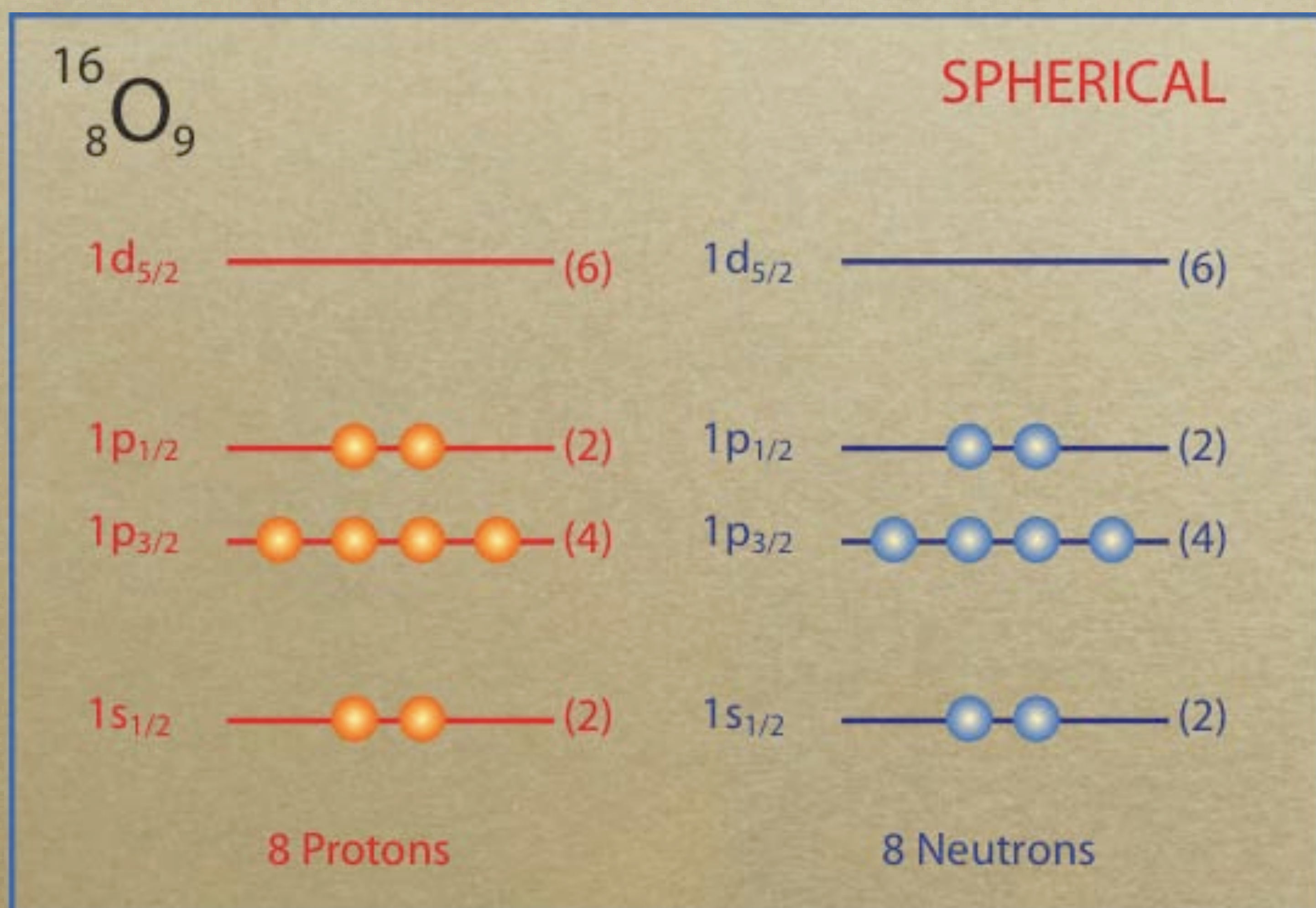
Harm. Osc => not good gaps

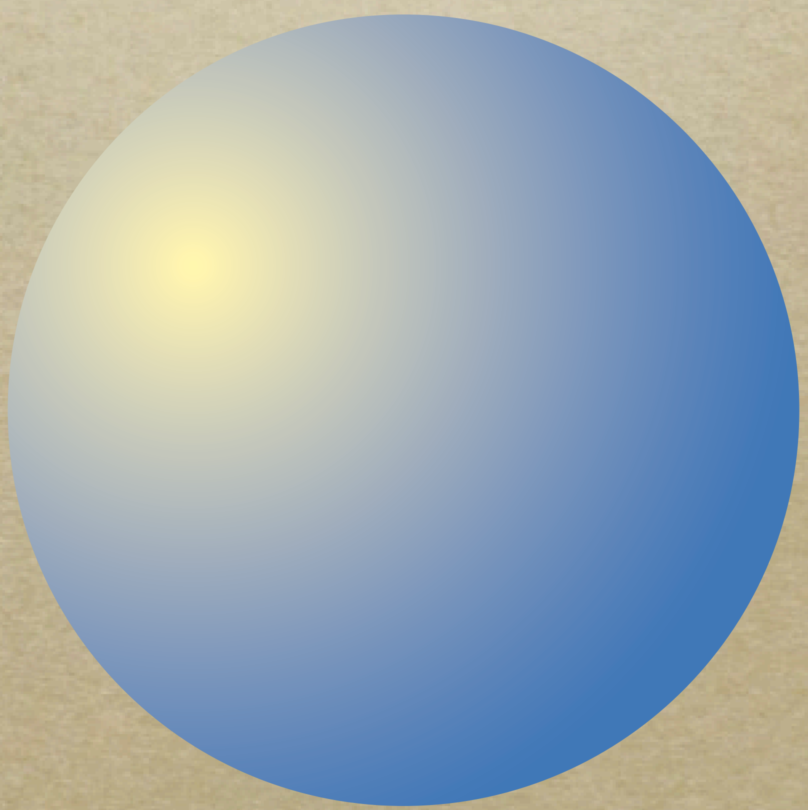
=> add a l^2 term and a l.s term

=> new magic numbers (the right ones)

Fill the levels and get a Spherical nuclei ...

Single particle Energies





Fermi levels, Occupancy ...

How to learn more about the properties due to symmetry ?

How to learn more about the properties due to symmetry ?

Break

it

To break the Symmetries we can act on:

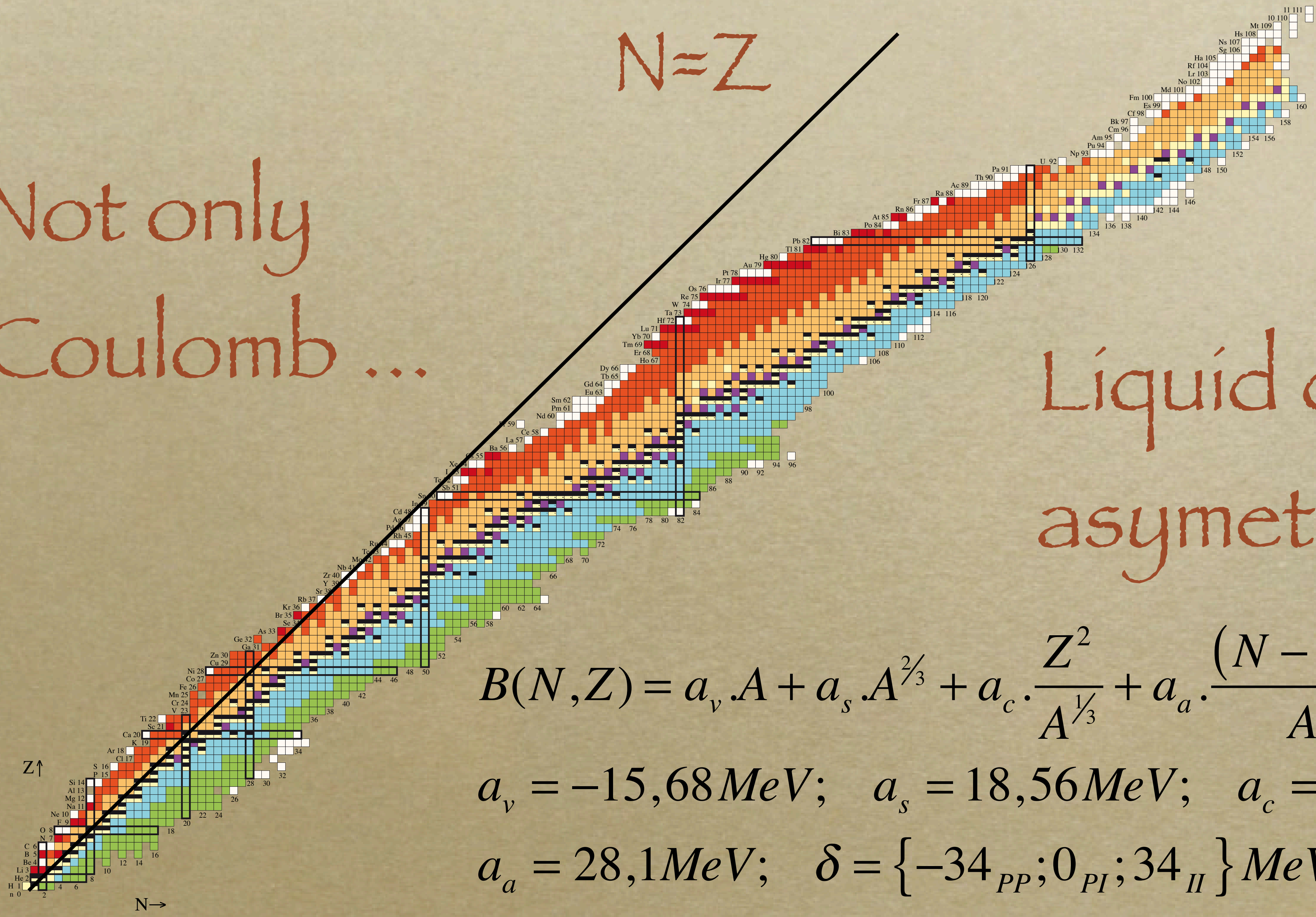
Isospin Content ...

time-reversal ...

deformation ...

Nucleonic content … Isospin …

Not only Coulomb …



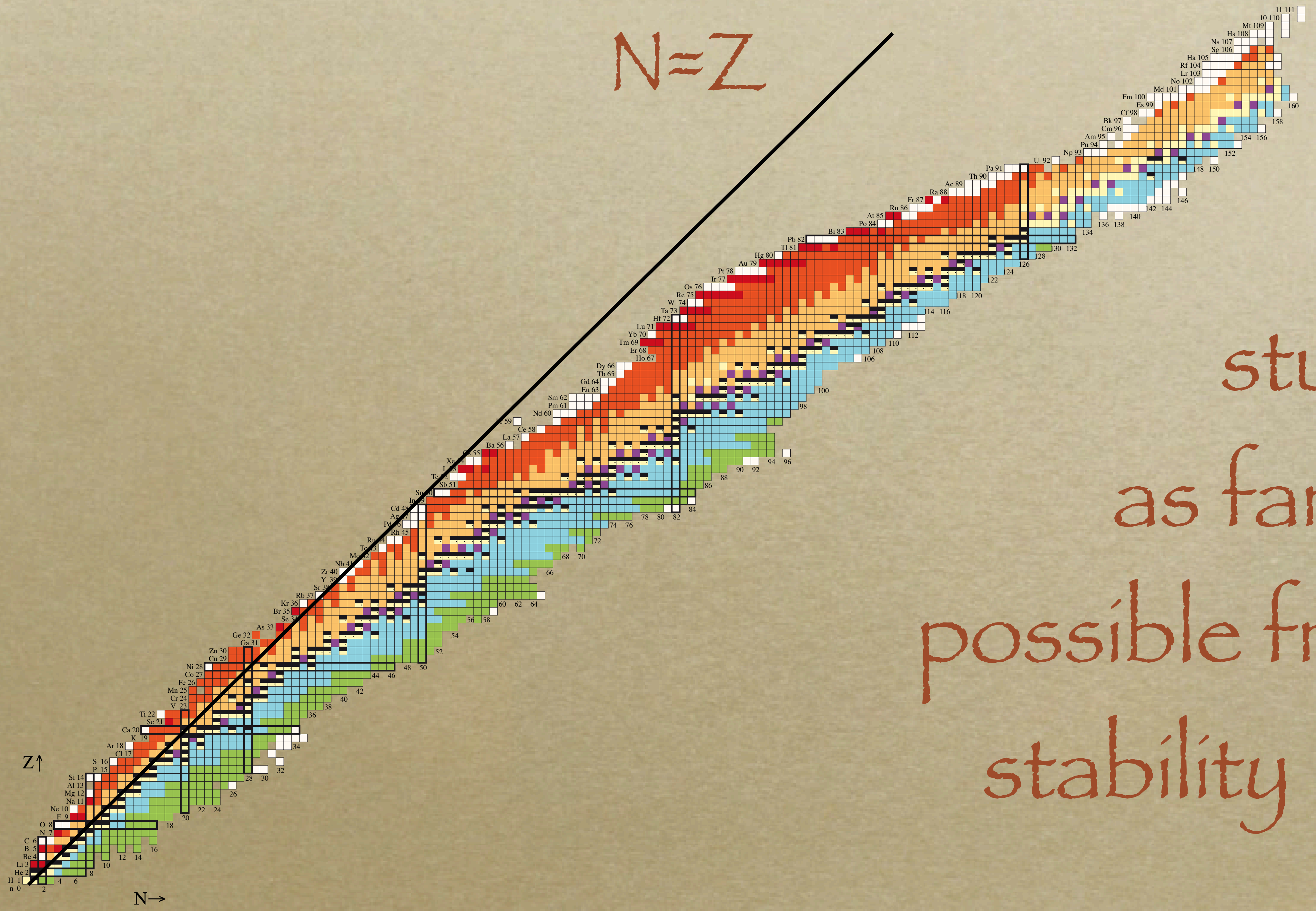
Liquid drop asymetry …

$$B(N,Z) = a_v.A + a_s.A^{2/3} + a_c.\frac{Z^2}{A^{1/3}} + a_a.\frac{(N-Z)^2}{A} + \delta.A^{-3/4}$$

$$a_v = -15{,}68\,MeV; \quad a_s = 18{,}56\,MeV; \quad a_c = 0{,}717\,MeV;$$

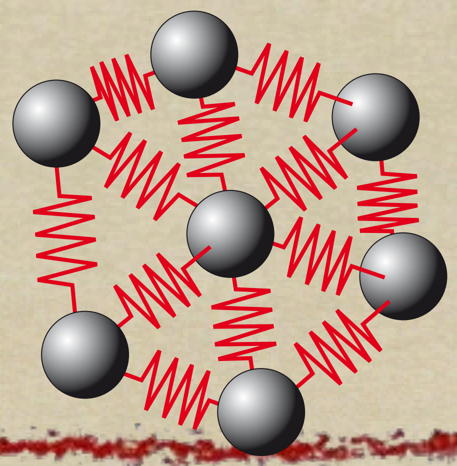
$$a_a = 28{,}1\,MeV; \quad \delta = \{-34_{PP}; 0_{PI}; 34_{II}\}\,MeV$$

Far far away ...



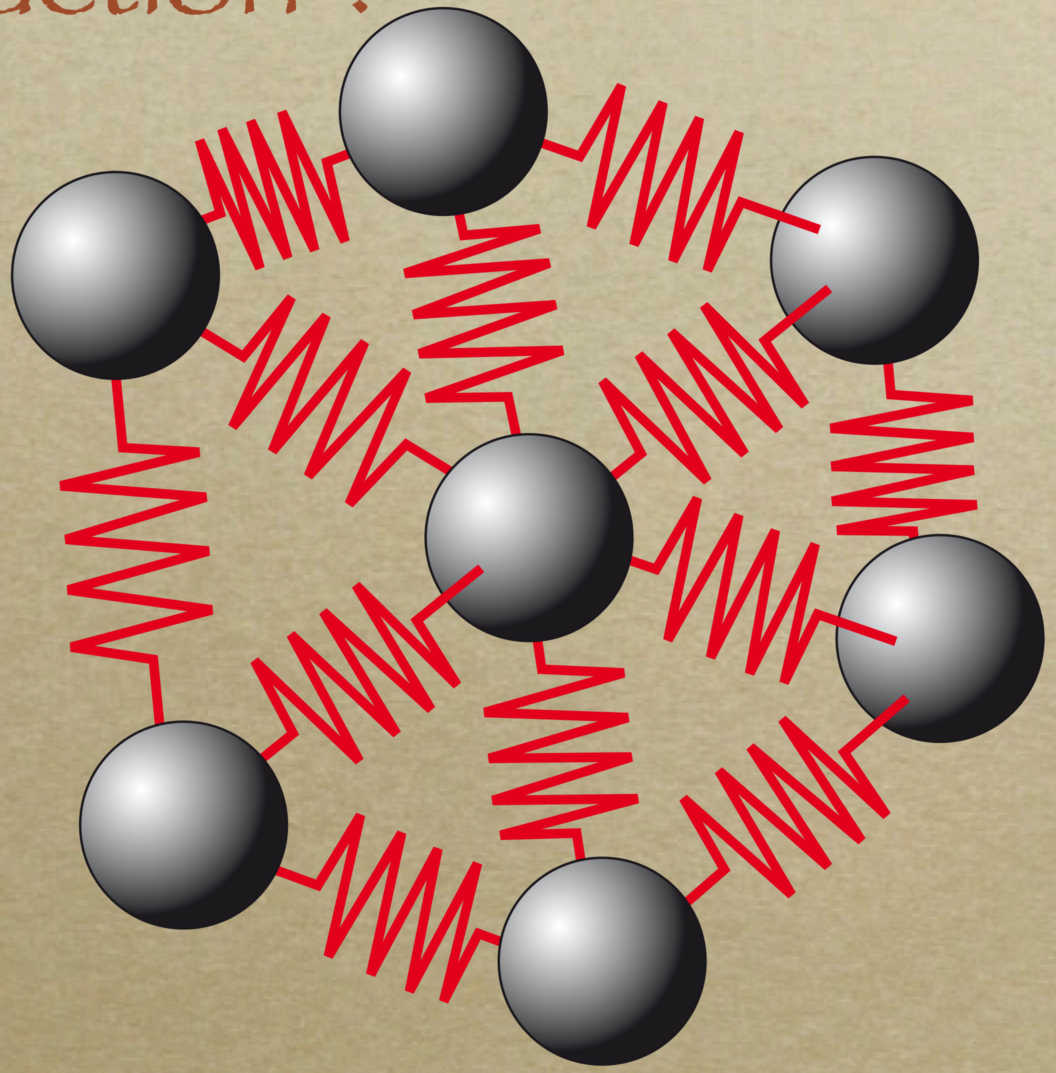
study
as far as
possible from
stability line

Self Consistency



If I act on a single nucleon

What is the core reaction ?



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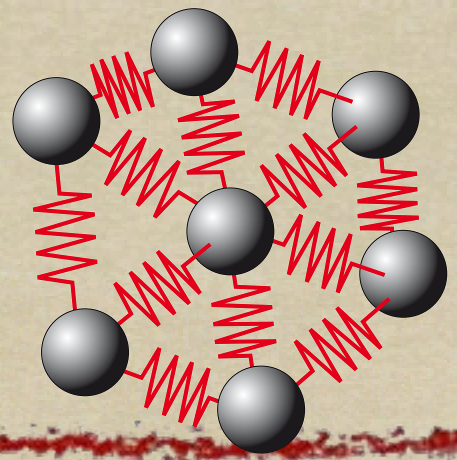

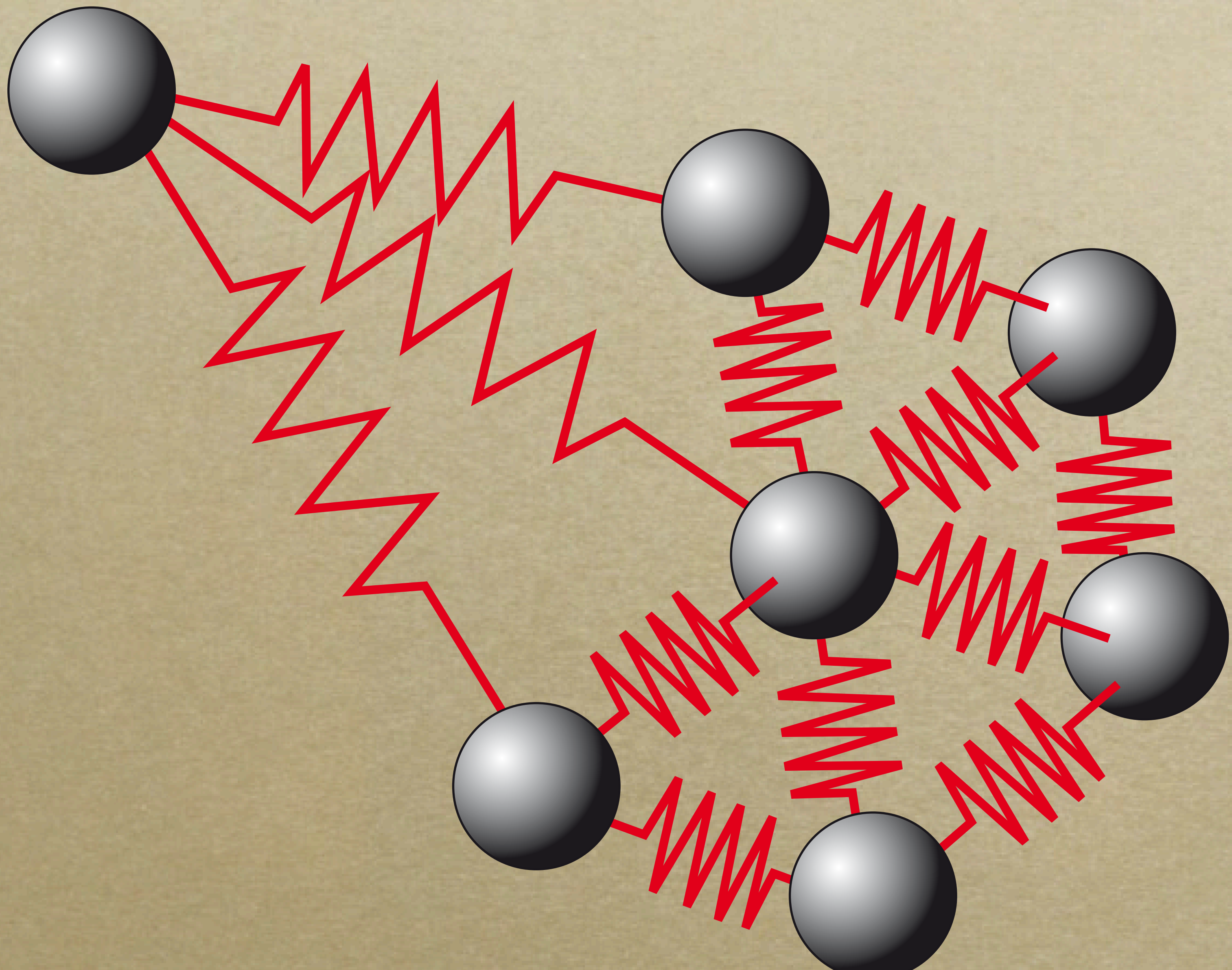

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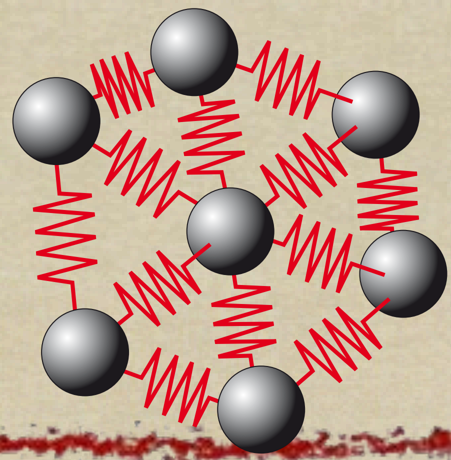

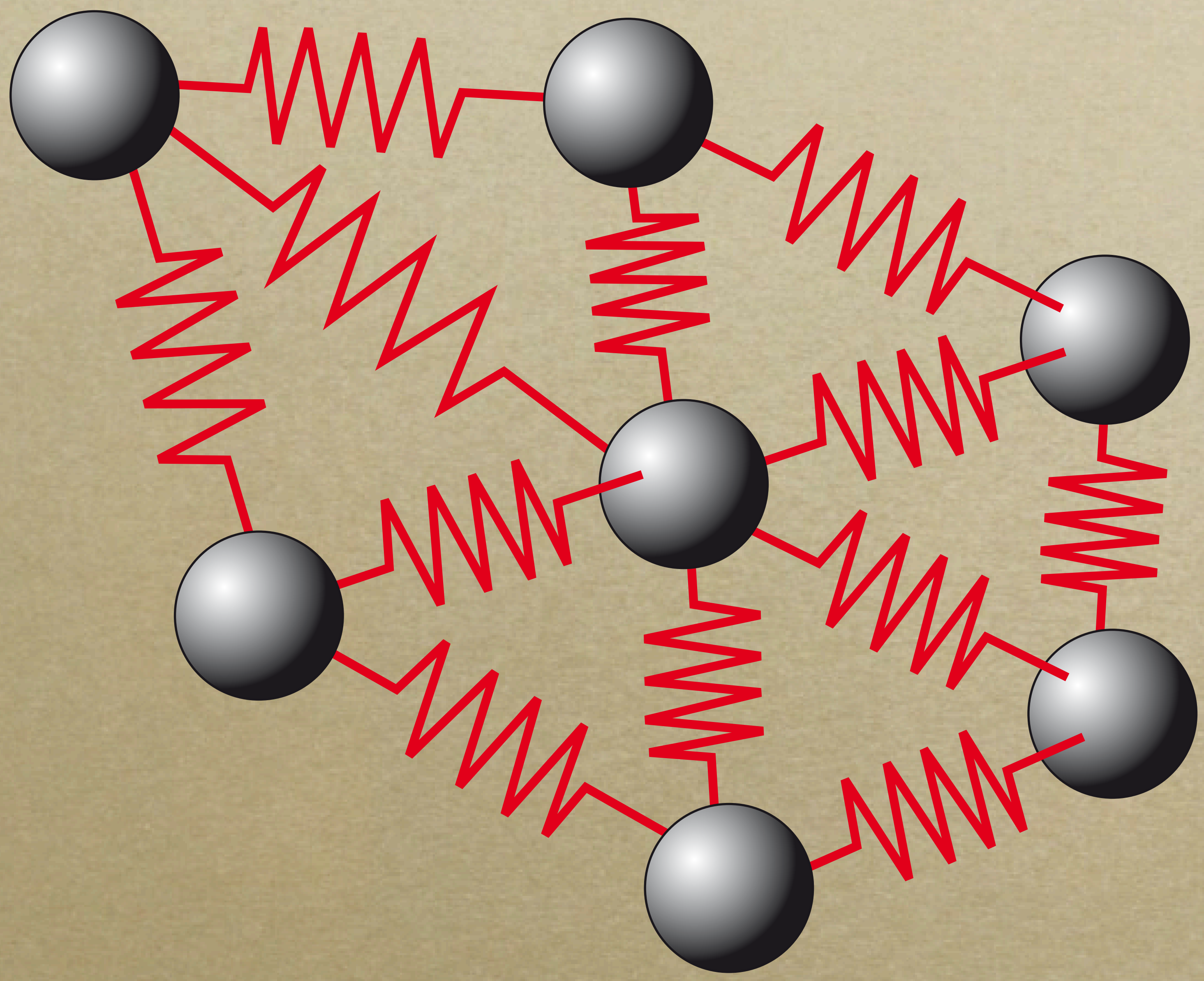

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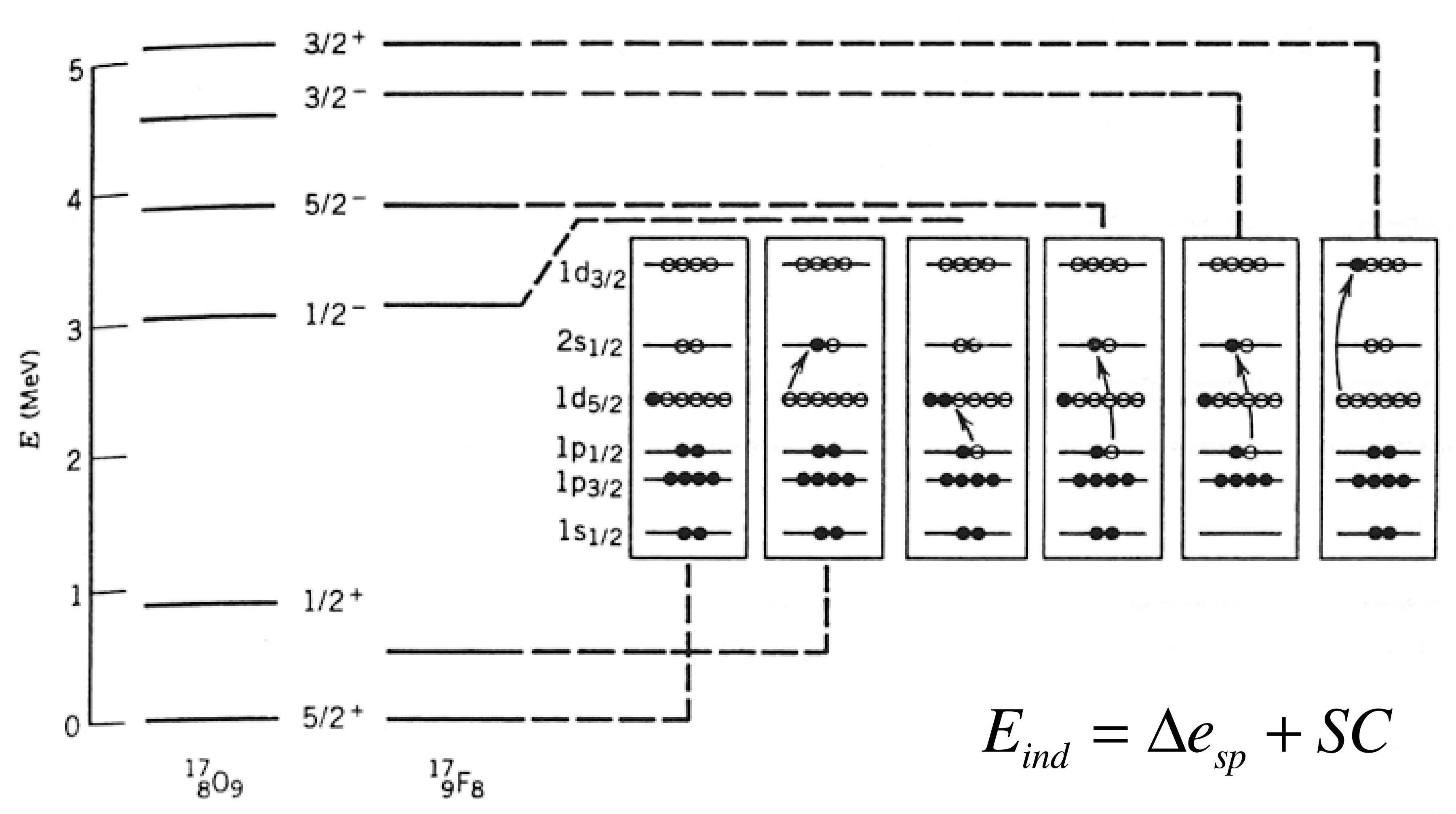
Excitations of nucleus

Individual Excitations

single particle excitations



$$E_{ind} = \Delta e_{sp} + SC$$

Collective Excitations

Rotation $E_{rot} = \frac{\hbar^2}{2\Im} J(J+1)$

Vibration $E_{vibr} = (N + \frac{3}{2})\hbar\omega$

Excitations of nucleus

^{152}Dy case :
shape coexistence

Collective Excitations

Rotationnal band

Collective Excitations

Individual Excitations

Vibration

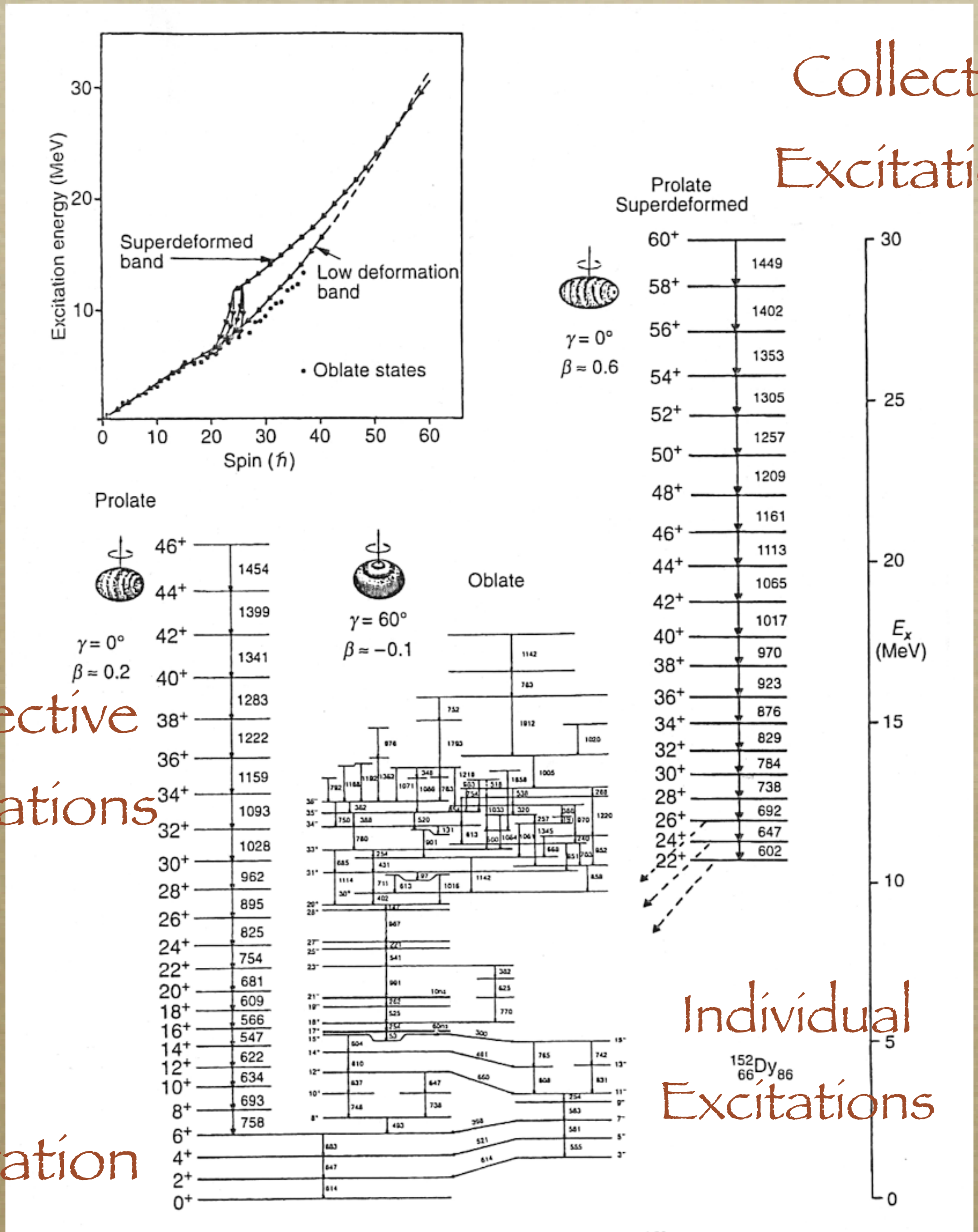


Fig. 12.19. The full spectrum observed for the nucleus ^{152}Dy showing the low-spin non-collective yrast states in the middle, a collective normal-deformed band to the left and the superdeformed band to the right. The inset in the upper left corner shows *E* versus *I* plotted in a schematic way for the different structures (from J.F. Sharpey-Schaffer, *Physics World*, Sept. 1990, p. 31).

