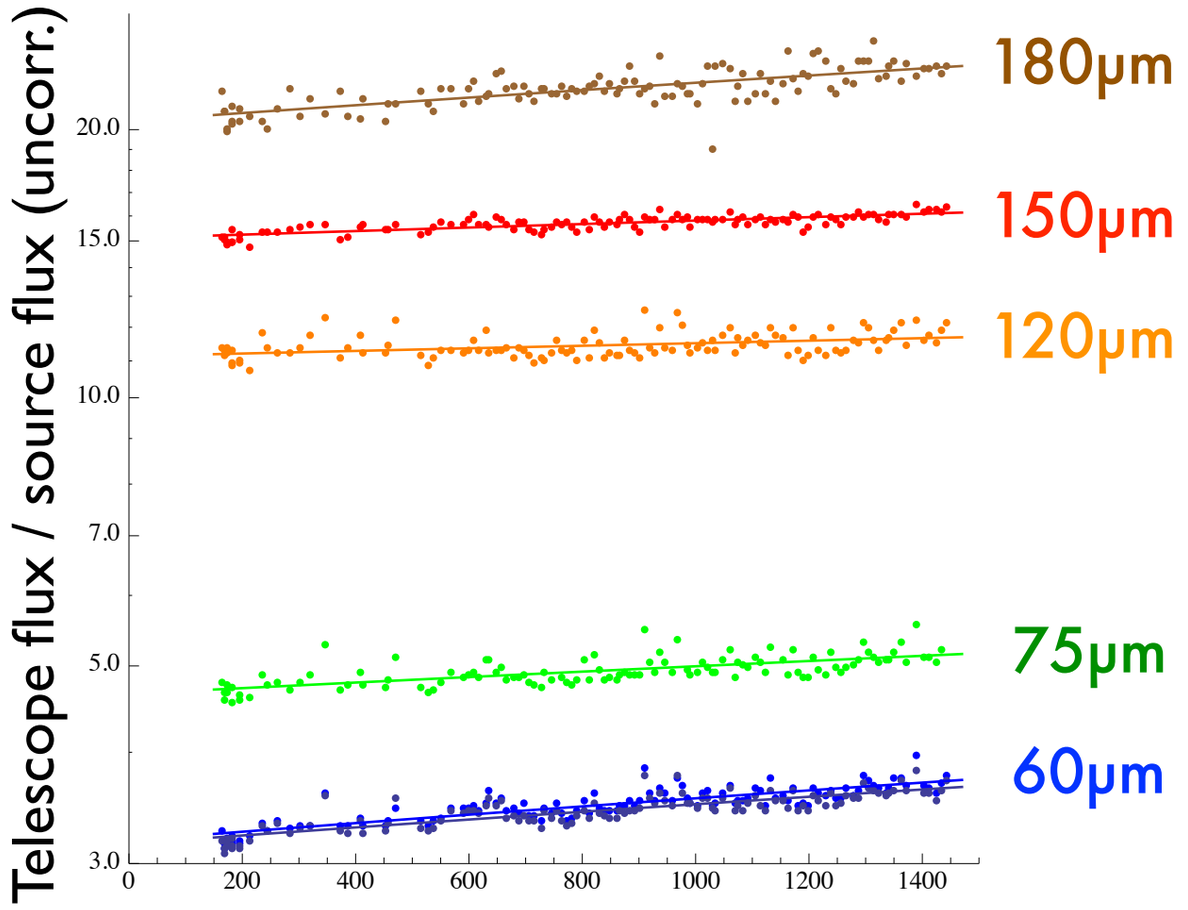
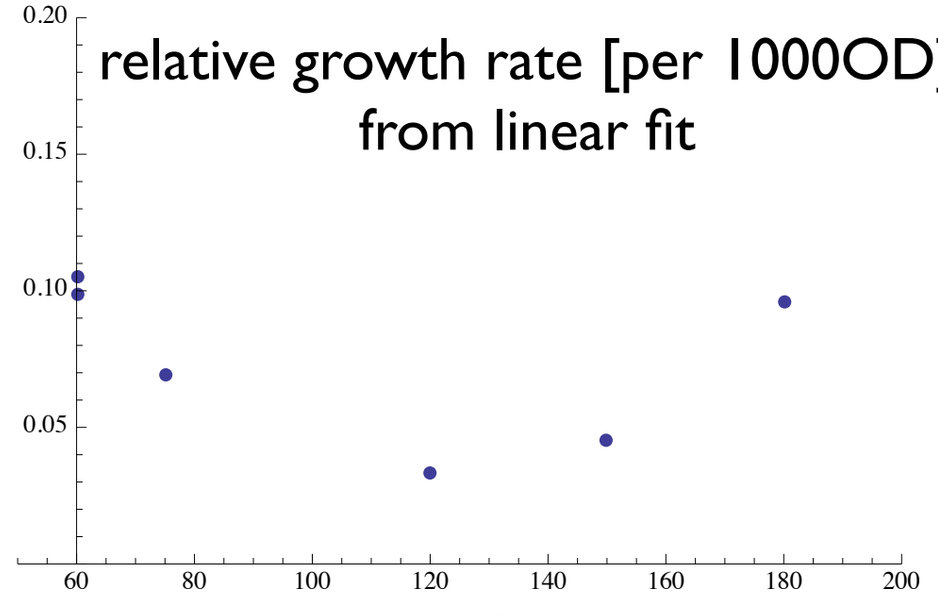
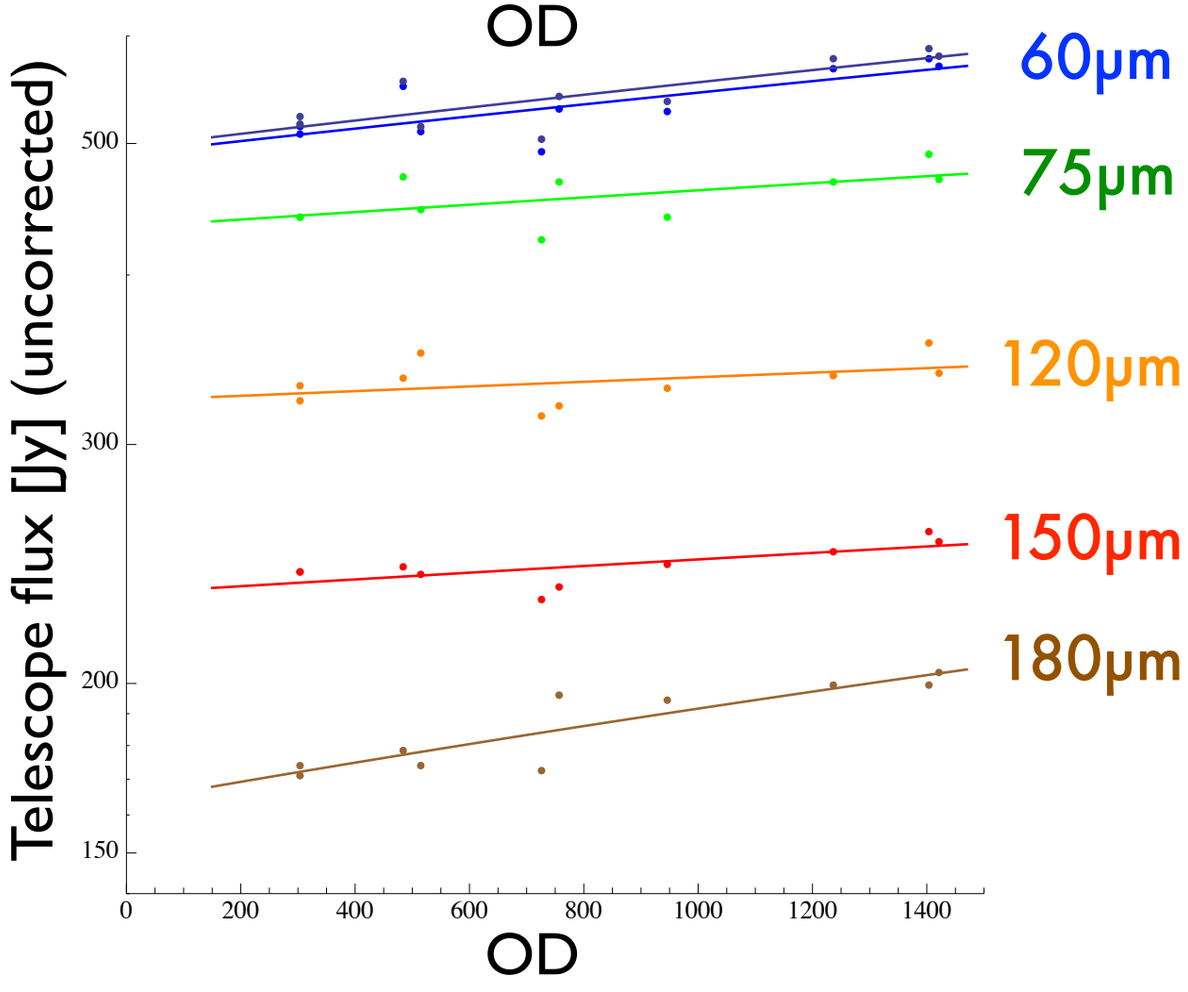
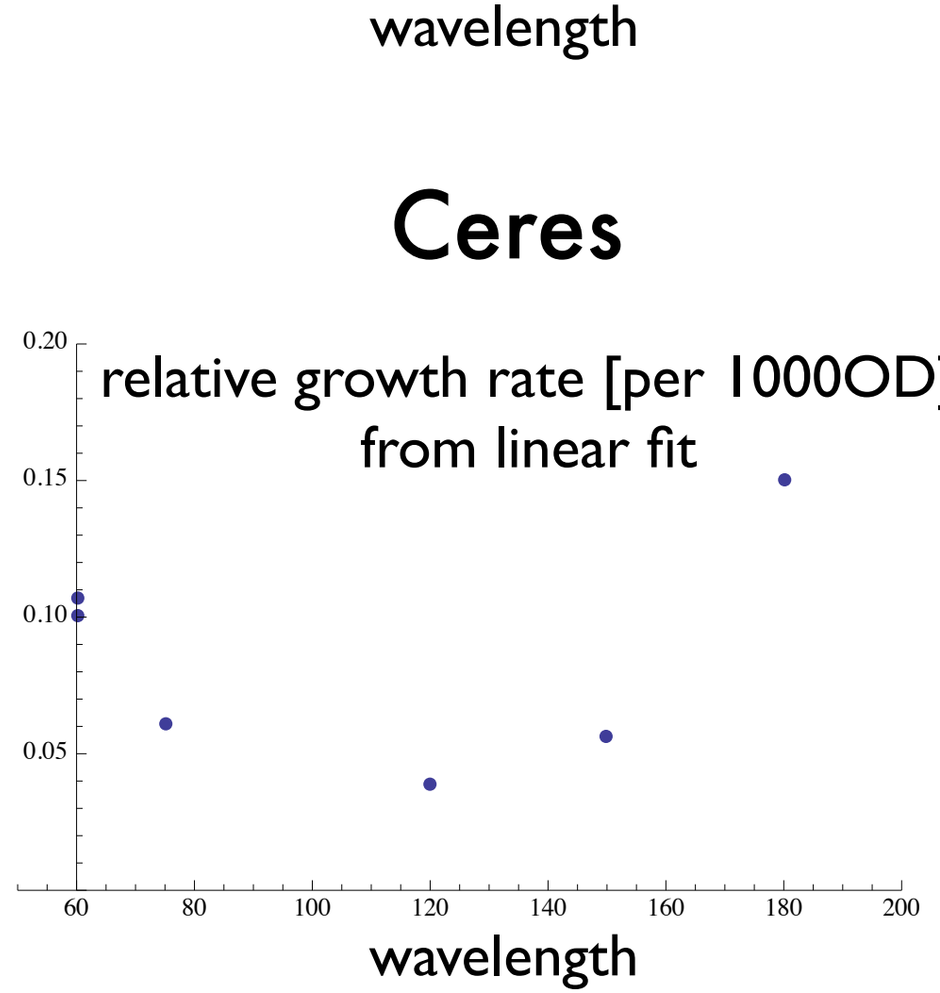
Evolution of Telescope Background with Time (OD)

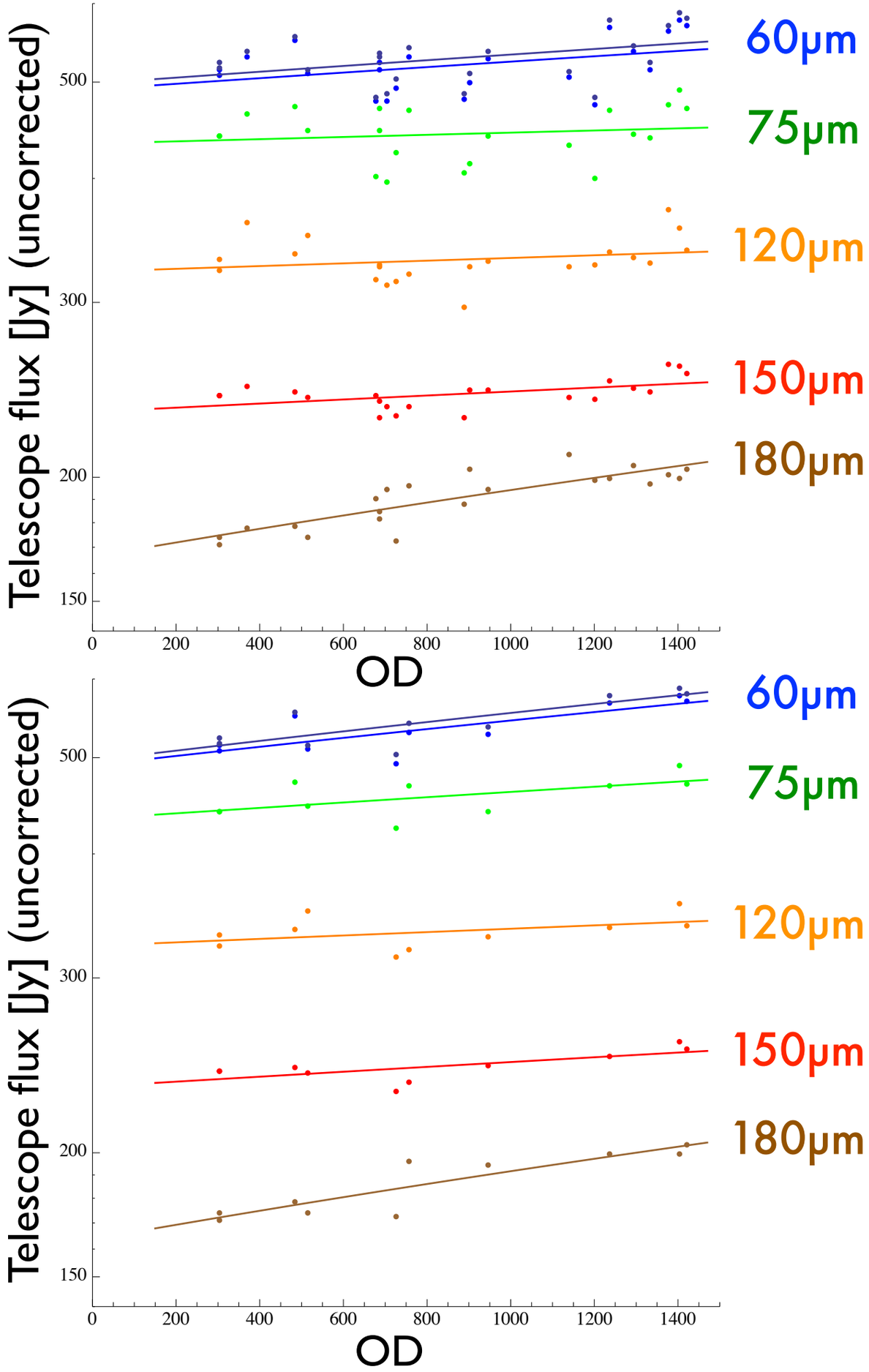
- Best sampling with HD161796, no absolute flux
  - Express telescope in units of source (3x3 co-added, no pointing or point source correction)
- Second-best sampling with Ceres, variable flux, absolute (model T.M.)
  - Express telescope in Jy from source flux (3x3 co-added, no pointing or point source correction)
- Combine Ceres, Pallas, Vesta - more points, larger spread in flux, absolute (model T.M.)
- Express evolution as linear growth (change per 1000 ODs as fraction of mean flux over mission), for each wavelength (60, 75, 120, 150, 180μm)


Telescope flux / source flux (uncorr.)
180μm
150μm
120μm
75μm
60μm
20.0
15.0
10.0
7.0
5.0
3.0
0
200
400
600
800
1000
1200
1400

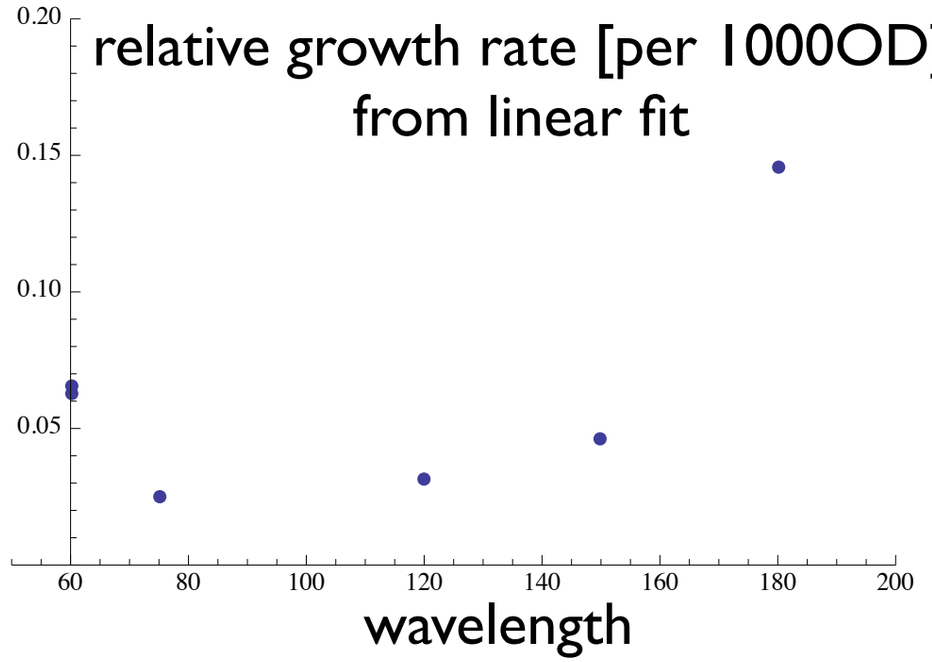

HD161796
relative growth rate [per 1000OD]
from linear fit
0.20
0.15
0.10
0.05
60
80
100
120
140
160
180
200
wavelength


