

Modelo de capas

17 de febrero de 2014

Discrepancias con la fórmula semiempírica de la masa

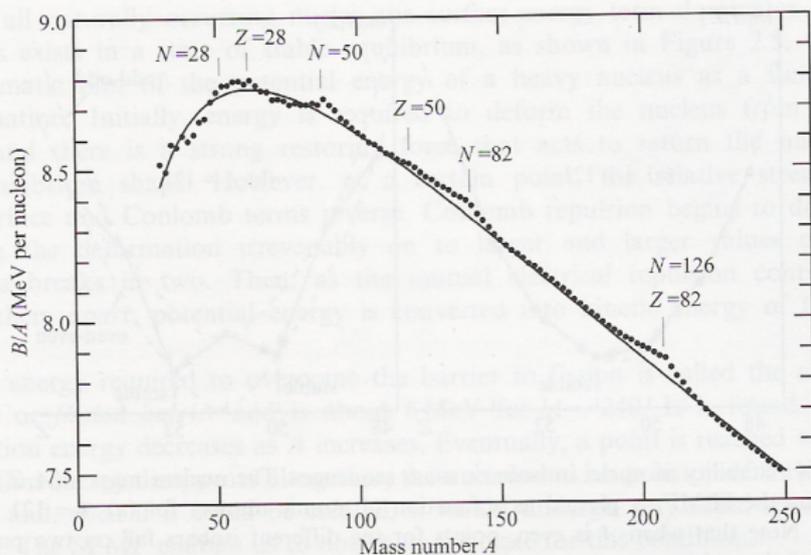
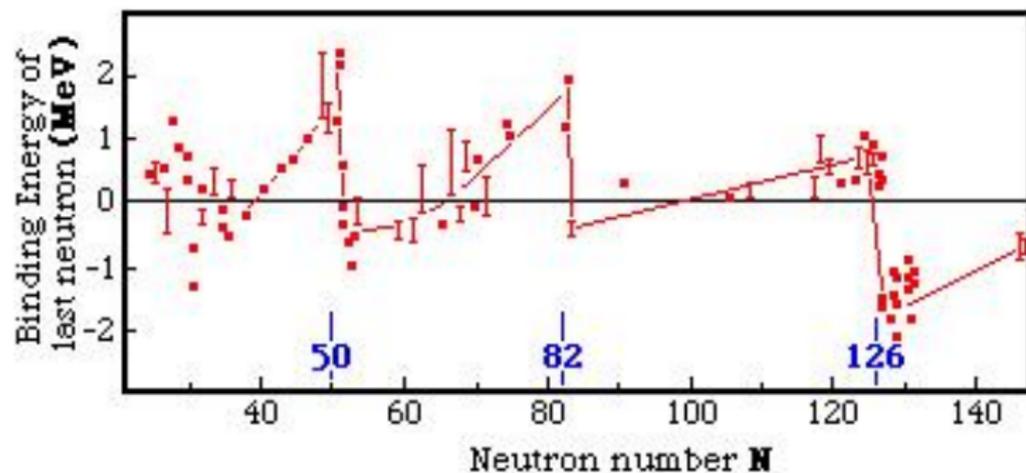
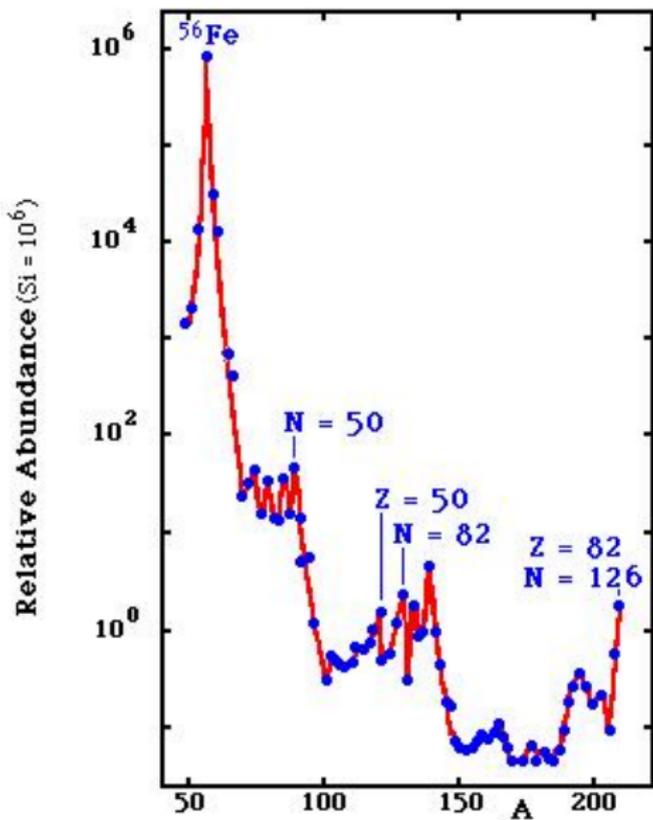


