Constraints on higher-order curvature corrections using gravitational-wave observations

Noah Sennett,1,2 Richard Brito,3,1 Alessandra Buonanno,1,2 Victor Gorbenko,4,5 and Leonardo Senatore5

1Max Planck Institute for Gravitational Physics (Albert Einstein Institute), Am Mühlenberg 1, Potsdam 14476, Germany
2Department of Physics, University of Maryland, College Park, MD 20742, USA
3Dipartimento di Fisica, “Sapienza” Università di Roma, Piazzale Aldo Moro 5, 00185, Roma, Italy
4School of Natural Sciences, Institute for Advanced Study, Princeton, NJ 08540, USA
5Stanford Institute for Theoretical Physics, Department of Physics, Stanford University, Stanford, CA 94306, USA

Gravitational-wave observations of coalescing binary systems allow us to perform novel tests of the strong-field regime of gravity. Using data from the Gravitational Wave Open Science Center of the LIGO Scientific and Virgo collaborations, we place the first constraints on an effective-field-theory extension of General Relativity whose action contains higher-order curvature corrections. We construct gravitational-wave templates that reproduce the inspiral behavior in this modified theory of gravity, and use Bayesian-selection methods to constrain this theory with respect to General Relativity. We focus on the two lowest-mass binary black-hole events observed to date—GW151226 and GW170608—and describe a general strategy for improving constraints as more observations become available in the future.