WASP 80-b: Update Alice Booth - 27/08/15

Logistics

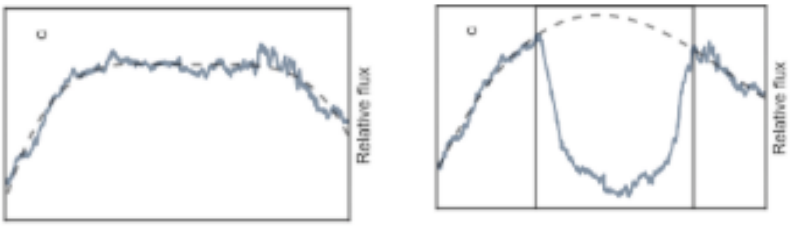
core.py is currently in src directory, this has been updated in all notebooks discussed below. Also, Stellar Parameters have been added to core.

GitHub

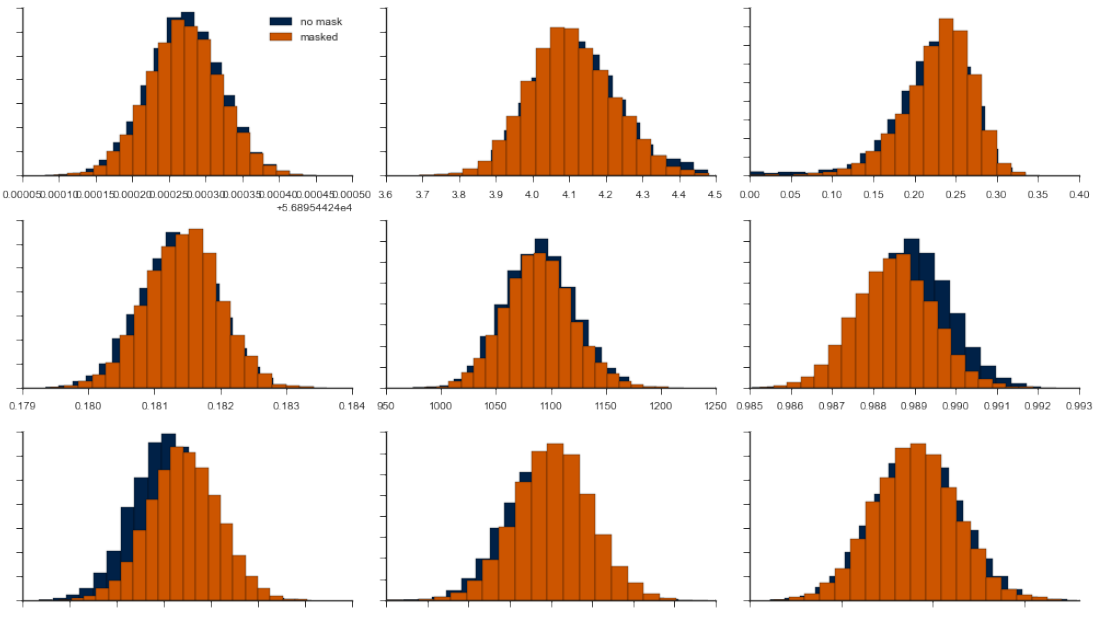
We have pushed our most recent notebooks and will update any changes.

