

KLIP for IFS data: a preliminary demonstration

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KLIP: Karhunen-Loeve Image Projection

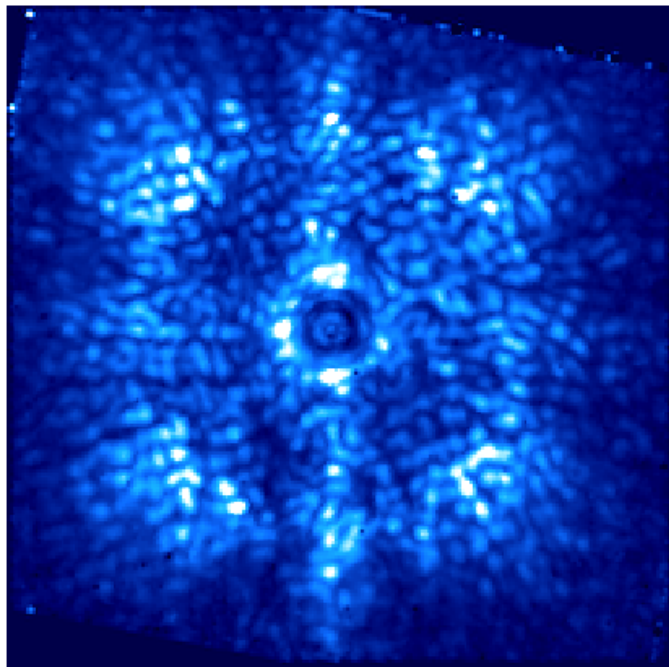
- by Soummer & Pueyo & Larkin (2012)
- Main advantage over LOCI for point source detection and characterization:

Because the propagation of a companion through the algorithm depends only on the projection of the source onto a basis formed strictly from the reference data set, forward modeling is possible. This can alleviate bias in astrometry and photometry.

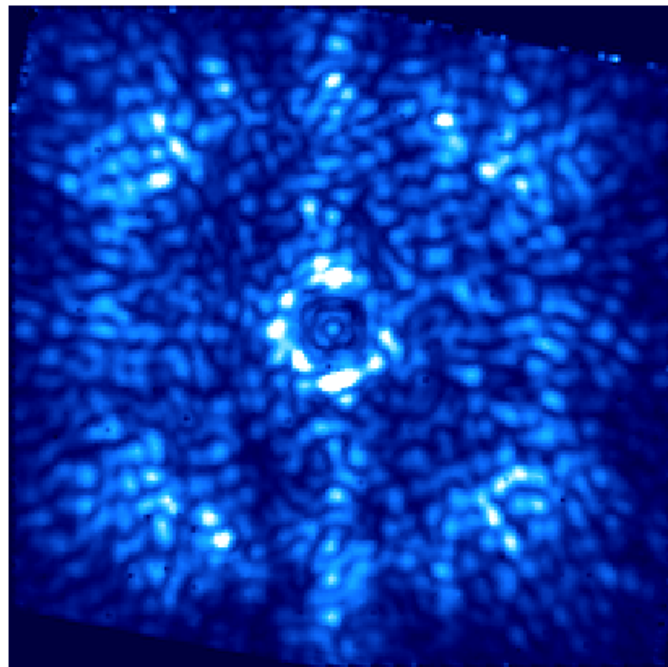
Lab IFS data cube (provided by Dino Mesa)

