



- Equations of motion for surface oscillator  $\underline{r}_s$  and ghost oscillator  $\underline{r}_g$ :

$$m_s \frac{d^2 \underline{r}_s}{dt^2} = \underbrace{-\underline{\nabla}_s V(\underline{r}_1 - \underline{r}_s, \underline{r}_2 - \underline{r}_s)}_{\text{Force due to PES}} - \underbrace{m_s \underline{\Omega}^2 \underline{r}_s}_{\text{Harmonic oscillator}} + \underbrace{m_s \underline{\Lambda}_{gs} \underline{r}_g}_{\text{Coupling to ghost oscillator}}$$

$$m_s \frac{d^2 \underline{r}_g}{dt^2} = \underbrace{-m_s \underline{\Omega}^2 \underline{r}_g}_{\text{Harmonic oscillator}} + \underbrace{m_s \underline{\Lambda}_{gs} \underline{r}_s}_{\text{Coupling to surface oscillator}} - \underbrace{\eta_{ph} \frac{d\underline{r}_g}{dt}}_{\text{Friction force}} + \underbrace{\underline{R}_{ph}(T_{ph})}_{\text{Random forces}}$$

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