Abstract for an Invited Paper
for the SES21 Meeting of
the American Physical Society

On the Origin of Supermassive Black Holes[1]

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One of the outstanding open questions of astrophysics is how the supermassive black holes (SMBHs) that reside in the centers of large galaxies come into being. After a short review of different ideas, I present a model that aims to explain the birth of all SMBHs via a single mechanism and involves them being the very first objects to form after the Big Bang. The model relies on special conditions that occur when the very first stars are forming co-located with the central cusps of dark matter minihalos, with these conditions enabling the growth of supermassive ($\sim$100,000 solar mass) stars, which then collapse to SMBHs. Key features of this model are that all SMBHs have formed by redshift 20 and show relatively weak clustering properties. Such features are testable by observations of the high z universe, e.g., with the HST and JWST, and by surveys of the local SMBH population. The model also makes predictions for the frequency of SMBH mergers, which may be tested by gravitational wave experiments, such as NANOGrav.