Y + J band: 37 channels spanning 0.951 – 1.349 μm

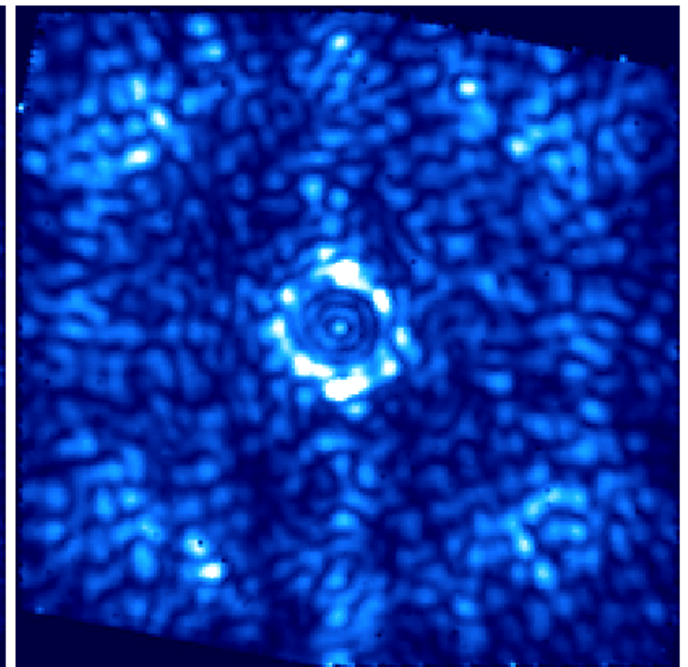
chan 1



chan 18



chan 35



0

20

40

60

80

100

120

140

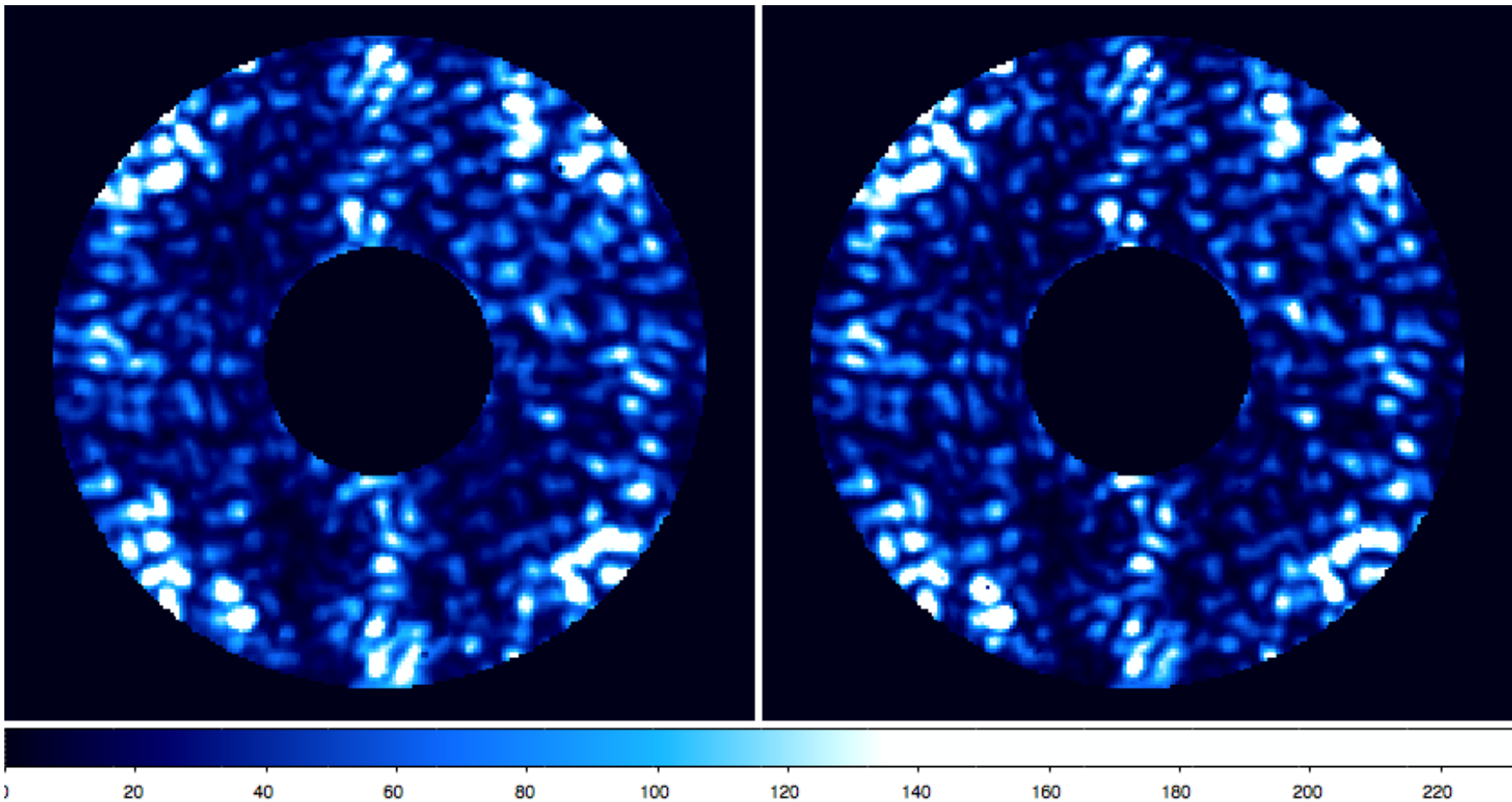
160

First step: registration

- To rescale cube to aberration space, need to solve for center and the stretch factors for each channel → a non-trivial optimization problem

