Stochastic Gravitational Wave Background from Global Cosmic Strings

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arXiv: 1910.04781, C.-F. with Yanou Cui

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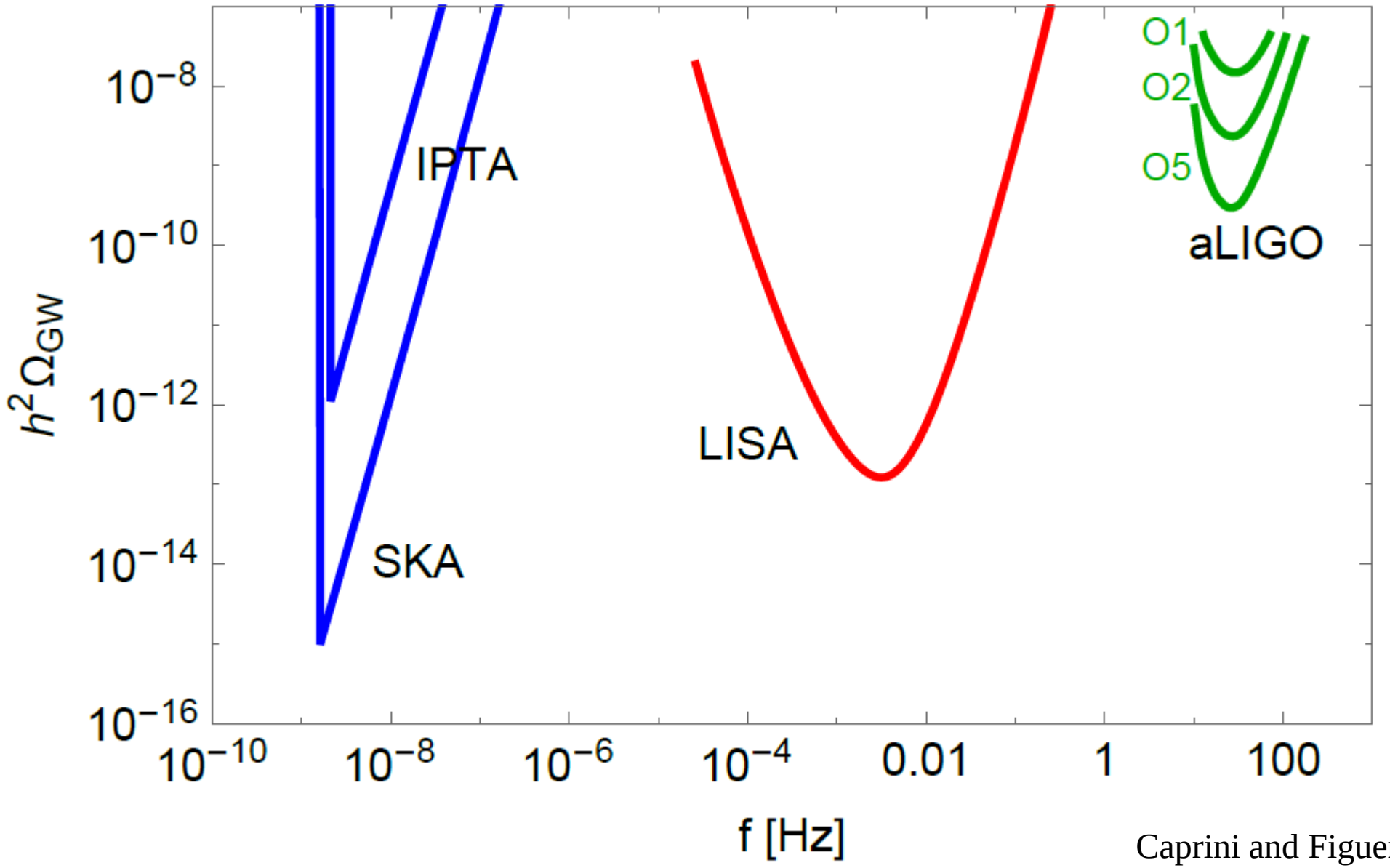
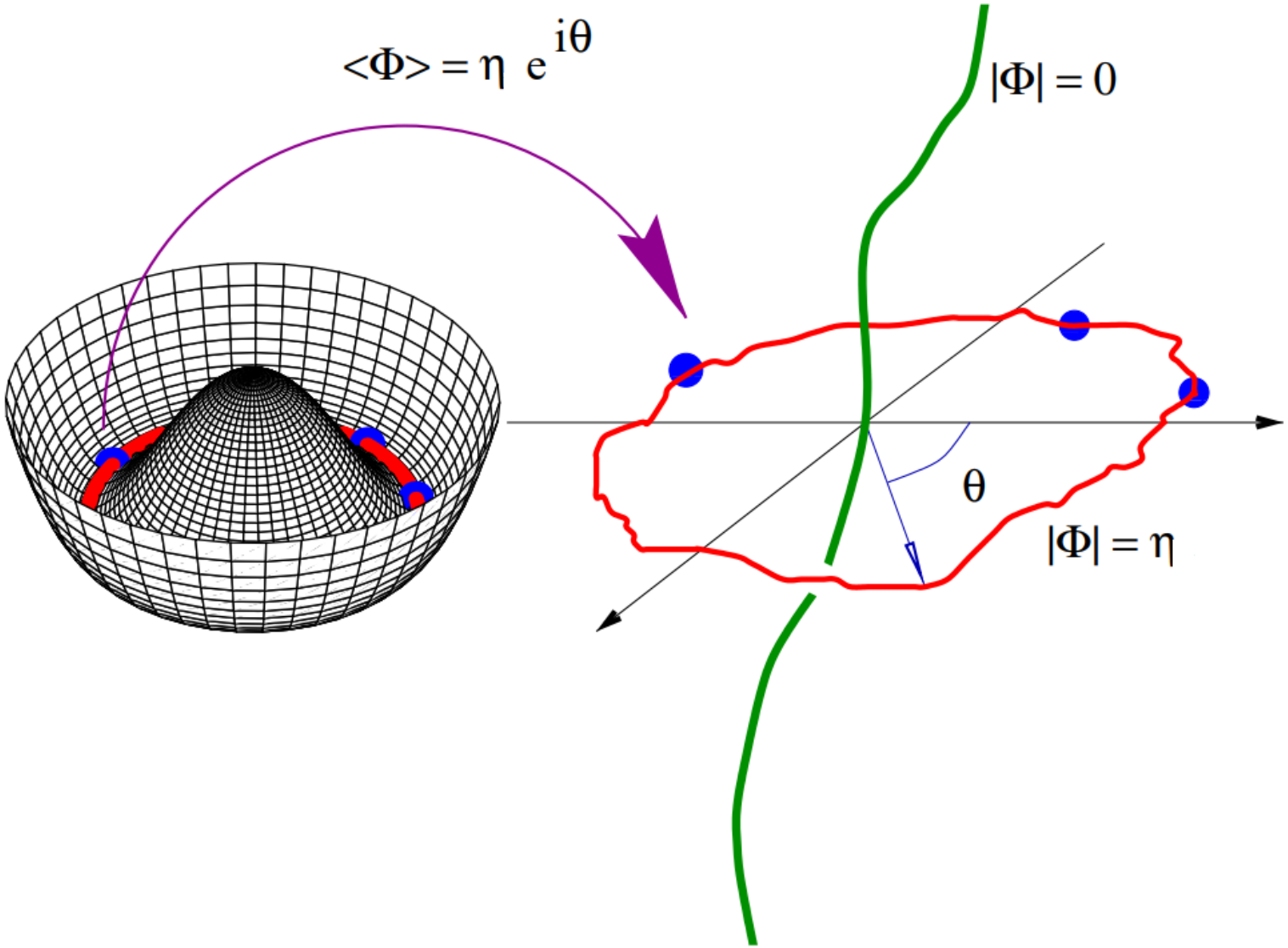
Discover early universe physics from Gravitational wave signal



