

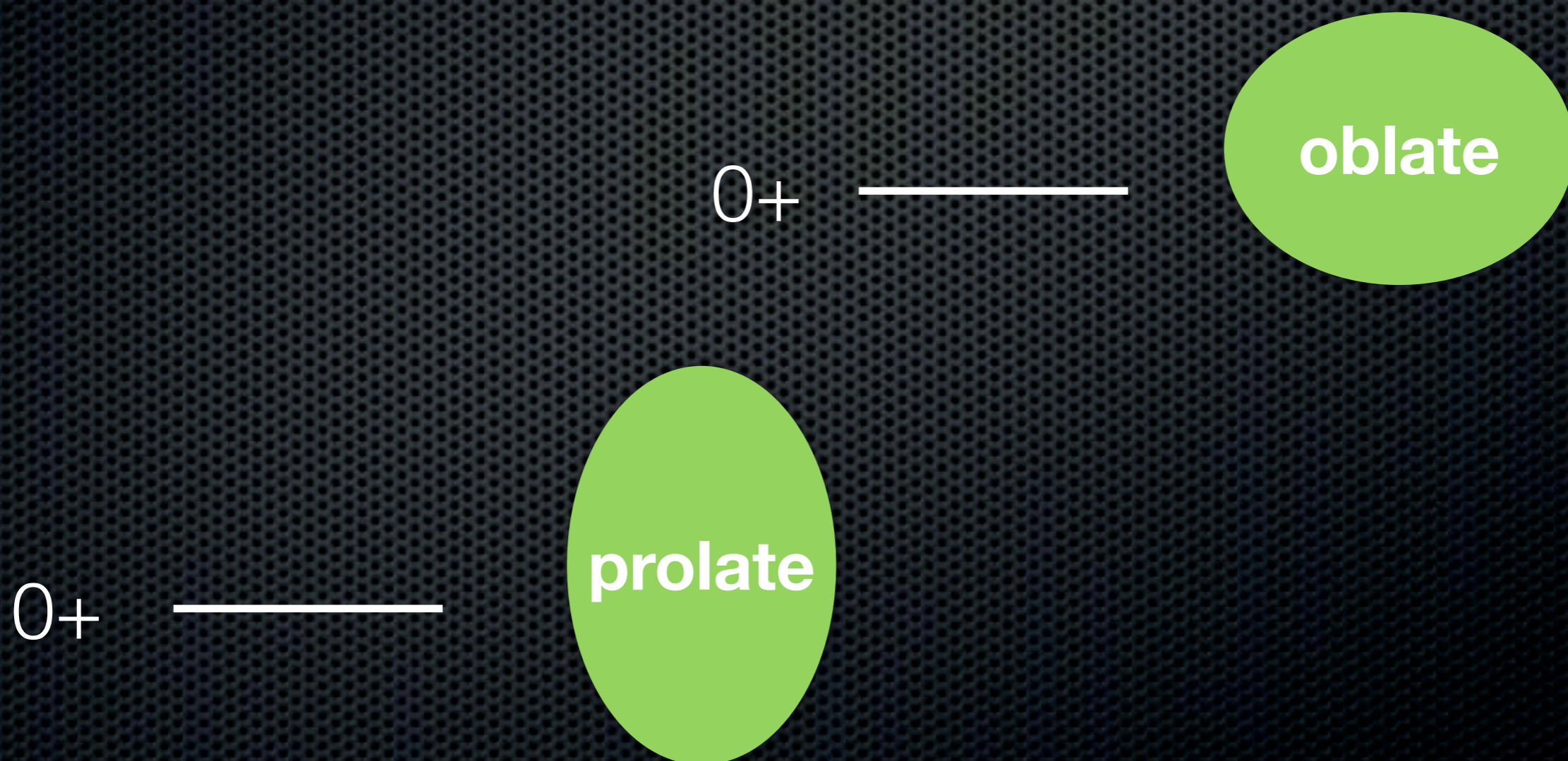
The islands of shape coexistence

INPP Demokritos

Andriana Martinou

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National State Foundation (IKY)

What is shape coexistence?