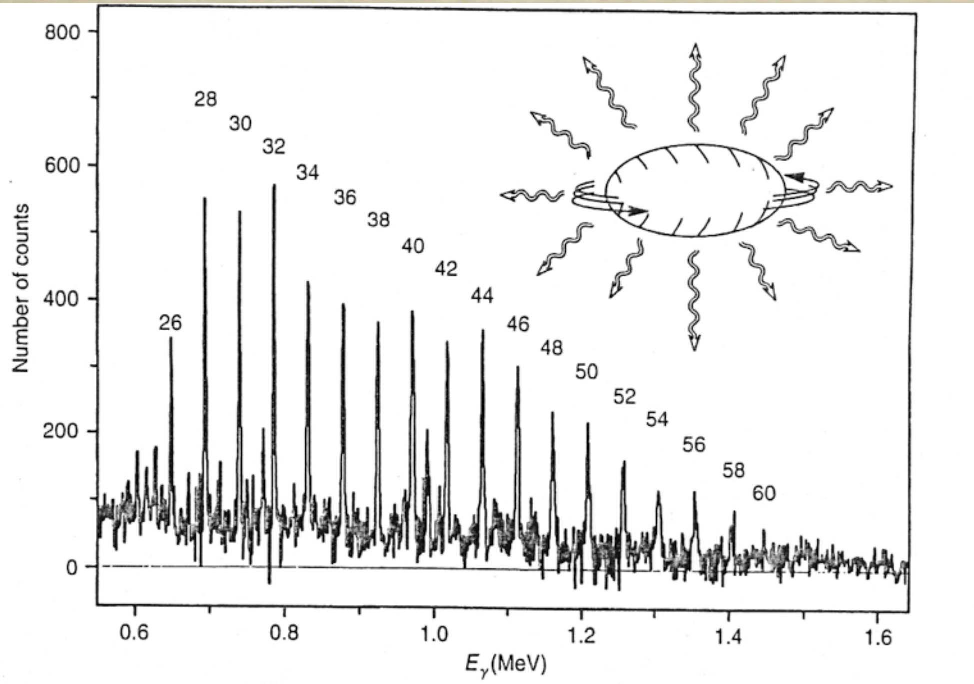


Fig. 12.18. The gamma-ray spectrum of the superdeformed band in ^{152}Dy as originally identified in the 1986 Daresbury experiment (from Twin *et al.*, 1986).

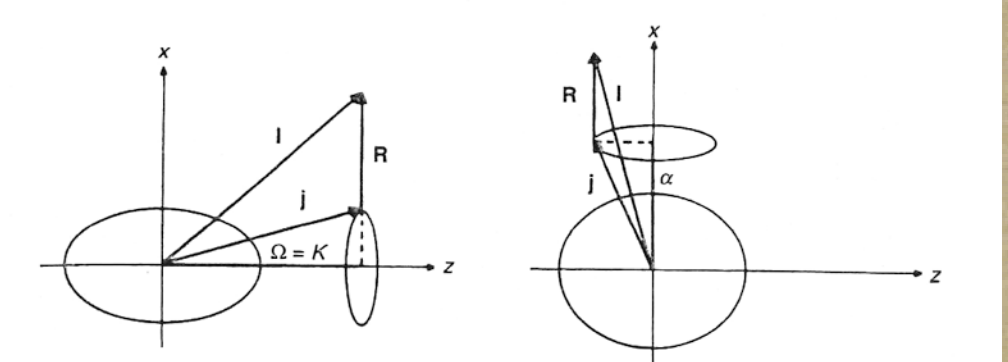
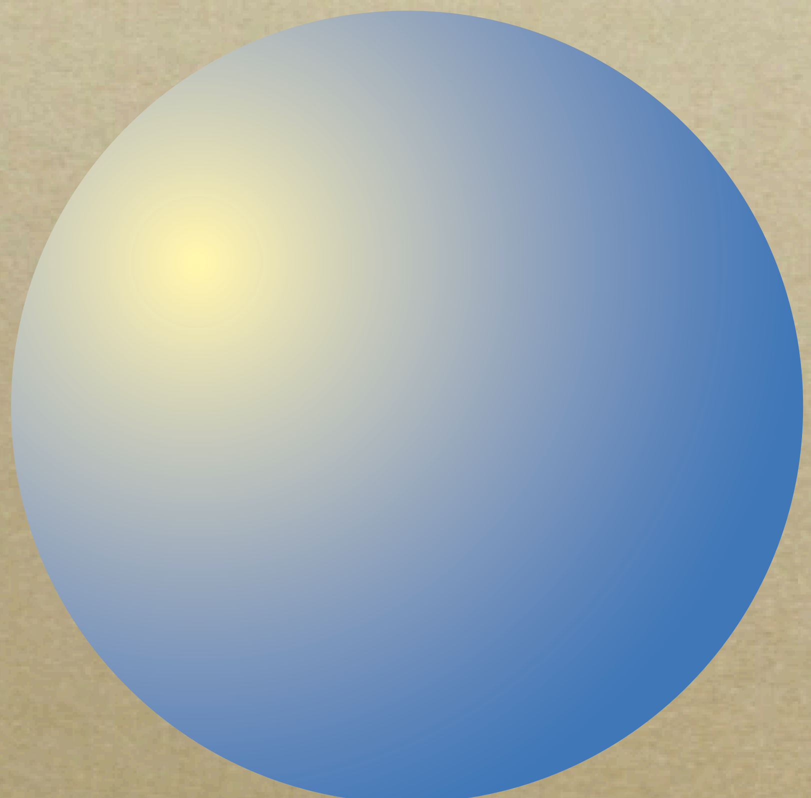


Fig. 11.3. Schematic illustration of the two extreme coupling schemes; deformation alignment (left figure) and rotation alignment (right figure) (from R.M. Lieder and H. Ryde, *Adv. in Nucl. Phys.*, eds. M. Baranger and E. Vogt (Plenum Publ. Corp., New York) vol. 10 (1978) p. 1).

Nuclear Rotation



<= perfect sphere

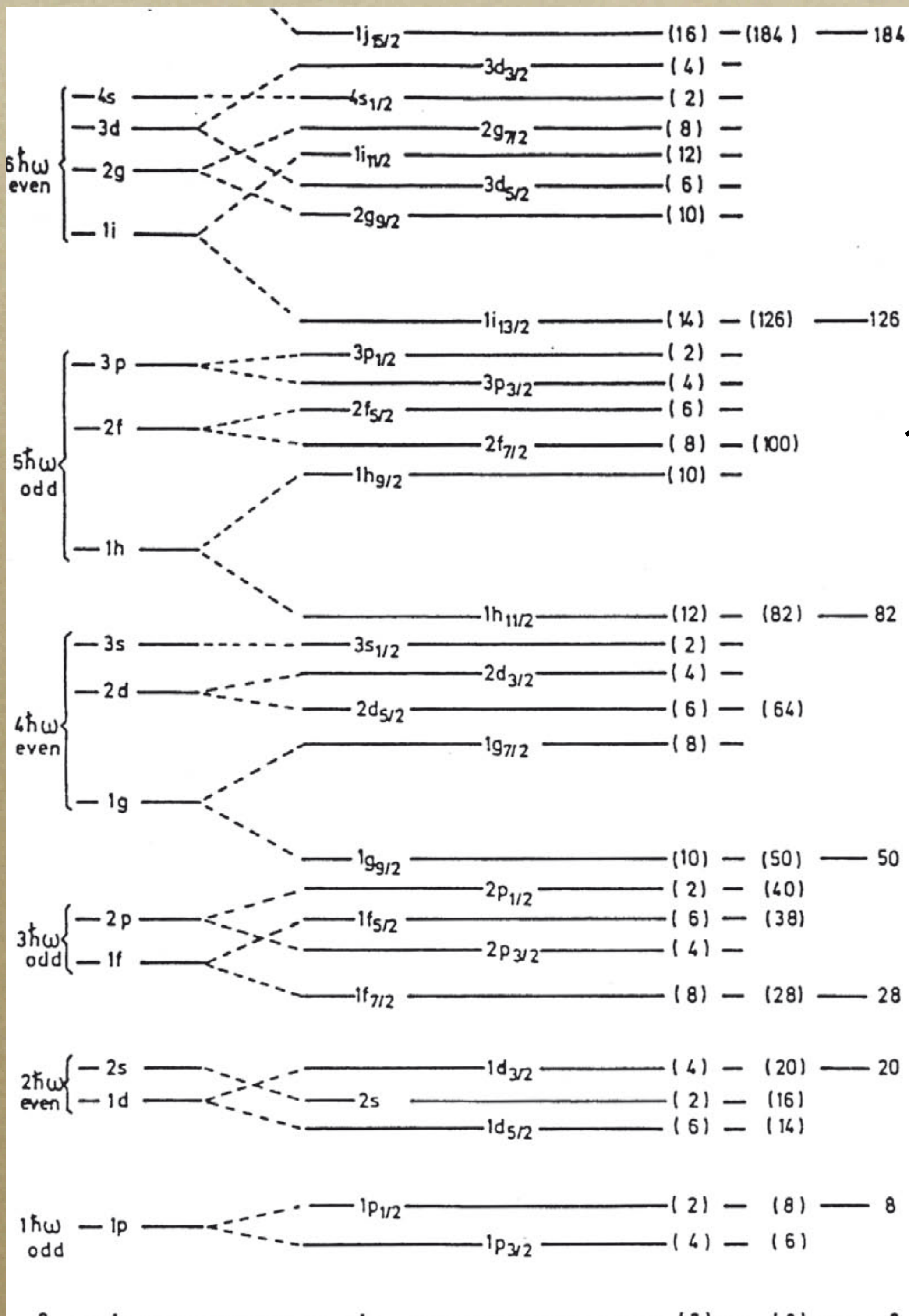
What are the symmetry axes ?

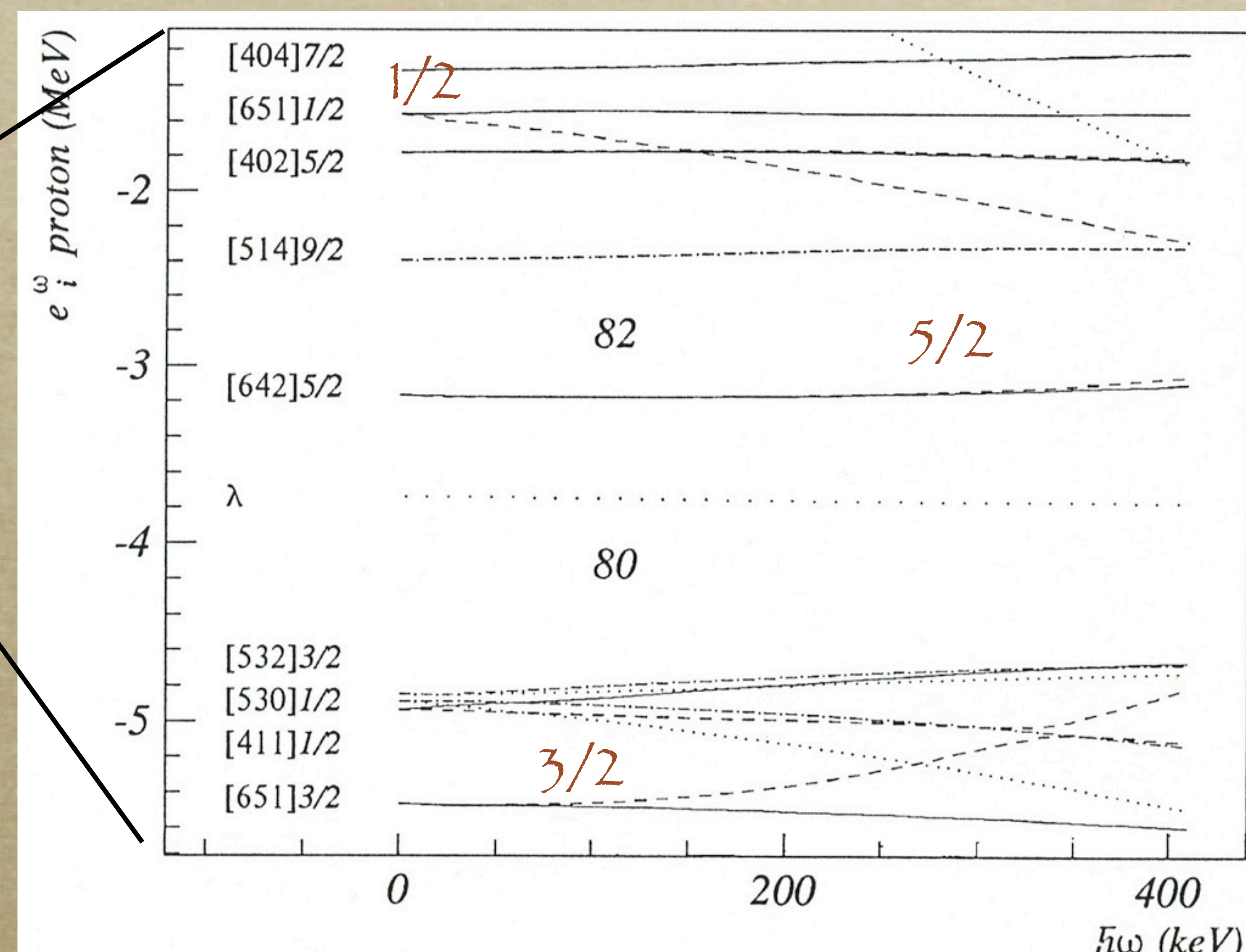
Can we see rotation ?

NO ... because it is

Forbidden by Quantum Mechanics ! ...

Effect of rotation on e_{sp}





Breakes the time-reversal symmetry ...

Theoretical Routhians e_{qp}

Due to pairig correlations, each sp level has a given occupancy

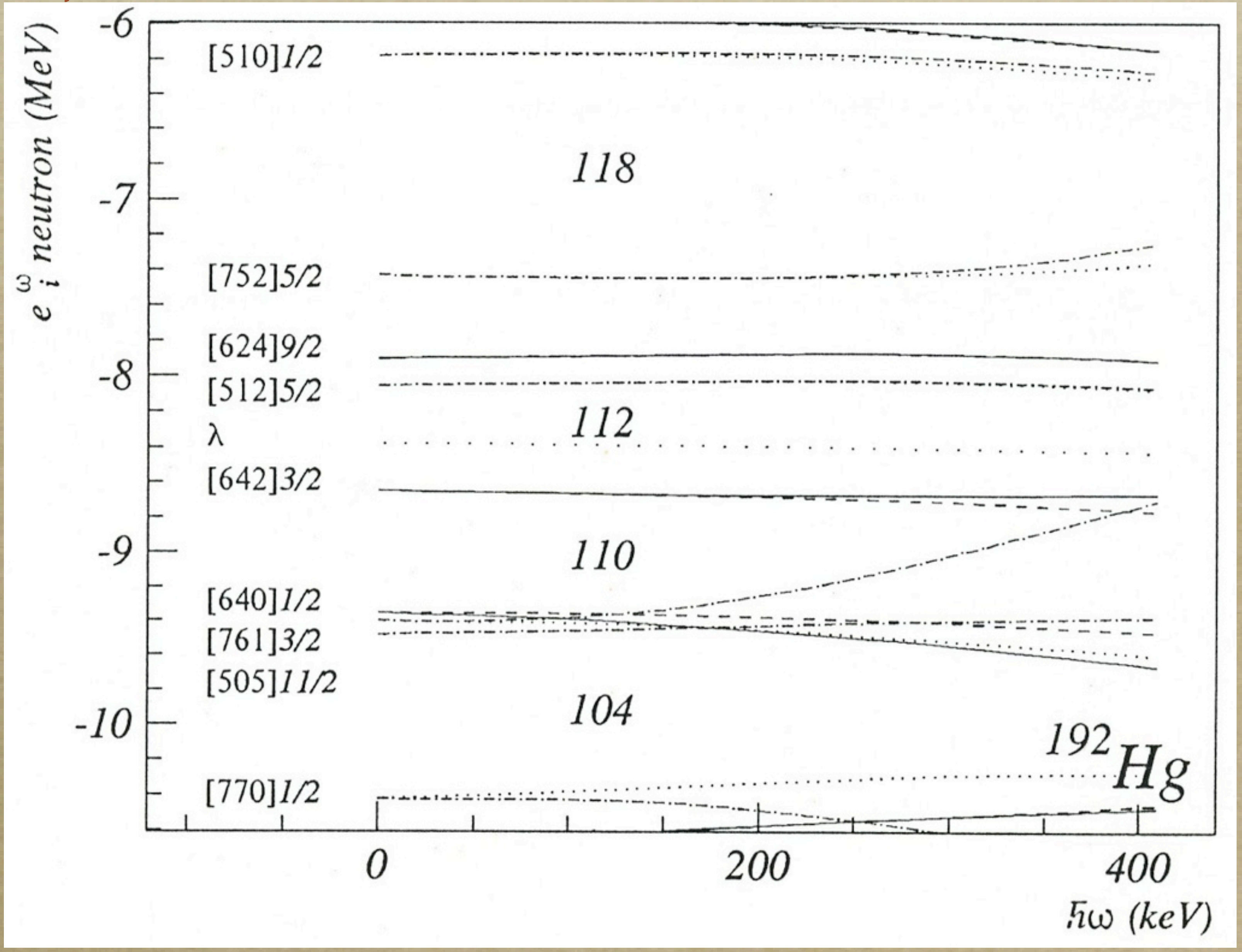
You can empty or fill each sp level arround Fermi

keep track of the origin of the orbital throug a labelling :

- p "particle state"
- h "hole state"

Pairing GAP is reduced by Corriolis

Anti-Pairing effect



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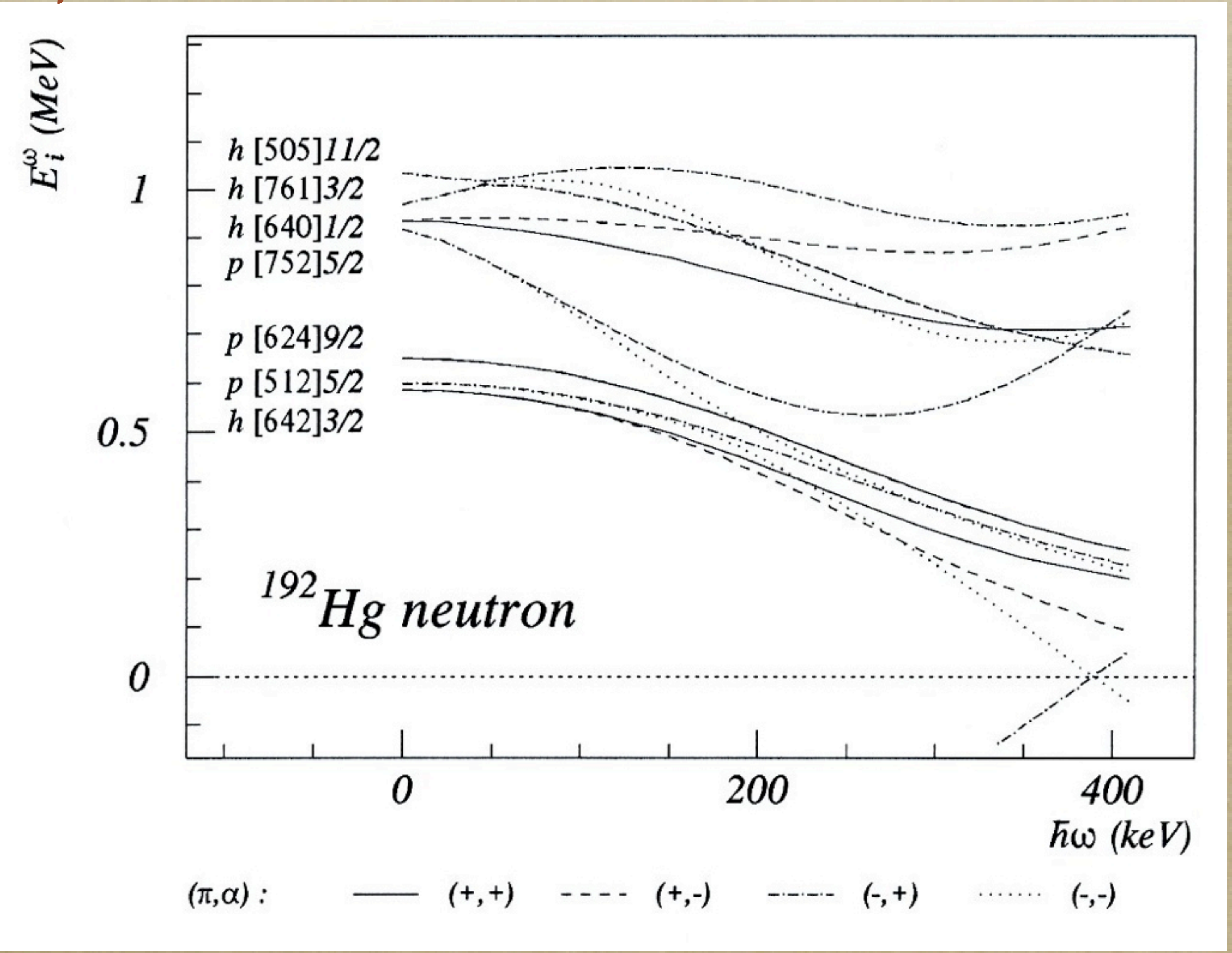
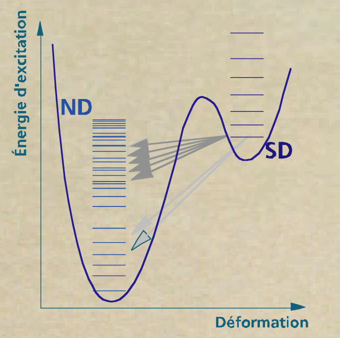


Experimental Routhians



$$Routhian: \quad E'(\hbar\omega) = E(\hbar\omega) - E_{rot}(\hbar\omega)$$

Considered band

Effect of Rotation

If not constant, shows that the nucleus is not rigid ...

In order to see the effect of individual orbitals we need to substract a core

$$E_{rot}(\hbar\omega) = \hbar\omega\sqrt{J(J+1) - K^2}$$

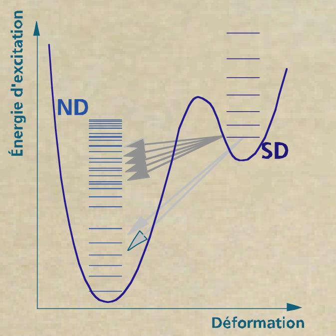
$$\hbar\omega = \frac{dE_{rot}}{dJ}$$

$$\hbar\omega \approx \frac{\Delta E}{\Delta J} = \frac{E(J+2) - E(J)}{(J+2) - J} = \frac{E_\gamma}{2}$$

$$Substracted\ Routhian: e' = E'(\hbar\omega) - E_{ref}(\hbar\omega)$$

Core

Experimental Routhians

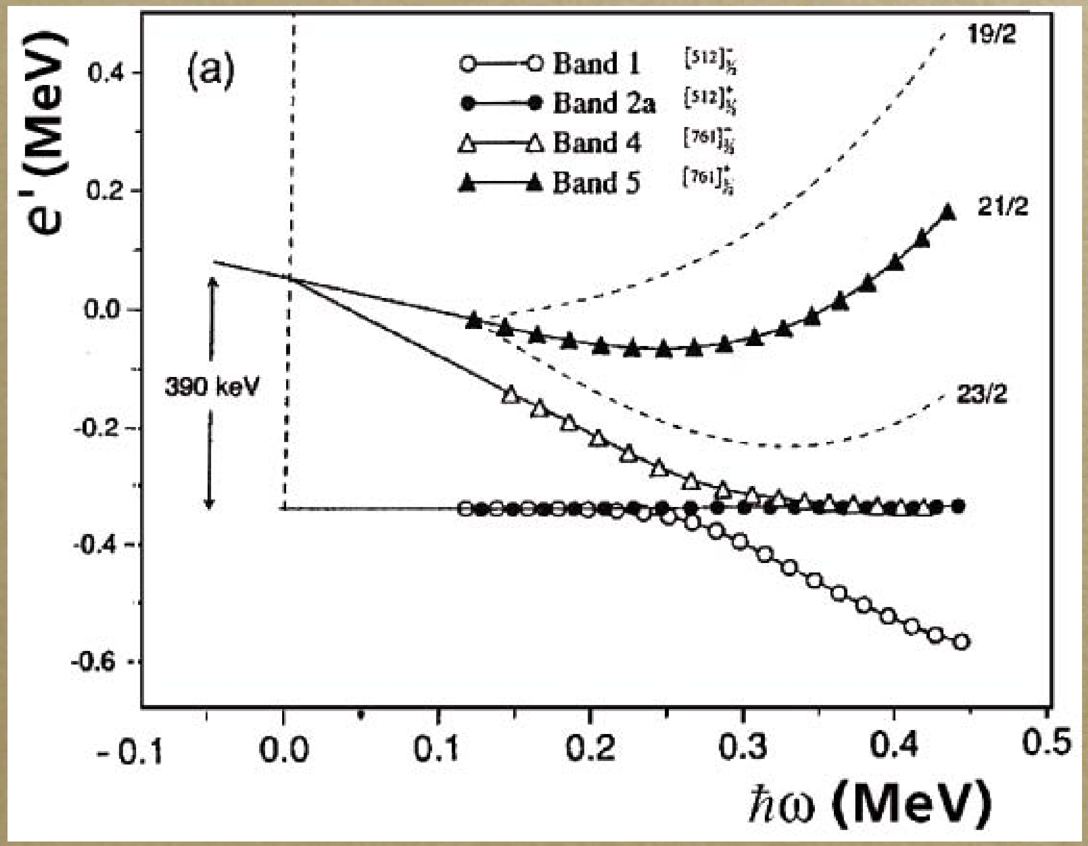


$$Substracted\ Routhian : e' = E'(\hbar\omega) - E_{ref}(\hbar\omega)$$

Example :

Spectroscopy of the odd-even nuclei ^{193}Hg

$$E_{ref}(\hbar\omega) = a + b\omega^2 + c\omega^4$$



M J Joyce et al. Phys Rev. Lett. 71. 2176 (1993)

—» Intensity splitted over several bands

—» The bands are linked together

—» Study of Routhains

Possibility to extract experimental quasi-particle routhians

Inertia and Rigid Rotor

$$E_{rot} = \frac{\hbar^2}{2\Im} J(J+1)$$ corresponds for an even-even to $$E_{classical} = \frac{\hbar^2 I^2}{2\Im}$$

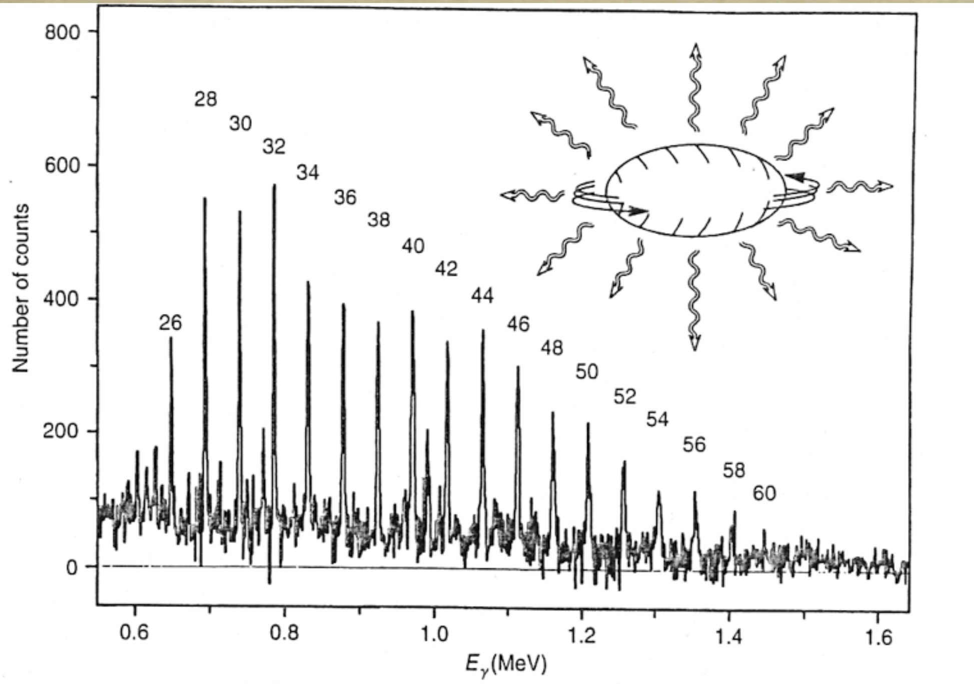


Fig. 12.18. The gamma-ray spectrum of the superdeformed band in ^{152}Dy as originally identified in the 1986 Daresbury experiment (from Twin *et al.*, 1986).

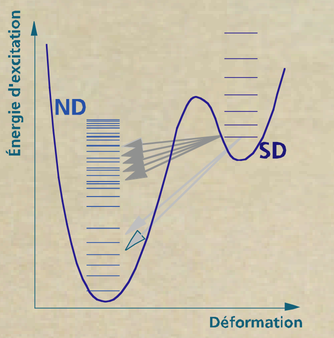
$$\Im_{rigid} = \frac{2}{5} MR^2 (1 + 0,31\beta)$$

$$\Im^{(1)} = \frac{\hbar^2}{2} \left(\frac{dE}{d(I^2)} \right)^{-1}$$

$$\Im^{(2)} = \hbar^2 \left(\frac{d^2E}{dI^2} \right)^{-1}$$

Inertia much smaller than Rigid rotor → due to superfluidity

Nuclear Pairing dependance on Rotation



Spectroscopy of ^{192}Hg and ^{194}Pb SD bands

- Constant Quadrupolar Moment
- Dynamical Moment of inertia : $\mathcal{J}^{(2)}$

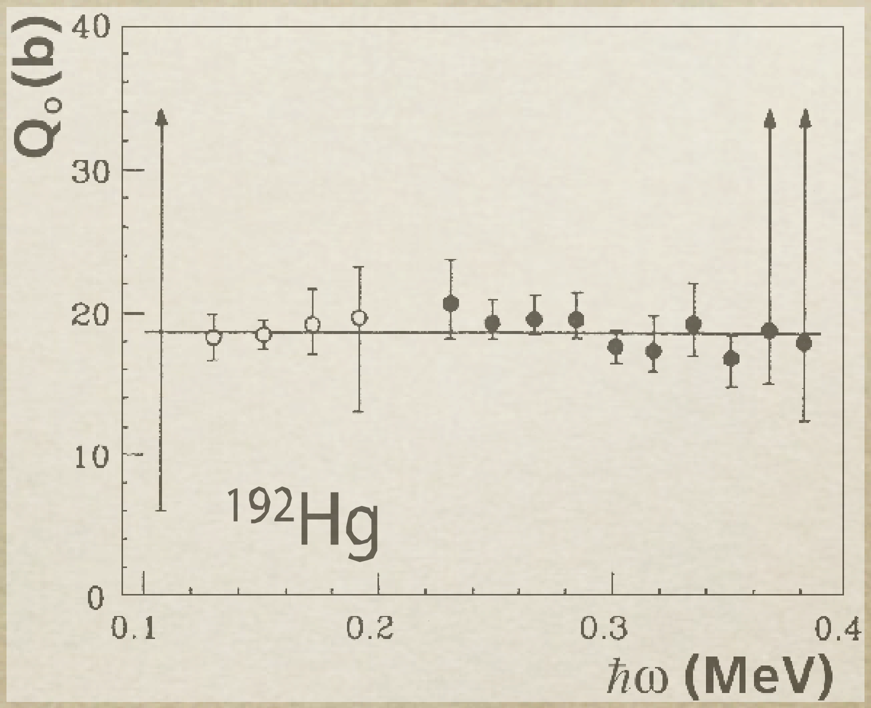
—» Steady increase

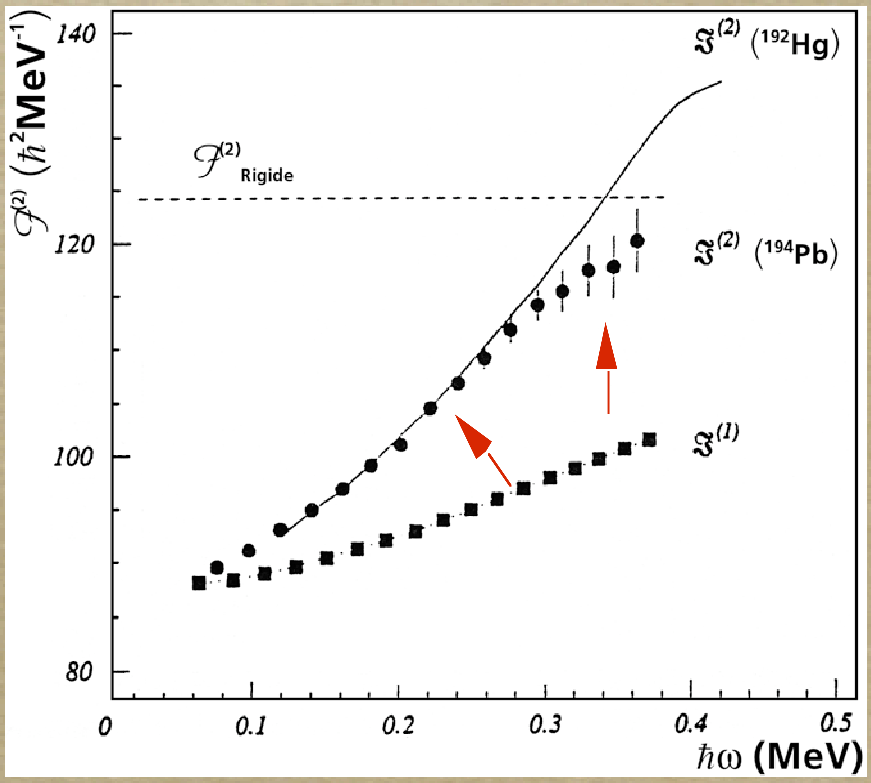
—» Saturation at high Frequency...

