MeV

$\epsilon_{d_{5/2}} = 3.5$

$\epsilon_{s_{1/2}} = 1.5$

$\epsilon_{p_{1/2}} = -1.2$

$\epsilon_{p_{3/2}} = -4.7$

WS potential $R_0 = 1.2A^{1/3}$ fm=2.7 fm

$U = U_0(1 + 0.4E) \rightarrow$ (exchange; Pauli)

$R(^{11}\text{Li})=4.58 \pm 0.13$ fm

$O = \left(\frac{R_0}{R}\right)^3 = \left(\frac{2.7}{4.58}\right)^3 \approx 0.2$

$m_k = \frac{m}{(1+O\times0.4)} \approx \frac{m}{1.08} \approx 0.93m$

$^{9}_{3}\text{Li}_6; \; U_0 = \left(-51 + 30\frac{N-Z}{A}\right)\text{MeV}=\text{-43 MeV}$

$\hbar\omega_{2^+} = 3.33$ MeV; $\beta_2 = 0.66$

clothing sp

$\langle R_0\partial U/\partial r \approx 1.4U_0 \approx -60$ MeV; $\langle j\|Y_2\|1/2\rangle \approx ((2j + 1)/4\pi)^{1/2} \approx 0.7$

$\langle H_c\rangle = \frac{\beta_2}{\sqrt{5}}\langle R_0\frac{\partial U}{\partial r}\rangle O\langle j\|Y_2\|1/2\rangle \approx \frac{0.7}{\sqrt{5}}(-60\text{MeV}) \times 0.2 \times 0.7 \approx -3$ MeV

$$\begin{pmatrix} (6.8 - \lambda) & -3 \\ -3 & (1.5 - \lambda) \end{pmatrix} = 0 \tag{0.0.1}$$

$$\begin{pmatrix} (-8 - \lambda) & -3.9 \\ -3.9 & (-1.2 - \lambda) \end{pmatrix} = 0 \tag{0.0.2}$$

$\tilde{\epsilon}_{s_{1/2}} = 0.15$ MeV

$\tilde{\epsilon}_{p_{1/2}} = 0.6$ MeV

$|\widetilde{1/2^-}\rangle = 0.91|p_{1/2}\rangle + 0.41|((p_{1/2}, p_{3/2}^{-1}) \otimes 2^+)_{0^+} p_{1/2}; 1/2^-\rangle$

$|\widetilde{1/2^+}\rangle = 0.91|s_{1/2}\rangle + 0.41|(d_{5/2} \otimes 2^+)_{0^+} 1/2^+\rangle$

halo–anti pairing effect s, p at threshold

$H_D = \kappa_1\mathbf{D} \cdot \mathbf{D}$

$\kappa_1 = s\kappa_1^0; \quad \kappa_1^0 \sim 5V_1 = 125$ MeV

$\kappa_1 \sim 5.6$ MeV ($s \approx 0.045$); $\qquad$ (8%)TRK $= \frac{9}{4\pi}\frac{\hbar^2}{2M}\frac{NZe^2}{A}$

$\hbar\omega_{pygmy} = \left((\epsilon_{1/2^+} - \epsilon_{1/2^-})^2 + \kappa_1(2 \times 0.08\text{TRK})^2\right)^{1/2} \approx 0.9$ MeV

$|\tilde{0}\rangle = |0\rangle_\nu + 0.7|(p_{1/2}, p_{3/2}^{-1})_{1^-} \otimes 1^-; 0\rangle + 0.1|(s_{1/2}, d_{5/2})_{2^+} \otimes 2^+; 0\rangle$

$|0\rangle_\nu = 0.45|s_{1/2}^2(0)\rangle + 0.55|p_{1/2}^2(0)\rangle + 0.04|d_{5/2}^2(0)\rangle$

$E_{corr} \approx 2\tilde{\epsilon}_{s_{1/2}} + \Delta E_b + \Delta E_i = 0.3 - 0.1 - 0.5$ MeV≈ -0.3 MeV