Figure 2.3 Experimental values of binding energy per nucleon B/A plotted as a function of mass number A . The smooth curve represents the semi-empirical mass formula with $a_v = 15.56$ MeV, $a_s = 17.23$ MeV, $a_a = 23.28$ MeV and $a_c = 0.7$ MeV. Each point represents an odd-even nucleus or an average of neighbouring nuclei (for A even) so that there is no effect due to the pairing term. Significant differences between experimental values and the SEMF occur near indicated values of N and Z .

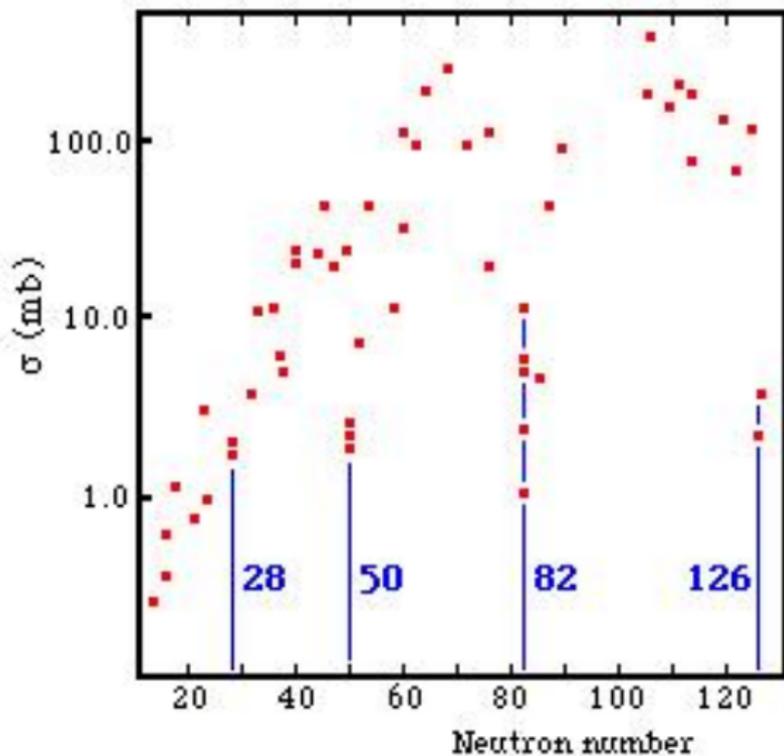
Discrepancias con la fórmula semiempírica de la masa



