$$\left(\hat{H} - 6\right)\left|\psi^{\upsilon L}_{I_0 I_n M_n}(k,6)\right\rangle = \left|\left[\mathcal{M}^{\upsilon L}(k)\otimes\psi_{I_0}\right]^{I_n M_n}\right\rangle$$

$$\underbrace{}_{\substack{\upsilon L \to \upsilon' L' \upsilon L \\ 0 \to i,f \\ k \to k,k'}}$$

$\Downarrow$

$$L^{if,I_n}_{\upsilon' L' \upsilon L}(k',k,6) = (-)^{I_n - I_i + L - L' + \upsilon'}\, g(I_n,6) \sum_{M_n} \left\langle \psi^{\upsilon' L'}_{I_f I_n M_n}(k',6)\middle|\psi^{\upsilon L}_{I_i I_n M_n}(k,6)\right\rangle$$

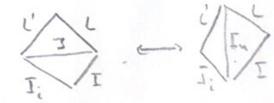
$\Downarrow$ inversion

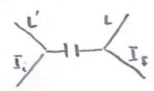
$$F^{I_{(i,f)} I_n}_{\upsilon' L' \upsilon L}(k,k',E)$$

$\Downarrow$ contract of internally propagating states with I_n
use total momentum transfer J

$$F^{I_{(i,f)}}_{\upsilon' L' \upsilon L, J}(k,k',E) = \sum_{I_n} 6j\, F^{\cdots I_n}_{\cdots}$$

recoupling





$$\left[\left[I_i \otimes L'\right]^{I_n} \otimes \left[I_f \otimes L\right]^{I_n}\right]^J$$

$$P^{I_{i,f}}_{\upsilon' L' \upsilon L J}(k,k') = 2\pi\, (-)^{L + I_f + I_i}\, \hat{L}\hat{L}' \int_{E_0}^{\infty} dE \left[\frac{F}{E - E_i - k} + \frac{F(\leftrightarrow')}{E - E_i + k'}\right]$$

$\Downarrow$

$\mathrm{Im}/\mathrm{Re}\,[P]$

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$$P^{I_{i,f}\,J}_{\lambda'\lambda L L'}(k,k') = \sum_{\upsilon,\upsilon' \in \{0,1\}} \lambda^{\upsilon'} \lambda^{\upsilon}\, P^{I_{i,f}}_{\upsilon' L' \upsilon L J}(k,k')$$

$\Uparrow$ multipole decomposition $\vec{\epsilon}_\lambda e^{i\underline{k}\cdot\underline{r}}$ <u>and</u> $\vec{e}_\lambda \cdot \underline{s}(k)$

amplitude QN: nuclear $I_{f,i}\; M_{f,i}$; optical $\lambda\lambda'\; \underline{k},\underline{k}'$:

$$T^{fi}_{\lambda\lambda'}(\underline{k},\underline{k}') = \# \cdot \sum_{\substack{L m_L \\ L' m_L' \\ J}} P^{i,f,J}_{\lambda\lambda' L L'}(k,k')\; \#(\text{rotation} \ldots)$$