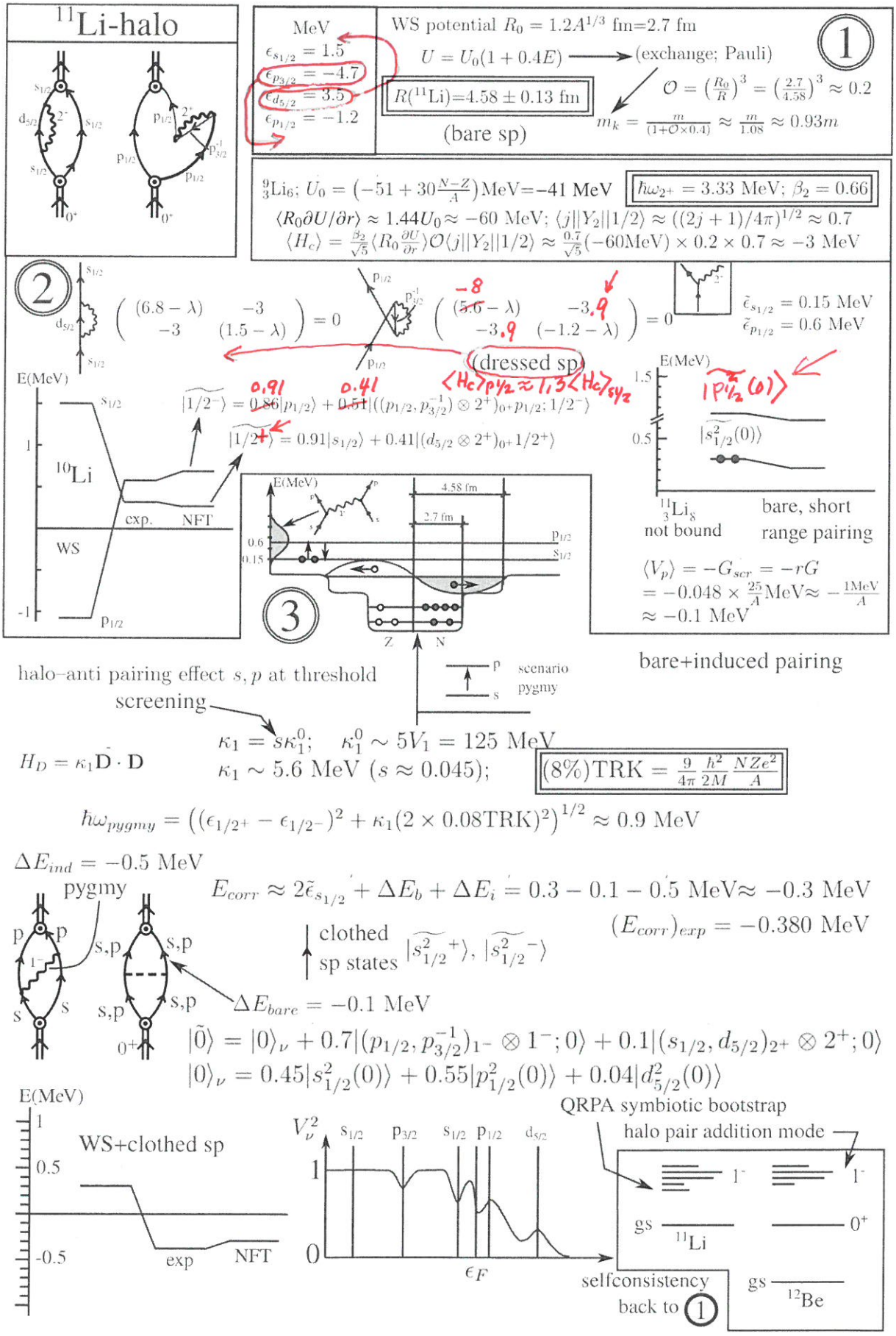
^{11}Li-halo
MeV
$\epsilon_{s_{1/2}} = 1.5$
$\epsilon_{p_{3/2}} = -4.7$
$\epsilon_{d_{5/2}} = 3.5$
$\epsilon_{p_{1/2}} = -1.2$
WS potential $R_0 = 1.2A^{1/3}$ fm=2.7 fm
$U = U_0(1 + 0.4E)$ (exchange; Pauli)
$R(^{11}\text{Li})$=4.58 ± 0.13 fm
(bare sp)
1
$\mathcal{O} = \left(\frac{R_0}{R}\right)^3 = \left(\frac{2.7}{4.58}\right)^3 \approx 0.2$
$m_k = \frac{m}{(1+\mathcal{O}\times 0.4)} \approx \frac{m}{1.08} \approx 0.93m$
$^9_3$Li$_6$; $U_0 = \left(-51 + 30\frac{N-Z}{A}\right)$MeV=−41 MeV
$\hbar\omega_{2^+} = 3.33$ MeV; $\beta_2 = 0.66$
$\langle R_0 \partial U/\partial r\rangle \approx 1.44U_0 \approx -60$ MeV; $\langle j||Y_2||1/2\rangle \approx ((2j+1)/4\pi)^{1/2} \approx 0.7$
$\langle H_c\rangle = \frac{\beta_2}{\sqrt{5}}\langle R_0\frac{\partial U}{\partial r}\rangle \mathcal{O}\langle j||Y_2||1/2\rangle \approx \frac{0.7}{\sqrt{5}}(-60\text{MeV}) \times 0.2 \times 0.7 \approx -3$ MeV
