Status of Processing NIRI Images for SN 2001hb (Satie)

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LBL

17 Jun 03

NIRI on Gemini North

Camera	**f/6**
Pixel Size	**0.″1163**
Science Field of View	**119.″9x119.″9**
Array	**Aladdin InSb**
Pixel format	**1024x1024 27** μm
Spectral Response	**1 to 5.5** μm
Dark Current	**0.25 e-/s/pix**
Dark Background	**0.5 e-/s/pix**
Read Noise (low background mode)	**13 e-/pix**
Read Noise (medium background mode)	**50 e-/pix**
Read Noise (high background mode)	**200 e-/pix**
Gain	**12.3 e-/ADU**
Well depth (near-IR)	**200,000 e-**
Well depth (thermal-IR)	**280,000 e-**
Quantum efficiency	90%
Flat field uniformity	$\pm 18\%$
Flat field repeatability	$\pm 0.3\%$
Residual image retention	$0.5 - 1\%$ **of a bright (saturated) source**
J-band zero-mag of a bright source	10.05 **(**80% **well depth)**
J-band background level (sky + scope)	50% **well in** 400 **s**

NIRI J-band Data Summary

J = 1.25 μm (1.15 - 1.33 μm)

$z \sim 1.05 \rightarrow$ **rest frame V-band**

14,15 May 2001 : bad

180 s exposure times saturate detector

16,17 May 2001 : bad weather

20,21,23,24 May 2001 : good

20 May $\rightarrow \quad 76 \times 60\ \mathrm{s} = 4560\ \mathrm{s}$

21 May $\rightarrow 151 \times 60\ \mathrm{s} = 9060\ \mathrm{s}$

23 May $\rightarrow 151 \times 60\ \mathrm{s} = 9060\ \mathrm{s}$

24 May $\rightarrow 142 \times 60\ \mathrm{s} = 8520\ \mathrm{s}$

Plus calibration stars

Total 8 h 51 m (520 images)

Average seeing $\sim 0\farcs5$ **for each night**

Total detection SNR = 15 (5-8 per night)

within radius of $0\farcs47$ **(4 pixels)**

Other Data

ISAAC IR imaging

HST Follow-up in I and Z

4 WFPC2/F814W

1 WFPC2/F850LP

Final references ACS/F850LP/F814W

Data Processing

Calibration flats (shutter open and closed)

- allow corrections dark current and thermal emission
- however, light path avoids mirrors affecting illumination variations compared to data frames
- night-to-night stability of 0.3%