Sign of the progressive reduction of Pairing-Correlations Effects with Rotation

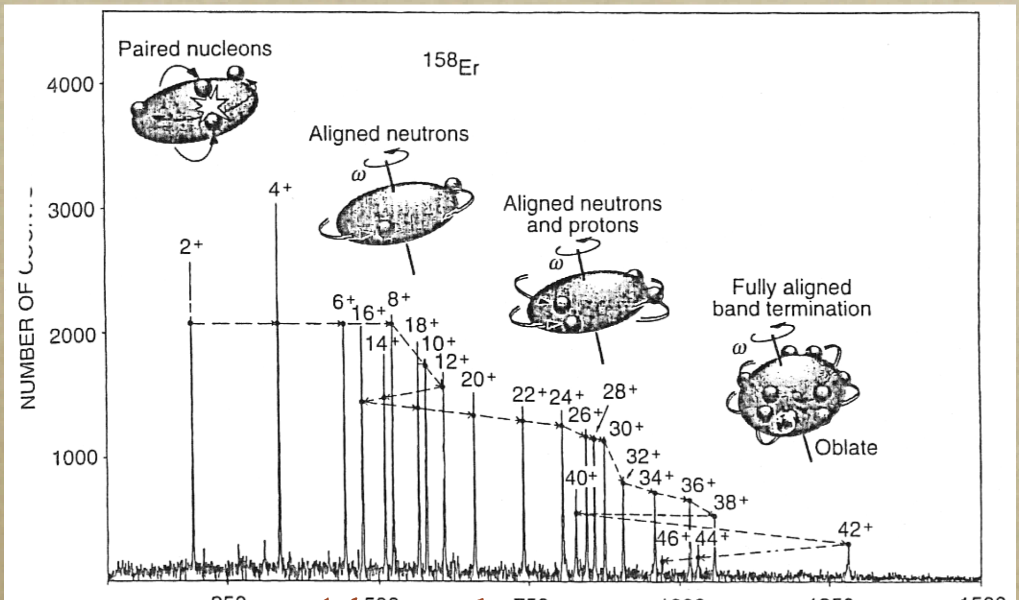
—» Different Saturation for different bands !

Sign of the single particule content of the nuclei especially in "intruder" orbitals





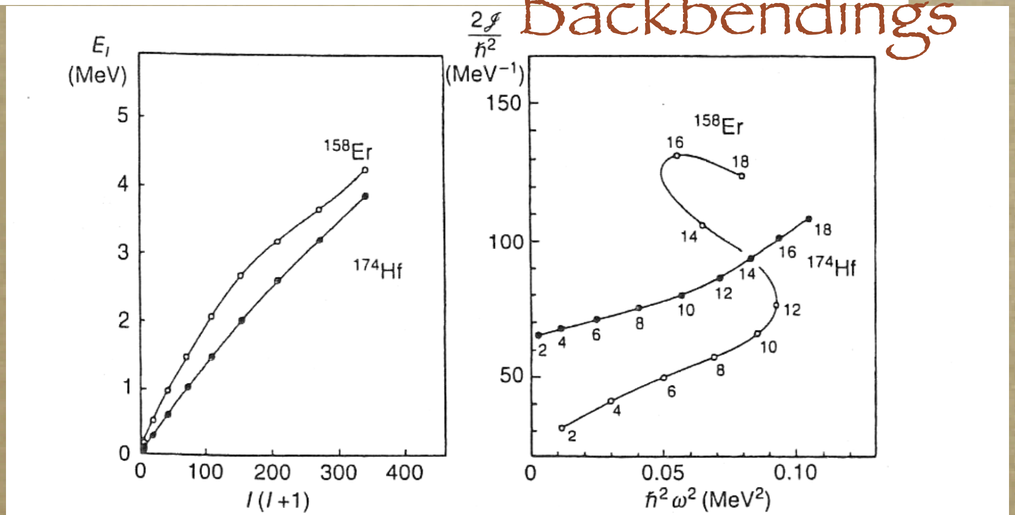
^{158}Er case : Backbendings



Rotationnal band

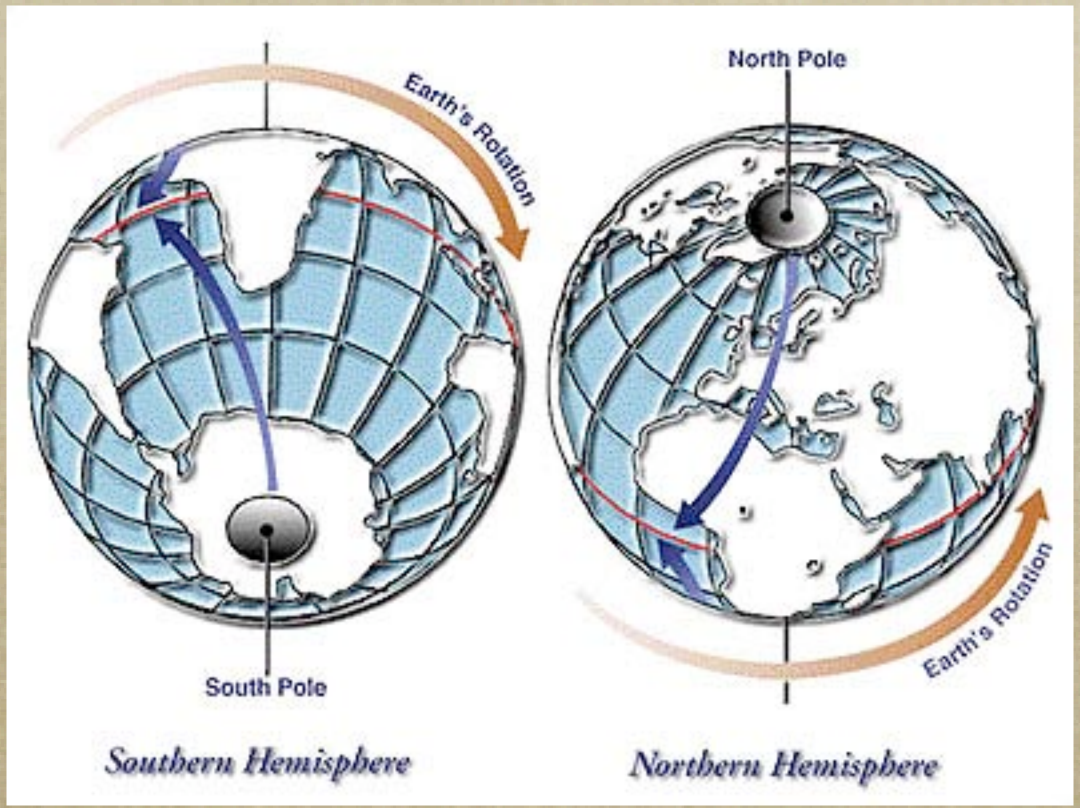
Fig. 11.12. Observed γ-ray energies of ^{158}Er formed in a reaction like the one illustrated in fig. 11.11. For $I \approx 14$ two $i_{13/2}$ neutrons become aligned resulting in a backbend while a second irregularity caused by the alignment of two $h_{11/2}$ proton… is seen for $I \approx 32$. The features for $I \geq 38$ with the final band termi… $I = 46$ are discussed in chapter 12.

Backbendings

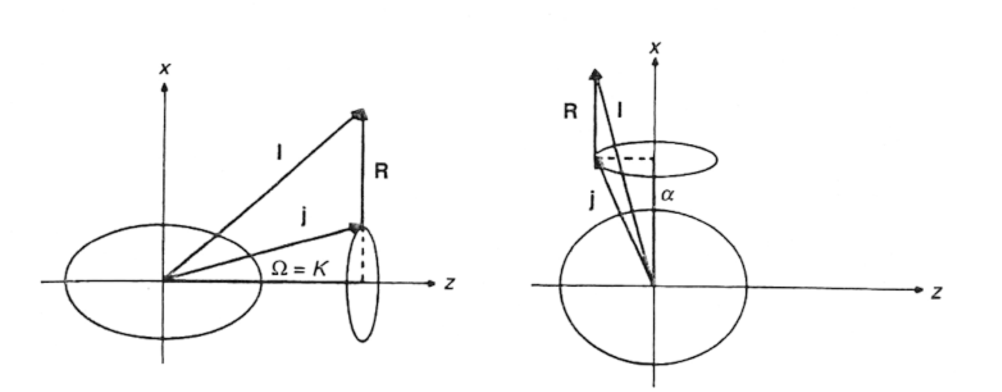


…ig. 11.13. Yrast energies in the $I = 0$–18 range of ^{158}Er and ^{174}Hf plotted versus $(I+1)$ and corresponding back-bending plots with the moment of inertia $\mathscr{J}$ versus …e squared rotational frequency, ω^2 (from R.M. Lieder and H. Ryde, *Adv. in Nucl. …hys.*, eds. M. Baranger and E. Vogt (Plenum Publ. Corp., New York) vol. 10 (1978)

Corriolis force $\boldsymbol{F}_C = -2\,m\,\boldsymbol{\Omega} \times \boldsymbol{v}$



Alignment on rotation



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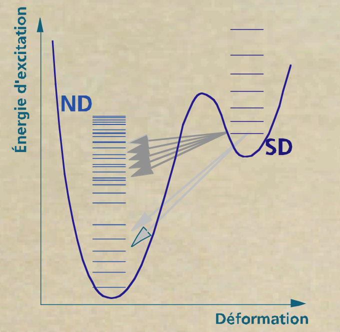
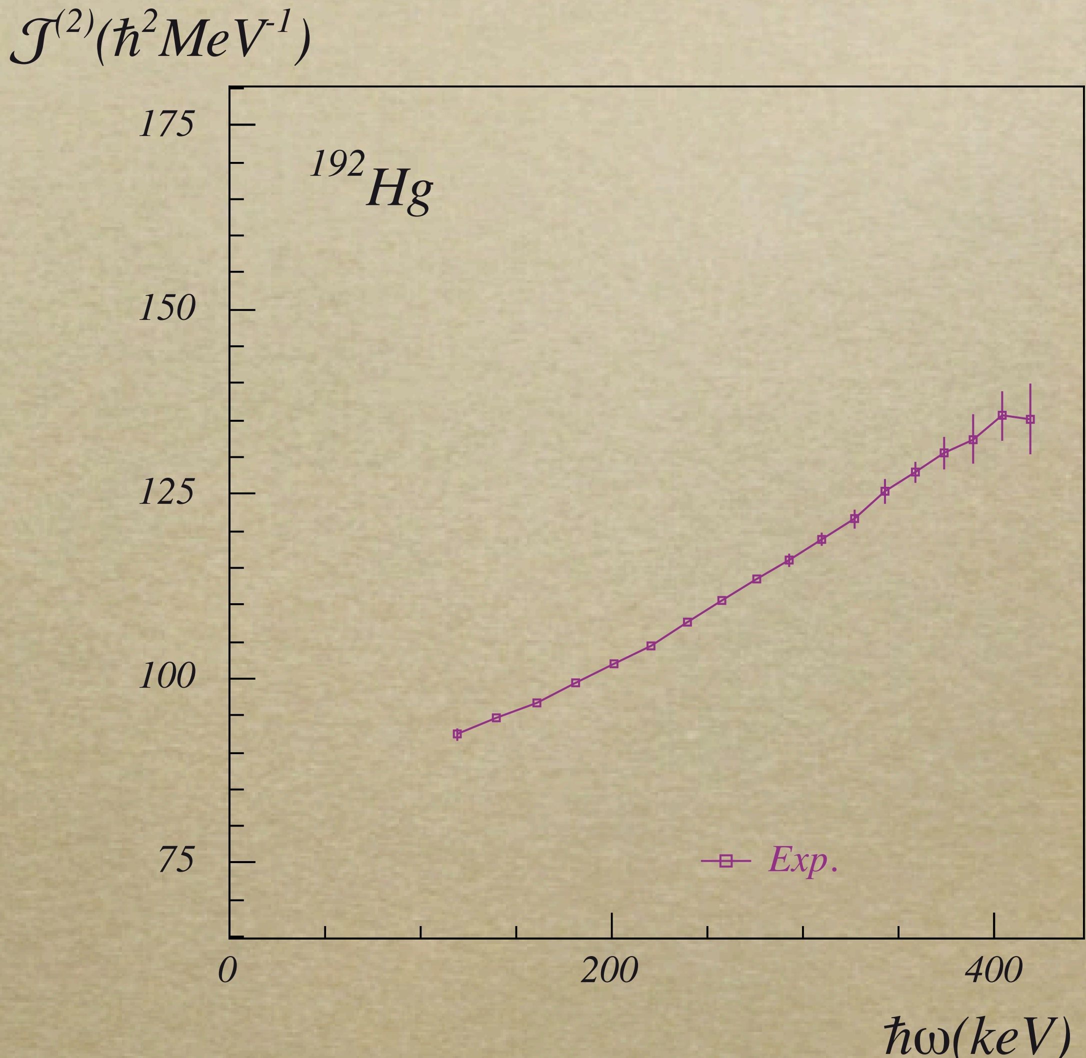
Nuclear Pairing dependance on Rotation

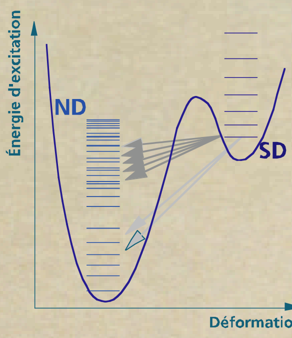


Cranked Hartree-Fock code



(Skm* + Seniority constant G)

Nuclear Pairing dependance on Rotation



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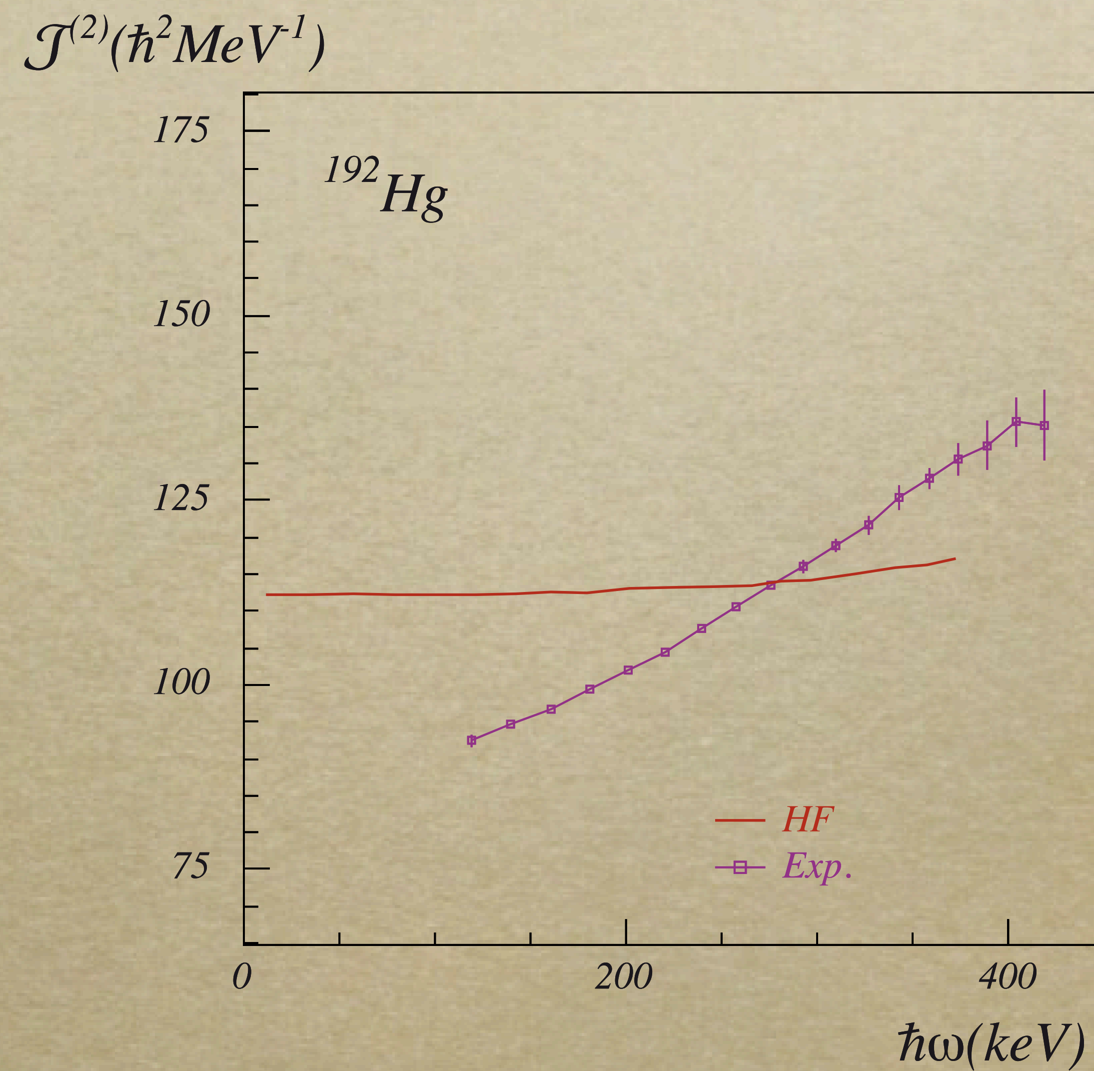
—» Pure HF almost flat



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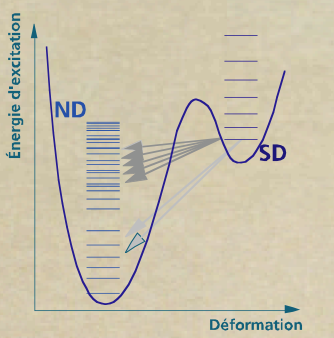

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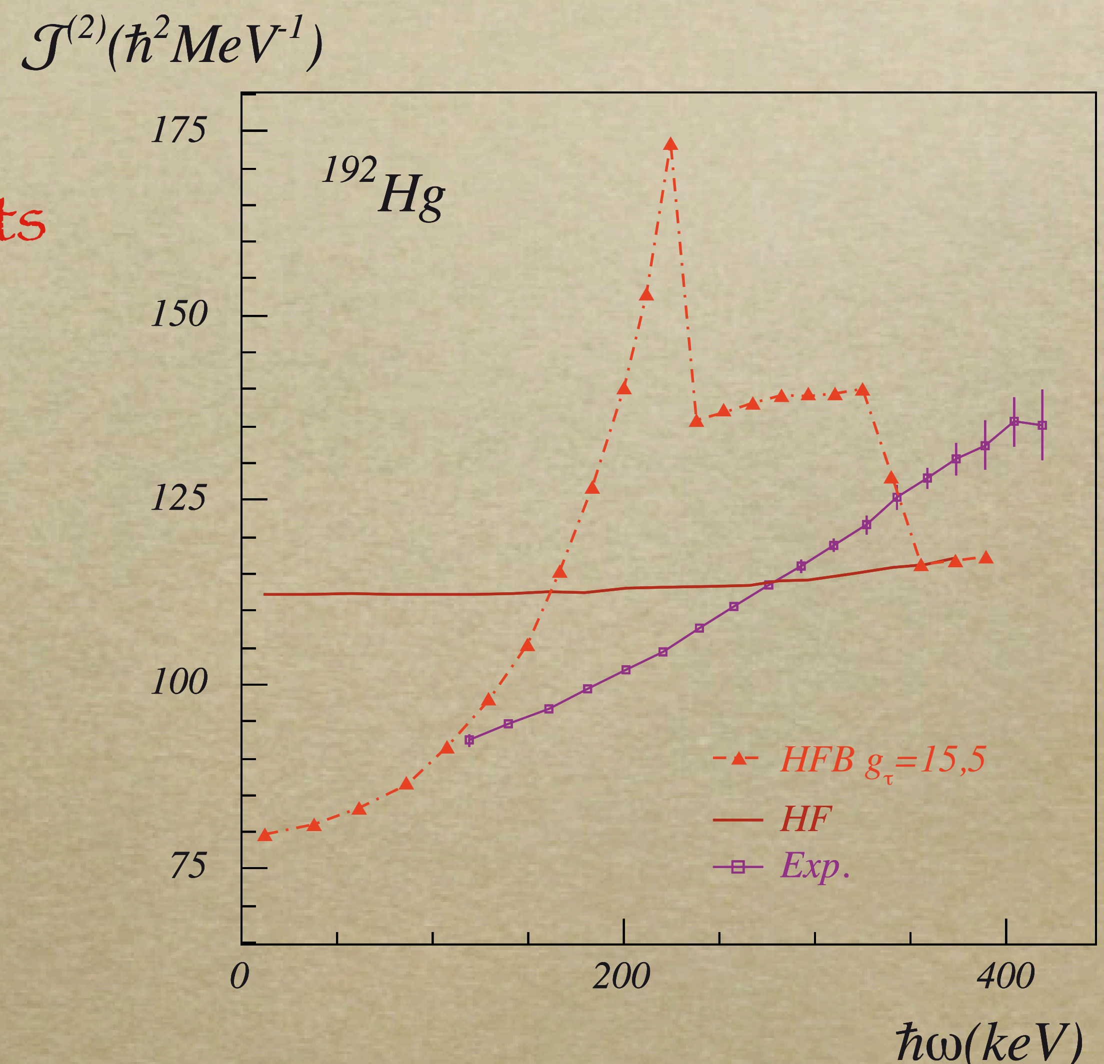
—» Pure HF almost flat

—» HFB Steady Increase but also sharp effects
ends on the HF solution at high-spin
...due to Pairing dissapearance



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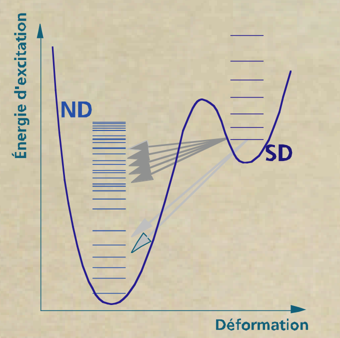

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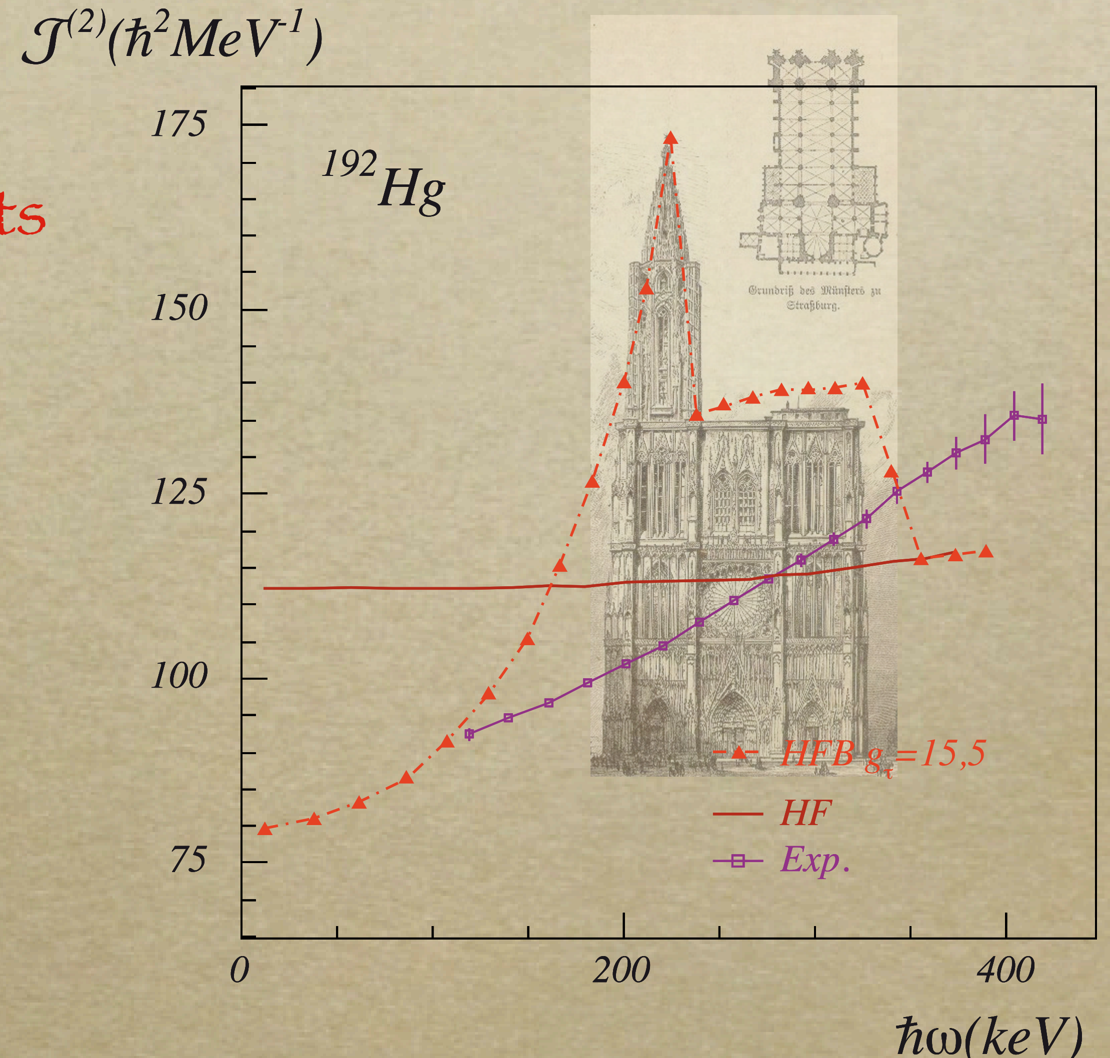

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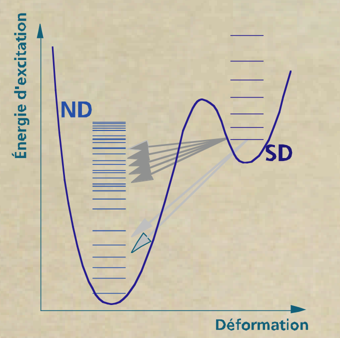

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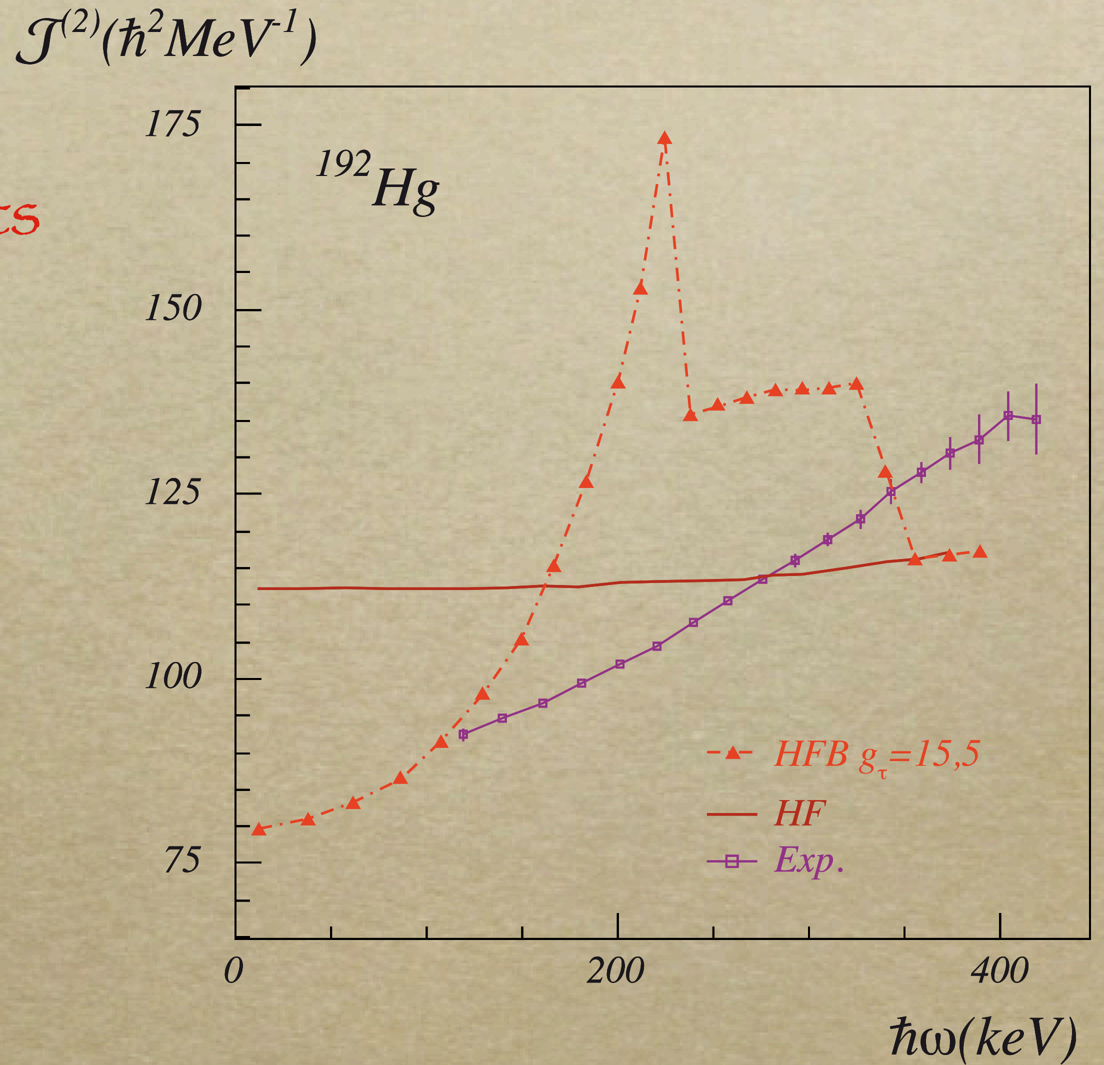
Signature of the pairing content and underlying Single-Particles orbitals



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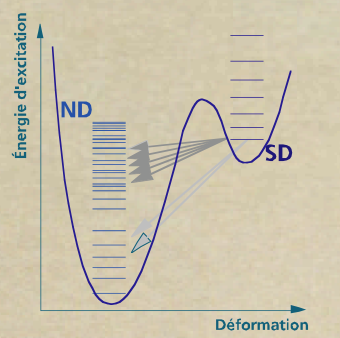
Nuclear Pairing dependance on Rotation



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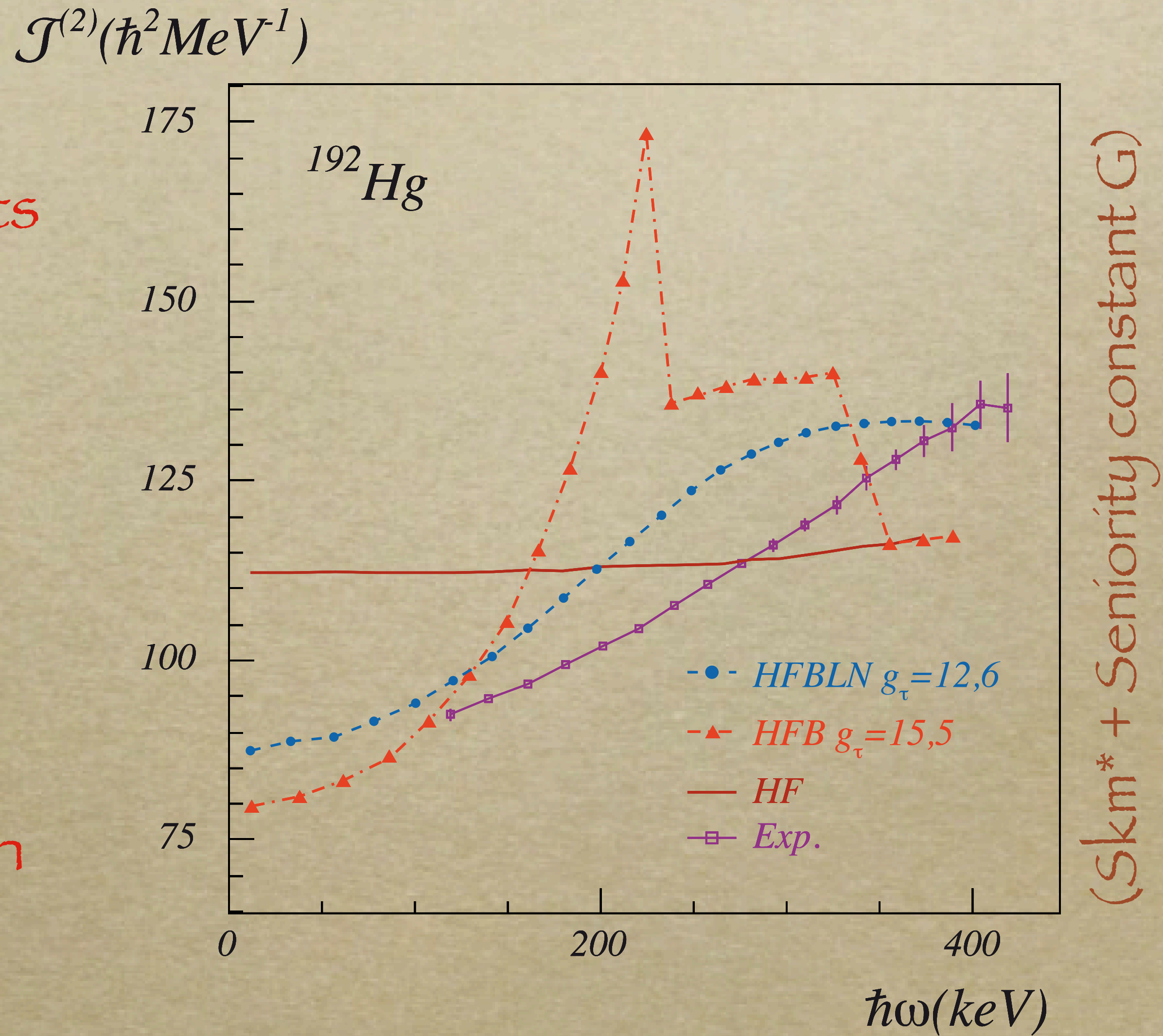
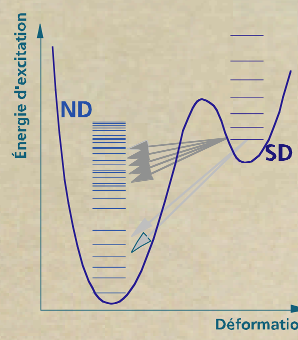
Signature of the pairing content and underlying Single-Particles orbitals