Telescope flux [Jy] (uncorrected)
60μm
75μm
120μm
150μm
180μm
500
300
200
150
0
200
400
600
800
1000
1200
1400
OD

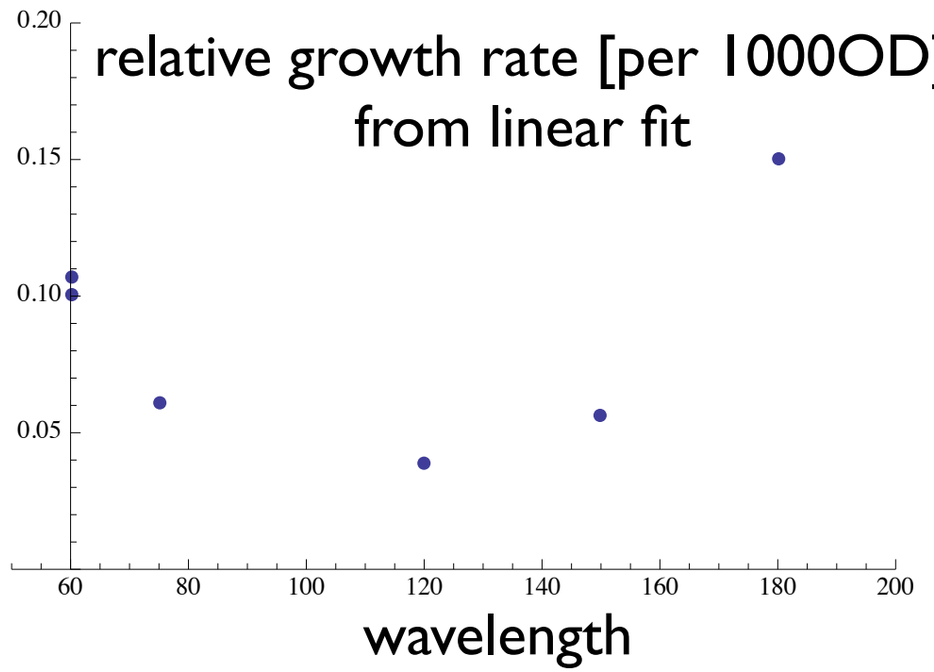

Ceres
relative growth rate [per 1000OD]
from linear fit
0.20
0.15
0.10
0.05
60
80
100
120
140
160
180
200
wavelength



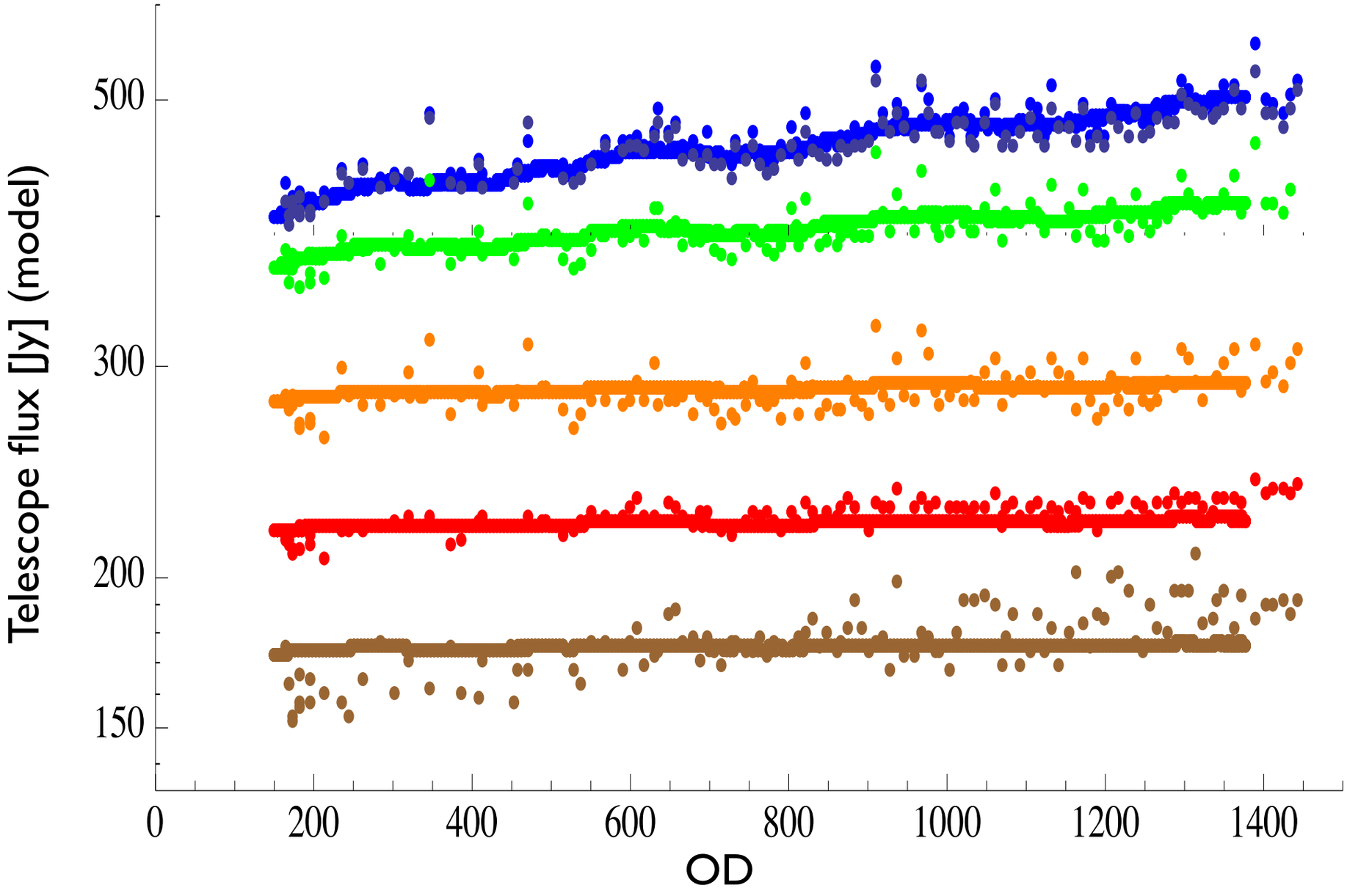
Ceres, Pallas, Vesta (combined)



Ceres

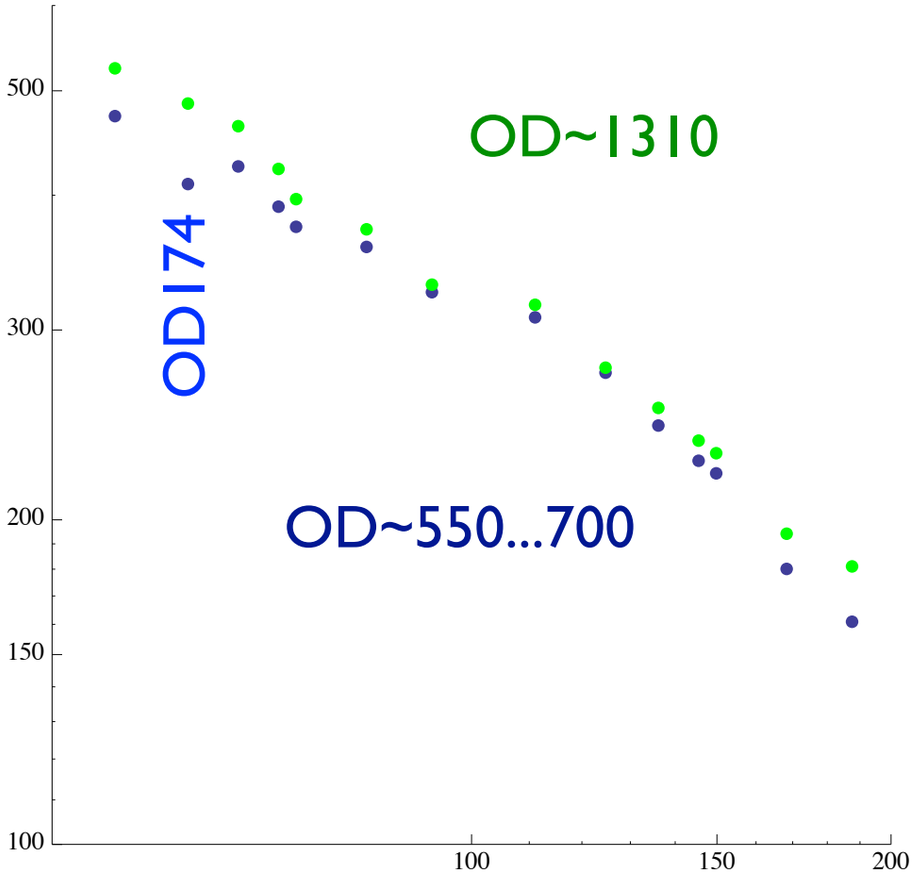


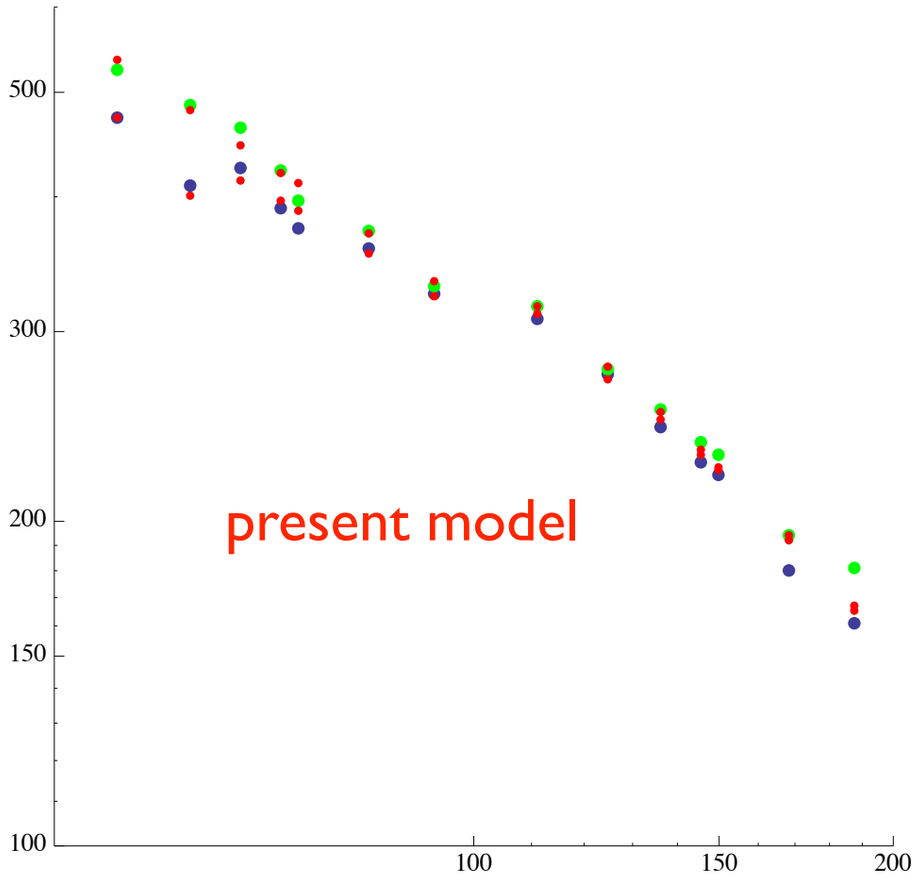
HD161796, shifted to line up with telescope model



Present telescope model does not reproduce evolution at λ>120μm correctly!

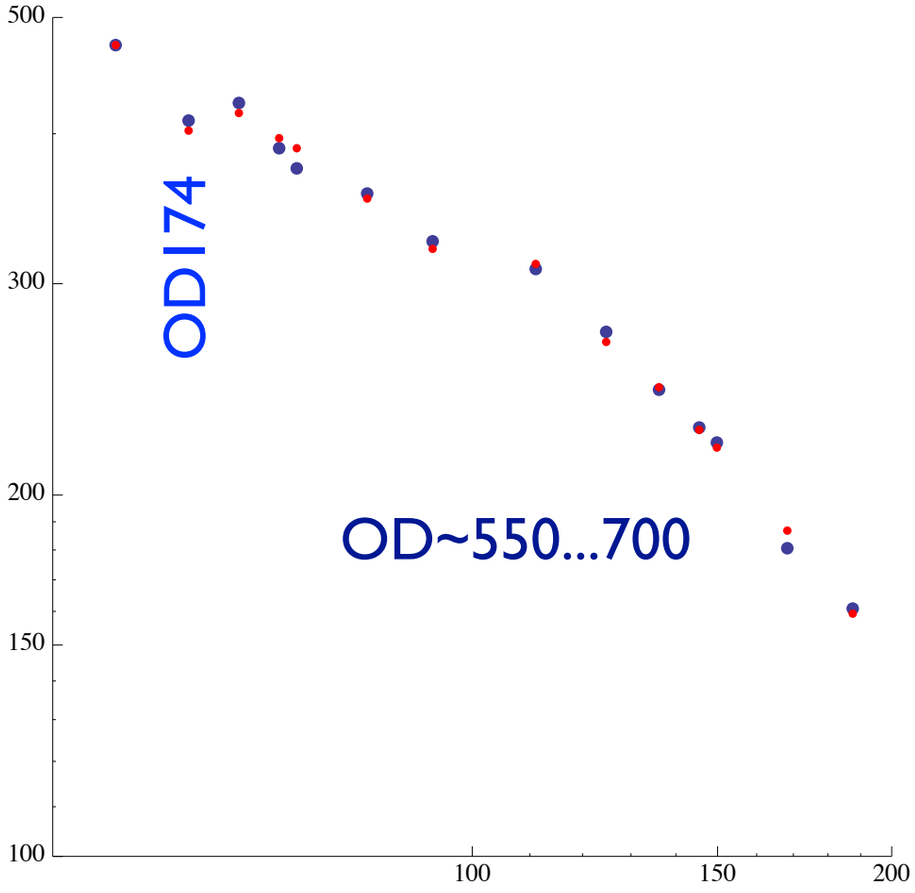
Telescope SED

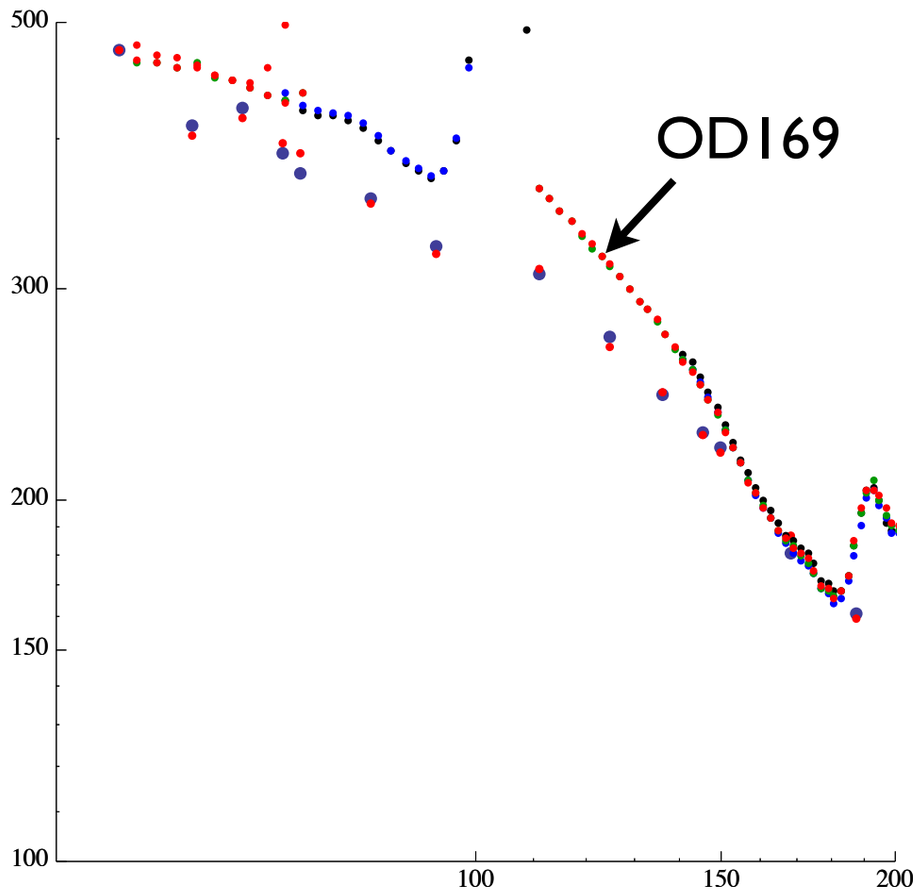




- There seem to be some "undulations" in the SED, which the model cannot reproduce.
- Could that be (partly) introduced by our point source correction?
- Need Neptune (et al.) SEDs; then correct telescope (how?) model but leave point source correction alone (?)

