PACS Photometer Flux Calibration

Current status and planned improvements

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On behalf of the PACS ICC and Calibration Working Group

Pacs Photometer Flux Calibration Current Status

- The calibration is based on scan maps of five fiducial standards
- Standard fluxes provided by Joris Blommaert based on Dehaes et al. (2011)
  - Recently updated (see talk by J. Blommaert)
- Repeatability of the individual sources are below 2%
- Absolute flux calibration is around 5% (dominated by model uncertainties)

Calibrators (3 K-type and 2 M-type stars)

	Old model			New model		
	70 μm	100 μm	160 μm	70 μm	100 μm	160 μm
α Tau	14.131	6.909	2.677	14.311	7.006	2.719
α Boo	15.434	7.509	2.891	15.855	7.736	2.989
γ Dra	3.283	1.604	0.621	3.347	1.638	0.636
α Cet	4.889	2.393	0.928	4.995	2.450	0.953
β And	5.594	2.737	1.062	5.730	2.810	1.094

Pacs Photometer Flux Calibration Current Status

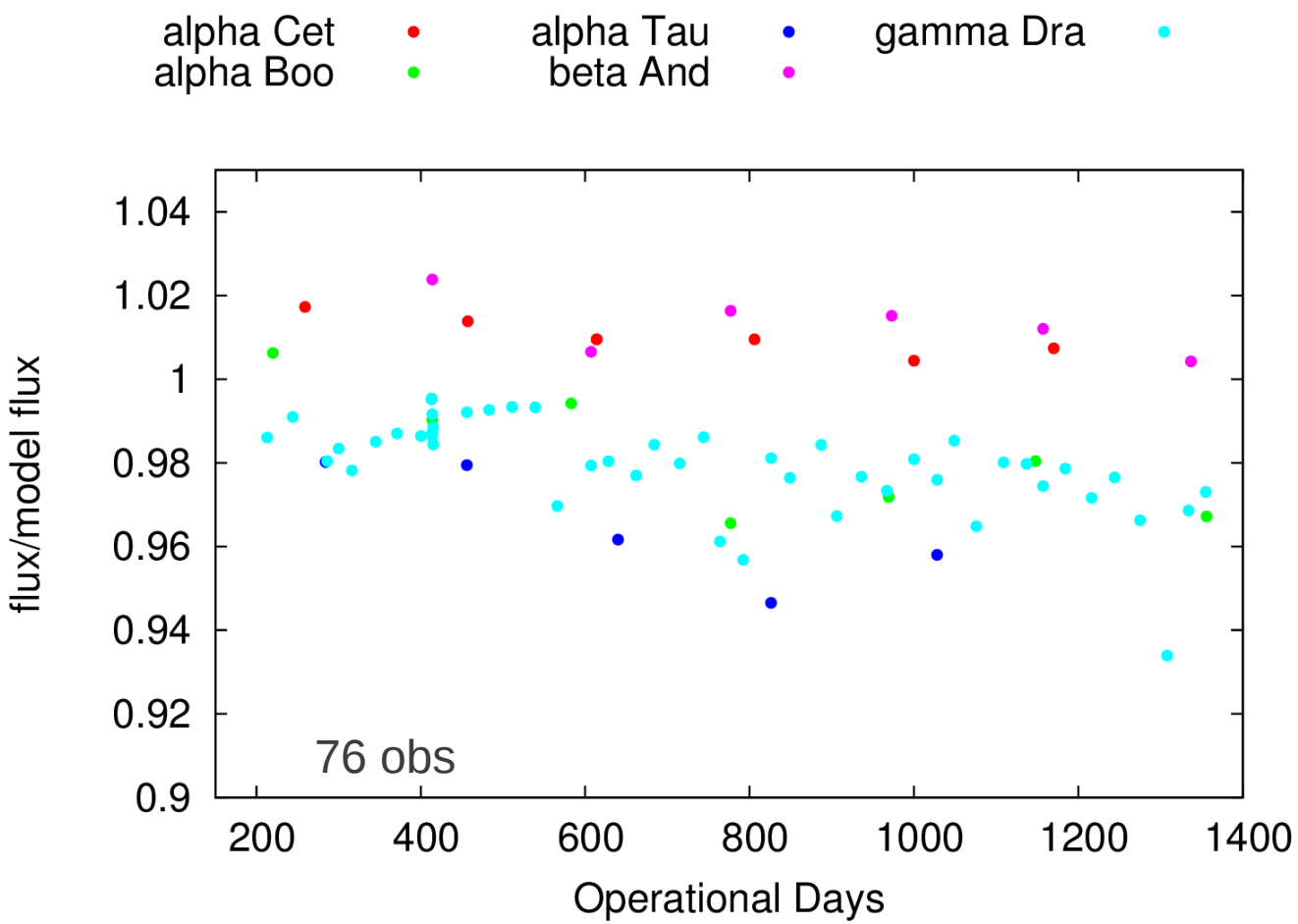
Data processing and photometry:

- All observations are processed exactly the same way
  - Processing scripts based on ipipe script
    - scan+Xscan combined
    - Masked high pass filtering
      - circular mask r=25”
    - HPF width 15, 20, 35 in blue, green and red
    - Non-linearity correction was not neccesary
  - Aperture photometry with aperture correction (see talk from M. Nielbock)
    - blue and green filters: aperture r=12”; sky = 35”-45”
    - red filter: aperture r=22”; sky = 35”-45
    - standard aperture correction built in HIPE

Pacs Photometer Flux Calibration Current Status

Photometry of fiducial stars

blue filter:



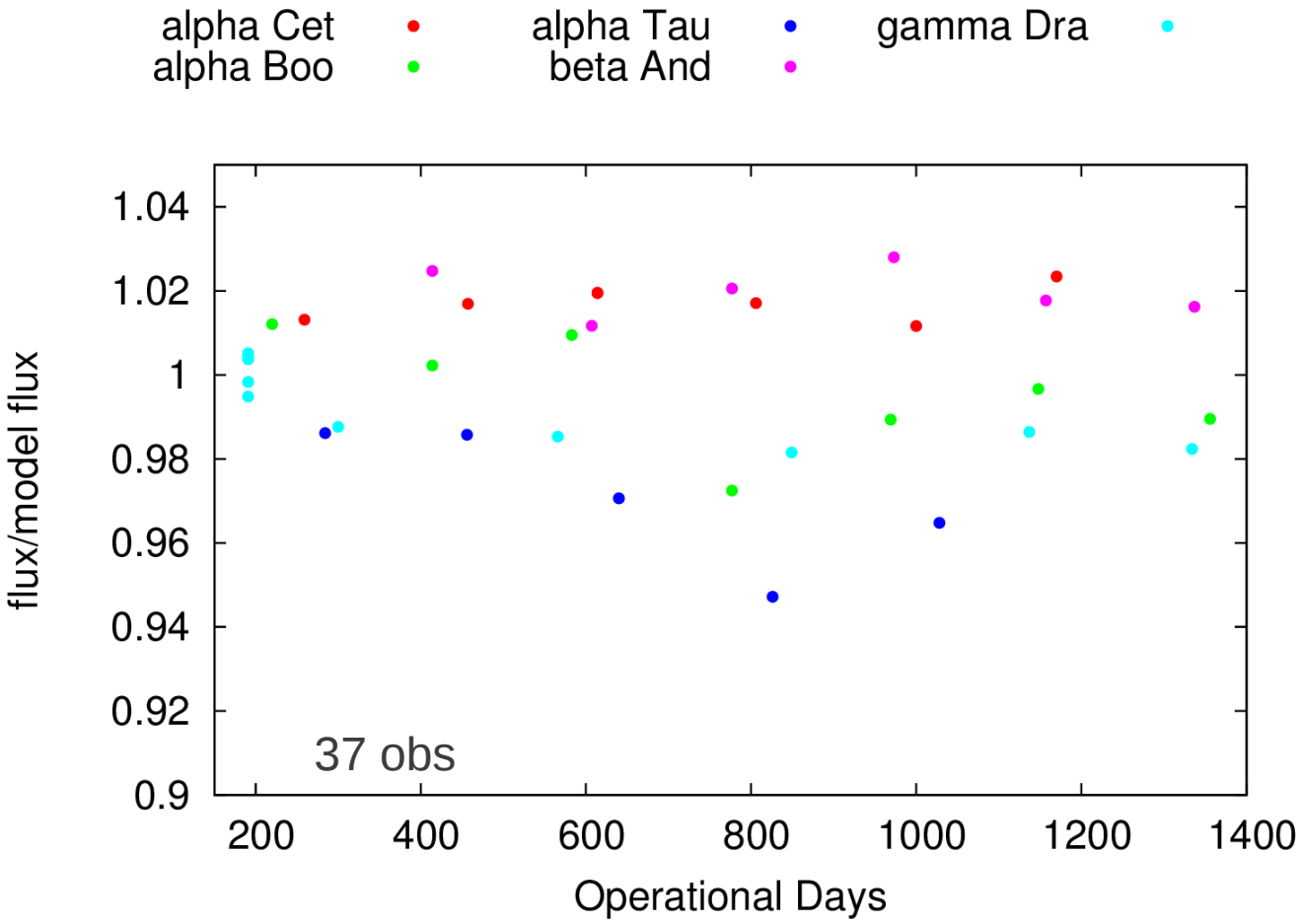
α Tau	0.969	0.017
α Boo	0.982	0.015
γ Dra	0.981	0.009
α Cet	1.010	0.004
β And	1.013	0.007