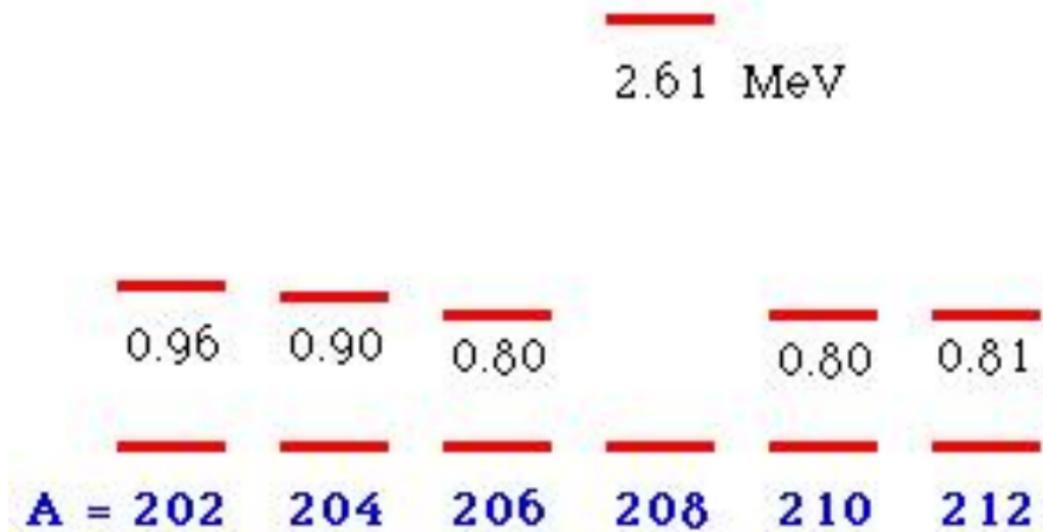
Abundancias relativas de los elementos



Sección eficaz de absorción de neutrones



Energía del primer nivel excitado en isótopos del Pb



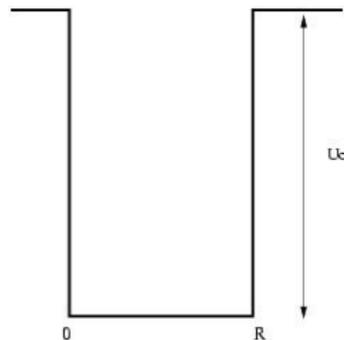
Pozo cuadrado infinito

Solución general

$$\Psi(r) = R_{nl}(r) Y_{lm}(\theta, \varphi)$$

Ecuación radial

$$\frac{1}{r} \frac{d}{dr} \left(r^2 \frac{dR_{nl}}{dr} \right) + \frac{2M}{\hbar^2} \left[E - V(r) - \frac{\hbar^2 \ell(\ell + 1)}{2Mr^2} \right] R_{nl} = 0$$



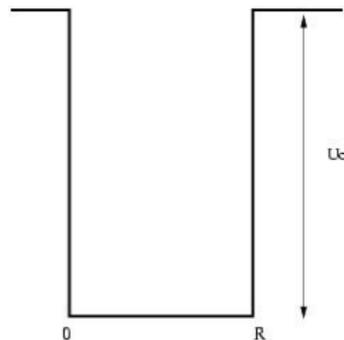
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Soluciones regulares en el origen para pozo cuadrado