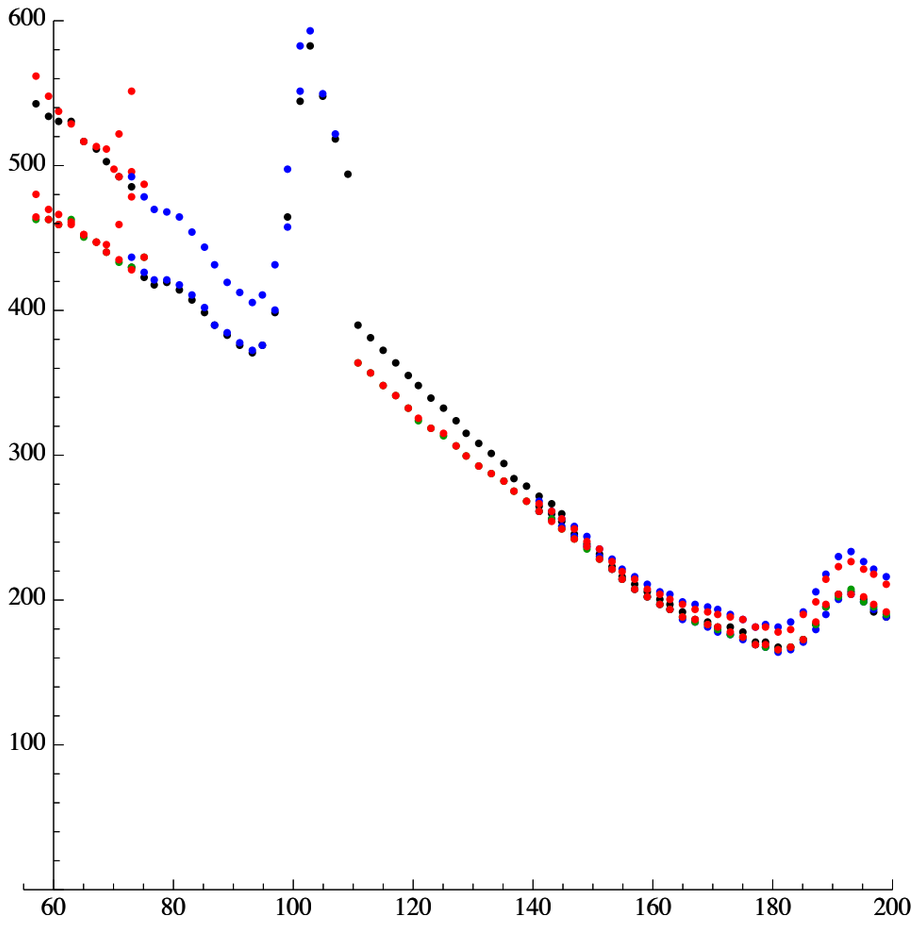
Telescope SED

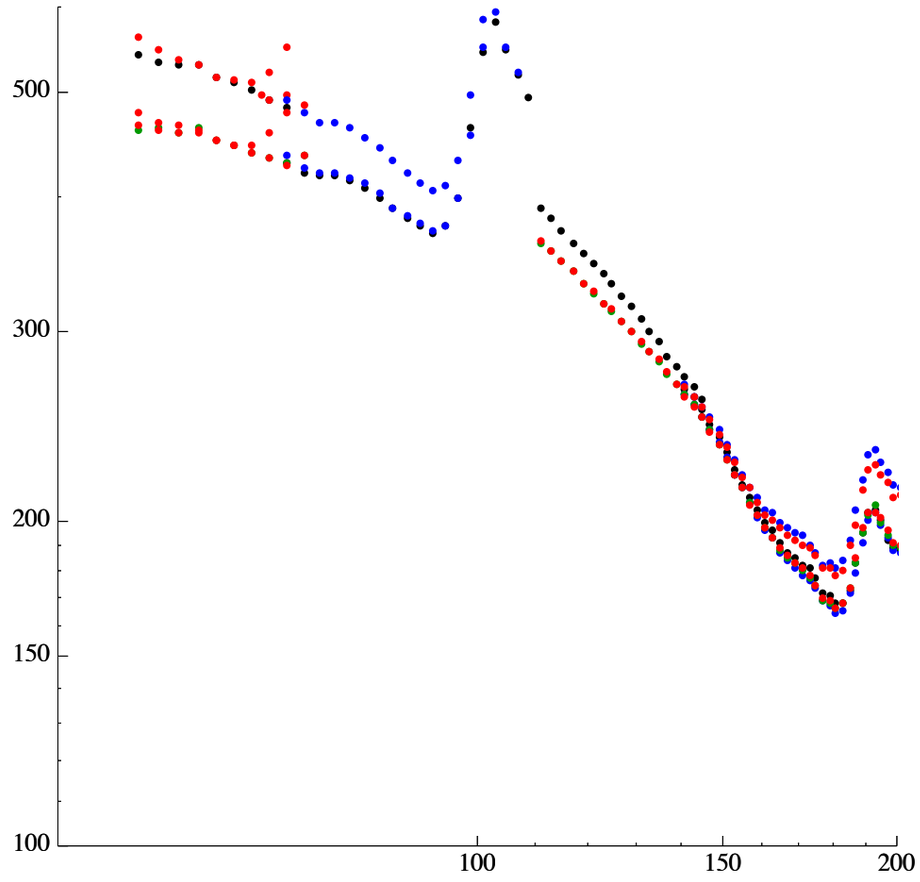




- Left panel: from asymmetrically chopped raster, fitted peak, canonical point-source correction
- Right panel: OD169 symmetrically chopped SED, 3x3 co-added, 3x3 to 1x1 correction from curve derived from raster observations, canonical point-source correction. SED shape on asymmetric chop is different than for symmetrically chopped/ nodded case! (Asymmetric case not representative for flux cal.)

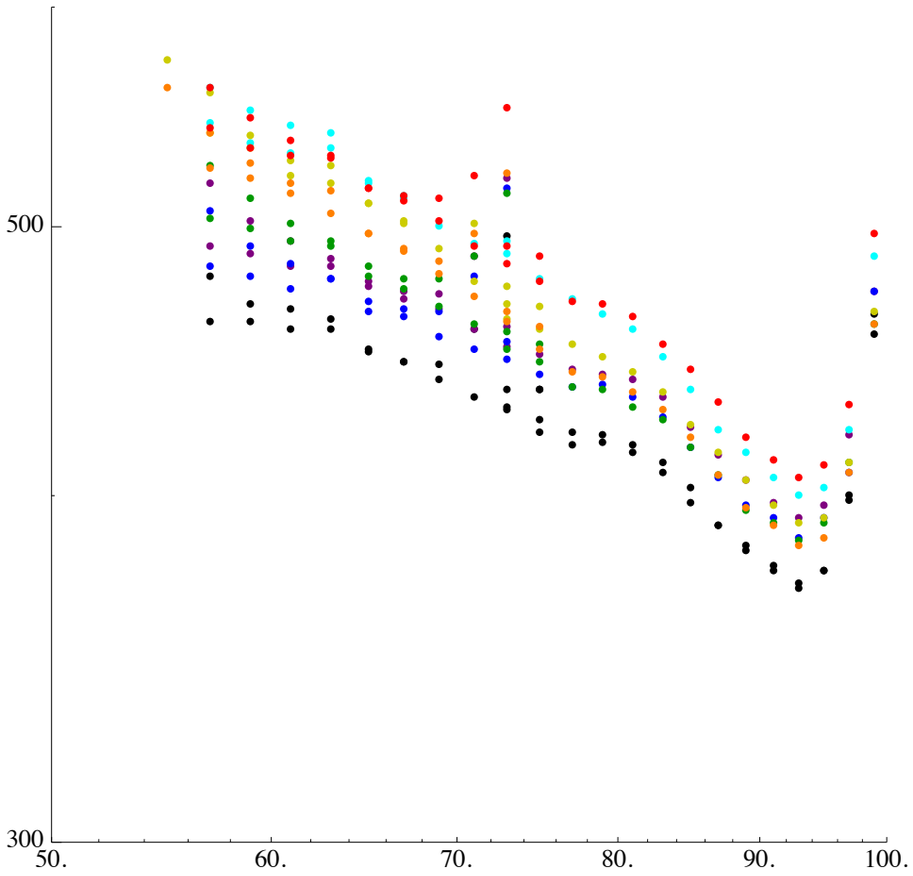
Telescope SED

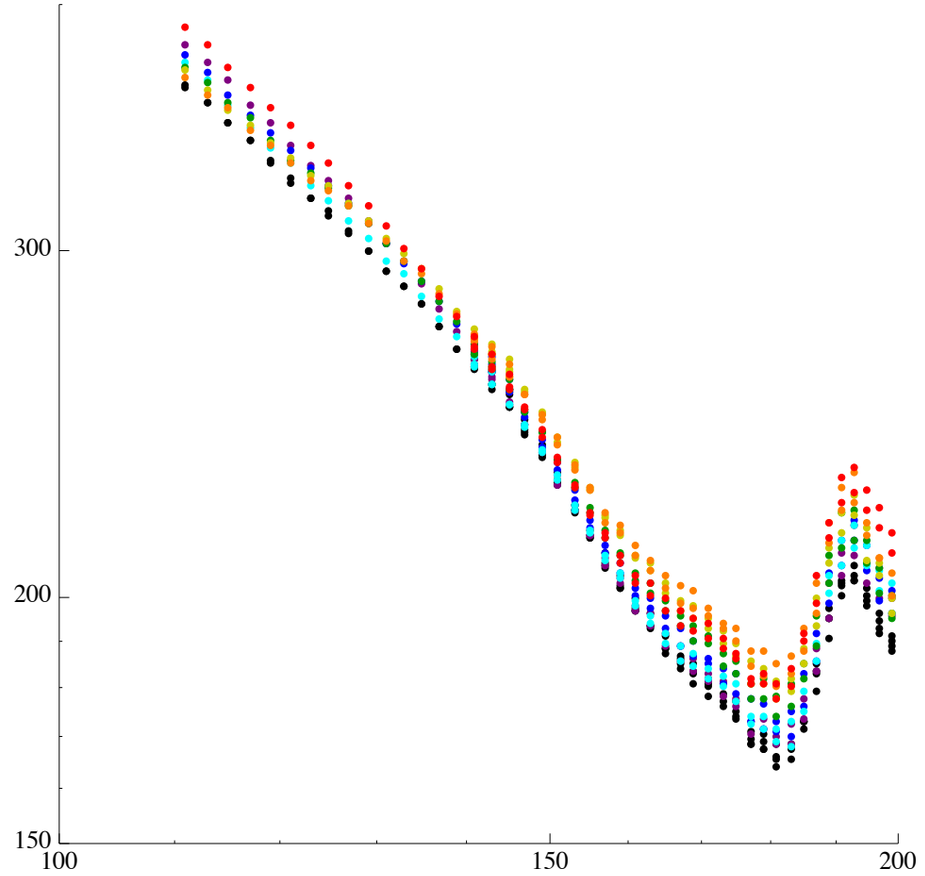




- Linear (left) and log-log plots of telescope derived from Neptune SED on OD169 (lower traces) and 1445 (upper traces)
- No modeling/correction for telescope temperature
- Maximum change at blue end, but significant evolution above 150μm, too

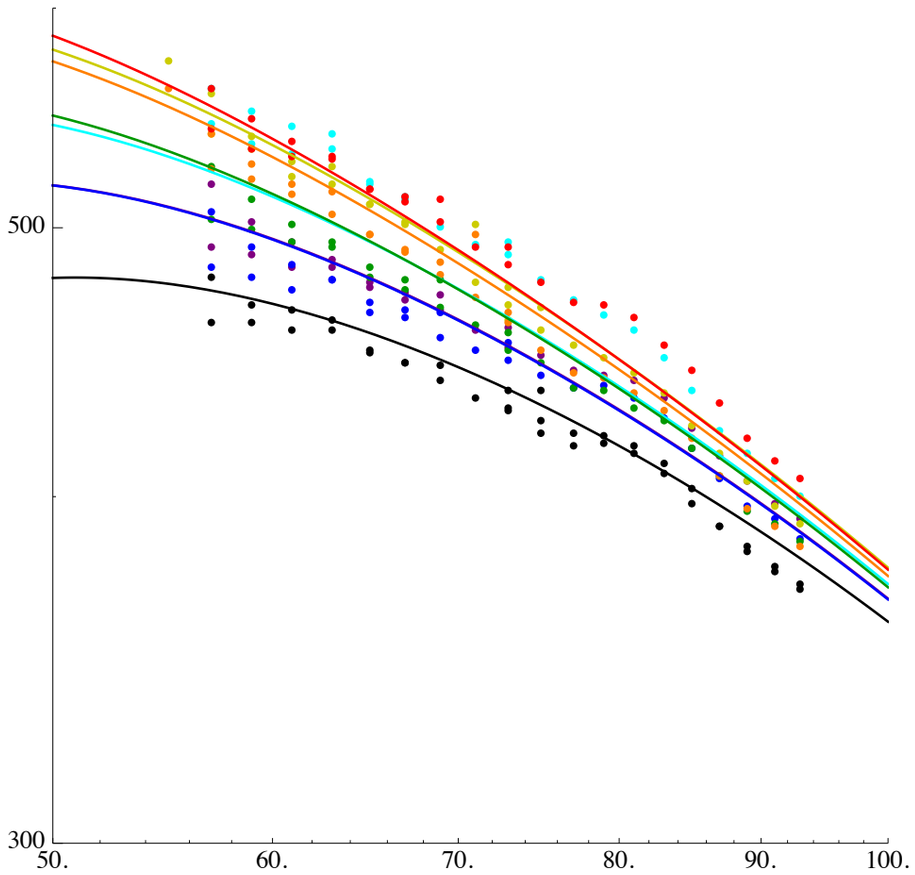
Telescope SED

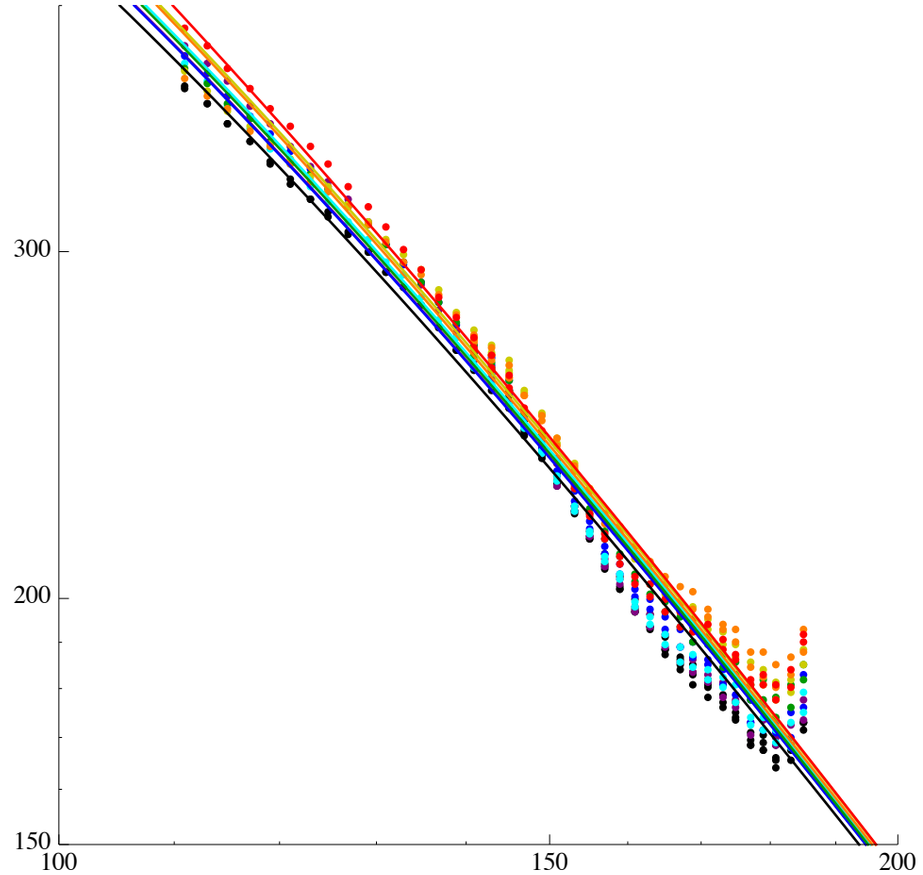




- Blue (left) and red (right) “Telescope SEDs” derived from standard chopped/nodded Neptune SED observations
- Data reduction with “short range” script on sliced (2μm) SED data (same method as key wavelength calibration)
- From OD169 (black) to OD1445 (red)

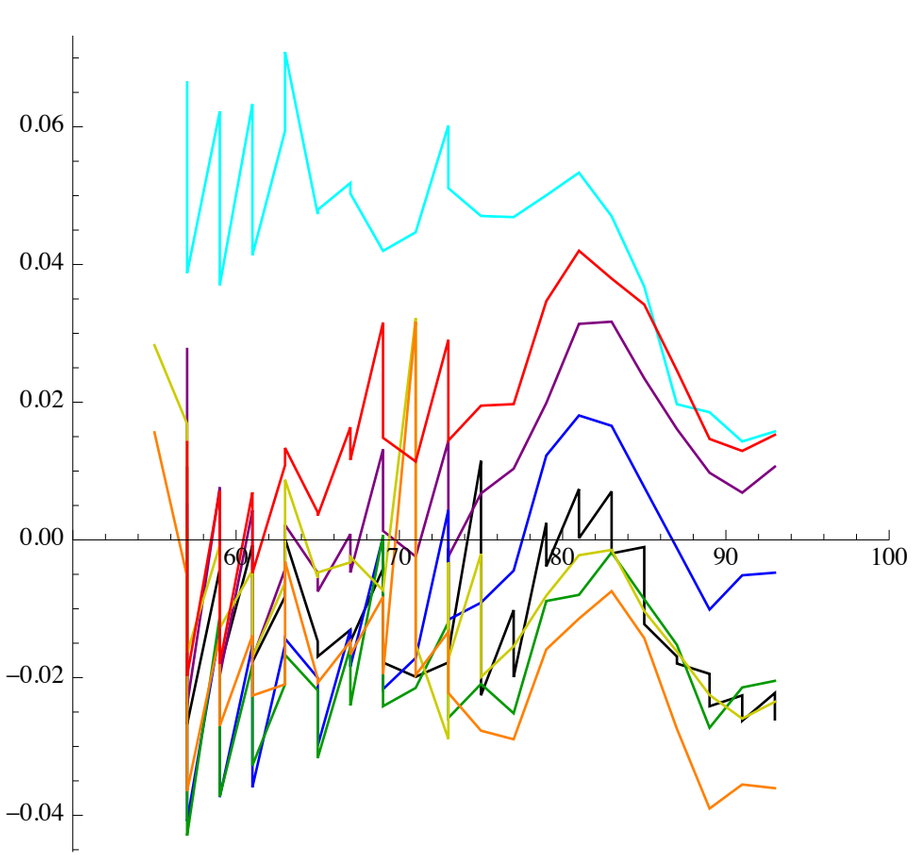
Telescope SED Model

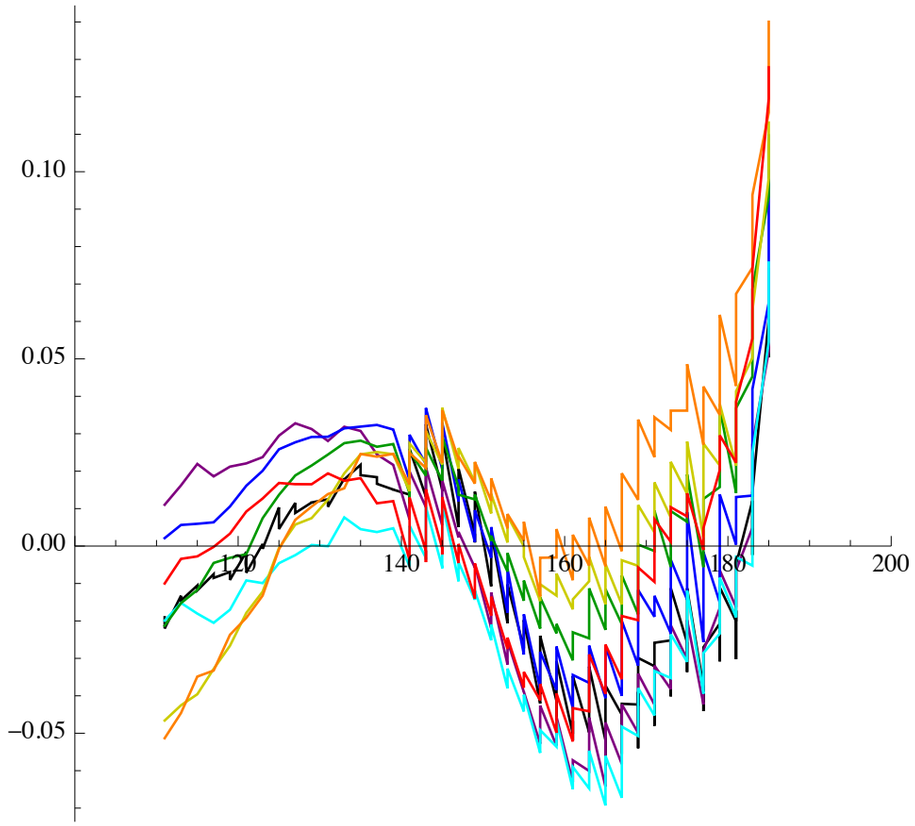




- Blue (left) and red (right) telescope models in the traditional style (dust emission [T], cooler extra BB component, surface degradation linear with OD)
- Fit separately in red and blue
- Quite ok in blue, off above 150μm in red