Mean: 0.991±0.019

Pacs Photometer Flux Calibration Current Status

Photometry of fiducial stars

green filter:



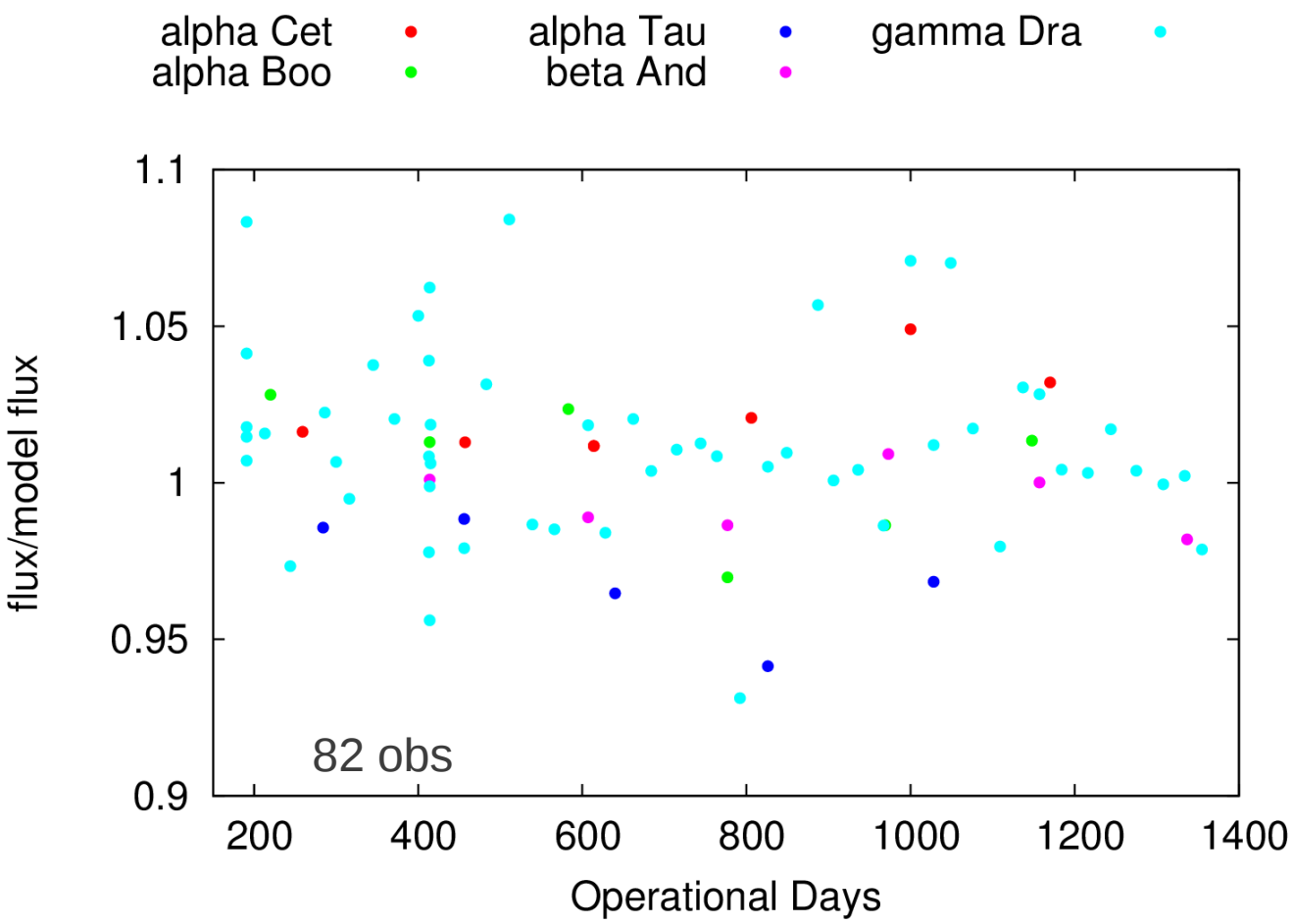
α Tau	0.973	0.015
α Boo	0.996	0.014
γ Dra	0.991	0.011
α Cet	1.017	0.004
β And	1.020	0.006

Mean: 0.999±0.020

Pacs Photometer Flux Calibration Current Status

Photometry of fiducial stars

red filter:



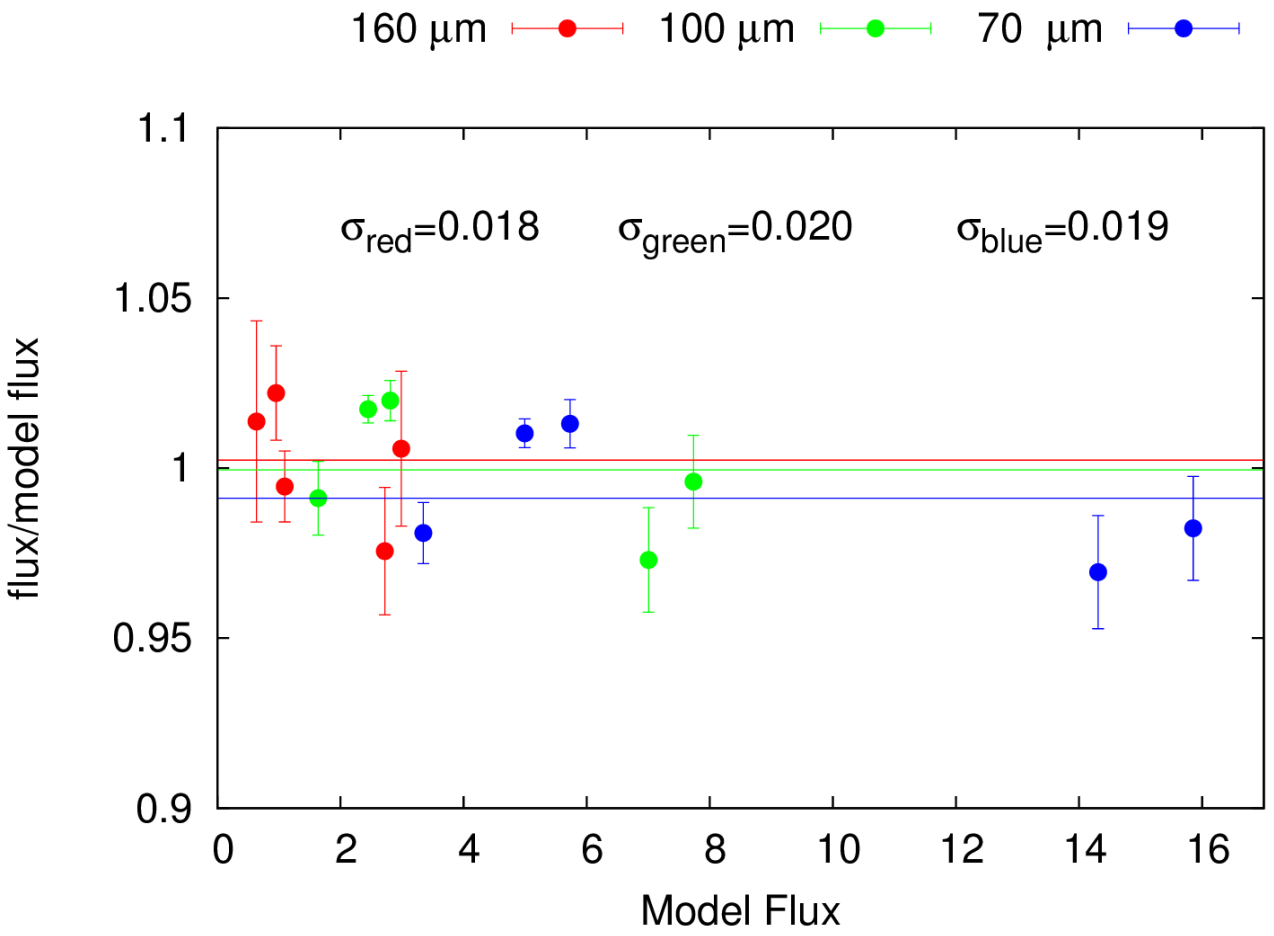
α Tau	0.976	0.019
α Boo	1.006	0.023
γ Dra	1.014	0.030
α Cet	1.022	0.014
β And	0.995	0.010

Mean: 1.002±0.018

Pacs Photometer Flux Calibration Current Status

Photometry of fiducial stars

Summary:



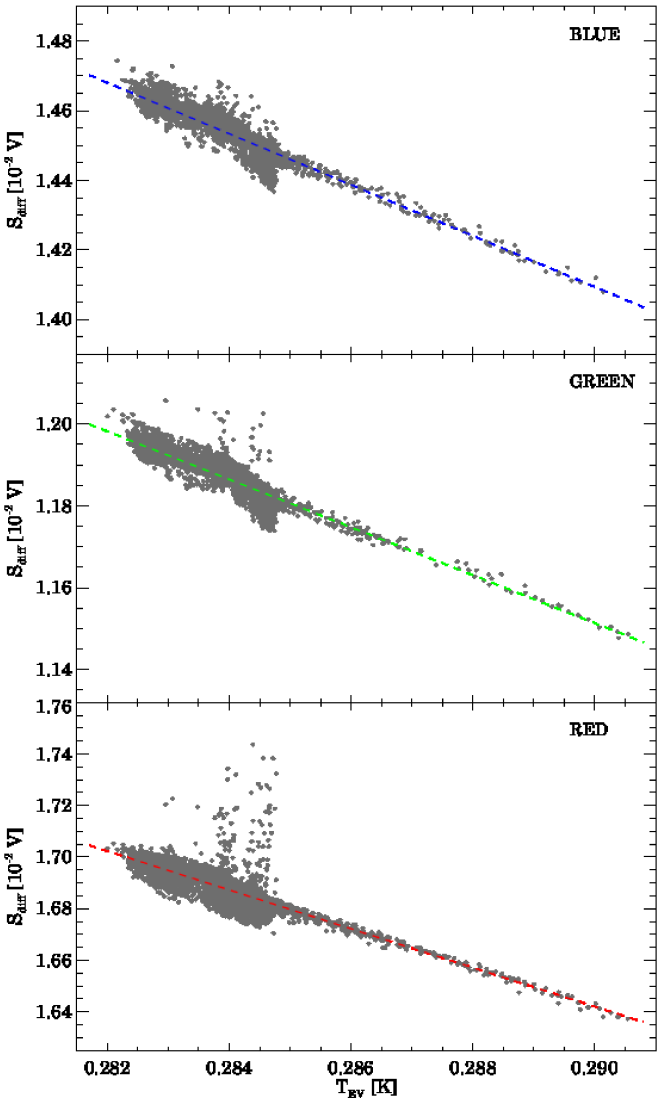
Mean: 0.991±0.019

Mean: 0.999±0.020

Mean: 1.002±0.018

Pacs Photometer Flux Calibration
Future improvement

Correction for evaporator temperature (see poster of Moor et al.)



Differential signal from the calibration sources as the function of the evaporator temperature

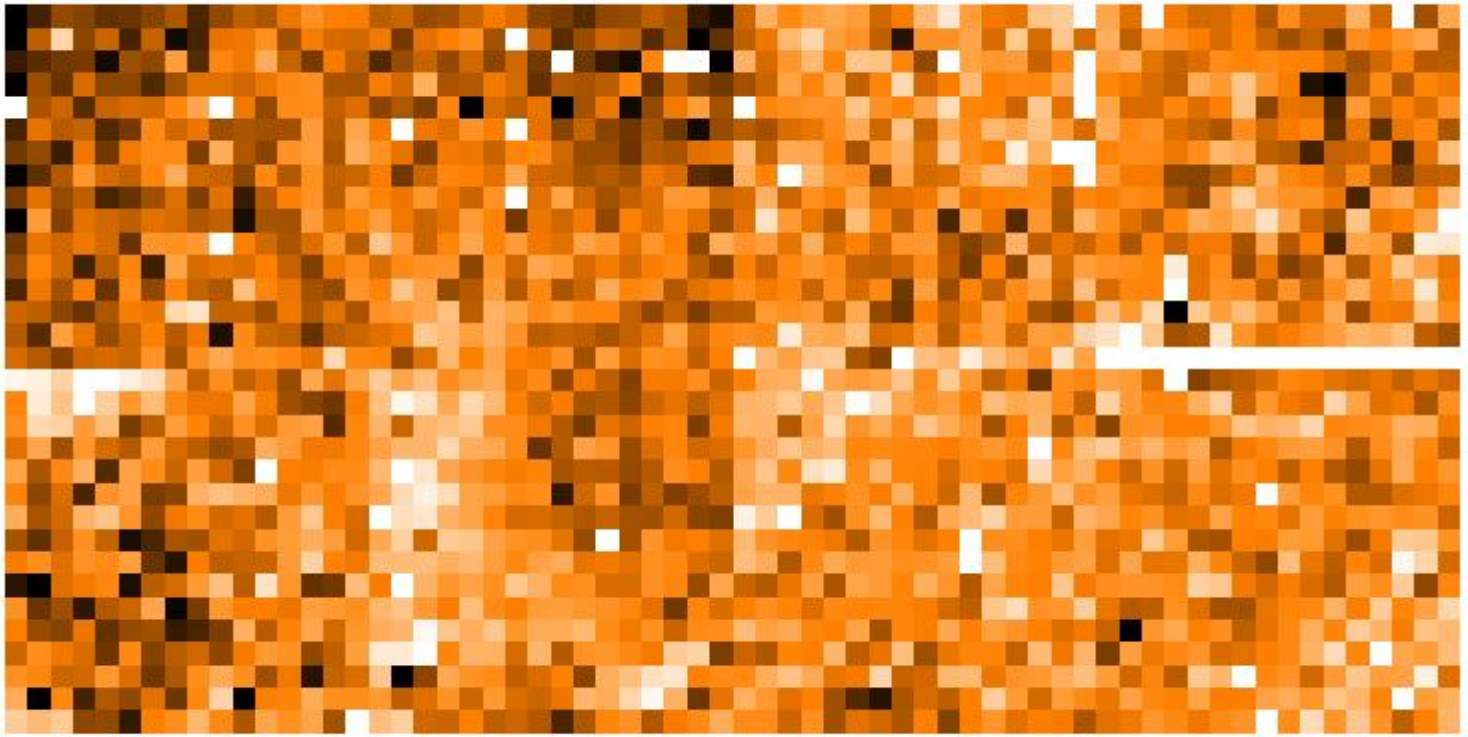
c1 = A + B * T_EV
c2 = A + B * 0.283
r = c2 / c1