—» HFB -LN approximate particle # projection



Nuclear Pairing dependance on Rotation



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Signature of the pairing content and
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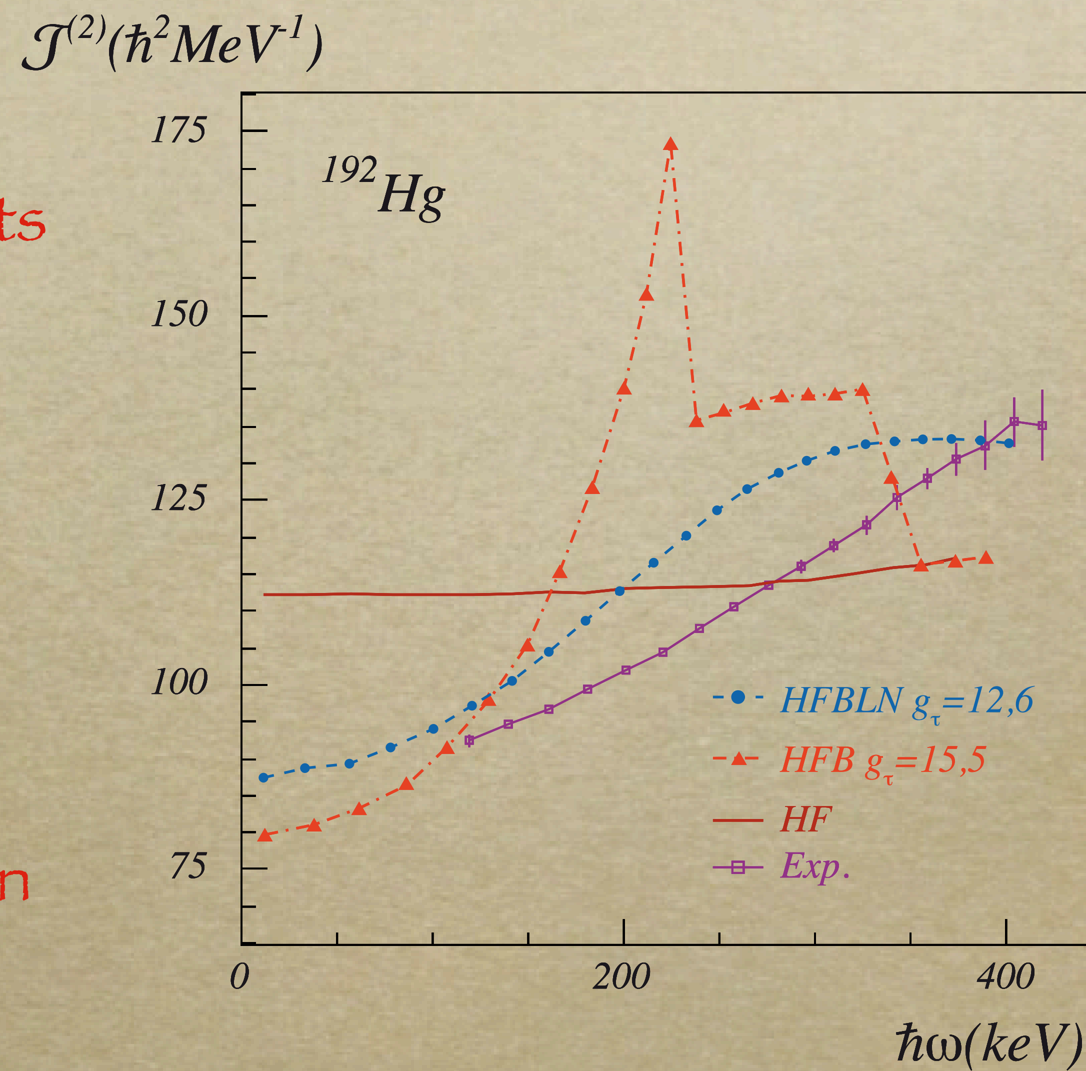
—» HFB -LN approximate particle # projection
Behaviour in agreement with experiment
Need more investigations



(Skm* + Seniority constant G)

On the good way ...

Improvements of the nuclear pairing description

SD-Bands in A=150 ...

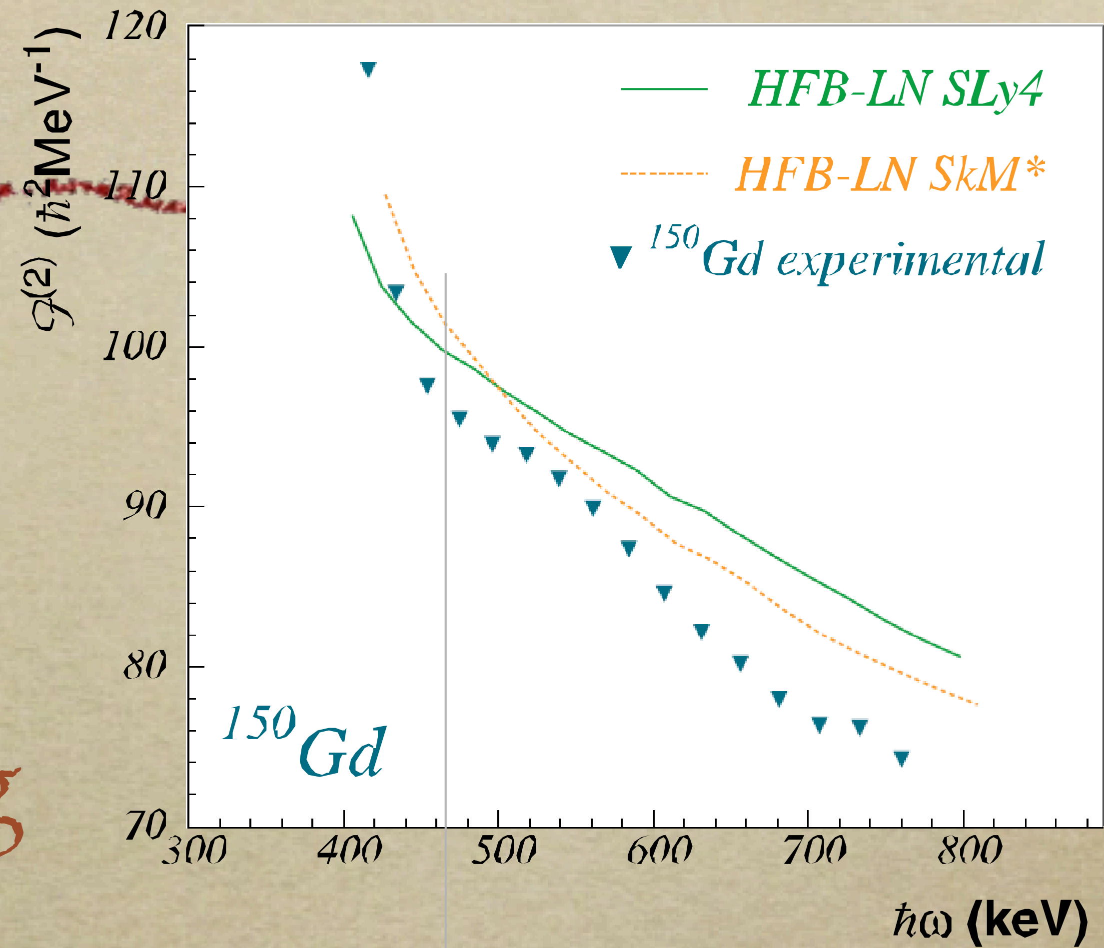
... Nuclear pairing still alive !

Implementation of a delta Pairing

$$V_p = \frac{V_0}{2}.(1-P^{\sigma}).\left(1-\frac{\rho(r_1)}{\rho_c}\right).\delta(r_1-r_2)$$

[J. Terasaki et al., NP A593(1995)1]

- determination of the right intensity
- Behaviour in agreement with experiment
- ID- Bands : Signature of the underlying Single-Particles orbitals (intruders)

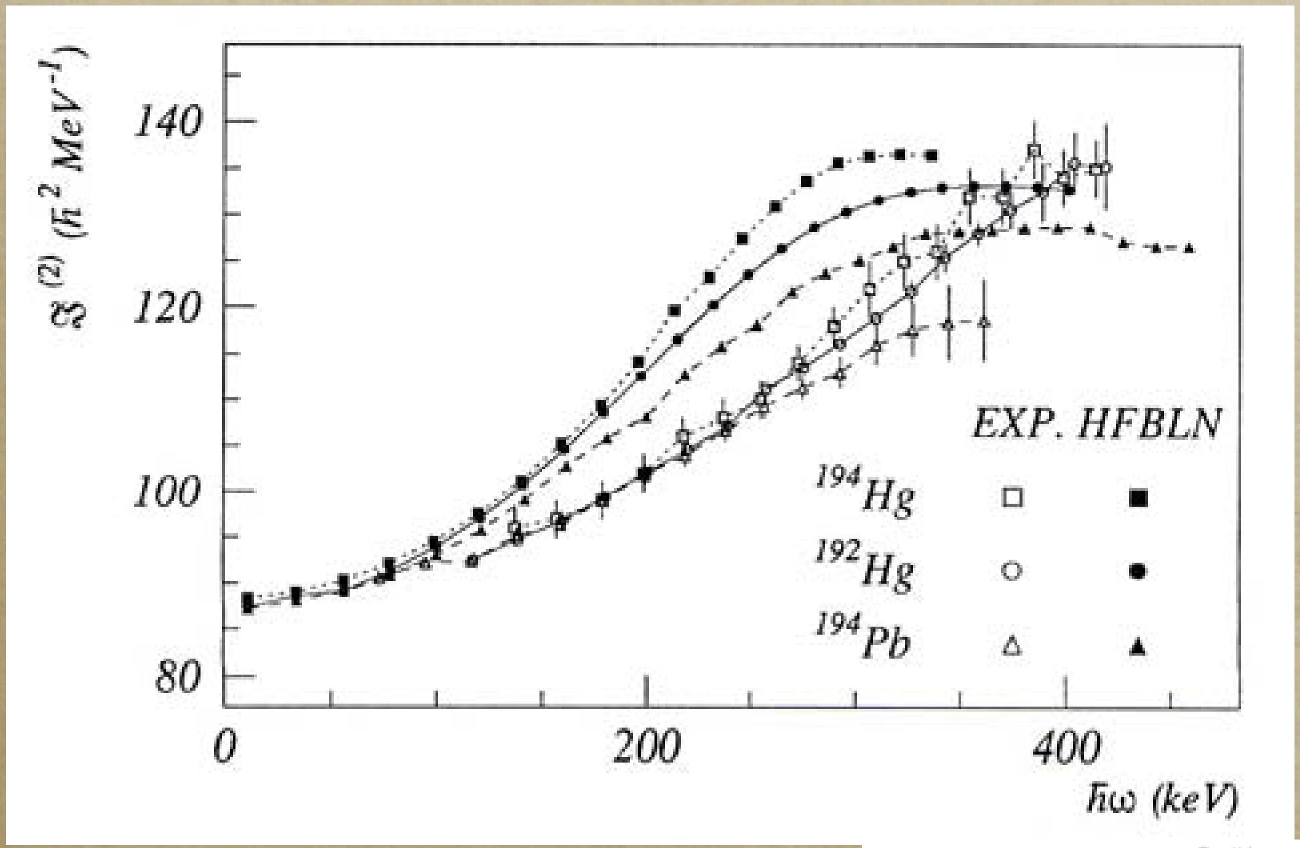


Active Pairing   No more Pairing

	SLy4	SkM*
1 cut	1000	880
2 cuts	1250	nd

C. Rigollet PhD at CRN Strasbourg

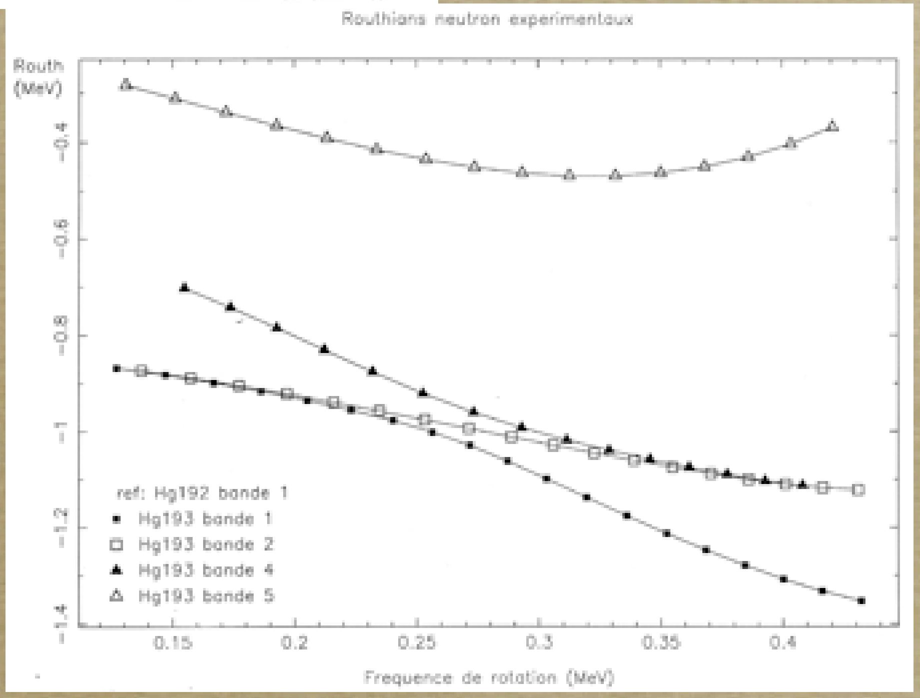
Experiment-Theory : complemantarity

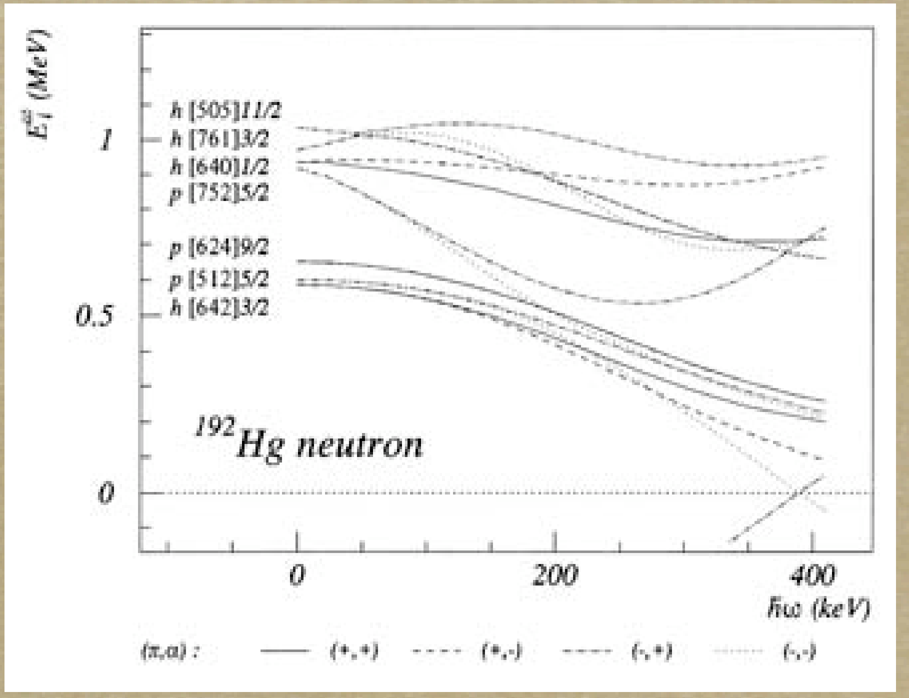


A ≈190 Sd Bands All Identical ?

- Behaviour in agreement with experiment
- Signature of the pairing content and underlying Single-Particles orbitals

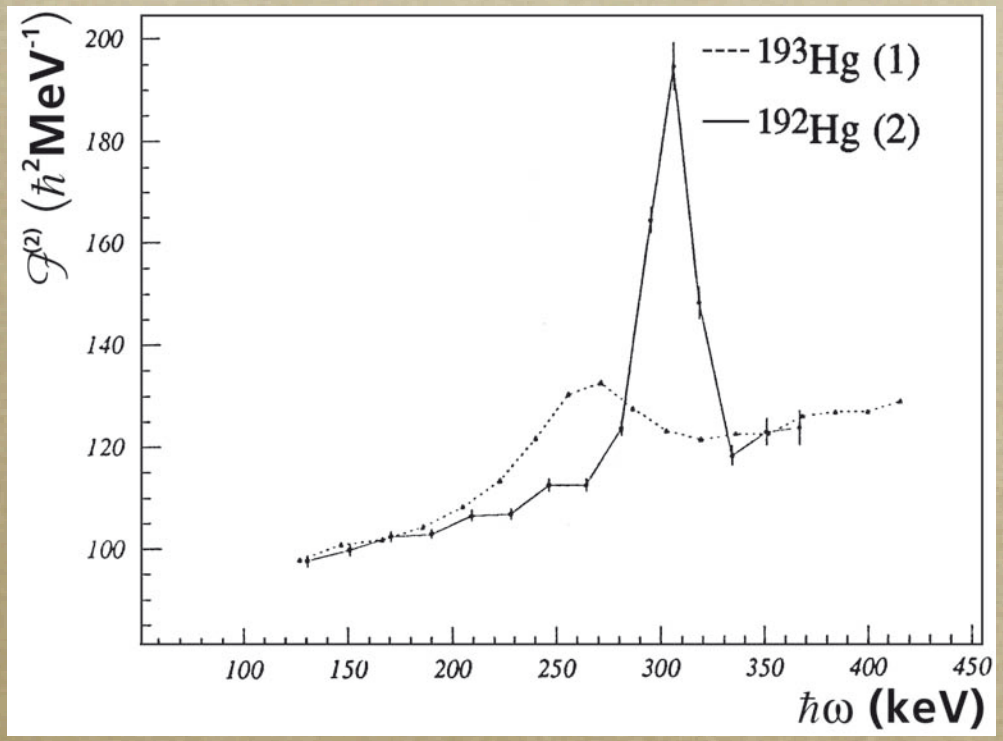
Complementarity

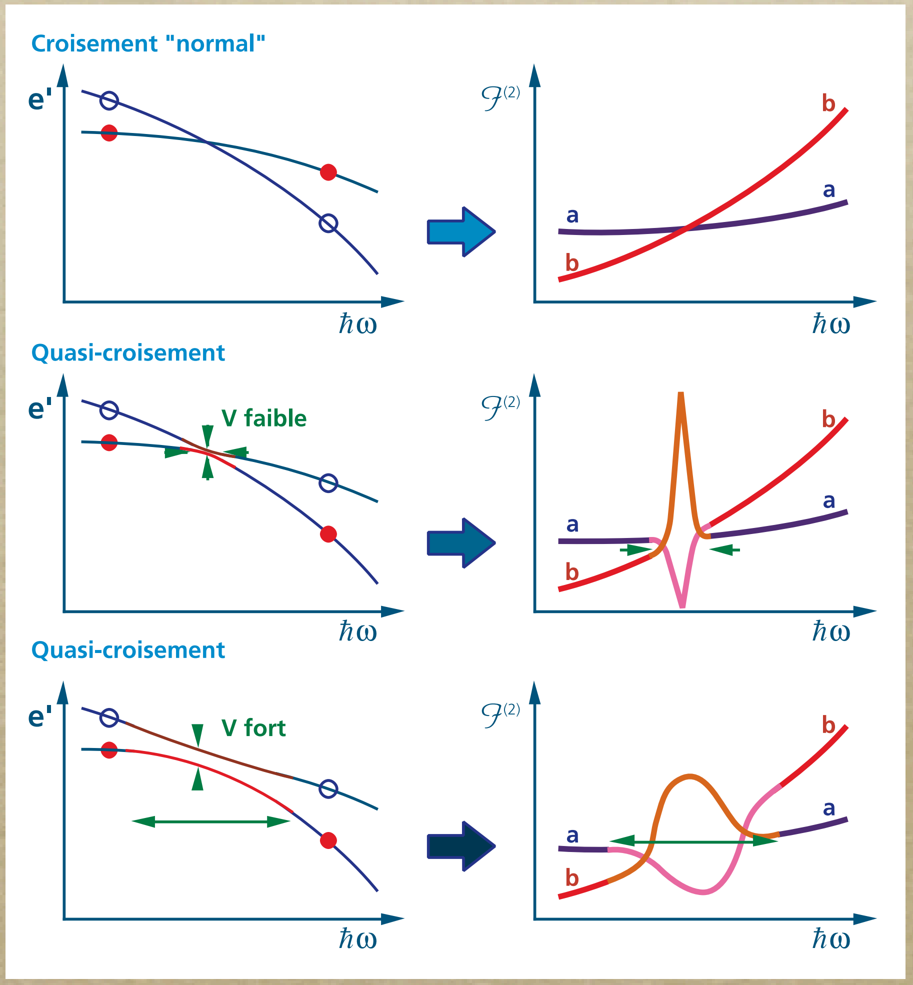


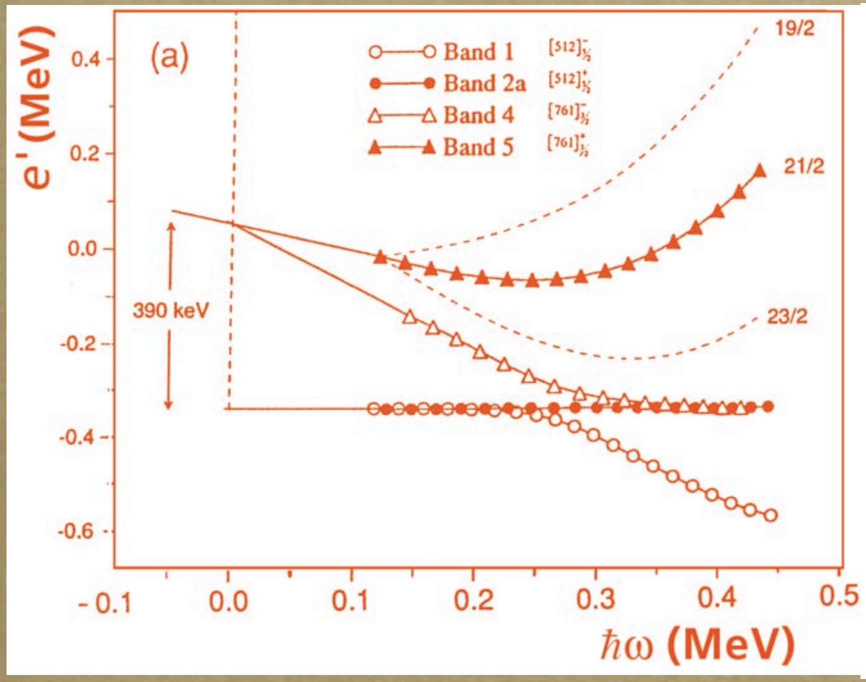


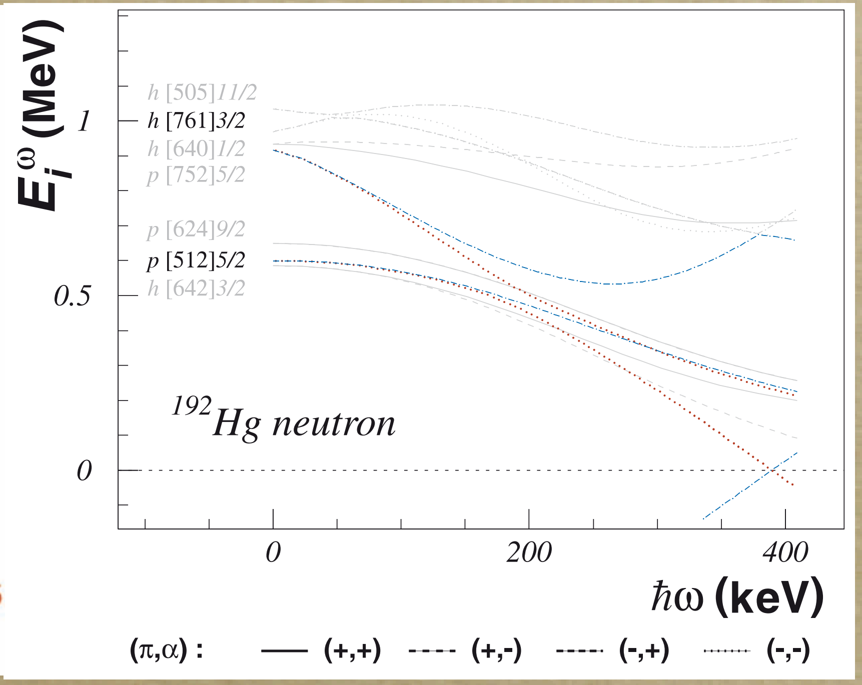
Orbital crossing

[512]5/2 et [761]3/2 crossing in ^{193}Hg (1) and ^{192}Hg (2)

