universe. Within MSSM, with two Higgses, it is possible to realize a curvaton scenario, where the inflaton energy density is dumped out of our own observable world, as a consequence the Higgses can dominate the energy density and create all the matter fields [840, 841]. However this scenario will work *only* if the inflaton does not couple to the MSSM sector at all, which is very unlikely.

1. Supersymmetric curvaton

An important constraint arises from CMB temperature anisotropy involving the ratio of the perturbation and the background VEV of the curvaton, since this ratio is related to the curvature perturbations [127, 129–131, 251]. Provided the perturbations do not damp during its evolution, strictly speaking for a quadratic potential, the final curvature perturbation is given by [106]:

$$\delta = \frac{\delta\varphi}{\varphi} = \frac{H_{inf}}{2\pi\varphi_{inf}} \sim 10^{-5}\,. \tag{446}$$

For an MSSM flat direction curvaton, it is important to keep in mind that the they carry SM gauge couplings, therefore, if the inflaton decay products create a plasma which has MSSM degrees of freedom then they would interact with the curvaton rendering thermal corrections to the curvaton potential inevitable. There are three issues which have to be taken into account.

- Curvaton must not have a renormalizable coupling to the inflaton, otherwise curvaton cannot obtain large VEV during inflation. For instance, neither H_uH_d nor LH_u are good curvaton candidates, because a gauge singlet inflaton can couple to these flat directions through renormalizable interactions [122, 123, 136]. The inflaton couplings to LH_u or H_uH_d ought to be very weak in order for them to be a curvaton candidate.

- Curvaton must not induce a mass $\geq m_\phi/2$ to the inflaton decay products, otherwise, the two-body inflaton decay into MSSM quanta will be kinematically blocked. The inflaton decay will be delayed until the relevant flat direction has started its oscillation and its VEV has been redshifted to sufficiently small values [122, 123, 136].

[106] A detailed analysis of a curvaton scenario for a non-quadratic potential can be found in Refs. [831, 862].