Caprini and Figueroa 1801.04268

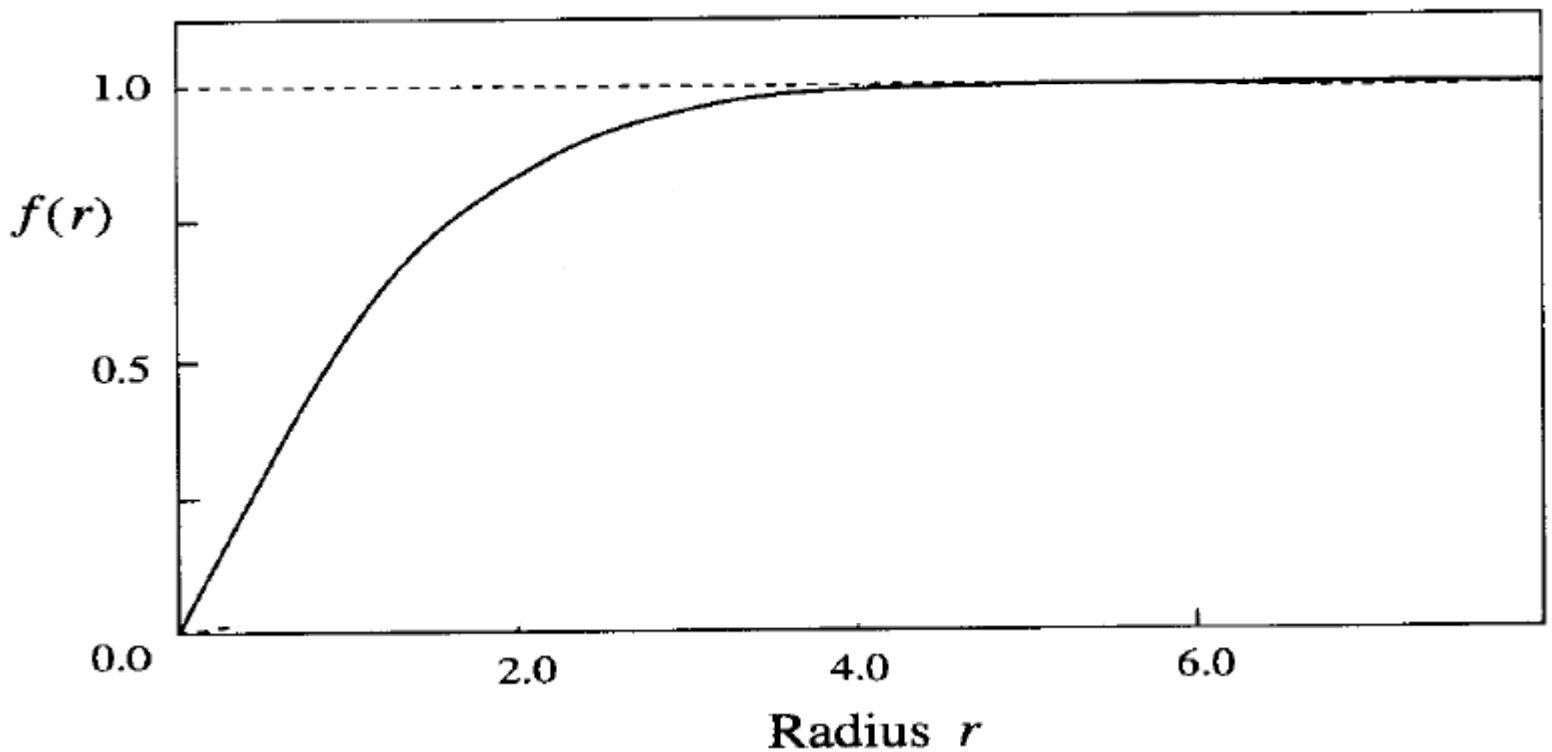
Formation of Cosmic Strings



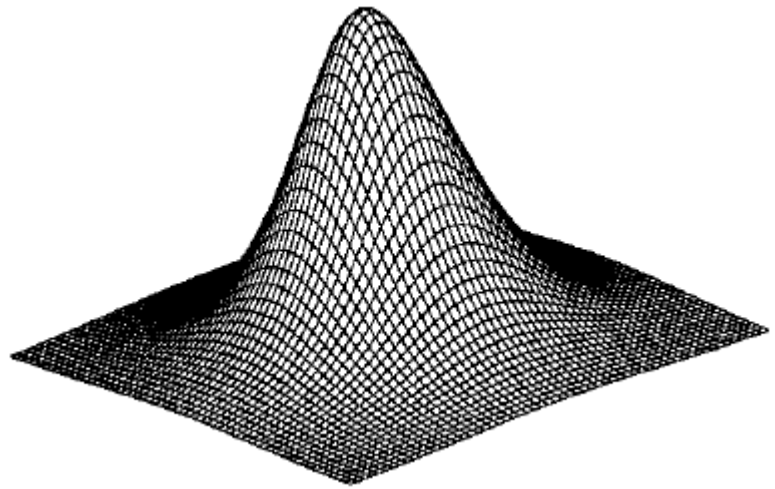
Christophe Ringeval 1005.4842

$$\partial_\mu \partial^\mu \phi + \frac{\lambda}{2}\phi(\phi\bar{\phi} - 1) = 0\,.$$

$$\phi_s(\mathbf{r}) = e^{in\theta} f(r)\,,$$



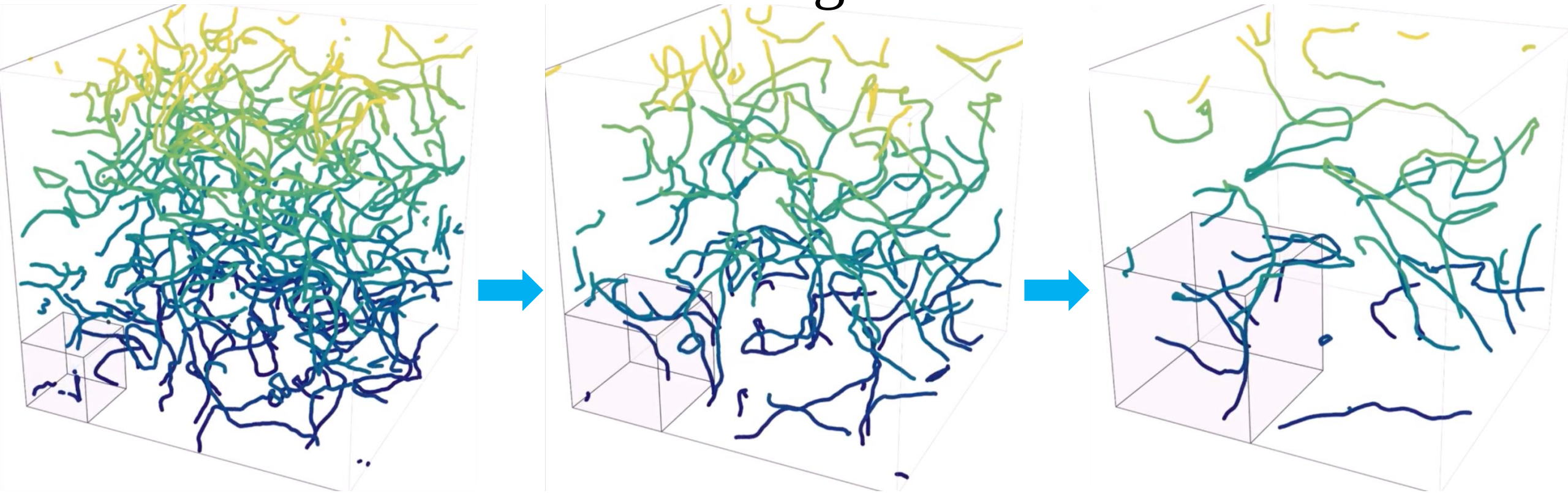
$$E = \int d^D x \left[\tfrac{1}{2} (\nabla \phi)^2 + V(\phi) \right]$$