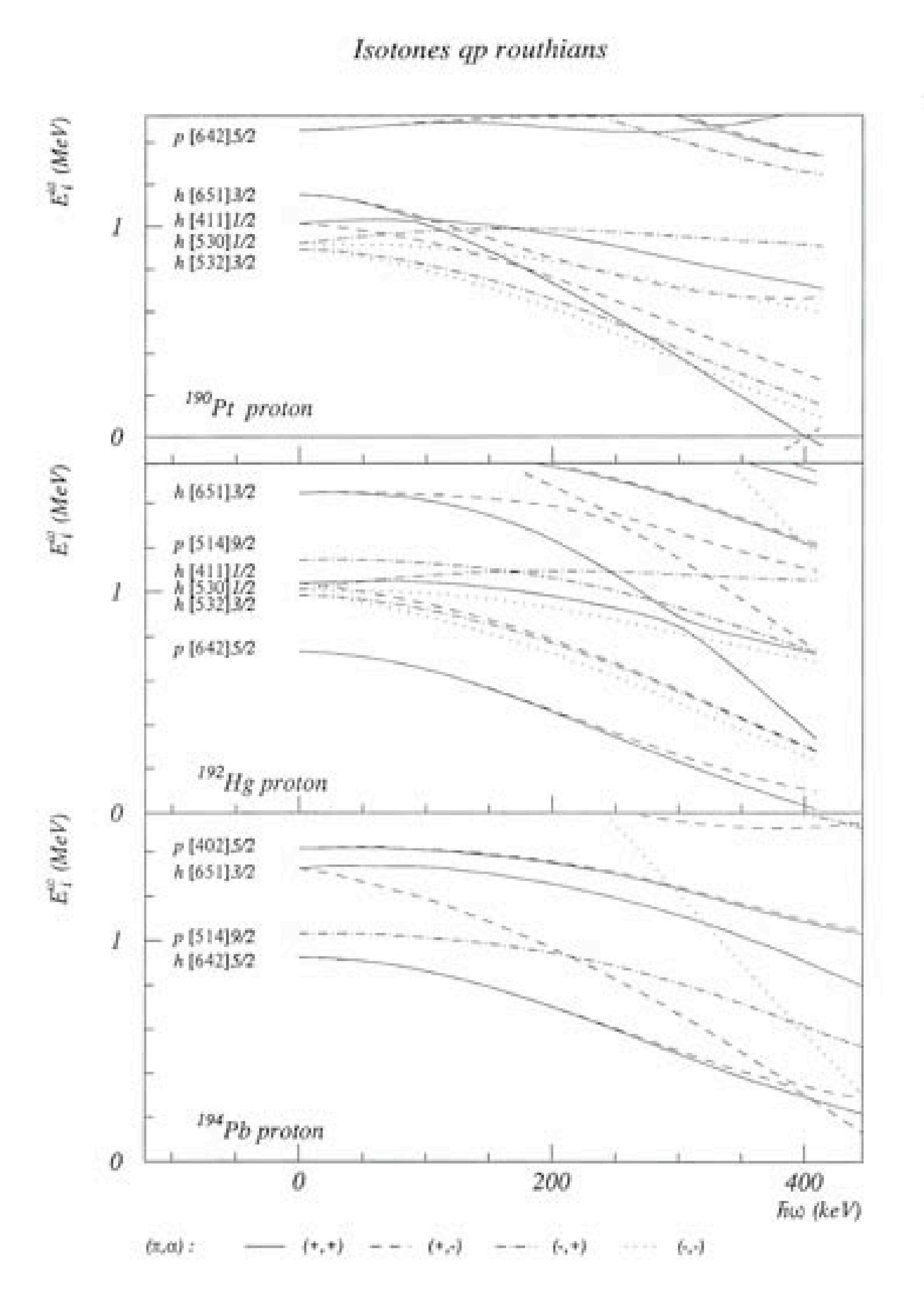




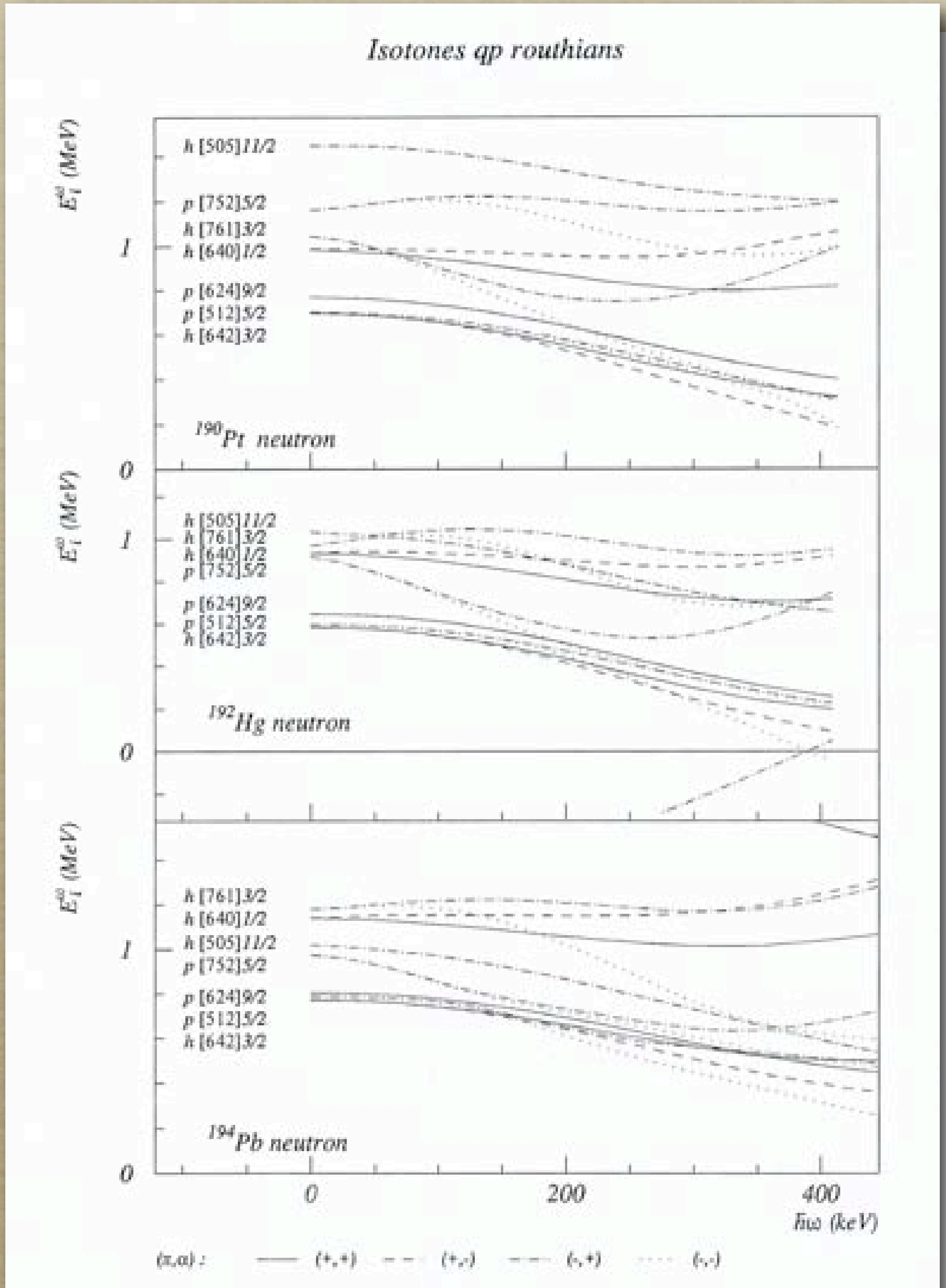




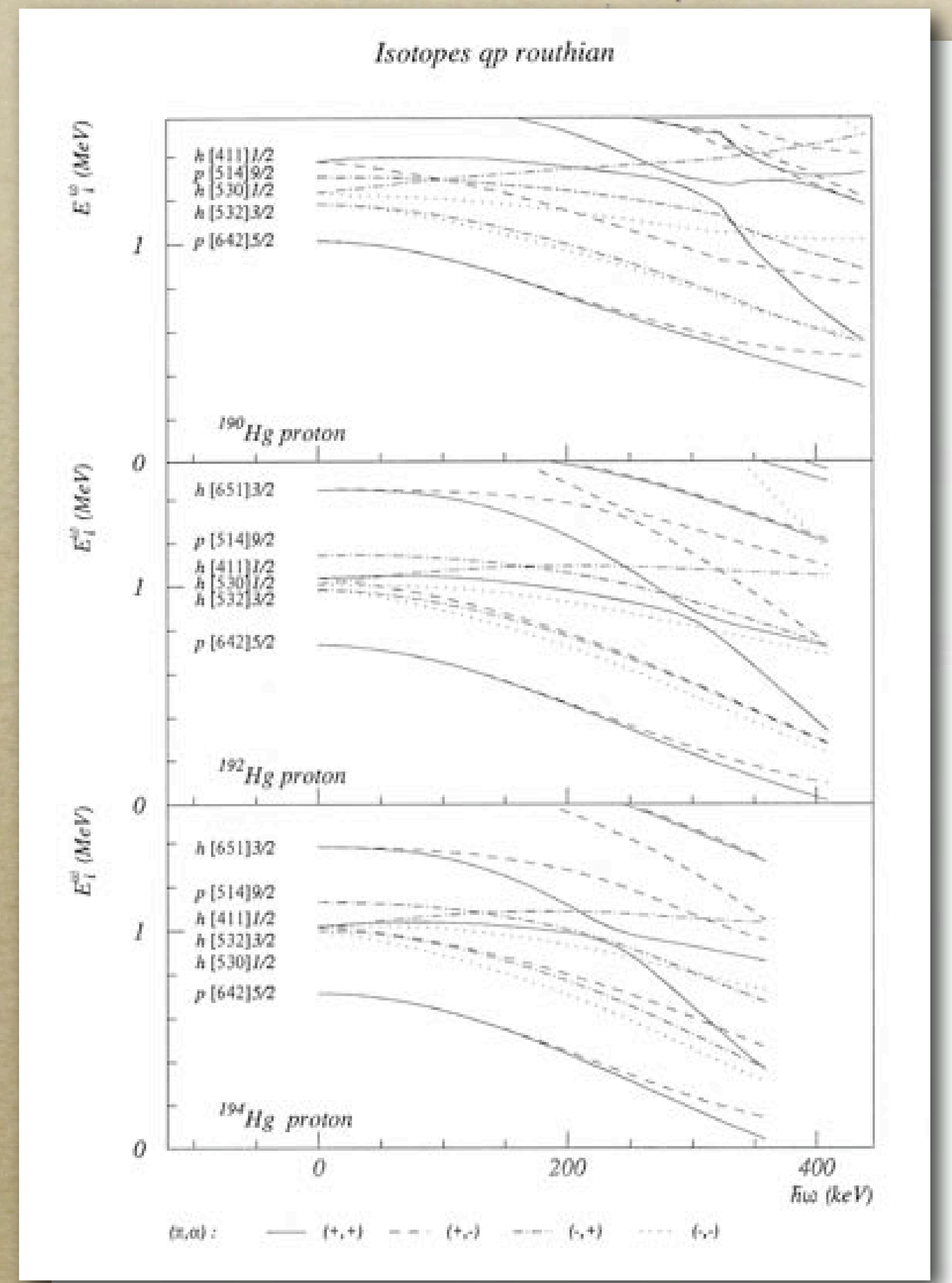
Experiment-Theory : complemantarity



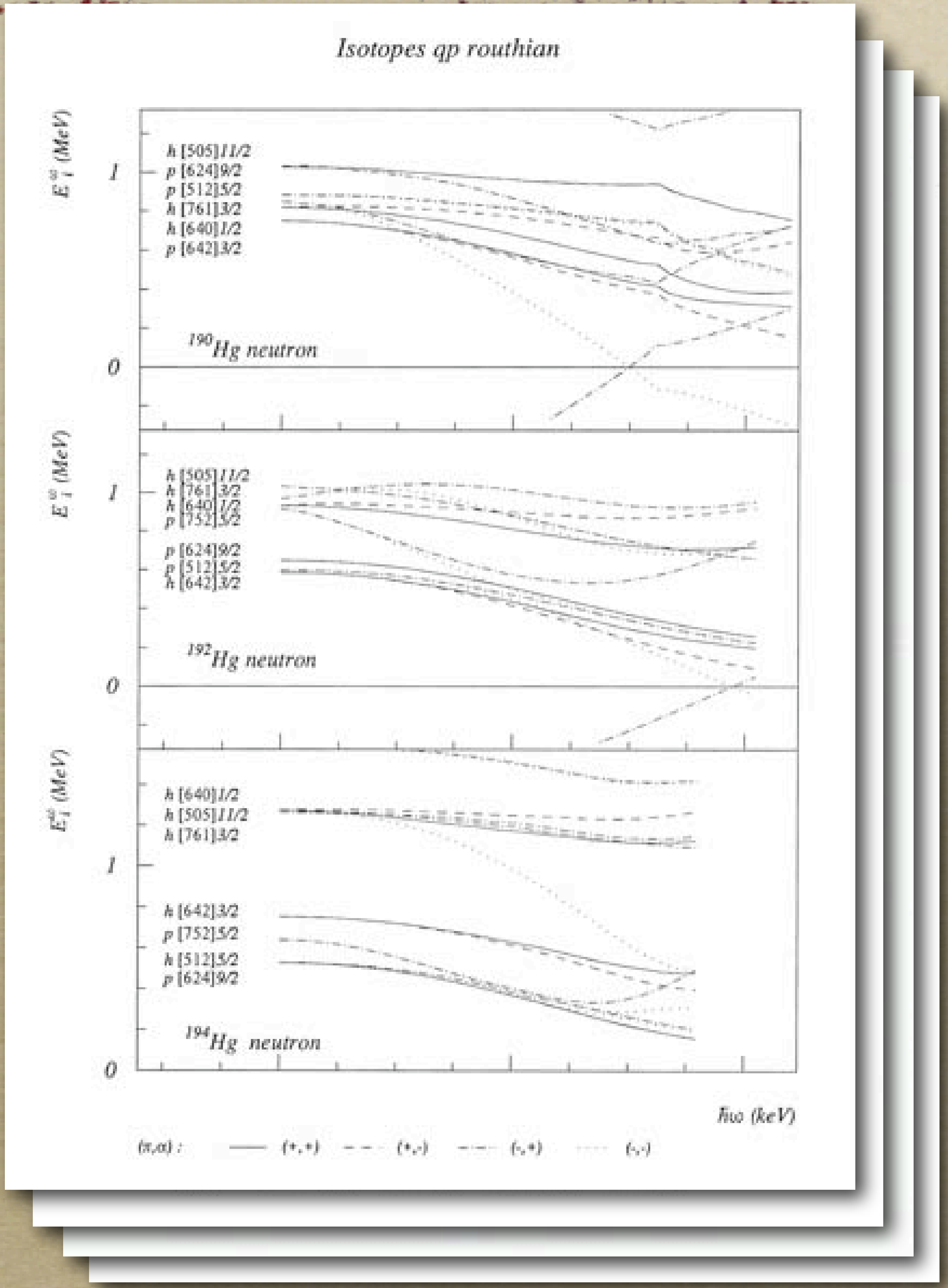
Experiment-Theory : complemantarity



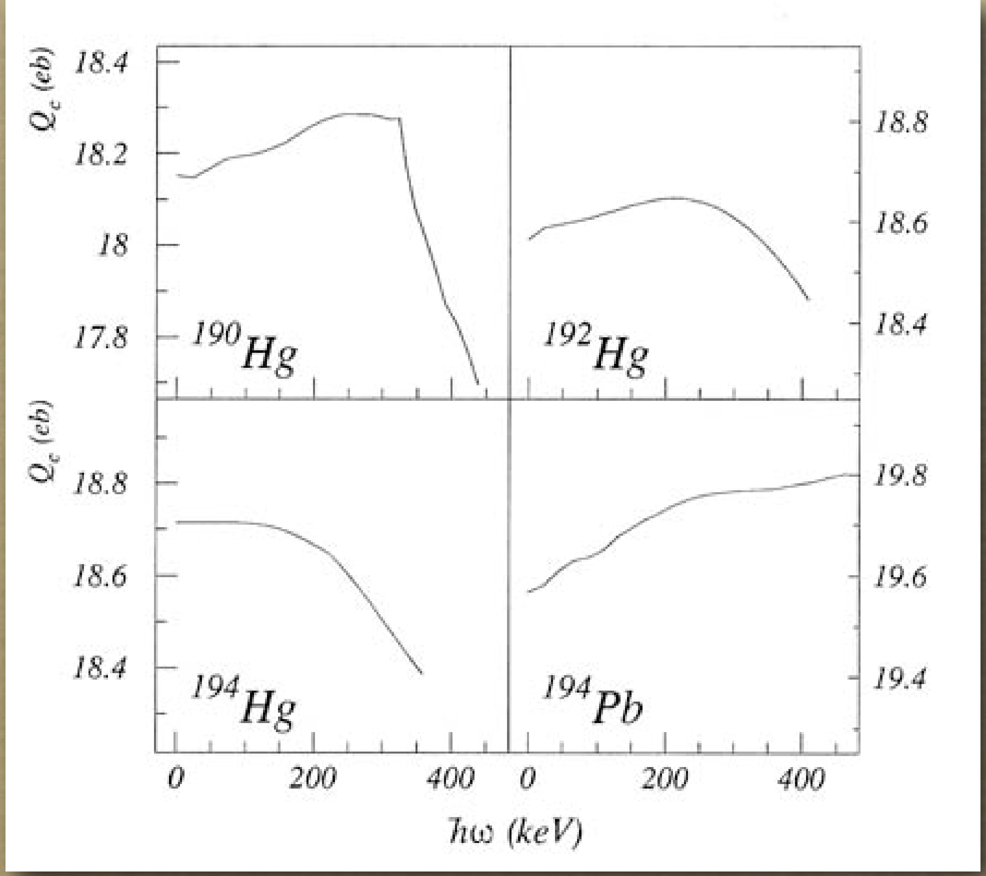
Experiment-Theory : complemantarity

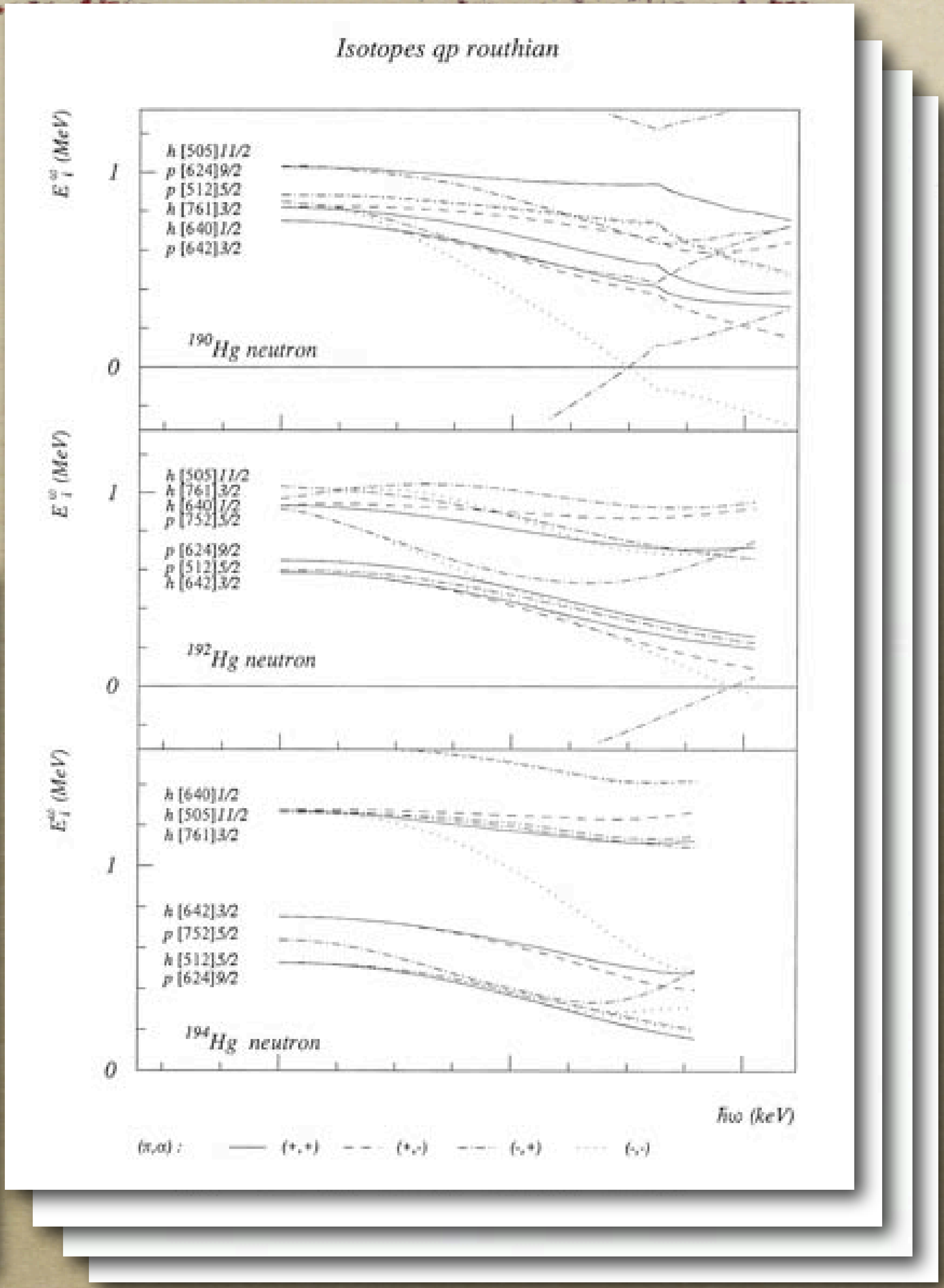


Experiment-Theory : complemantarity

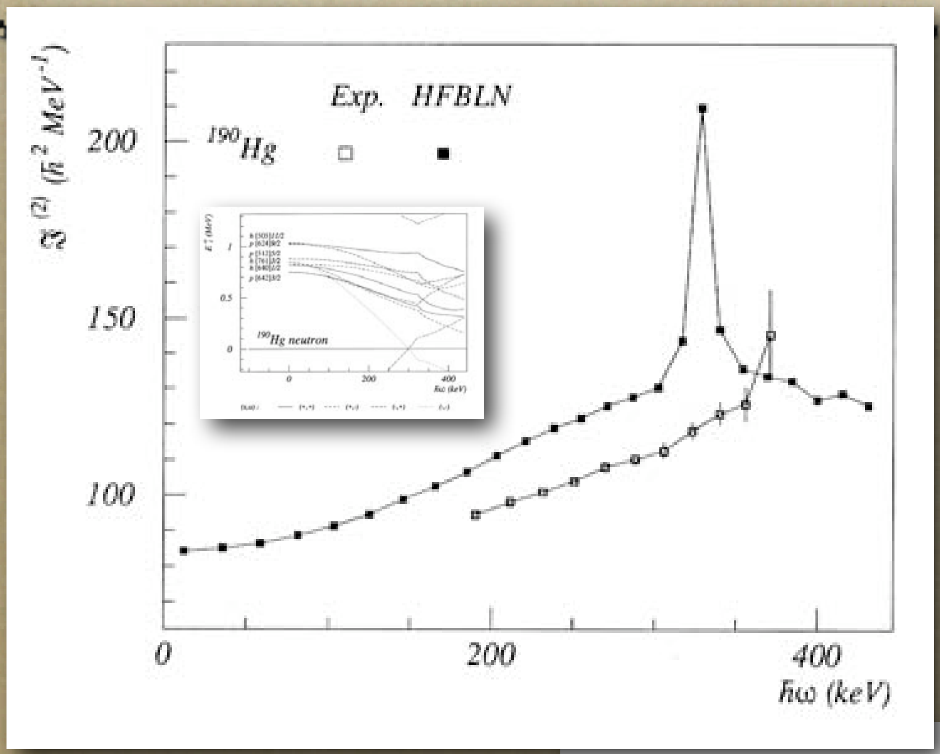


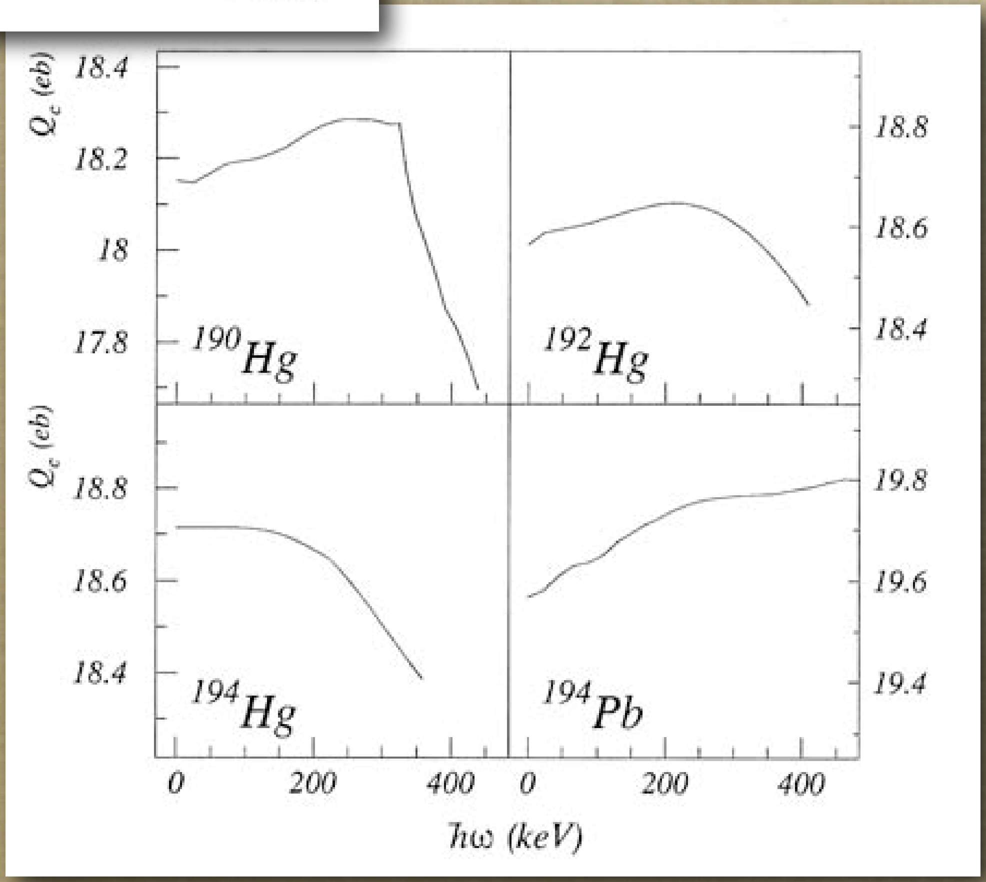
Experiment-Theory : complemantarity

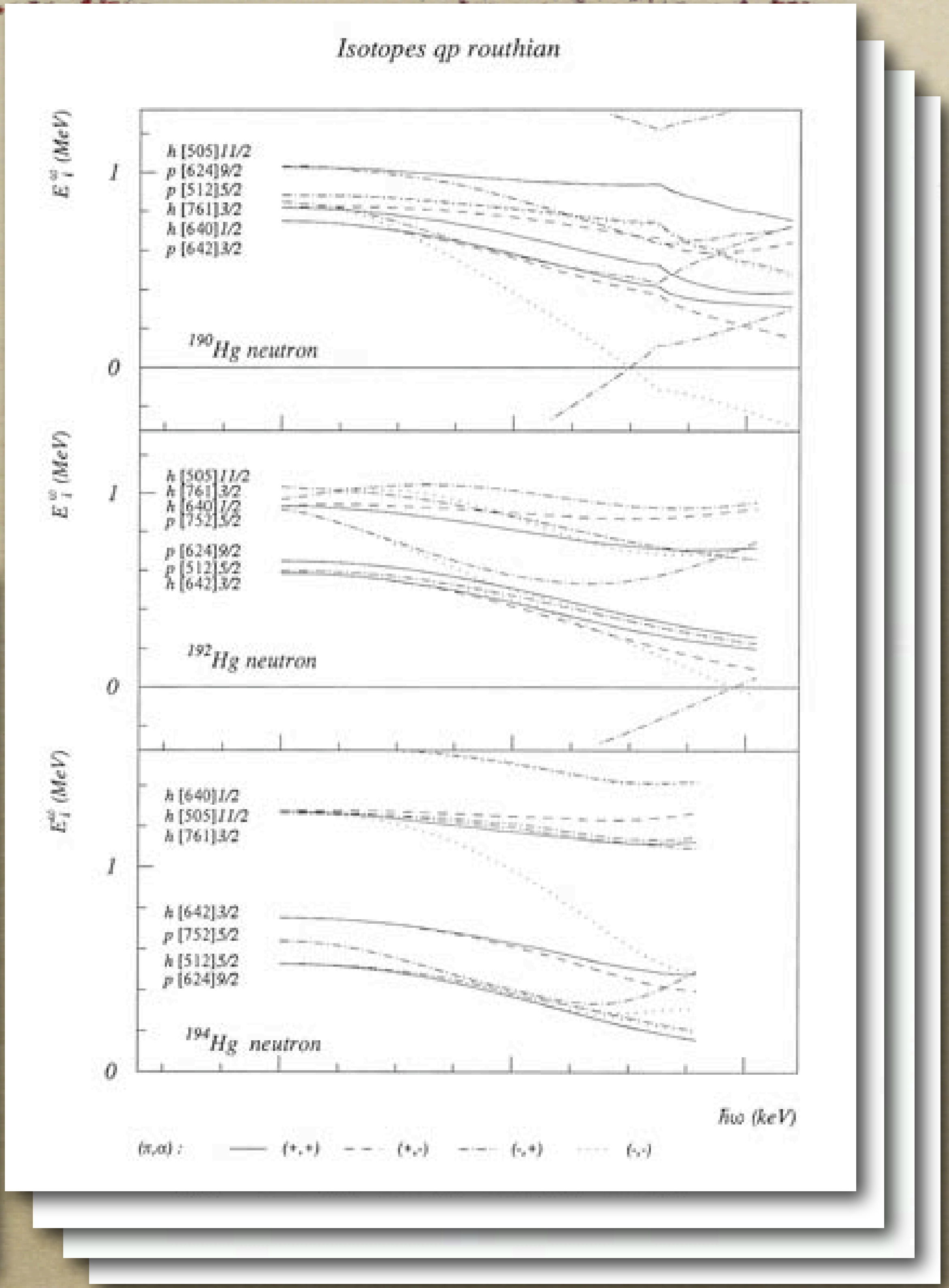




Experiment-Theory : complemantarity





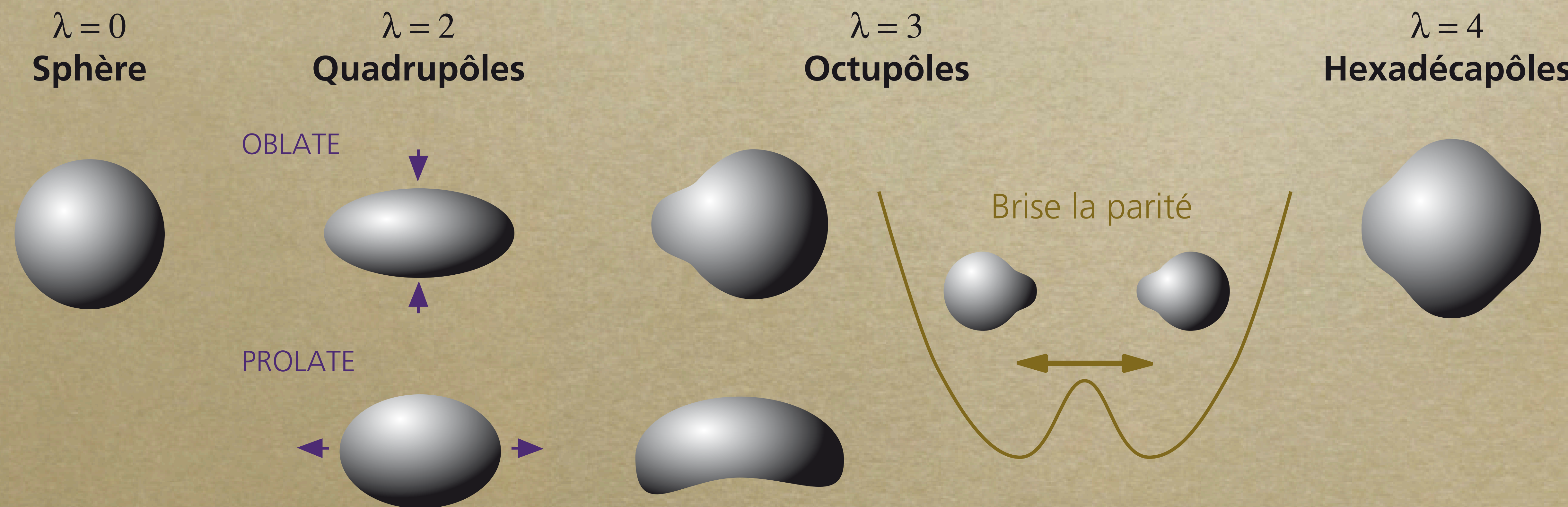


Outline

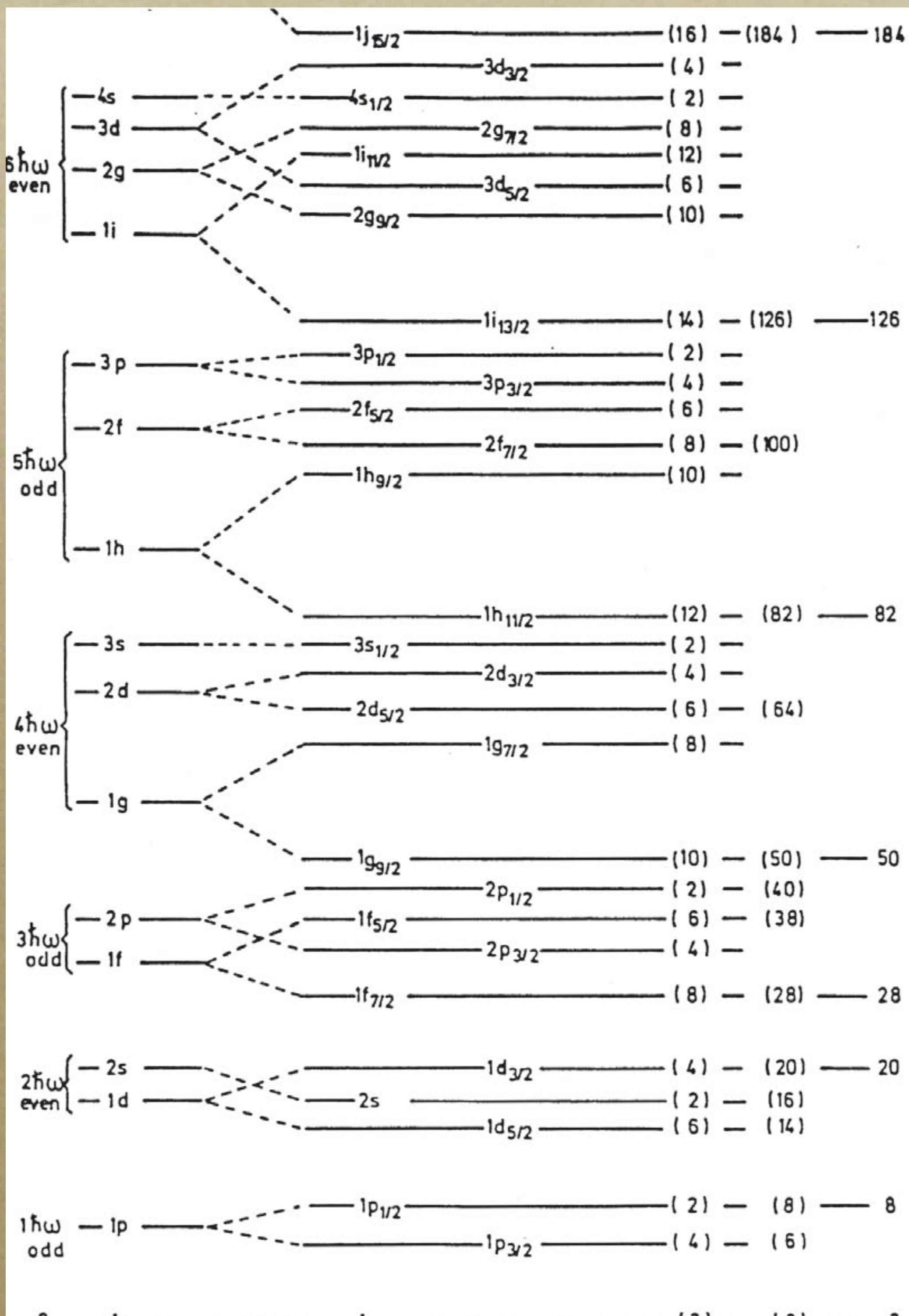
- Preliminary considerations
- Excitations of the nuclei; case of rotationnal bands
- Effect of Nuclear deformation
- Experimental toolboxes & selected cases

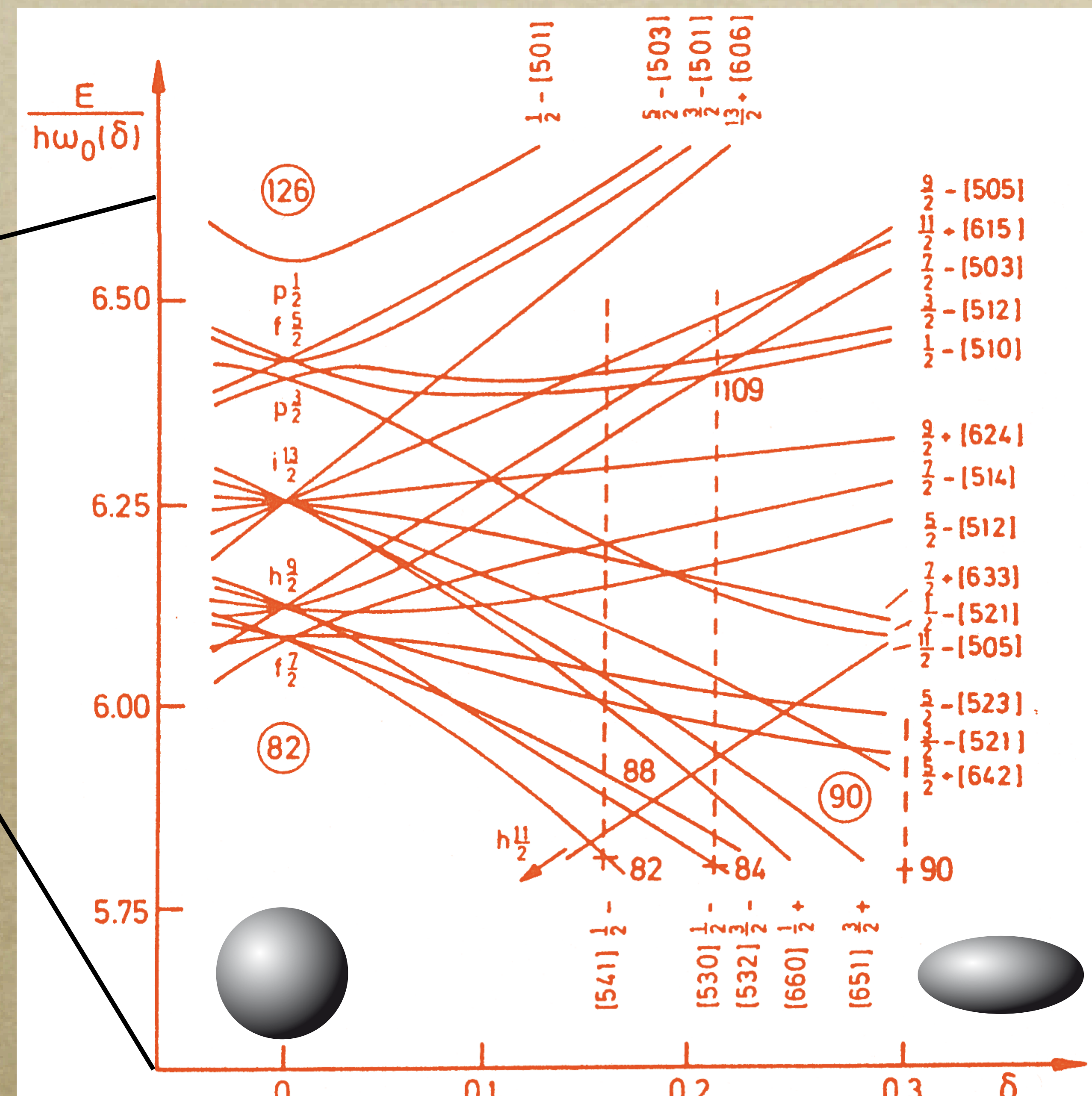
Simples nuclear shapes

Parametrisation of the nuclear radius : $R(\theta,\phi) \propto Y_{\lambda\mu}(\theta,\phi)$



Effect of deformation on e_{sp}





Les VHE ...
on the road to SHE

What are the SHE gaps ?

Deformed gaps in VHE ...

Common Orbitals ? ...

