

$$L(\vec{R}, \vec{X}, \vec{q}) = \sum_{i=1}^N U_i(R_i) - g_{s_i}^i R_i + \sum_{i,u} q_u^i \left(\sum_{v:v \in V} X_{vu}^i - \sum_{v:v \in V} X_{uv}^i \right)$$