Project 3 Progress Report

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The M–σ and M-L Relations In Galactic Bulges, and Determinations of Their Intrinsic Scatter

Gültekin et al (2009) calculates a new slope of the power-law M-σ relation using the maximum likelihood estimation method. Not only do they calculate the log-log power law slope for the full sample, but they also see how the slope varies across morphologies. For the full sample, they found that $log(M_{BH}/M_{\odot}) = \alpha+\beta log(\sigma/200km\cdot s^{-1})$ has the values $(\alpha, \beta, \epsilon_0) = (8.12\pm0.08, 4.24\pm0.41, 0.44\pm 0.06)$. To make the fit, they use the maximum likelihood method with Gaussian errors on the measurements. They also include upper limit measurements in their calculation of the power law slope.

Updating the (supermassive black hole mass)–(spiral arm pitch angle) relation: a strong correlation for galaxies with pseudobulges

Davis et al. (2017) use BCES Bisector to estimate $\alpha = 5.65 \pm 0.79$, which is higher than the lower values calculated in the past for the M-σ relation.

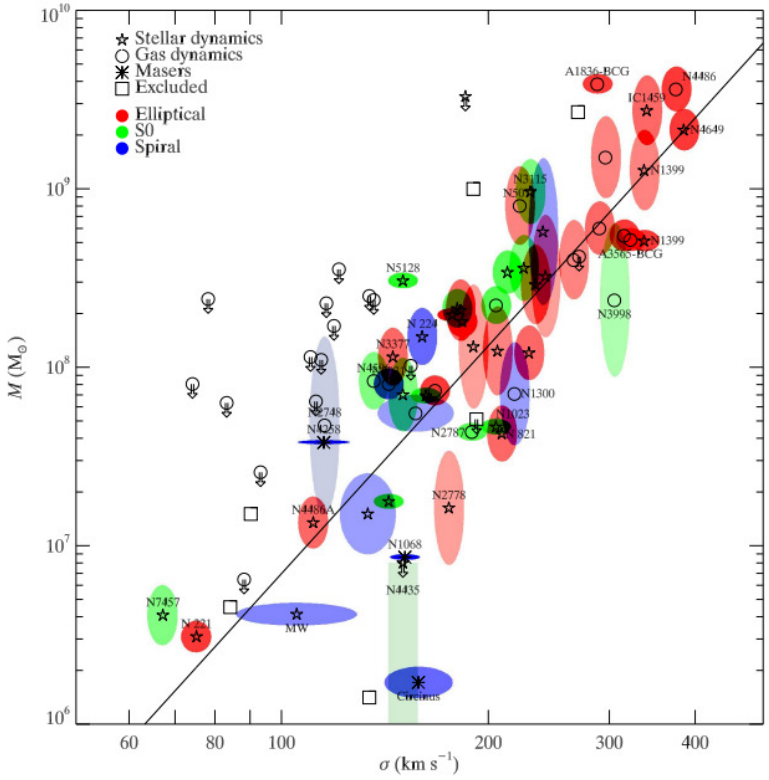
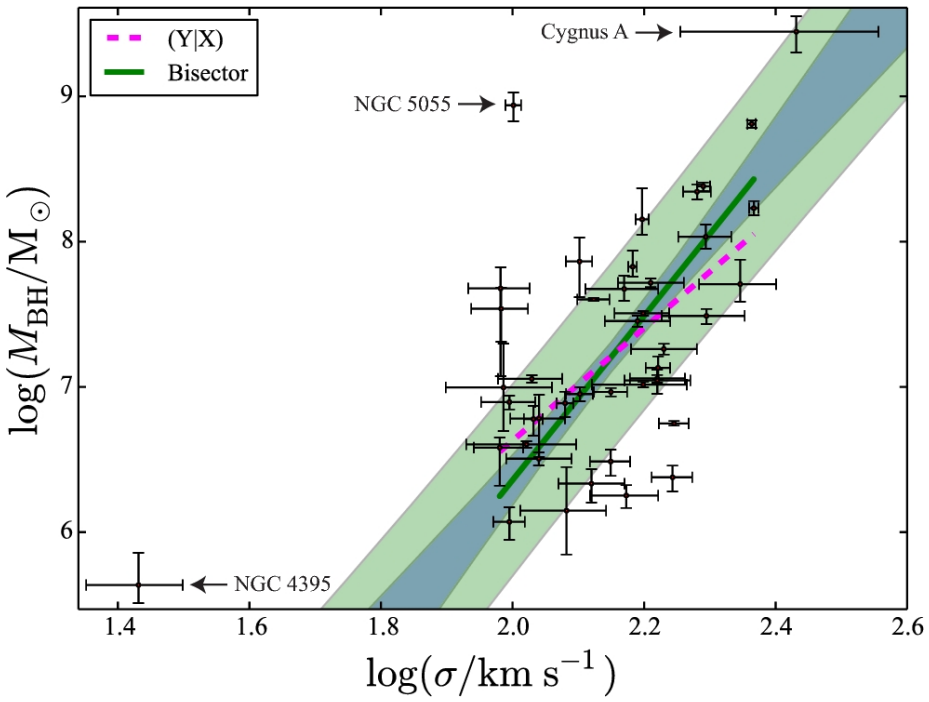


