

# Beyond $\delta N$ formalism

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- ① At leading order, you will only solve “B.G. equations”.

$$\partial_{\tilde{t}}^2 \phi + 3\tilde{H} \partial_{\tilde{t}} \phi + V_\phi = \cancel{\Delta \phi} + \dots$$

$$d\tilde{t} = \alpha(t, x^i) dt \quad \tilde{H} \equiv \frac{\partial_{\tilde{t}} \tilde{a}}{\tilde{a}} = \frac{\partial_{\tilde{t}} (a e^\zeta)}{(a e^\zeta)}$$

- ② Actually, you don't know “ $\alpha$ ” as an explicit function of “ $t$ ”.

$$\alpha = f \left[ \phi_{BG}(\tilde{t}) \right] = f \left[ \phi_{BG} \left( \int \alpha dt \right) \right]$$

- ③ Then, you cannot calculate spatial gradient terms...

$$\partial_i \phi(\tilde{t}) = \partial_{\tilde{t}} \phi_{BG}(\tilde{t}) \partial_i \tilde{t} = \partial_{\tilde{t}} \phi_{BG}(\tilde{t}) \int \partial_i \alpha dt$$