2. Formation of cosmic (super)strings after brane inflation

Recently, a new class of models of inflation was proposed, mimicking hybrid inflation within extra-dimensional theories (see VIII B). This model like D-term hybrid inflation produces cosmic string-like objects called F- and D-strings [459–461]. The nature of these objects are distinct from regular cosmic strings, as F-strings are Fundamental strings of cosmic size and D-strings are D-brane of spatial dimension 1. Fundamental strings are expected to have a Planckian size and therefore a Planckian mass-per-unit length $\mu \sim M_{\rm Pl}^2$, leading to $G\mu \sim 1$ that is incompatible with observation. However in the context of the recently proposed large extra dimension, the fundamental Planck mass can be reduced by large warp factors and these object can be formed with a cosmic size. In fact the range of mass-per-unit length in Planckian unit for these objects is: $10^{-13} < G\mu < 10^{-6}$.

The D-strings can be formed at the end of brane inflation when a brane collide another brane of different dimension or an anti-brane, giving rise to the production of Dp-branes, with p dimensions, of which 1 is in the non-compact dimensions. This mechanism is considered as a generalization of the production of regular cosmic strings at the end of D-term inflation in $N = 1$ SUGRA [462]. The energy per unit length (or the tension) of a $D1$-brane is given by $\mu = M_s^2/(2\pi g_s)$, where M_s is the string scale and g_s the string coupling. But for $g_s \gtrsim 1$ this can give rise to too large of a tension, considering the CMB bounds (see below). Therefore some $D(p-2)$-branes are assumed with $(p-3)$ dimensions compactified to the volume V_c. Then the string tension reads the generic value [459]

$$\mu = \frac{M_s^{p-1} V_c}{(2\pi)^{p-2} g_s} = \frac{M_s^2}{4\alpha\pi} \simeq 2M_s^2 \ , \tag{157}$$

if the gauge coupling $\alpha \simeq 1/25$. The CMB constraint, $\mathcal{P}_\zeta \sim 10^{-10}$, requires from brane inflation that $M_s \sim 10^{15}$ GeV leading to $G\mu \simeq 10^{-7}$.

3. Cosmological consequences of (topological) defects

Let's turn to the consequences of the formation of topological defects for observations, keeping in mind that a phase of inflation has to take place at some energy to explain the most recent CMB observations and solve the horizon problem. For reviews on defect evolution, see [452, 454–457]. Domain walls, that is topological defects of space-time dimension 3, are cosmologically disastrous as they evolve following $\rho_{\rm DW} \propto t^{-1}$ and would dominate the