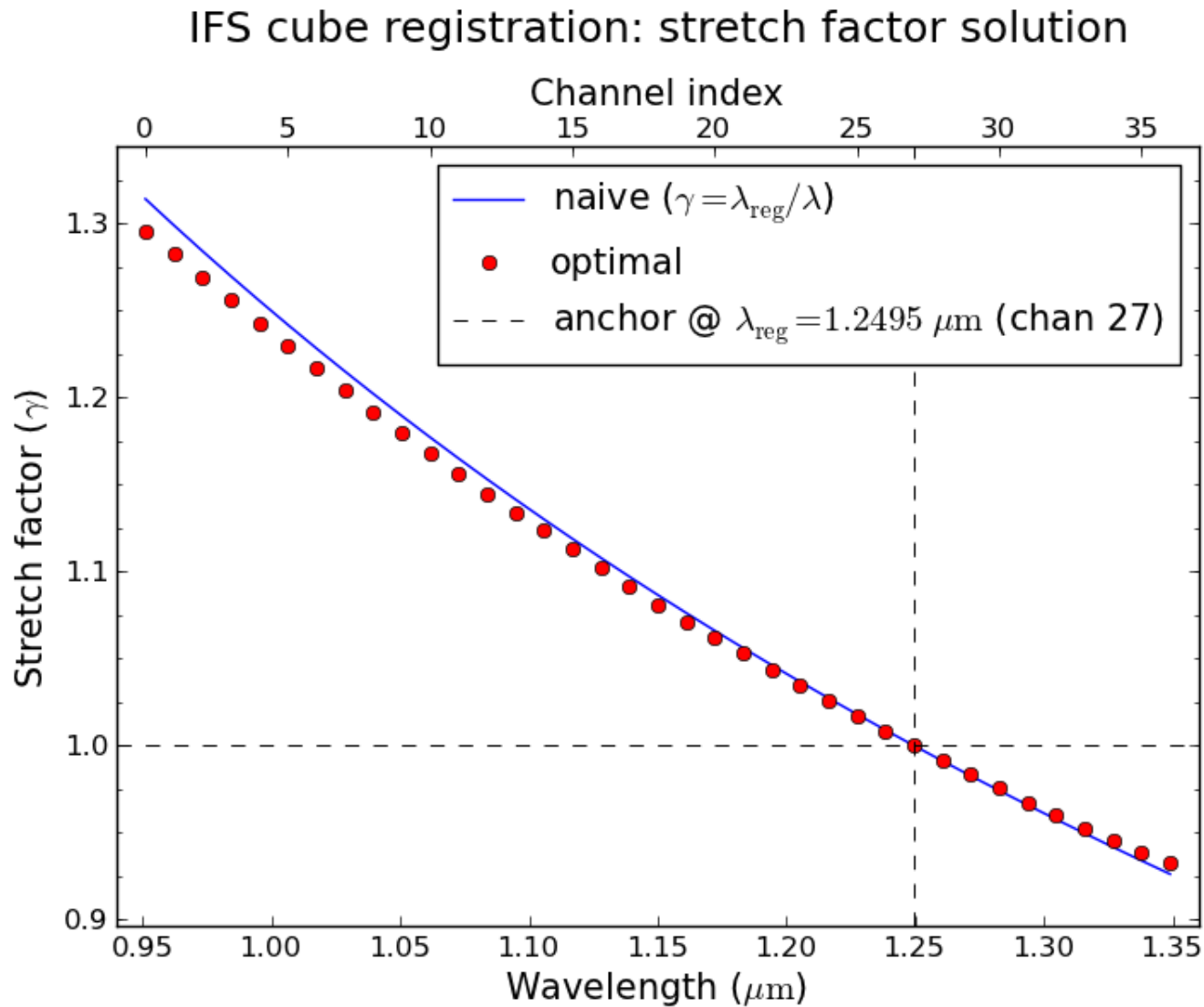
chan 1 (rescaled)

chan 35 (rescaled)