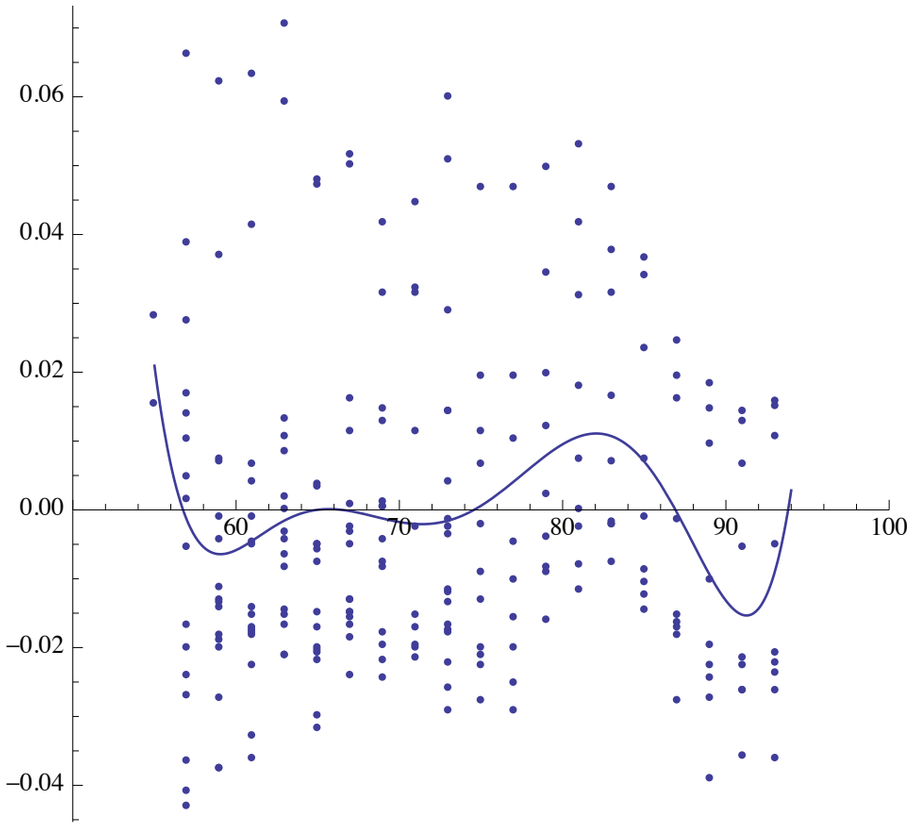
Telescope SED Model Residuals

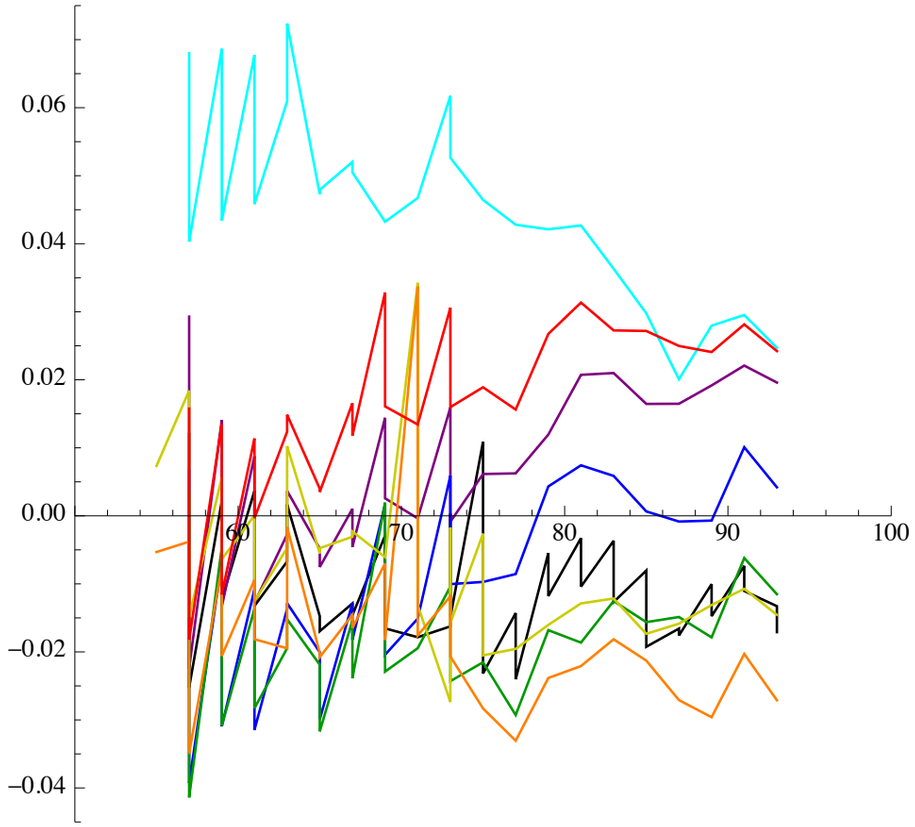




- Shown are relative residuals (ΔF/F)
- Blue (left) showing “hump” around 83μm in all traces
- Red (right) showing something like third-order parabola
- No pointing correction may introduce systematic offset

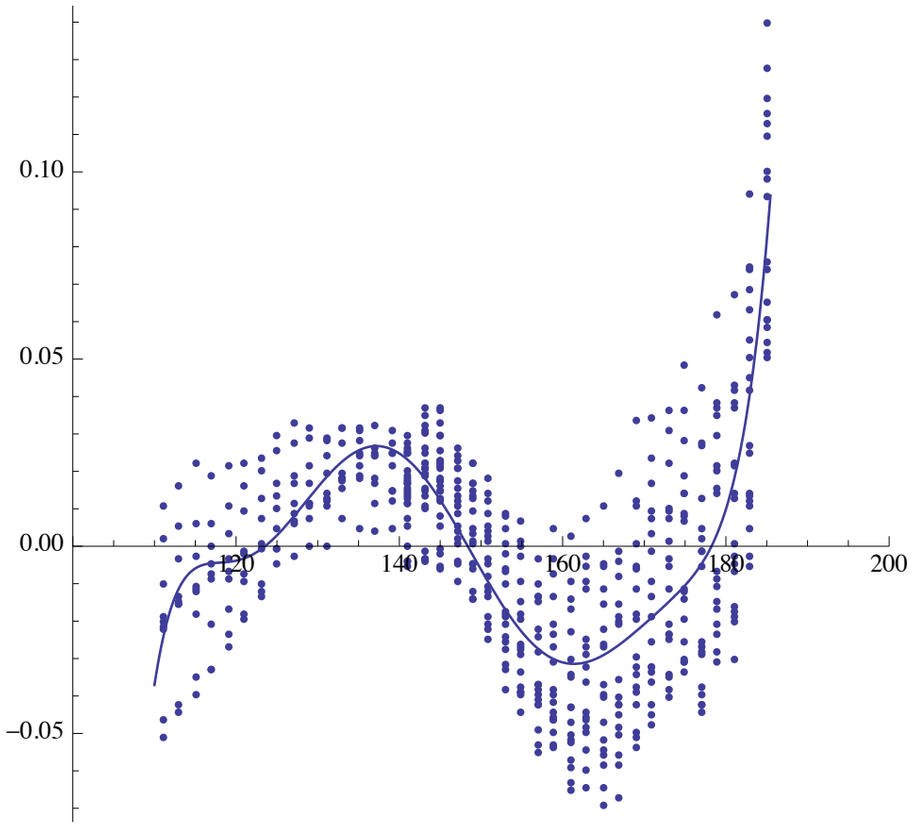
Telescope SED Model Residuals (Blue)

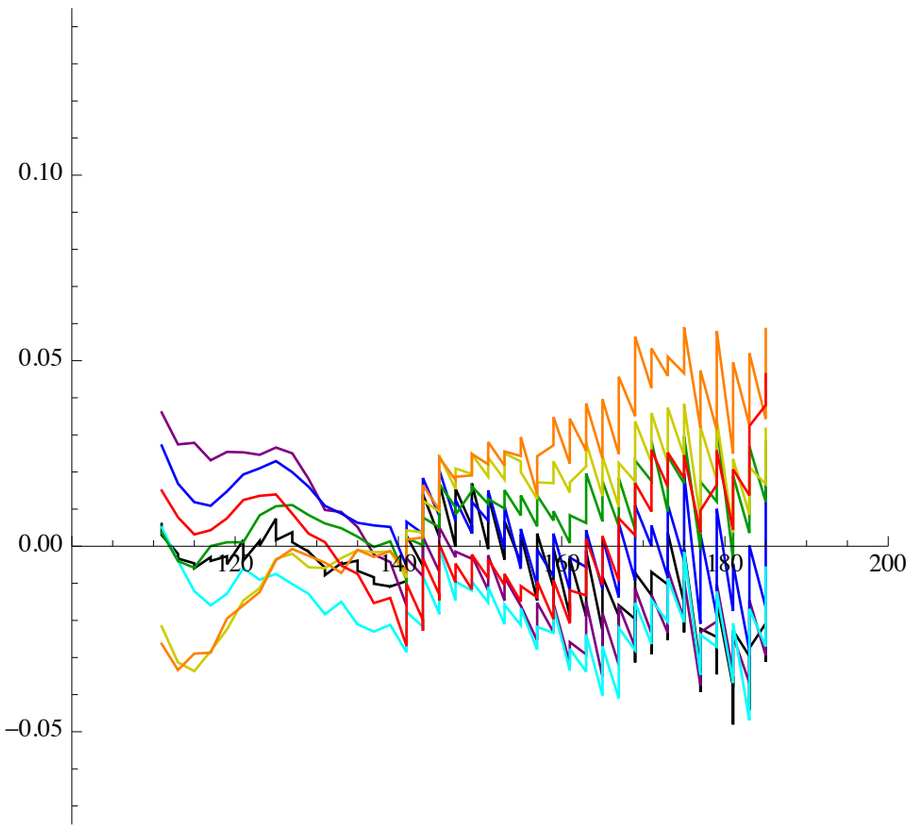




- Common polynomial fit to all ODs (left)
- Residuals after subtraction of polynomial (right)
  - no distinct features left

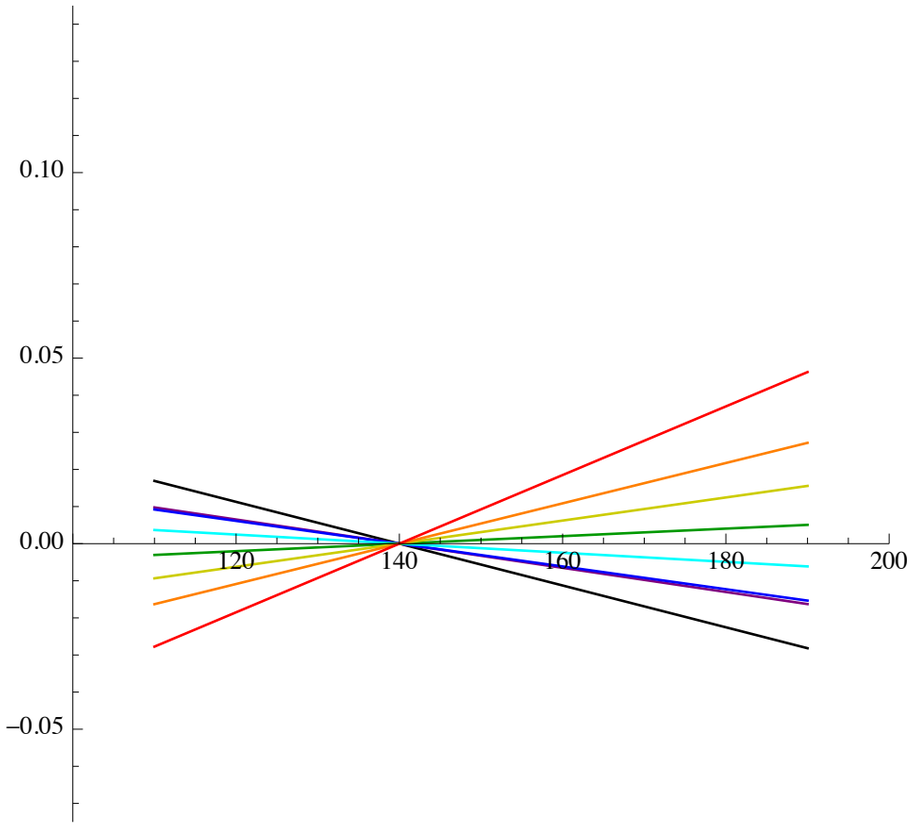
Telescope SED Model Residuals (Red)

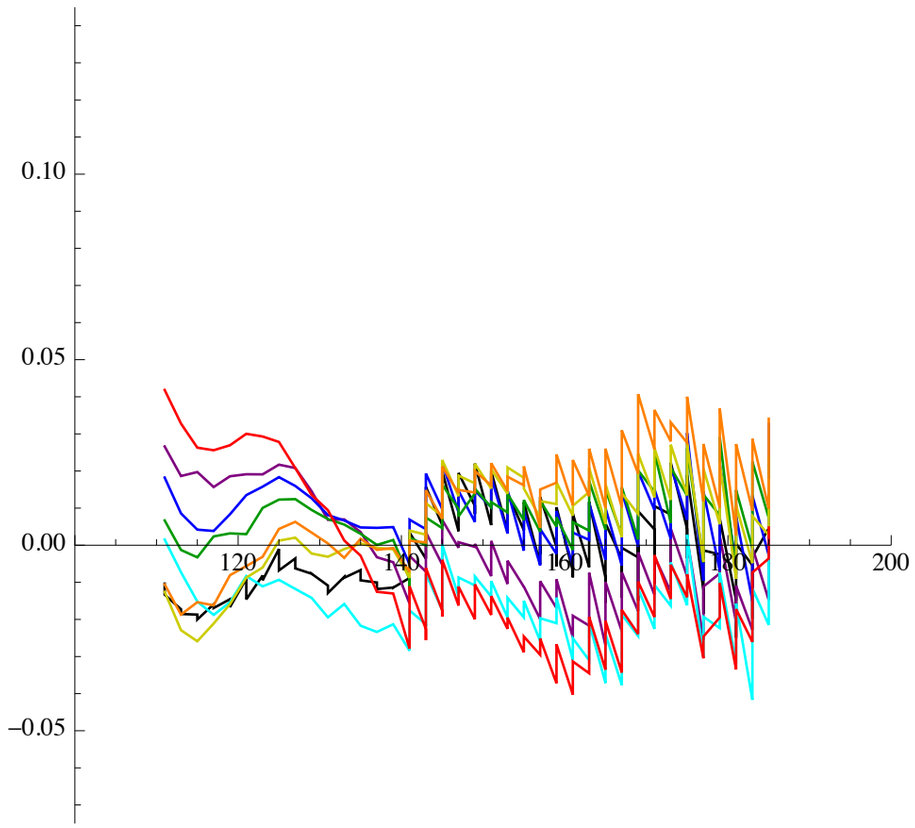




- Common polynomial fit to all ODs (left)
- Residuals after subtraction of polynomial (right)
  - drift term left

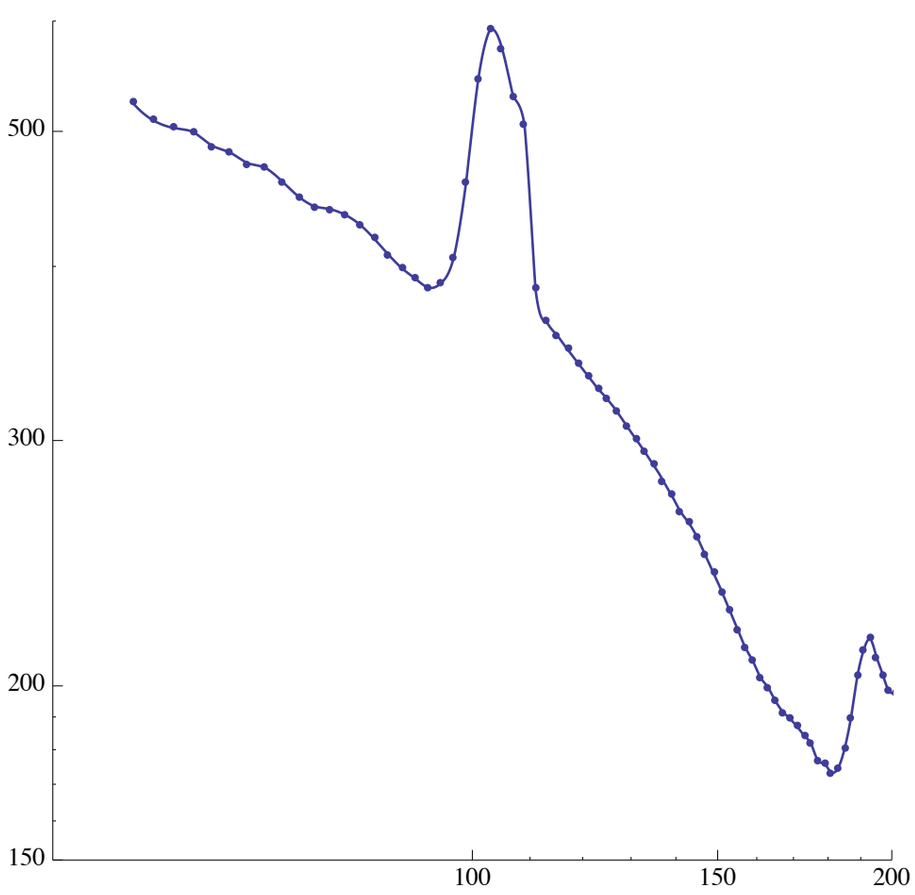
Telescope SED Model Residuals (Red)