$$R_{nl}(r) = j_\ell(kr)$$

$$k^2 = \frac{2M}{\hbar^2} (E + U_0)$$

Pozo cuadrado infinito

La función de onda debe anularse para $r=R$

$$R_{nl}(r) = j_l(k_{nl}R) = 0 \quad \implies \quad k_{nl}R = \eta_{nl}$$

$$E_{nl} = \frac{\hbar^2 \eta_{nl}^2}{2MR^2}$$

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Ejemplo

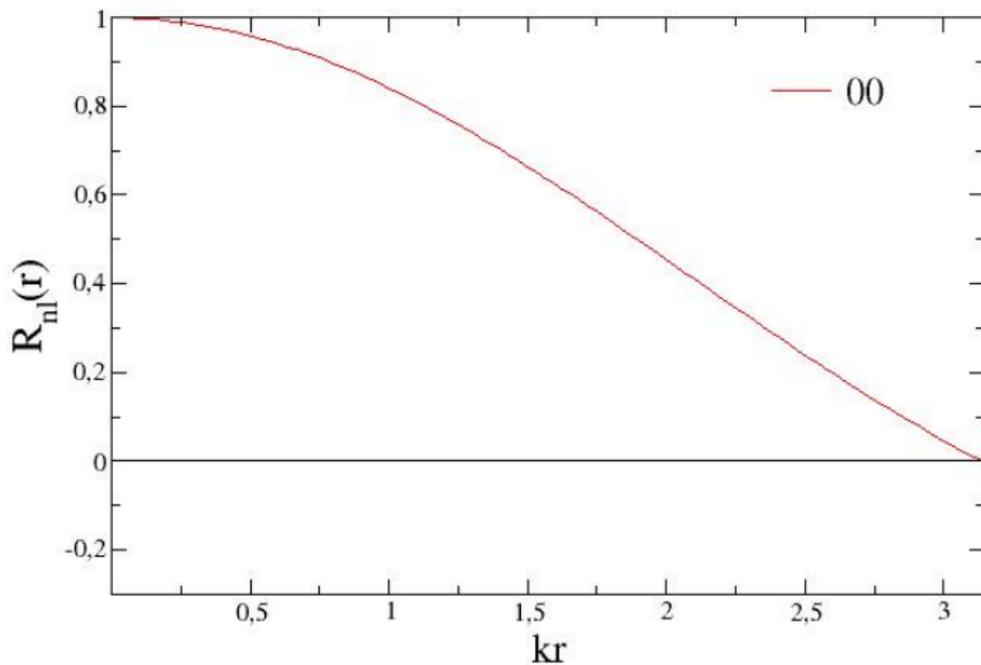
$$j_0(x) = \frac{\sin x}{x}$$

$$\eta_{00} = \pi$$

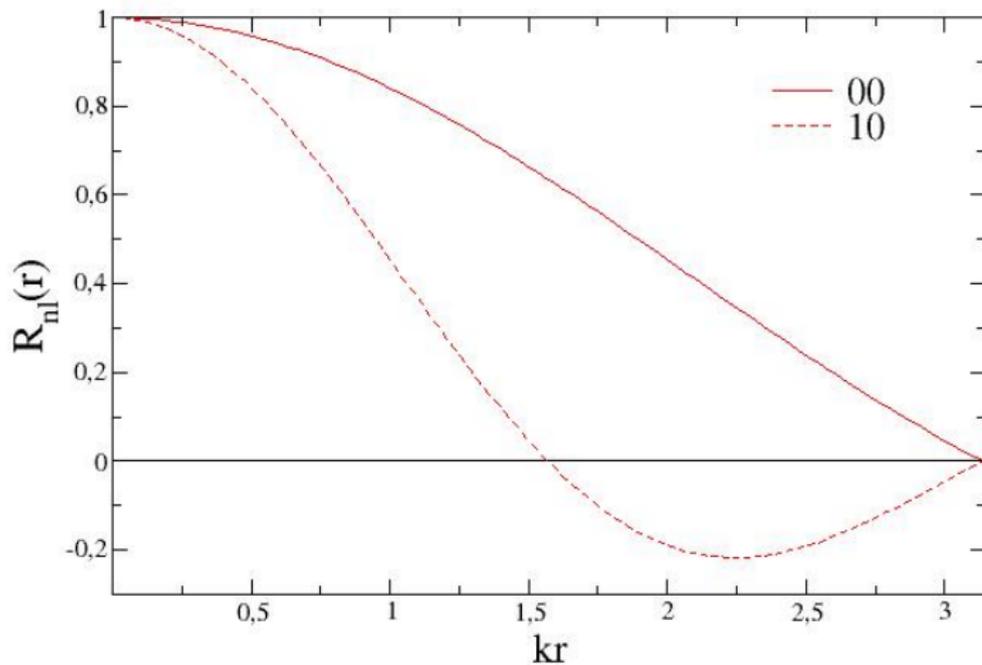
$$\eta_{10} = 2\pi$$

$$\eta_{20} = 3\pi$$

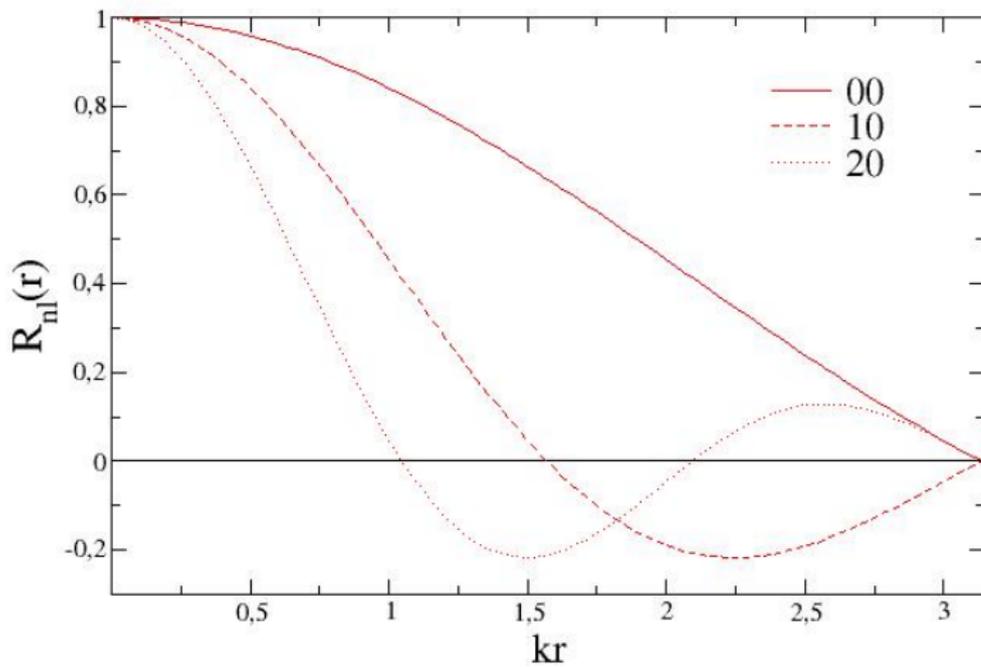
