Consider a negatively charged bead (mass m, charge $-q$) constrained to move without friction along the axis of a positively charged ring.

- Place bead on x-axis near center of ring: $|x| \ll a$: $E_x \simeq \dfrac{kQx}{a^3}$

- Restoring force: $F = -qE_x = -k_s x$ with $k_s = \dfrac{kQq}{a^3}$

- Harmonic oscillation: $x(t) = A\cos(\omega t + \phi)$

- Angular frequency: $\omega = \sqrt{\dfrac{k_s}{m}} = \sqrt{\dfrac{kQq}{ma^3}}$