Notebooks

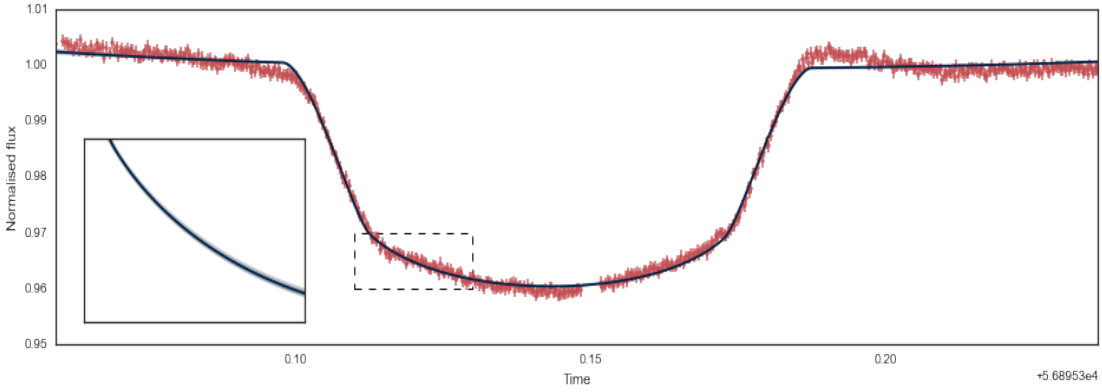
- Wavelength Calibration-
  All is well in this notebook although; I think the wavelength calibration plots for ccd2 could be improved.
- Master Bias and Flat field Frames-
  All is well.
- Spectrum Overview and Data Cube creation-
  Again, all is well.
- Spectra and Light Curves-
  We did not think the flat field correction is applied. We have written code to do this and it is in the notebook but it is commented out, we are unsure if it works as intended. Also, in the plots of relative flux for the comparison and target star the curves do not have the same shape (comparison star curve is much flatter). Do we want them to be the same? Does this mean that the light curve model is not working as it should?



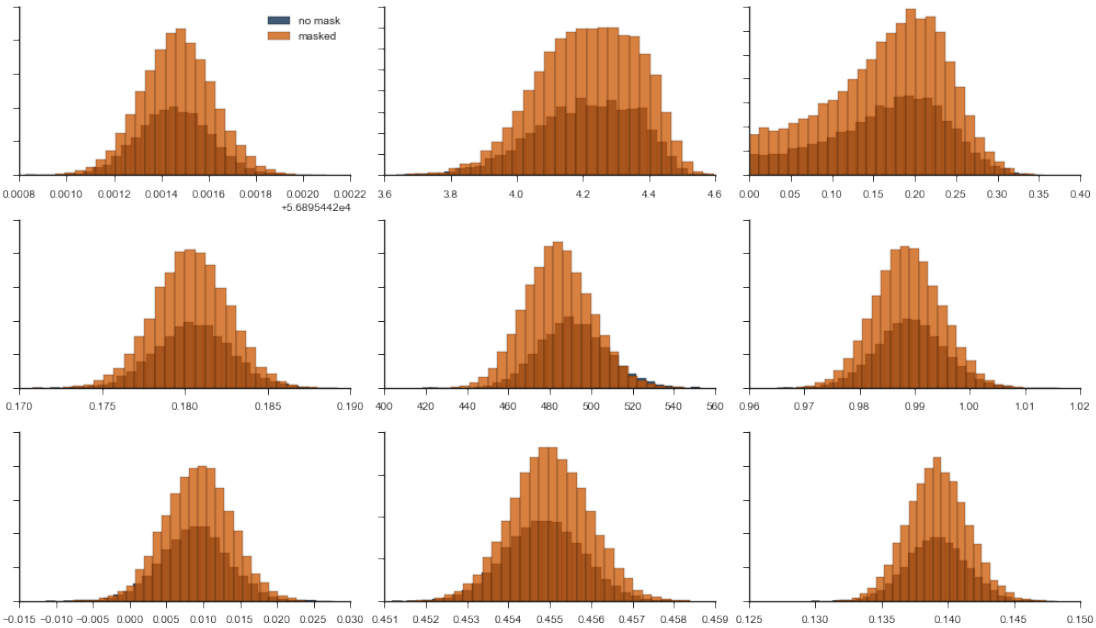
- Broadband Modelling-
  a. White Noise -
     Histograms for parameters are very good. There is little difference in estimates for masked and unmasked light curves. Parameters: tc, rho, b, k, e_ppm, c, x, u, v, respectively.



