Coronagraphic Imaging of the Exoplanet TWA 7 b

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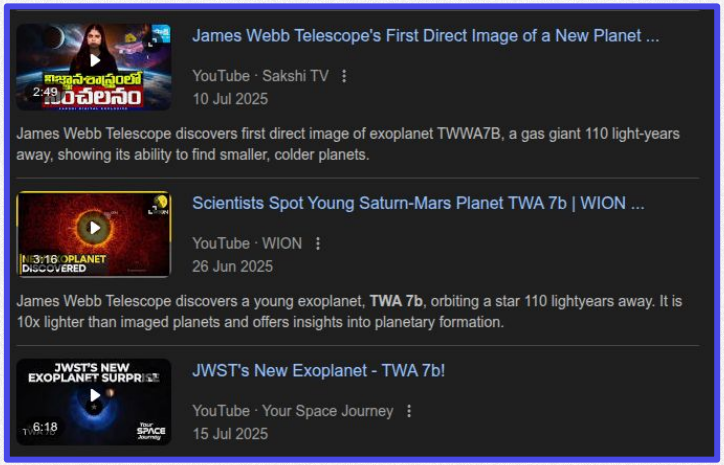
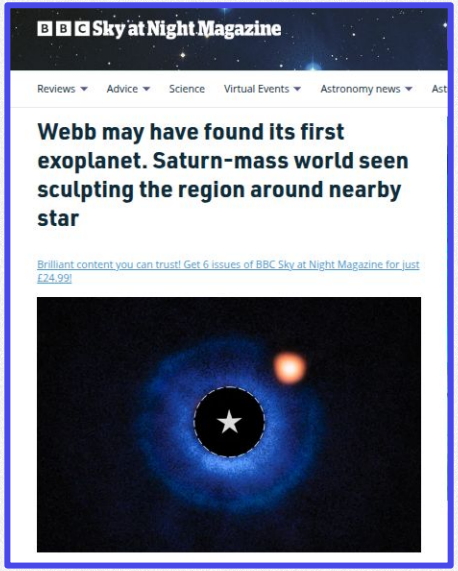




Evidence for a sub-jovian planet in the young TWA7 disk

A.-M. Lagrange[1,2]*, C. Wilkinson[1], M. Mâlin[3], A. Boccaletti[1], C. Perrot[1], L. Matrà[4], F. Combes[5], D. Rouan[1], H. Beust[2], A. Chomez[1,2], B. Charnay[1], S. Mazevet[6], O. Flasseur[7], J. Olofsson[8], A. Bayo[8], Q. Kral[1], G. Chauvin[6], P. Thebault[1], P. Rubini[9], J. Milli[2], F. Kiefer[1], A. Carter[10], K, Crotts[10], A. Radcliffe[1], J. Mazoyer[1], T. Bodrito[11], S. Stasevic[1], P. Delorme[2], M. Langlois[7]

Under revision at Nature
Initial version submitted on July, 25th, 2024
Revised version submitted on January, 19th, 2025

Stage 1

TWA7b_MIRI_Reduction.ipy

Markdown

The following cell will run the `Coron1Pipeline` for all input data in the spaceKLIP database, saving the output to a subdirectory named `stage1`. This can take a long time to run, so be patient.

```
spaceKLIP.coron1pipeline.run_obs(database=database,
                                 steps={'group_scale': {'skip': False},
                                        'dq_init': {'skip': False, 'save_results':False},
                                        'saturation': {'n_pix_grow_sat': 1,
                                                       'grow_diagonal': False},
                                        'ipc': {'skip': True},
                                        'firstframe': {'skip': False},
                                        'lastframe': {'skip': False},
                                        'reset': {'skip': False},
                                        'linearity': {'skip': False},
                                        'rscd': {'skip': False},
                                        'dark_current': {'skip': True},
                                        'refpix': {'skip': False,
                                                   'odd_even_columns': True,
                                                   'four_group_rejection_threshold': 8.,
                                                   'maximum_cores': '1'},
                                        'ramp_fit': {'save_calibrated_ramp': False,
                                                     'maximum_cores': '1'},
                                        'gain_scale': {'skip': False}},
                                 subdir='stage1')
```

Kernel Restarting

The kernel for TWA7b_MIRI_Reduction.ipynb appears to have died. It will restart automatically.

