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Evaporating primordial black holes, the string axiverse, and hot dark radiation

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We show that primordial black holes (PBHs) develop non-negligible spins through Hawking emission of the large number of axion-like particles generically present in string theory compactifications. This is because scalars can be emitted in the monopole mode (l=0), where no angular momentum is removed from the BH, so a sufficiently large number of scalars can compensate for the spin-down produced by fermion, gauge boson, and graviton emission. The resulting characteristic spin distributions for $10^8 - 10^{12}$ kg PBHs could potentially be measured by future gamma-ray observatories, provided that the PBH abundance is not too small. This yields a unique probe of the total number of light scalars in the fundamental theory, independent of how weakly they interact with known matter. The present local energy density of hot, MeV-TeV, axions produced by this Hawking emission can possibly exceed $_{CMB}$. Evaporation constraints on PBHs are also somewhat weakened.

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