the radial scattering wave function

$$\Psi^+(r) = \Psi_c(r) + \Psi_a^+(r)$$

$$\Psi_c(r) = \sum_{k=0}^{N-1} A_k \phi_k(r) \qquad \text{short range part}$$

$$\Psi_a^+(r) = \Omega_0(r) + \mathcal{L}\,\Omega_1(r) \qquad \text{asymptotic part}$$

$$\Omega_0(r) = \sqrt{\frac{mq}{2\hbar^2}}\left[\mu_{00} j_0(qr) + \mu_{01} \bar{y}_0(qr)\right]$$

$$\Omega_1(r) = \sqrt{\frac{mq}{2\hbar^2}}\left[\mu_{10} j_0(qr) + \mu_{11} \bar{y}_0(qr)\right]$$

$$q^2 = E/(\hbar^2/m)$$

$$\mathcal{L} = R \equiv \operatorname{tg}\delta \qquad \mu = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$

$$\mathcal{L} = S = e^{2i\delta} \qquad \mu = \begin{pmatrix} i & -1 \\ i & 1 \end{pmatrix}$$

$$[\mathcal{L}] = \mathcal{L} - \frac{2}{\det(\mu)} \langle \Psi^- | H - E | \Psi^+ \rangle$$