Prompt Spectroscopy :

- Moment of inertia
- g-factor (odd nuclei)

Decay spectroscopy

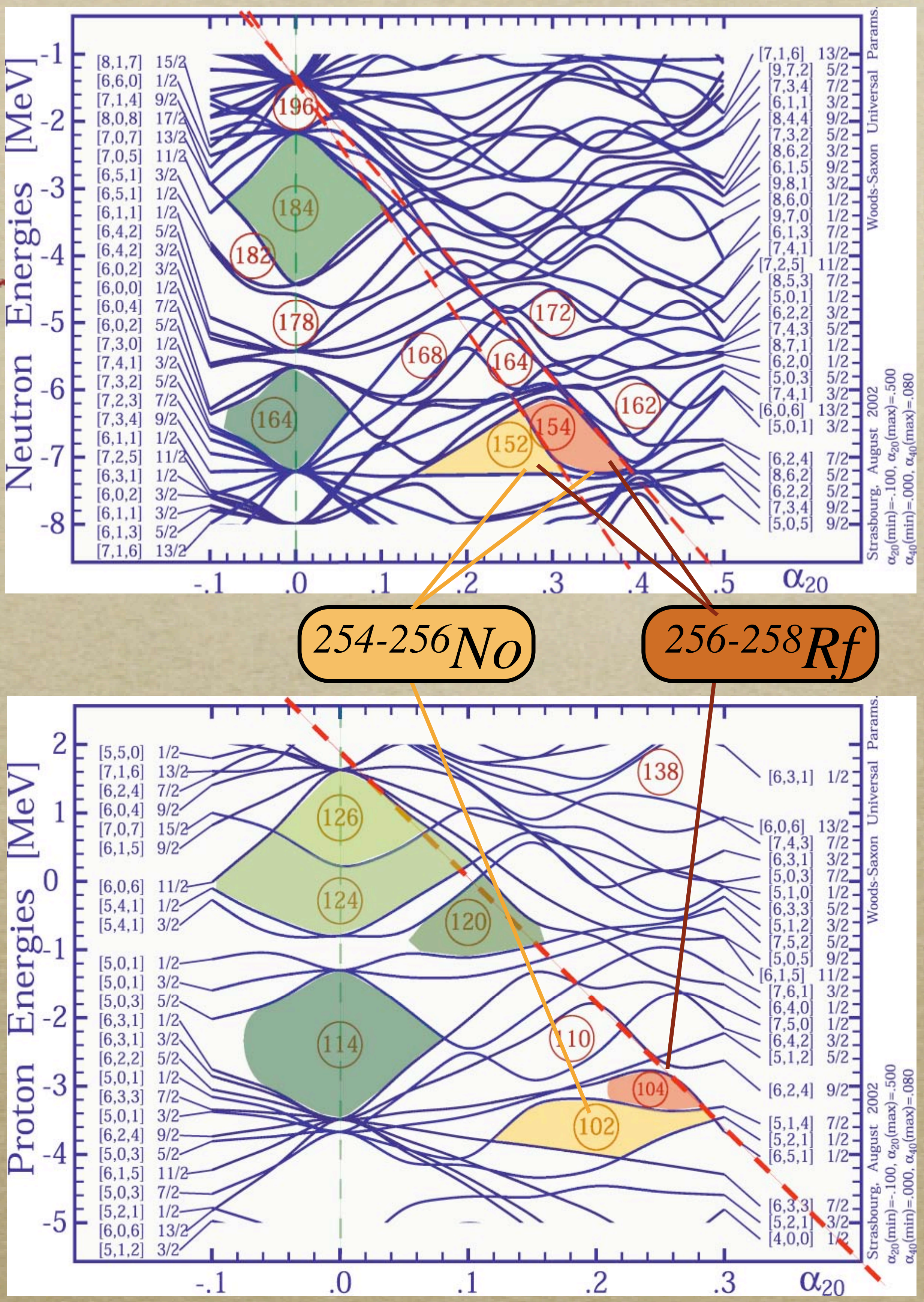
- isomers

Contraints on the different theories

Cf. D. Ackermann's talk

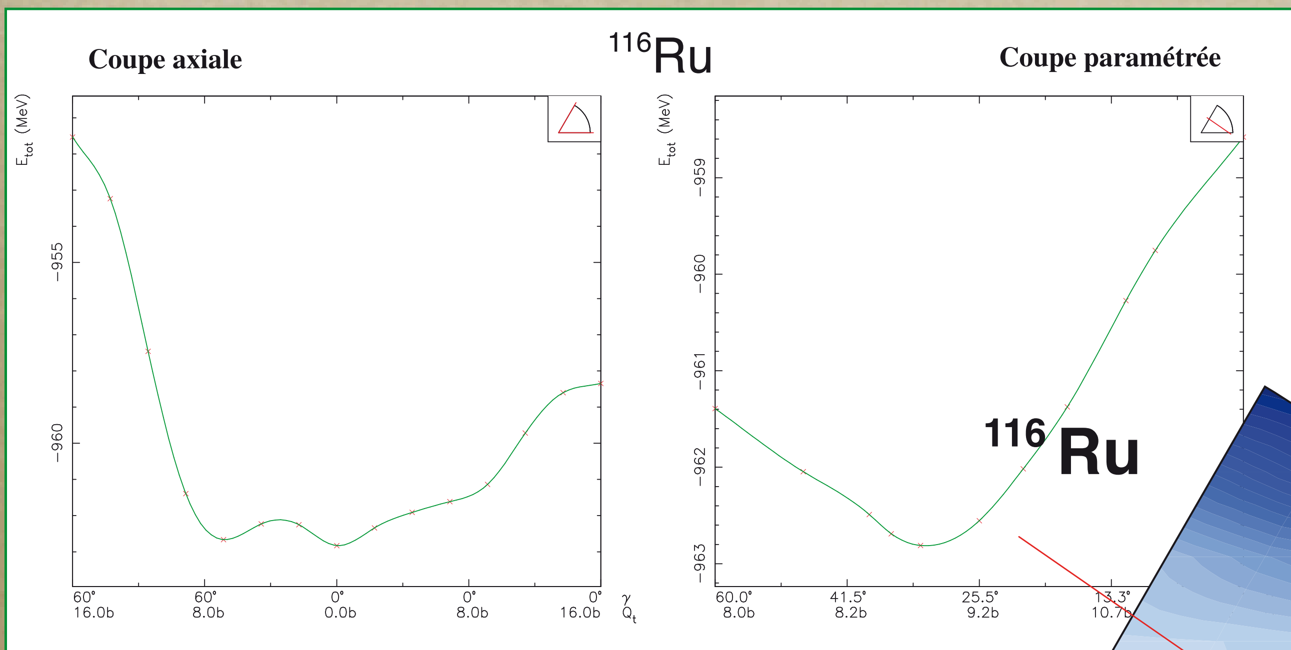
Spectroscopy of Z >100 fruitfull but...

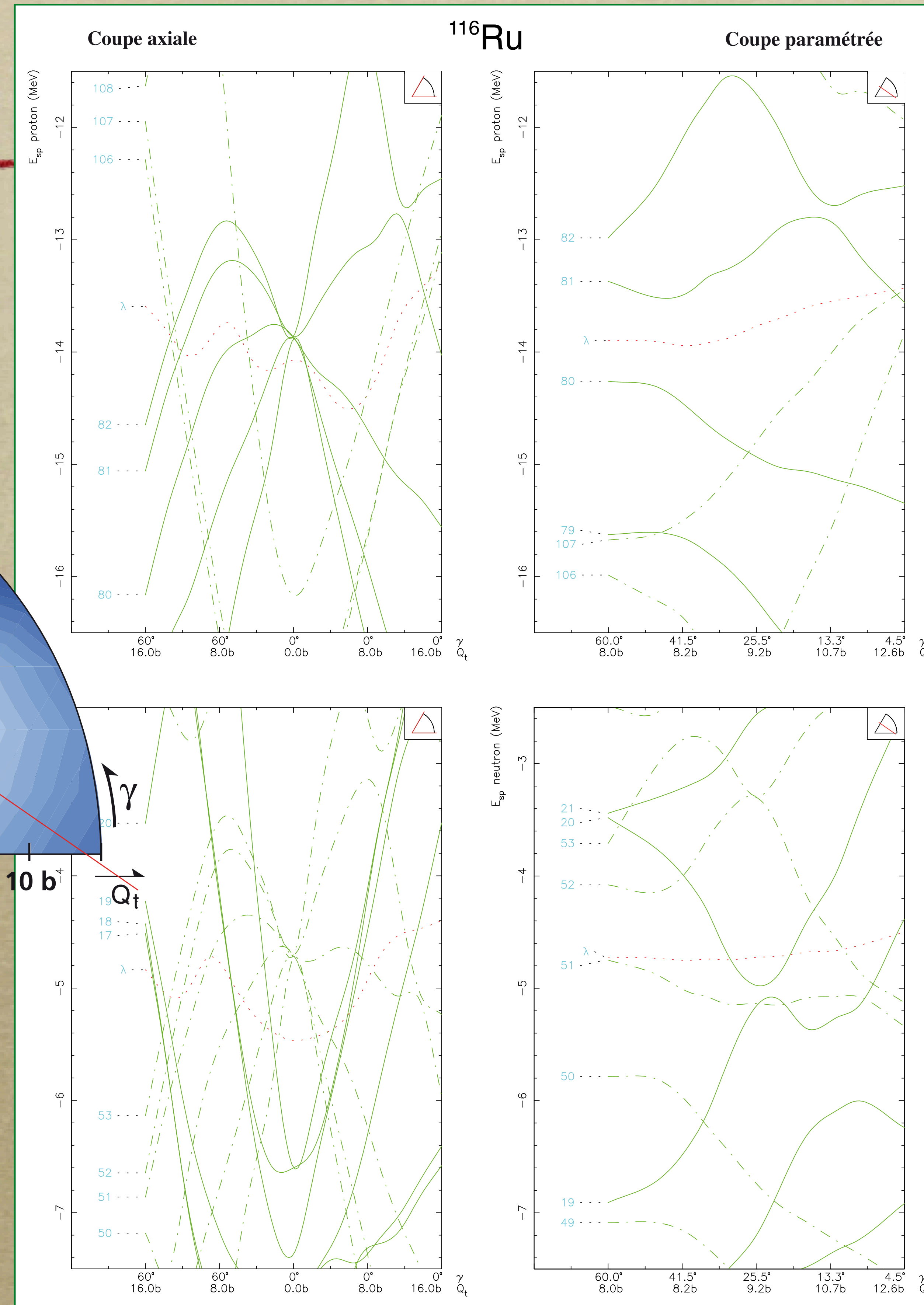
- Very low production cross-sections
- and low-energy transitions highly-converted ...

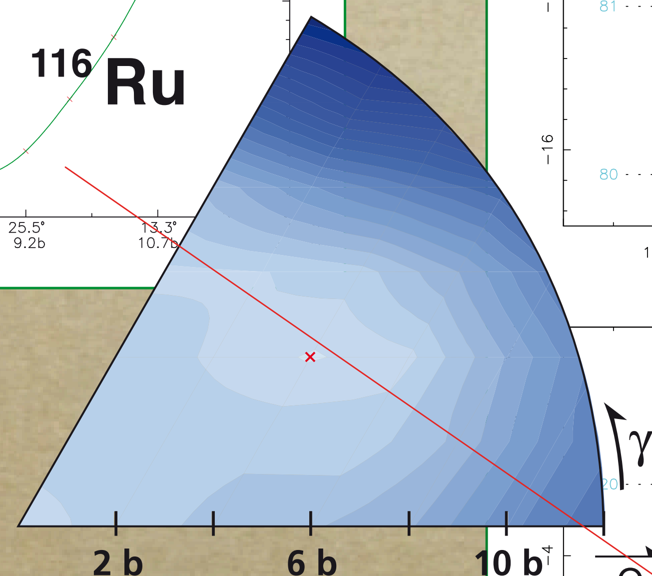


Need of new developpments

A ~ 100 Neutron-rich Nuclei Spectroscopy

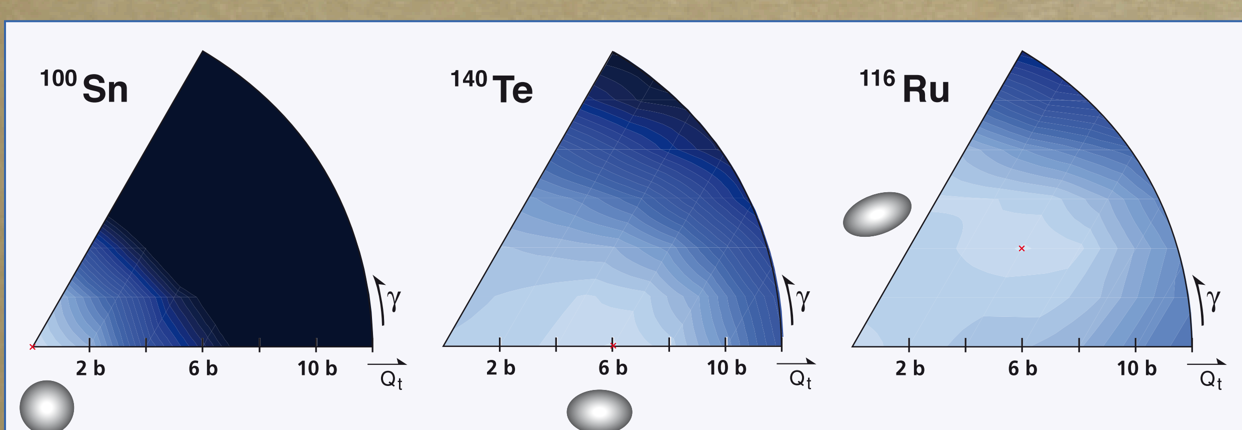






Triaxial nucleus

Diagonal cuts ...

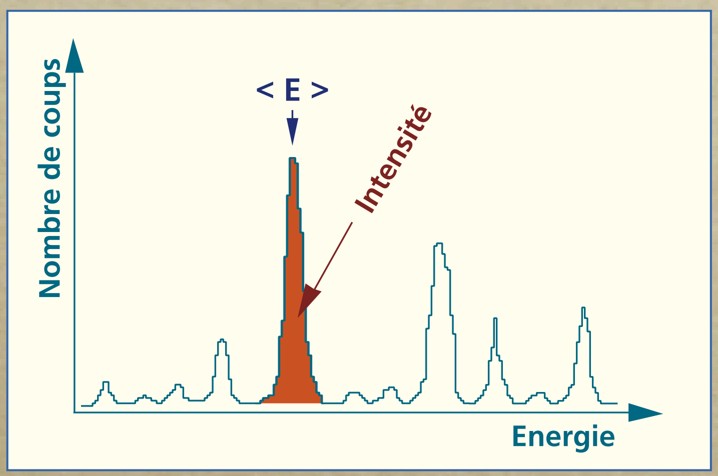


Outline

- Preliminary considerations
- Excitations of the nuclei; case of rotationnal bands
- Effect of Nuclear deformation
- Experimental toolboxes & selected cases

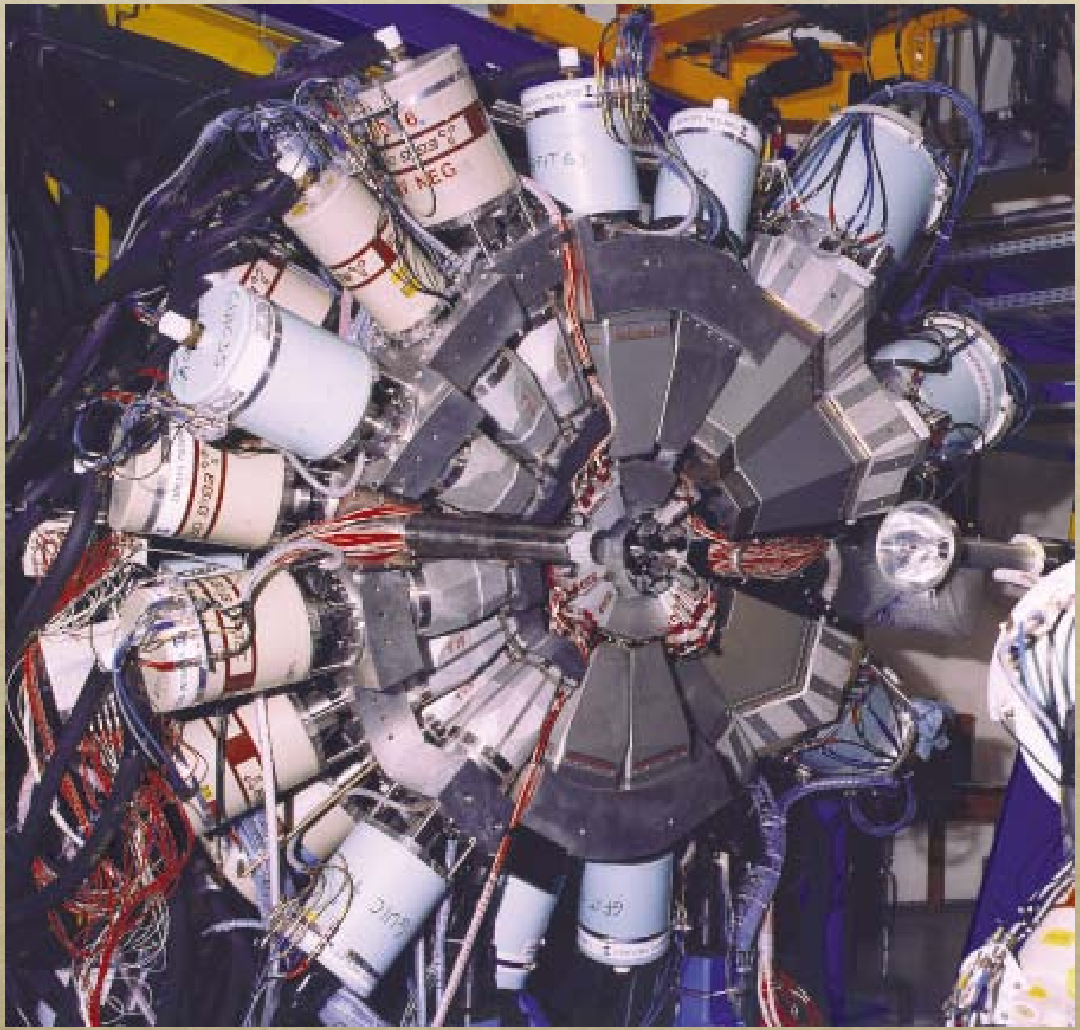
Experimental toolbox ...

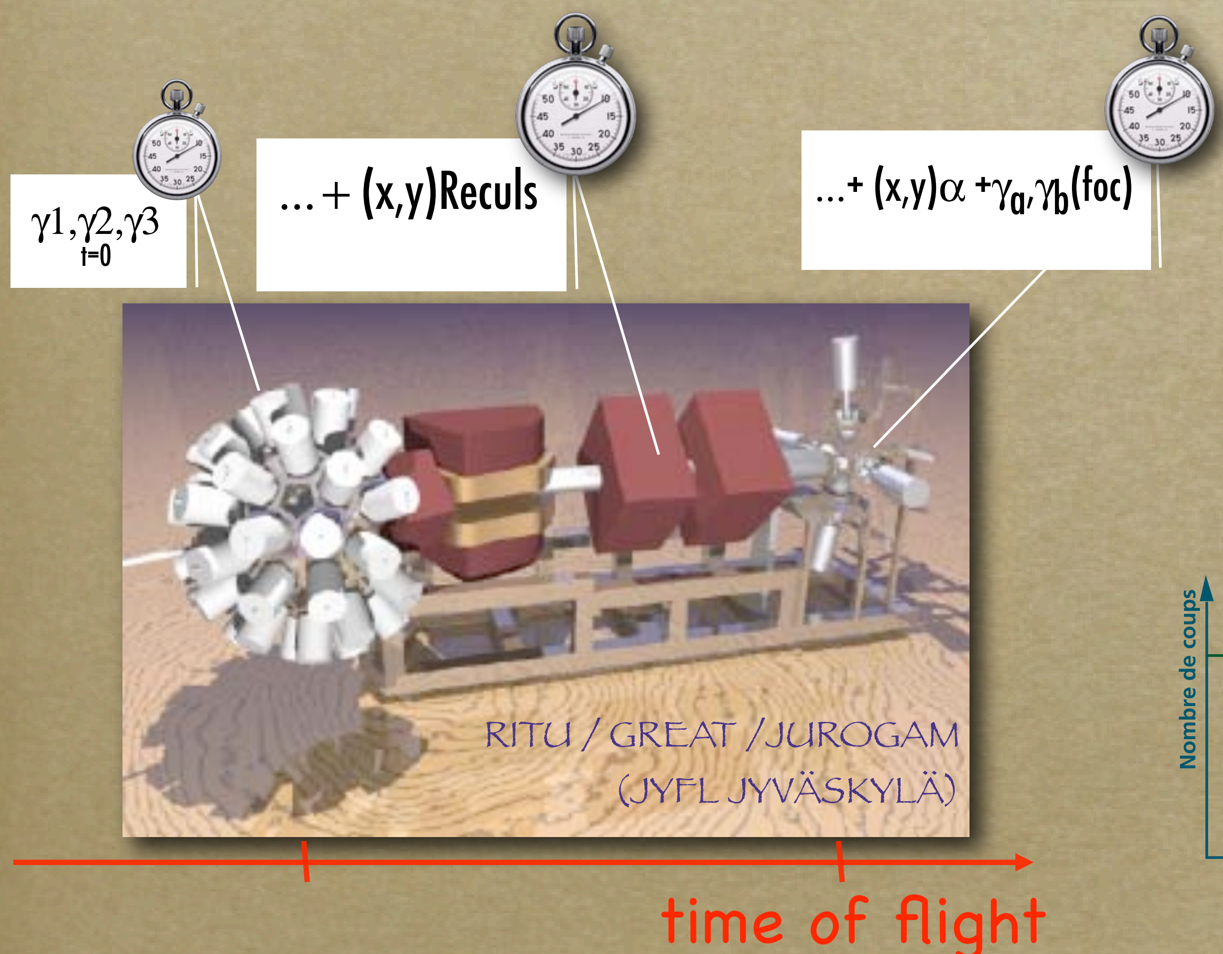
... & selected cases

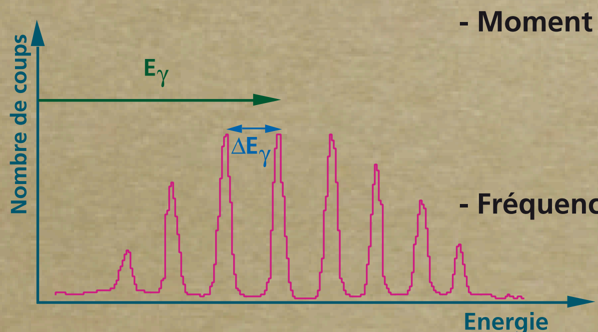


$$Q_0(eb) = \iiint \rho_p.(3z^2-r^2).dv$$

$$B(E2, I_i \rightarrow I_f) = \frac{5}{16\pi} e^2 Q_0^2 \langle I_i\, 2\, K\, 0 \mid I_f\, K \rangle^2$$





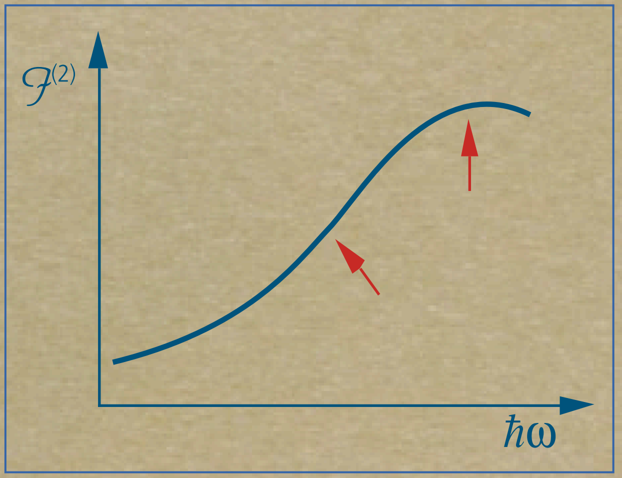


- Moment d'inertie dynamique :

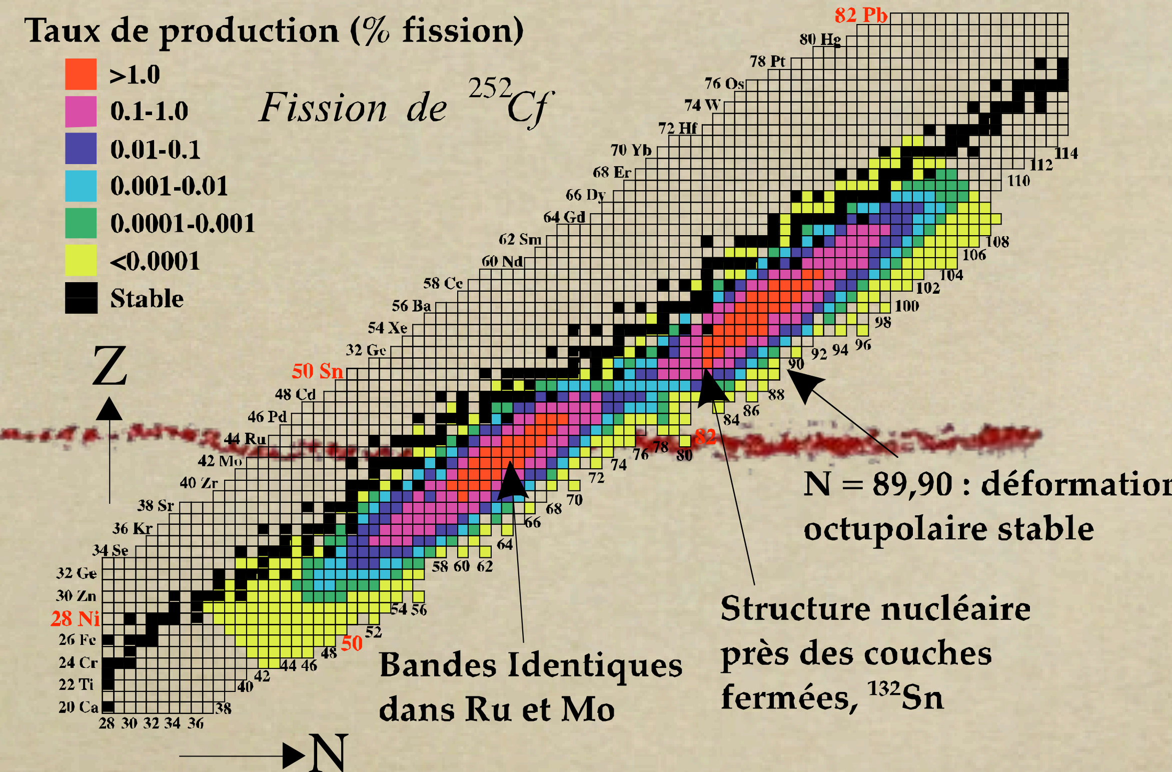
$$\mathcal{J}^{(2)} = \frac{\Delta E_\gamma}{4}$$

- Fréquence de rotation :

$$\hbar\omega = \frac{E_\gamma}{2}$$



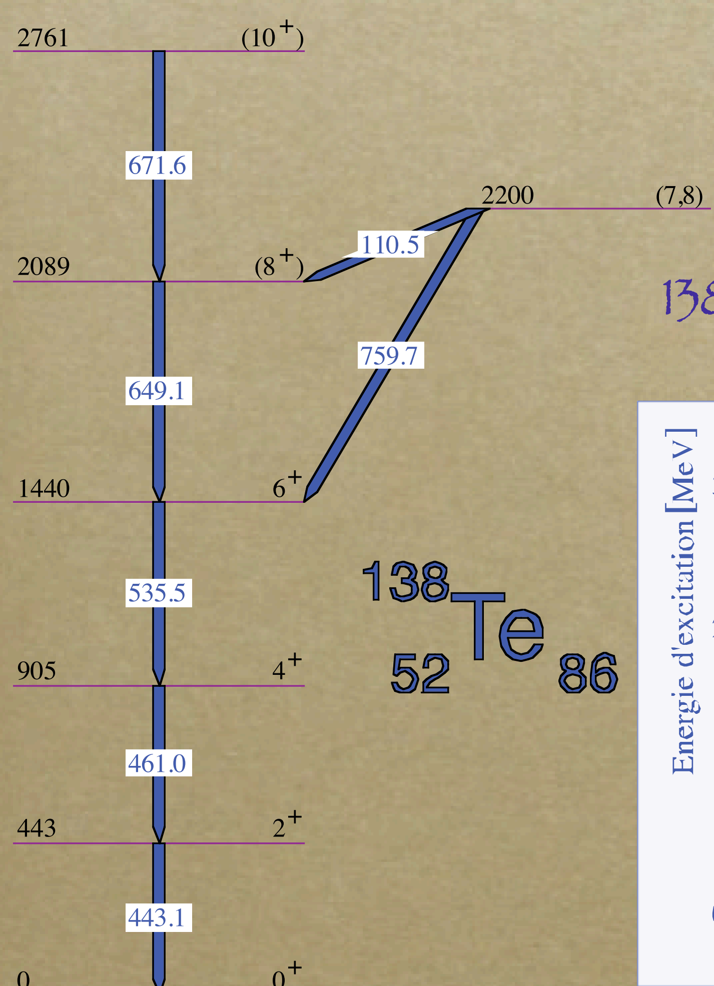
A ~ 100 Neutron-rich Nuclei



Fission-Fragments Spectroscopy

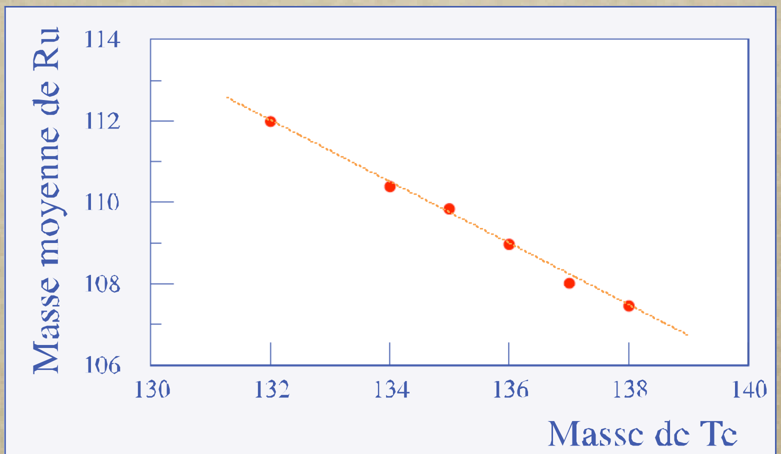
^{138}Te correspond to a vibrationnal structure

	Vibration	Rotation	^{138}Te
$E(4^+)/E(2^+)$	2	3,3	2,06
$E(6^+)/E(2^+)$	3	7,0	3,26
$E(8^+)/E(2^+)$	4	12,0	4,71

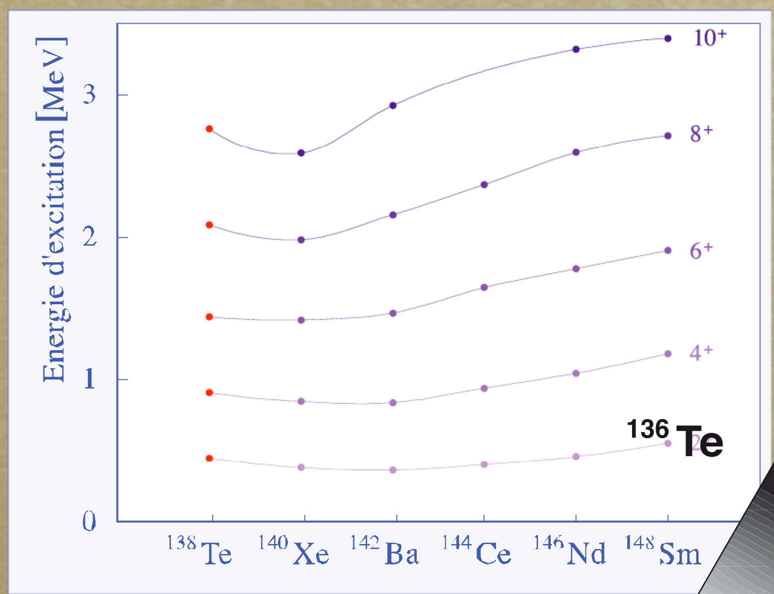


(*) [F. Hoellinger et al., EPJ A 6 (1999)375]

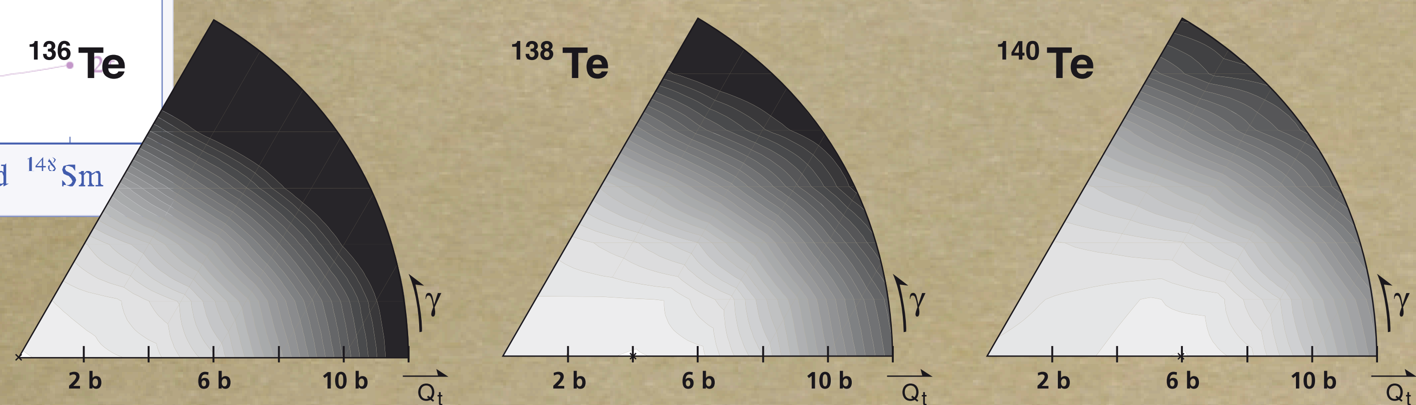
$^{138}_{52}Te_{86}$



^{138}Te is calculated prolate ...