FIG. 1.— The M–σ relation for galaxies with dynamical measurements. The symbol indicates the method of BH mass measurement: stellar dynamical (*pentagrams*), gas dynamical (*circles*), masers (*asterisks*). Arrows indicate $3\sigma_{68}$ upper limits to BH mass. If the $3\sigma_{68}$ limit is not available, we plot it at 3 times the $1\sigma_{68}$ or at 1.5 times the $2\sigma_{68}$ limits. For clarity, we only plot error boxes for upper limits that are close to or below the best-fit relation. The color of the error ellipse indicates the Hubble type of the host galaxy: elliptical (*red*), S0 (*green*), and spiral (*blue*). The saturation of the colors in the error ellipses or boxes is inversely proportional to the area of the ellipse or box. Squares are galaxies that we do not include in our fit. The line is the best fit relation to the full sample: $M_{\rm BH} = 10^{8.12}\ {\rm M}_\odot (\sigma/200\ {\rm km\ s^{-1}})^{4.24}$. The mass uncertainty for NGC 4258 has been plotted much larger than its actual value so that it will show on this plot. For clarity, we omit labels of some galaxies in crowded regions.


(Y|X)
Bisector
Cygnus A
NGC 5055
NGC 4395
9
8
7
6
1.4
1.6
1.8
2.0
2.2
2.4
2.6
$\log(M_{\rm BH}/{\rm M}_\odot)$
$\log(\sigma/{\rm km\ s^{-1}})$

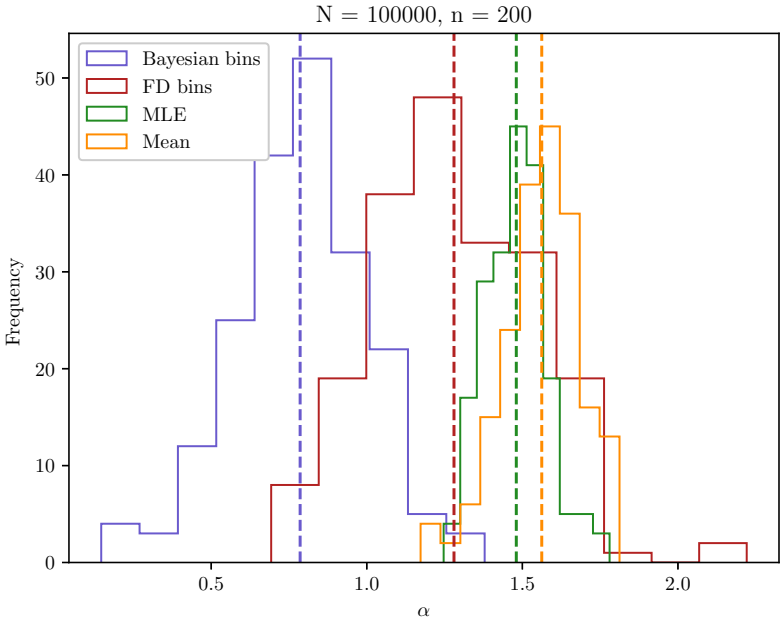


Figure 1: Different distributions of α for the different calculation methods.