Appendix F
Simple model of Pauli principle corrections

The induced interaction shown in Fig. F.1(a) leads to the contribution

$$v_{kk'} = \sum_{\alpha} \frac{V^2(k, k'\alpha)}{\varepsilon_k - (\varepsilon_{k'} + \hbar\omega_\alpha)},$$

while that shown in Fig. F.1(c) leads to

$$(v_{kk'})_{\text{Pauli}} = -\sum_{\alpha\alpha'} \sum_{ik''} \frac{V(k, k'\alpha')V(k, k''\alpha)}{(\varepsilon_k - (\varepsilon_{k'} + \hbar\omega_{\alpha'}))} \times \frac{V(k', i\alpha)V(k'', i\alpha')}{(\varepsilon_k - (\varepsilon_{k'} + \varepsilon_{k''} - \varepsilon_i))(\varepsilon_k - (\varepsilon_{k''} + \hbar\omega_\alpha)}. \quad \text{(F.1)}$$

In what follows we shall carry out an order of magnitude estimate of the ratio of $(v_{kk'})_{\text{Pauli}}/v_{kk'}$ making use of the schematic two-level model (see Fig. F.2) and nuclear field theory rules.

The Hamiltonian describing the system

$$H = H_{\text{sp}} + H_{\text{TB}}, \quad \text{(F.2)}$$

is composed of a single-particle Hamiltonian and a two-body interaction. The particle-vibration coupling matrix element is

$$V(k, k'\alpha) = -K_0\sqrt{\Omega}, \quad \text{(F.3)}$$

and the collective RPA solution of (F.2) has an energy

$$\hbar\omega = \varepsilon - K_0\Omega. \quad \text{(F.4)}$$

Let us assume $\hbar\omega \approx \frac{1}{2}\varepsilon$. Thus $K_0 = \frac{\varepsilon}{2\Omega}$ and

$$(v_{kk'})_{\text{Pauli}} \approx -v_{kk'} \frac{V^2(k, k'\alpha)}{\hbar\omega \times \varepsilon} \approx -\frac{v_{kk'}}{2\Omega}. \quad \text{(F.5)}$$

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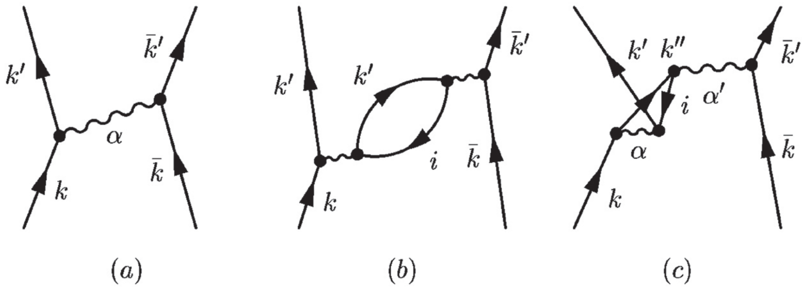

Figure F.1. (*a*) Induced interaction. (*b*) Schematic representation of the induced interaction showing one of the possible bubble contributions to the collective state (RPA). (*c*) Pauli principle contribution to the induced interaction arising from the exchange of the particle moving in the state k' in the bubble of graph (*b*) and in the final state. Note that graph (*b*) has been drawn only for the purpose of illustration as this process is forbidden by the rules of nuclear field theory (Bes *et al*. (1976a, 1976b)).

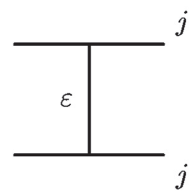

Figure F.2. Schematic model used in the estimates. The two orbitals have the same pair degeneracy $\Omega = (2\gamma + 1)/2$. The lowest level is assumed to be filled.

For ^{11}Li, where $\Omega = (2j + 1)/2 \approx 1$ ($s_{1/2}p_{1/2}$ single-particle space) one thus obtains

$$(v_{kk'})_{\text{Pauli}} \approx -0.5 v_{kk'}. \tag{F.6}$$

On the other hand, for nuclei lying along the stability valley, where

$$\Omega \approx A^{2/3}, \tag{F.7}$$

one obtains

$$(v_{kk'})_{\text{Pauli}} \approx \frac{v_{kk'}}{2A^{2/3}}. \tag{F.8}$$

For medium/heavy nuclei ($A^{1/3} \approx 5$) this expansion leads to the ratio

$$\frac{(v_{kk'})_{\text{Pauli}}}{v_{kk'}} \approx -2 \times 10^{-2}. \tag{F.9}$$