Ok

```
[spaceKLIP.coron1pipeline:INFO] --> Concatenation JWST_MIRI_MIRIMAGE_F1140C_NONE_4QPM_1140_MASK1140
[spaceKLIP.coron1pipeline:INFO]   --> Coron1Pipeline: processing jw03662001001_04101_00001_mirimage_uncal.fits
```

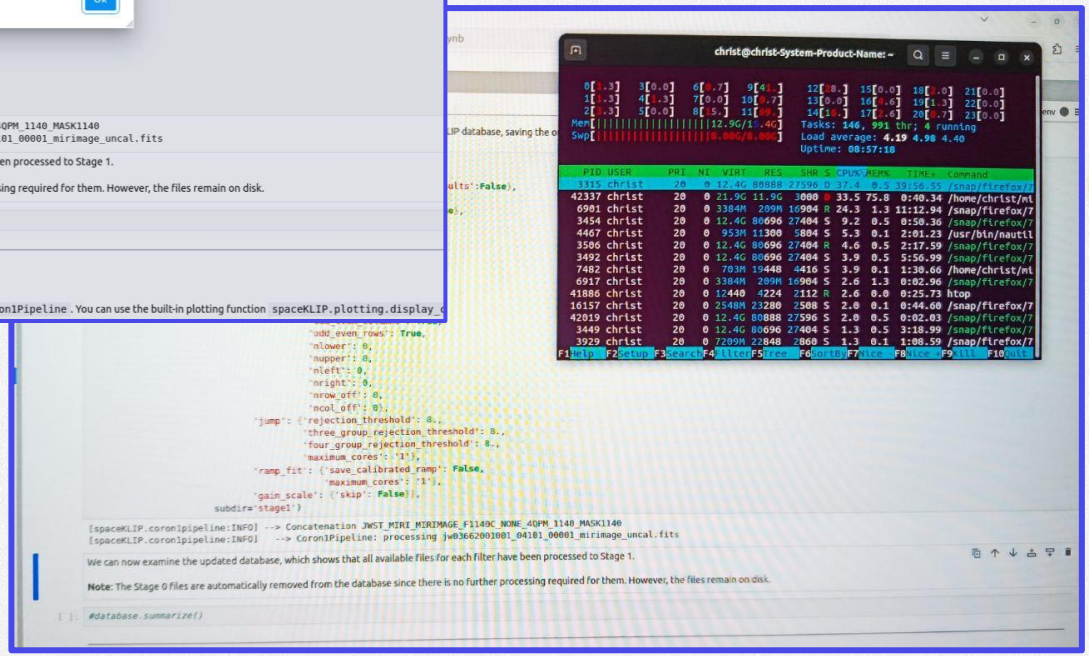
We can now examine the updated database, which shows that all available files for each filter have been processed to Stage 1.