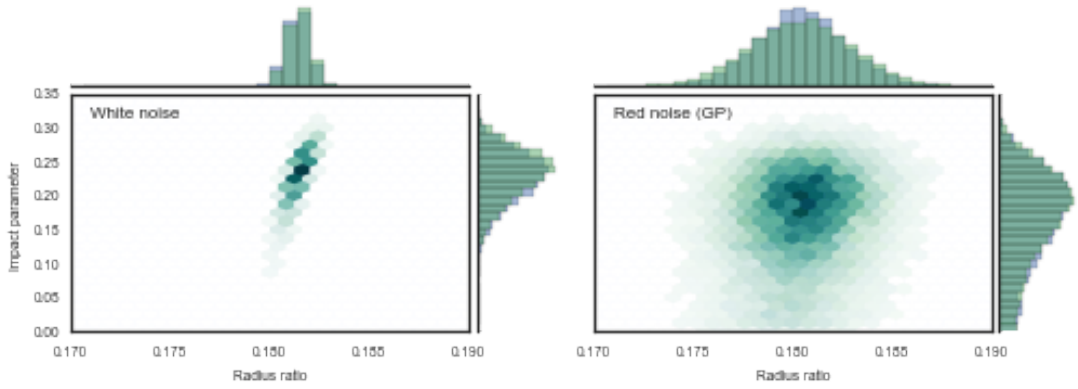
Additional plots were made to show transit model and data as in the exo_tutorial. This is the plot. The model fits wells aside from the over and under estimation at ingress and egress. We hoped that GP would solve this.



b. Red Noise (GP) - Histograms are good and again there is only a small variation between the masked and unmasked results. The difference area is due to different autocorrelation lengths (therefore thinning) for the masked and unmasked chains. The impact parameter quite is asymmetric (3rd chart).



c. Result/Analysis
The impact parameter and radius ratio correction diagram for the red noise are slightly different to that of TrES, not showing as much correlation for GP.

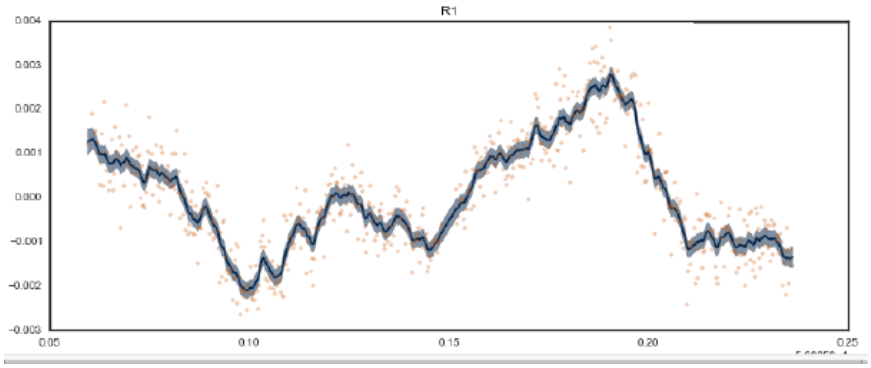


d. GP Noise

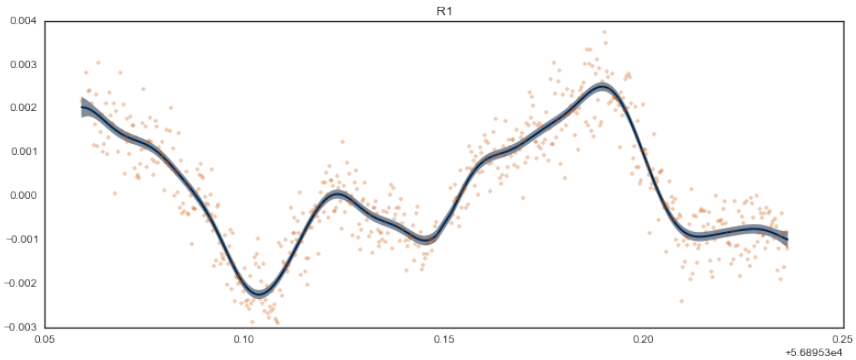
An additional notebook was created to investigate the choice of GP priors and if the model was working properly. It contains histograms for the standard deviation and log inverse length parameters and a correlation plot. We tried a few different values of the priors but couldn't really improve on the original results where the gp_std wasn't wide enough, but since they are correlated it was hard to produce two Gaussian distributions.

