Crescendo Beyond the Horizon

More Gravitational Waves from Domain Walls Bounded by Inflated Cosmic Strings

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work in progress with Keisuke Harigaya and Lian-Tao Wang

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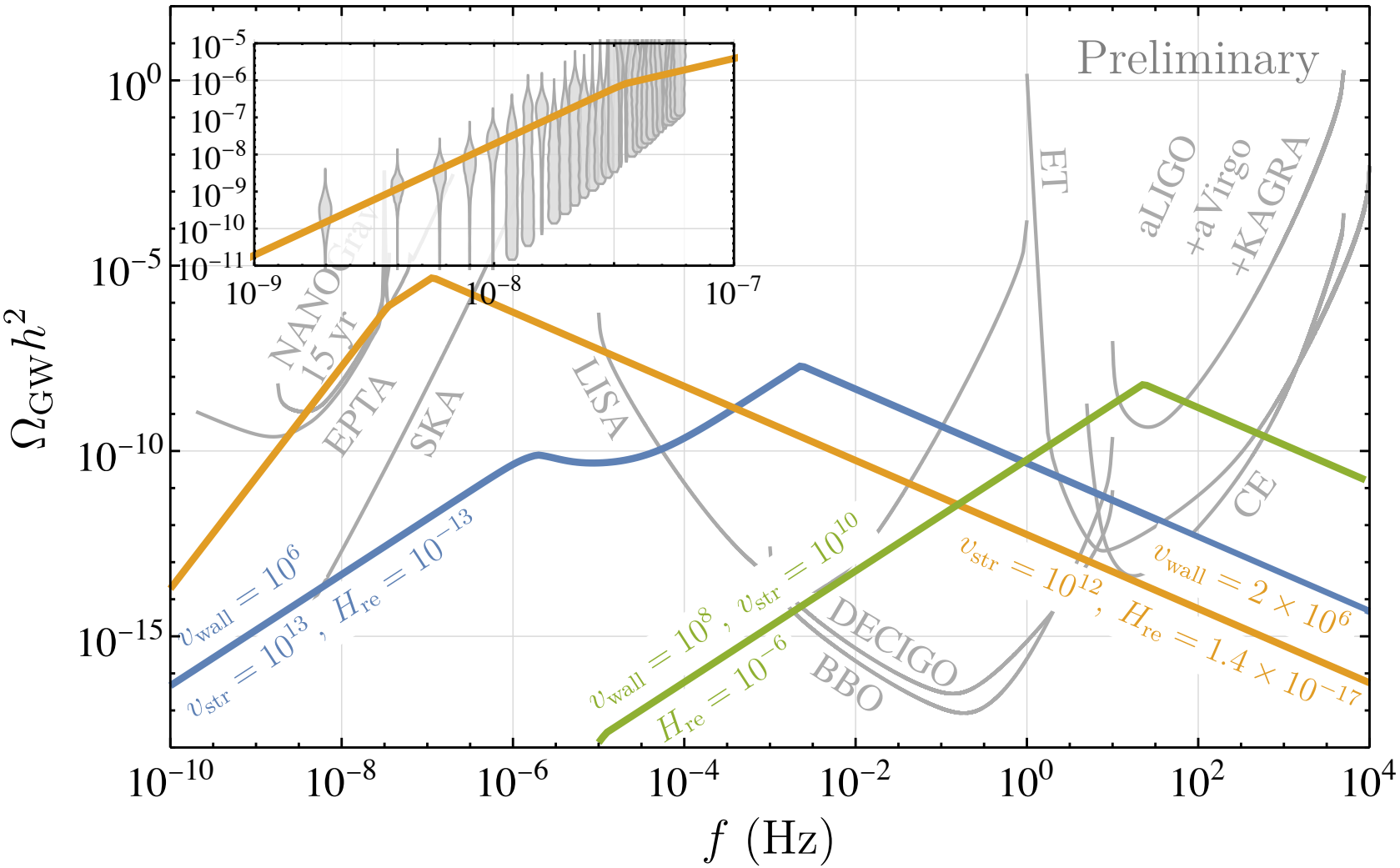
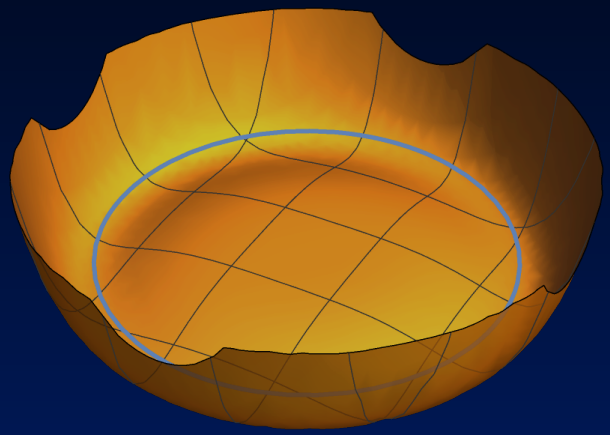
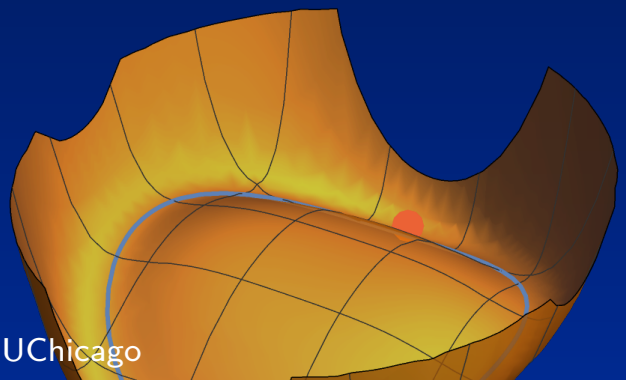
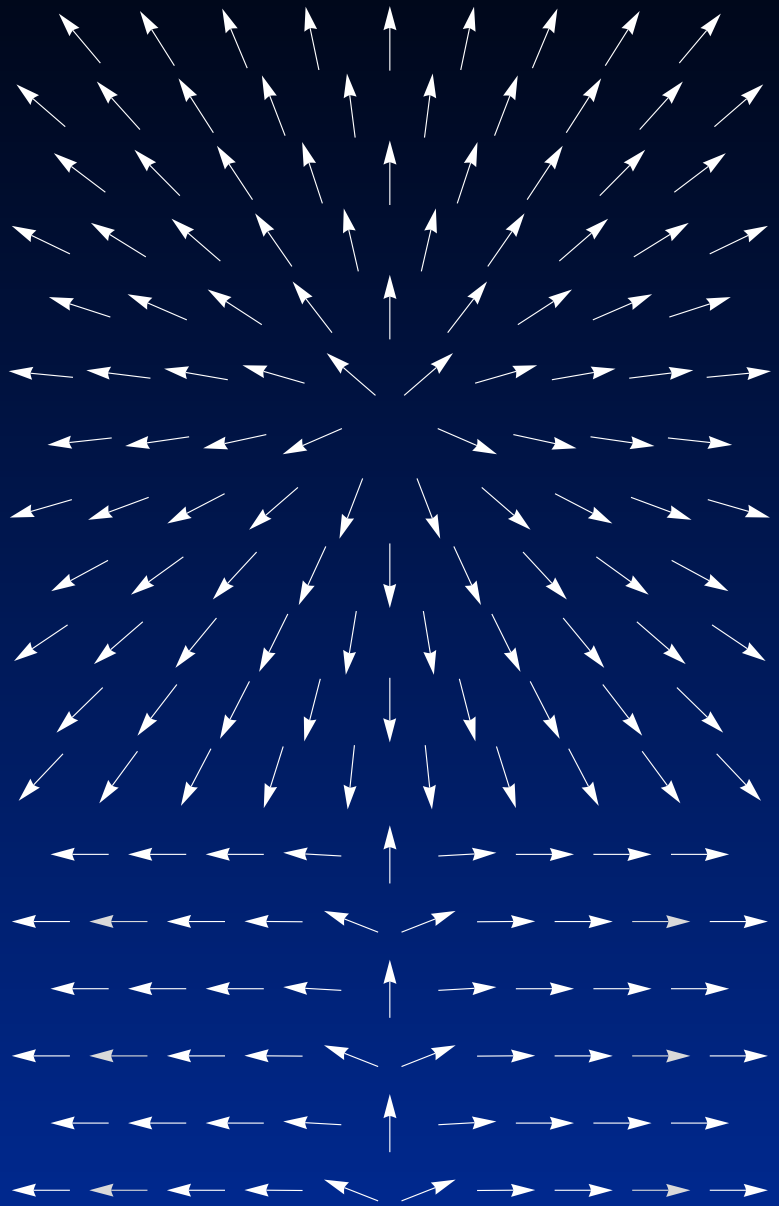
Benchmark GW Spectra



