

I worked with no one on this worksheet. It took about 3×10^{14} cm to complete (3 hours).

Curve Fitting

(a)

First I plotted the raw data, without any fitting.

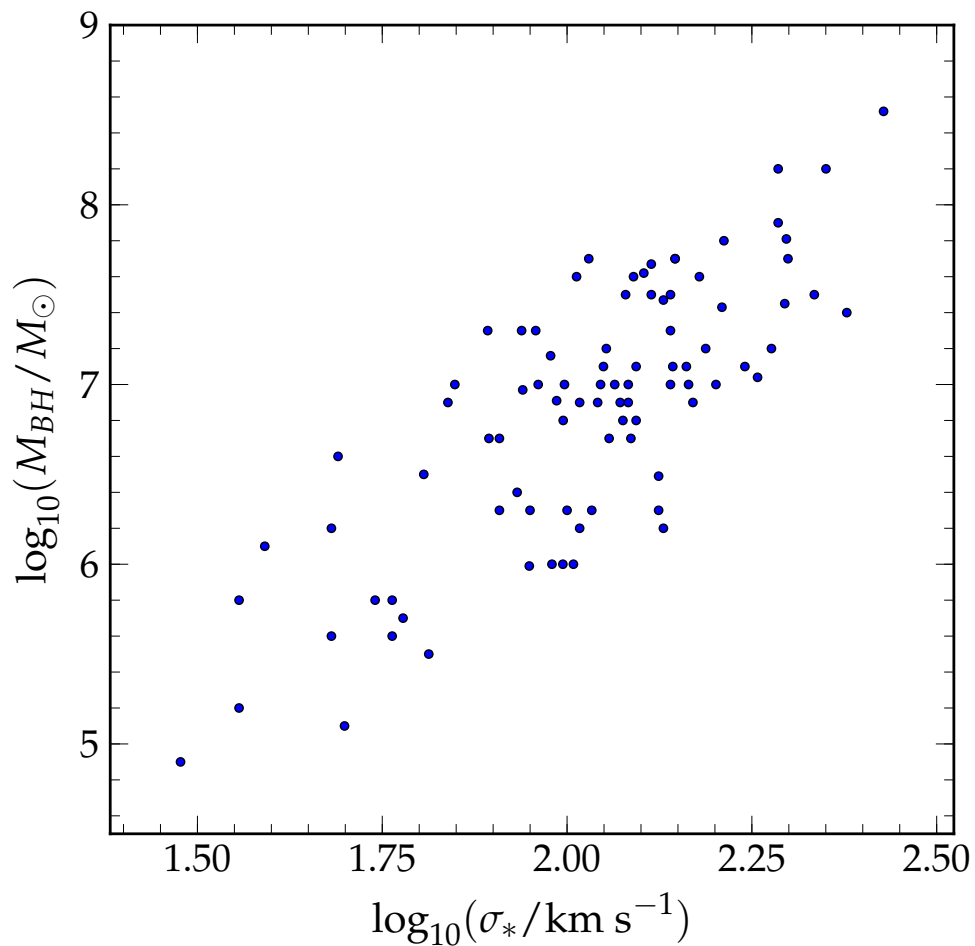


Figure 1: The relation between stellar velocity dispersion σ_* in a galaxy bulge and the mass M_{BH} of the supermassive black hole at the center of the galaxy.

(b)

Then I fit the data to a linear function, ignoring the errors in M_{BH} . I did this by setting all the σ_i to a constant (specifically, 1 – the exactly constant value doesn't matter, because it ultimately cancels in the definitions of a_1 and a_2).

