Abstract Submitted
for the APR21 Meeting of
The American Physical Society

Measurement of intermediate mass black hole binaries including the mass gap in the upcoming LIGO-Virgo observations AJIT MEHTA, ALESSANDRA BUONANNO, JONATHAN GAIR, Max Planck Institute for Gravitational Physics, COLE MILLER, University of Maryland, RICHARD DEBOER, MICHAEL WIESCHER, University of Notre Dame, FRANK TIMMES, EB FARAG, Arizona State University — The formation mechanism, evolutionary history and mass function of intermediate mass black holes (IMBHs) are still not well known, as it is very difficult to observe them and measure their masses in the electromagnetic window. In this work, we explore the possibility to measure source parameters of IMBH binaries via gravitational waves in upcoming O4 LIGO-Virgo observation. We perform parameter estimation (PE) on a large set of non-precessing IMBH binaries and show that primary source mass can typically be measured with accuracy $10 \sim 40\%$, far better than what might be possible by electromagnetic observations of such binaries. A particular subset of IMBH population in mass range $\sim 50-130 M_\odot$ is prohibited from the stellar evolution theory due to what is known as the pair production instability. The limits of this mass range, however, are subject to uncertainties in nuclear reaction rates. In this work, we also perform evolution of massive Helium stars using MESA stellar evolution code to understand the susceptibility of mass gap range to plausible changes in these nuclear rates. Having established the mass gap range, we perform PE study and show that upcoming LIGO-Virgo detectors are capable of robustly identifying binaries with components lying in the mass gap.

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Date submitted: 08 Jan 2021 Electronic form version 1.4