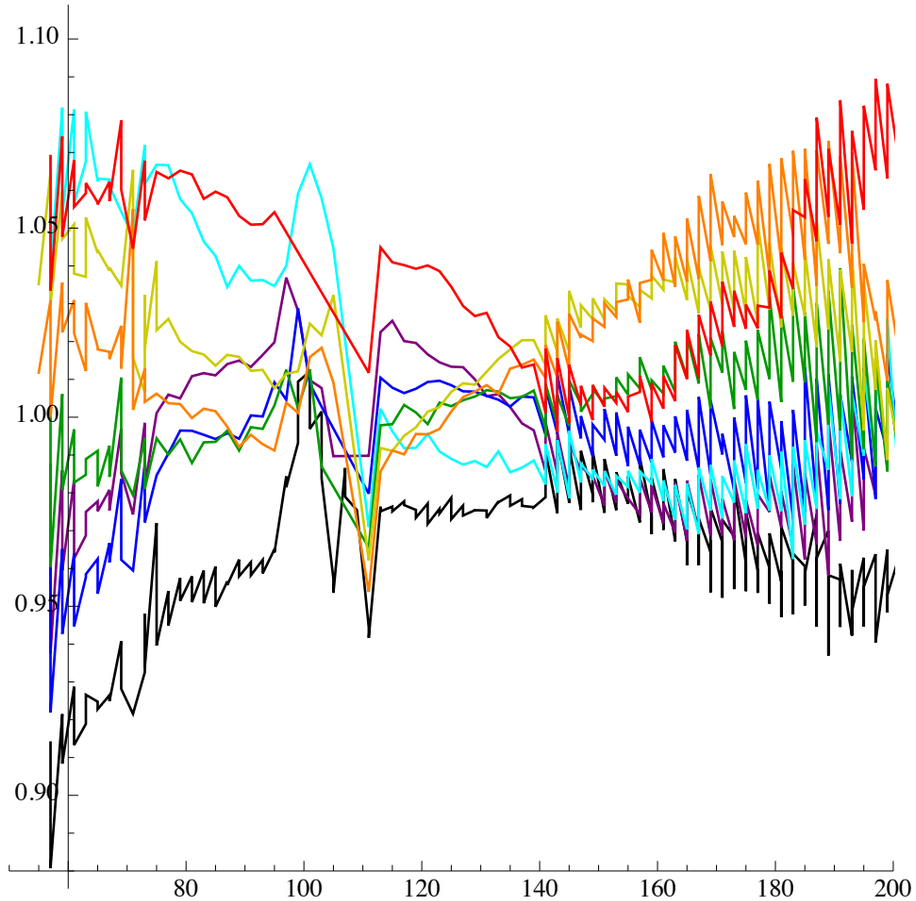




- Fit of linear drift to remaining residuals of all ODs (left)
- Total residuals after subtraction of static polynomial and linear drift model
  - no simple drift left, but still some baseline "waves"
  - could try further refinement

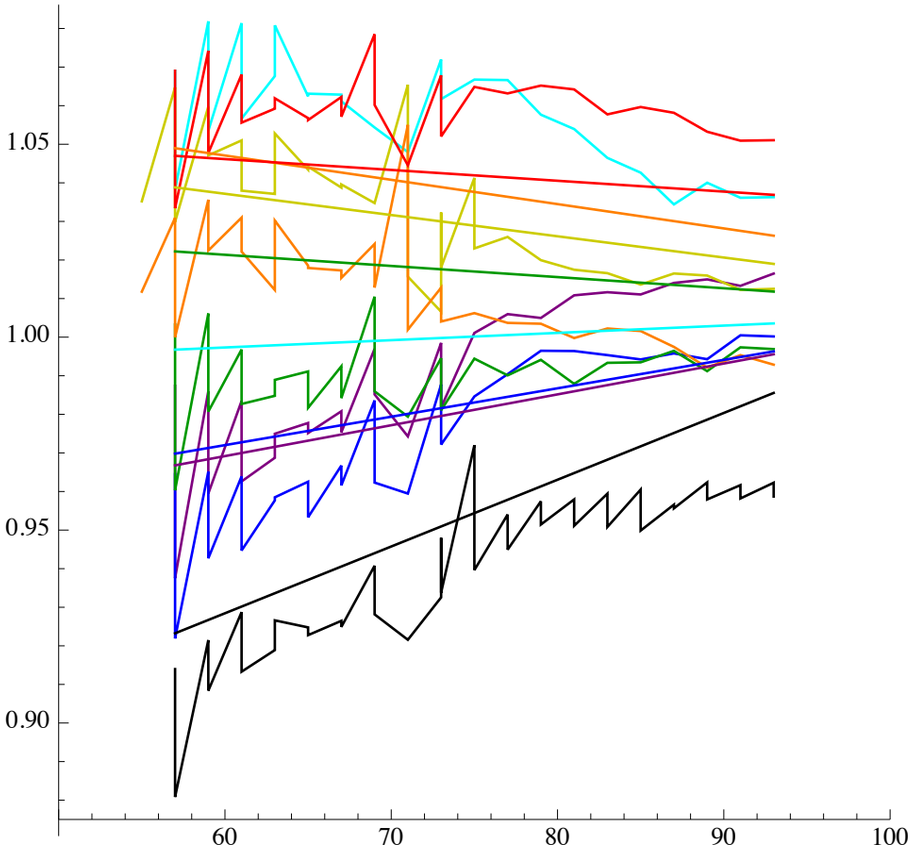
Telescope SED - Alternative Model

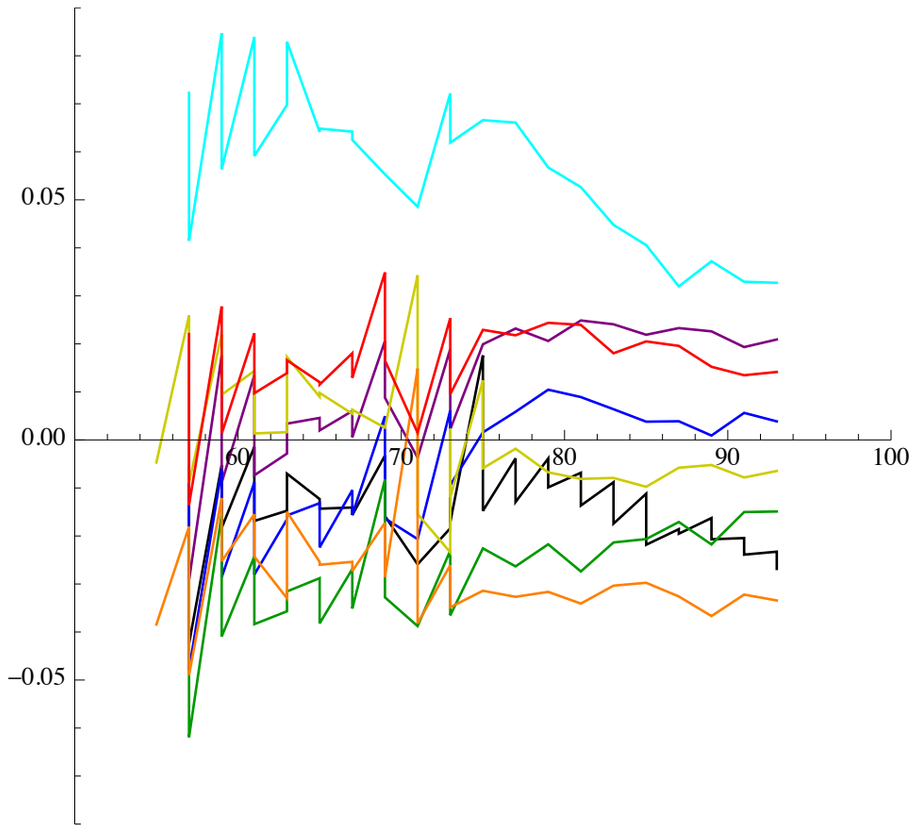




- Determine mean telescope SED (all ODs) and try to describe/parametrize the evolution with time
- Left: mean of individual SEDs
- Right: relative residuals of individual SEDs w.r.t. mean

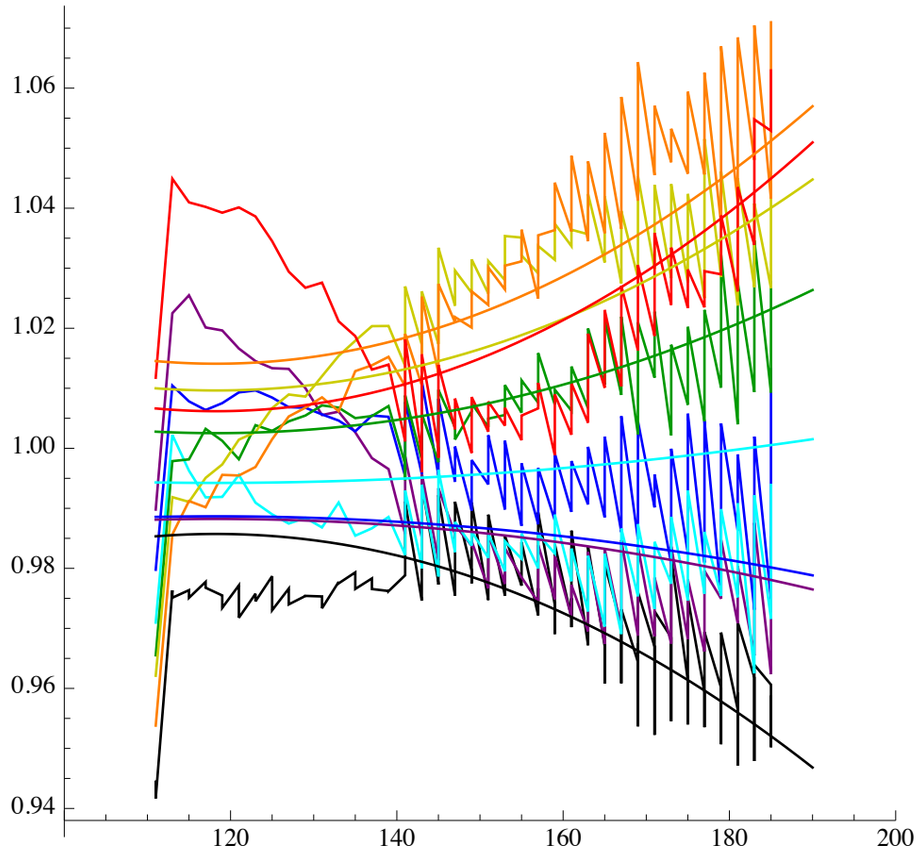
Telescope SED - Alternative Model (Blue)

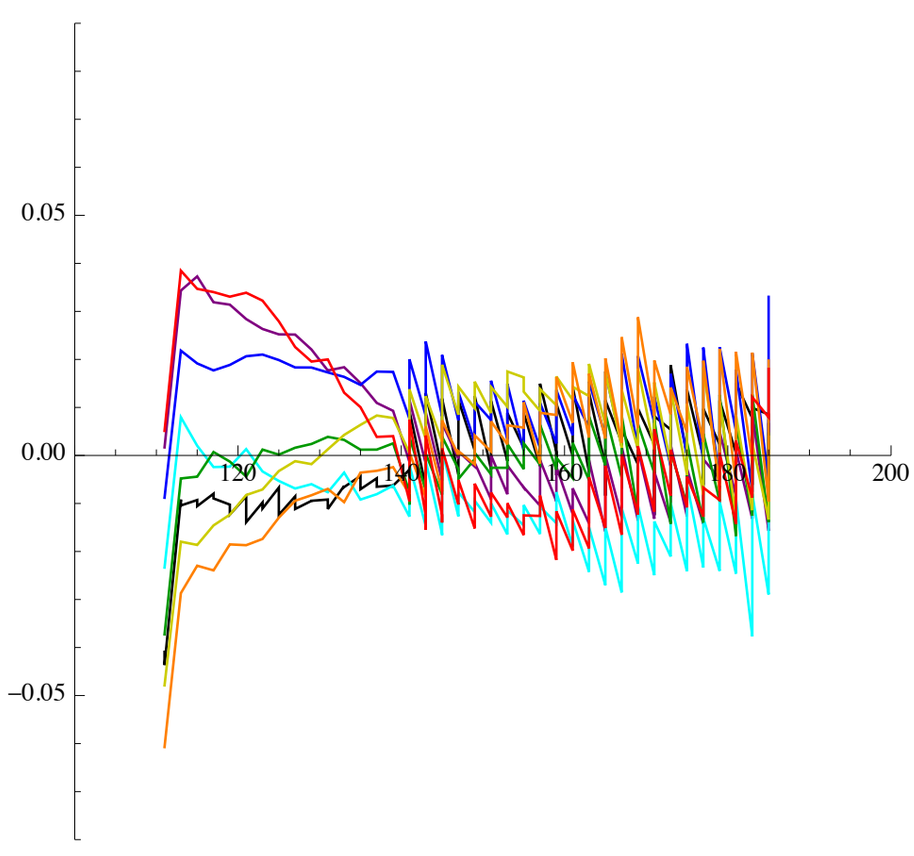




- Approximate residuals as linear function of wavelength, with time (OD) variable parameters (2nd order)
- Result no worse than “physical” telescope model

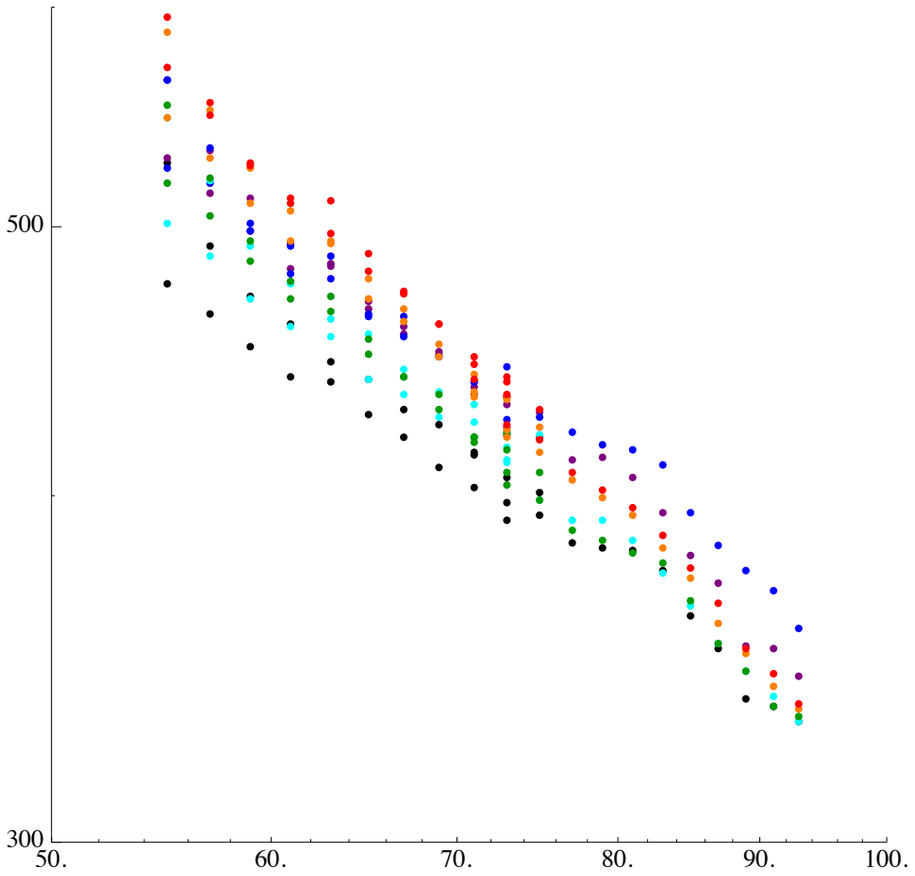
Telescope SED - Alternative Model (Red)

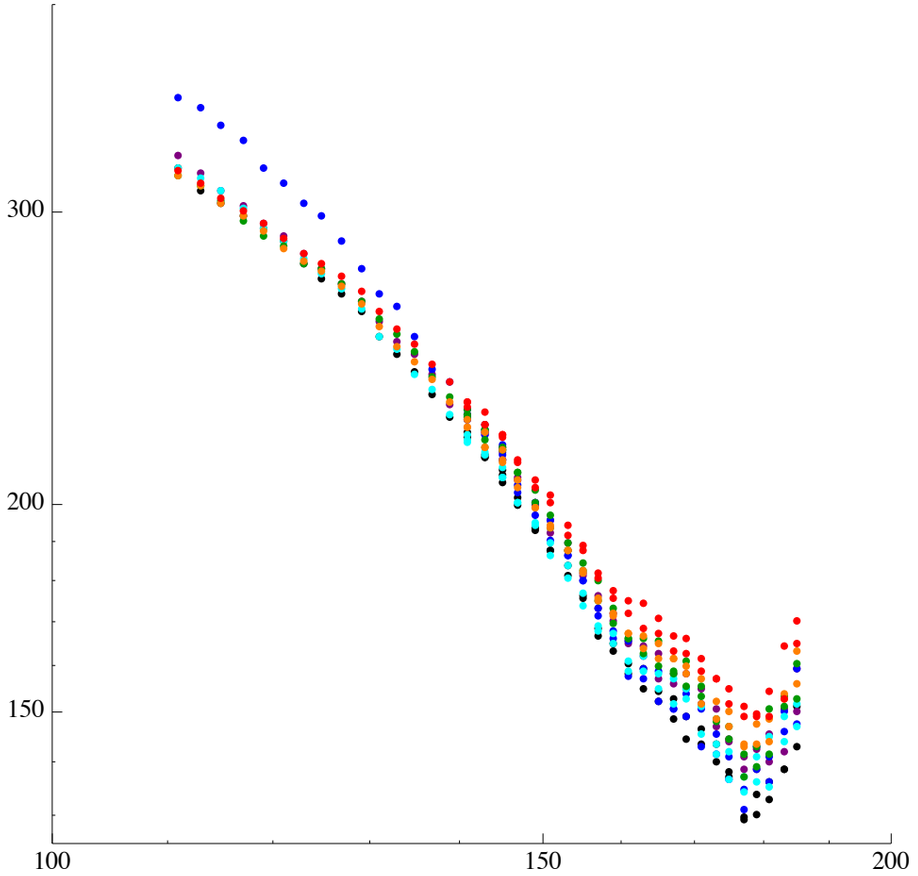




- Approximate residuals as second order function of wave-length, with time (OD) variable parameters (3rd order)
- Residuals a bit less “periodic” than “physical” telescope model, but still some divergence below 140μm
  - better approach to parametrize shape and its evolution?

