Contribution ID: **16** | Type: **not specified**

Searching for gravitational waves from inspiraling planetary-mass primordial black holes in LIGO O3 data

Wednesday 21 May 2025 14:50 (20 minutes)

Gravitational waves from sub-solar mass inspiraling compact objects would provide almost smoking-gun evidence for primordial black holes (PBHs). We perform the first search for inspiraling planetary-mass compact objects in equal-mass and highly asymmetric mass-ratio binaries using data from the first half of the LIGO-Virgo-KAGRA third observing run. Though we do not find any significant candidates, we determine the maximum luminosity distance reachable with our search to be of $\mathcal{O}(0.1-100)$ kpc, and corresponding model-independent upper limits on the merger rate densities to be $\mathcal{O}(10^3-10^{-7})$ kpc^{-3}yr^{-1} for systems with chirp masses of $\mathcal{O}(10^{-4}-10^{-2})M_\odot$, respectively. Furthermore, we interpret these rate densities as arising from PBH binaries and constrain the fraction of dark matter that such objects could comprise. {For equal-mass PBH binaries, we find that these objects would compose less than 4-100% of DM for PBH masses of $10^{-2}M_\odot$ to $2\times10^{-3}M_\odot$, respectively. For asymmetric binaries, assuming one black hole mass corresponds to a peak in the mass function at $2.5M_\odot$, a PBH dark-matter fraction of 10% and a second, much lighter PBH, we constrain the mass function of the second PBH to be less than 1 for masses between $1.5\times10^{-5}M_\odot$ and $2\times10^{-4}M_\odot$. Our constraints, released on Zenodo, are robust enough to be applied to any PBH or exotic compact object binary formation models, and complement existing microlensing results.

Author: MILLER, Andrew

Presenter: MILLER, Andrew

Session Classification: PBHs and GWs