More Test

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> ***1, repeat analysis excluding Orbit 1? Orbit #1 is usually less stable than the rest and excluding it would help us verify that those data are not influencing the rest of the data some odd ways via affecting the normalization factors. I suspect that this is not the case, but we should verify.***

> ***2, Reduce dither positions 1-3 and 2-4 pairs separately: By reducing and fitting data from groups of only two of the dithering positions (about half the total data) we can verify that the signal we are seeing is present in both halves of the data, which is very convincing.***

I made several least square fittings with respect to above two points and I plotted the photometric points with the fitted light curve in Figure 1

Excluding the first orbit does not change the result too much. For the light curve of F125W, the fitted sine curve to the data set without the first orbit has almost the same amplitude as that of the whole data-set and a period 1 hr longer. For F160W, the two fit only have very slight difference in phase.

However, when splitting the data set into two halves, the fitting results have more significant difference, especially for F125W. Two halves of the F125W data set generally have similar trend – ascend in first two orbits and descend in 2-5 orbits. However, one significant difference is that in the first half, the light curve goes up in the last orbit while in the second half it continues descending. This difference leads to large deviation in the result of sine curve fitting. The periods of best fitted sine curves to the two halves of data are very different. It is 8.8 hr for the first half and 16.9 hr for the second half. Although considering the large scattering, I would guess there would be a local minimum for the fit to the second half at a smaller period. For F160W, the fitting result for the two halves are more similar. The biggest difference is the amplitude, it is 0.006 for the first half and 0.01 for the second half.

The difference for the fitting result for two halves would at least cast some doubt on the amplitude and period measurement. Also I think it may provide some idea on the uncertainty of the measurement.

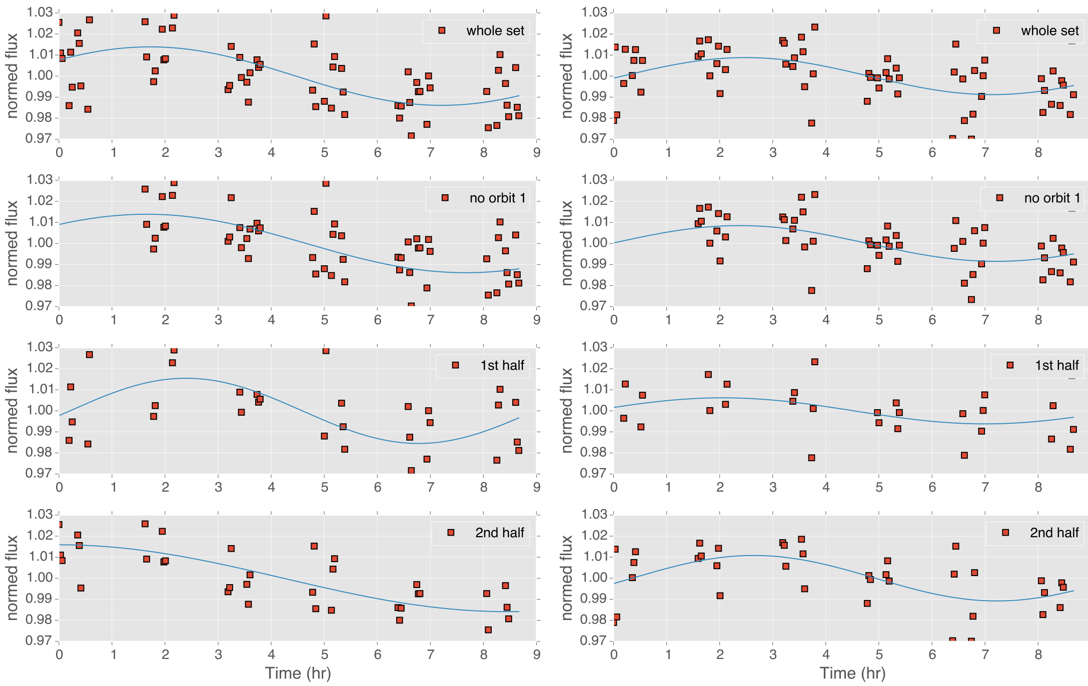

Figure 1: phototmetry and fitted sine curves for different data set. The left panel is for F125W and the right is for F160W. The first row is the whole data set, the second is the fit with Orbit # 1 removed, the third is the fit for the first half and the forth is for the second half.