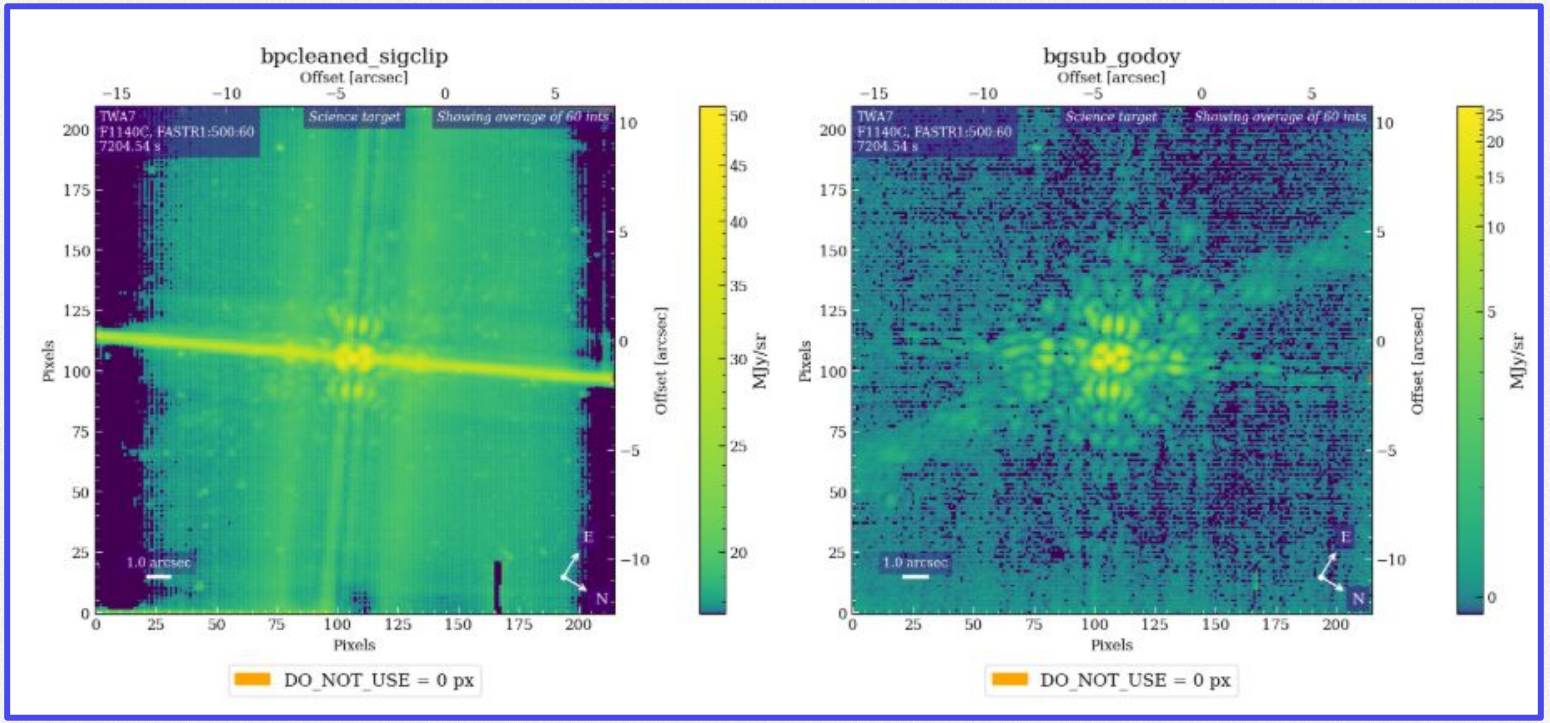
Note: The Stage 0 files are automatically removed from the database since there is no further processing required for them. However, the files remain on disk.

