

$$\begin{aligned}
\frac{J_v}{a} \equiv & -\frac{1}{\sqrt{2\epsilon}M_P} \frac{\Lambda^2 H^2}{M^4} \frac{1}{\mathcal{H}^2} \left\{ 6\Delta^{-1} \left[ (\Delta\delta\sigma')^2 - \partial_i\partial_j\delta\sigma' \partial_i\partial_j\delta\sigma' + \Delta\delta\sigma\Delta\delta\sigma'' - \partial_i\partial_j\delta\sigma \partial_i\partial_j\delta\sigma'' \right] \right. \\
& - 2\mathcal{D}_{ij} \left[ \partial_i\delta\sigma' \partial_j\delta\sigma' + \partial_i\partial_j\delta\sigma \Delta\delta\sigma - \partial_i\partial_k\delta\sigma \partial_j\partial_k\delta\sigma - \delta\sigma'' \partial_i\partial_j\delta\sigma \right] \\
& \left. - 4 \left[ \delta\sigma'' \Delta\delta\sigma + 2\delta\sigma' \Delta\delta\sigma' \right] \right\} - \frac{12}{\sqrt{2\epsilon}M_P} \frac{\Lambda^2 H^2}{M^4} \partial_i\delta\sigma \left[ -\frac{2}{\mathcal{H}} \partial_i\delta\sigma' + \partial_i\delta\sigma \right], \tag{4.2}
\end{aligned}$$