

Black hole entropy is a robust prediction of quantum gravity with no observational test to date. We use the Bekenstein-Hawking entropy formula to determine the probability distribution of the spin of black holes at equilibrium in the microcanonical ensemble. We argue that this ensemble is relevant for black holes formed in the early universe and predicts the existence of a population of black holes with zero spin. Observations of such a population at LIGO, Virgo, and future gravitational wave observatories would provide the first experimental test of the statistical nature of black hole entropy.