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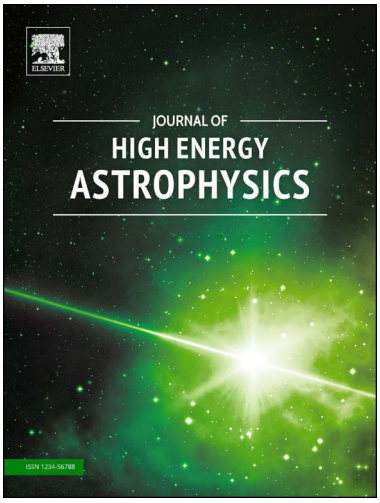

Cosmological evolution of primordial black holes

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Cosmological evolution of primordial black holes

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Abstract

The cosmological evolution of primordial black holes (PBHs) is considered. A comprehensive view of the accretion and evaporation histories of PBHs across the entire cosmic history is presented, with focus on the critical mass holes. The critical mass of a PBH for current era evaporation is $M_{cr} \sim 5.1 \times 10^{14}$ g. Across cosmic time such a black hole will not accrete radiation or matter in sufficient quantity to hasten the inevitable evaporation, if the black hole remains within an average volume of the universe. The accretion rate onto PBHs is most sensitive to the mass of the hole, the sound speed in the cosmological fluid, and the energy density of the accreted components. It is easy for a PBH to accrete to $30M_{\odot}$ by $z \sim 0.1$ even outside any overdense region of the universe, so two merging PBHs are a plausible source for the gravitational wave events GW150914 and GW151226. However it is difficult for isolated PBHs to grow to supermassive black holes (SMBHs) at high redshift with masses large enough to fit observational constraints.

Keywords:

1. Introduction

Primordial black holes (PBHs) are among the most intriguing ghosts in the universe. A singular PBH of sufficient mass can navigate the history of the universe without detectable clues to its existence; a true cosmic ghost. Low mass PBHs evaporate before the current epoch and the radiation signature of an isolated high mass PBH is too weak to detect. The last moments of

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