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)

$R(^{11}\mathrm{Li})$=4.58 ± 0.13 fm
$O = \left(\frac{R_0}{R}\right)^3 = \left(\frac{2.7}{4.58}\right)^3 \approx 0.2$
$m_k = \frac{m}{(1+O\times 0.4)} \approx \frac{m}{1.08} \approx 0.93m$
$^9_3\mathrm{Li}_6$; $U_0 = \left(-51 + 30\frac{N-Z}{A}\right)$MeV=-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; $\langle j\|Y_2\|1/2\rangle \approx ((2j+1)/4\pi)^{1/2} \approx 0.7$
$\langle H_c\rangle = \frac{\beta_2}{\sqrt{5}}\langle R_0\frac{\partial U}{\partial r}\rangle O\langle j\|Y_2\|1/2\rangle \approx \frac{0.7}{\sqrt{5}}(-60\mathrm{MeV}) \times 0.2 \times 0.7 \approx -3$ 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

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

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

halo–anti pairing effect s, p at threshold
$H_D = \kappa_1 \mathbf{D}\cdot\mathbf{D}$
$\kappa_1 = s\kappa^0_1$; $\quad \kappa^0_1 \sim 5V_1 = 125$ MeV
$\kappa_1 \sim 5.6$ MeV ($s \approx 0.045$); $\qquad$ (8%)TRK $= \frac{9}{4\pi}\frac{\hbar^2}{2M}\frac{NZe^2}{A}$
$\hbar\omega_{pygmy} = \left((\epsilon_{1/2^+} - \epsilon_{1/2^-})^2 + \kappa_1(2 \times 0.08\mathrm{TRK})^2\right)^{1/2} \approx 0.9$ MeV
$|\tilde{0}\rangle = |0\rangle_\nu + 0.7|(p_{1/2}, p^{-1}_{3/2})_{1^-} \otimes 1^-; 0\rangle + 0.1|(s_{1/2}, d_{5/2})_{2^+} \otimes 2^+; 0\rangle$
$|0\rangle_\nu = 0.45|s^2_{1/2}(0)\rangle + 0.55|p^2_{1/2}(0)\rangle + 0.04|d^2_{5/2}(0)\rangle$
$E_{corr} \approx 2\tilde{\epsilon}_{s_{1/2}} + \Delta E_b + \Delta E_i = 0.3 - 0.1 - 0.5$ MeV≈ -0.3 MeV
$\langle V_p\rangle = -G_{scr} = -rG$
$= -0.048 \times \frac{25}{A}MeV\approx -\frac{1\mathrm{MeV}}{A}$

≈ -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
$q = \hbar \Delta L / R_g$
$\frac{p_{\rm final}}{p_{\rm ini}} = \sqrt{\frac{(E-E_x)}{E}} \approx 1$ $\frac{p_{\rm final}}{p_{\rm ini}} < 1$ $E \gg E_x$ $E \sim E_x$ $\mathbf{q} = \mathbf{p}_{\rm final} - \mathbf{p}_{\rm ini}$
$\Delta L = R_g \sqrt{2mE}\left(1 - \sqrt{1 - \frac{E_x}{E}}\right)$

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

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

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

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

where $M = m_f - m_i$, and

$$\begin{aligned} I(K, l_a, l_b) &= 2\pi^{1/2} i^{l_a - l_b} e^{i(\sigma_i^{l_a} + \sigma_i^{l_b})} (2l_a+1)^{3/2} (2K+1)(2l_i+1) \\ &\times \sqrt{(2J_i+1)(2l_f+1)} \begin{Bmatrix} l_i & 1/2 & J_i \\ J_f & K & l_f \end{Bmatrix} \langle l_a\ 0\ K\ 0 | l_b\ 0\rangle \\ &\times \langle l_i\ 0\ K\ 0 | l_f\ 0\rangle Y^{l_b}_{-M}(\hat{k}_f) \int f_{l_a}(R)\, g_{l_b}(R) \rho_K(R)\, dR. \end{aligned} \tag{0.0.7}$$

≈ 1.2 MeV (10^{-2})
$\beta = 0$ $\beta = \pm 2$
$\xi = \frac{\hbar v_F}{\pi |E_{corr}|}$

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

$v_F/c \approx 0.27$ (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

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

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

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

($\Delta \approx 0.8$ MeV)

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