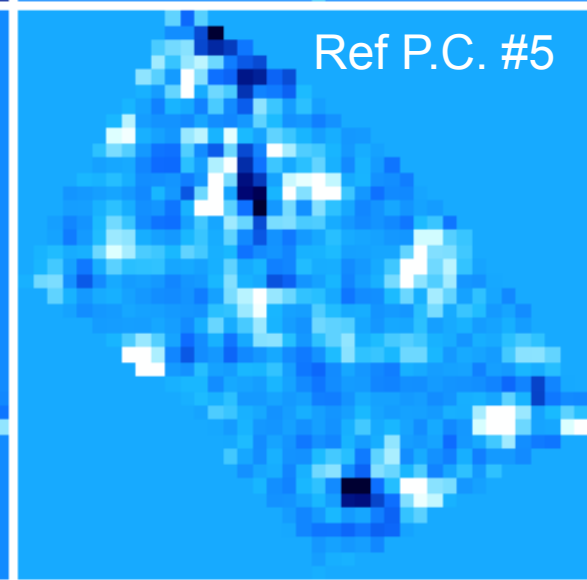
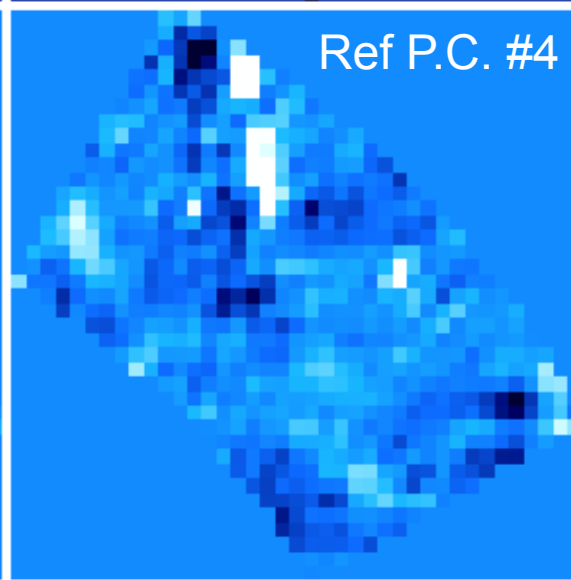
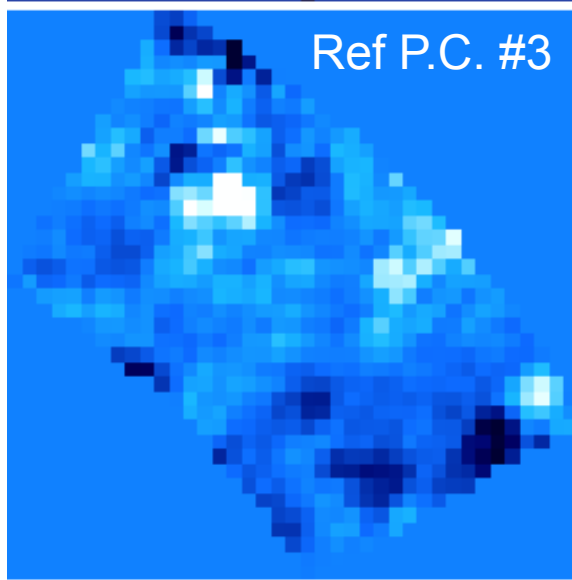
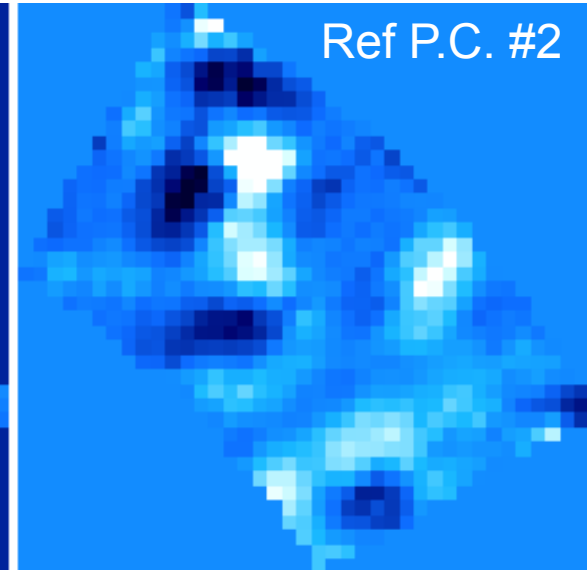
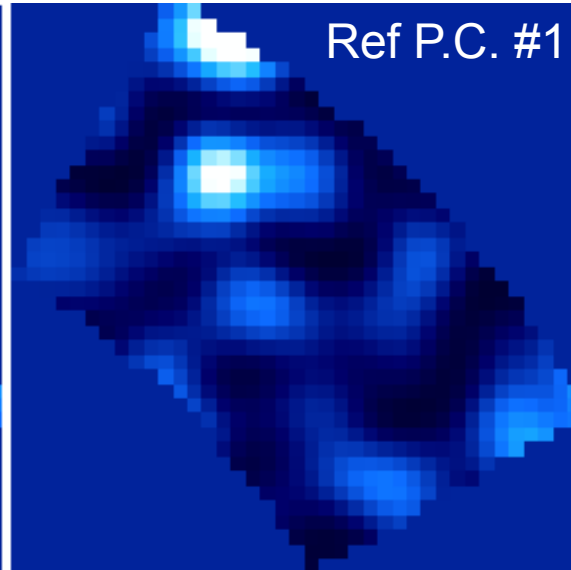
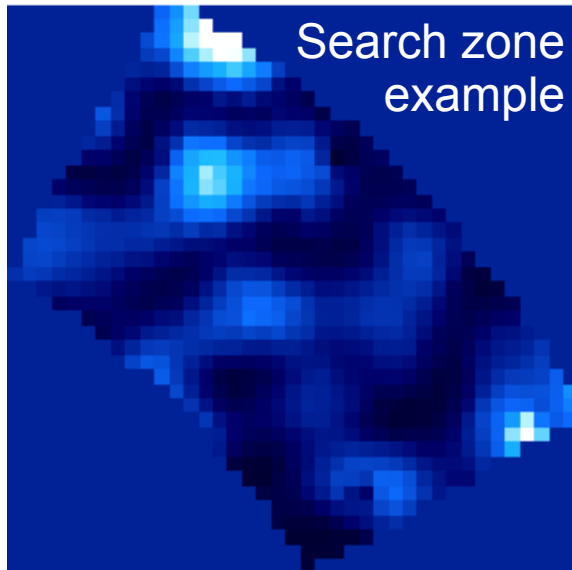


