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Popcorns in the sky: identifying primordial black holes in the gravitational-wave background

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Primordial black holes (PBHs) are possible sources of a gravitational-wave background (GWB), detectable with LISA and the next observing runs of LIGO–Virgo–KAGRA. In case of a detection, it will be crucial to distinguish the possible sources of this GWB. One possibility is to exploit the duty cycle that quantifies the number of sources present in the time domain signal, which can be very different depending on the nature and population of the sources. We focus on early PBH binaries, for extended realistic PBH mass distributions including the effects of the QCD epoch on the PBH formation, which is typically boosted in the solar-mass range. We compute the duty cycle and the contribution of the different PBH masses, and we derive the ratio between the shot-noise, popcorn and continuous GWBs. These are compared to other typical sources. We find that PBH models lead to specific and distinguishable predictions compared to astrophysical sources or cosmological backgrounds. Our work therefore emphasises the interest in developing specific analysis tools of the duty cycle that should ideally include a frequency dependence.

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