2
$\begin{pmatrix} (6.8-\lambda) & -3 \\ -3 & (1.5-\lambda) \end{pmatrix} = 0$
$\begin{pmatrix} (5.6-\lambda) & -3.9 \\ -3.9 & (-1.2-\lambda) \end{pmatrix} = 0$
$\tilde{\epsilon}_{s_{1/2}} = 0.15$ MeV
$\tilde{\epsilon}_{p_{1/2}} = 0.6$ MeV
(dressed sp)
E(MeV)
$|\widetilde{1/2^-}\rangle = 0.86|p_{1/2}\rangle + 0.51|((p_{1/2}, p^{-1}_{3/2}) \otimes 2^+)_{0^+} p_{1/2}; 1/2^-\rangle$
$|\widetilde{1/2^+}\rangle = 0.91|s_{1/2}\rangle + 0.41|(d_{5/2} \otimes 2^+)_{0^+} 1/2^+\rangle$
^{10}Li
exp.
NFT
WS
E(MeV)
4.58 fm
2.7 fm
3
$^{11}_3$Li$_8$
not bound
bare, short range pairing
$\langle V_p\rangle = -G_{scr} = -rG$
$= -0.048 \times \frac{25}{A}MeV\approx -\frac{1\text{MeV}}{A}$
≈ -0.1 MeV
bare+induced pairing
halo–anti pairing effect s, p at threshold
screening
p scenario
s pygmy