The spherical to prolate shape transition is higher in mass for Te's



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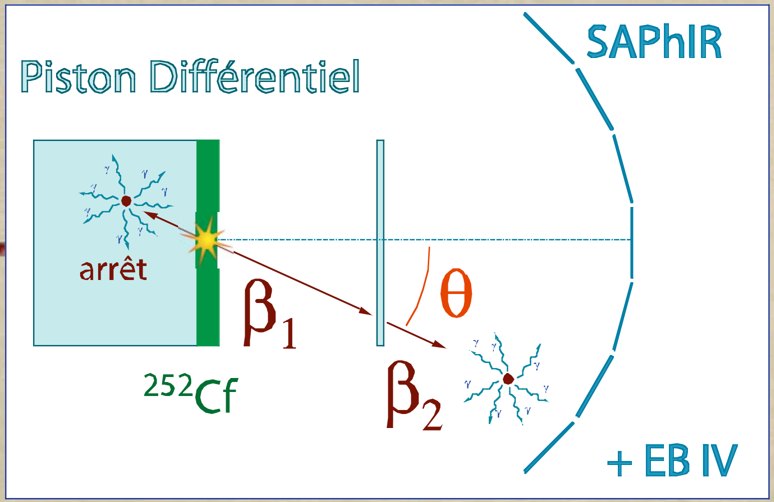
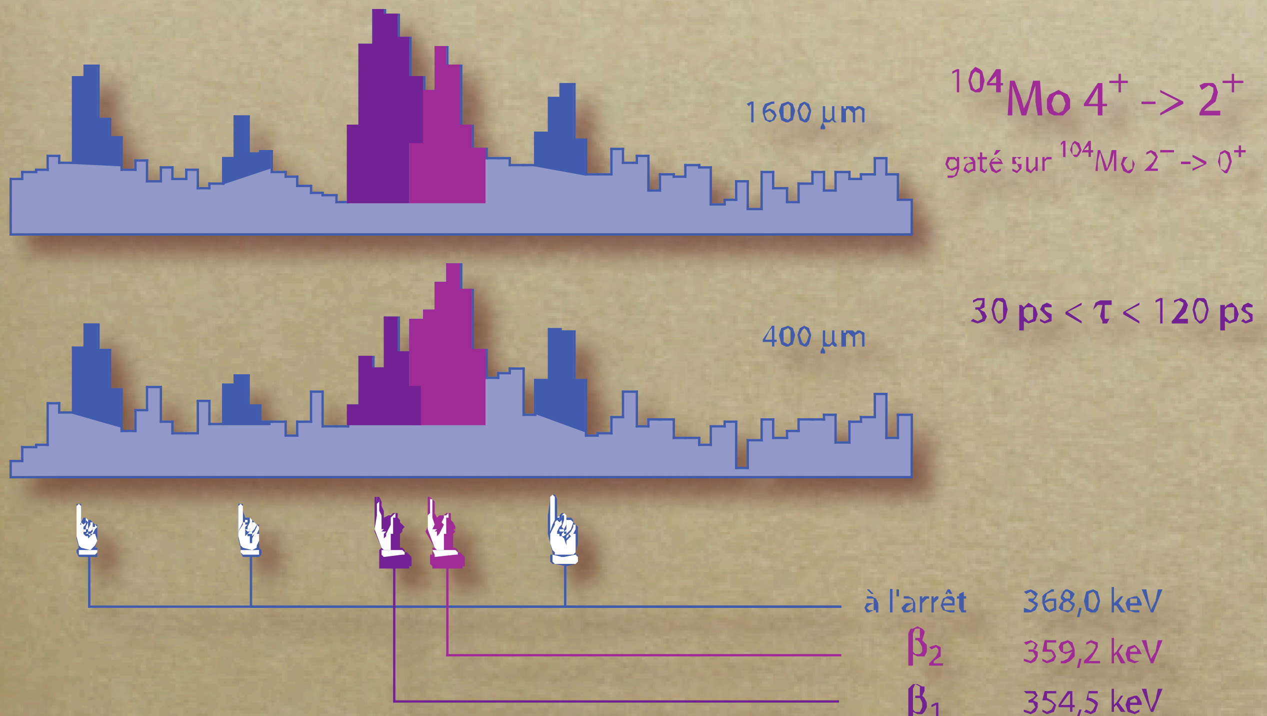
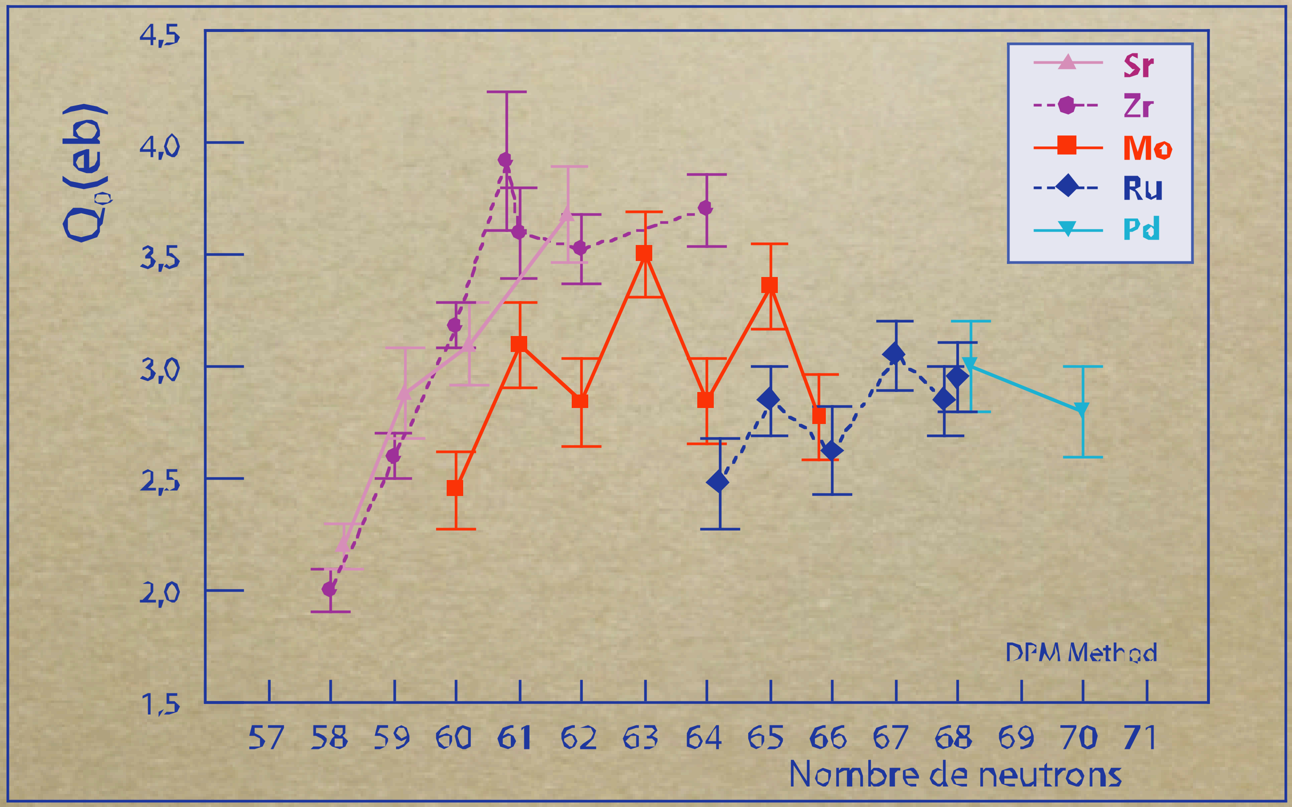
A ~ 100 Neutron-rich Nuclei Spectroscopy



Quadrupole Moment Measurments



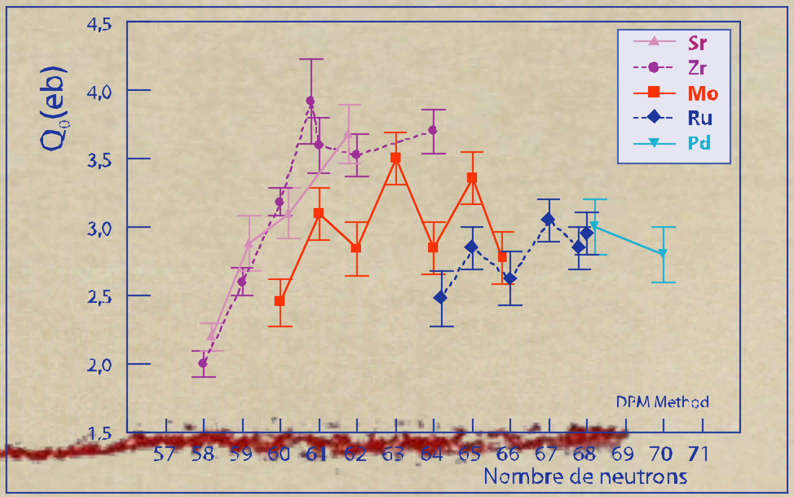
A.G. SMITH et al. (Manchester University)

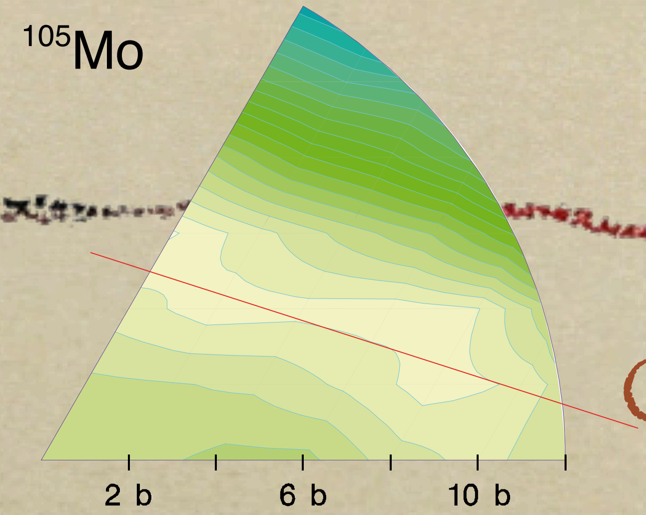


The Mo isotopes oscillate between two behaviors (Sr, Zr) and (Ru, Pd) ... Shape transition Région

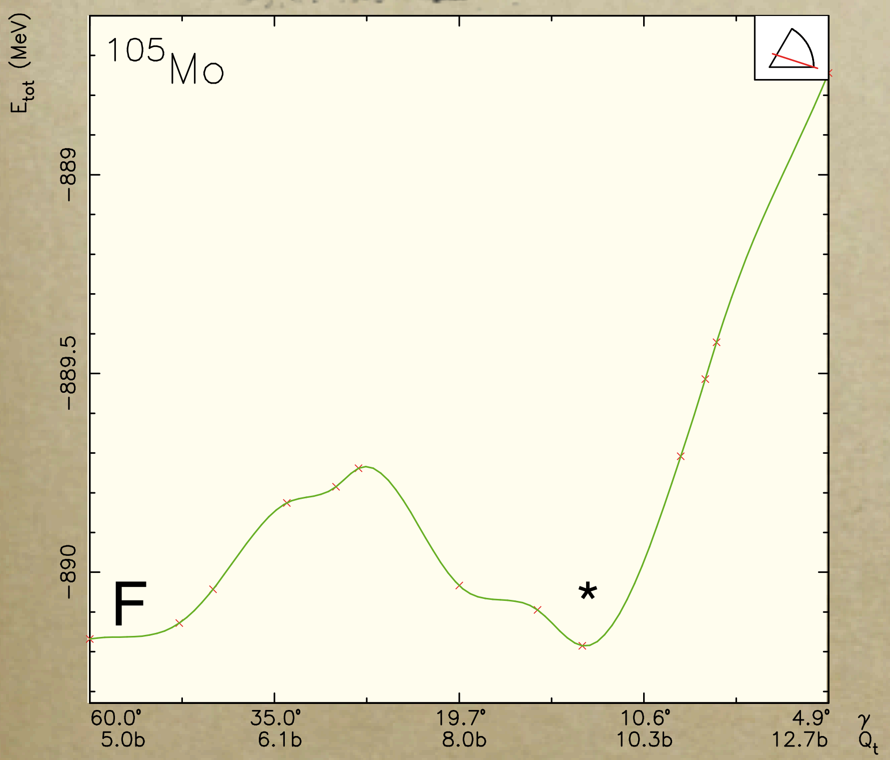
Experiments in Strasbourg

A ~ 100 Neutron-rich Nuclei Spectroscopy

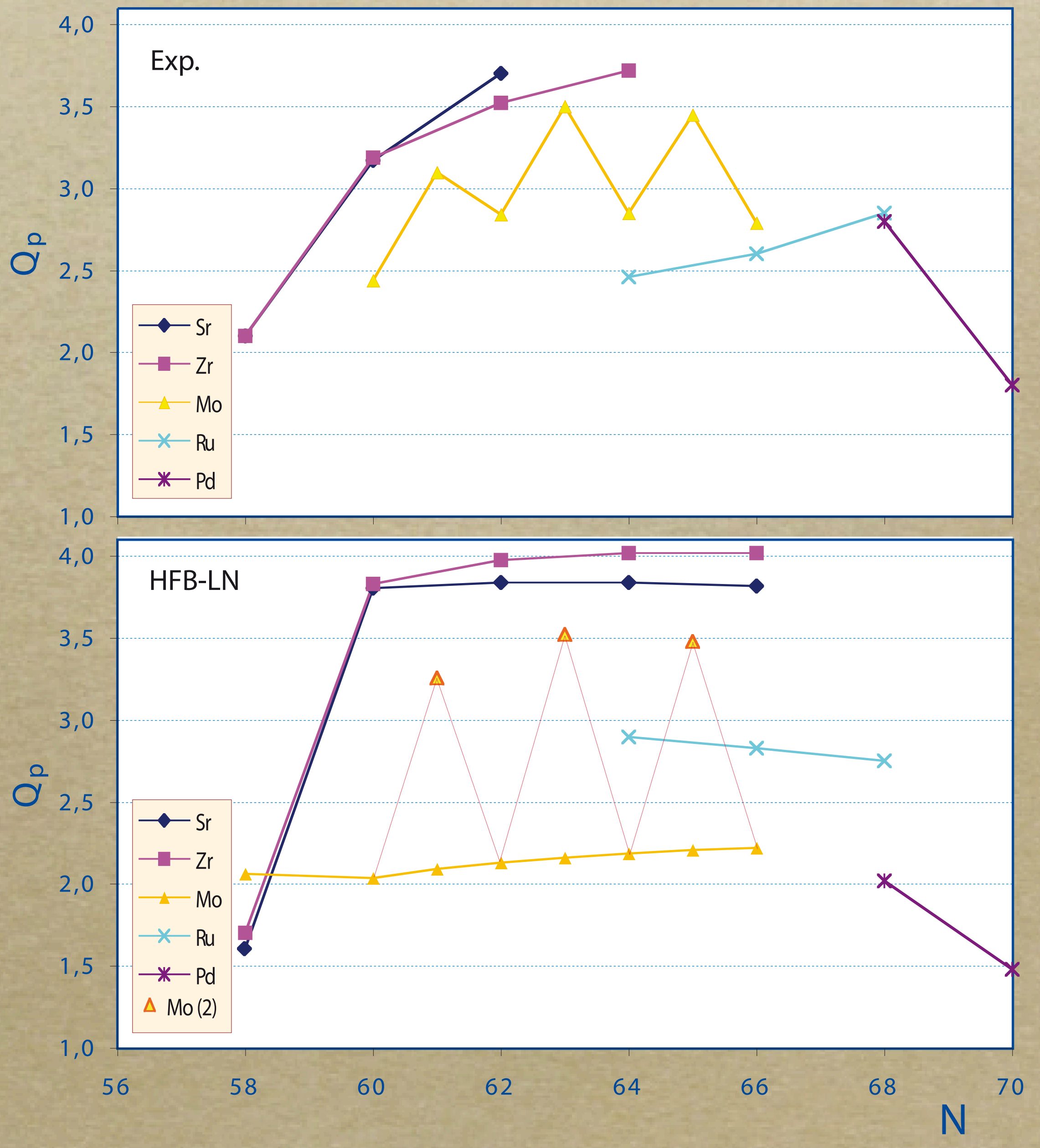


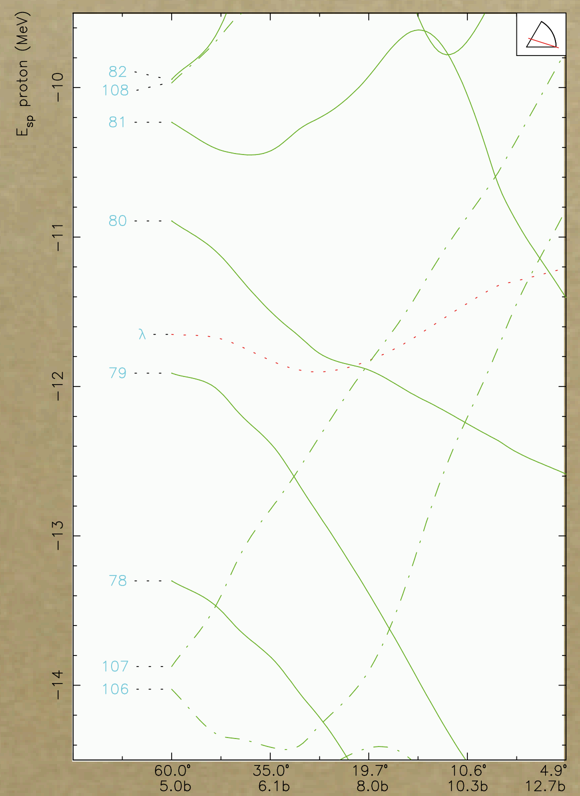


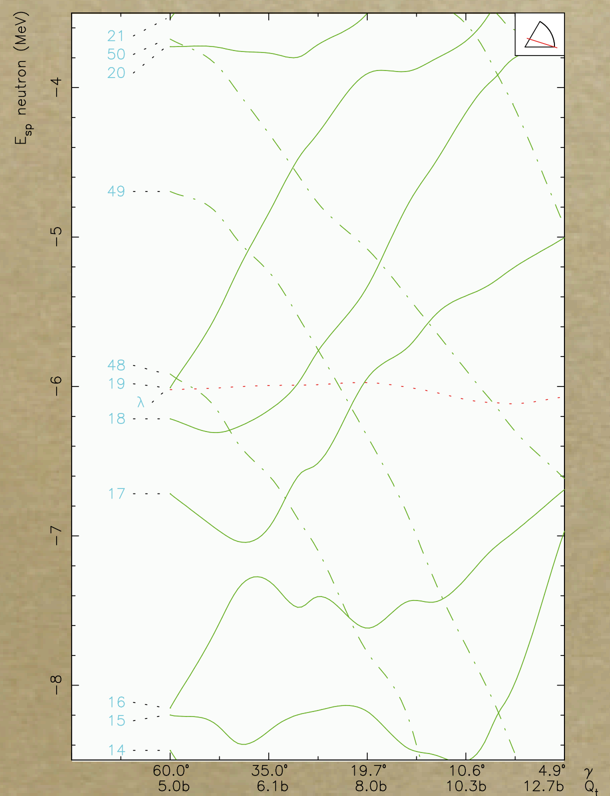
Gamma-soft nucleus



Diagonal cuts ...







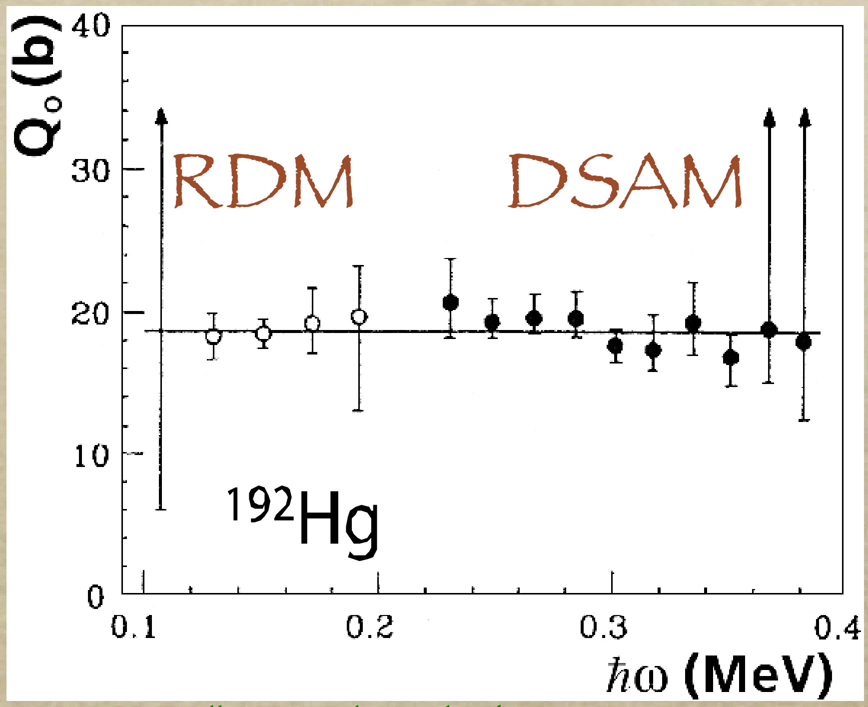
Nuclear Pairing dependance on Rotation - even-even SD Bands

Spectroscopy of Yrast ^{192}Hg and ^{194}Pb SD bands

- Quadrupolar moment measurement

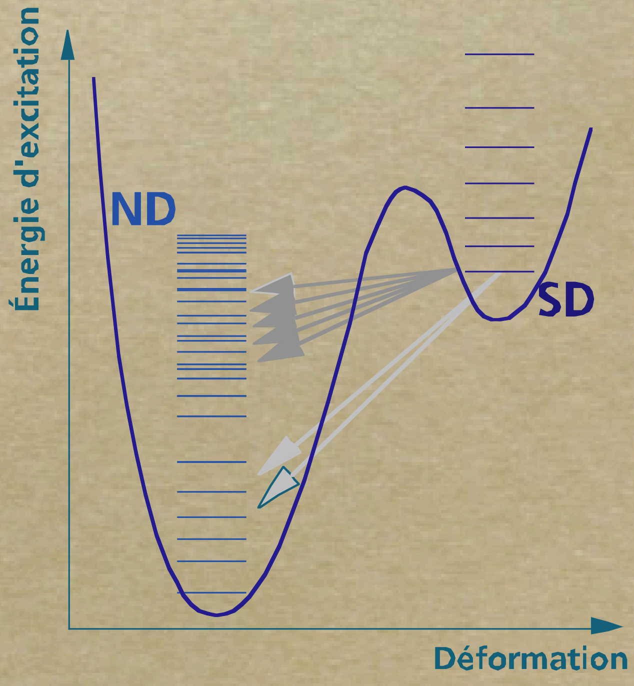
—» DSAM

—» RDM



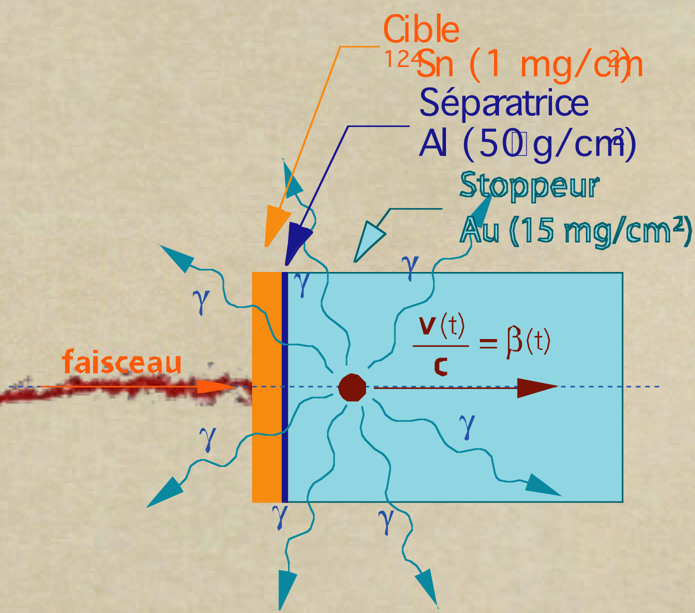
P. Willsau et al. Nucl. Phys A574 (1994) 560

The deformation stays Constant from higher spin of the SD-band up to the lower spins of the band ...



Best "lab" to study the influence of rotation alone on nuclear pairing.

A=150 Identical Bands and quadrupole moments



	protons	neutrons	Q_0 (H.S.)	Q_0 (C.R.)	Q_0 (HFB)	Q_0 (OH)	ε_2 (ε_4)
^{148}Gd(Y)	6^2 ● ●	7^1 ● ● ● ○ ○ ○	14,6 0,2	-	x	16,0 (14,7)	0,545 (0,029)
^{148}Gd(2)	6^2 ● ●	7^1 ● ● ○ ● ○ ○	14,8 0,3	-	x	16,0 (14,7)	0,545 (0,029)
^{148}Gd(5)	6^4 ○ ○	7^2 ○ ○ ● ● ○ ○	17,8 1,3	-	x	19,6 (18,0)	0,618 (0,029)
^{149}Gd(Y)	6^2 ● ●	7^1 ● ● ● ● ○ ○	15,0 0,2	-	15,5	16,5 (15,2)	0,555 (0,029)
^{149}Gd(2)	6^2 ● ●	7^2 ● ● ● ○ ○ ○	15,6 0,3	-	-	16,7 (15,4)	0,556 (0,029)
^{149}Gd(3)	6^3 ○ ●	7^1 ● ● ● ● ○ ○	15,2 0,4	-	-	17,4 (16,0)	0,576 (0,029)
^{149}Gd(4)	6^4 ○ ○	7^2 ● ● ● ○ ○ ○	17,5 0,6	-	-	19,3 (17,8)	0,612 (0,029)
^{152}Dy(Y)	6^4 ● ●	7^2 ● ● ● ● ○ ○	17,5 0,4	18,5 0,5	17,5	18,9 (17,4)	0,582 (0,029)
^{153}Dy(Y)	6^2 ● ●	7^3 ● ● ● ● ○ ○	-	18,4 0,5	17,6	-	-
^{153}Dy(2)	6^2 ● ●	7^2 ● ● ● ● ● ○	-	17,9 0,5	17,2	-	-
^{153}Dy(3)	6^2 ● ●	7^2 ● ● ● ● ○ ●	-	18,2 0,5	17,2	-	-
Config ->	6^x [301]1/2,-1/2 [301]1/2,+1/2	7^y [411]1/2,-1/2 [411]1/2,+1/2 [651]1/2,-1/2 [651]1/2,+1/2 [402]5/2,-1/2 [402]5/2,+1/2	Experiment		Theory		

DSAM experiments with same stopper :

^{124}Sn(^{30}Si,6-5n)^{148,149}Gd à 158 MeV (@EGII)

^{120}Sn(^{36}S,4n)^{152}Dy à 170 MeV(@EGII)

^{120}Sn(^{34}S,6-5n)$^{152-153}$Dy à 175 MeV(@GS)

Absolute errors due to stopping power remains but relative errors are small

HFB-LN (SLy4, pub, 2 cuts) Calculations

Good agreement with experimental quadrupolar moments

Important Influence of intruders orbitals

Identical bands correspond to similar quadrupole moments but to slightly different deformation (see last row)

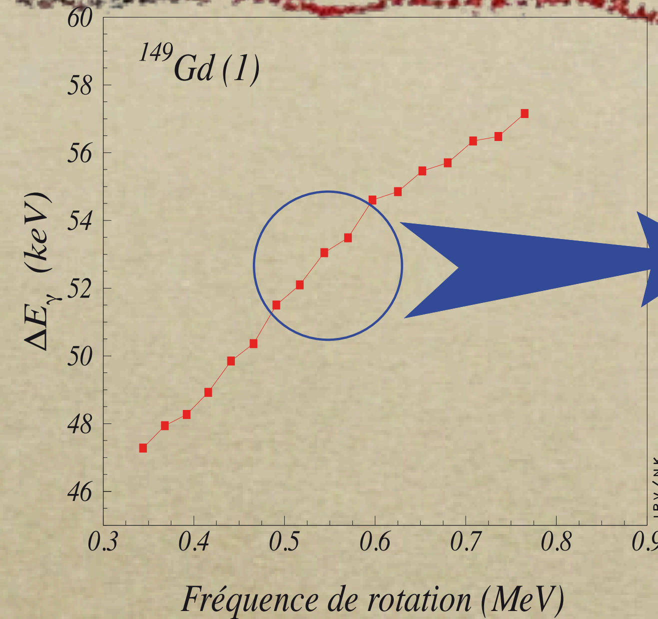
PhD Thesis of H. SAVAJOL & C. RIGOLLET

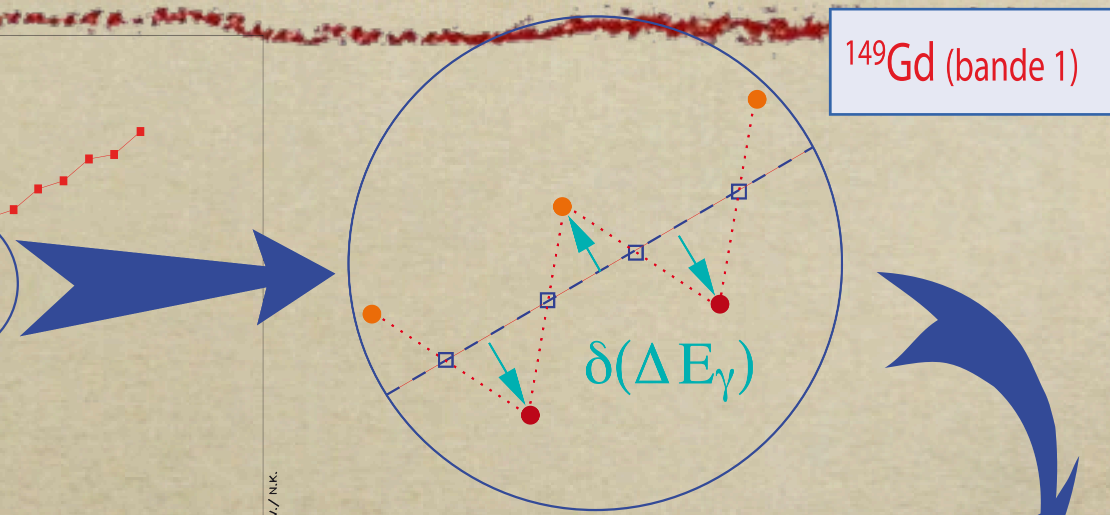
C4 symmetry … Staggering…

Very small Phenomenon

60 +/-10 eV @ 20 MeV

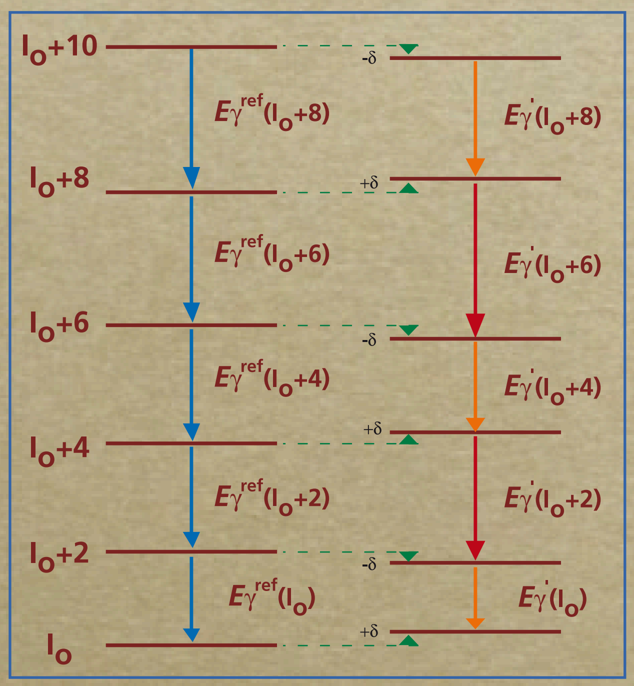
excitation energy …

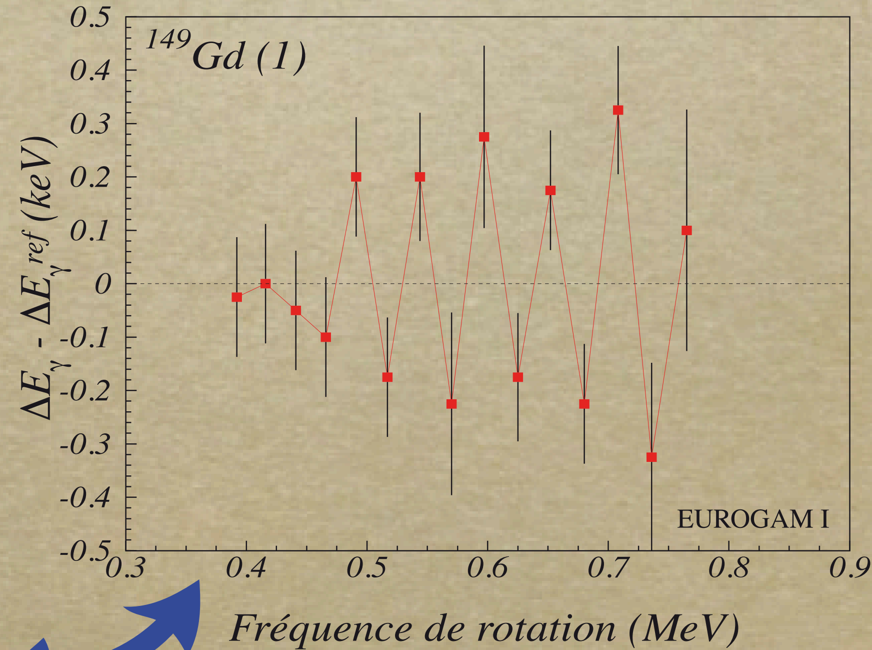


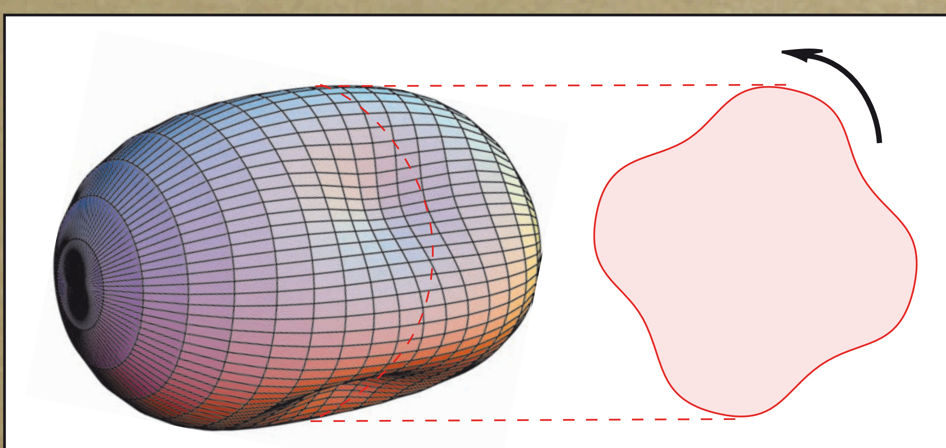


$\delta(\Delta E_\gamma) = \Delta E_\gamma(I) - \Delta E_\gamma^{ref}(I)$

$\Delta E_\gamma^{ref}(I) = \left[\Delta E_\gamma(I+2) + 2\Delta E_\gamma(I) + \Delta E_\gamma(I-2)\right] / 4$







(*) [I. Hamamoto, B. Mottelson, Phys. Lett. B333 (1994)]

2 séquences de spin :

I, I+4, I+8, ...

