FCI Questions

Patryk Kozlowski

April 2, 2023

$$\langle\Psi|V|\Psi\left(k_i \to k_i'\right)\rangle = v^{\alpha\beta\gamma\delta}\left(-1\right)^{\varepsilon\left(\kappa_1,\ldots,\kappa_i',\ldots\kappa_n\right)} \langle 0|\left(\prod_{\kappa=(\kappa_n\ldots\kappa)} a_\kappa\right) a_\alpha^\dagger a_\beta^\dagger a_\gamma a_\delta \left(\prod_{\kappa'=(\kappa_1\ldots\kappa_n)} a_{\kappa'}^\dagger\right)|0\rangle \tag{1}$$

$$= v^{\alpha\beta\gamma\delta}\left(-1\right)^{\varepsilon\left(\kappa_1,\ldots,\kappa_i',\ldots,\kappa_n\right)} \langle 0|\left(\prod_{\kappa=(\kappa_n\ldots\kappa_1)} a_\kappa\right)\left(a_\alpha^\dagger a_\beta^\dagger a_\gamma \delta_{\delta\kappa_1} - a_\alpha^\dagger a_\beta^\dagger a_\gamma a_{\kappa_1}^\dagger a_\delta\right)\left(\prod_{\kappa'=(\kappa_2\ldots\kappa_n)} a_{\kappa'}^\dagger\right)|0\rangle \tag{2}$$

$$= v^{\alpha\beta\gamma\delta}\left(-1\right)^{\varepsilon\left(\kappa_1,\ldots,\kappa_i',\ldots,\kappa_n\right)} (\langle 0|\left(\prod_{\kappa=(\kappa_n\ldots\kappa_1)} a_\kappa\right)\left(\delta_{\delta\kappa_1} a_\alpha^\dagger a_\beta^\dagger \delta_{\gamma\kappa_2} - \delta_{\delta\kappa_1} a_\alpha^\dagger a_\beta^\dagger a_{\kappa_2}^\dagger a_\gamma\right)\left(\prod_{\kappa'=(\kappa_3\ldots\kappa_n)} a_{\kappa'}^\dagger\right)|0\rangle - \langle 0|\left(\prod_{\kappa=(\kappa_n\ldots\kappa_1)} a_\kappa\right)\left(a_\alpha^\dagger a_\beta^\dagger \delta_{\gamma\kappa_1} a_\delta - a_\alpha^\dagger a_\beta^\dagger a_{\kappa_1}^\dagger a_\gamma a_\delta\right)\left(\prod_{\kappa'=(\kappa_2\ldots\kappa_n)} a_{\kappa'}^\dagger\right)|0\rangle) \tag{3}$$

$$= v^{\alpha\beta\gamma\delta}\left(-1\right)^{\varepsilon\left(\kappa_1,\ldots,\kappa_i',\ldots,\kappa_n\right)} (\langle 0|\left(\prod_{\kappa=(\kappa_n\ldots\kappa_1)} a_\kappa\right)\left(\delta_{\delta\kappa_1}\delta_{\gamma\kappa_2} a_\alpha^\dagger a_\beta^\dagger\right)\left(\prod_{\kappa'=(\kappa\ldots\kappa_n)} a_{\kappa'}^\dagger\right)|0\rangle) \tag{4}$$