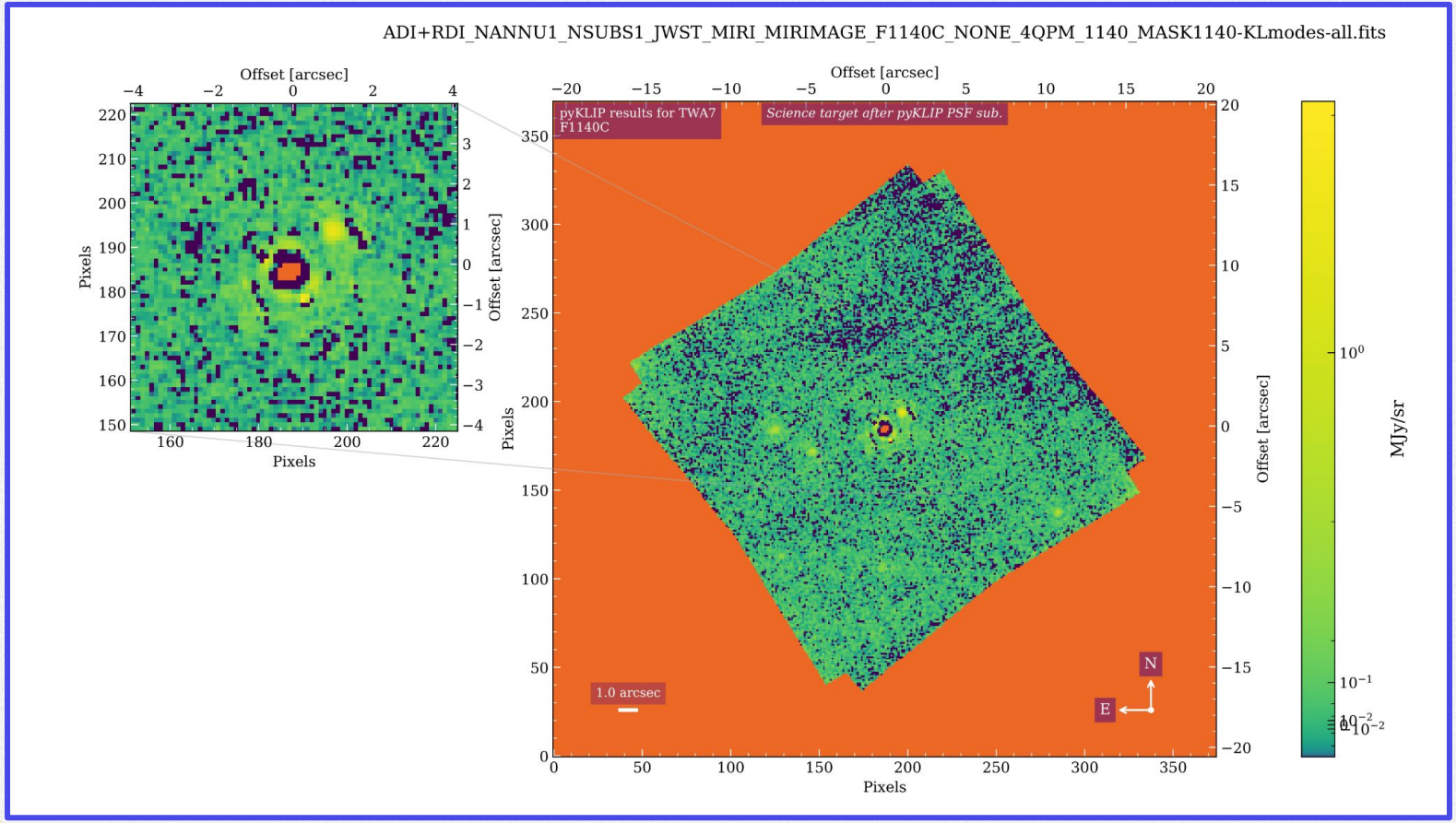
```
#database.summarize()
```

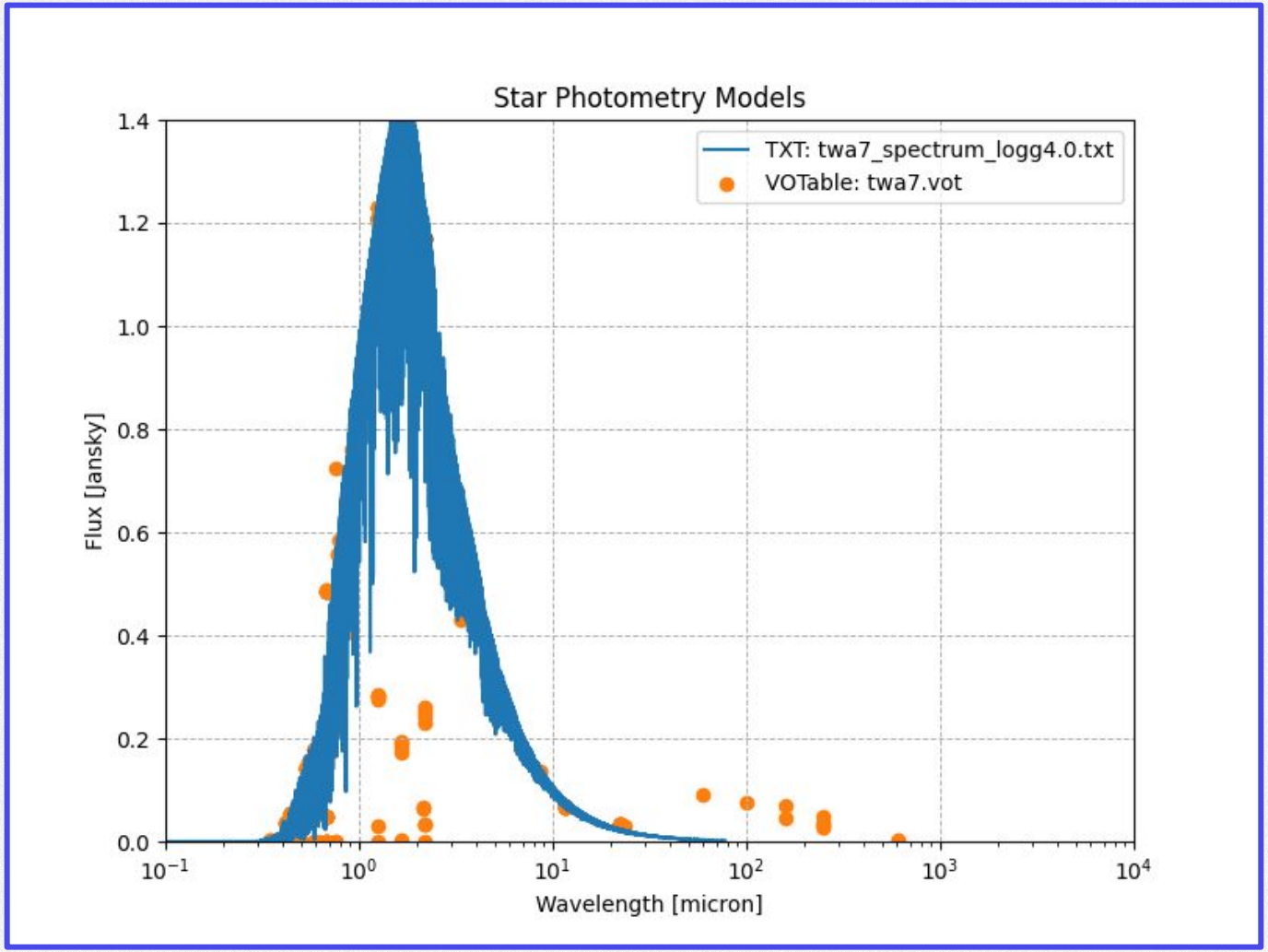
Display Stage 1 Reductions

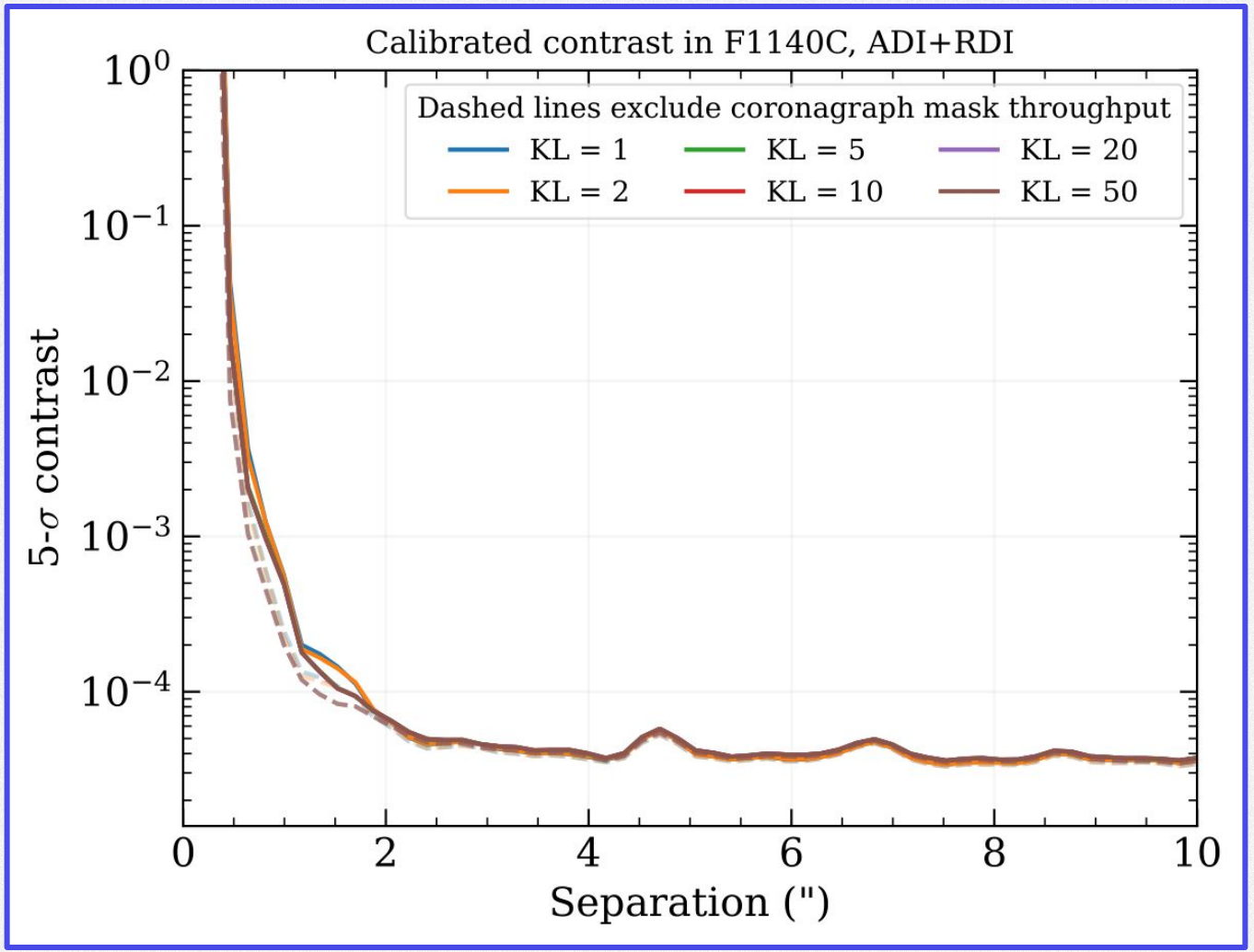
Let's examine the science and reference PSF data in the F1550C filter we processed through the `Coron1Pipeline`. You can use the built-in plotting function `spaceKLIP.plotting.display_c`




bpcleaned_sigclip
Offset [arcsec]
TWA7
F1140C, FASTR1:500:60
7204.54 s
Science target