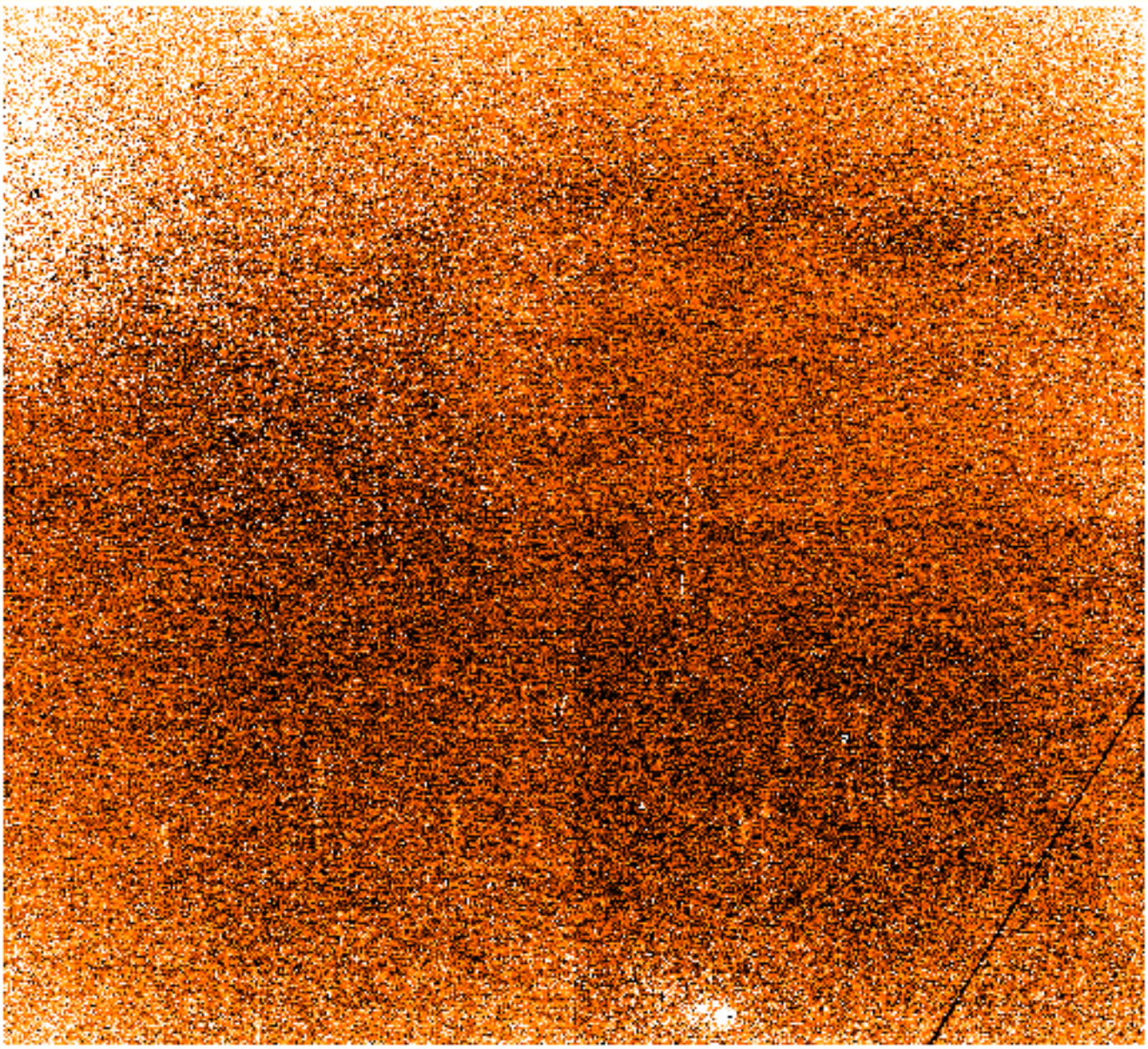
Sky flats

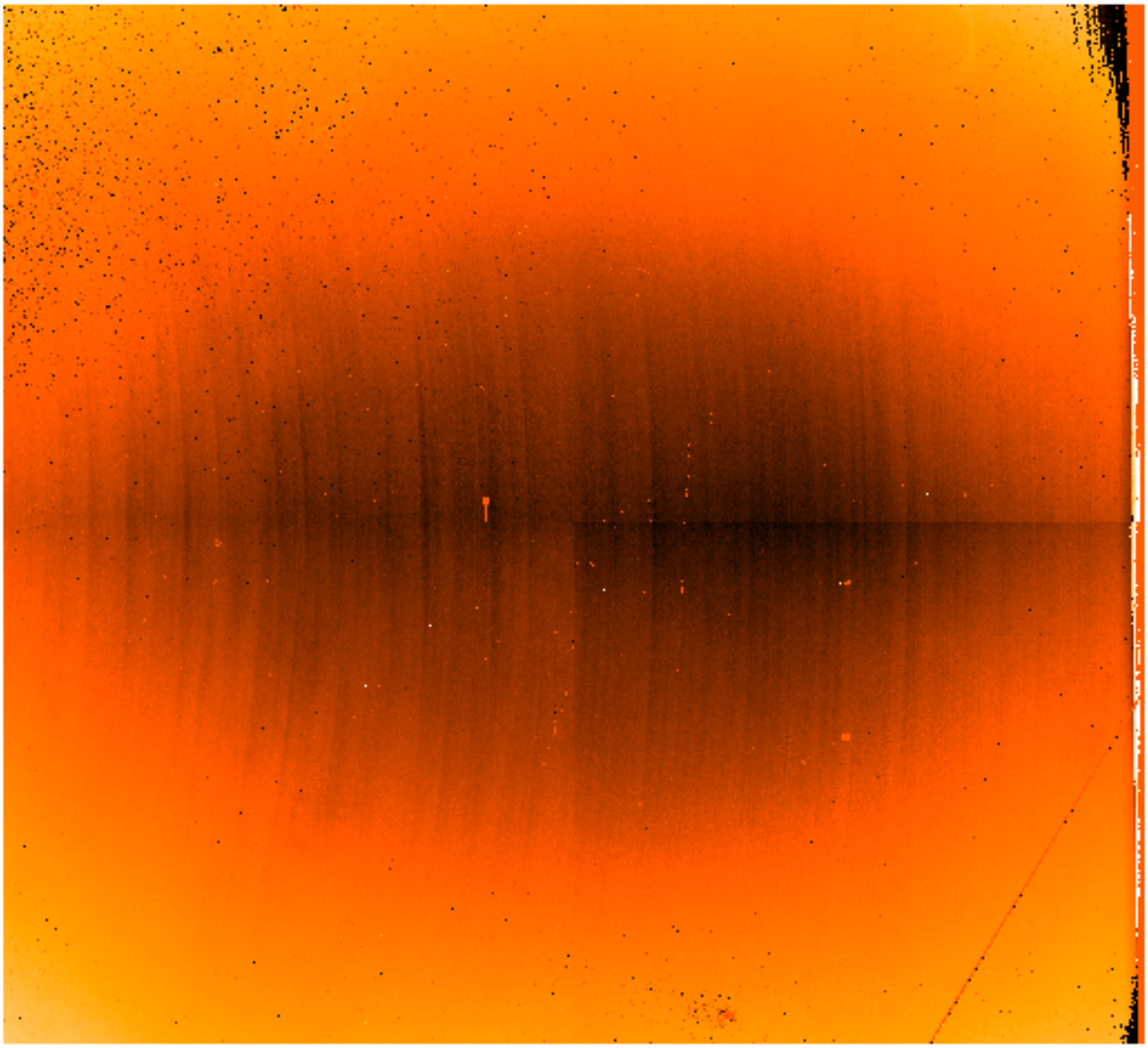
- cannot correct for dark and thermal components
- dark current variations (timescale of hours) limit accuracy
- example dark (see figure $\rightarrow$)
- differences from "cal" flats can be $2-3\%$ (see figure $\rightarrow$)
- large-scale pattern differences small compared to changes in dark current
- but found to better flatten data - r.m.s. reduced by $\sim 1\%$
- built sky flats for each good night

NIRI software

(IRAF package) used to dark substract, gain correct, and flat-field

(see figure of raw frame $\rightarrow$)
(see figure of sky-flattened frame $\rightarrow$)