$$\pi_1(\mathcal{M}) \neq I$$

vacuum manifold

Cosmic String Evolution

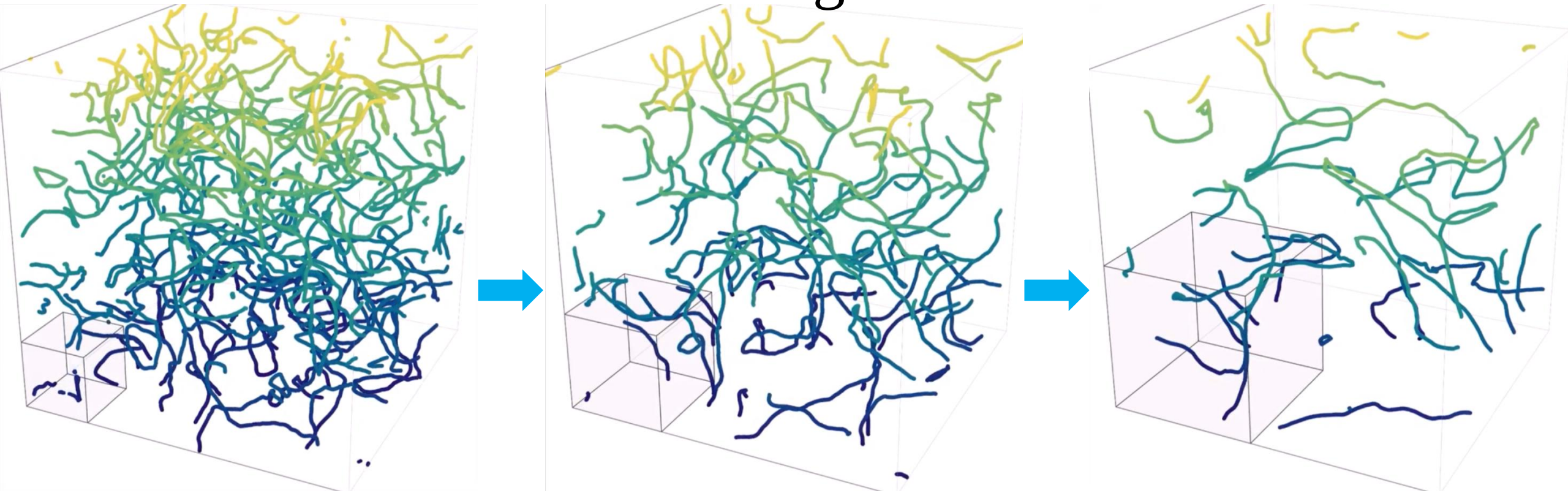


Marco Gorghetto 1806.04677

$$\left(2-\frac{1}{N}\right)\frac{dL}{dt}=2HL\left(1+\bar{v}_{\infty}^{2}\right)+\frac{L\bar{v}_{\infty}^{2}}{\ell_f}+\bar{c}\bar{v}_{\infty}+\Gamma_L G\mu+s\frac{\bar{v}_{\infty}^{6}}{N},$$

