Derivation of Brown–Bolsteri model

Wavefunction of the particle-hole state

\[ \psi_{i}(\varphi_{p}, \varphi_{h}) = (-1)^{i} [Y_{c}(\varphi_{h}, \varphi_{p}) Y_{e+1}(\varphi_{p}, \varphi_{p})]_{0} \]

\[ \times \Re_{h}(\varphi_{h}) \Re_{e+1}(\varphi_{p}) \]

Phase factor

Notice that \( c = Y_{10} \) and the initial state is \( 0^{+} \), so that the particle hole state has to be coupled to \( 0^{+} \)

\[ \{Y_{c} Y_{e+1}\}_{0} = \sum \delta_{h, h'} c(\varphi_{c}, \varphi_{e+1}; h, -h', 0) Y_{c} Y_{e+1} \]

We now calculate the matrix elements. Since our goal is to find the energy of the particle hole state, we calculate the m.e. of the particle hole Hamiltonian assumption

\[ \sqrt{C_{p} - C_{h}} = V_{0} \delta(C_{h} - C_{p}) \]

\[ \{Y_{c}(\vartheta, \varphi) Y_{e+1}(\vartheta, \varphi)\}_{0} \Rightarrow Y_{0}^{0}(\vartheta, \varphi) \]

Because this is the only \( \delta \) vector that can be made from \( \vartheta \) and \( \varphi \)

With the normalization factors, we obtain

\[ \{Y_{c}(\vartheta, \varphi) Y_{e+1}(\vartheta, \varphi)\}_{0} = \frac{\pi}{(2\pi)^{2}} Y_{0}^{0}(\vartheta, \varphi) \]