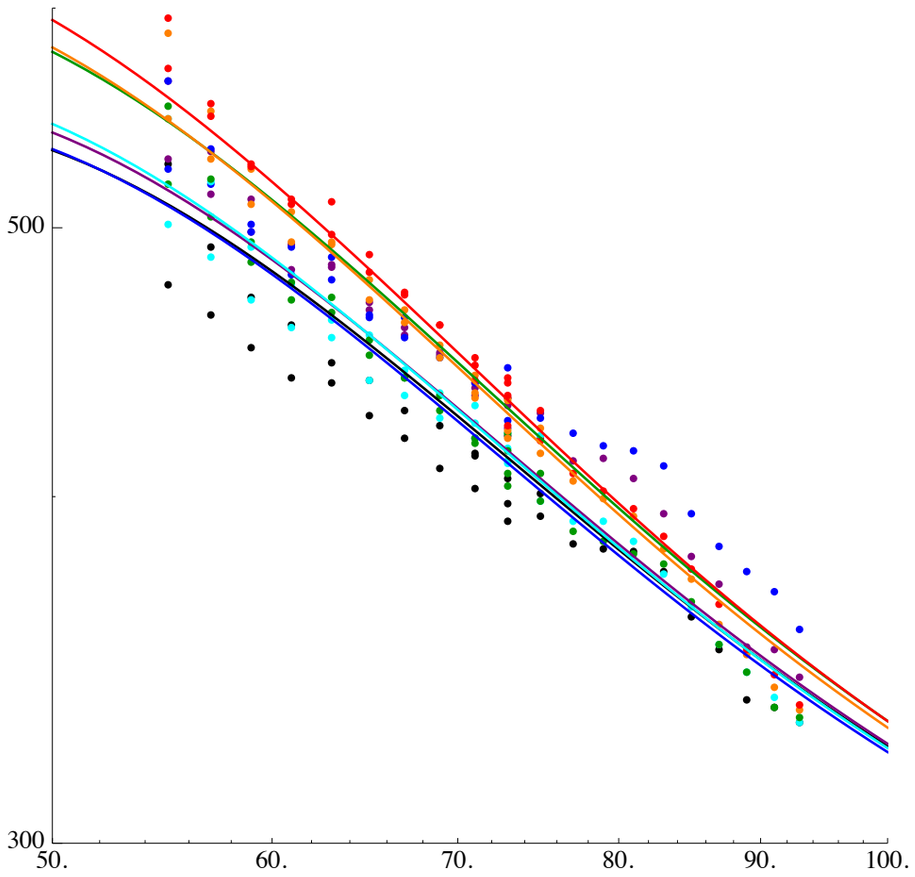
Telescope SED (Ceres)

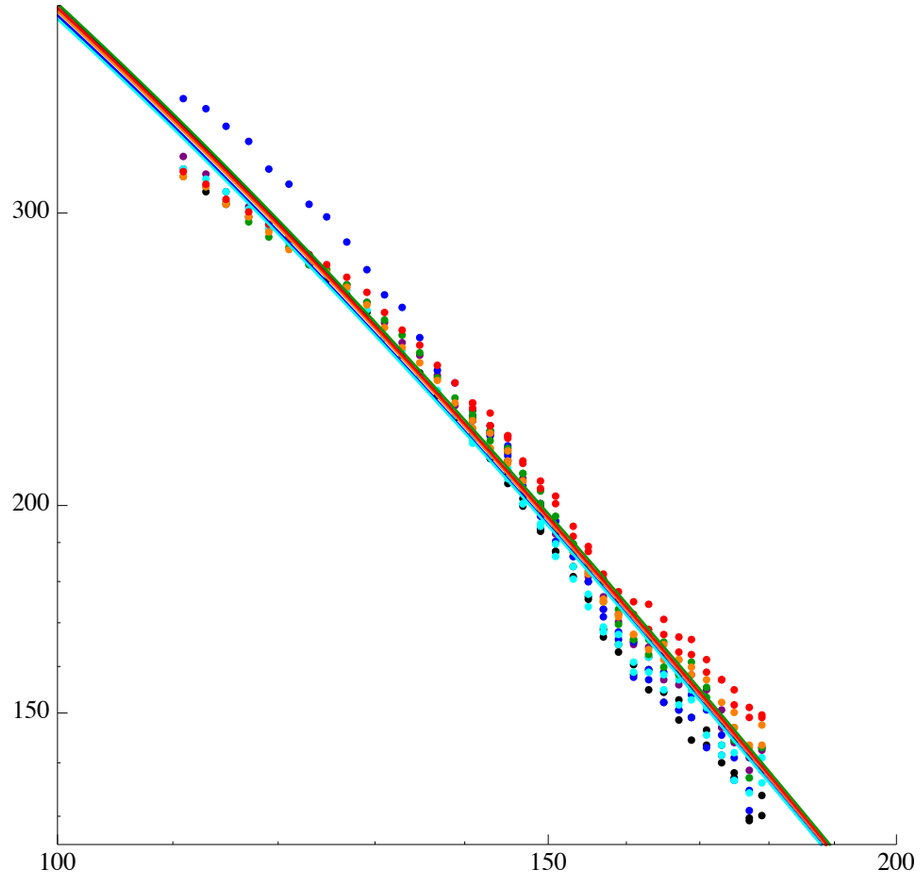




- Blue (left) and red (right) “Telescope SEDs” derived from standard chopped/nodded Ceres SED observations
- Data reduction with “short range” script on sliced (2μm) SED data (same method as key wavelength calibration)
- From OD286 (black) to OD1420 (red)

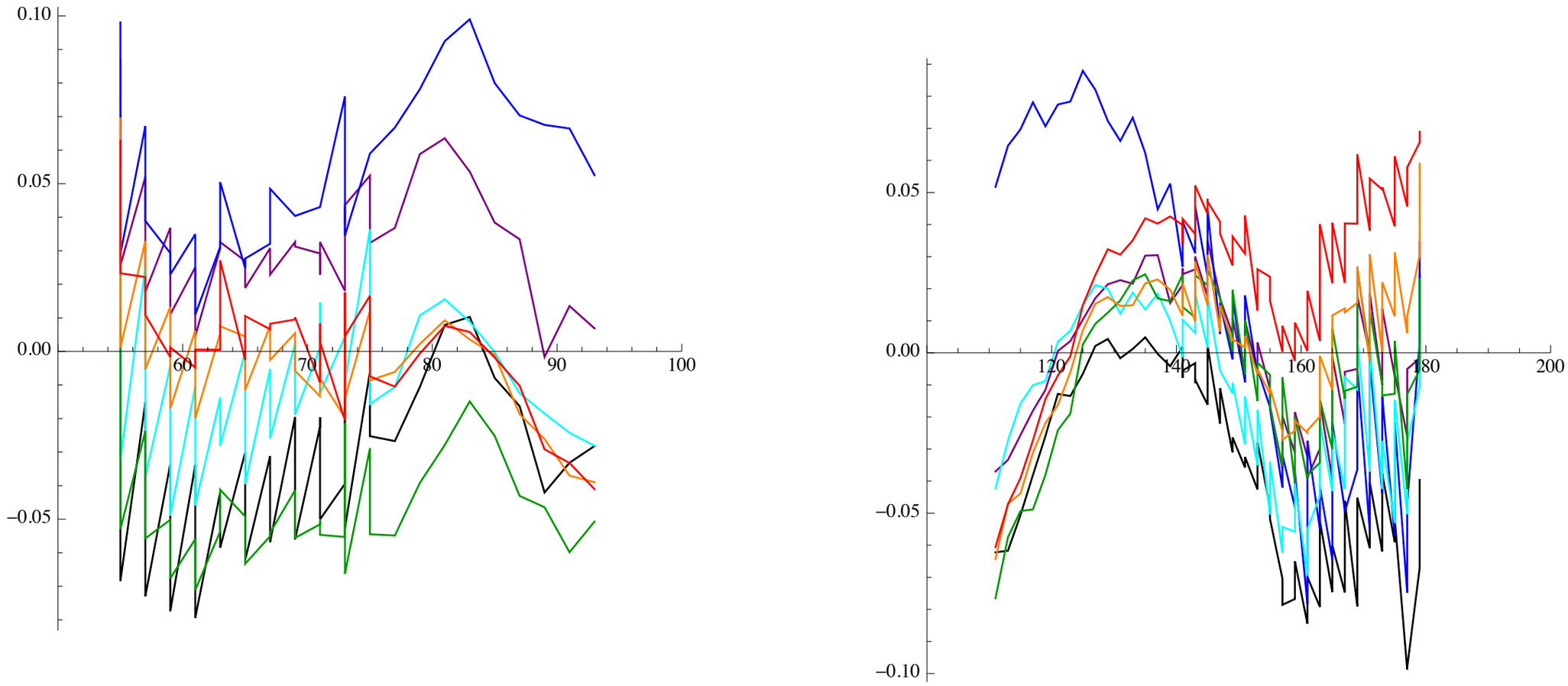
Telescope SED Model (Ceres)





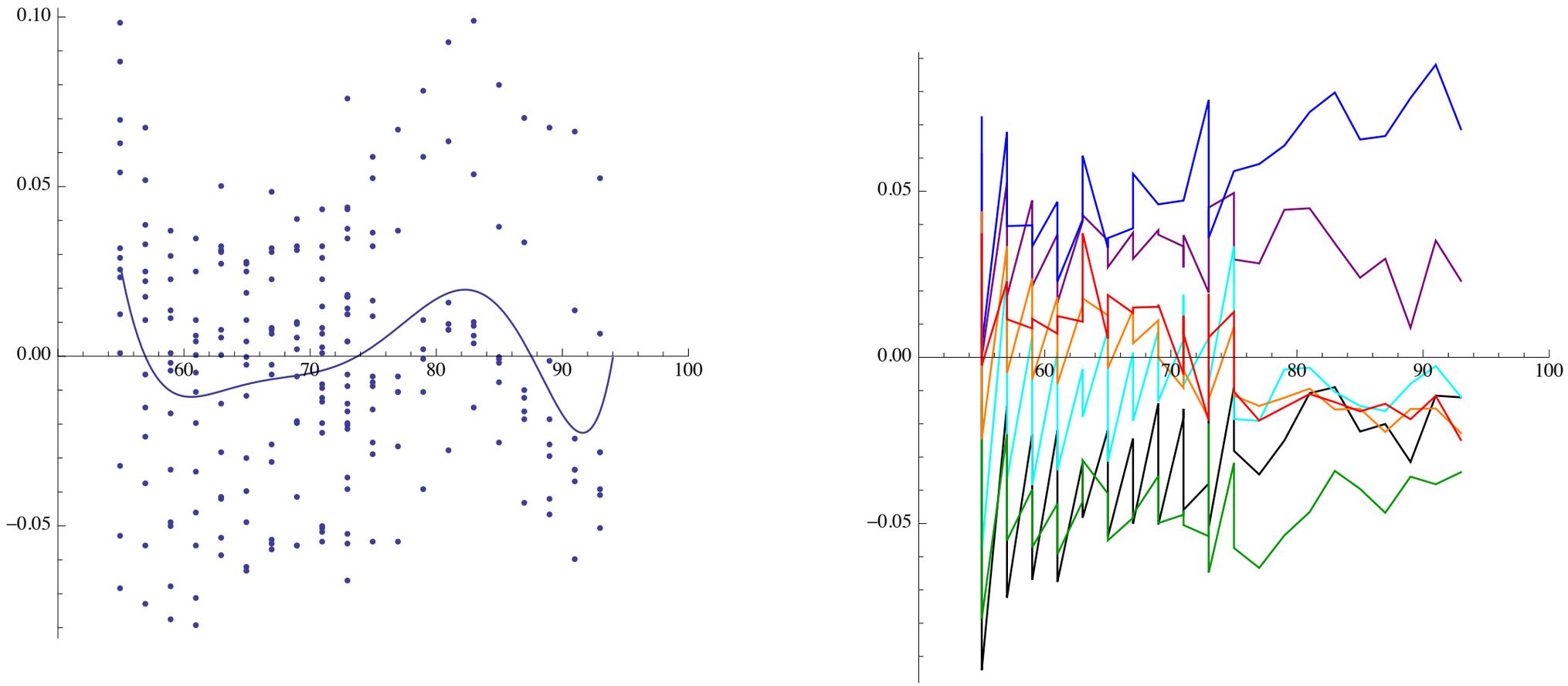
- Blue (left) and red (right) telescope models in the traditional style (dust emission [T], cooler extra BB component, surface degradation linear with OD)
- Fit separately in red and blue
- OD523 (blue points) is outlier, probably affecting fit!

Telescope SED Model Residuals (Ceres)



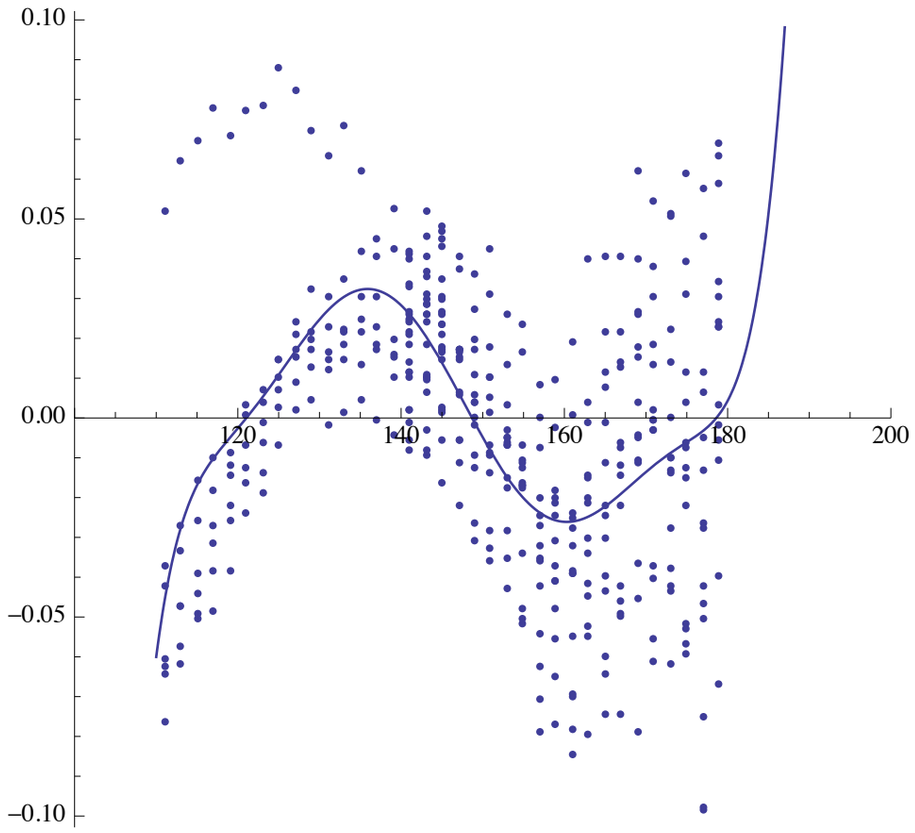
- Shown are relative residuals (ΔF/F)
- Blue (left) showing “hump” around 83μm in all traces
- Red (right) showing something like third-order parabola
- No pointing correction may introduce systematic offset

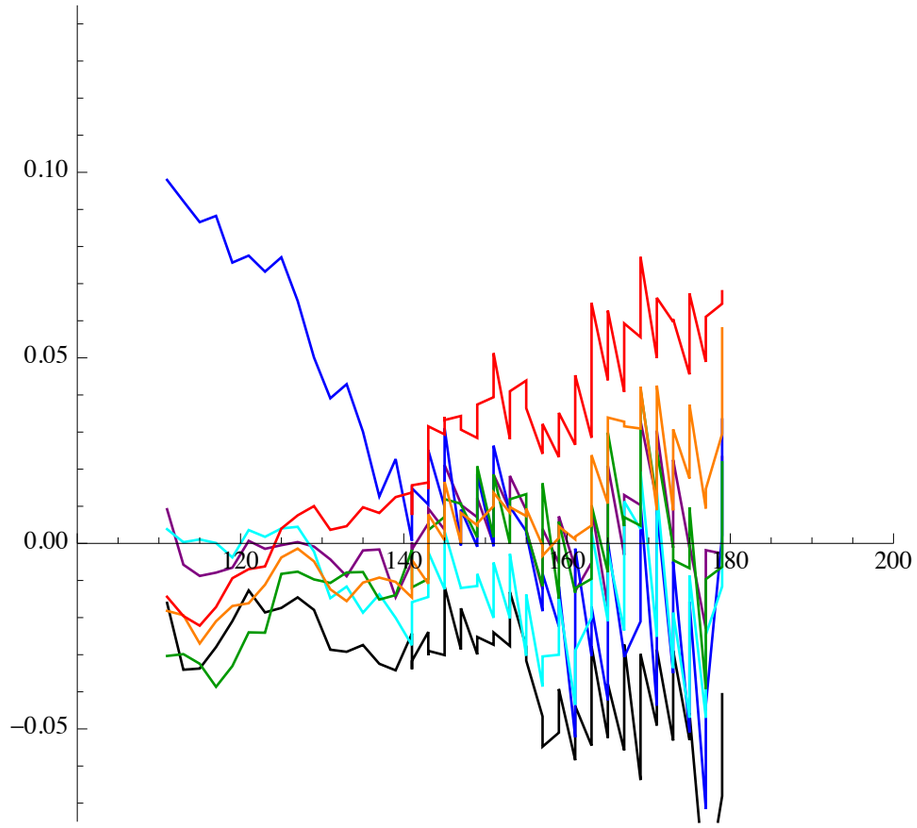
Telescope SED Model Residuals (Blue)