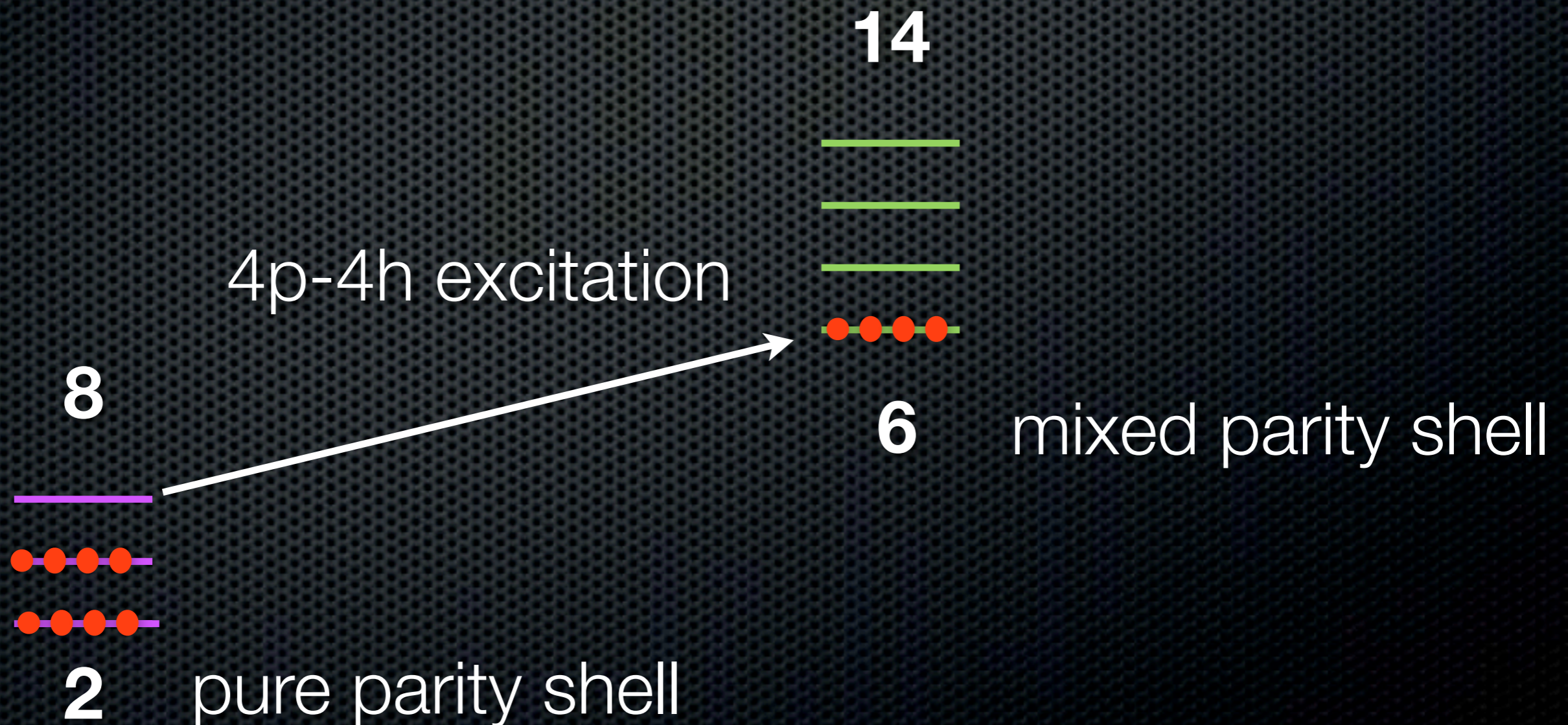


The first era-160


Interpretation of Some of the Excited States of $4n$ Self-Conjugate Nuclei

H. Morinaga

Phys. Rev. **101**, 254 – Published 1 January 1956



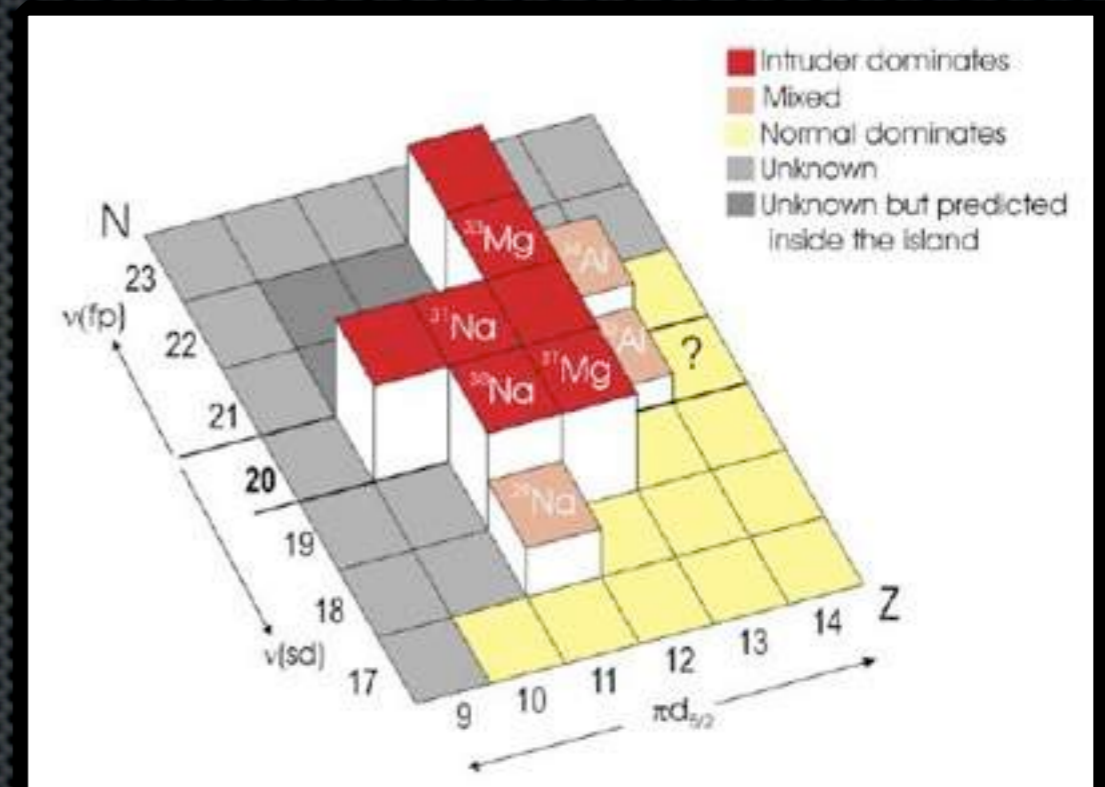
The second era, μ moments


 Physics Letters B
 Volume 658, Issue 5, 10 January 2008, Pages 203-208

g factor of the exotic $N = 21$ isotope ^{34}Al : probing the $N = 20$ and $N = 28$ shell gaps at the border of the “island of inversion”

P. Himpe ^a, G. Neyens ^{a,*,} D.L. Balabanski ^b, G. Bélier ^c, J.M. Daugas ^c, F. de Oliveira Santos ^d, M. De Rydt ^a, K.T. Flanagan ^a, I. Matea ^e, P. Morel ^e, Yu.E. Penionzhkevich ^f, L. Perrot ^d, N.A. Smirnova ^{g,1}, C. Stodel ^d, J.C. Thomas ^d, N. Vermeulen ^a, D.T. Yordanov ^a, Y. Utsuno ^h, T. Otsuka ^{h,i}

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Particle excitations from the 8-20 harmonic oscillator shell to the 6-14 spin-orbit like shell, cause the inversion of states, or breaking of the magic number $N=20$

Shape Coexistence in light nuclei = Inversion of states

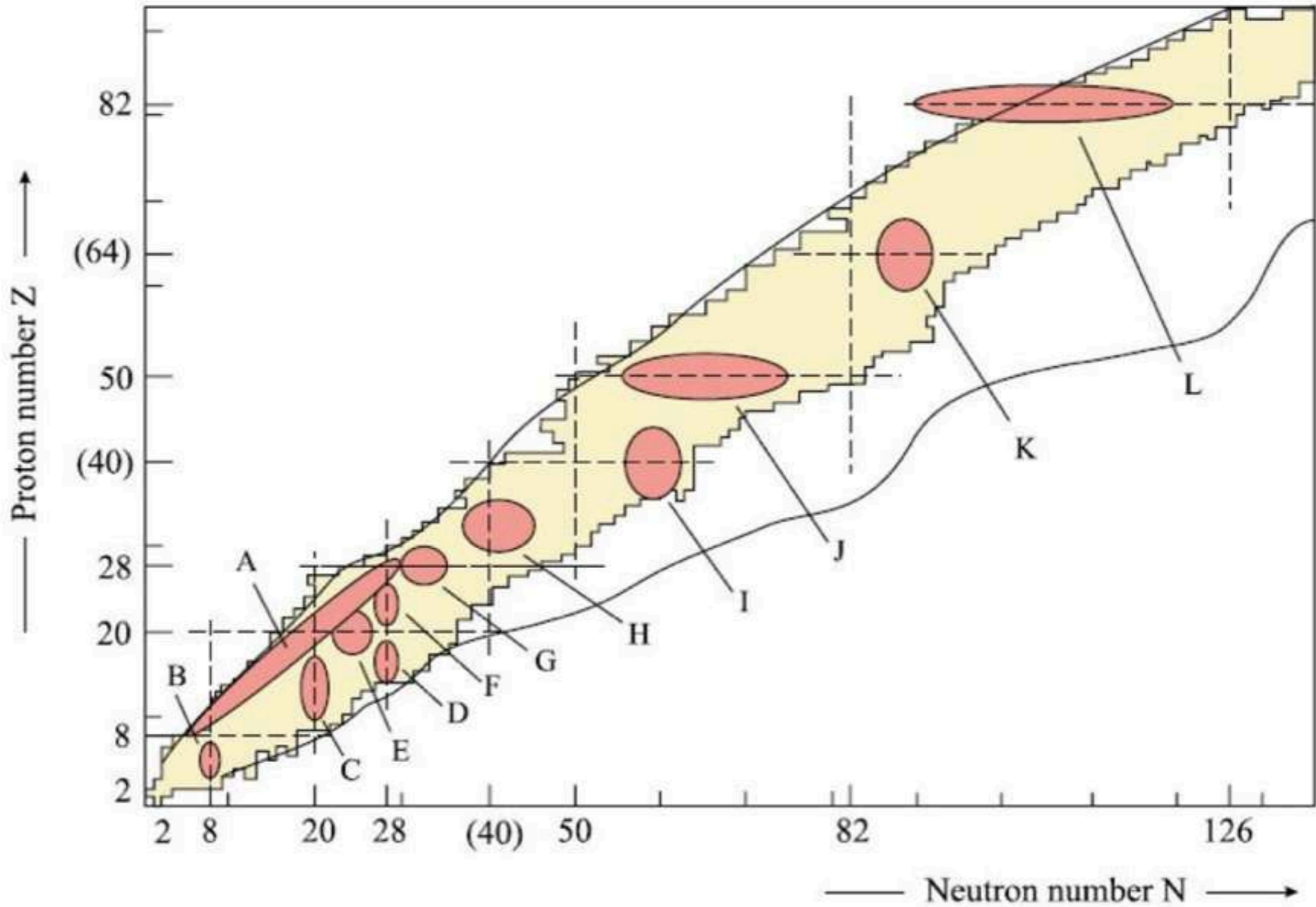
Spin-orbit like shell
“**proxy-SU(3)** symmetry”

particle-hole
excitations



Harmonic Oscillator Shell
“**Elliott SU(3)** symmetry”