Autofunciones del pozo cuadrado



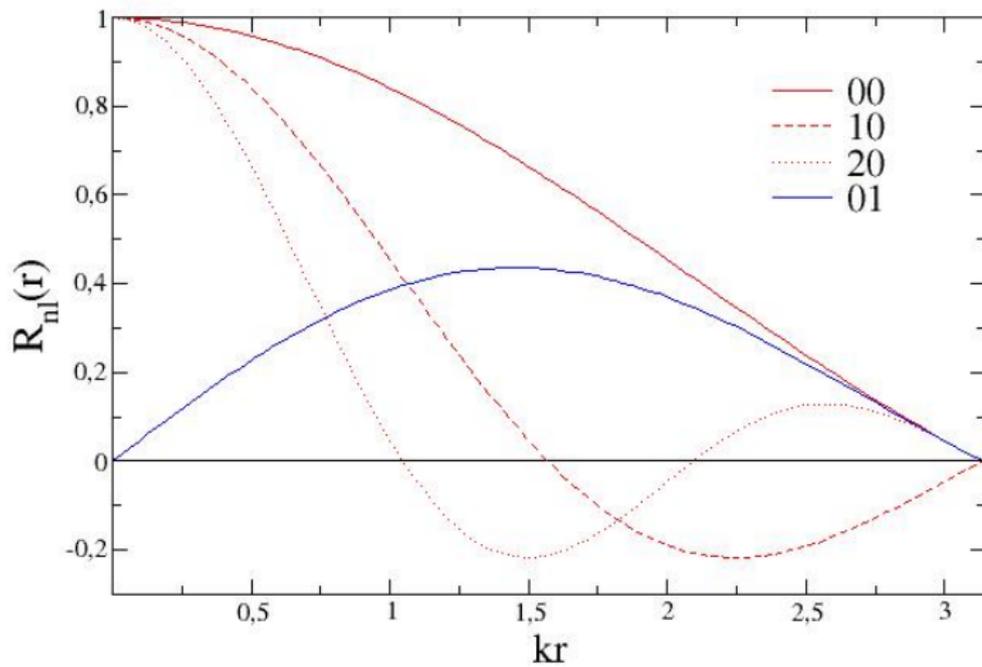
Autofunciones del pozo cuadrado



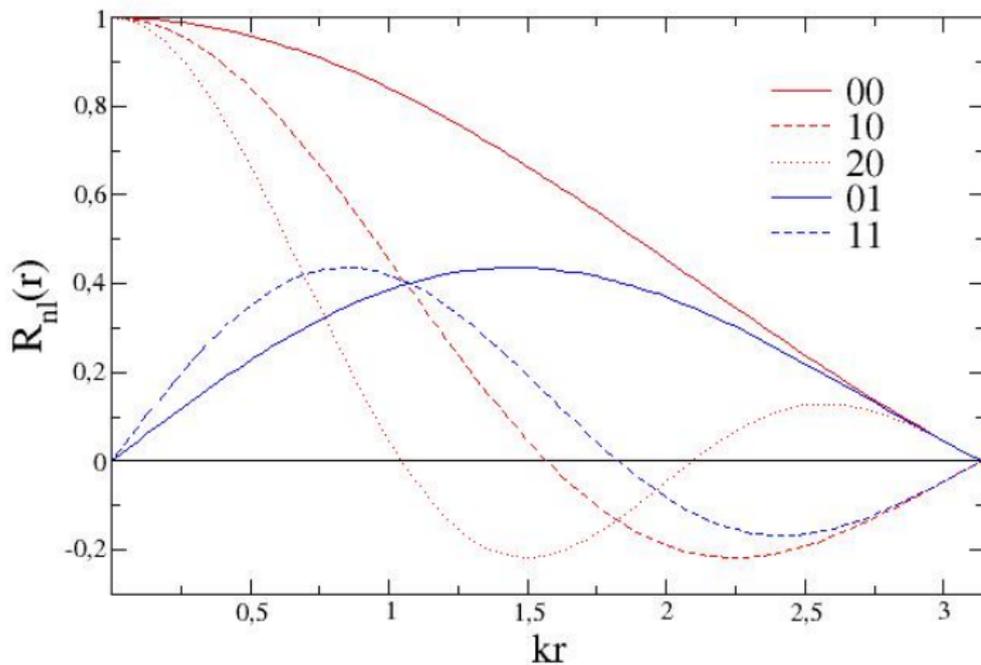
Autofunciones del pozo cuadrado



Autofunciones del pozo cuadrado



Autofunciones del pozo cuadrado



Autovalores pozo cuadrado

$n\ell$	Estado	η^2	Degeneración $2(2\ell + 1)$	Σ
00	1s	9.87	2	2
01	1p	20.191	6	8
02	1d	33.218	10	18
10	2s	39.479	2	20
03	1f	48.831	14	34
11	2p	59.680	6	40
04	1g	66.955	18	58
12	2d	82.719	10	68

Oscilador armónico