There are also models and data with and without residual extinction and plots to investigate if the residuals from this were being modelled well by the GP kernel. Additions were made to lpf_ww to do this. We do not think that the exponential kernel is modelling the small variations too well and not the more gradual changes around ingress and egress. We each ran the broadband with a squared exponential and matern kernel respectively to see how this affected the results. These are plots of the residuals from the data – model with each kernel. There is still the issue with the variation at ingress and egress though as with the white noise which we hoped red noise would solve. The histograms for different kernels gave similar results.

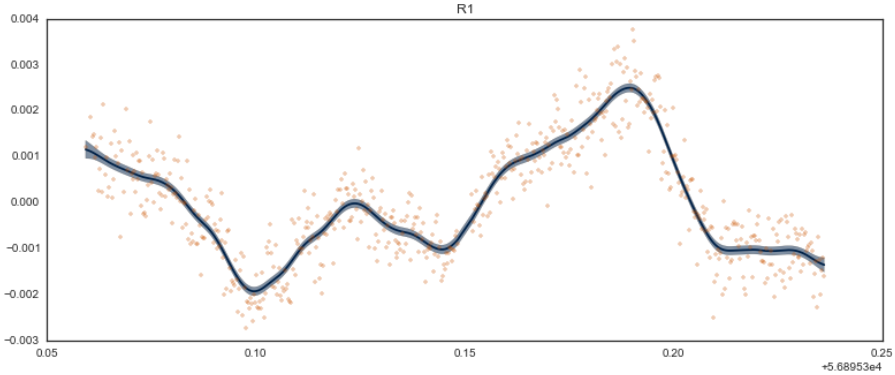