Heyde and Wood






Conclusion:

Shape coexistence
appears in **certain islands**
on the nuclear chart



Review

The islands of shape coexistence within the Elliott and the proxy-SU(3) Models

Andriana Martinou^{1,a}, Dennis Bonatsos¹, T. J. Mertzimekis^{2,b} , K. E. Karakatsanis^{1,3} , I. E. Assimakis¹, S. K. Peroulis¹, S. Sarantopoulou¹, N. Minkov^{4,c} 

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The Hamiltonian

$$H = H_0 - \frac{\kappa}{2} Q Q,$$

harmonic
oscillator

quadrupole
interaction

$$H_{HO} - H_{SO} = (H_{0,HO} - H_{0,SO}) + \frac{\kappa}{2} (Q Q_{SO} - Q Q_{HO}),$$

$$E_{HO} - E_{SO} \geq 0,$$

Condition within the islands
of shape coexistence

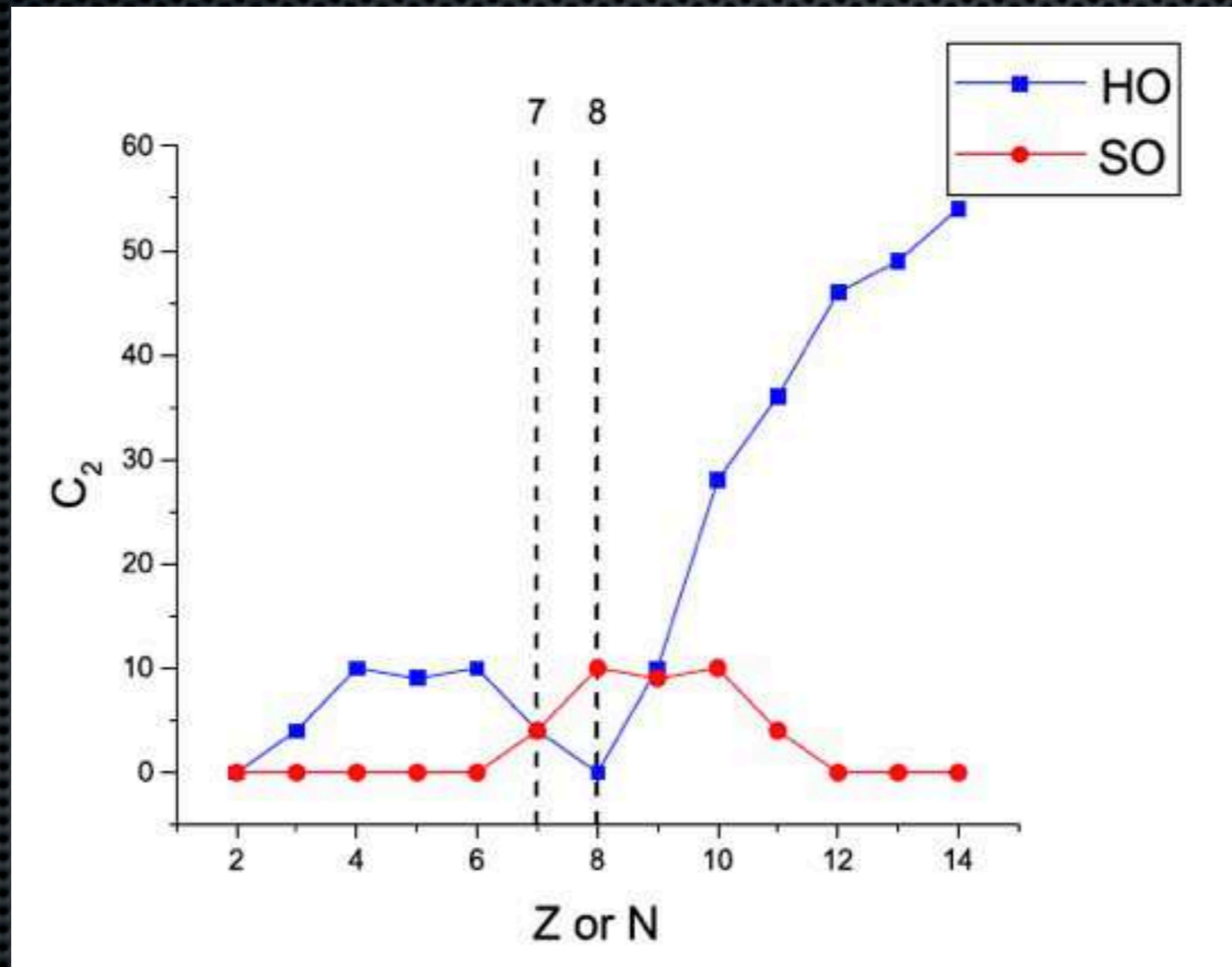
How we calculate the QQ

$$\begin{aligned}Q \cdot Q &= 4C_2 - 3L^2, \\C_2 &= \lambda^2 + \mu^2 + \lambda\mu + 3(\lambda + \mu), \\ \beta^2 &= \frac{4\pi}{5(A\bar{r}^2)^2}(C_2 + 3)\end{aligned}$$

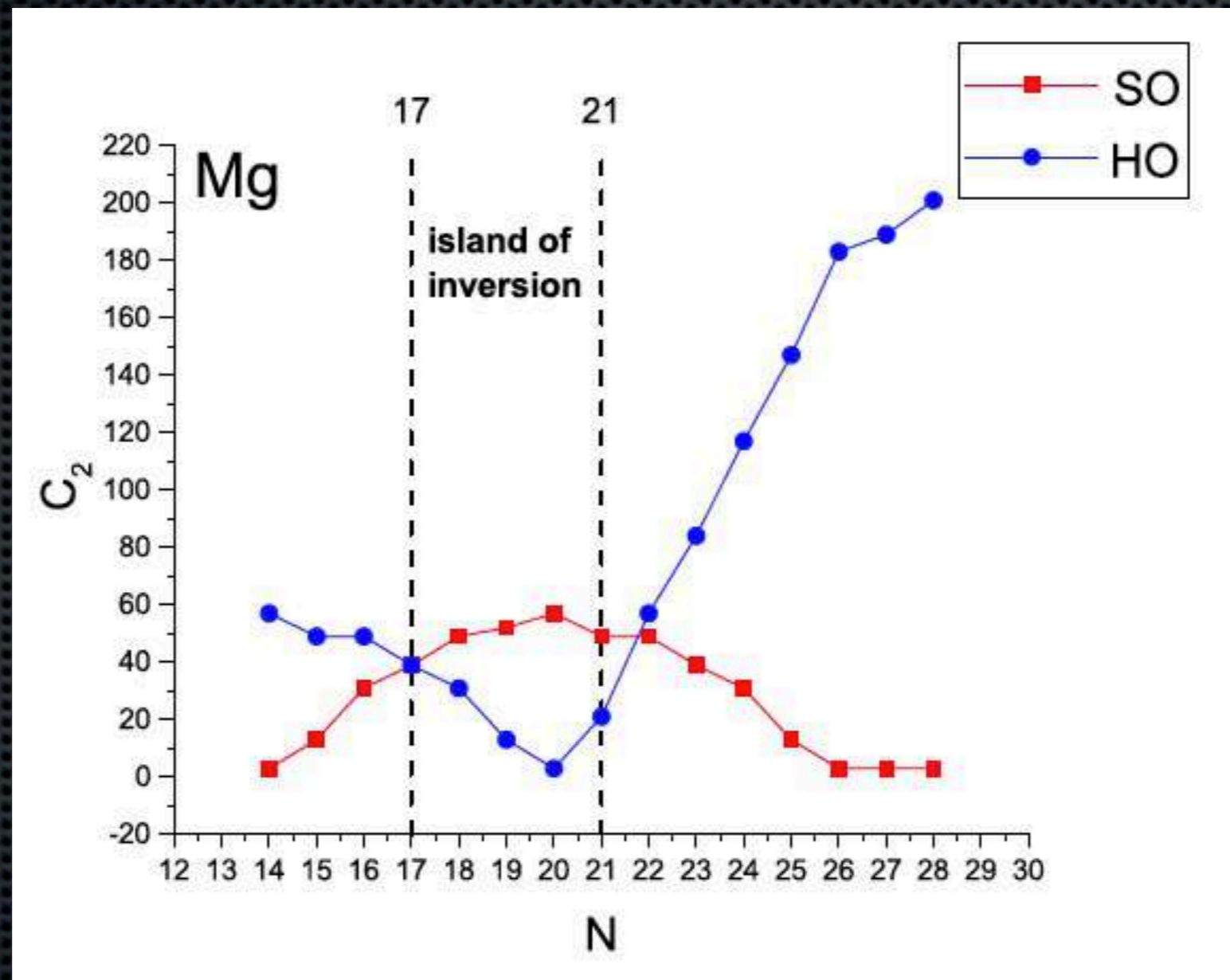
$$\gamma = \arctan \left(\frac{\sqrt{3}(\mu + 1)}{2\lambda + \mu + 3} \right)$$