$$V(r) = -U_0 + \frac{1}{2}M\omega^2 r^2$$

Soluciones

$$R_{n\ell}(r) = N_{n\ell}(\nu r)^\ell e^{\nu^2 r^2/2} \mathcal{L}_{n-1}^{\ell+1/2}(\nu^2 r^2)$$

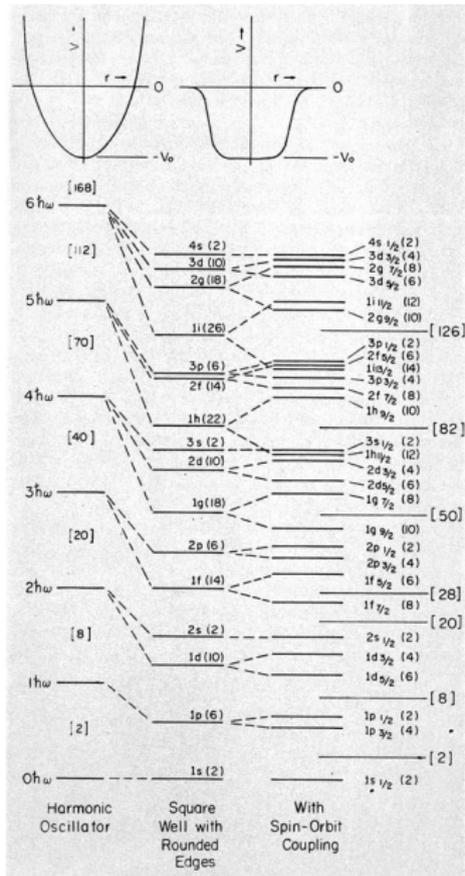
$$\nu = \sqrt{\frac{m\omega}{\hbar}} \quad N_{n\ell} = 2(n-1) + \ell$$

$$E_{n\ell} = (N_{n\ell} + \frac{3}{2})\hbar\omega - U_0$$

Autovalores Oscilador armónico

N_{nl}	$E_N(\hbar\omega)$	nl	Degeneración $2(2\ell + 1)$	Σ
0	3/2	1s	2	2
1	5/2	1p	6	8
2	7/2	2s,1d	12	20
3	9/2	2p,1f	20	40
4	11/2	3s,2d,1g	30	70
5	13/2	3p,2f,1h	42	112
6	15/2	4s,3d,2g,1i	56	168

