problem [291–295].

- Low primordial tensor to scalar ratio:
  One of the bold predictions of string theory models of inflation is that the tensor to scalar ratio will be generically small, i.e. $r < 0.001$. In order to obtain large tensor to scalar ratio, i.e. $r \sim 0.1$, one requires field values to be in the range, where $\Delta\phi \gg M_{\rm P}$ [210]. In a stringy setup the scale of inflation is *always* below the $4d$ Planck scale, $M_{\rm P}$. Note that the *chaotic type inflation* is now driven with the help of *assisted inflation* [287, 557], where the largest tensor to scalar ratio could be detectable by the future experiments if $r < 0.13$. Similar arguments hold for brane inflation models, where the brane-anti-brane separation acts as an inflaton, but the tensor to scalar ratio remains quite small [879, 880].

- Cosmic (super)strings, localized gravity waves:
  In brane-anti-brane case, inflation ends via annihilation of the branes. This process is likely to generate cosmic strings [459–461, 881], see Sec. III G 2. However their longevity is a model dependent issue [460]. Brane-anti-brane annihilation would also lead to exciting gravity waves on sub-Hubble scales with a peak frequency governed by the string scale and a distinct sharp spectrum [727]. If the string scale is close to TeV, then there is a possibility of detecting them in future gravitational wave observatories.

Stringy models of inflation also bring various challenges, whose roots are tied to the origin of particle phenomenology. One of the issues is pertaining to exciting the SM degrees of freedom, baryons and cold dark matter. Reheating and thermalization of the SM degrees of freedom in stringy models of inflation are poorly understood [882–886].

- Embedding MSSM in a stringy setup:
  There are tremendous progress in embedding MSSM in a stringy setup, with the help of intersecting branes in Type IIA/B theories. Typically these theories have quantized fluxes in presence of sources which lead to a warped geometry. Embedding MSSM in a realistic warped geometry is not well understood yet. Most of the constructions are done in a simple background geometry [887–894]. Furthermore, besides the SM gauge group there are extra $U(1)$'s which appear in the spectrum, which can be advantageous for cosmology, such as a natural embedding for neutrino masses, leptogenesis, for a