- (λ, μ) are the quantum numbers of SU(3). They depend on the choice of magic numbers. β is the deformation and γ is the angle which distinguishes prolate from oblate.

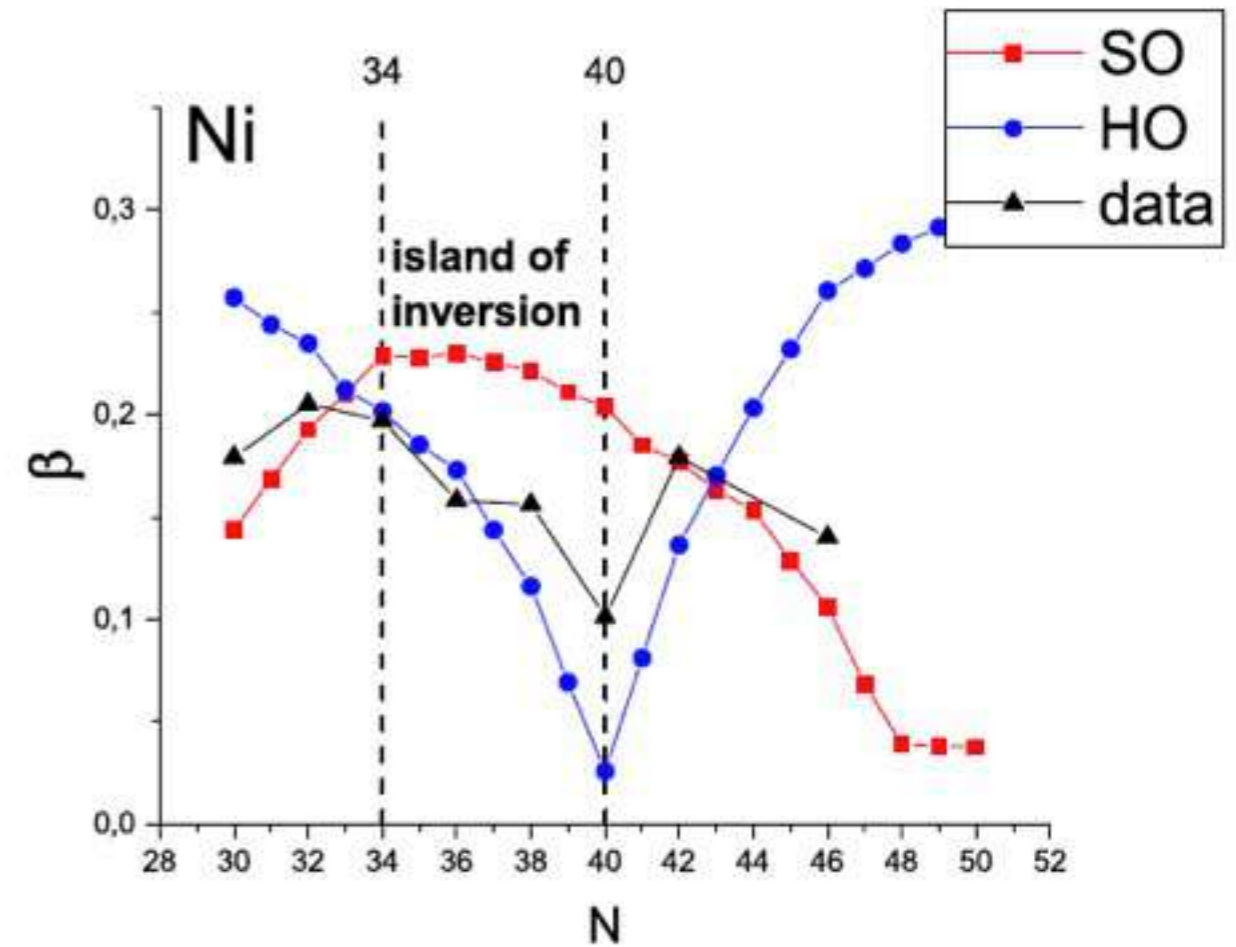
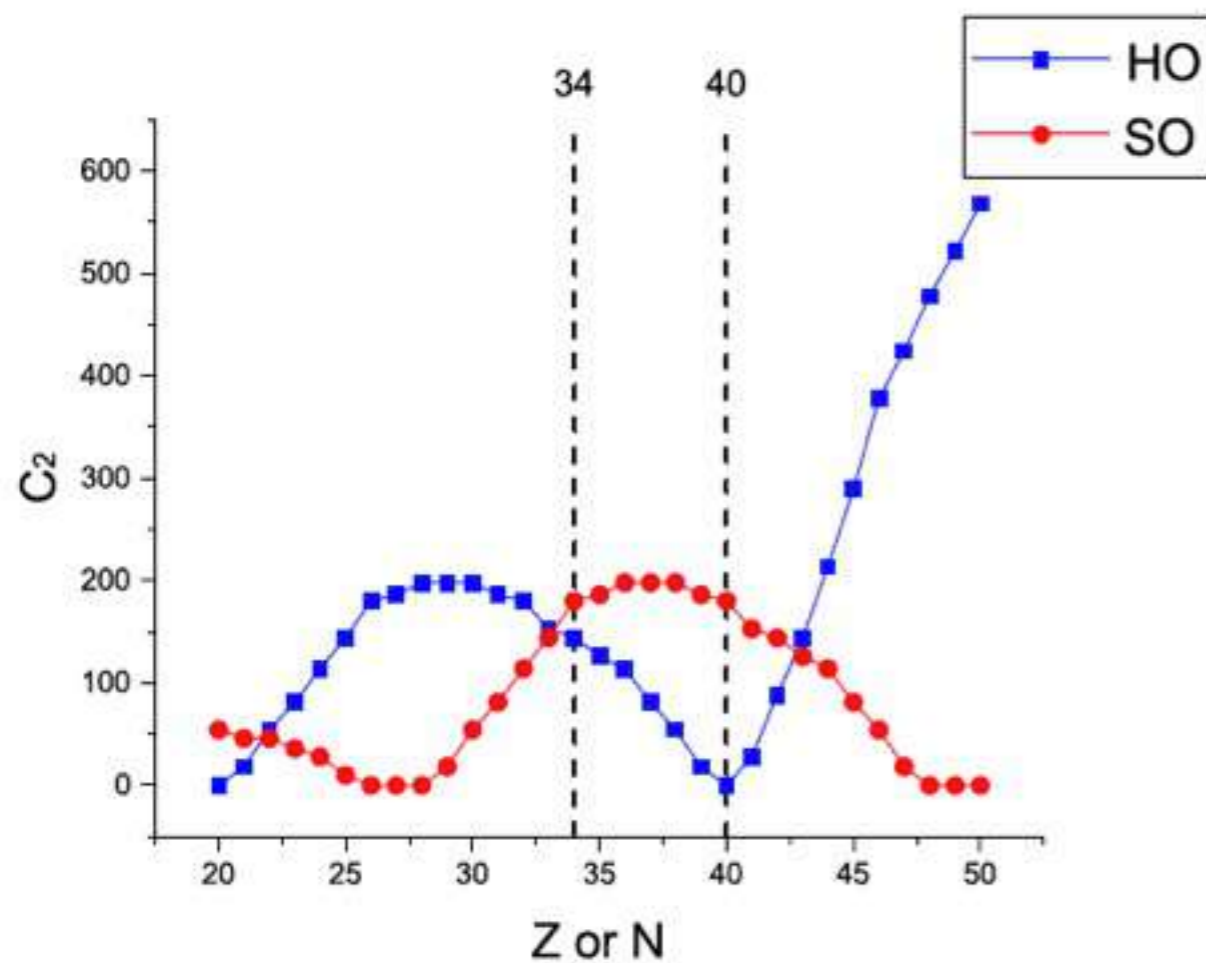
Parity inversion in the ^{11}Be



