

intermediate channel

$$\begin{split} \chi_{m_{s}}^{1/2}(\sigma_{p})\phi_{d}(\mathbf{r}_{p1},\sigma_{1})\psi_{A}(\xi_{A})\varphi_{l_{f},j_{f},m_{f}}^{A+1}(\mathbf{r}_{A2},\sigma_{2}) \\ G(\mathbf{r}_{dF},\mathbf{r}_{dF}') &= i\sum_{l}\sqrt{2l+1}\frac{f_{l}(k_{dF},r_{<})g_{l}(k_{dF},r_{>})}{k_{dF}r_{dF}r_{dF}'}\Big[Y^{l}(\hat{r}_{dF})Y^{l}(\hat{r}_{dF}')\Big]_{0}^{0} \\ T_{succ}^{(2)} &= 2\sum_{l_{i},j_{i}}\sum_{l_{f},j_{f},m_{f}}\sum_{\sigma_{1}\sigma_{2}}\int d\xi_{A}d\mathbf{r}_{dF}d\mathbf{r}_{p1}d\mathbf{r}_{A2}\chi_{pB}^{(-)*}(\mathbf{r}_{pB})\chi_{B}^{*}(\xi_{B})v(\mathbf{r}_{p1})\phi_{d}(\mathbf{r}_{p1})\varphi_{l_{f},j_{f},m_{f}}^{A+1}(\mathbf{r}_{A2},\sigma_{2}) \\ &\times\chi_{m_{s}}^{1/2}(\sigma_{p})\Psi_{A}(\xi_{A})\frac{2\mu_{dF}}{\hbar^{2}}\int d\xi_{A}'d\mathbf{r}_{dF}'d\mathbf{r}_{p1}'d\mathbf{r}_{A2}'G(\mathbf{r}_{dF},\mathbf{r}_{dF}') \\ &\times\chi_{tA}^{(+)}(\mathbf{r}_{tA})\psi_{A}^{*}(\xi_{A}')v(\mathbf{r}_{p2}')\phi_{d}(\mathbf{r}_{p1}')\varphi_{l_{f},j_{f},m_{f}}^{A+1}(\mathbf{r}_{A2}',\sigma_{2}') \\ &= 2\sum_{l_{i},j_{i}}\sum_{l_{f},j_{f},m_{f}}\sum_{\sigma_{1}\sigma_{2}}\int d\mathbf{r}_{dF}'d\mathbf{r}_{p1}'d\mathbf{r}_{A2}\chi_{pB}^{(-)*}(\mathbf{r}_{pB})v(\mathbf{r}_{p1})\phi_{d}(\mathbf{r}_{p1})\left[\varphi_{l_{f},j_{f},m_{f}}^{A+2}(\mathbf{r}_{A1},\sigma_{1},\mathbf{r}_{A2},\sigma_{2})\right]_{0}^{0} \\ \times\frac{2\mu_{dF}}{\hbar^{2}}\int d\mathbf{r}_{dF}'d\mathbf{r}_{p1}'d\mathbf{r}_{A2}'G(\mathbf{r}_{dF},\mathbf{r}_{dF}')\chi_{tA}^{(+)}(\mathbf{r}_{tA}')v(\mathbf{r}_{p2}')\phi_{d}(\mathbf{r}_{p1}',\sigma_{1}')\phi_{d}(\mathbf{r}_{p2}',\sigma_{2}')\varphi_{l_{f},j_{f},m_{f}}^{A+1}(\mathbf{r}_{A2}',\sigma_{2}') \end{split}$$

$$\begin{split} T_{NO}^{(1)} &= 2 \sum_{l_i,j_i} \sum_{l_f,j_f,m_f} \sum_{\sigma_1\sigma_2} \int d\xi_A d\mathbf{r}_{dF} d\mathbf{r}_{p1} d\mathbf{r}_{A2} \chi_{pB}^{(-)*}(\mathbf{r}_{pB}) \chi_B^*(\xi_B) v(\mathbf{r}_{p1}) \phi_d(\mathbf{r}_{p1}) \varphi_{l_f,j_f,m_f}^{A+1}(\mathbf{r}_{A2},\sigma_2) \\ &\times \chi_{m_s}^{1/2}(\sigma_p) \Psi_A(\xi_A) \frac{2\mu_{dF}}{\hbar^2} \int d\xi_A' d\mathbf{r}_{dF}' d\mathbf{r}_{p1}' d\mathbf{r}_{A2}' \\ &\times \chi_{tA}^{(+)}(\mathbf{r}_{tA}) \psi_A^*(\xi_A') \phi_d(\mathbf{r}_{p1}') \mathbb{I} \varphi_{l_f,j_f,m_f}^{A+1}(\mathbf{r}_{A2}',\sigma_2') \\ &= 2 \sum_{l_i,j_i} \sum_{l_f,j_f,m_f} \sum_{\sigma_1\sigma_2 \atop \sigma_1'\sigma_2'} \int d\mathbf{r}_{dF} d\mathbf{r}_{p1} d\mathbf{r}_{A2} \chi_{pB}^{(-)*}(\mathbf{r}_{pB}) v(\mathbf{r}_{p1}) \phi_d(\mathbf{r}_{p1}) \left[\varphi_{l_f,j_f,m_f}^{A+2}(\mathbf{r}_{A1},\sigma_1,\mathbf{r}_{A2},\sigma_2) \right]_0^0 \\ &\times \frac{2\mu_{dF}}{\hbar^2} \int d\mathbf{r}_{dF}' d\mathbf{r}_{p1}' d\mathbf{r}_{A2}' \chi_{tA}^{(+)}(\mathbf{r}_{tA}') \phi_d(\mathbf{r}_{p1}',\sigma_1') \phi_d(\mathbf{r}_{p2}',\sigma_2') \varphi_{l_f,j_f,m_f}^{A+1}(\mathbf{r}_{A2}',\sigma_2') \end{split}$$