> ***3, My biggest (but not major) concern is the effect of flat fielding errors. I am not quite sure how to exclude their effect completely, perhaps Glenn has a good suggestion. Given that we don't really control the flat field errors, one test we should do is to introduce a flat field error and see what changes, if any, this introduces. I am thinking here on the following: create an artificial flat error mask (AFEM) with uniformly distributed noise with a mean value of 1.00 and a sigma of ~ 1%. Then multiply all your frames with this AFEM right before you start the actual reduction; and then compare the light curve emerging from your AFEM reduction and the original one, including fitting a sine wave.***

> ***I would think that a PSF model in which the residuals and the diffraction-limited (Tiny-Tim) components are scaled together is more realistic than keeping the residuals fixed. Would you try scaling these together and see if the results are still the same?***

Actually by adding an artificial flat error mask or scaling the residual together with the Tiny-Tim PSFs together does not change the photometric measurement too much. The F125W light curve measured as original, with an AFEM, and with residual part scaling together with PSFs are shown in Figure 2. The trends of the three light curves are very similar. For measurement with an AFEM, the maximum deviation of normalized photometry point from the original is around 0.005, which is $\sim 50\%$ of the amplitude of the fitted sine curve. For most of the data points, the deviation is below 0.002. For the measurement with residual part scaling together with Tiny Tim PSFs, the light curve is almost identical. The maximum difference comparing to the original one is at 1×10^{-4} level, which is one order of magnitude smaller than the amplitude of the sine curve.

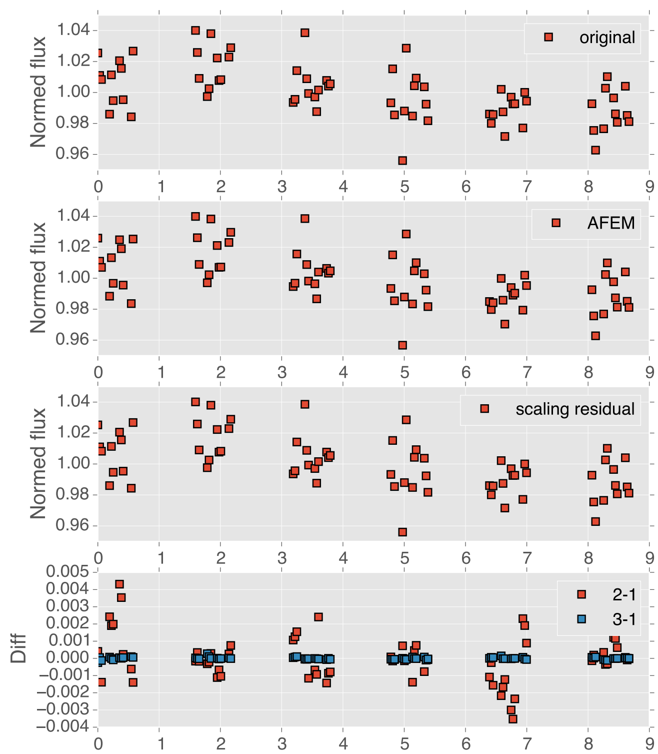

Figure 2: light curves of the original one (1st), the one measured with an AFEM applied (2nd), the one measured with residual part scaling together (3rd) and their difference. In the 4th panel, red points are the difference of the AFEM LC and the original LC, and blue points are the difference of the residual scaling LC and the original LC.