signal =signal * r

Pacs Photometer Flux Calibration
Future improvement

Correction for evaporator temperature

Example calibration file at 70 micron

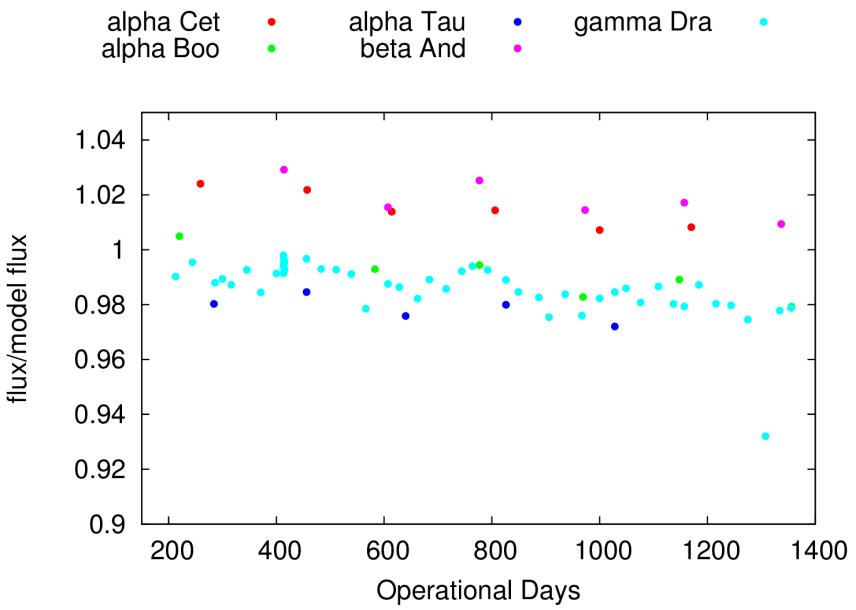


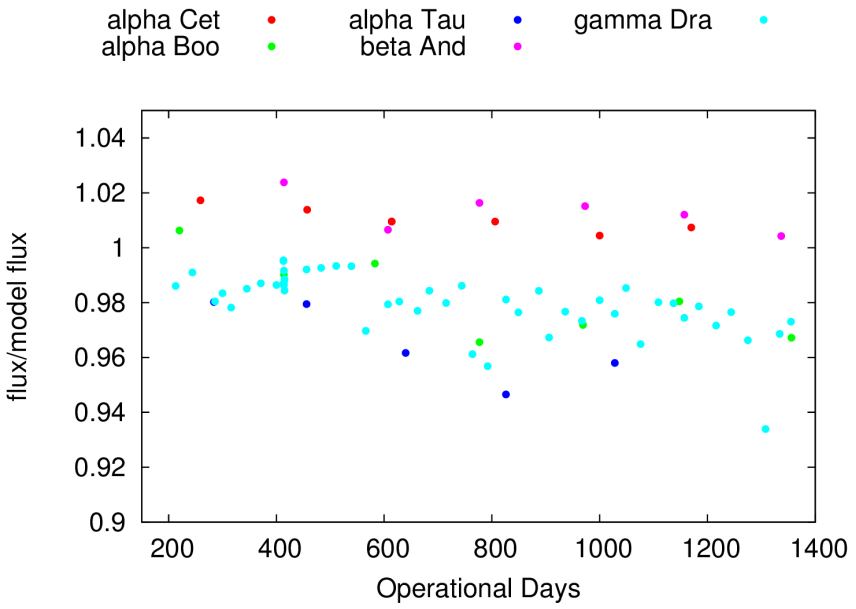
Pacs Photometer Flux Calibration
Future improvement

Correction for evaporator temperature

Comparing the fluxes with and without the correction

blue filter - old model fluxes:



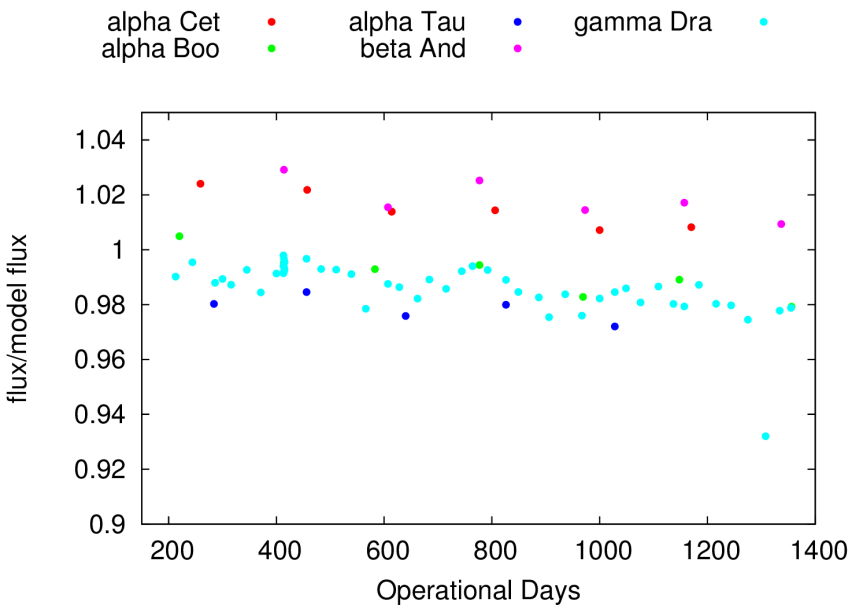


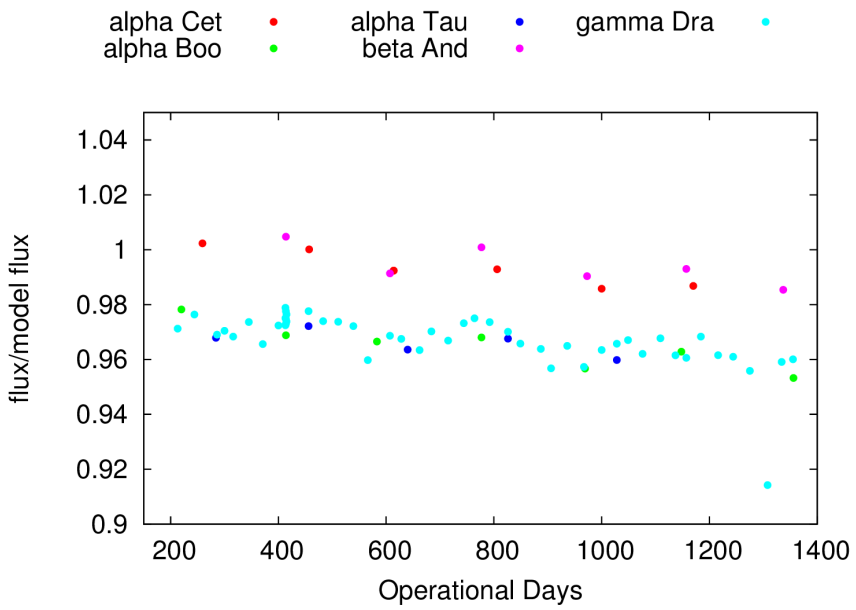
Pacs Photometer Flux Calibration
Future improvement