- Common polynomial fit to all ODs (left)
- Residuals after subtraction of polynomial (right)
  - no distinct features left

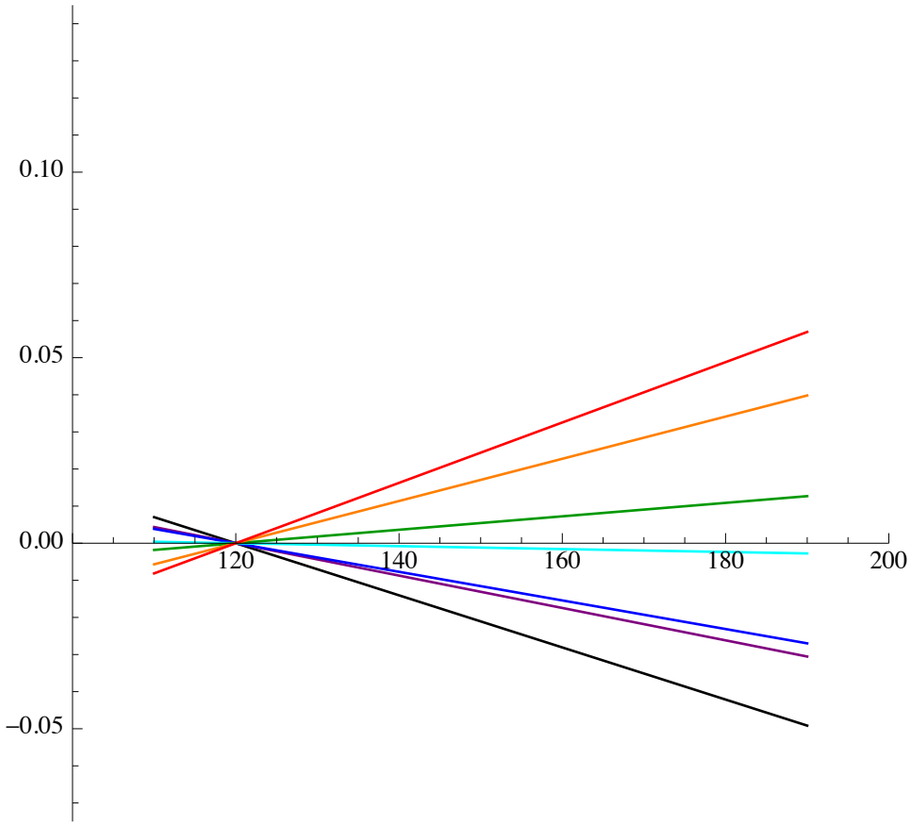
Telescope SED Model Residuals (Red)

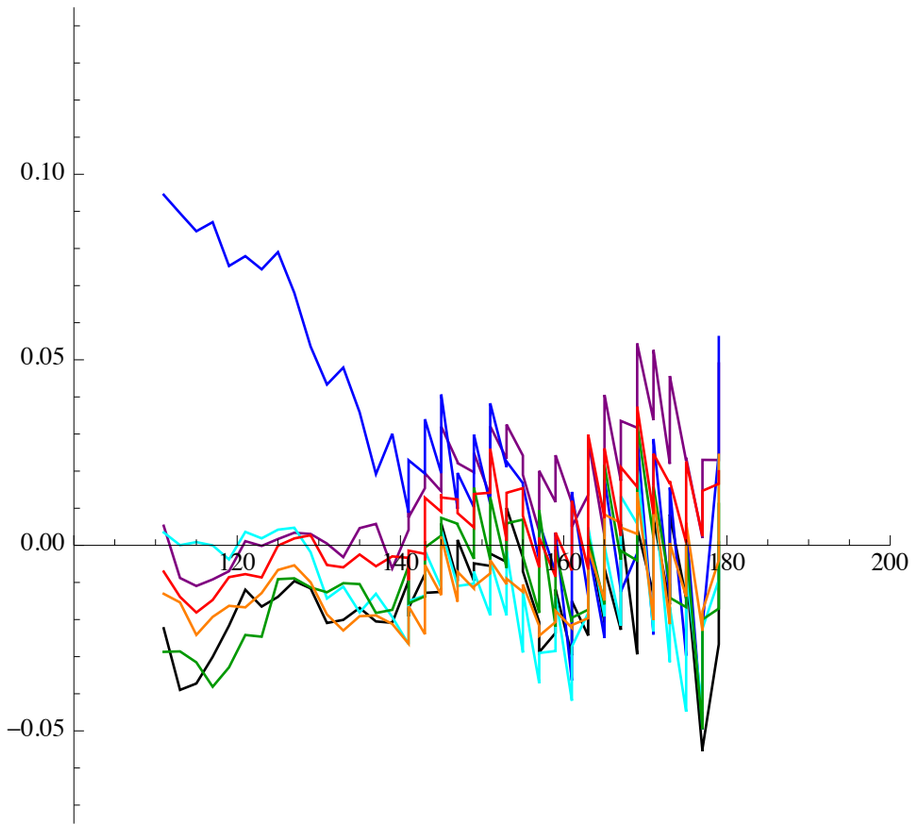




- Common polynomial fit to all ODs (left)
- Residuals after subtraction of polynomial (right)
  - drift term left

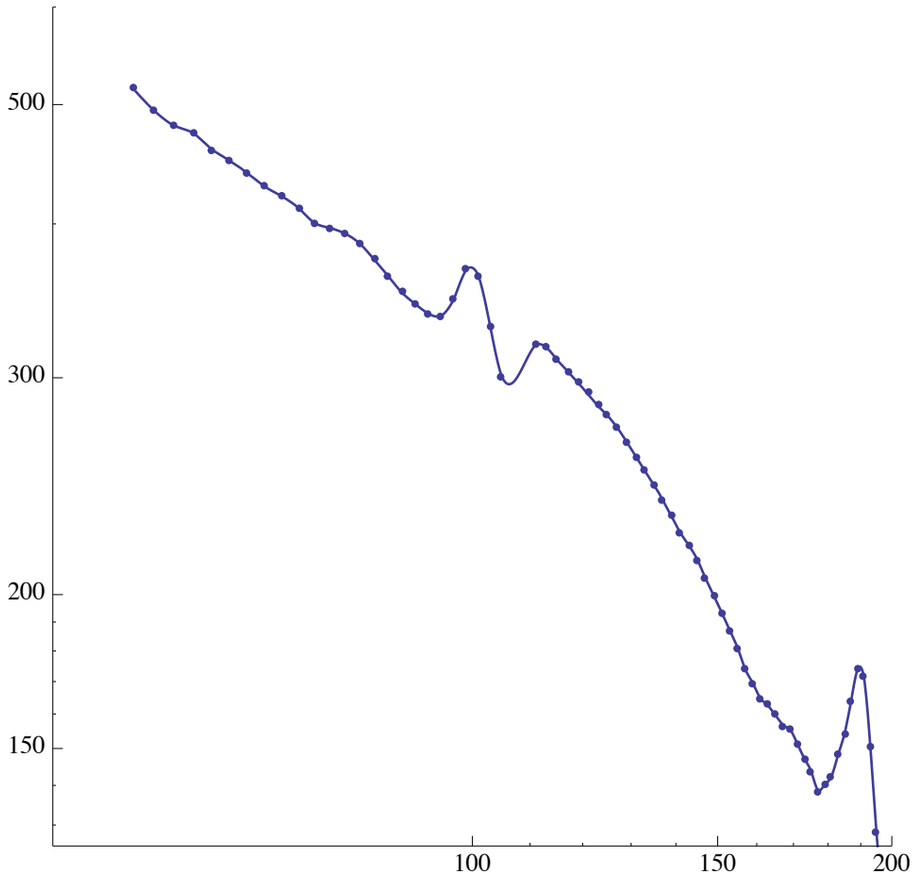
Telescope SED Model Residuals (Red)

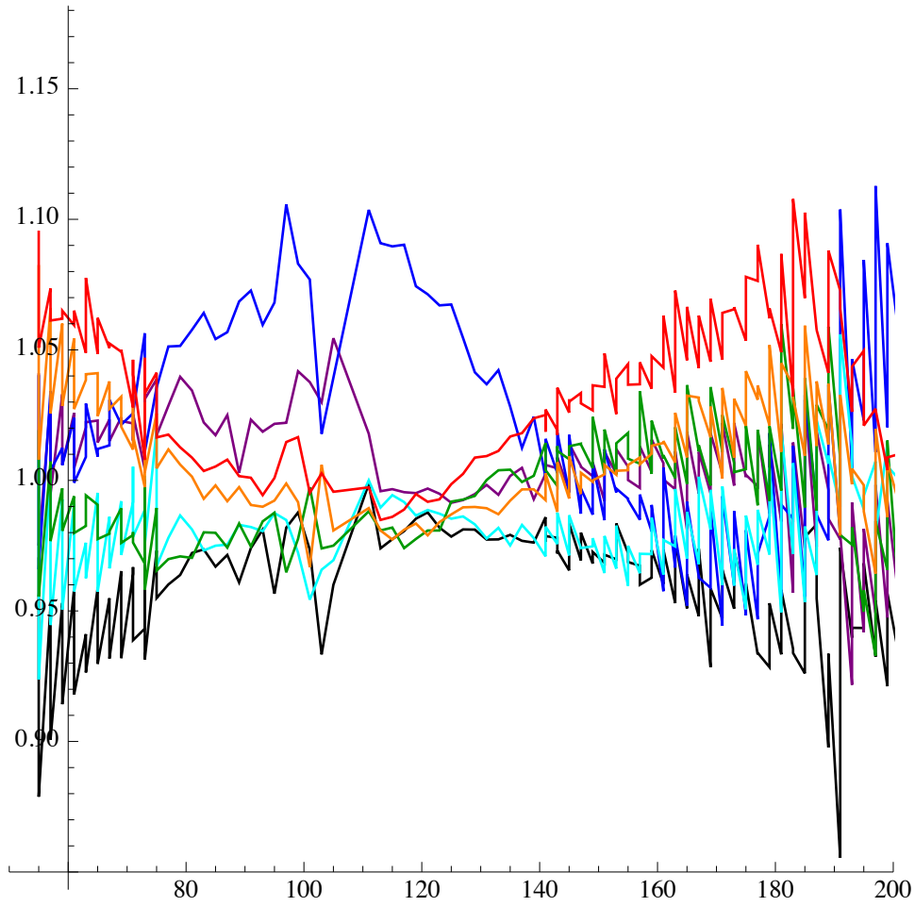




- Fit of linear drift to remaining residuals of all ODs (left)
- Total residuals after subtraction of static polynomial and linear drift model
  - no simple drift left, but still some baseline “waves”
  - OD523 is clear outlier

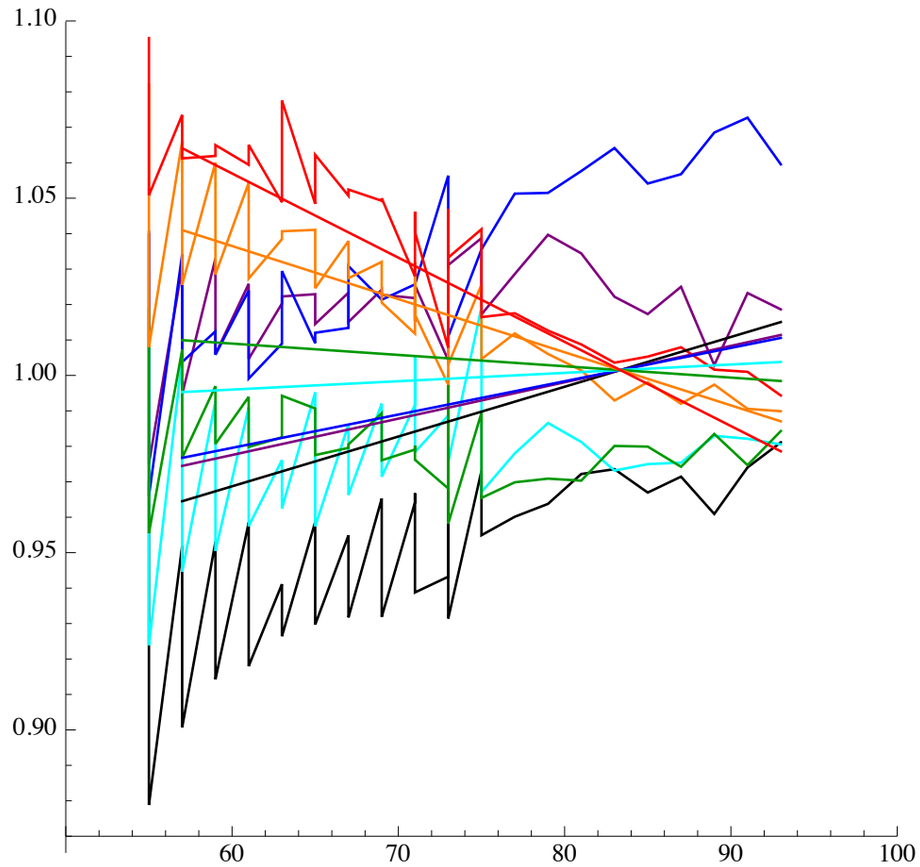
Telescope SED (Ceres) - Alternative Model

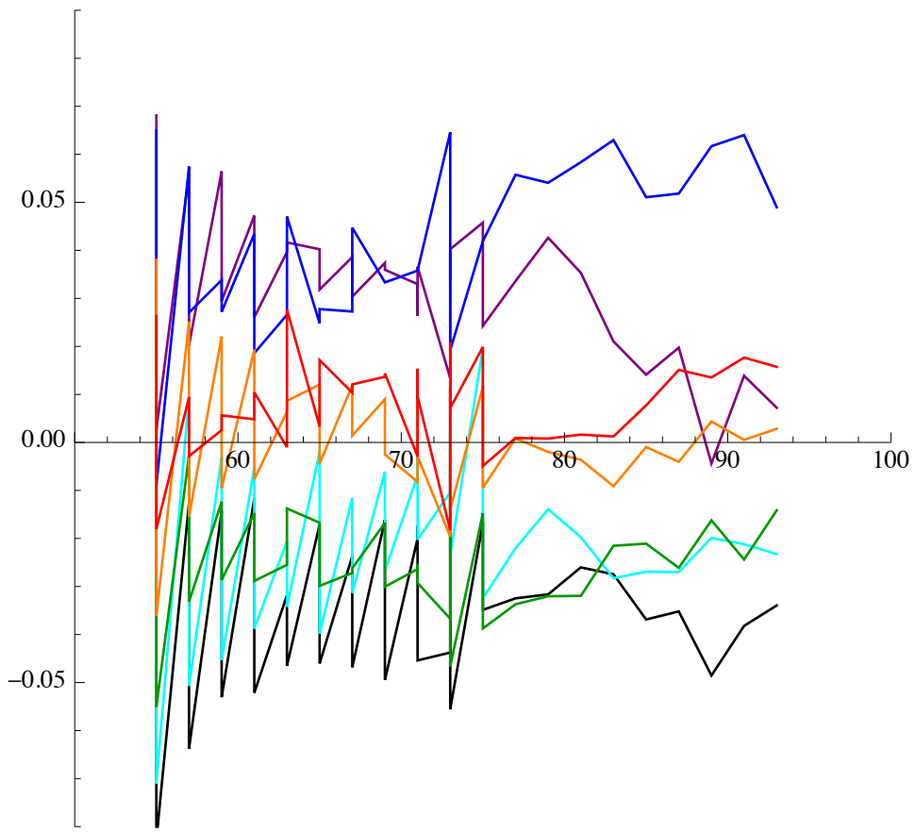




- Determine mean telescope SED (all ODs) and try to describe/parametrize the evolution with time
- Left: mean of individual SEDs
- Right: relative residuals of individual SEDs w.r.t. mean

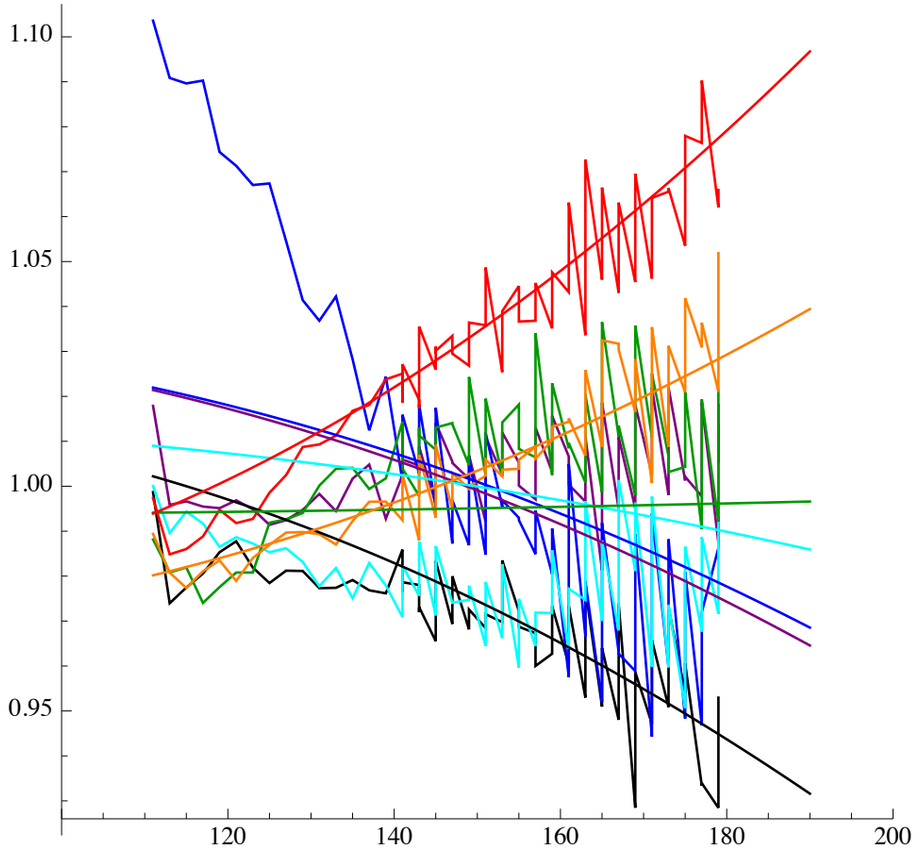
Telescope SED - Alternative Model (Blue)