- ExonentialKernal



- SquaredExponentialKernal

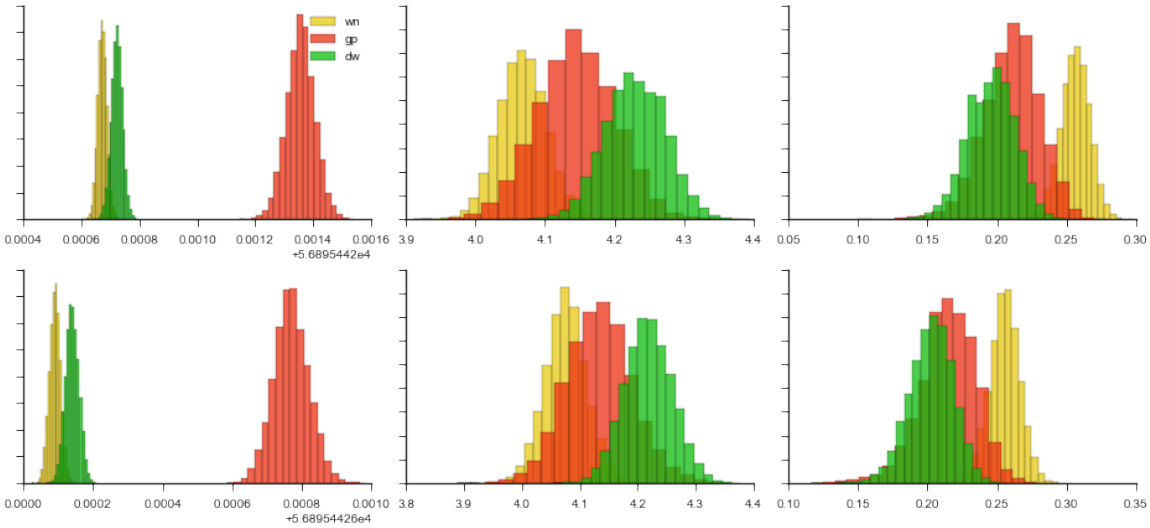


- Matern32Kernel

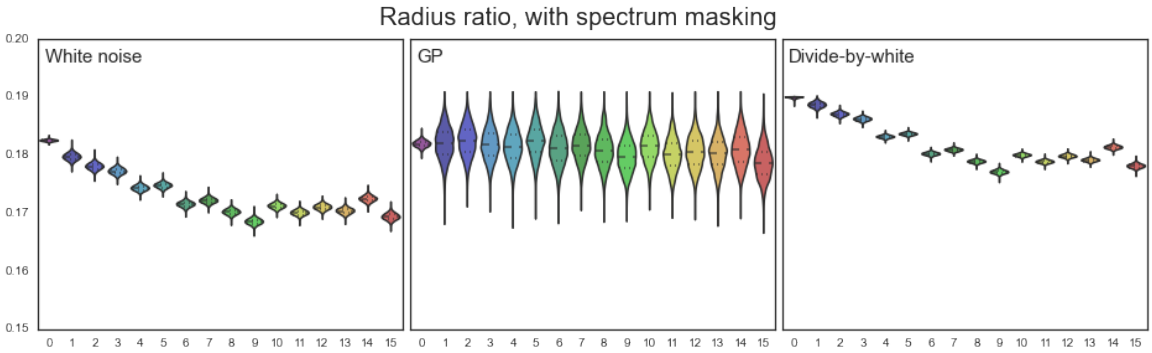


- Narrowband Modelling-
    a. Results

    Histograms for pass band independent parameters came out alright. There is a significant difference in transit centre for white nose and gp though. The transit values for white and gp are incompatible with each other and with a recent orbital ephemeris:
    http://www.aanda.org/articles/aa/pdf/2014/02/aa23265-13.pdf
    This may be due to the variations at ingress and egress not being modelled properly by the white noise and red noise models.

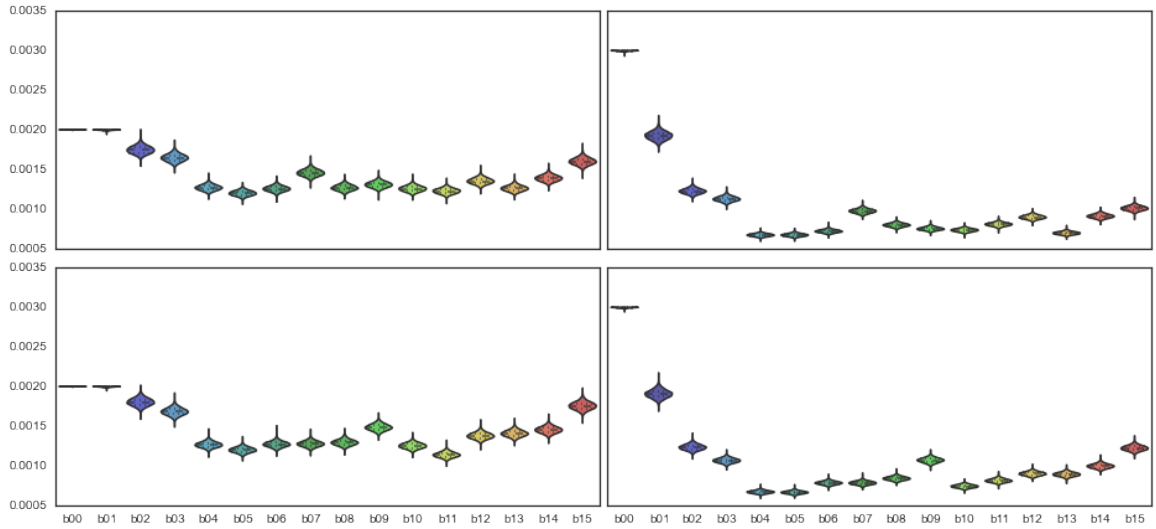


The radius ratio violin plots have a much larger uncertainty in gp than wn and dw.