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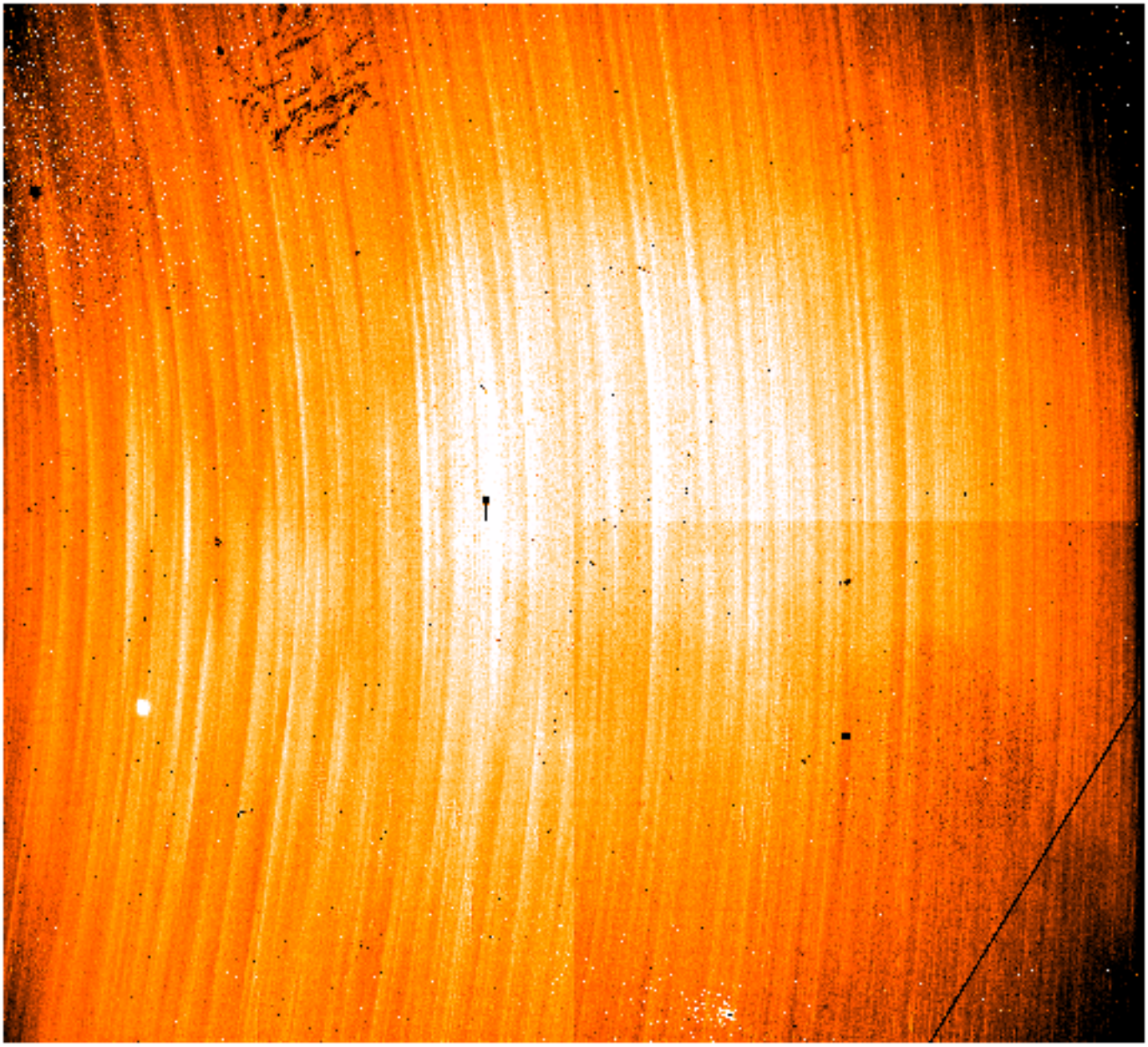