First step: registration

The registration is anchored with respect to chan 27, the center of J-band (1.25 μm).



Search scheme: 3 annuli x 12 azimuthal zones
spanning radii $0.25''$ - $0.72''$ from star

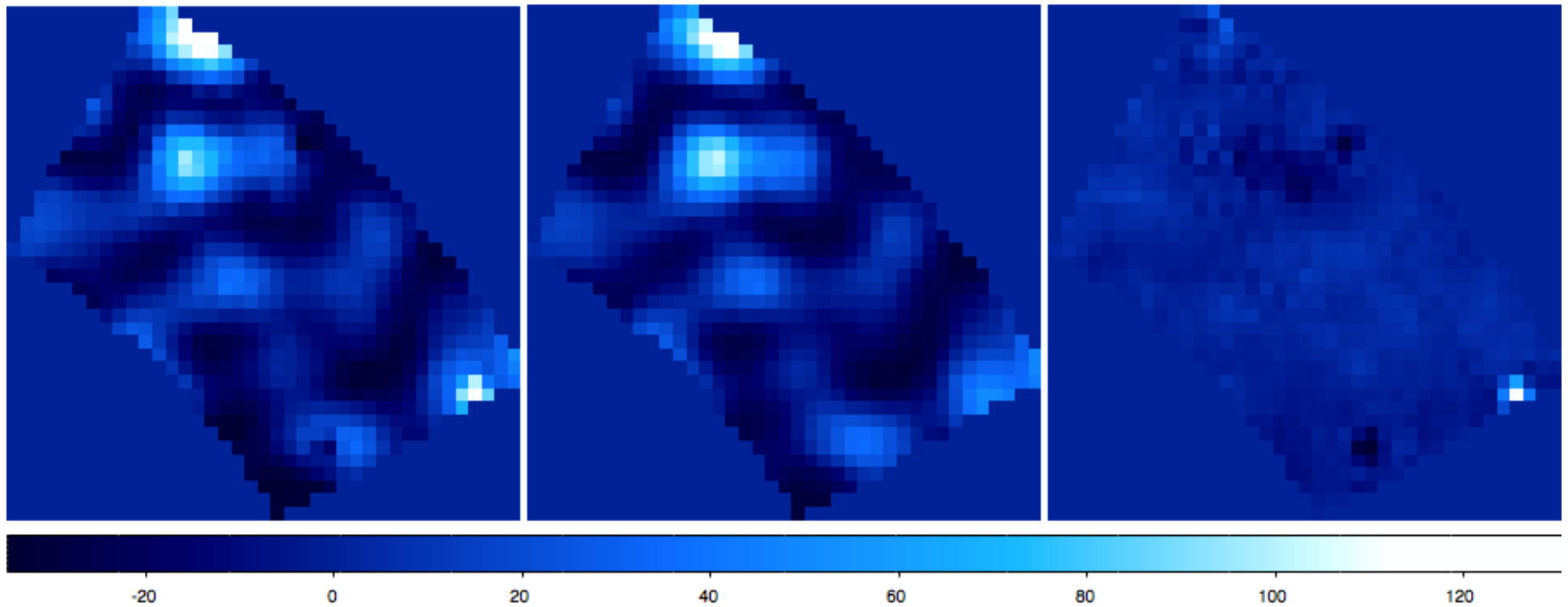


Example KLIP subtraction: chan 28, annulus radius span [0.41", 0.57"]