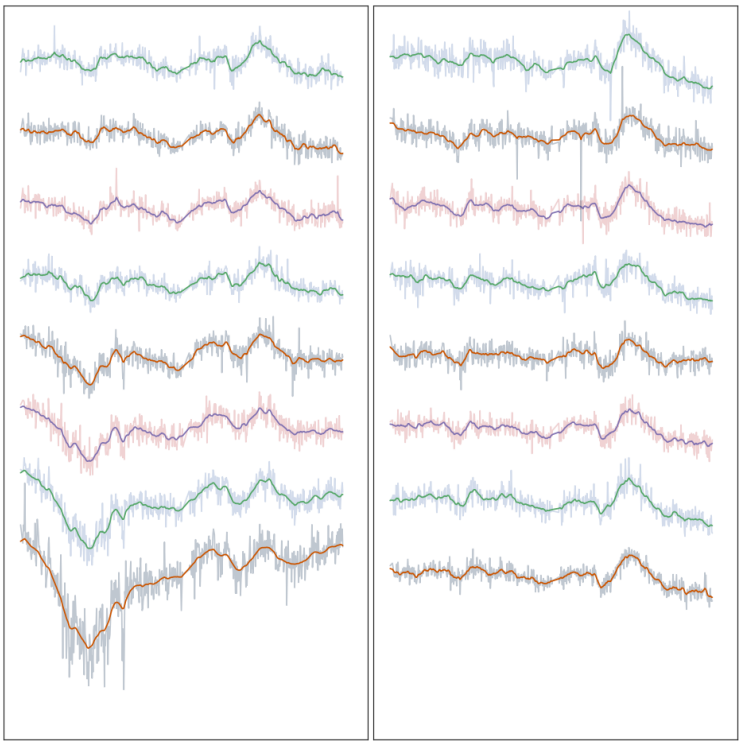
We think that these discrepancies' with the GP model may be due to choice of kernel or an issue with the hyperparameters. Since we do not have time to run the narrow band GP analysis again we cant be sure.

These are the plots of average noise for white and divide by white, unmasked and masked.



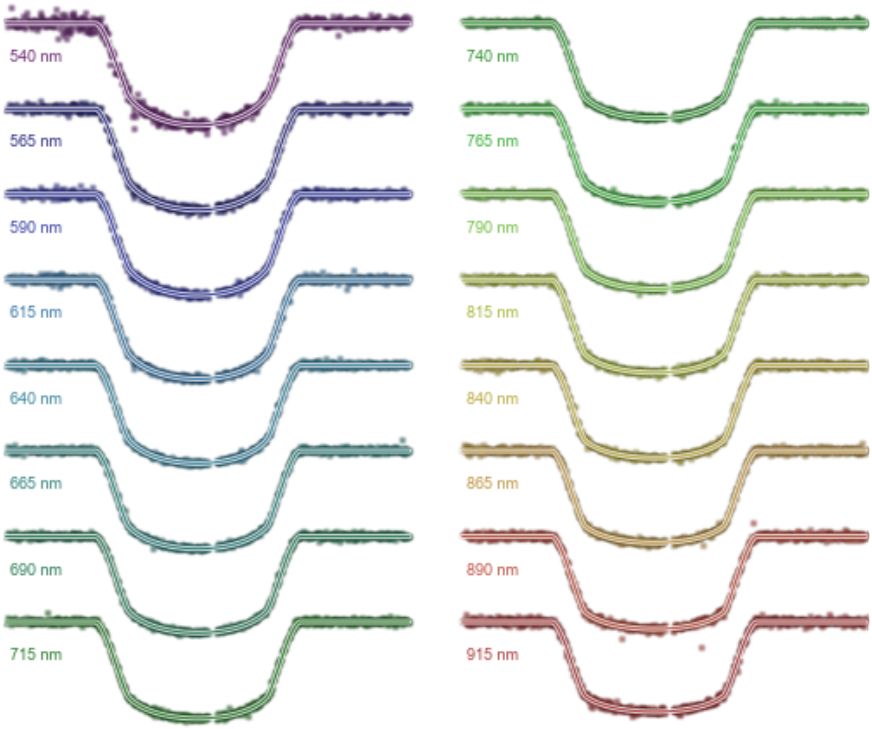
The violin plots for shortest wavelength bins appear squashed. We think that this is due to the higher levels of noise in these bands being outwith the prior. We would run these narrow bands again with a widened prior, a standard deviation of 50e-4 instead of 20e-4 if we had the time. We ran the broadband analysis again with the widened prior, since signal to noise is much better for bb, it doesn't really affect the bb wn parameter results. For narrowband analysis, especially for the shorter wavelength bins, a wider white noise std prior is required. We should have time to run the white noise narrow band analysis with a wider prior.