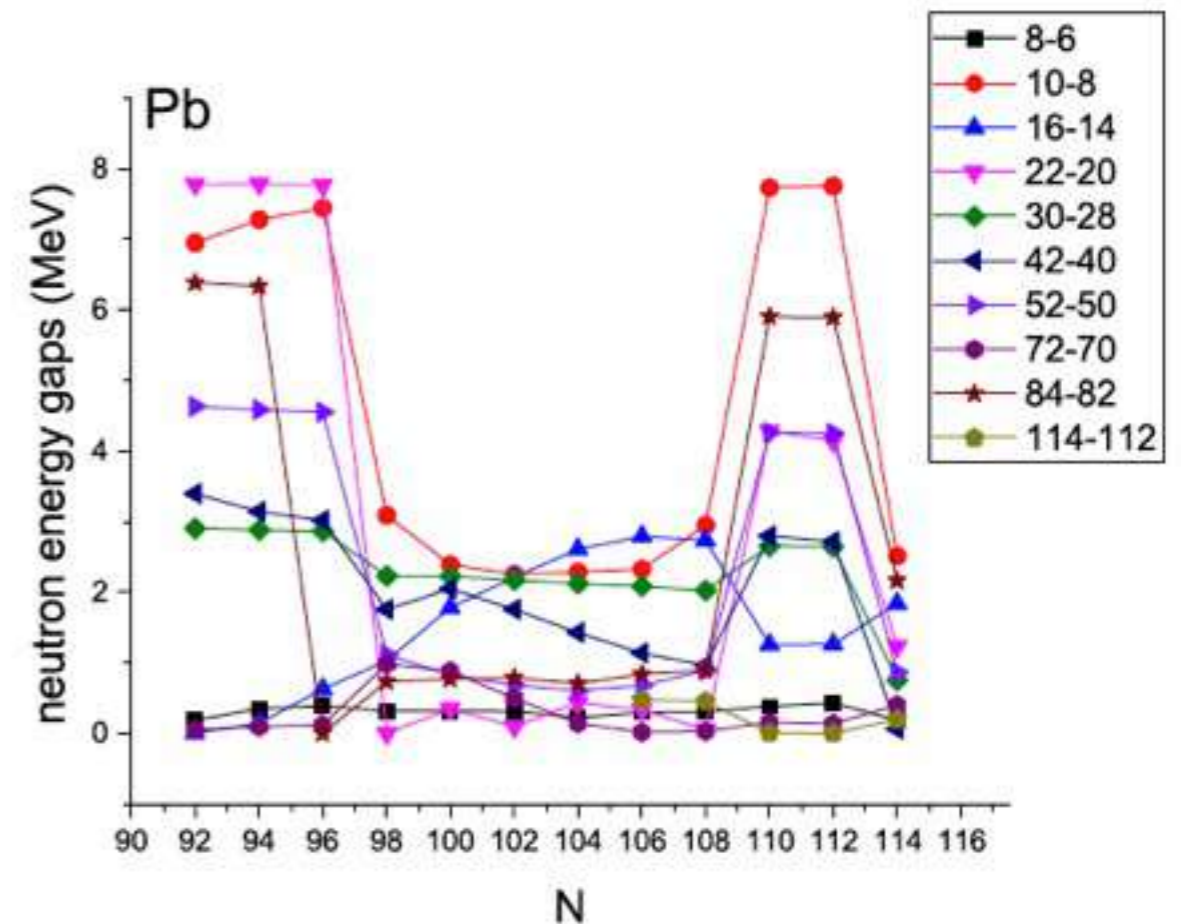
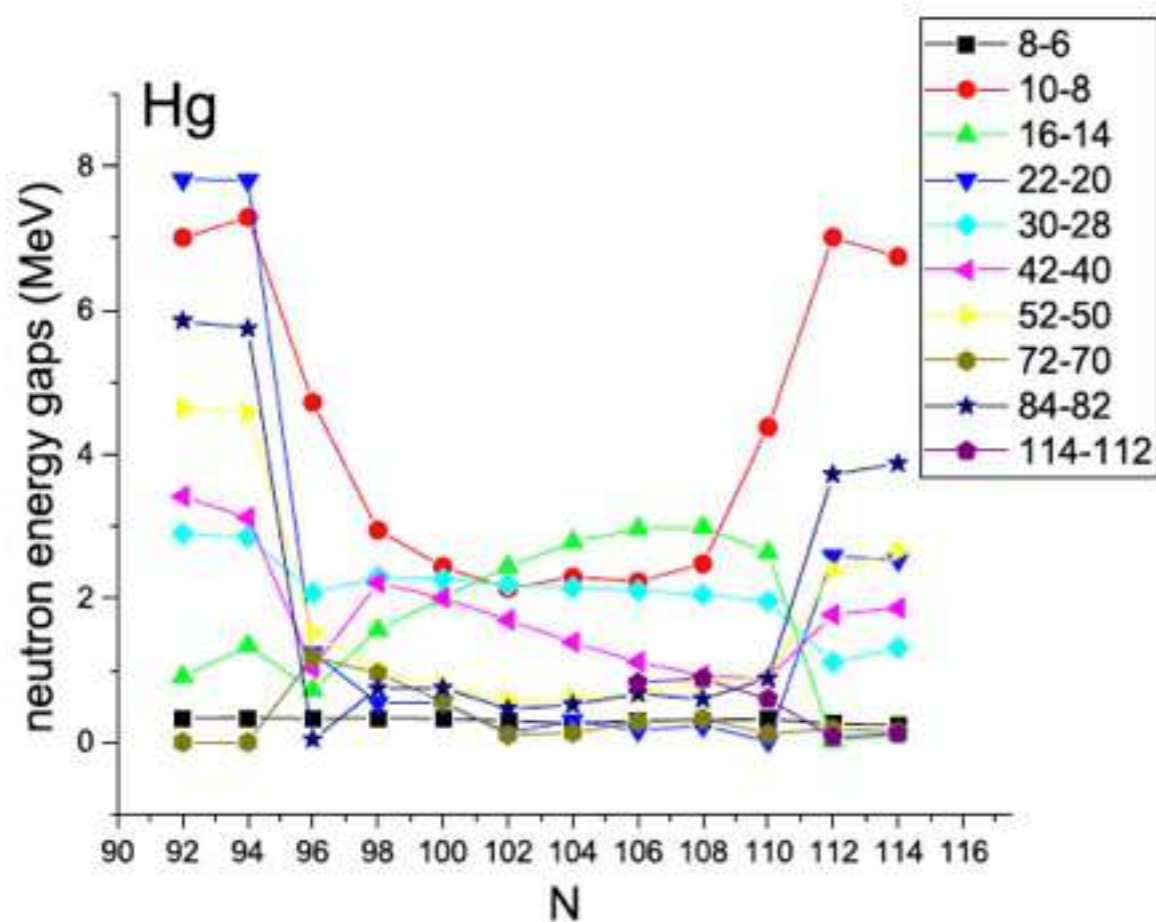
Island of inversion in the Mg isotopes



