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The Origin of the Relationship between Black Hole Mass and Host Galaxy Bulge Luminosity

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Abstract. There is a strong decrease in scatter in the $M_{\bullet} - L_{bulge}$ relationship with increasing luminosity and very little scatter for the most luminous galaxies. It is shown that this is a natural consequence of the substantial initial dispersion in the ratio of black hole mass to total stellar mass and of subsequent galaxy growth through hierarchical mergers. “Fine-tuning” through feedback between black hole growth and bulge growth is neither necessary nor desirable.

Keywords: black hole growth, galaxies: fundamental parameters, galaxies: nuclei, galaxies: bulges
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The dispersions in the relationships between black hole mass, M_{\bullet} , host galaxy bulge luminosity, L_{bulge} , and stellar velocity dispersion have been shown [1, 2] to decrease strongly with increasing L_{bulge} (see Fig. 1). The trend in Fig. 1 can easily be modeled by assuming that bulges grow through mergers and that the M_{\bullet}/L_{stars} ratio initially has a log-normal distribution with a substantial dispersion as is observed for the lowest luminosity galaxies. A substantial scatter in the initial M_{\bullet}/L_{stars} ratio is required. “Fine-tuning” through feedback is unnecessary and produces too low a dispersion in M_{\bullet}/L_{bulge} .

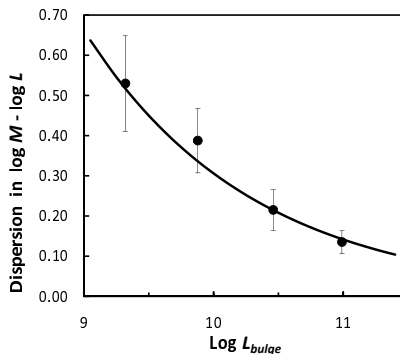


FIGURE 1. The $1-\sigma$ scatter in the AGN $M_{\bullet} - L_{bulge}$ relationship as a function of bulge luminosity [2]. The solid line shows the predicted decrease in scatter for hierarchical merging.

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