

$$S_{\text{Long}} = \int \frac{a^3 d^3 k dt}{(2\pi)^3} \frac{1}{2} \left(\left| \partial_t \phi + \frac{a^2 m^2}{k^2 + a^2 m^2} H \phi \right|^2 - (m^2 + k^2/a^2) |\phi|^2 \right).$$