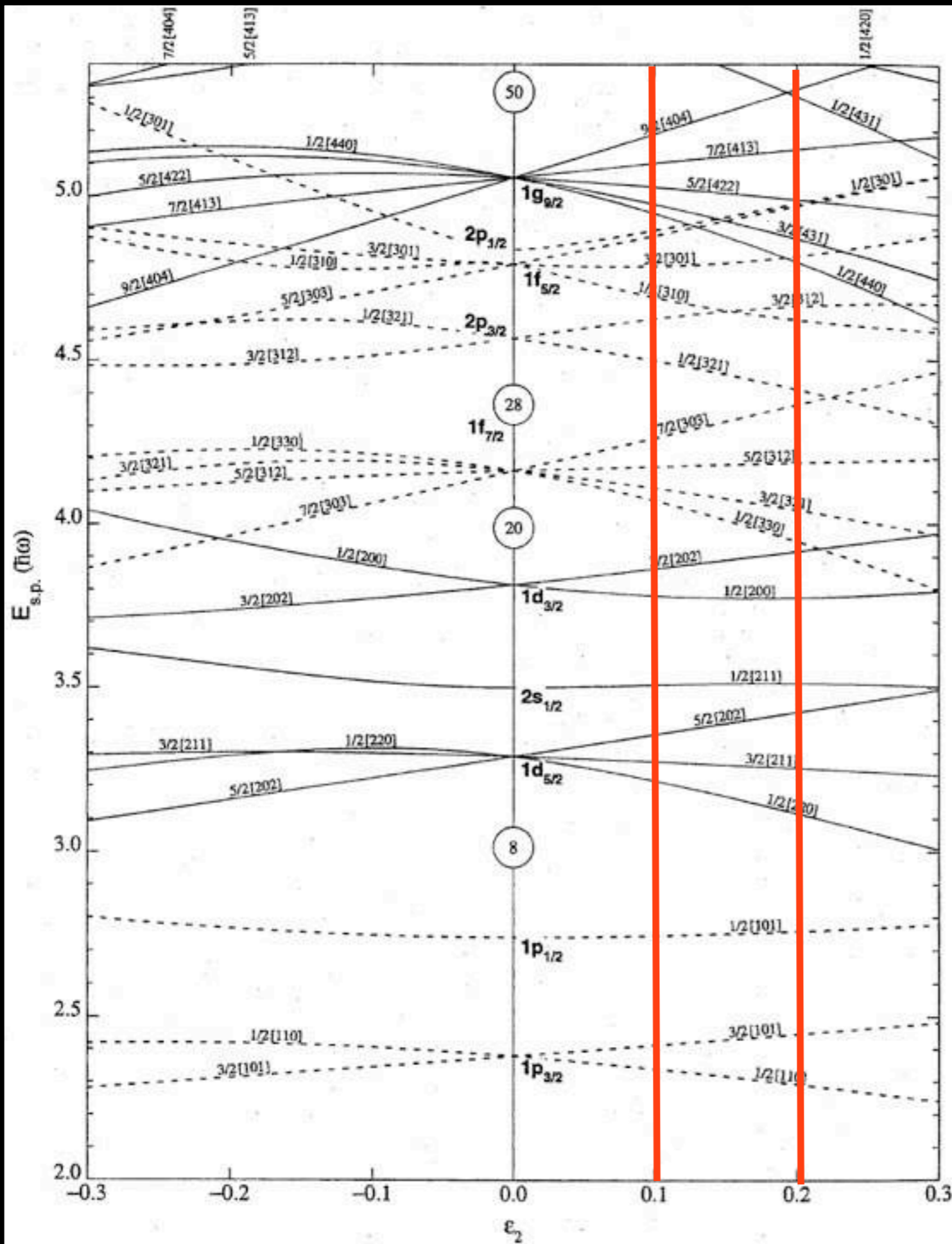
Island of inversion in the Ni isotopes



The dissolution of the spin-orbit like magic numbers



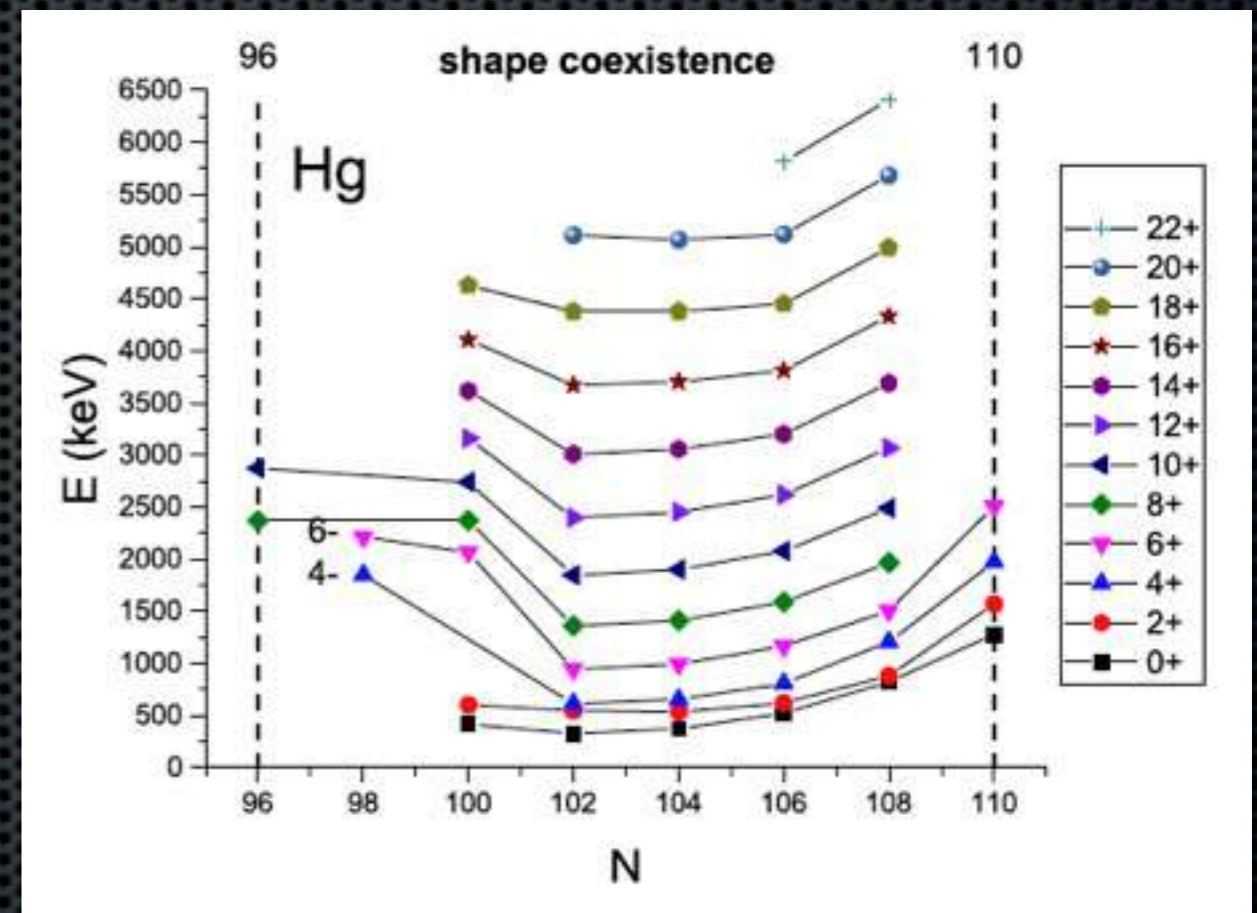
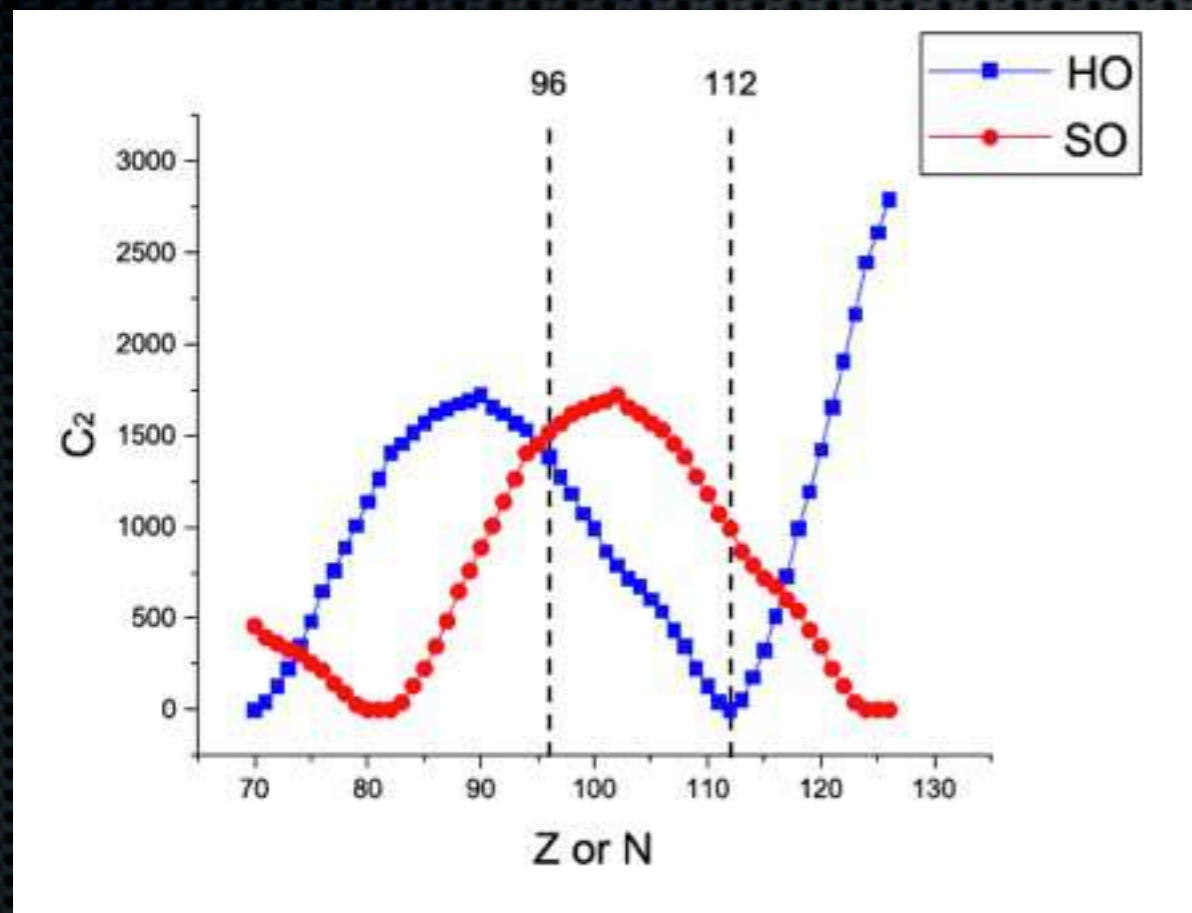
energy density functional calculations