Comparación pozo cuadrado vs. oscilador armónico



Modelo de capas con spin órbita

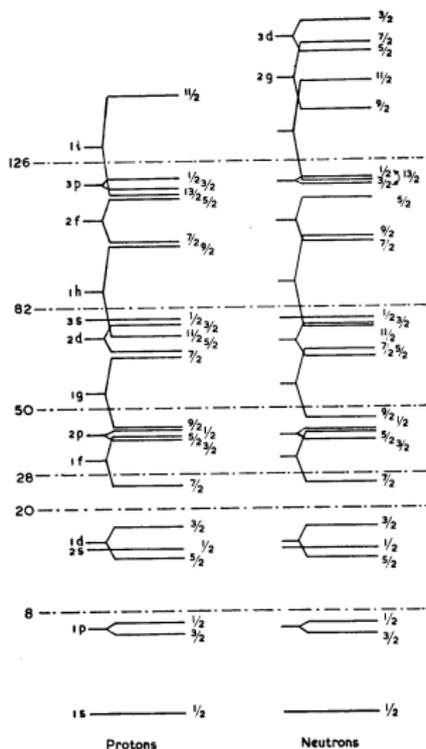
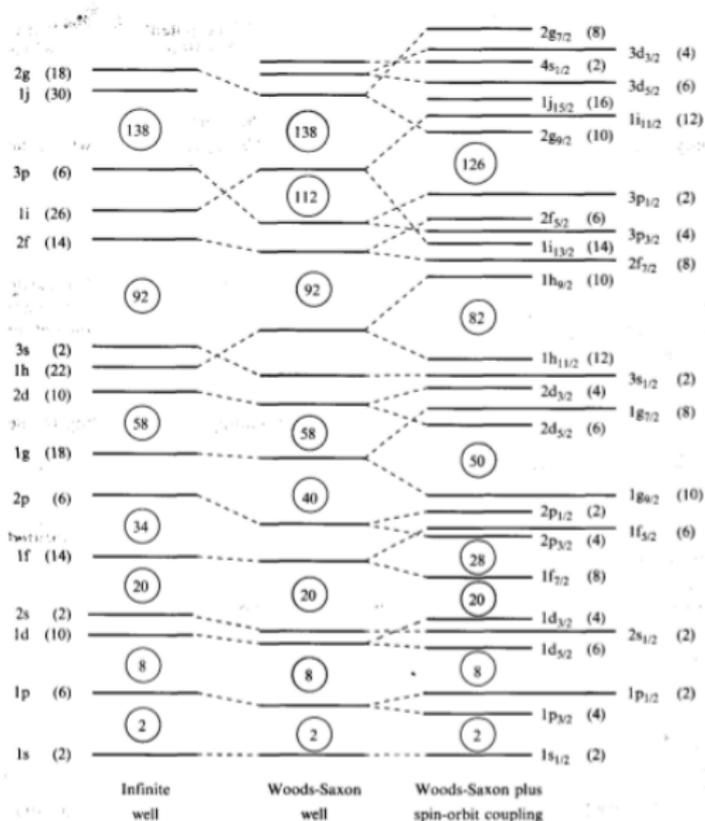


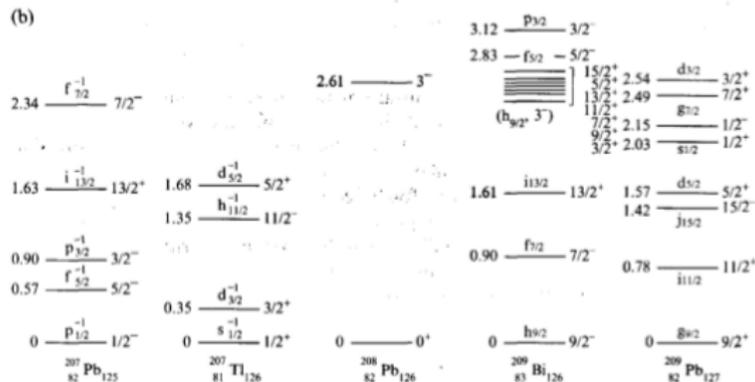
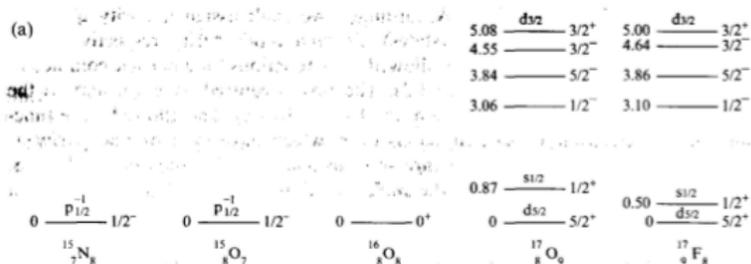
FIG. 5.6. PROTON AND NEUTRON LEVEL SCHEMES

[After Klinkenberg, F. F. A., *Revs. Mod. Phys.*, **24**, p. 63 (1952), Fig. 1.]

Modelo de capas con spin órbital



Ejemplos de Modelo de capas



Núcleos deformados