$\kappa_1 = s\kappa_1^0; \quad \kappa_1^0 \sim 5V_1 = 125$ MeV
$\kappa_1 \sim 5.6$ MeV $(s \approx 0.045)$;
$H_D = \kappa_1 \mathbf{D}\cdot\mathbf{D}$
(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
$\Delta E_{ind} = -0.5$ MeV
pygmy
$E_{corr} \approx 2\tilde{\epsilon}_{s_{1/2}} + \Delta E_b + \Delta E_i = 0.3 - 0.1 - 0.5$ MeV≈ -0.3 MeV
$(E_{corr})_{exp} = -0.380$ MeV
clothed sp states $|\widetilde{s^2_{1/2}{}^+}\rangle$, $|\widetilde{s^2_{1/2}{}^-}\rangle$
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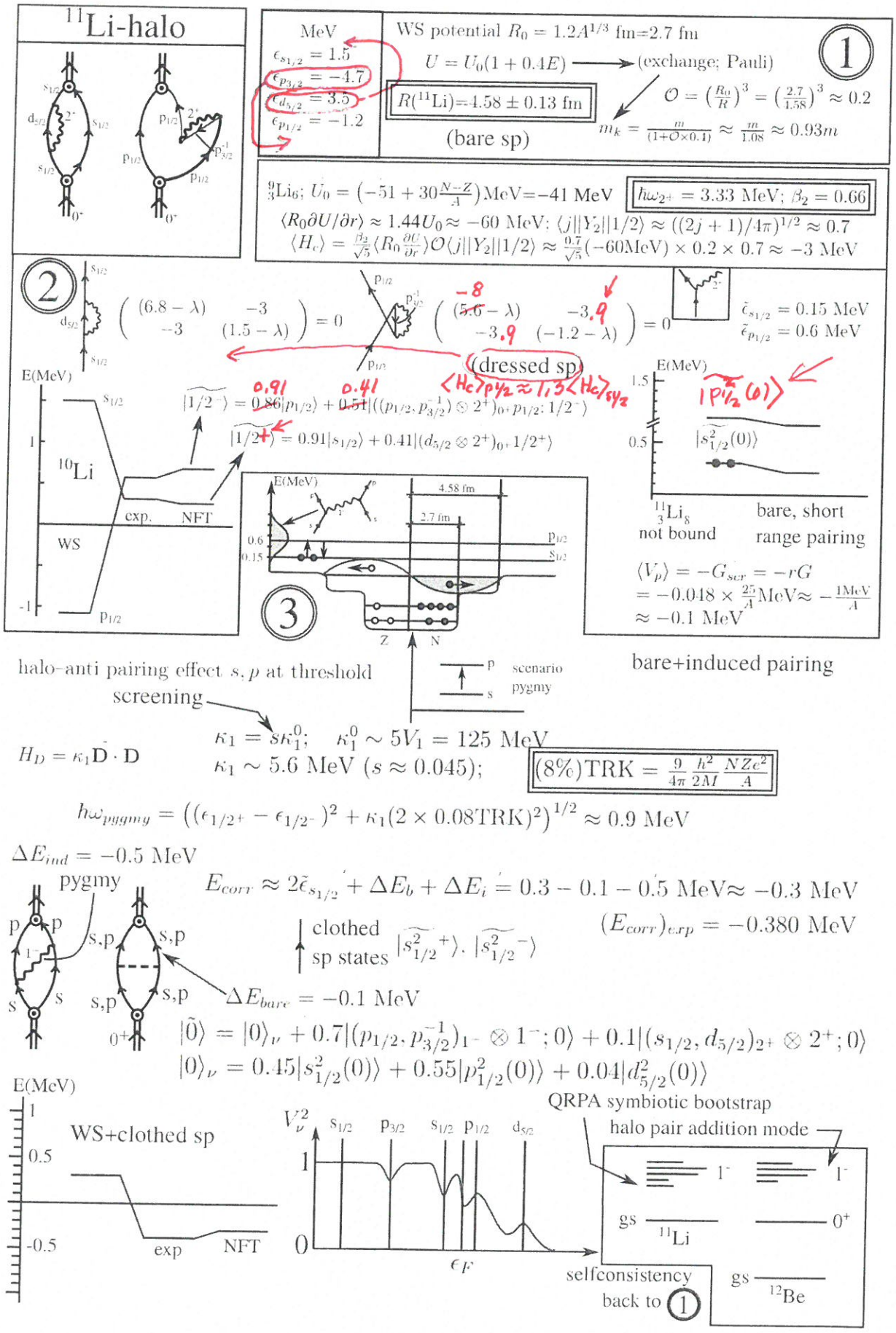
$|\tilde{0}\rangle = |0\rangle_\nu + 0.7|(p_{1/2}, p^{-1}_{3/2})_{1^-} \otimes 1^-; 0\rangle + 0.1|(s_{1/2}, d_{5/2})_{2^+} \otimes 2^+; 0\rangle$
$|0\rangle_\nu = 0.45|s^2_{1/2}(0)\rangle + 0.55|p^2_{1/2}(0)\rangle + 0.04|d^2_{5/2}(0)\rangle$
E(MeV)
WS+clothed sp
exp
NFT
V^2_ν
ϵ_F
QRPA symbiotic bootstrap
halo pair addition mode
gs ^{11}Li