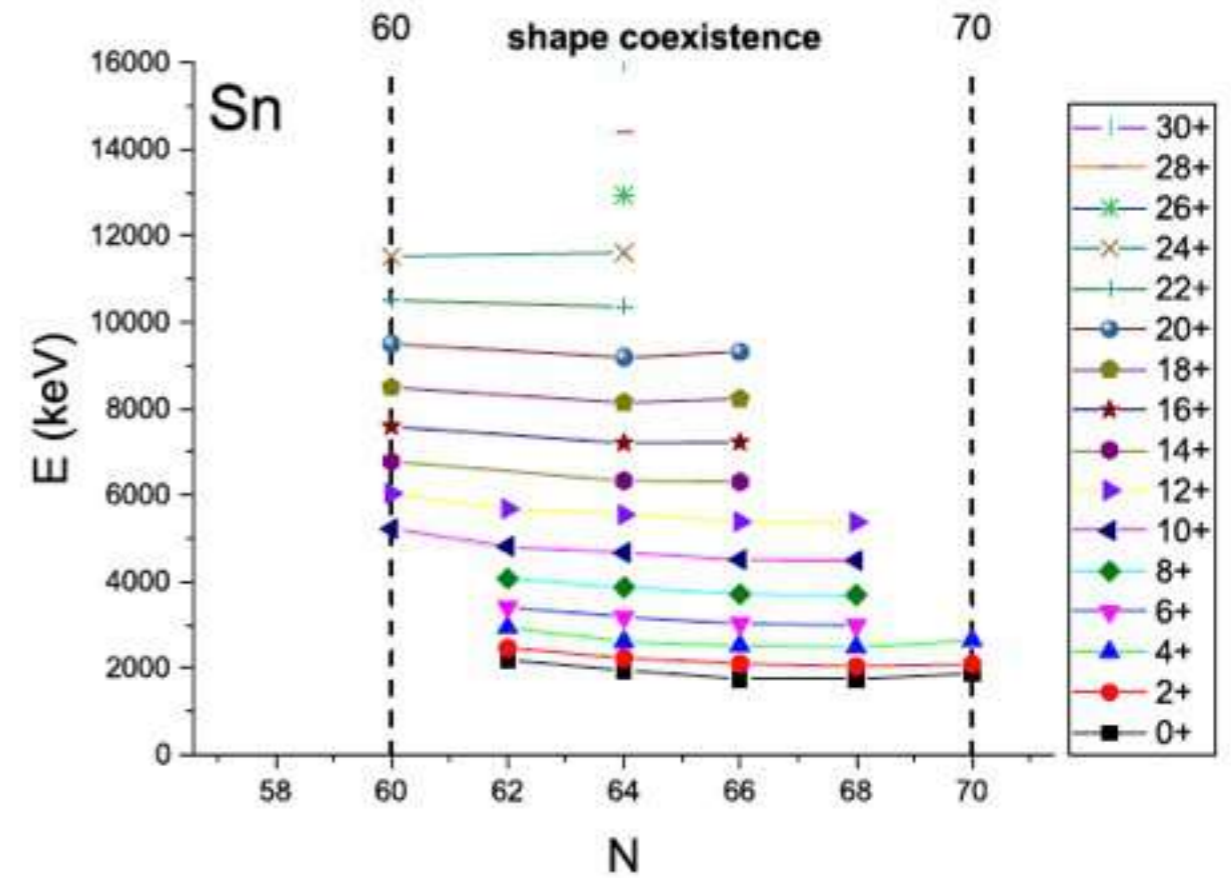
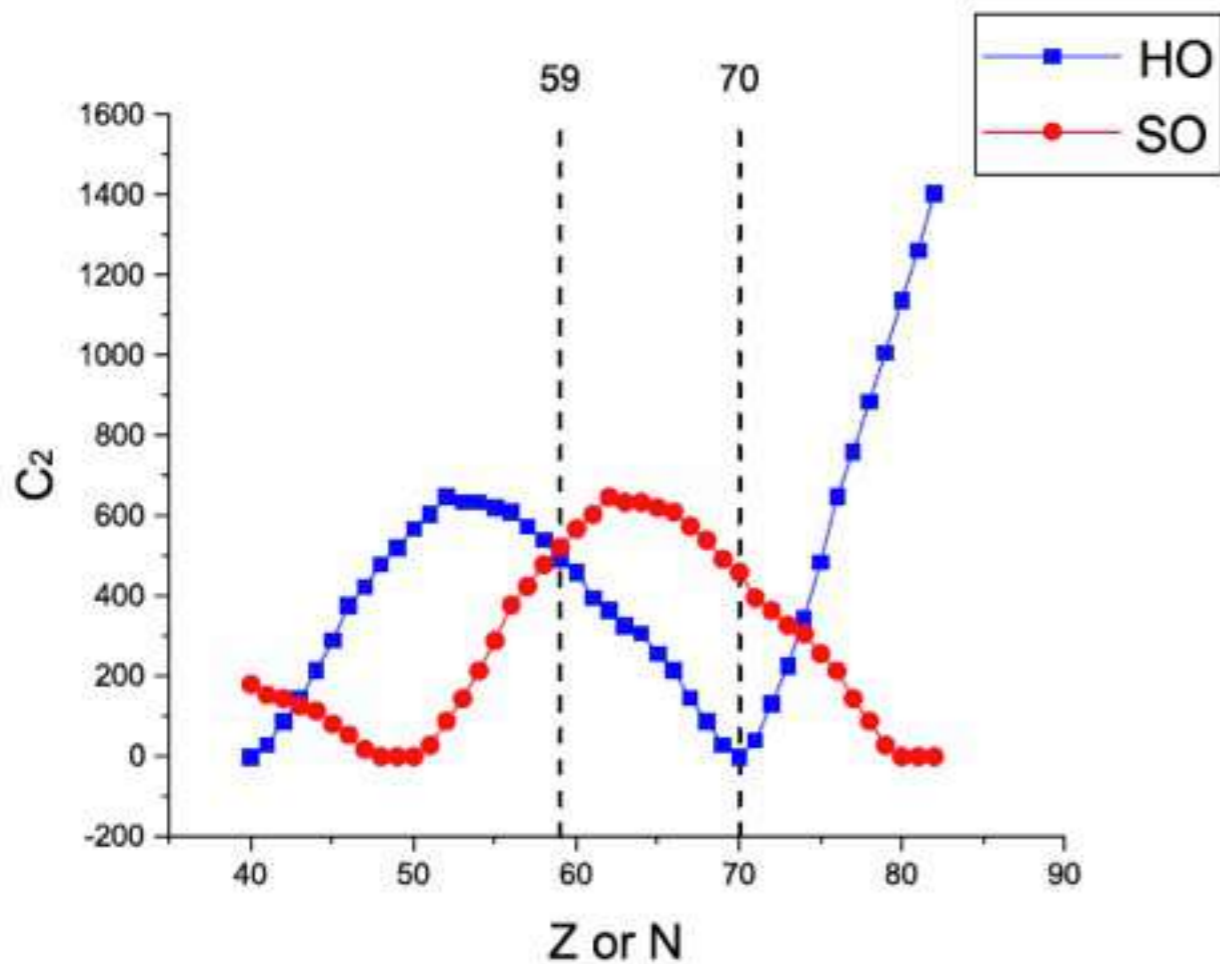
Why shell merging becomes possible?

- Deformed nuclei have no major magic numbers!

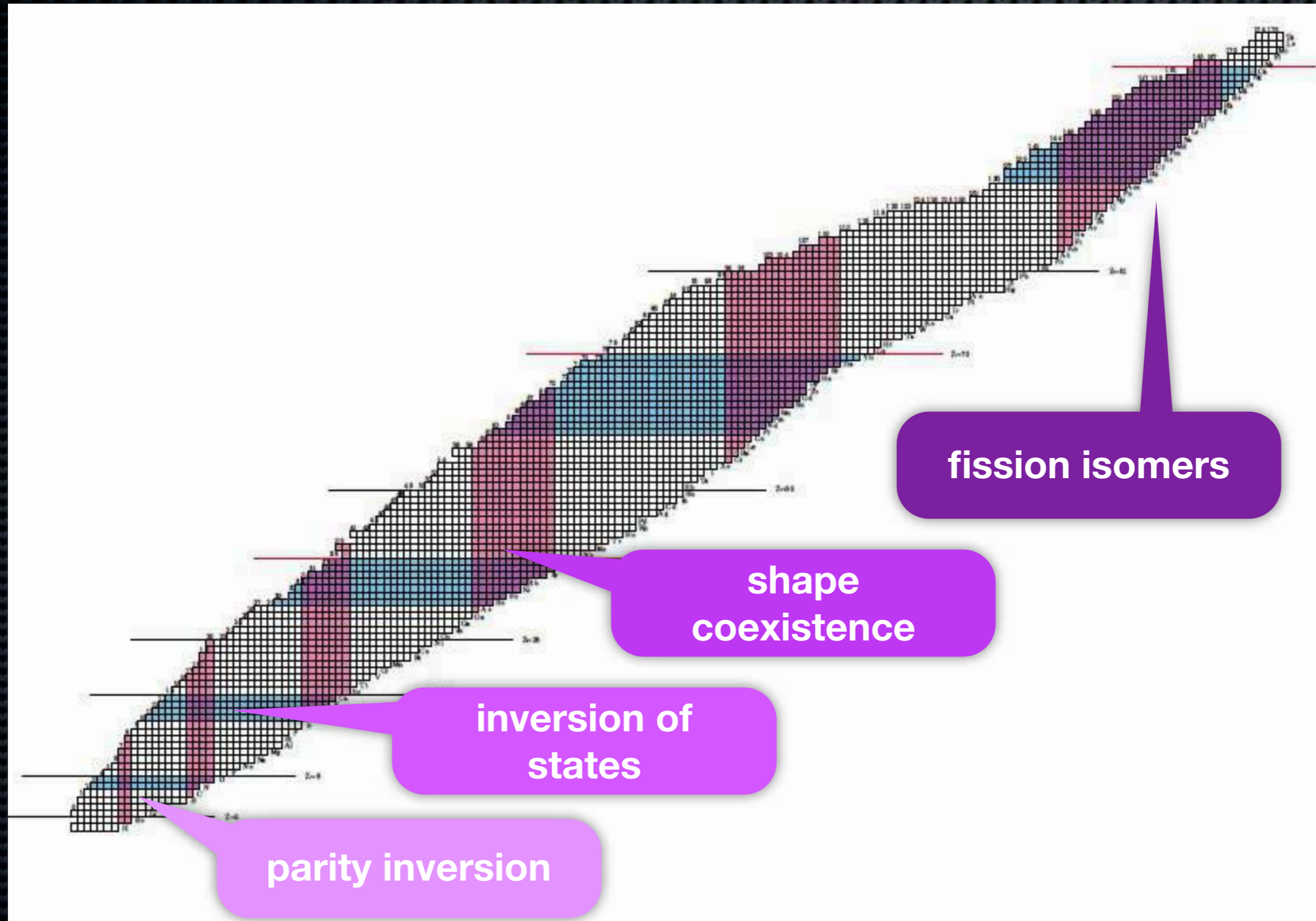
The islands of shape coexistence in heavy nuclei



The 60-70 island of shape coexistence



The shades of shape coexistence



Thank you