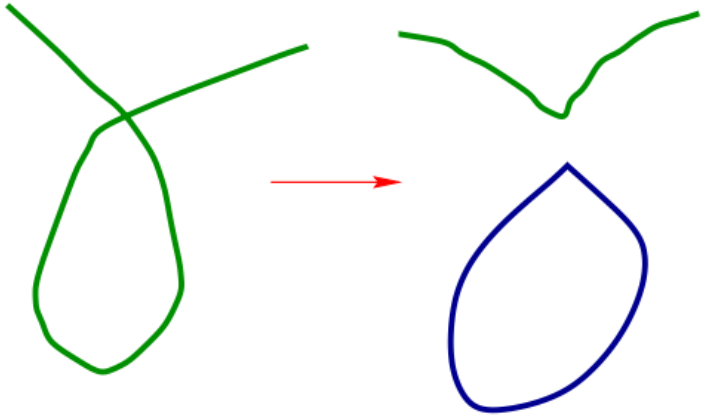
CJAP Martins 2018

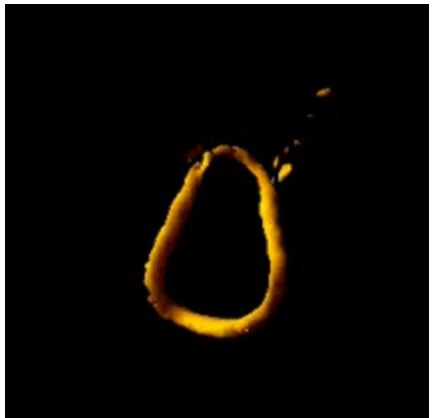
Cosmic String Evolution

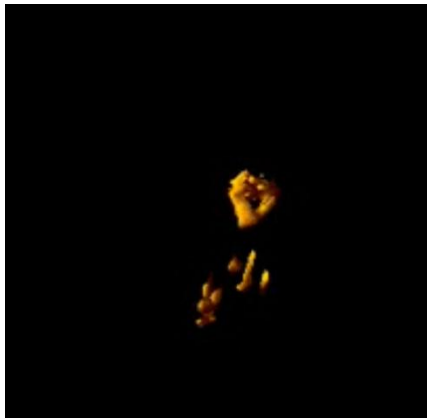


Marco Gorghetto 1806.04677

