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A possible mass distribution of primordial black holes implied by LIGO-Virgo

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The LIGO-Virgo Collaboration has so far detected around 90 black holes, some of which have masses larger than what were expected from the collapse of stars. The mass distribution of LIGO-Virgo black holes appears to have a peak at ~ $30M_\odot$ and two tails on the ends. By assuming that they all have a primordial origin, we analyze the GWTC-1 (O1&O2) and GWTC-2 (O3a) datasets by performing maximum likelihood estimation on a broken power law mass function f(m), with the result $f \propto m^{1.2}$ for $m > 35M_\odot$ and $f \propto m^{-4}$ for $m > 35M_\odot$. This appears to behave better than the popular log-normal mass function. Surprisingly, such a simple and unique distribution can be realized in our previously proposed mechanism of PBH formation, where the black holes are formed by vacuum bubbles that nucleate during inflation via quantum tunneling. Moreover, this mass distribution can also provide an explanation for supermassive black holes formed at high redshifts.

Primary author: DENG, Heling

Presenter: DENG, Heling

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