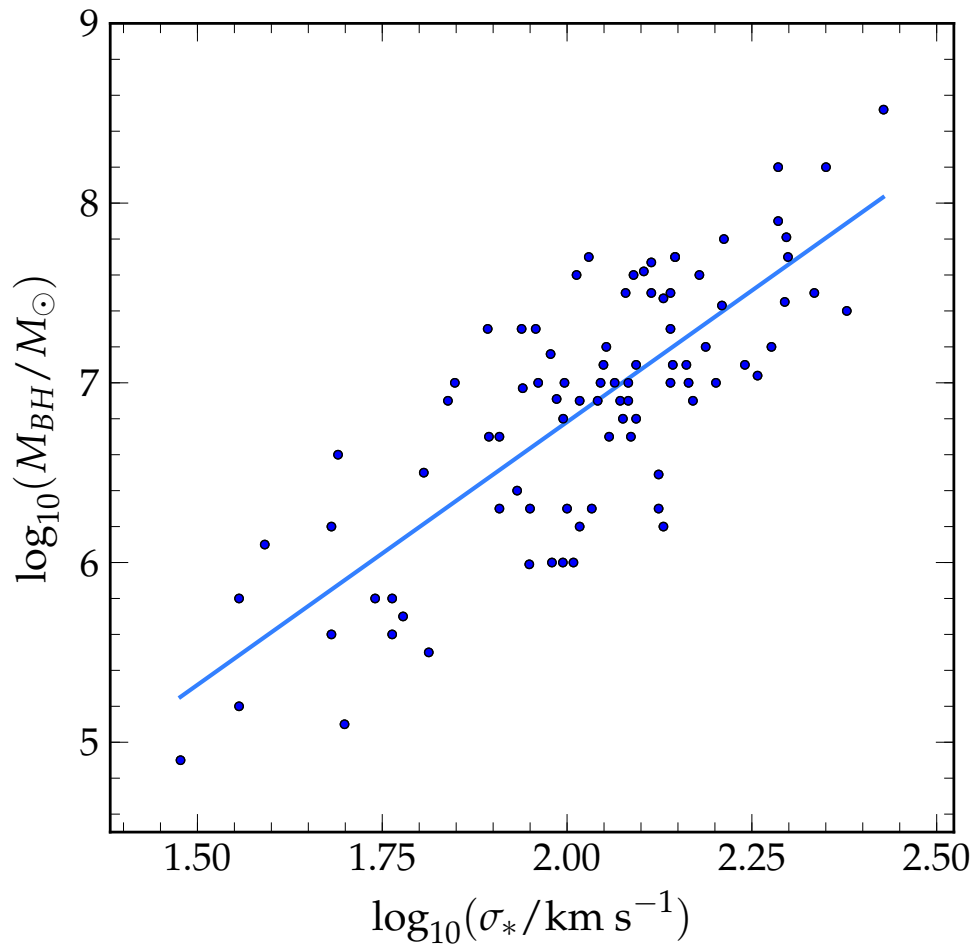


Figure 2: The relation between stellar velocity dispersion σ_* in a galaxy bulge and the mass M_{BH} of the supermassive black hole at the center of the galaxy. A linear fit of the data, ignoring errors, is given.

I then rescaled my plot and overlaid its data points with those of Greene & Ho so that the linear fits could be compared. Clearly there is a somewhat large discrepancy between the fits, with a 9° angle between the two fit lines. Because this angle is dependent on the x-y plot scaling, it is meaningless by itself, but I will soon use it to assess how much closer to Greene & Ho's fit my next fit will be. I can think of two reasons for this discrepancy: first, Greene & Ho have data that I lack, almost all of which is above my line on the right side of the plot, which helps to explain why mine dips lower than theirs toward the right. Secondly, their fit undoubtedly takes error into account, which may help to further explain the discrepancy.

