$10^{500} - 10^{1000}$ [45, 57, 58], and one in 10^{10} could be SM like [59–61]. False vacuum inflation in such a landscape is generic with all possible scales of inflation down to the current cosmological constant [55]. However, our patch of the universe must have had a graceful exit from inflation at least before BBN. Exiting from such eternally inflating regime and exciting the SM degrees of freedom pose a new challenge for string theory.

In order to seek an observable sector origin of inflation, it is important to ask whether inflation can happen within the GUT theory [62–85]. Invariably all of the models of inflation require an *absolute gauge singlet* inflaton couplings to the GUT/MSSM fields to drive the first phase of inflation, or to prepare the initial conditions for inflation. There is also an interesting proposal to realize inflation within the SM, with a non-trivial Higgs coupling to the Ricci scalar [86]. The advantage is that inflation occurs within an observable sector physics, therefore the origin of matter creation is ascertained. But this idea does not rely on SUSY at all, and assumes the SM to be valid all the way up to the Planck scale.

In a recent development, it has been shown that within MSSM parameters allow a unique possibility to realize inflation with the help of *gauge invariant flat directions* [87–90]. In MSSM there are many scalars, which span into a moduli space of *gauge invariant* F-and D-flat directions made up of squarks and sleptons (SUSY partners of quarks and leptons) (for a review, see [91, 92]), which carry the SM charges, i.e. baryon and/or lepton number. These inflatons have an *enhanced symmetry point* near the origin (at a VEV defined by zero). Away from the origin the inflatons break wholly or partly the SM gauge symmetry depending on the flat direction. But such a spontaneous breaking of charge and color in the early universe is not considered to be dangerous, provided they all settle down to their minimum before the electroweak phase transition. Note that in all these cases inflation occurs within an observable sector, where their mass and couplings are all well motivated from low energy physics.

In any inflationary scenario, it is important to understand the mechanisms of how to excite the SM quarks and leptons, known as the reheating [93–96] and preheating [97–119], and how to thermalize the universe with the MS(SM) degrees of freedom [120–124], for a review see [125]. In this regard the observable sector models of inflation have an advantage, since the inflaton couplings to the matter fields are all known.

There is yet another paradigm for generating the amplitude for the CMB perturbations, known as the curvaton scenario [126–131]. The curvaton is a light scalar field, which obtains