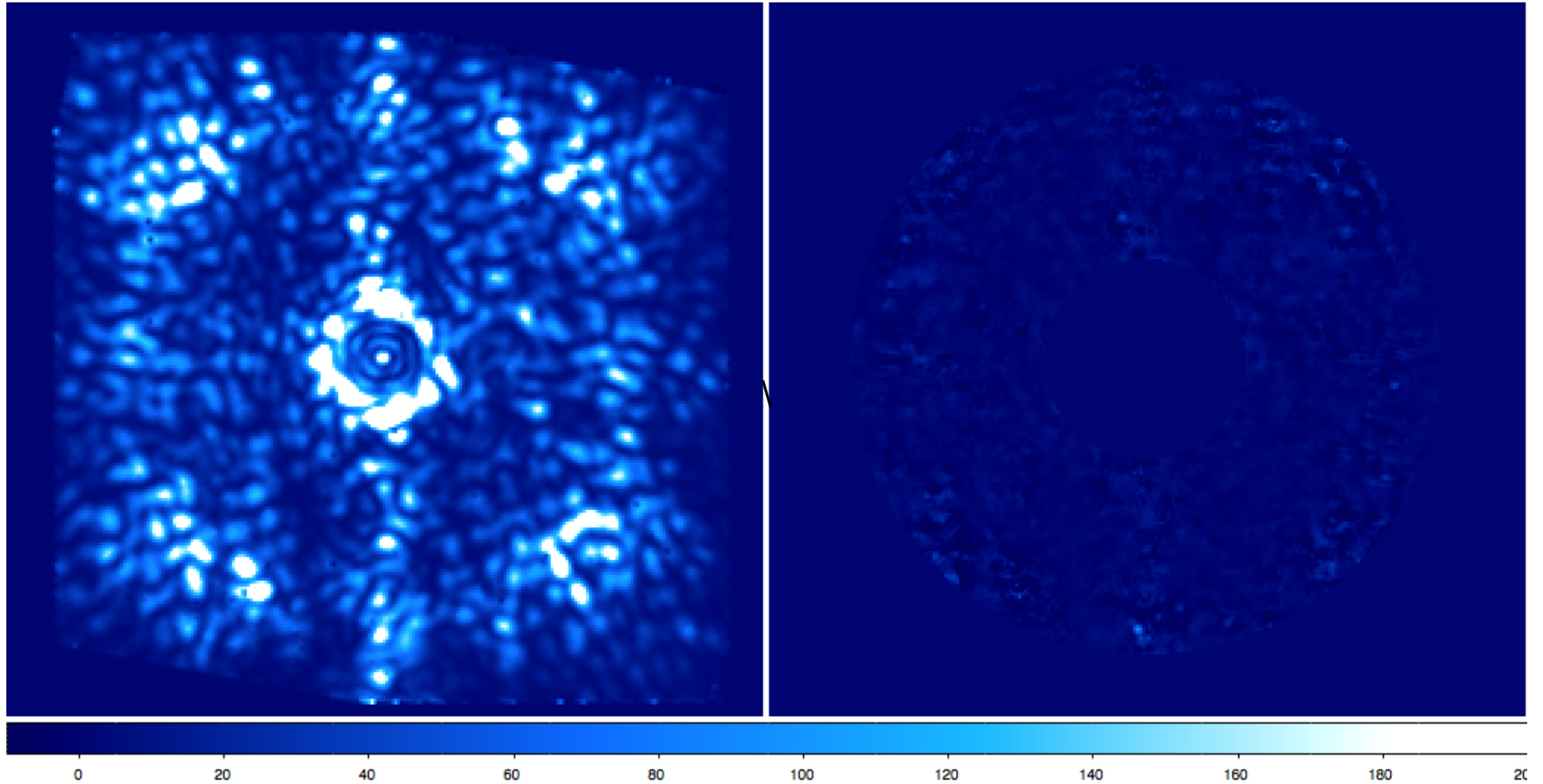
Target data

Local KLIP PSF estimate

Residual



Full subtraction result (chan 28)



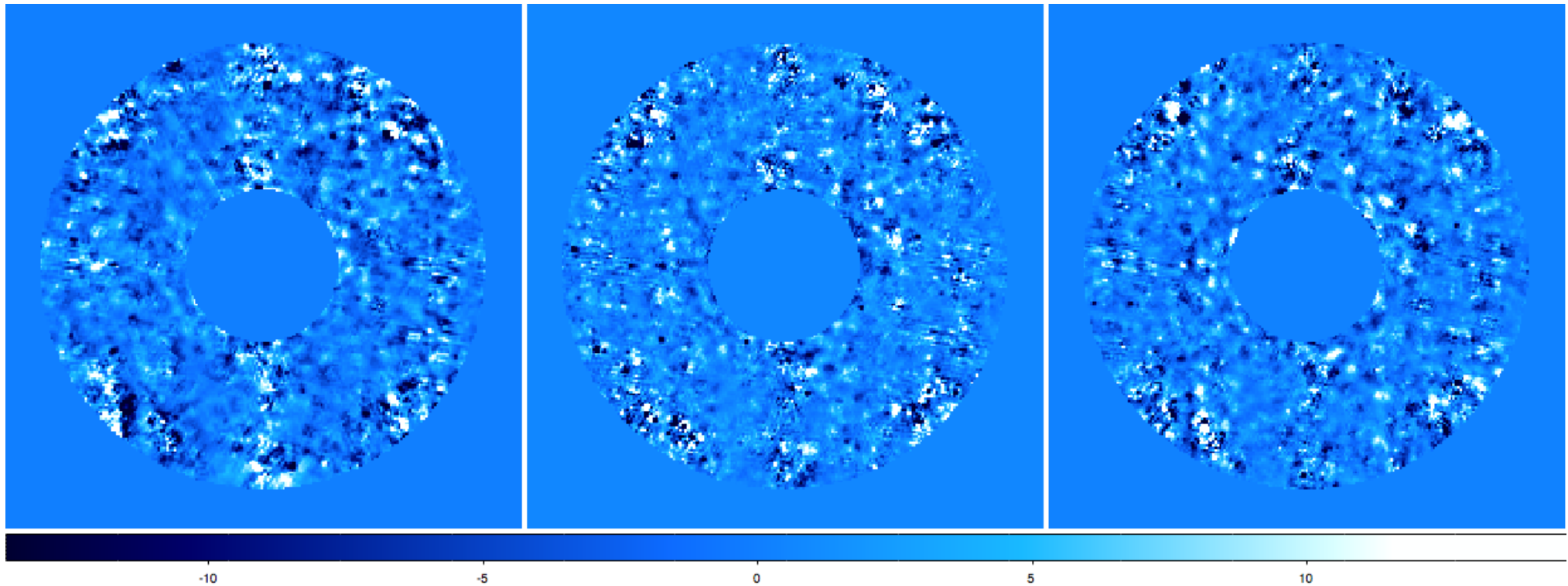
this is a matched linear flux scale

A closer look at the residual noise

chan 1

chan 18

chan 35



Next steps

- Include outlier pixel filtering
- Implement outer search zones with more complicated geometry (corners, boundaries)
- Add synthetic planet signals, implement forward modeling to assess spectrum retrieval accuracy as a func of contrast
- Incorporate more lab data as it becomes available
→ larger, more realistic reference library