Correction for evaporator temperature

Comparing new and old model fluxes

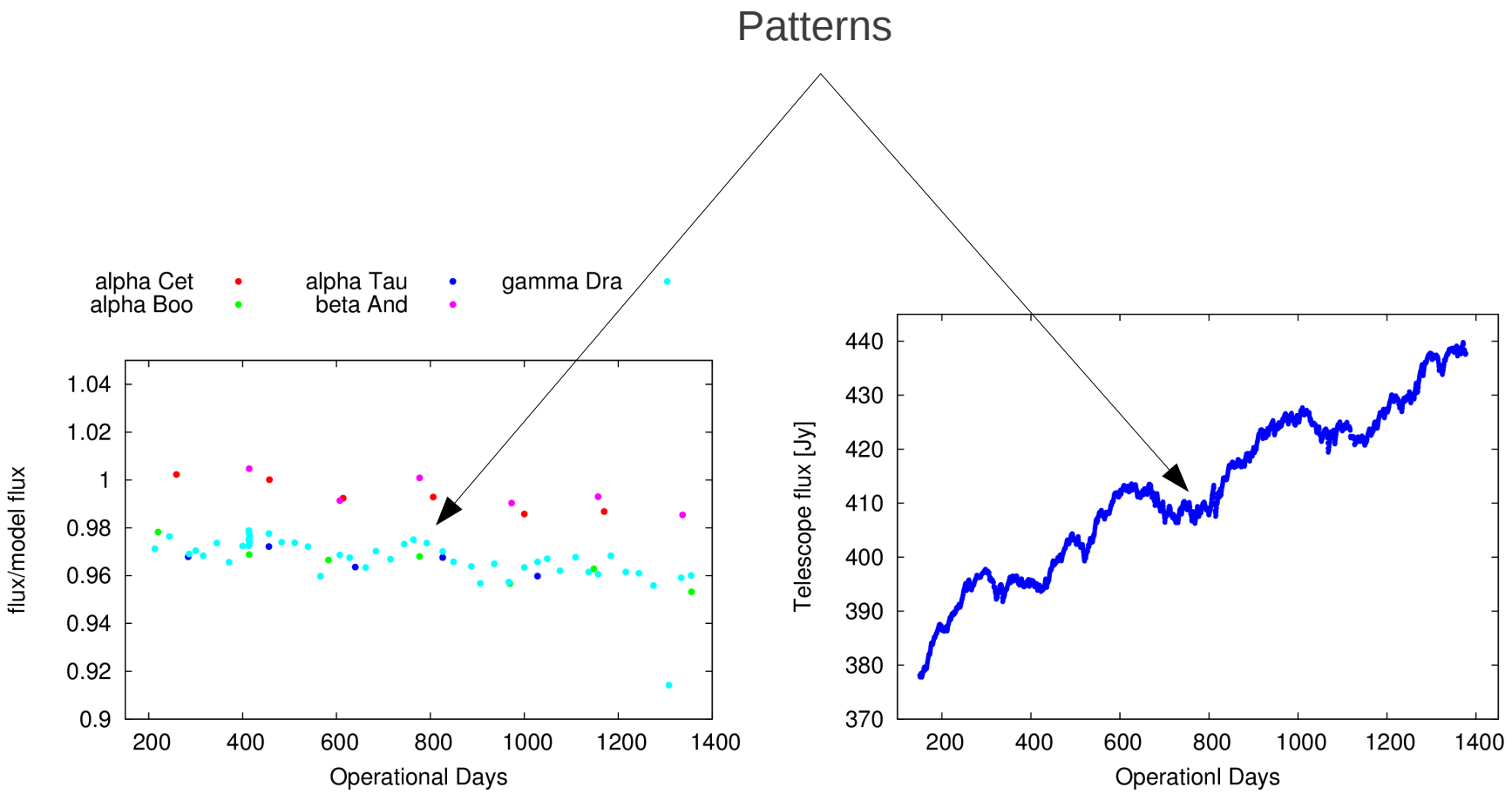
with evaporator temperature correction





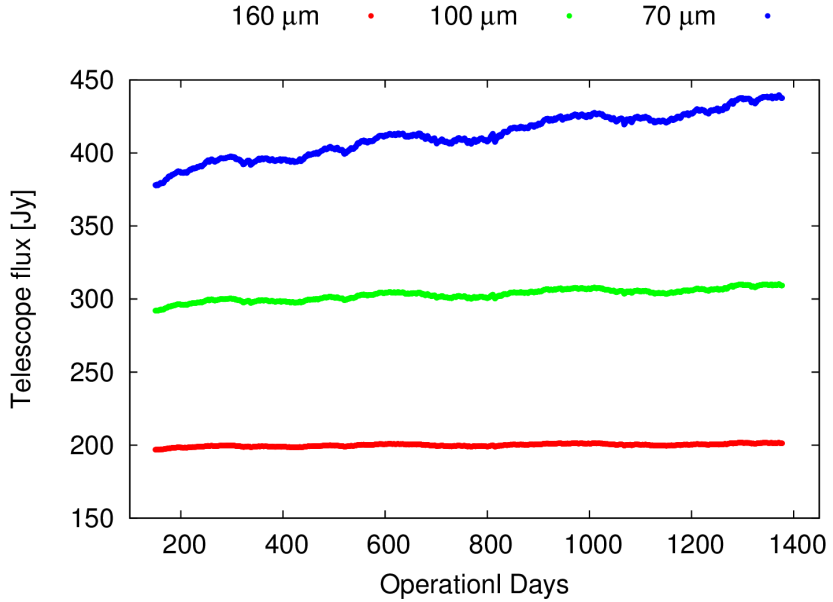
Pacs Photometer Flux Calibration
Future improvement

