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Probing Dynamical Chern-Simons Gravity with Gravitational Waves from Black Hole Binaries[1] KENT YAGI, NICOLAS YUNES, Montana State University, TAKAHIRO TANAKA, Yukawa Institute for Theoretical Physics — The study of how well gravitational waves can test General Relativity in the strong, non-linear and dynamical regime is essential. As an example, we focus on tests of dynamical Chern-Simons gravity, which is the only parity-violating, quadratic-curvature theory with a single dynamical axion, and is well-motivated by several fundamental theories, such as heterotic superstring theory. With the new, quadratic-in-spin black hole solutions we recently found, we construct a self-consistent gravitational waveform from black hole binaries in the inspiral phase. We find that both dissipative and conservative corrections enter at 2nd post-Newtonian order in the waveform and couple to spin. The network of second-generation ground-based interferometers will be able to place constraints that will be 6 orders of magnitude stronger than current Solar System ones. We find that gravitational wave observations might be the only ways to constrain this theory to such accuracy.

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