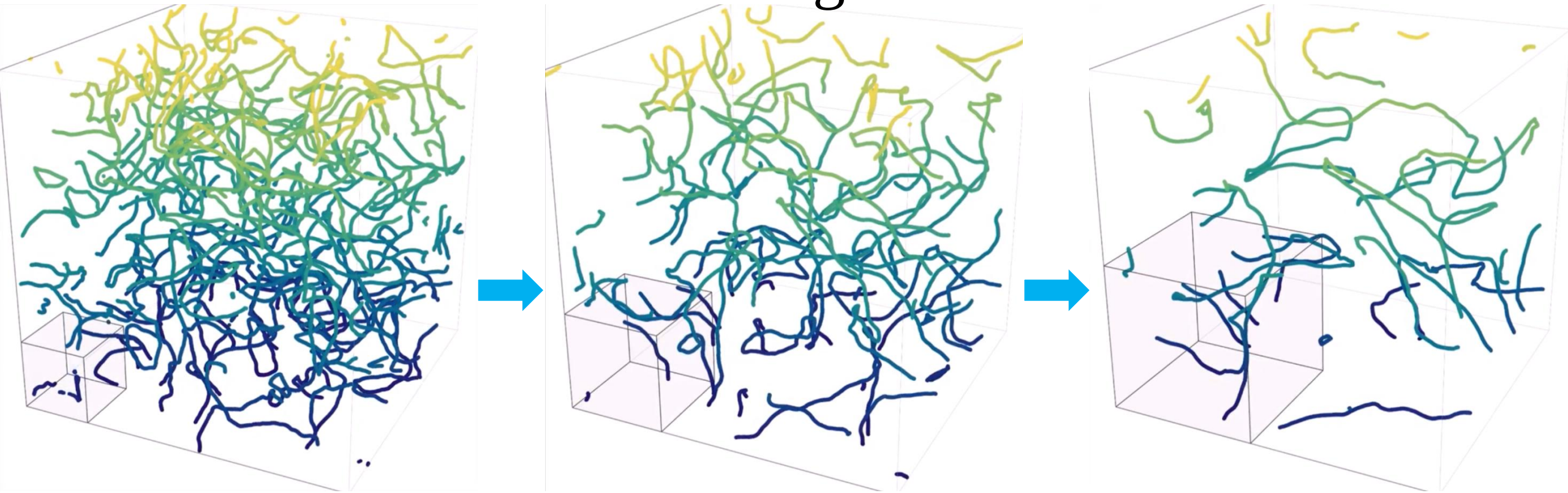
Self-intercommutation





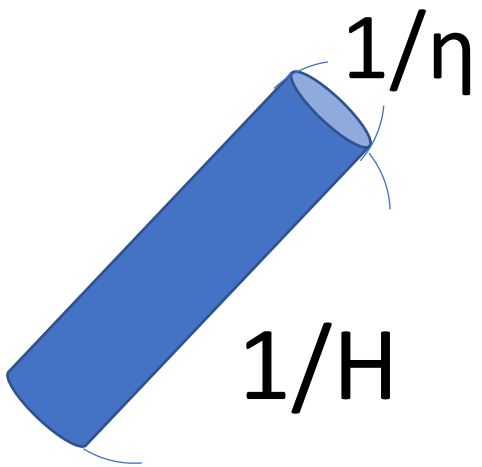


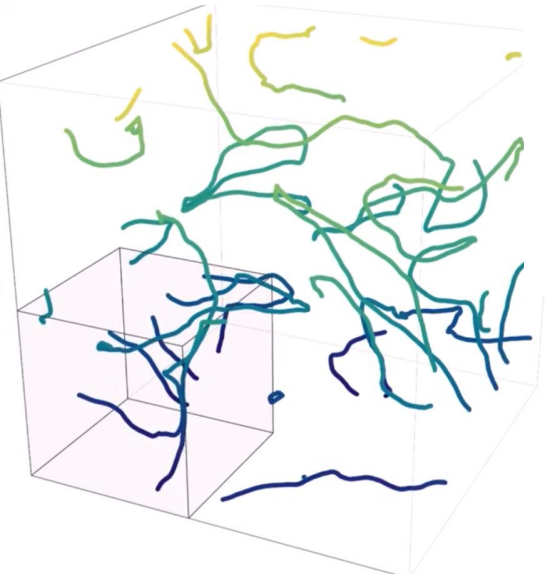
Cosmic String Evolution