- GP Hyper parameters
  We have to run 5b before being able to run fit_color_gp, which was added at the start of 5a. We changed fit_color_gp slightly, which might be the main reason that gp estimate for transit centre is so diferent, you will see the changes in the code.
  Here are the masked plots:



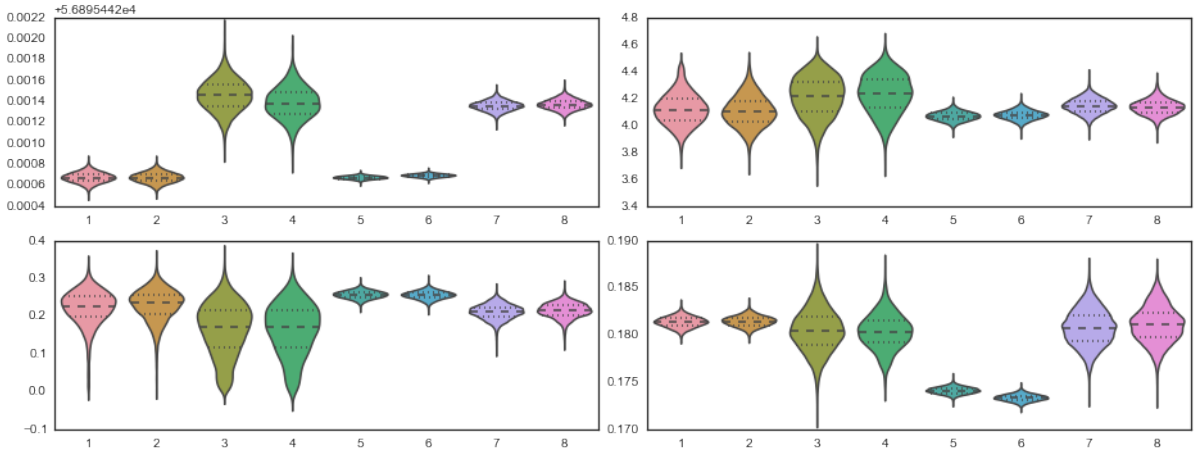
We are unsure weather these plots are good or not, the large variation in the 8th one is especially makes us doubtful.

b. Light Curve Plots
These are the corrected narrow band light curves:



The first pass bands have a lot more noise than the latter ones.

- Final Parameter Estimates-
The final violin plots for tc, rho, b and k look a little strange:

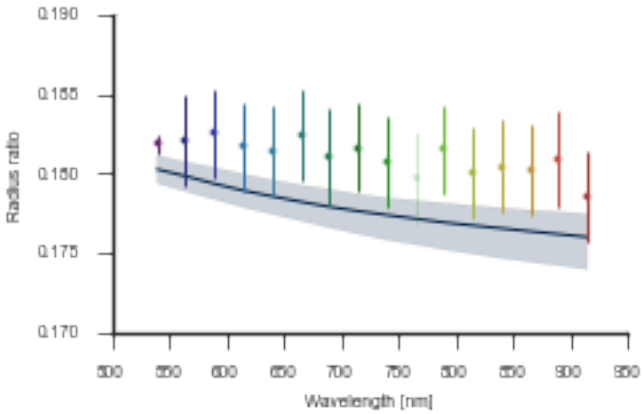


These are the estimated values for GP:
tc = 56895.44337 ± 0.00005
rho = 4.13388 ± 0.05560
b = 0.21569 ± 0.01913
k = 0.18107 ± 0.00194

These are the estimated values for WN:
tc = 56895.44269 ±0.00002
rho = 4.07612 ±0.03499
b = 0.25578 ±0.01067
k = 0.17332 ±0.00036

The values are significantly different, possibly due to an error in the GP method.

- Toy Models
  We ran both the constrained and unconstrained models, primarily to see if they worked and these outcomes. Both run fine and there is little difference between the two with the line not exactly fitting the data. However, for the unconstrained model, the temperature that fits the data best makes sense (<4000, not 50000K)



- Telluric Absorption and Spots and Contamination
  We ran these also for same reason as above, we don't know if they are physically necessary. We aren't sure about the light curves in the telluric absorption notebook, one is quite noisy. For the spots and contamination notebook we again have run through everything and generated the plots but are unsure of their meanings.