Cosmic Strings and Domain Walls



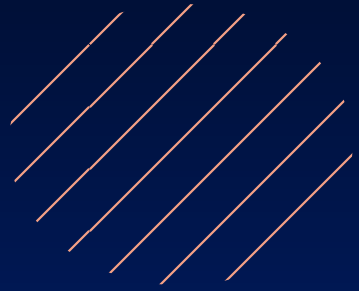




Energy of Domain Walls and Cosmic Strings

cosmic string

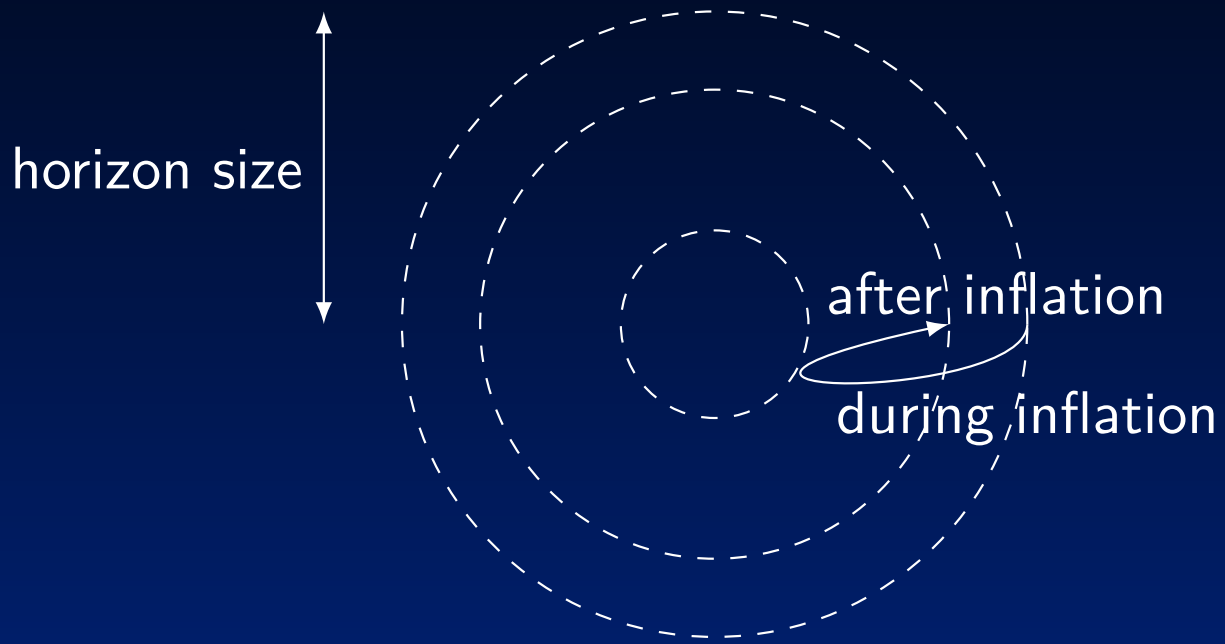
domain wall



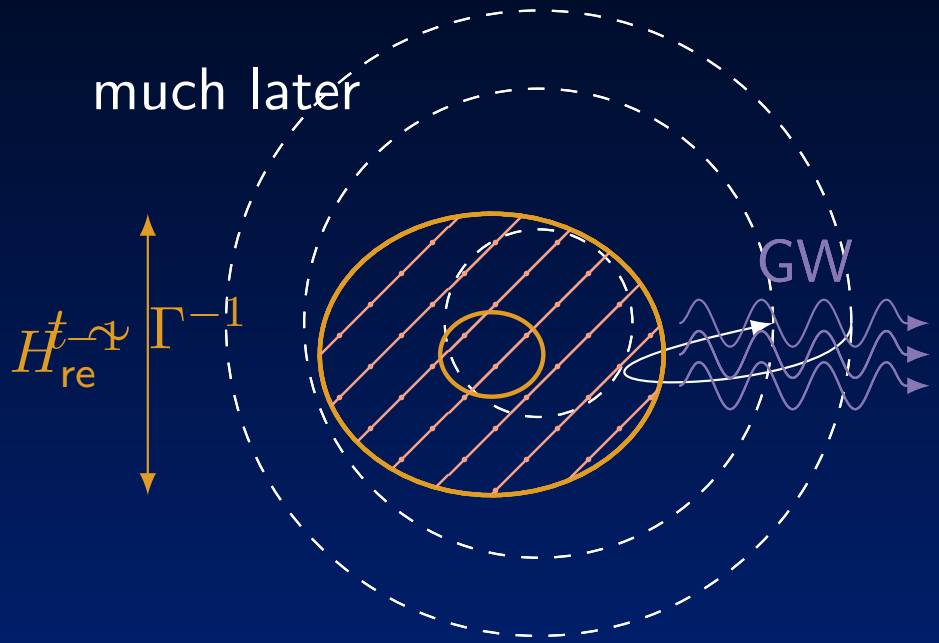
$$E_{\text{str}} \sim \mu L, \quad [\mu] = 2, \qquad (2)$$

