Strangeness Nuclear Physics – homework assignments

- Assume that the isospin $I = 0$ $\bar{K}N$ s-wave interaction is strongly attractive, with a matrix element V_0, and that the isospin $I = 1$ matrix element V_1 is negligible with respect to V_0. Focusing on core nuclei in the s shell and neglecting the NN tensor force, what quantum numbers L, S, J, parity π and isospin I (all 'total') are the most likely ones for $\bar{K}NN$, $\bar{K}NNN$ and $\bar{K}\bar{K}NN$ bound-states? Is the isospin of the nuclear core I_C a good quantum number? How would all of this change if the $\bar{K}N$ interaction were isospin independent?

- The ΛN effective interaction, for a $1s_\Lambda$ in the nuclear p shell, is given (apart from an induced nuclear spin-orbit term) by

$$V_{\Lambda N} = \bar{V} + \Delta\, \vec{s}_N \cdot \vec{s}_\Lambda + S_\Lambda\, \vec{l}_N \cdot \vec{s}_\Lambda + T\, S_{N\Lambda}, \tag{1}$$

Eq. (7) of my notes. Assuming LS-coupling for ^{6}Li g.s. (L=0, S=1, I=0) and for ^{8}Be 1st excited 2^+ state (L=2, S=0, I=0), with fully symmetric spatial wavefunctions for the p-shell nucleons, show that the splitting of the g.s. doublet states $J^\pi = 1/2^+, 3/2^+$ in $^{7}_{\Lambda}$Li is given by $\frac{3}{2}\Delta$, and the splitting of the $J^\pi = 3/2^+, 5/2^+$ excited doublet states in $^{9}_{\Lambda}$Be is given by $\frac{5}{2}S_\Lambda$.