selfconsistency back to 1
gs ^{12}Be

Figure 1.9.1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-8
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$|\widetilde{1/2^+}\rangle = 0.91|s_{1/2}\rangle + 0.41|(d_{5/2} \otimes 2^+)_{0^+} 1/2^+\rangle$
0.91
0.41
$\langle H_c|p_{1/2}\rangle \approx 1.3\langle H_c|s_{1/2}\rangle$
$|p_{1/2}^2(0)\rangle$
$|s_{1/2}^2(0)\rangle$
^{10}Li
exp. NFT
WS
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E(MeV)
WS+clothed sp
exp NFT
V_ν^2
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halo pair addition mode
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selfconsistency back to 1
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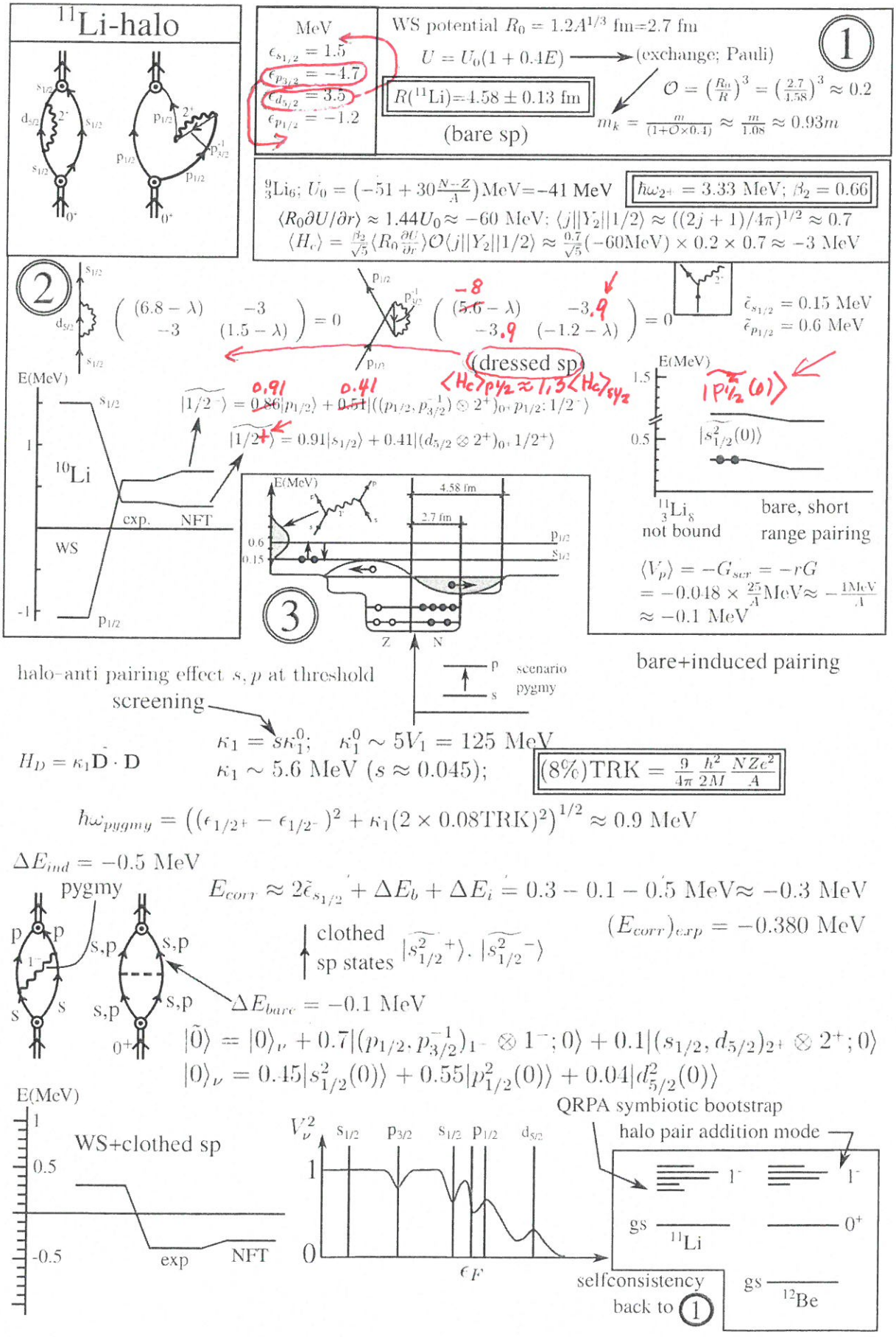
Figure 1.9.1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^{10}Li
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Figure 1.9.1