$$E_{\text{wall}} \sim \sigma L^2, \quad [\sigma] = 3. \qquad (3)$$

Inflation Shrinks Horizon



Inflated String-bounded Wall



Timescales in Evolution of Strings and Walls

$$[\mu] = 2, \quad [\sigma] = 3$$

$$\Gamma_{\text{str}} \sim \frac{\mu H_{\text{re}}}{M_{\text{Pl}}^2} \tag{4}$$

$$\Gamma_{\text{wall}} \sim \frac{\sigma}{M_{\text{Pl}}^2} \tag{5}$$

GW Spectral Peak

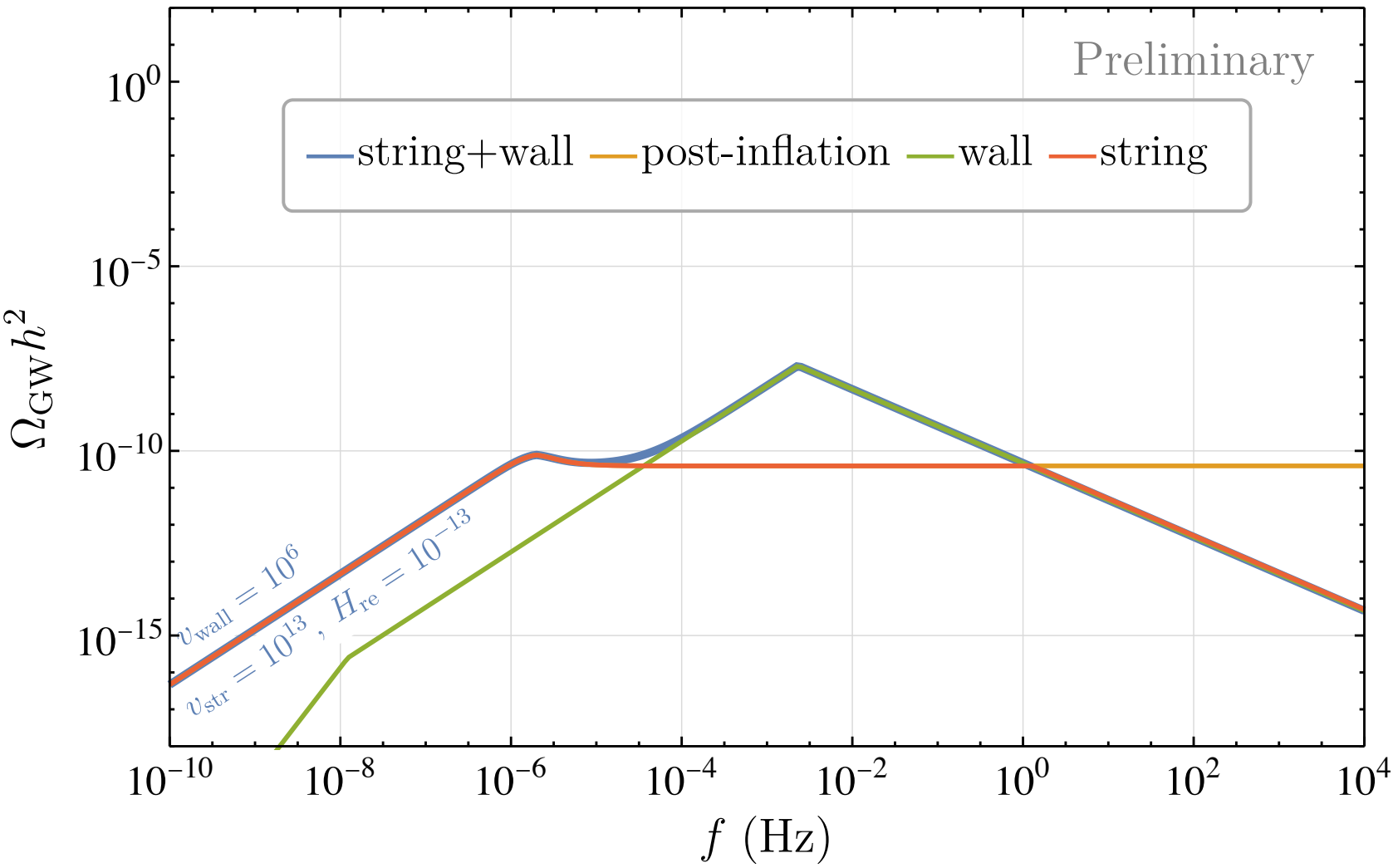
usual cosmic string

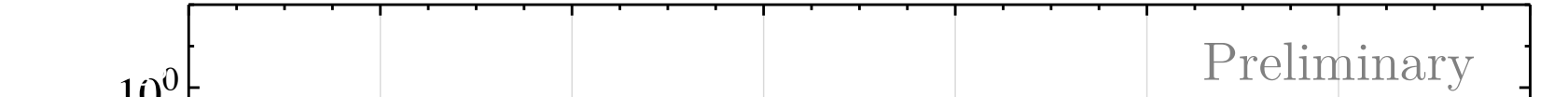
$$\Omega_{\mathsf{GW}} h^2 \Big|_{\mathsf{now}} \sim \Omega_{\mathsf{rad}} h^2 \sqrt{\frac{\mu}{M_{\mathsf{Pl}}^2}} \approx 4 \times 10^{-11} \left(\frac{\mu^{1/2}}{10^{13}\,\mathsf{GeV}} \right) \tag{6}$$

