Abstract Submitted
for the APR20 Meeting of
The American Physical Society

Cosmic String Loop Collapse in Full General Relativity THOMAS HELFER, Johns Hopkins University, JOSU C. AURREKOETXEA, EUGENE LIM, King's College London — We present the first fully general relativistic dynamical simulations of Abelian Higgs cosmic strings using 3+1D numerical relativity. Focusing on cosmic string loops, we show that they collapse due to their tension and can either (i) unwind and disperse or (ii) form a black hole, depending on their tension $G\mu$ and initial radius. We show that these results can be predicted using an approximate formula derived using the hoop conjecture, and argue that it is independent of field interactions. We extract the gravitational waveform produced in the black hole formation case and show that it is dominated by the $l = 2$ and $m = 0$ mode. We also compute the total gravitational wave energy emitted during such a collapse, being 0.5 ± 0.2 % of the initial total cosmic string loop mass, for a string tension of $G\mu = 1.6\times10^{-2}$ and radius $R = 100\ M_{pl}^{-1}$. We use our results to put a bound on the production rate of planar cosmic strings loops as $N \leq 10^{-2}$ Gpc^{-3} yr^{-1}.

Thomas Helfer
Johns Hopkins University

Date submitted: 08 Jan 2020 Electronic form version 1.4