



Black Hole Mass and Bulge Luminosity for Low-mass Black Holes

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We study the scaling between bulge magnitude and central black hole (BH) mass in galaxies with virial BH masses $< 10^6$ solar mass. Based on careful image decomposition of a snapshot Hubble Space Telescope I-band survey, we found that these BHs are found predominantly in galaxies with pseudobulges. Here we show that the $\log(\text{bulge})$ relation for the pseudobulges at low mass is significantly different from classical bulges with BH masses $> 10^7$ solar mass. Specifically, bulges span a much wider range of bulge luminosity, and on average the luminosity is larger, at fixed black hole mass. The trend holds both for the active galaxies from Bentz et al. and the inactive sample of Gültekin et al. and cannot be explained by differences in stellar populations, as it persists when we use dynamical bulge masses. Put another way, the ratio between bulge and BH mass is much larger than ~ 1000 for our sample. This is consistent with recent suggestions that black hole mass does not scale with the pseudobulge luminosity. The low-mass scaling relations appear to flatten, consistent with predictions from Volonteri & Natarajan for massive seed BHs.

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