wall bounded by inflated string

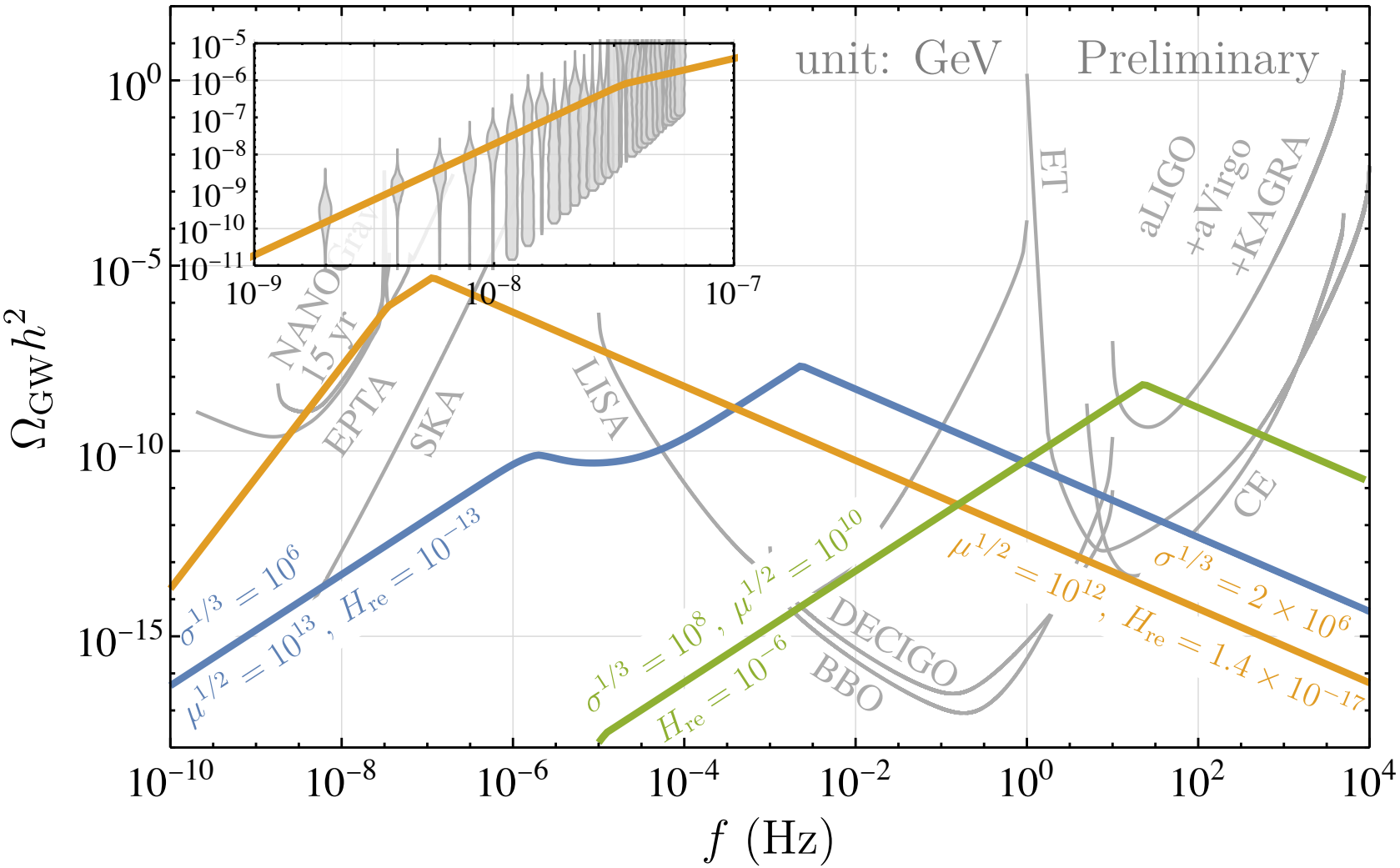
$$\begin{aligned} \Omega_{\mathsf{GW}} h^2 \Big|_{\mathsf{now}} &\sim \Omega_{\mathsf{rad}} h^2 \sqrt{\frac{\sigma}{M_{\mathsf{Pl}}^2 H_{\mathsf{re}}}} \\ &\approx 2 \times 10^{-8} \left(\frac{\sigma^{1/3}}{10^{6}\,\mathsf{GeV}} \right)^{3/2} \left(\frac{10^{-14}\,\mathsf{GeV}}{H_{\mathsf{re}}} \right)^{1/2} \end{aligned} \tag{7}$$

Comparison


Preliminary
string+wall
post-inflation
wall
string
10^{0}
10^{-5}
10^{-10}
10^{-15}
$\Omega_{\rm GW}h^2$
$v_{\rm wall} = 10^{6}$
$v_{\rm str} = 10^{13}$, $H_{\rm re} = 10^{-13}$
10^{-10} 10^{-8} 10^{-6} 10^{-4} 10^{-2} 10^{0} 10^{2} 10^{4}
f (Hz)


Preliminary

Benchmarks


unit: GeV
Preliminary
$\Omega_{\rm GW}h^2$
f (Hz)
NANOGrav 15 yr
EPTA
SKA
LISA
ET
aLIGO +aVirgo +KAGRA
CE
DECIGO
BBO
$\sigma^{1/3} = 10^6$
$\mu^{1/2} = 10^{13}$, $H_{\rm re} = 10^{-13}$
$\sigma^{1/3} = 10^8$, $\mu^{1/2} = 10^{10}$
$H_{\rm re} = 10^{-6}$
$\mu^{1/2} = 10^{12}$, $H_{\rm re} = 1.4 \times 10^{-17}$
$\sigma^{1/3} = 2 \times 10^6$