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# Forming the Earliest SMBHs through Dark Capture in Pop-III Stars

The existence of supermassive black holes (SMBHs) at high redshifts remains a significant challenge for standard black hole formation models. In this work, we explore the scenario where non-annihilating dark matter (DM) interacts non-gravitationally with Standard Model (SM) particles and accumulates within early Population III (Pop-III) stars. Such accumulation can lead to the untimely death of these stars, resulting in early black hole formation. Over cosmic time, these black holes could efficiently accrete mass, giving rise to SMBHs observed in the early Universe. We demonstrate that certain allowed regions in the parameter space of asymmetric dark matter models can explain some of these observed SMBHs. Additionally, we discuss the unique gravitational wave signatures from mergers of these SMBHs, highlighting the potential of forthcoming experiments such as LISA and pulsar timing array (PTA) to probe this scenario.

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