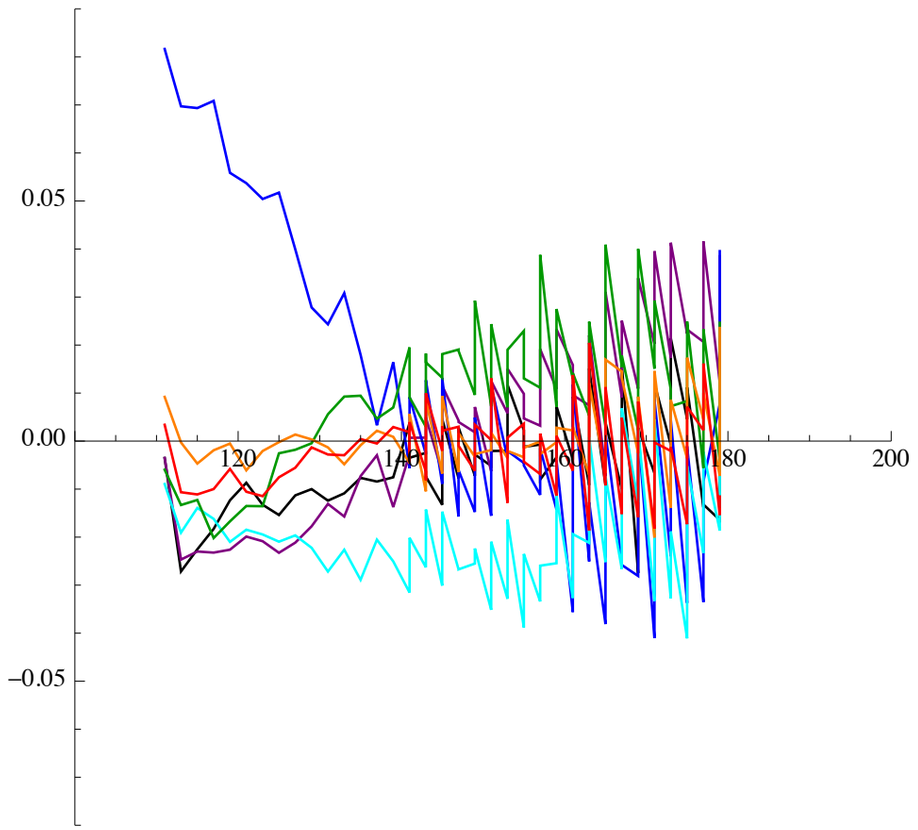




- Approximate residuals as linear function of wavelength, with time (OD) variable parameters (2nd order)
- Result no worse than “physical” telescope model

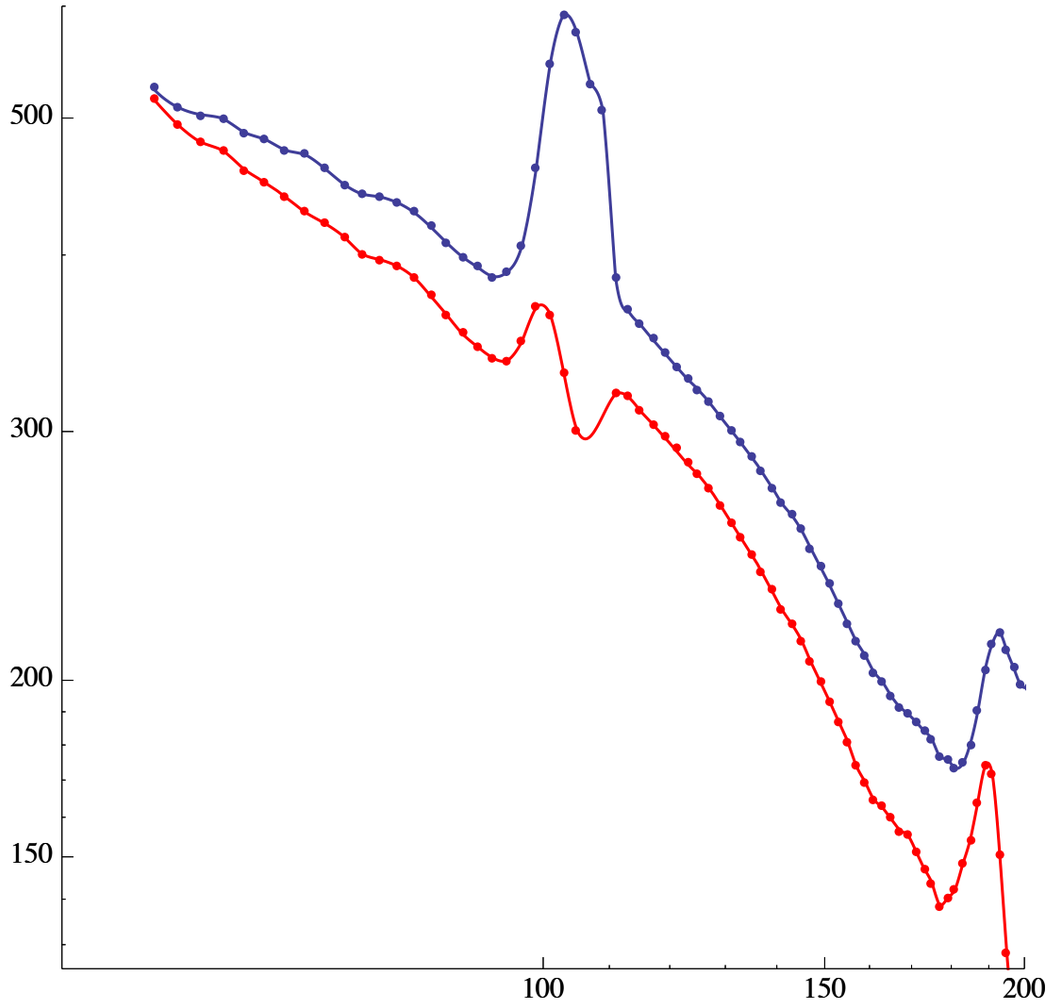
Telescope SED - Alternative Model (Red)

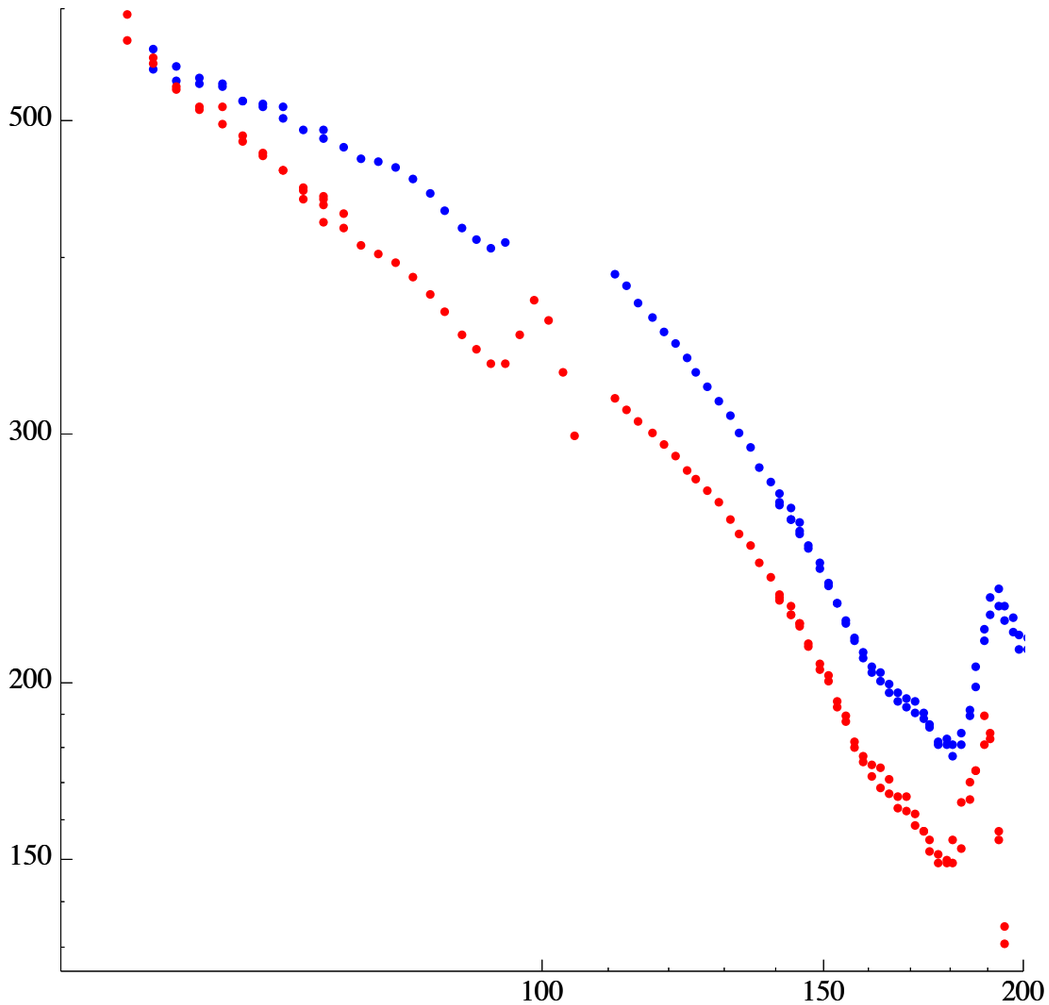




- Approximate residuals as second order function of wave-length, with time (OD) variable parameters (3rd order)
- Residuals a bit less “periodic” than “physical” telescope model, but outlier compromising fit somewhat

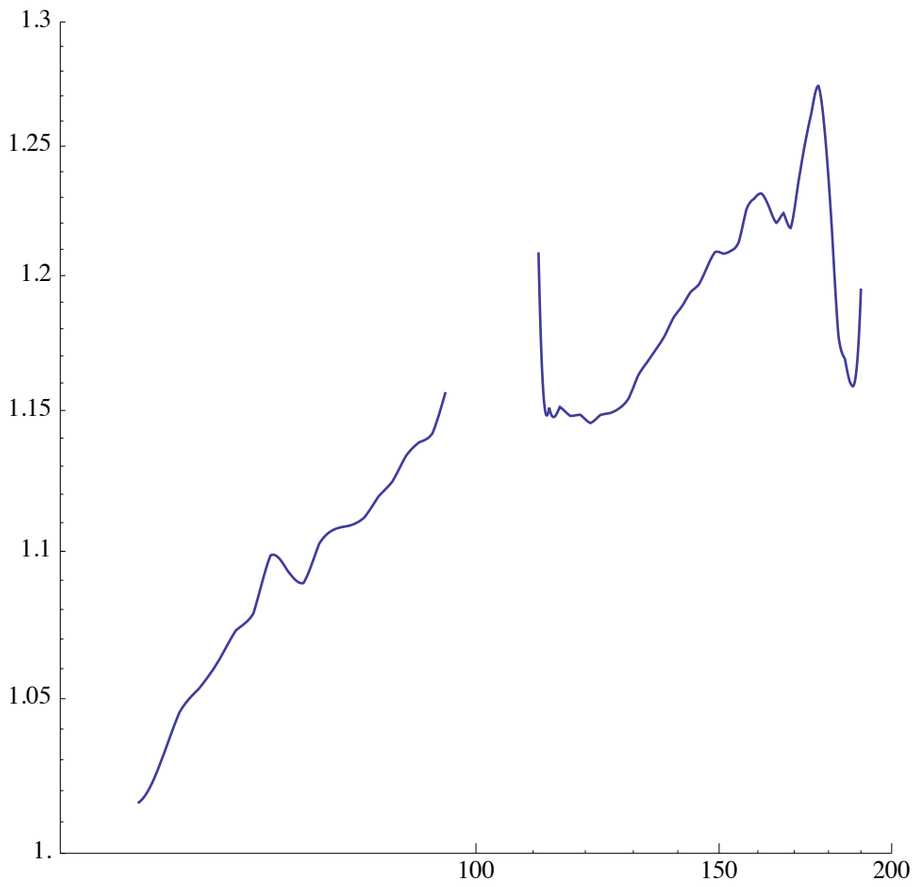
Comparison of Telescope SEDs from Neptune and Ceres

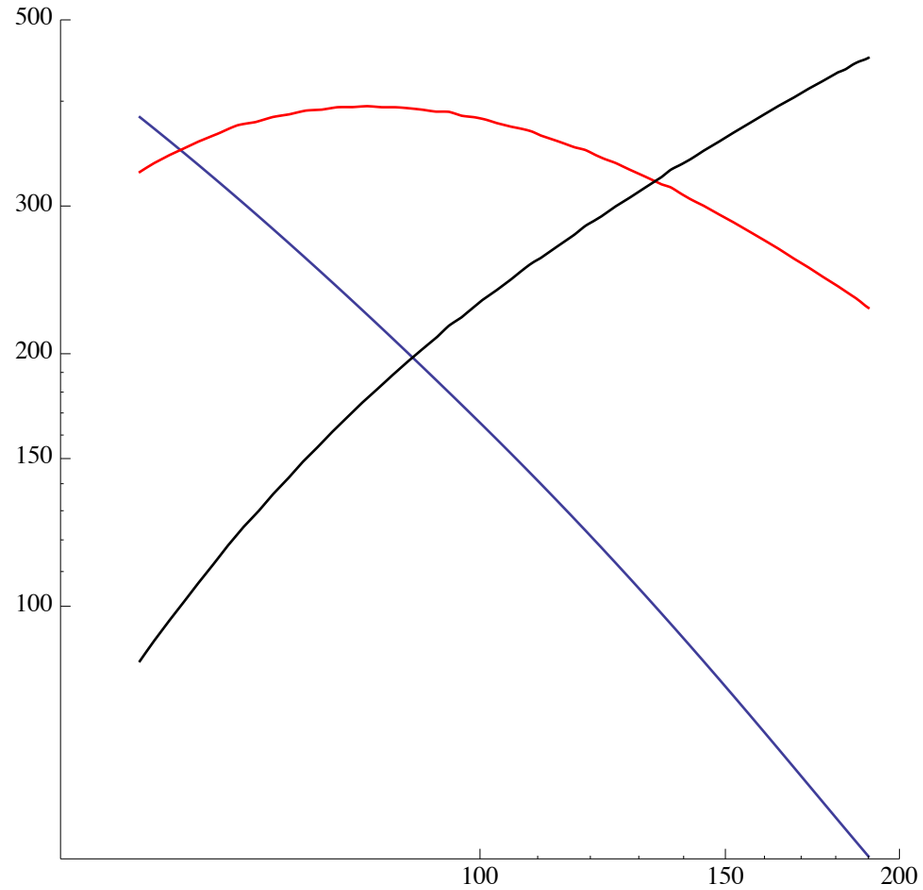




- Left: mean of SEDs from Neptune (blue) and Ceres (red)
- Right: SEDs on OD1420 (Ceres) / OD1445 (Neptune)
- Systematic discrepancy of up to ~20% at long λ end
  - non-linearity in chopped vs. static response?

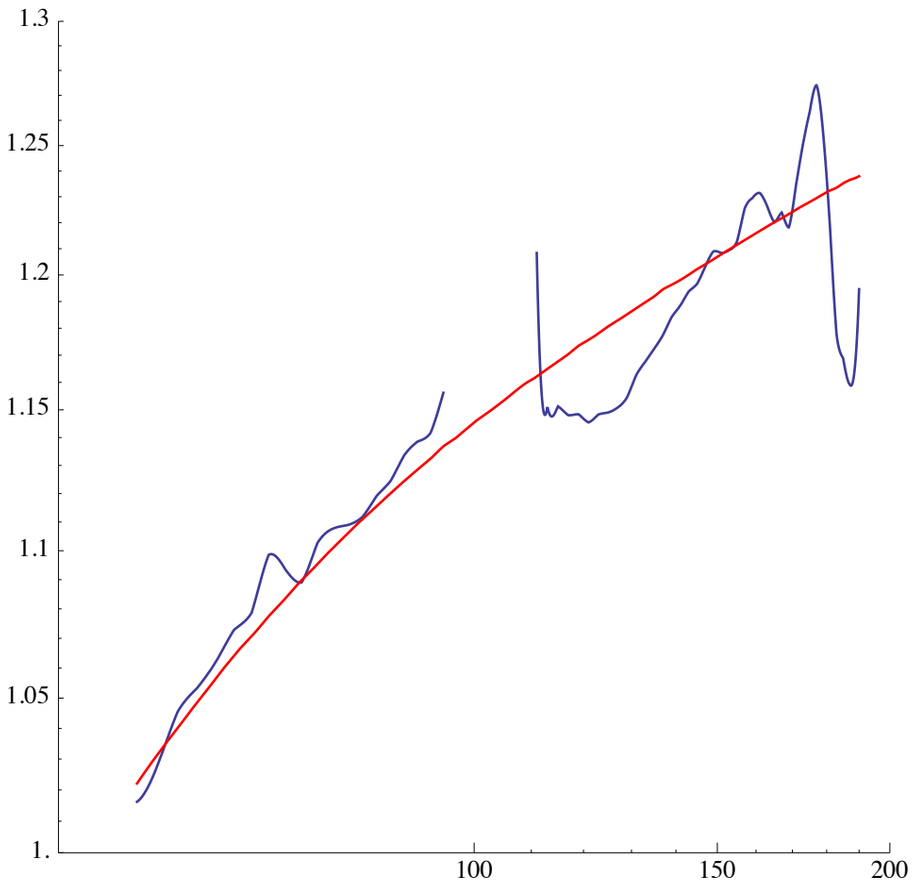
Comparison of Telescope SEDs from Neptune and Ceres





- Left: ratio of mean SED from Neptune and Ceres
- Right: SEDs of Ceres (blue) and Neptune (red) and flux ratio of Neptune/Ceres [%] (black)
  - link between flux ratio and discrepancy?

Comparison of Telescope SEDs from Neptune and Ceres



- Blue: ratio of mean SED from Neptune and Ceres
- Red: (flux ratio of Neptune/Ceres)$^{0.12}$
  - looks intriguing but more relevant input parameters for description of effect should be source flux vs. telescope flux etc.