$\langle V_p\rangle = -G_{scr} = -rG$

earth $= -0.048 \times \frac{25}{A}MeV\approx -\frac{1\text{MeV}}{A}$

≈ -0.1 MeV

$|\widetilde{s^2_{1/2}}(0)\rangle$

$|\widetilde{p^2_{1/2}}(0)\rangle$

$|\widetilde{s^2_{1/2}}^+\rangle, |\widetilde{s^2_{1/2}}^-\rangle$

$\Delta E_{ind} = -0.5$ MeV

$\Delta E_{bare} = -0.1$ MeV

$(E_{corr})_{exp} = -0.380$ MeV

V_ν^2

ϵ_F

$q = \hbar \Delta L / R_g$

Daniel Mateo, $\frac{p_{\text{final}}}{p_{\text{ini}}} = \sqrt{\frac{(E - E_x)}{E}} \approx 1 \; \frac{p_{\text{final}}}{p_{\text{ini}}} < 1 \; E \gg E_x \; E \sim E_x \; \mathbf{q} = \mathbf{p}_{\text{final}} - \mathbf{p}_{\text{ini}}$

$\Delta L = R_g \sqrt{2mE} \left(1 - \sqrt{1 - \frac{E_x}{E}} \right)$

$$T_{m_i,m_f} = \sum_{L_a,L_b} \langle L_a \; 0 \; 2 \; M | L_b \; M \rangle \tag{0.0.3}$$

$$\langle J_i \; m_i \; 2 \; M | J_f \; m_f \rangle Y^{L_b}_{-M}(\theta) I(L_a, L_b), \tag{0.0.4}$$

$$T^{L_g}_{m_i,m_f} = \langle L_g \; 0 \; 2 \; M | L_g \; M \rangle \tag{0.0.5}$$

$$\langle J_i \; m_i \; 2 \; M | J_f \; m_f \rangle Y^{L_g}_{-M}(\theta) I(L_g, L_g), \tag{0.0.6}$$

where $M = m_f - m_i$, and

$$I(K, l_a, l_b) = 2\pi^{1/2} i^{l_a - l_b} e^{i(\sigma^{l_a}_i + \sigma^{l_b}_i)} (2l_a + 1)^{3/2} (2K + 1)(2l_i + 1)$$

$$\times \sqrt{(2J_i + 1)(2l_f + 1)} \left\{ \begin{array}{ccc} l_i & 1/2 & J_i \\ J_f & K & l_f \end{array} \right\} \langle l_a \; 0 \; K \; 0 | l_b \; 0 \rangle$$

$$\times \langle l_i \; 0 \; K \; 0 | l_f \; 0 \rangle Y^{l_b}_{-M}(\hat{k}_f) \int f_{l_a}(R) \, g_{l_b}(R) \rho_K(R) \, dR. \tag{0.0.7}$$

≈ 1.2 MeV (10^{-2})

$\beta = 0 \; \beta = \pm 2$

$\xi = \frac{\hbar v_F}{\pi |E_{corr}|}$

$$\xi = \frac{\hbar v_F}{\pi |E_{corr}|} \tag{0.0.8}$$

	$1p_{1/2}^{-1}2s_{1/2}$	$1p_{1/2}^{-1}3s_{1/2}$	$1p_{1/2}^{-1}4s_{1/2}$	$1p_{1/2}^{-1}1d_{3/2}$	$1p_{3/2}^{-1}4d_{5/2}$	$1p_{3/2}^{-1}5d_{5/2}$	$1p_{3/2}^{-1}6d_{5/2}$
X	-0.780	0.479	0.220	0.103	0.166	0.241	0.250
Y	0.078	0.108	0.106	0.075	0.139	0.208	0.221