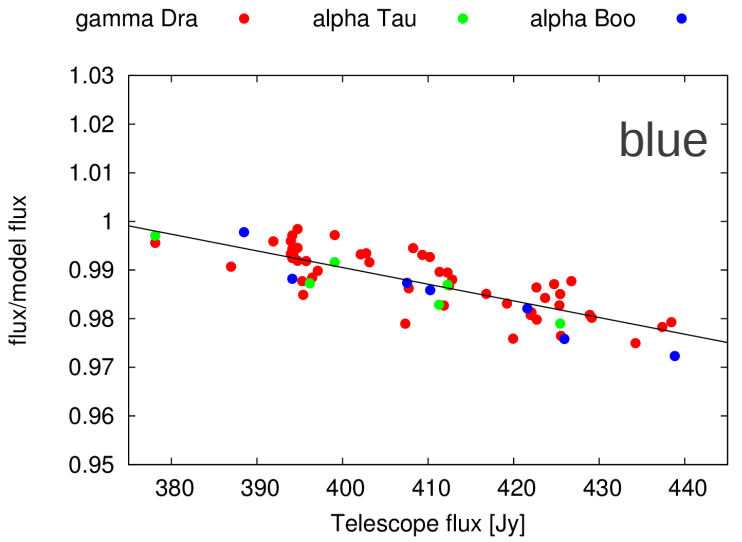
Correction for telescope flux

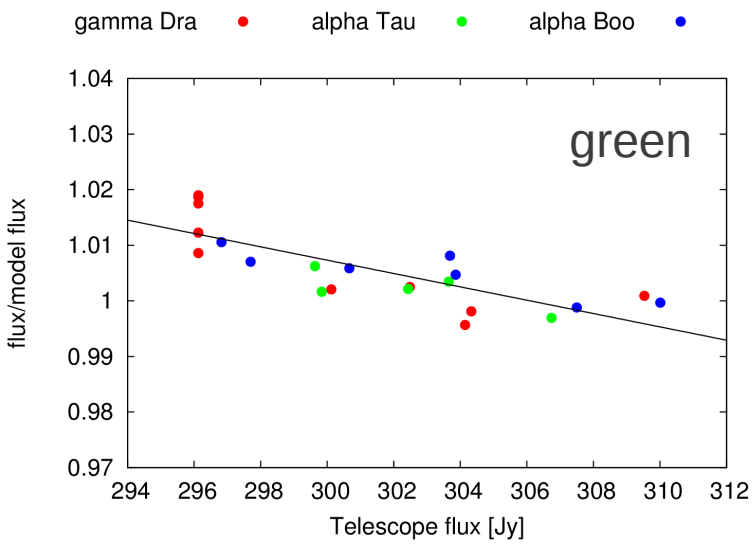


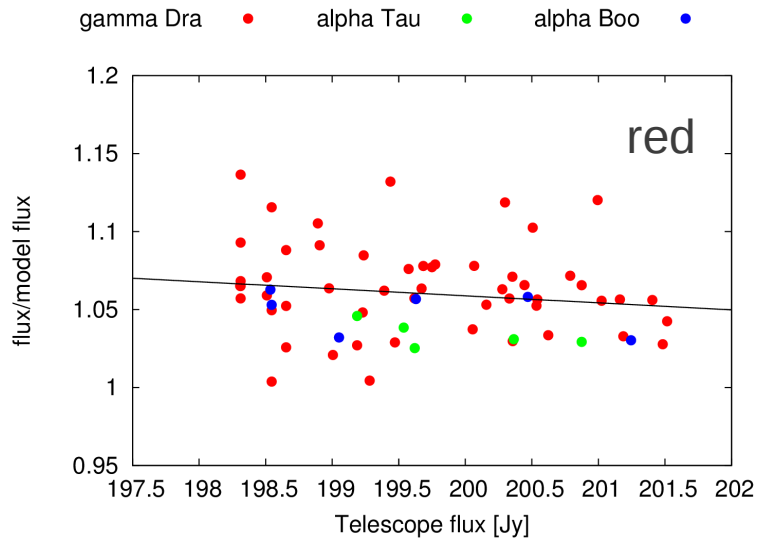
Pacs Photometer Flux Calibration
Future improvement

Correction for telescope flux





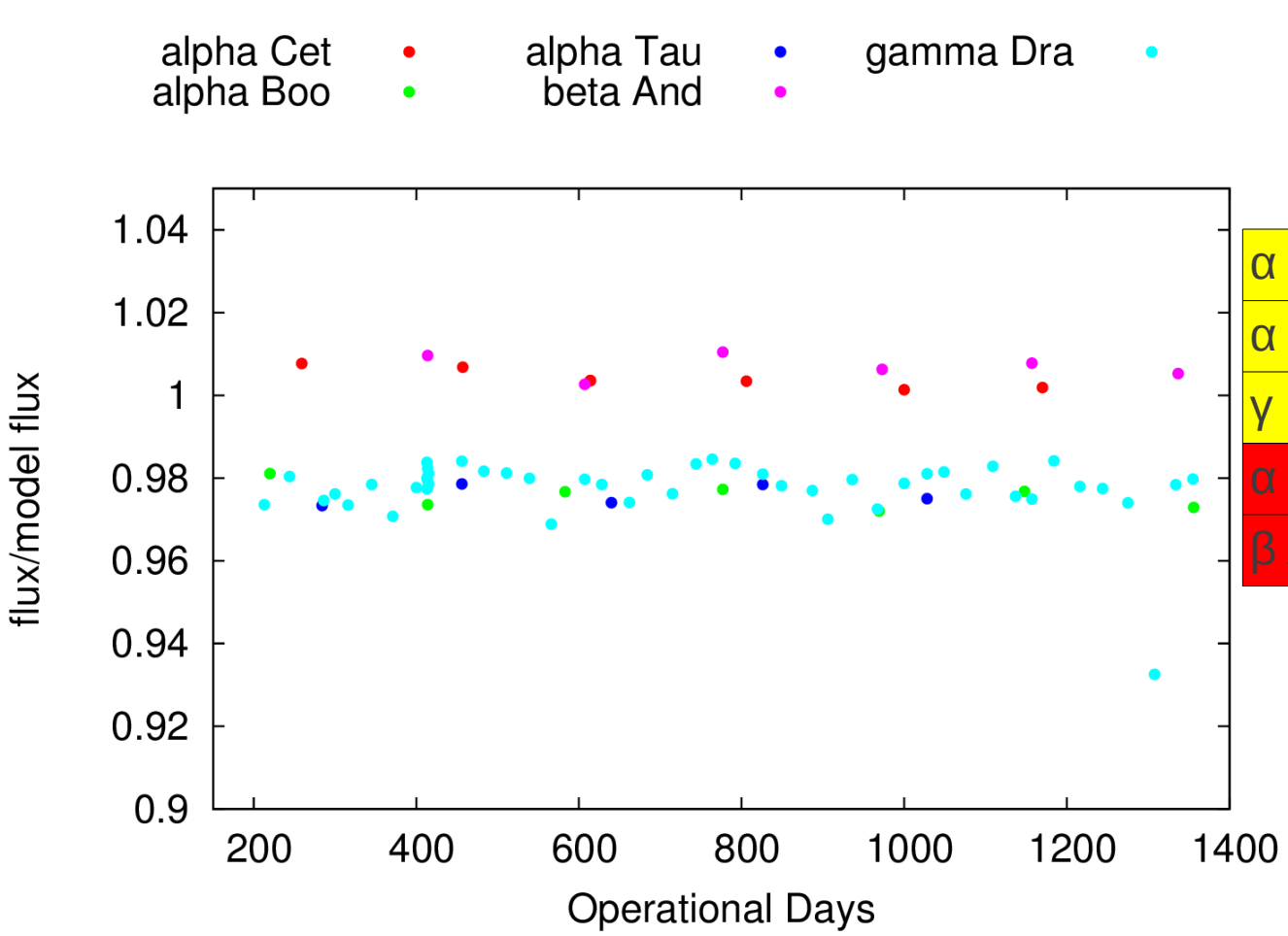




Pacs Photometer Flux Calibration Future improvement

Photometry of fiducial stars

blue filter:



Current calibration

α Tau	0.976	0.002	0.017
α Boo	0.976	0.003	0.015
γ Dra	0.978	0.004	0.009
α Cet	1.004	0.002	0.004
β And	1.007	0.003	0.007