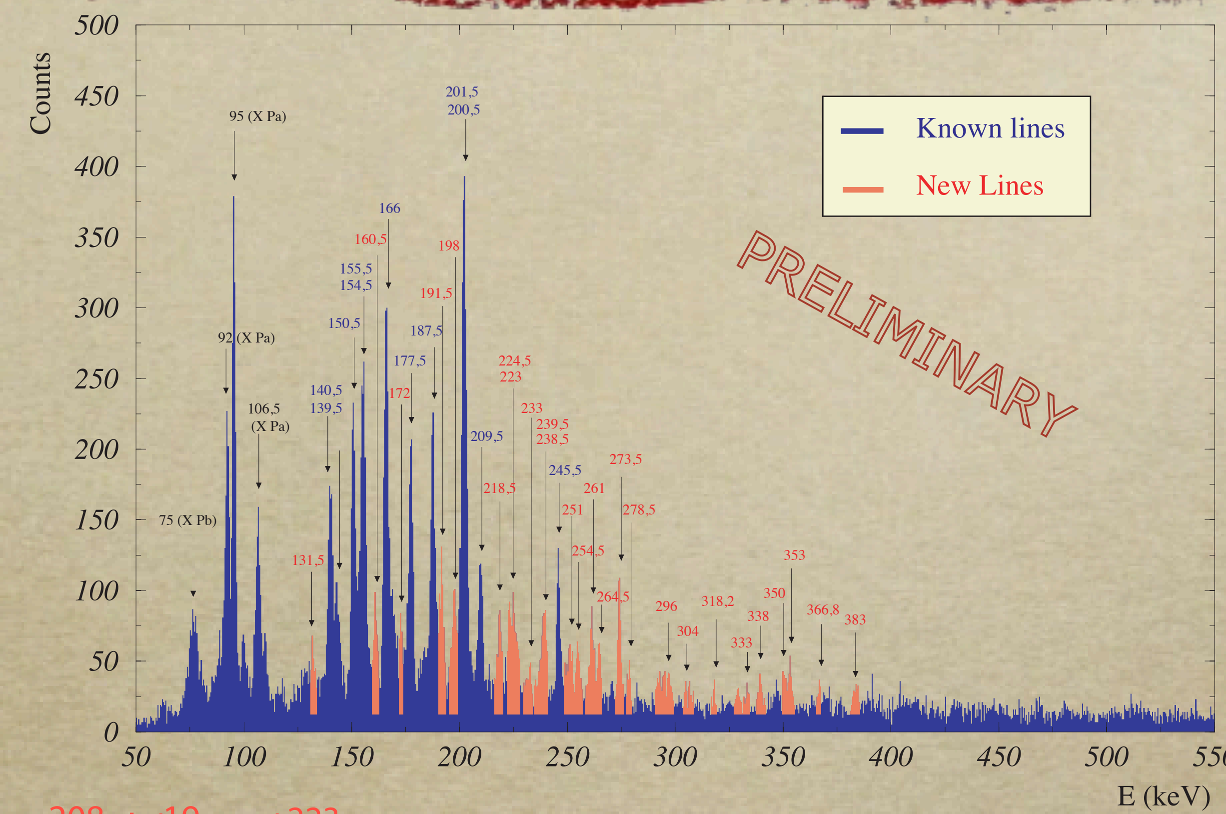
I+2, I+6, I+10, ...

(*) [Flibotte et al., PRL71 (1993)]
(**) [N. Kintz Thèse IReS/ULP 2000]

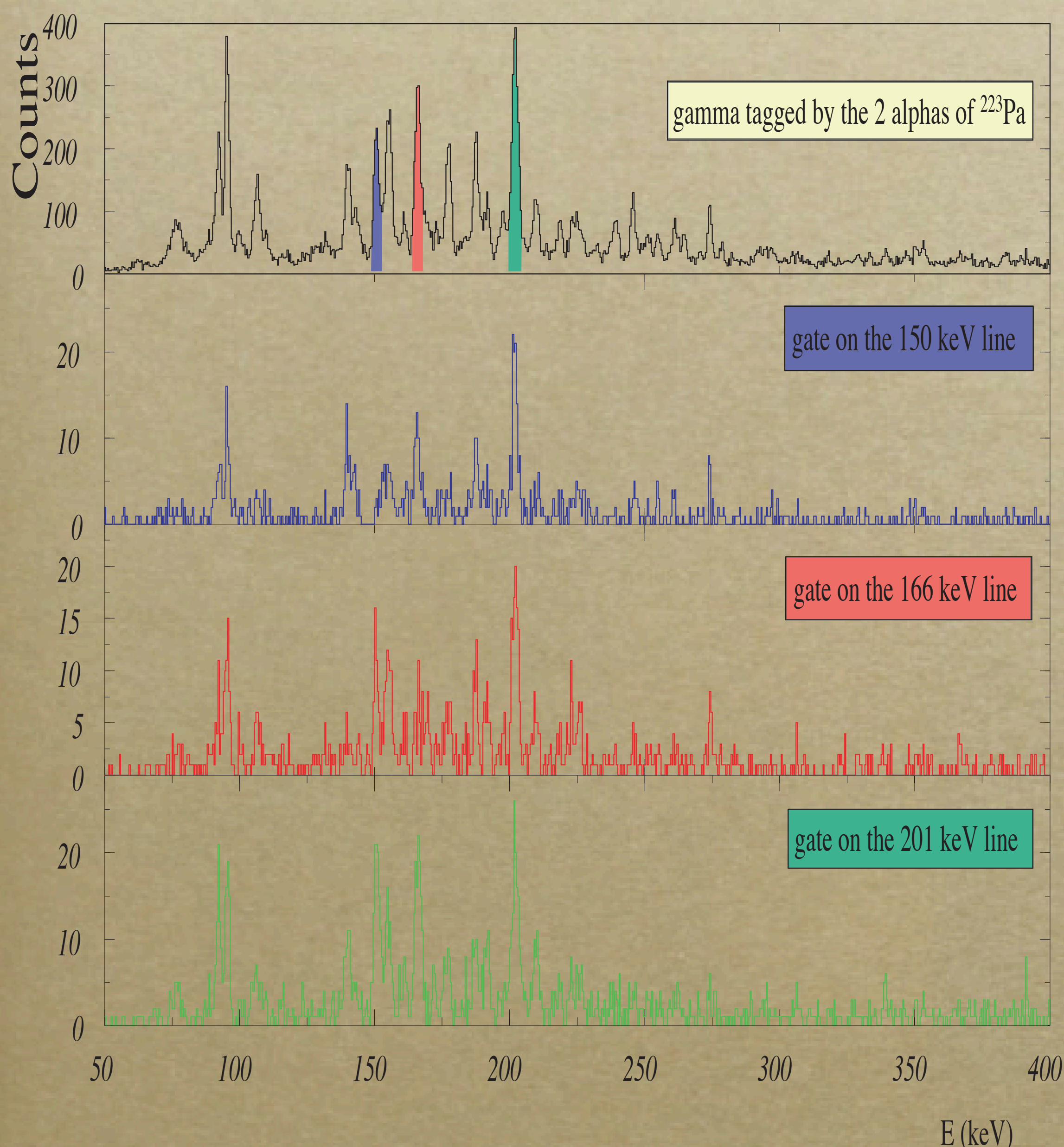
Octupole Deformation in ^{223}Pa

Gamma-rays spectrum Tagged by the 2 alpha lines of $^{223}_{91}$Pa

RITU + JUROGAM, 8-19 December 2003



Gamma gated spectra Tagged by the 2 alpha lines of $^{223}_{91}$Pa



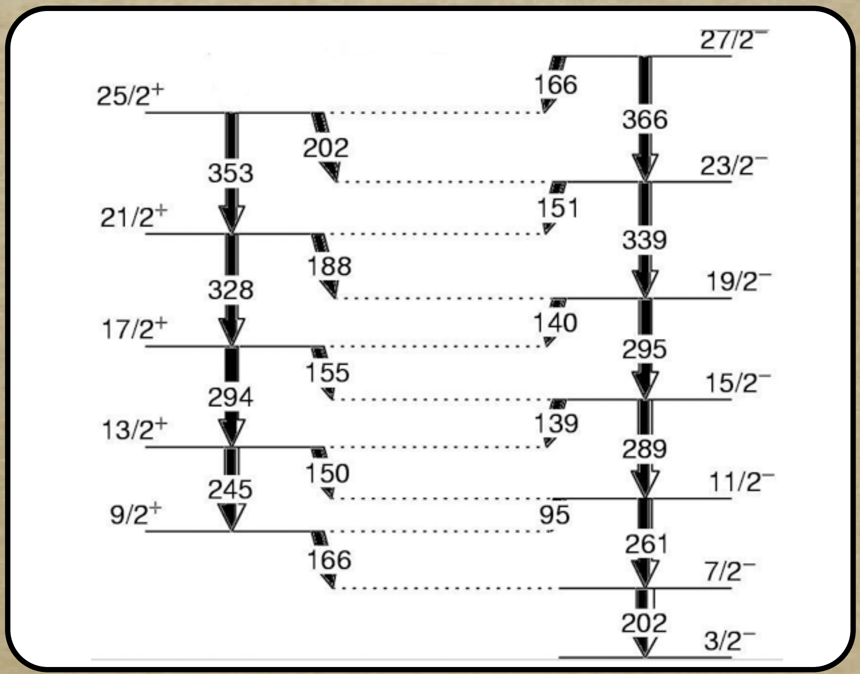
Reaction : $^{208}Pb(^{19}F,4n)^{223}Pa$ @ 99 MeV,

v/c = 0.8 %,

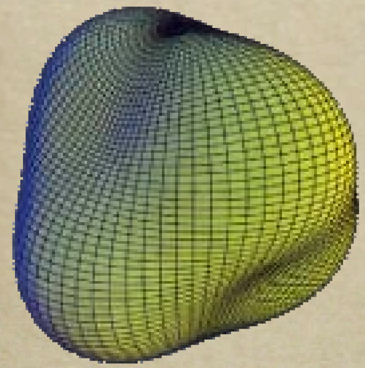
e = 150 - 250 μg/cm^2,

I ~ 40 pnA,

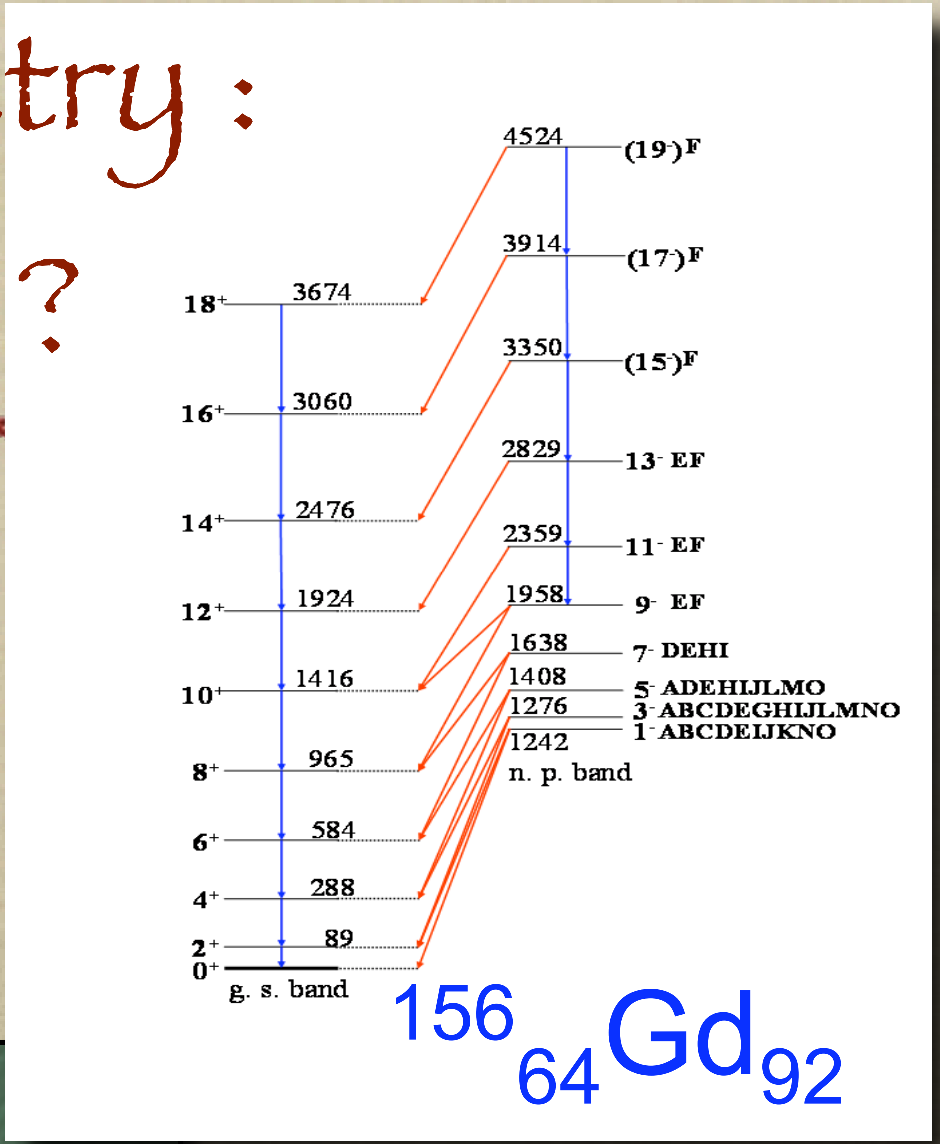
σ ~ 100 μb



PhD Thesis F. HOELLINGER & F. KHALFALLAH



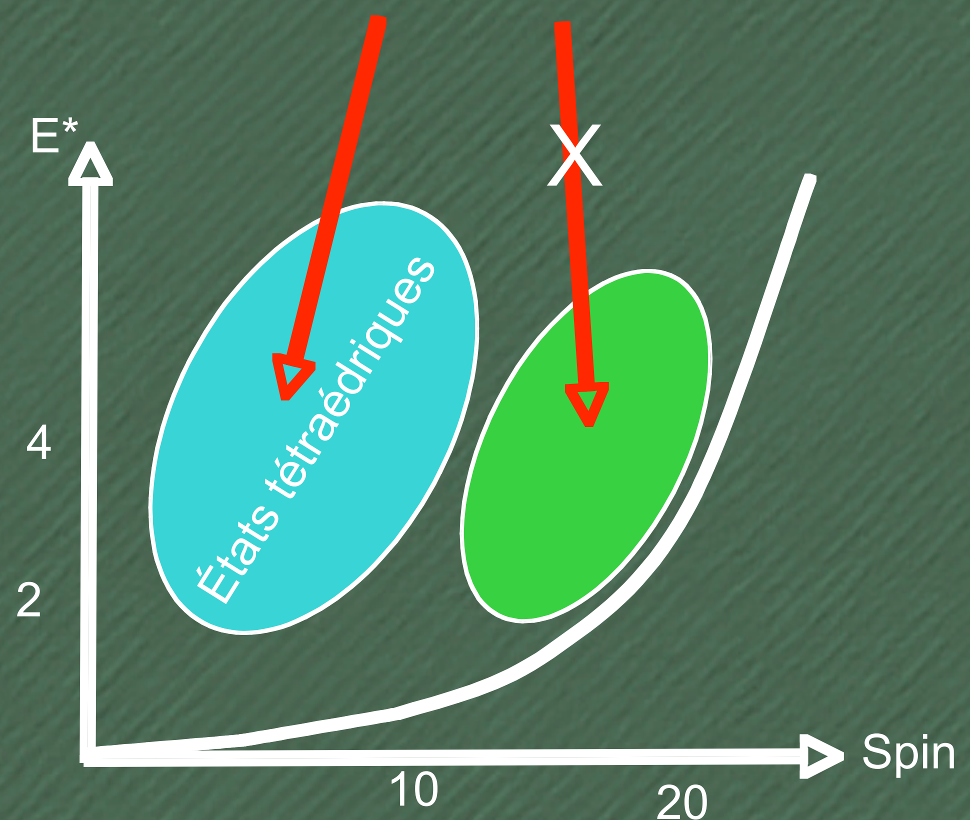
Higher order symmetry : Tetrahedral Shapes ?



Tetrahedral Fingerprints:

– Vanishing Q_2 (rotational bands without E2's)

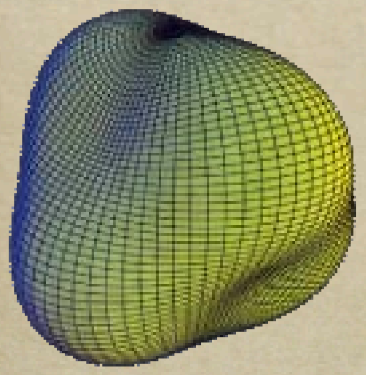
– Large B(E1;I --> I-1)
-- Branching ratios are spin dependent
(difference with usual octupole)



- ~~Coulex?~~
- Transfert ?
- Fusion évaporation
  ~~ions lourds?~~
  ions légers?
- Autres ?

$R = B(E2)_{in} / B(E1)_{out}$

Réactions possibles:
A=155Gd(n,γ)
D=156Gd(n,n'γ)
E=154Sm(α,2nγ)
F=150Nd(13C,α3nγ)
G=Coulomb Excitation
L=158Gd(p,t)
M= 154Gd(t,p)
?? 7Li transfert massif de 2p
(7Li,p4n)



Higher order symmetry : Tetrahedral Shapes ?

The tetrahedral nuclei are predicted around the following new shell closures:

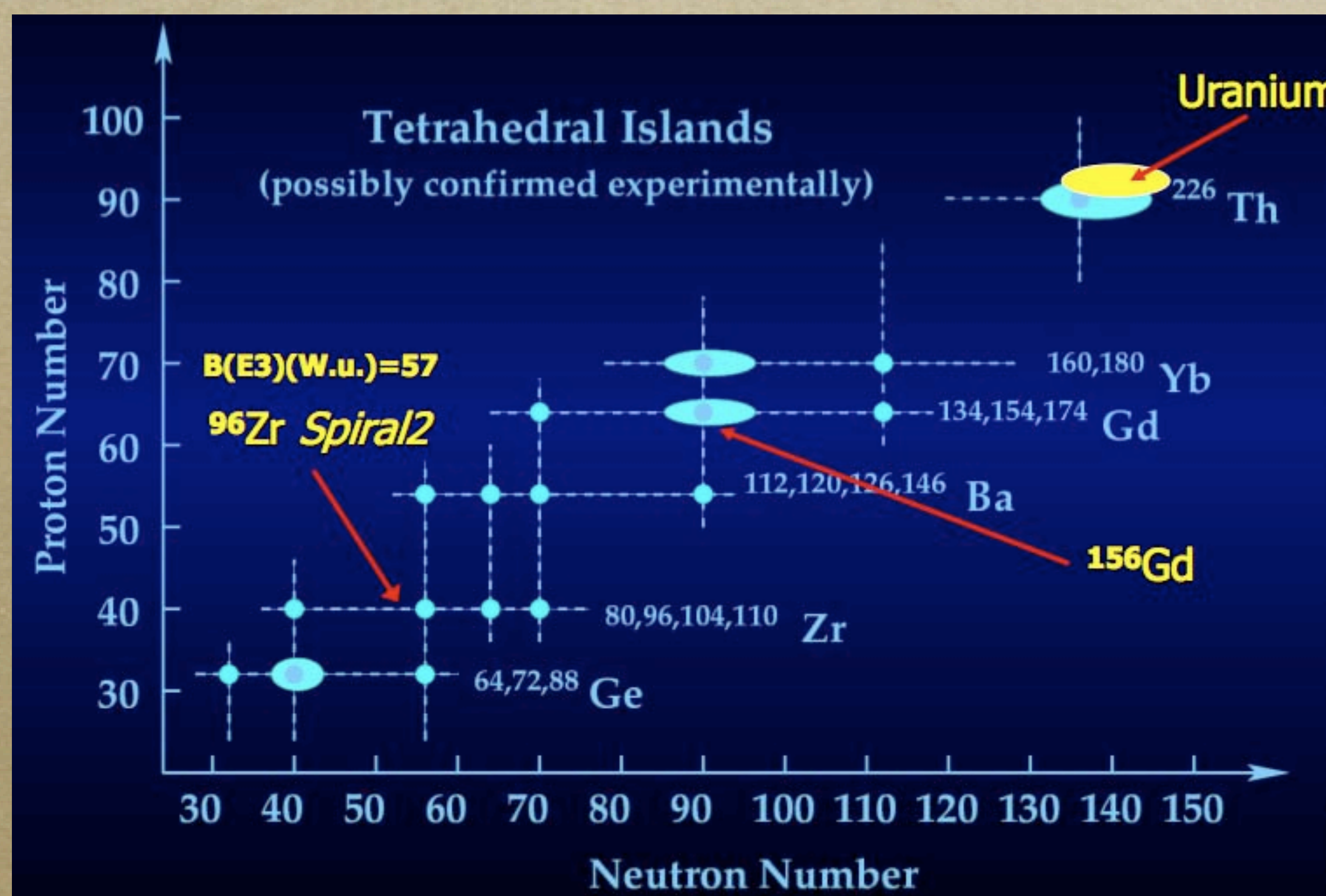
(Zt, Nt) = (32, 40, 56, 64, 70, 90, 136)

Corresponding to the doubly magic nuclei:

^{64,72,88}Ge (Z=32) ^{80,96,110}Zr (Z=40) ^{112,126}Ba (Z=56)

^{134,154}Gd (Z=64) ^{160}Yb (Z=70) ^{226}Th (Z=90)

Candidates ?



Summary

- Preliminary considerations
- Excitations of the nuclei; case of rotationnal bands
- Effect of Nuclear deformation
- Experimental toolboxes & selected cases

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Pairing Correlations in Rotating Nuclei and the Frequency-Deformation Scaling

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Received January 18, 1990; accepted February 16, 1990

Abstract

The dynamical pairing correlations are discussed using the rotating harmonic oscillator model and the RPA formalism. The dependence of the pairing strength distribution on rotational frequency and deformation is given special attention. In particular, the influence of coupling between different oscillator shells is analyzed in detail. Explicit formulae are given for the overlap matrix elements between the rotating and nonrotating states of the cranked harmonic oscillator.

1. Introduction

The competition between the short-range pairing force giving rise to a superfluid structure and the Coriolis and centrifugal forces acting in a rotating atomic nucleus has been discussed for several years starting with a classical work by Mottelson and Valatin [1]. At very high spins the Coriolis and centrifugal forces may become strong enough as to destroy to a large extent the superfluid pairing correlations. In the description of nuclear structure in terms of a mean-field approximation (such as, e.g. the Hartree–Fock–Bogolyubov–Cranking model or its simpler version – the Rotating-BCS model, RBCS) this effect manifests itself by the existence of a critical angular frequency ω_c of rotation below which the pairing-gap Δ collapses. In this picture the static pair deformation (corresponding to $\Delta \neq 0$) disappears. Nevertheless, the short-range pairing interactions may still play an important role by creating a dynamical type of correlations usually referred to as a pair-vibrations [2]. At this point it is worthwhile to stress that the conventional division into the "static" and "dynamic" pairing makes sense only within the mean field theory where correlations are neglected and the particle number symmetry is spontaneously broken. The mean field approach is useful if correlations can be added and the broken symmetry restored with only minor perturbation of the intrinsic state. In a general case some more powerful methods such as for example the particle number projection before variation (FBCS) or the generator coordinate method (GCM) could be employed. For a system with a finite number of particles, like the atomic nucleus, the mean field approximation breaks down around the pairing phase transition from superfluid to normal phase (for more details concerning this point we refer reader to Ref. [3] and refs. quoted therein). Consequently, the vibrational corrections obtained within the RPA method cannot cure this pathological behaviour near the critical point. However, both below and above ω_c the vibrational approximation has proved to be very accurate [4–6].

The systematics of high-spin experimental data indicate that at large rotational frequencies a gradual transition to the unpaired regime takes place [7]. Indeed, the near-yrast excitations observed in the 40–50 spin region have characteristic features that are not consistent with the quasiparticle picture [8].

The recent discovery of superdeformed (SD) rotational bands in the rare earth nuclei around ^{152}Dy (see, e.g. Ref. [9]) opens a possibility to study a competition between rotation, deformation and pairing in very extreme conditions. Due to the particularly low density of single-particle states in the SD configurations [10–13] pairing correlations are seriously quenched already at low rotational frequencies. A futher reduction of pairing is then caused by the angular momentum alignment of high-j nucleons [14, 15] and the Coriolis-antipairing effect (CAP). The rotational frequencies in the SD bands are in the range of 500 keV $< \hbar\omega <$ 800 keV. At such high angular momenta the static pairing is gone [13, 15–17] and pairing fluctuations become important. When dynamical correlations are taken into account in calculations, the agreement between calculated SD rotational bands and experimental data is improved [14, 15, 17, 18]. This is due to the additional (negative) contribution to the total spin coming from the frequency-dependent pairing correlation energy.

In the previous paper [19] the importance of pairing fluctuations in fast rotating and well deformed nuclei was studied using the rotating harmonic oscillator model (rho). It has been shown that the pairing energy and the associated angular momentum (de)alignment depend on ω through the ratio ω/ε, where ε is a quadrupole deformation parameter. Such a rotation-deformation scaling can be easily understood as the Coriolis force is proportional to ω while the splitting between Nilsson orbitals is roughly proportional to ε. However, in Ref. [19] the couplings between different oscillator shells were neglected, an approximation that could modify some results for very elongated shapes. For example, the contributions because of the $\Delta N = 2$ coupling give around 10% of the total moment if inertia at $\varepsilon \approx 0.6$ [20] and they can influence the calculated equilibrium deformations at very high spins [21]. The main objective of this study was, therefore, to check whether the concept of scaling can still be applied in the general case. As a by-product the explicit expressions for the

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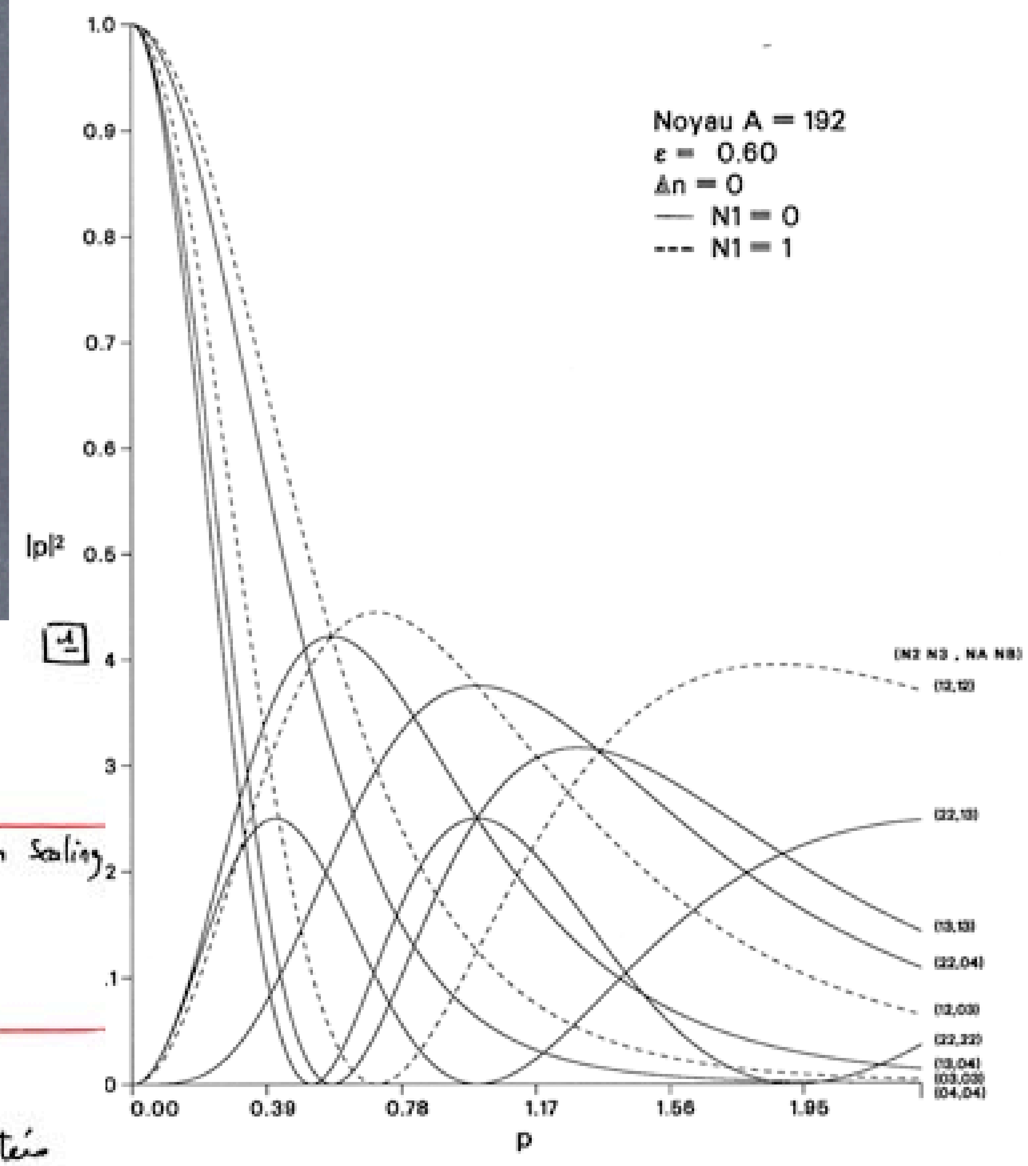
Force de pairing versus deformation



STAGE DE DEA

Etude de l'article suivant :

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W. SATULA . Z SZYMANSKI W NAZAREWICZ

PHYSICA SCRIPTA. VOL 42, 515–521, 1990

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→ article à bon pour le stage 237

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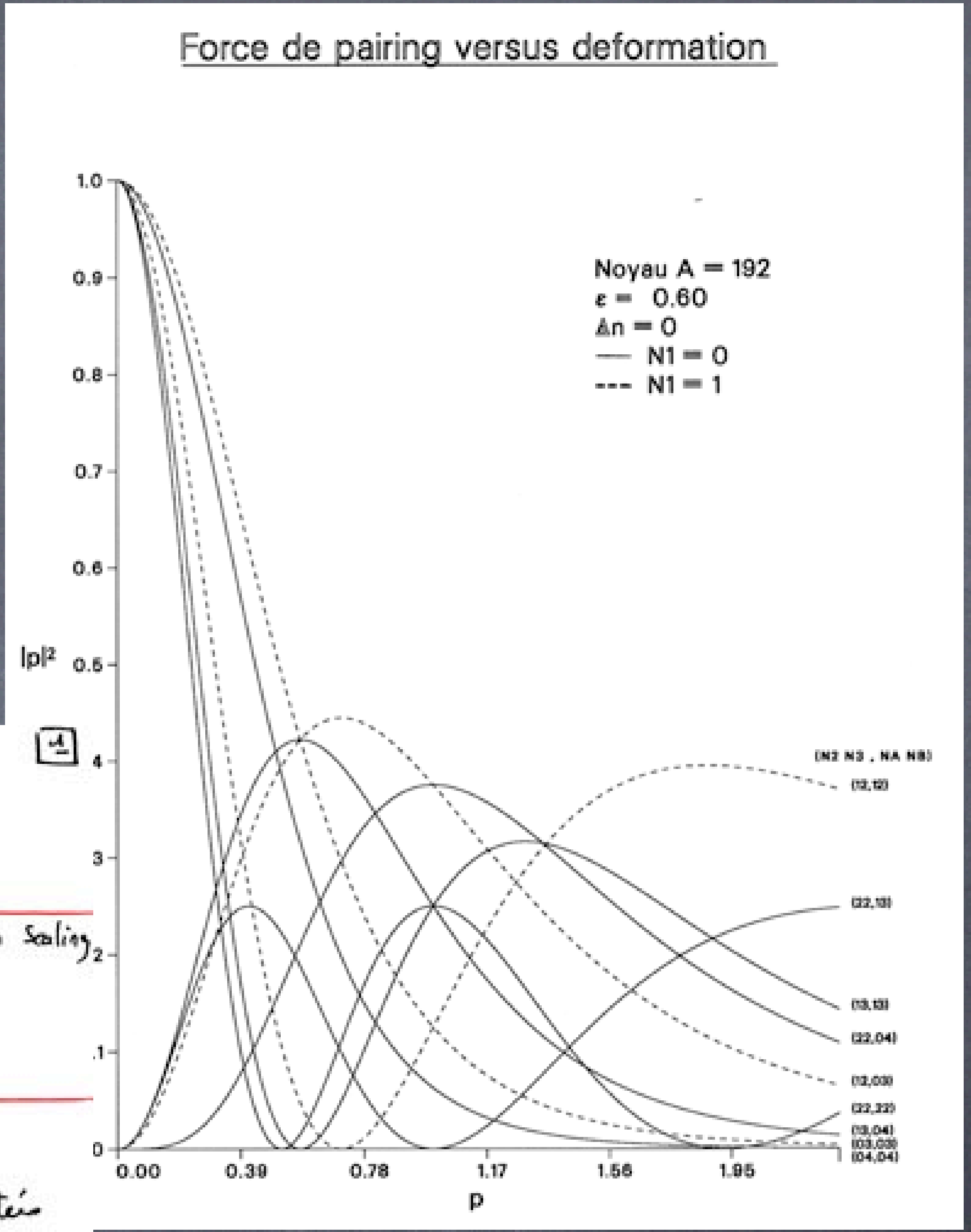

First Contact With nuclear Physics