Showing average of 60 ints
Pixels
Offset [arcsec]
MJy/sr
1.0 arcsec
E
N
DO_NOT_USE = 0 px
bgsub_godoy
Offset [arcsec]
TWA7
F1140C, FASTR1:500:60
7204.54 s
Science target
Showing average of 60 ints
Pixels
Offset [arcsec]
MJy/sr
1.0 arcsec
E
N
DO_NOT_USE = 0 px


ADI+RDI_NANNU1_NSUBS1_JWST_MIRI_MIRIMAGE_F1140C_NONE_4QPM_1140_MASK1140-KLmodes-all.fits
Offset [arcsec]
Pixels
Offset [arcsec]
pyKLIP results for TWA7
F1140C
Science target after pyKLIP PSF sub.
1.0 arcsec
N
E
MJy/sr


Star Photometry Models
TXT: twa7_spectrum_logg4.0.txt
VOTable: twa7.vot
Flux [Jansky]
Wavelength [micron]
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
10^{4}


Calibrated contrast in F1140C, ADI+RDI
Dashed lines exclude coronagraph mask throughput
KL = 1
KL = 2
KL = 5
KL = 10
KL = 20
KL = 50
5-σ contrast
Separation (")
10^0
10^-1
10^-2
10^-3
10^-4
0
2
4
6
8
10

@VEGASTROMAHDI

You could find me on the Instagram!

Thank You!