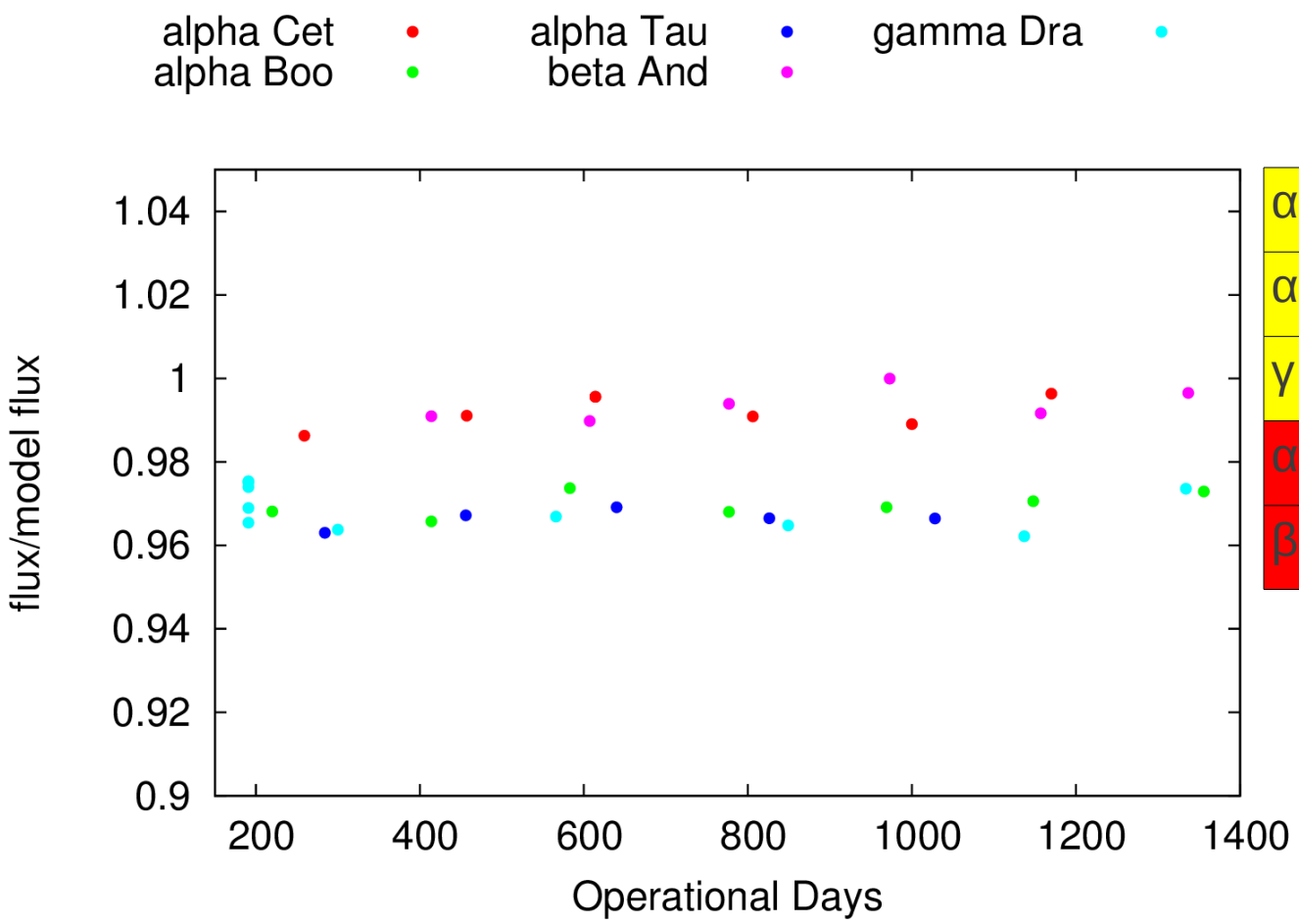
Mean: 0.982±0.016

Pacs Photometer Flux Calibration Future Improvement

Photometry of fiducial stars

green filter:

Current calibration



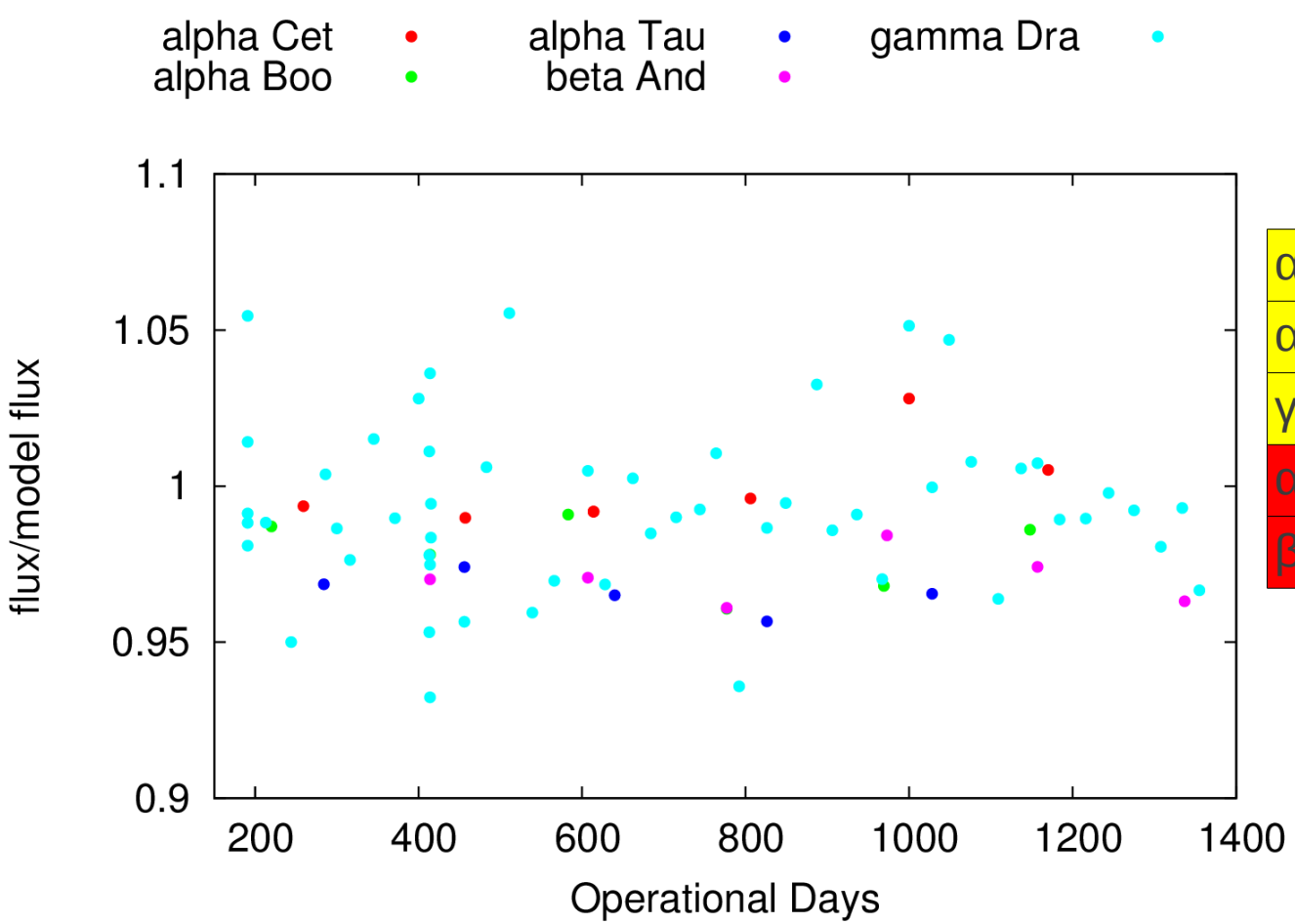
α Tau	0.976	0.002	0.015
α Boo	0.979	0.003	0.014
γ Dra	0.979	0.005	0.011
α Cet	1.002	0.004	0.004
β And	1.004	0.004	0.006

Mean: 0.989±0.014

Pacs Photometer Flux Calibration Future Improvement

Photometry of fiducial stars

red filter:



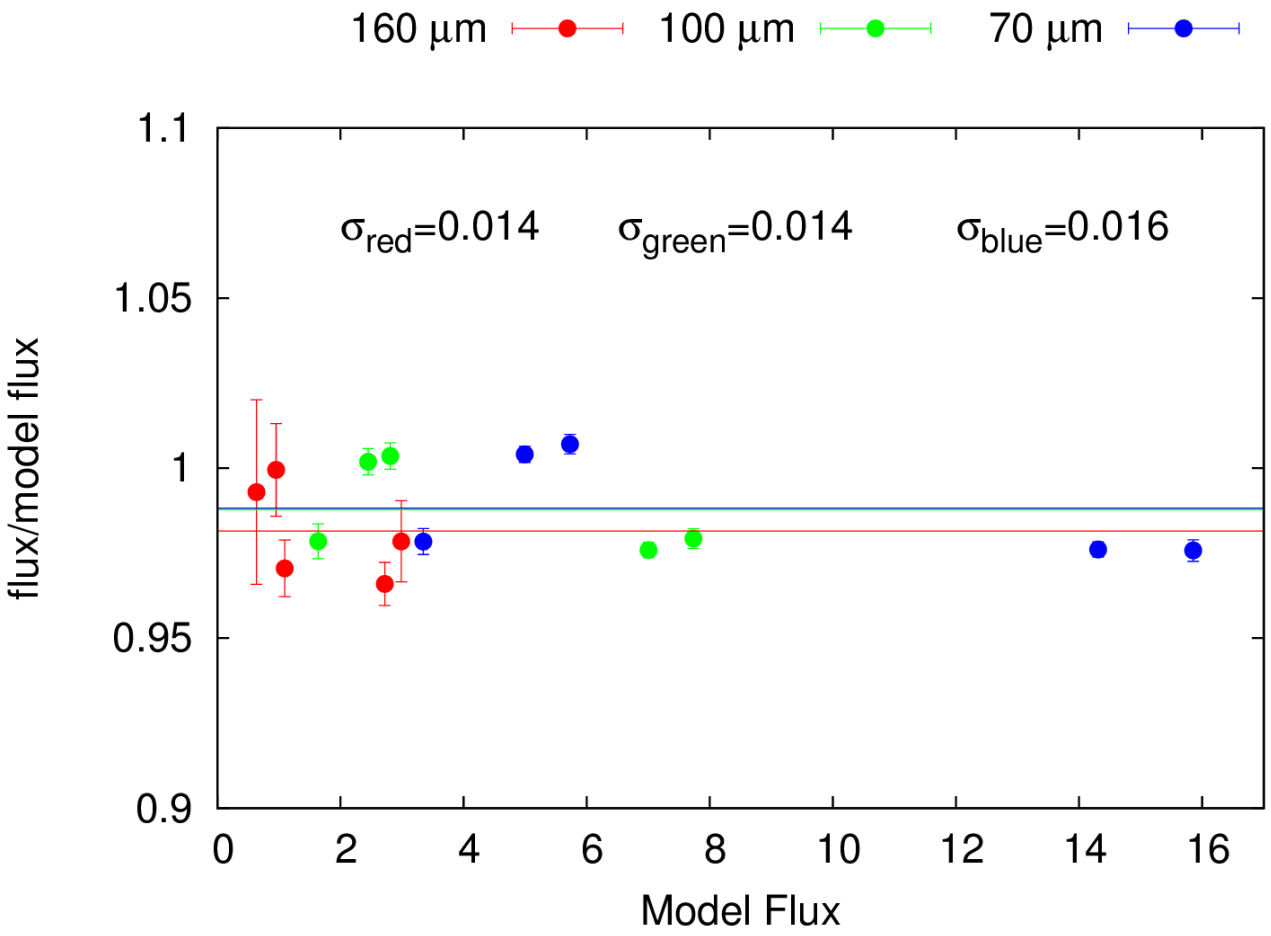
Current calibration

α Tau	0.966	0.006	0.019
α Boo	0.979	0.012	0.023
γ Dra	0.993	0.027	0.030
α Cet	0.999	0.014	0.014
β And	0.971	0.008	0.010

Mean:0.982±0.014

Pacs Photometer Flux Calibration Future improvement

Photometry of fiducial summary



Mean: 0.982±0.016

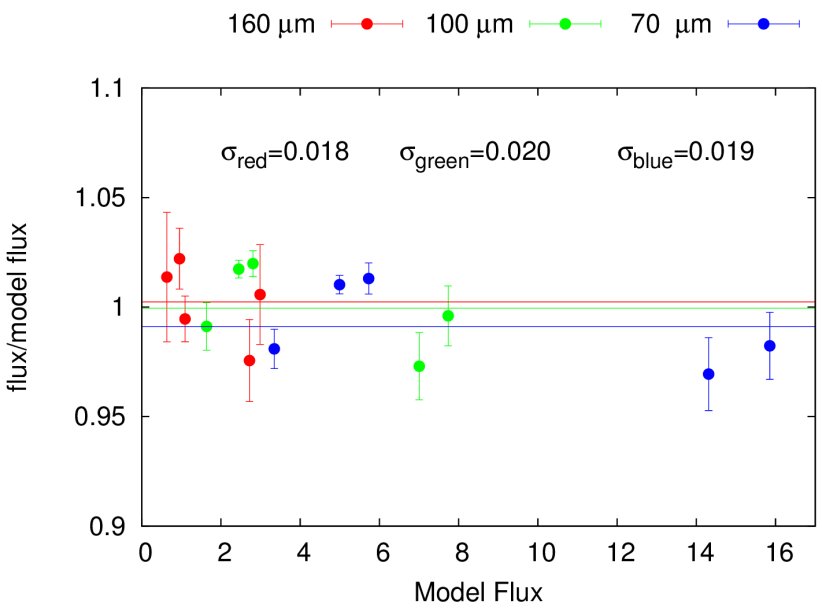
Mean: 0.989±0.014

Mean: 0.982±0.014

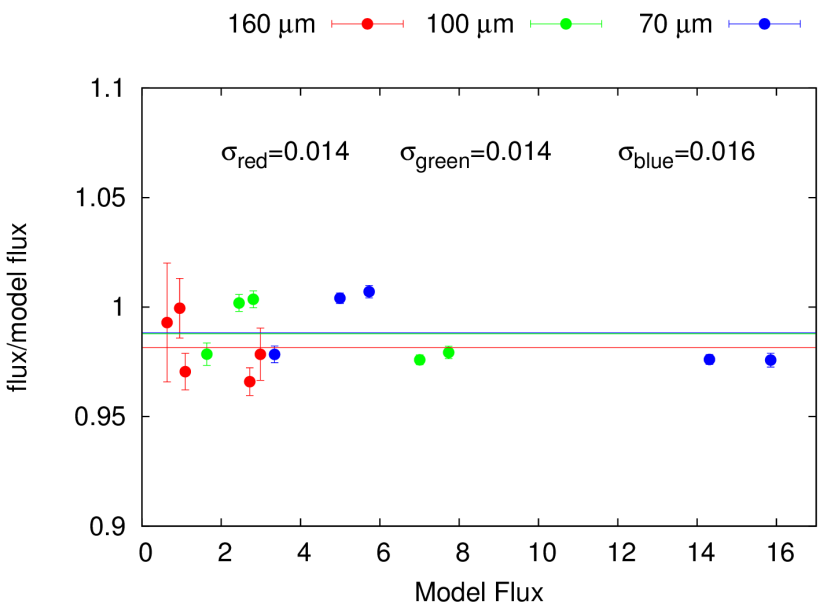
Pacs Photometer Flux Calibration Future improvement

Photometry of fiducial summary

Current



Improved



Pacs Photometer Flux Calibration Summary

- Current calibration is within the expected limit (uncertainity ~ 5%) in all bands dominated by model uncertainties
- With further corrections the uncertainty coming from instrumental effects can be significantly improved
  - Ongoing work
  - Aim in intrinsic uncertainty (repeatability) < 1%
  - Currently the absolute flux calibration is limited by model flux uncertainty
  - Clear distinction between K and M stars
- Complete reprocessing of all calibrators after the He boil-off
- New calibration file expected to bring the flux calibration back to the average of the five fiducial stars
  - Improved model fluxes
  - T_{EV} correction
  - Telescope flux correction
  - new focal plane geometry (see M. Nielbock talk)