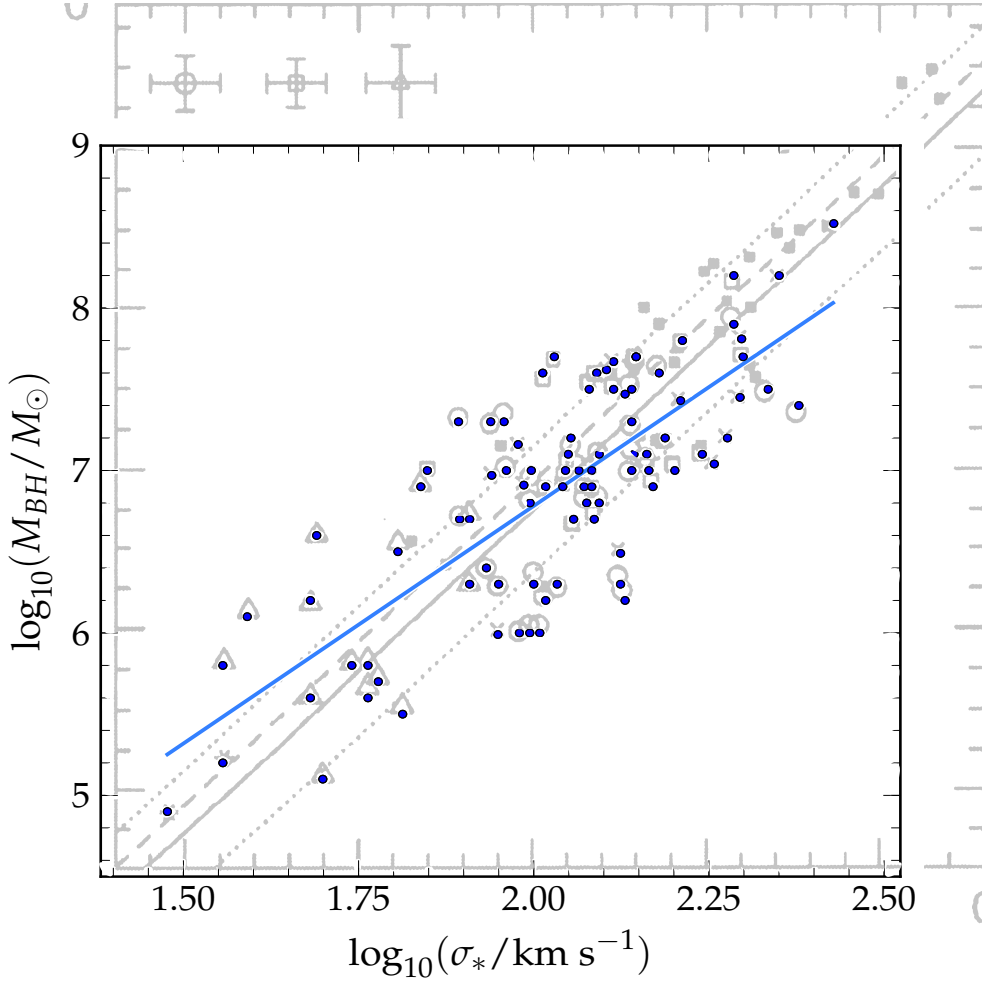


Figure 3: The relation between stellar velocity dispersion σ_* in a galaxy bulge and the mass M_{BH} of the supermassive black hole at the center of the galaxy. Our plot and linear fit is superimposed with the plot and linear fit of Greene & Ho.

(c)

I then fit the data including errors in $\log M_{BH}$; the result is the red dashed line in Fig. 4. I chose to use the error titled “Formal uncertainty (or lower limit) in $\log M$ ” because it was the only one of the two error columns for $\log M$ that contained an error for each $\log M$ value.

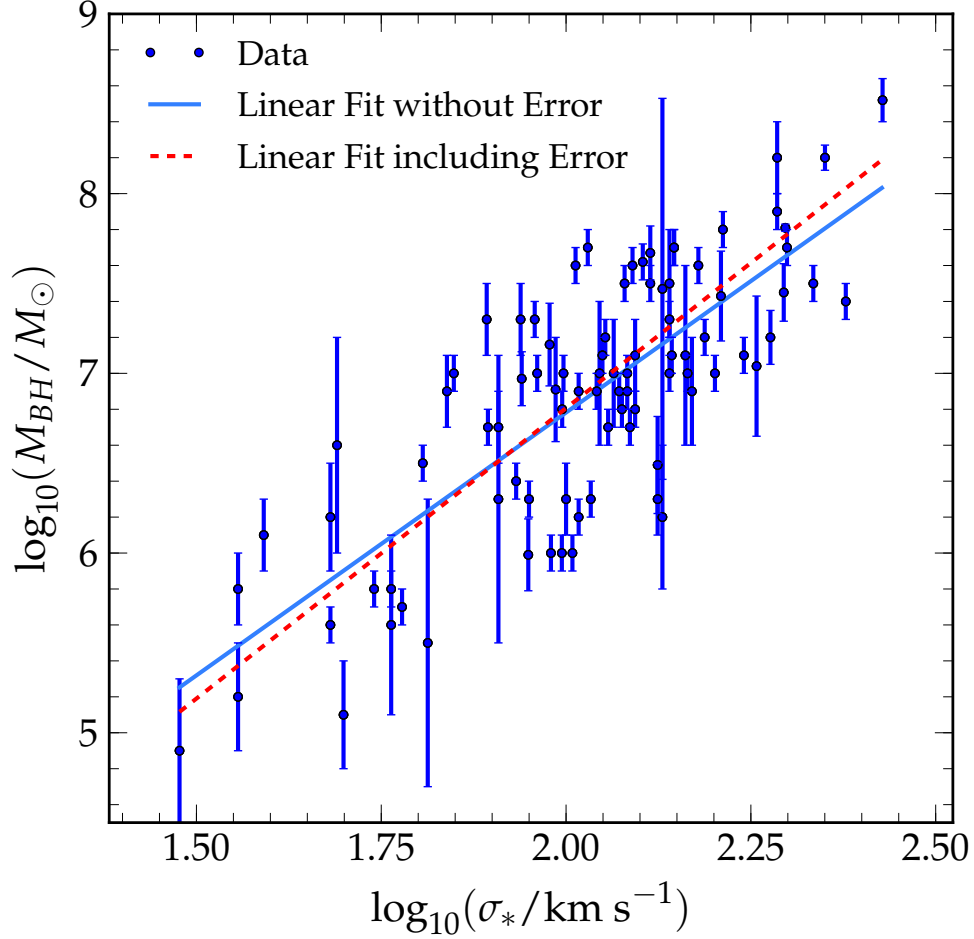


Figure 4: The relation between stellar velocity dispersion σ_* in a galaxy bulge and the mass M_{BH} of the supermassive black hole at the center of the galaxy. Two linear fits of the data, one ignoring errors (blue) and one including errors (red), are given.

This inclusion of errors in M_{BH} results in a linear fit closer to that of Greene & Ho. The discrepancy in angle between the fits has been reduced from 9° to 5° , a reduction in the discrepancy of 44%.