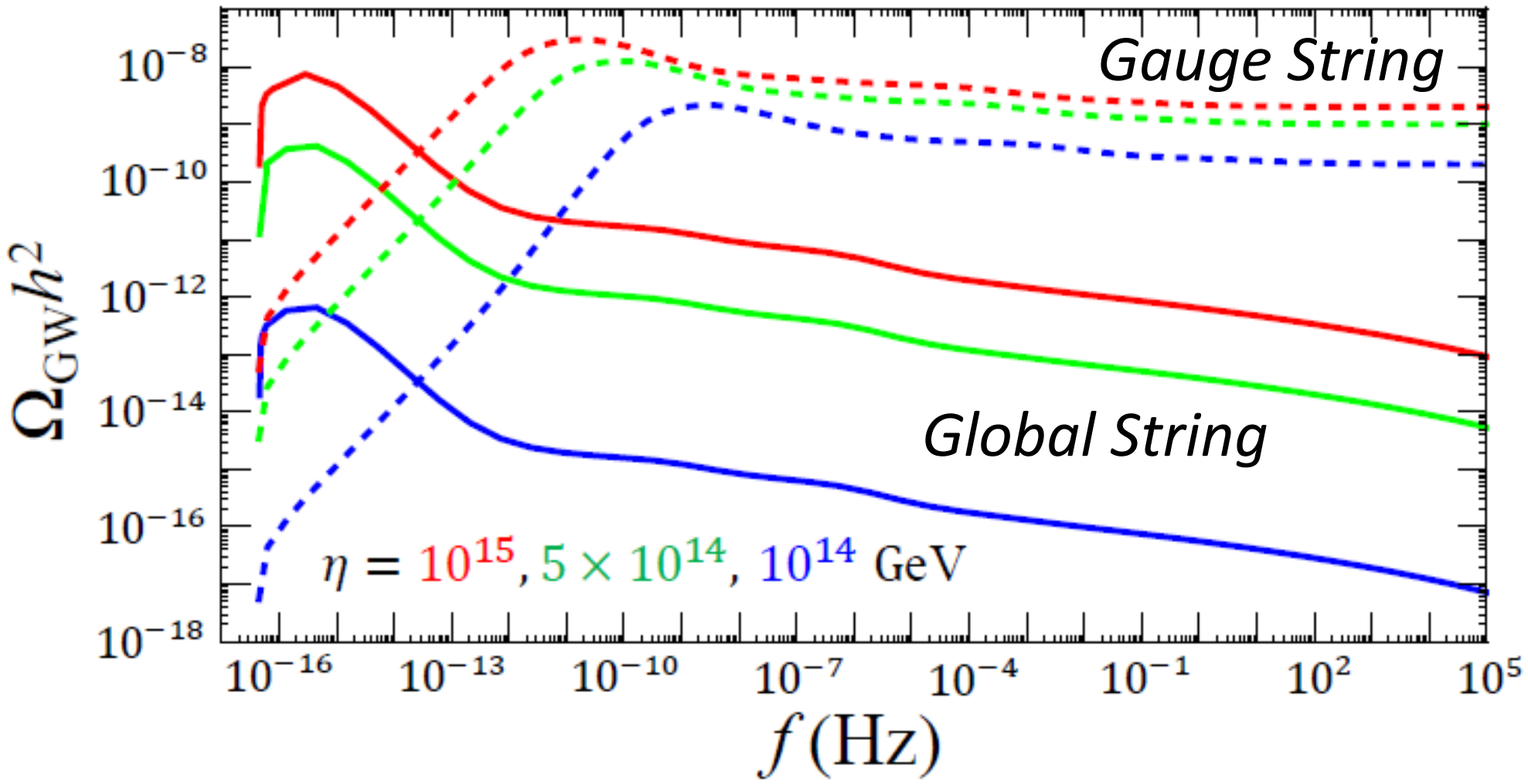


Marco Gorghetto 1806.04677

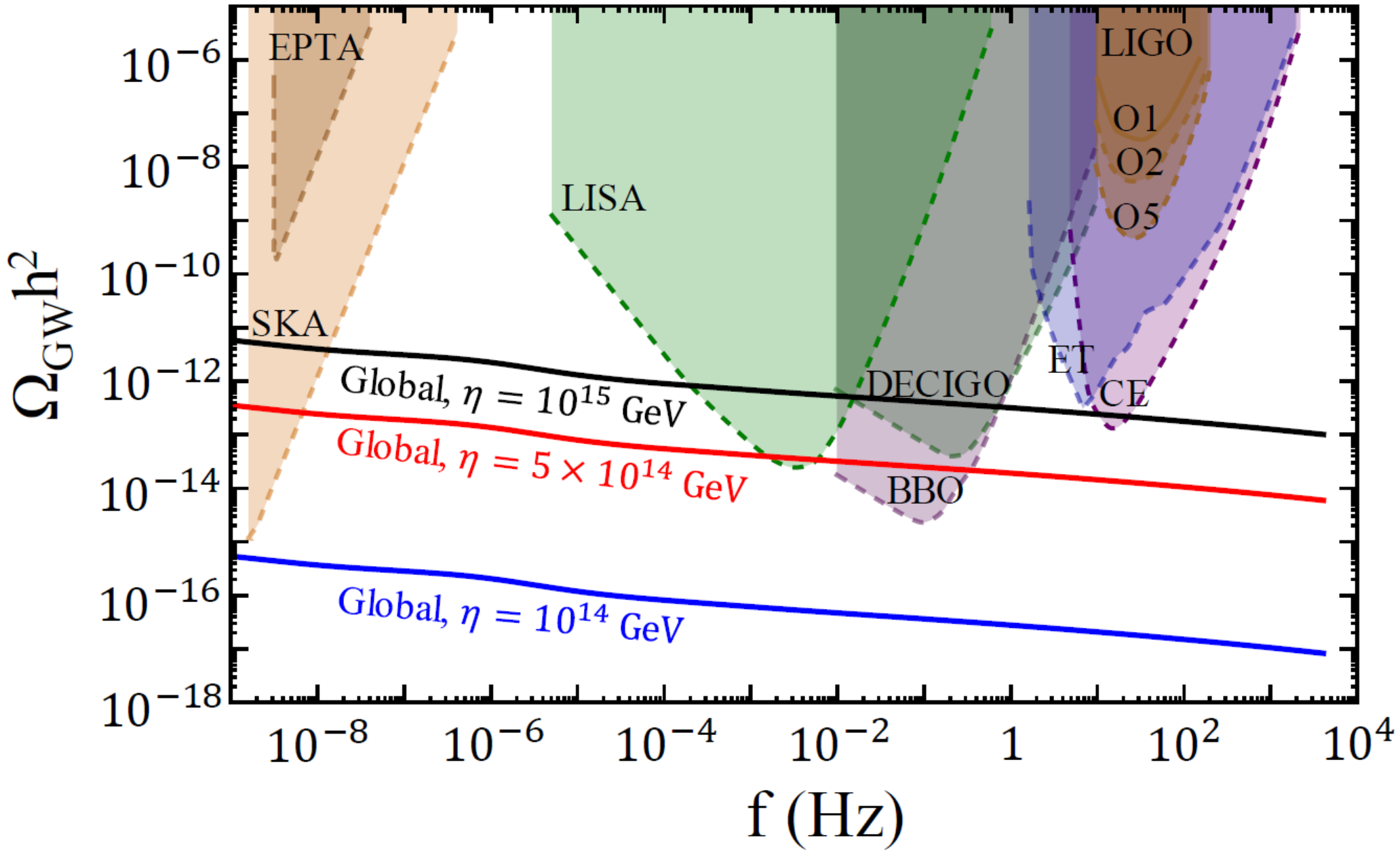
$$\ell(t) \simeq \alpha t_i - \Gamma G\mu(t - t_i) - \kappa(t - t_i),$$


