With this identification, we shall have the time dependent parameters $G(k)$ and $\Lambda(k)$ as:

$$G(t) = G_0 \left[1 - \tilde{\omega} \left(\frac{t_{pl}}{t} \right)^2 + \mathcal{O} \left(\frac{t_{pl}}{t} \right)^4 \right] \tag{6}$$

$$\Lambda(t) = \Lambda_0 + \tilde{\nu} m_{pl}^2 \left(\frac{t_{pl}}{t} \right)^4 \left[1 + \mathcal{O} \left(\frac{t_{pl}}{t} \right)^2 \right] \tag{7}$$

where $\tilde{\omega} \equiv \omega \xi^2$ and $\tilde{\nu} \equiv \nu \xi^4$.

The conversion of fundamental units such as c, $\hbar$ and G to variable ones is a debatable issue [16]. In this regard, considering G as a coupling constant, the decision of where and how we should apply the improvement of G_0 to $G(x)$ is an important question.

The first and simplest way to do this can be called the *solution improvement*, in which the parameter G_0 is replaced by $G(x)$ in any solution of the non–improved theory. The second approach is *equation improvement*. This is done at the level of the equations of motion, not the solutions. The difference between these two methods becomes bold for non–vacuum solutions and the latter seems to be more acceptable if the quantum corrections are negligible in the action. Generally speaking the improvement of the equations of motion, may leads to solutions different from the former method.

By the third approach which we call the *action parameters improvement* [17], one means substitution of G_0 with $G(x)$ in the action, without adding any kinetic term for it. The improved field equations are obtained from this new action and the externally prescribed field $G(x)$ equation comes from the RGE. If one adds some kinetic term for it, there would be no guarantee that the obtained $G(x)$ coincides with the result of RGE. Finding a suitable kinetic term is very intricate.

Here we shall improve the equations of motion, which seems more suitable.

III Improved perturbations and MSE

Metric perturbation during the inflation era and its relation to the matter inhomogeneity is an apt quantum mechanical mechanism generating initial seeds of structure formation (for a