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Modified Gravity and the Black Hole Mass Gap[1] MARIA STRAIGHT, Whitworth University, JEREMY SAKSTEIN, The University of Hawaii at Manoa, ERIC BAXTER, The University of Hawaii at Manoa Institute for Astronomy (IfA) — Modified gravity theories seek to explain dark energy and the observed expansion of the universe. These theories predict fifth forces that alter the structure and evolution of population-III stars. Because massive population-III stars experience pair-instability that can cause them to explode in a supernova that does not leave behind a black hole, theory predicts a gap in the distribution of astrophysical black hole masses. We find that increasing the strength of gravity exacerbates the pair-instability and changes the location of this black hole mass gap. We pioneer the black hole mass gap as a probe for modified gravity theories in a novel test of the strong equivalence principle where we apply our results to an analysis of the first ten LIGO/Virgo binary black hole merger events to obtain a 7% bound on the gravitational constant experienced by baryonic matter relative to that experienced by black holes. The recently detected GW190521 event of two black holes with masses within the canonical mass gap can be explained by modified gravity if the black holes formed in a galaxy where the value of the gravitational constant is either enhanced or reduced by $\sim 30\%$.

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