

Jacobian of the transformation
is 1 *

$$\int \prod_{i=1}^N d\mathbf{r}_i = \int \prod_{i=1}^N d\xi_i$$

Kinetic Energy Term:

$$\sum_i \frac{1}{2m} p_i^2 = \frac{1}{2M} P^2 + \sum_{i=2}^N \frac{1}{2\mu_i} p_{\xi_i}^2$$

$$\mu_i = \left(\frac{N-i+1}{N-i+2} \right) m.$$

$$[\vec{P}_\alpha, \vec{R}_\beta] = -i\hbar \delta_{\alpha\beta}$$

$$[p_{\xi_i}^\alpha, \xi_j^\beta] = -i\hbar \delta_{\alpha\beta} \delta_{ij}$$