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The Formation of Supermassive Black Holes from Pop III.1 Protostars powered by Dark Matter Annihilation

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The origin of supermassive black holes (SMBHs) is a key open question for contemporary astrophysics and cosmology. Here we discuss the predictions of a model of SMBH formation from Pop III.1 protostars, i.e., metal-free stars forming in locally isolated dark matter minihalos, where dark matter annihilation has a chance to alter the structure of the star allowing growth to supermassive scales (Banik, Tan & Monaco 2019; Singh, Monaco & Tan 2023). The model predicts that all SMBHs have already formed by z ~ 25 with a spatial distribution that is initially relatively unclustered. We also present predictions for SMBH occupation fractions, host galaxy properties, frequency of binary AGN and the gravitational wave background from this SMBH population. These predictions are compared to latest results from HST, JWST and pulsar timing array observations.

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