1/η
1/H




Gauge String
Global String
$\eta = 10^{15}, 5\times10^{14}, 10^{14}$ GeV
$\Omega_{\rm GW}h^2$
f (Hz)
10^{-8}
10^{-10}
10^{-12}
10^{-14}
10^{-16}
10^{-18}
10^{-16}
10^{-13}
10^{-10}
10^{-7}
10^{-4}
10^{-1}
10^{2}
10^{5}

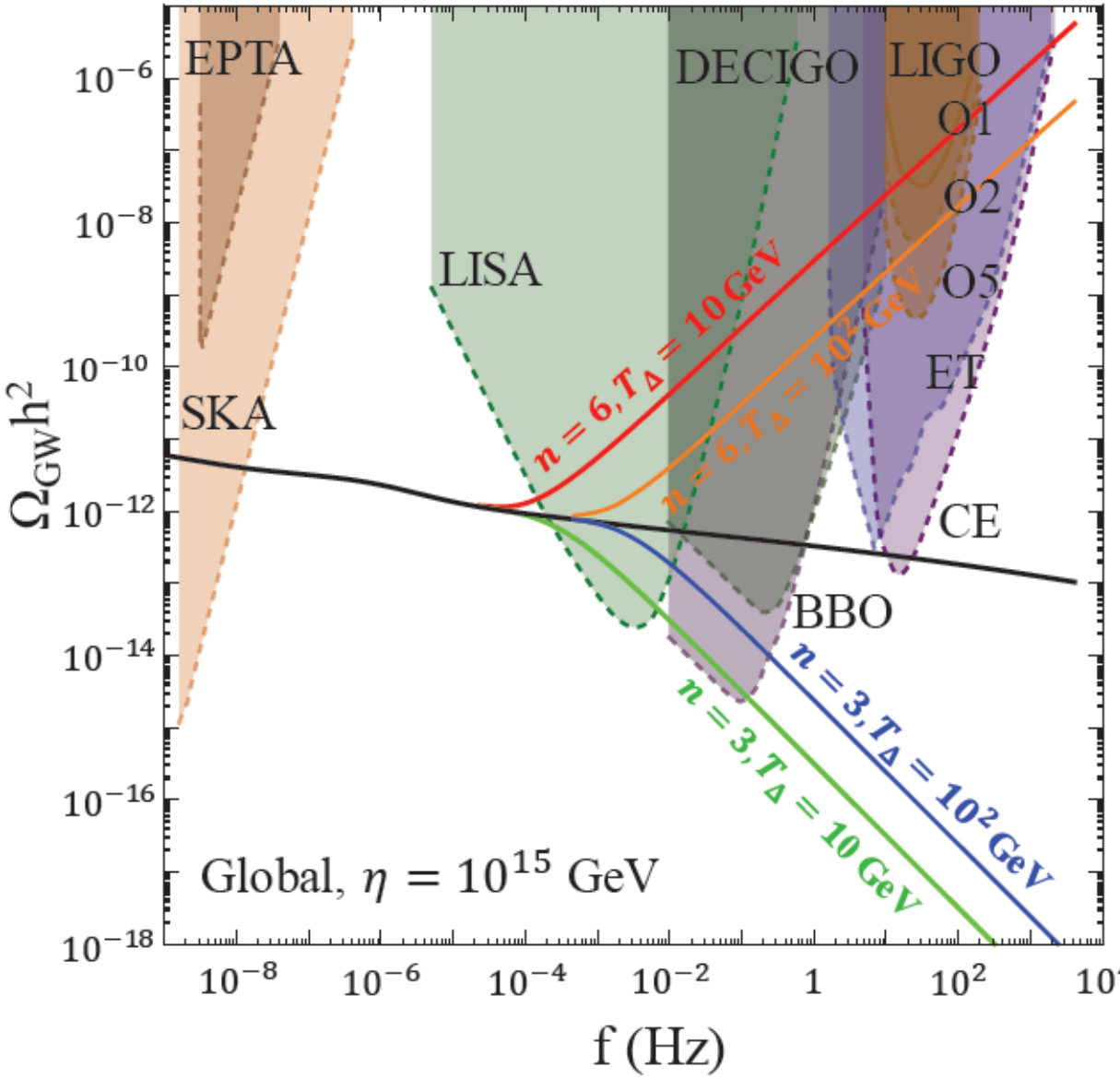
Searching the cosmic string signal

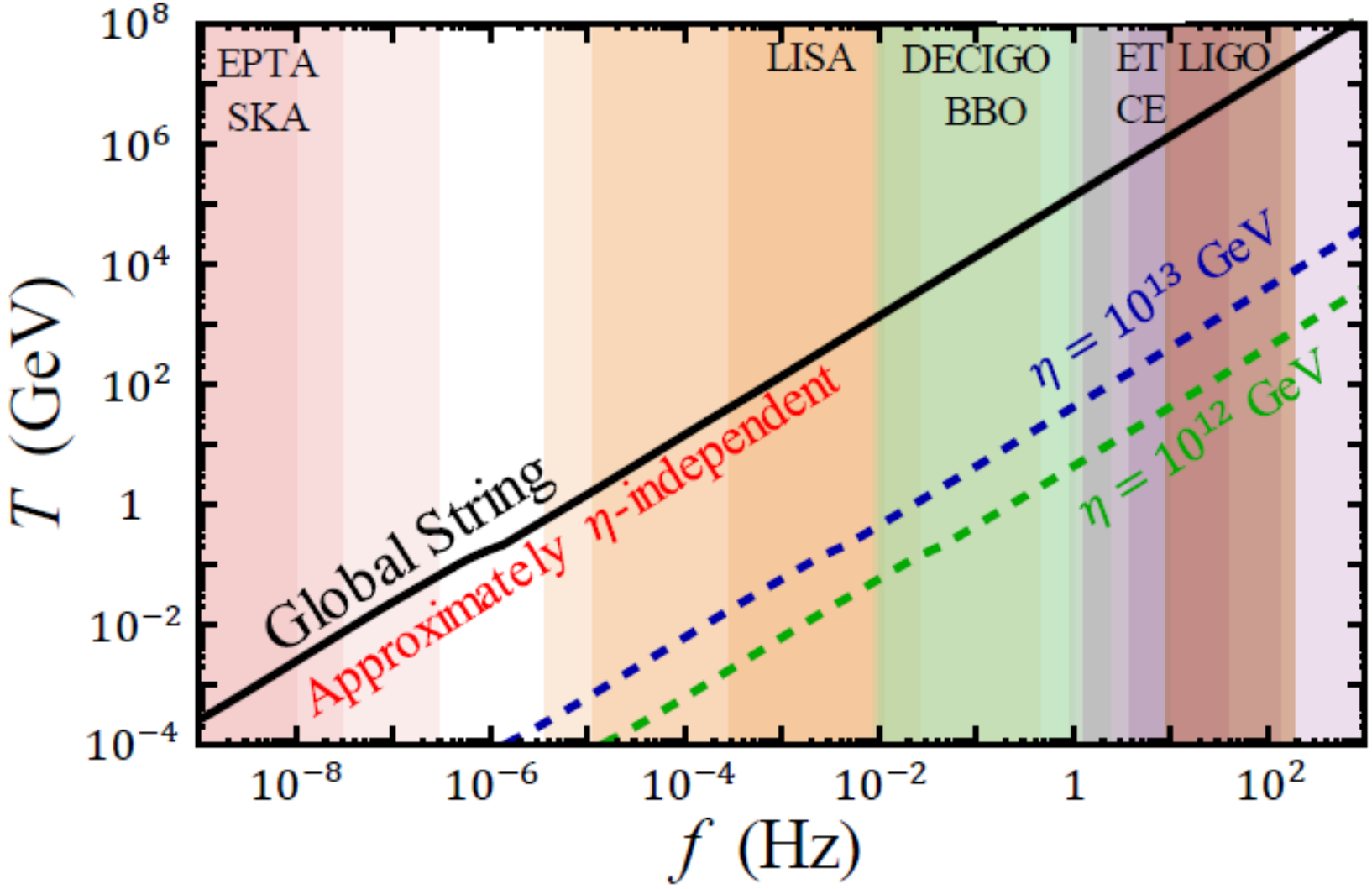


Searching the cosmic string signal

Non-Standard Cosmology

$$\rho(t) = \begin{cases} \rho_{\rm st}(t_\Delta)\left[\dfrac{a(t_\Delta)}{a(t)}\right]^n & ; t < t_\Delta \\ \rho_{\rm st}(t) & ; t \geq t_\Delta \end{cases}$$





$$f \simeq \frac{a(t)}{a(t_0)} \frac{2}{\ell(t)}, \qquad \ell(t) \simeq \alpha t_i - \Gamma G \mu (t - t_i) - \kappa (t - t_i),$$

Conclusion

- We develop the new analysical calculation for GW from global string.
- The GW from global string is detectable if a high symmetry breaking scale is occurred.
- The recently detectors are able to discover the new physics in early universe up to

$$T \sim 10^8\,\mathrm{GeV}$$

by GLOBAL cosmic string

Thank you