

$$\hat{H}_N = \frac{p^2}{2} - \frac{1}{q}$$

$$\hat{H}_{[1PN]} = \frac{1}{8}(3\nu - 1)p^4 - \frac{1}{2}[(3 + \nu)p^2 + \nu p_r^2] \frac{1}{q} + \frac{1}{2q^2}$$

$$\begin{aligned} \hat{H}_{[2PN]} &= \frac{1}{16}(1 - 5\nu + 5\nu^2)p^6 \\ &+ \frac{1}{8}[(5 - 20\nu - 3\nu^2)p^4 - 2\nu^2 p_r^2 p^2 - 3\nu^2 p_r^4] \frac{1}{q} \\ &+ \frac{1}{2}[(5 + 8\nu)p^2 + 3\nu p_r^2] \frac{1}{q^2} - \frac{1}{4}(1 + 3\nu) \frac{1}{q^3} \end{aligned}$$