$v_F/c \approx 0.27$ (0.16, ^{11}Li)
$\xi = 14$ fm (20 fm, ^{11}Li)

$$q_\xi = \frac{\hbar^2}{2m\xi^2}\frac{1}{|E_{corr}|} \approx 0.05 \quad (0.1,{}^{11}\text{Li}) \tag{0.0.9}$$

strongly correlated ($q_\xi \ll 1$), weakly "bound" ($|E_{corr}|/\epsilon_F \lesssim 0.06$)
very extended ($\xi/d \gtrsim 7$, $d = \left(\frac{4\pi R^3}{3A}\right)^{1/3}$) objects

$$\langle r^2\rangle_{def}^{1/2} = \xi = \frac{\hbar v_F}{\pi|E_{corr}|} \approx 29 \text{ fm} \tag{0.0.10}$$

($E_{corr} \approx 0.6$ MeV)

$$\langle r^2\rangle_{Cooper}^{1/2} = \xi = \frac{\hbar v_F}{\pi\Delta} \approx 21 \text{ fm} \tag{0.0.11}$$

($\Delta \approx 0.8$ MeV)

$$\langle H_c\rangle_{p_{1/2}} \approx 1.3\langle H_c\rangle_{s_{1/2}} \tag{0.0.12}$$

$$(v_F/c \approx 0.27) \tag{0.0.13}$$

$$\Delta \approx 1.5 \text{ MeV} \tag{0.0.14}$$

$$q = \frac{\hbar^2}{ma^2}\frac{1}{|v_0|} \approx 0.5 \tag{0.0.15}$$

$$q_\xi = \frac{\hbar^2}{2m\xi^2}\frac{1}{2\Delta} \approx 0.06 \tag{0.0.16}$$

$$\xi = \frac{\hbar v_F}{2\Delta} \approx 18 \text{ fm} \tag{0.0.17}$$

$$\Delta t = R_0/v = R_0 \sqrt{\frac{m}{2E}} \tag{0.0.18}$$

$\hbar\omega_2$
$2 \times \hbar\omega_2$
$3 \times \hbar\omega_2$
$2 \times \hbar\omega_3$
$\hbar\omega_3$
J^π

$$\hbar\omega = 2.494 \text{ MeV} \tag{0.0.19}$$

$$d\sigma/d\Omega(\text{mb/sr}) \tag{0.0.20}$$

$$\theta_{CM} \tag{0.0.21}$$

$$|\text{int}\rangle \quad |0\rangle \tag{0.0.22}$$

$$|\widetilde{1/2^-}\rangle = \sqrt{0.81}\,|1p_{1/2}\rangle + \sqrt{0.15}\,|((1p_{1/2}, 1p_{3/2})_{2^+}^{-1} \otimes 2^+)_{0^+} 1p_{1/2}\rangle + \sqrt{0.02}\,|(d_{5/2} \otimes 3^-)_{1/2^-}\rangle$$
$$+ \sqrt{0.04}\,|(1p_{1/2}^2(0) \otimes 0^{(-)})_{0^+} p_{1/2}\rangle$$
$$|\widetilde{1/2^+}\rangle = \sqrt{0.83}\,|2s_{1/2}\rangle + \sqrt{0.17}\,|(d_{5/2} \otimes 2^+)_{1/2^+}\rangle + \sqrt{0.01}\,|(s_{1/2}^2(0) \otimes 0^{(-)})_{0^+} s_{1/2}\rangle$$
$$|0^{(-)}\rangle = |^8\text{Be}(gs, 0^+)\rangle \quad \text{monopole pair removal mode of the closed shell system } {}^{10}_{4}\text{Be}_6$$
$$|\widetilde{5/2^-}\rangle = \sqrt{0.34}\,|d_{5/2}\rangle + \sqrt{0.32}\,|(s_{1/2} \otimes 2^+)_{5/2^+}\rangle + \sqrt{0.34}\,|(d_{5/2} \otimes 2^+)_{5/2^+}\rangle$$
$$+ \sqrt{0.003}\,|(d_{5/2}(0)^2 \otimes 0^{(-)})_{0^+} d_{5/2}\rangle$$

Møller