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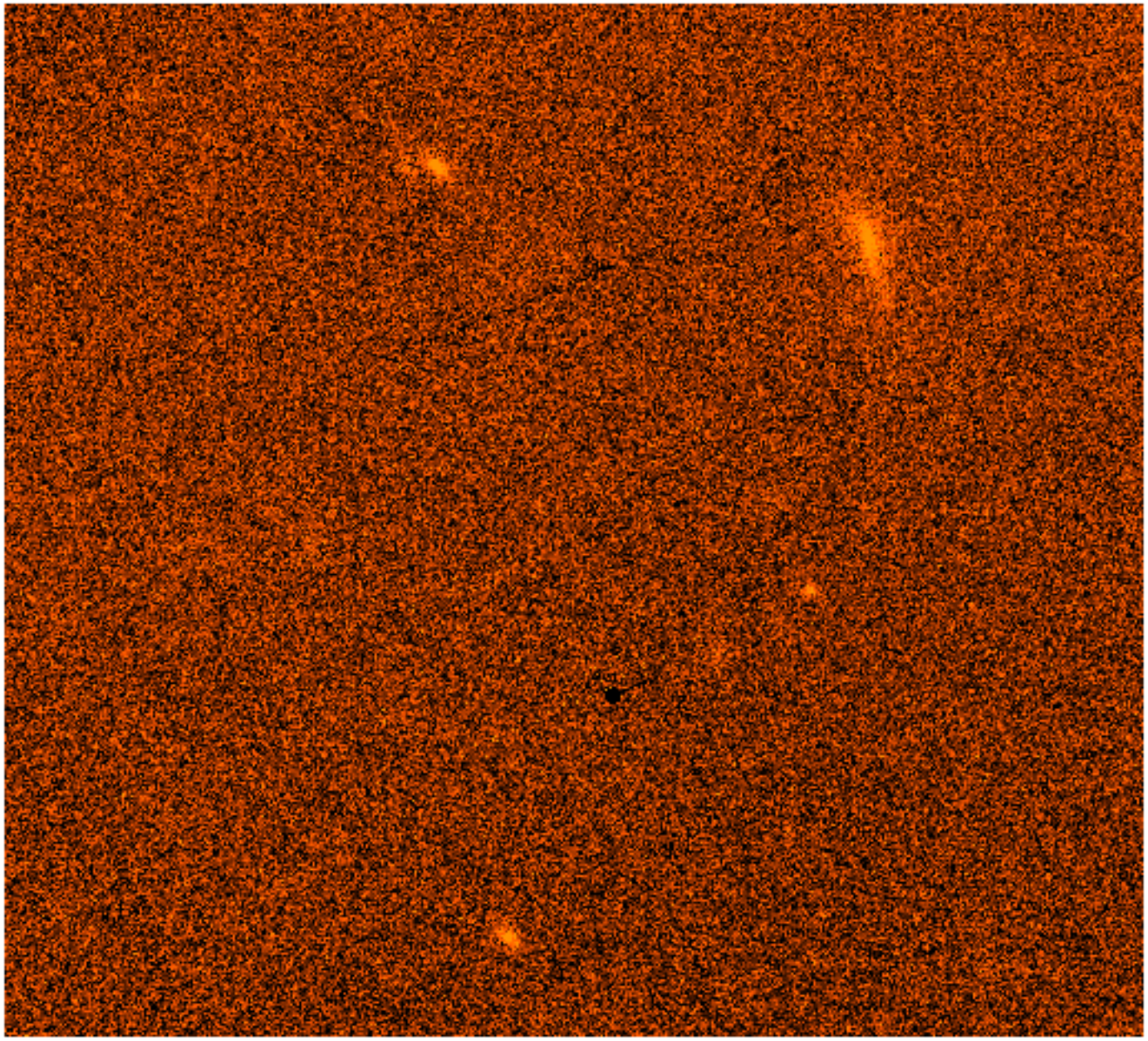

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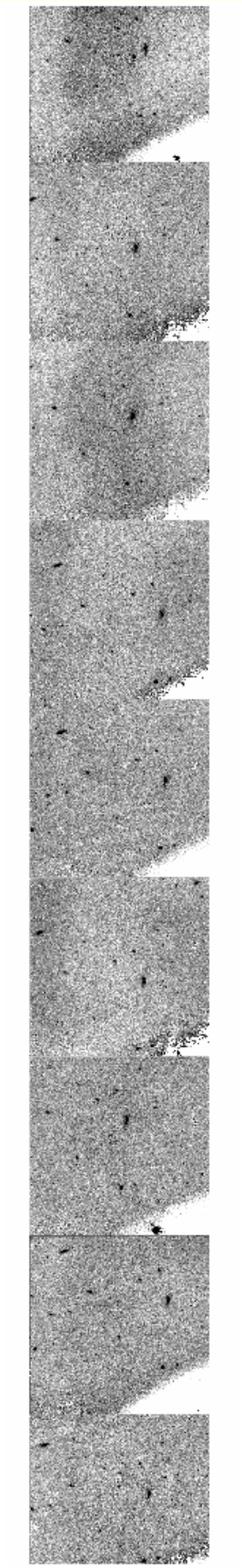
Data Processing

Co-adding Images

- wrote package in IRAF

Rough Pass Through Data: Bad Pixel Masks

- exclude images at beginning of each sequence (see figure →)
- static mask - defective pixels
- static mask - vignetting by structure
- cosmic ray masks
  - rough sky subtraction using 4 adjacent images
  - image shifts from cross-correlations of 6 brightest objects
  - shift and median
  - shift median back
  - detect deviant pixels



Data Processing

Object Mask

- allows better sky-flat and better sky-subtraction
- shift and add
- detect objects
- shift masks back

(see figure →)

Second Iteration Sky-subtraction

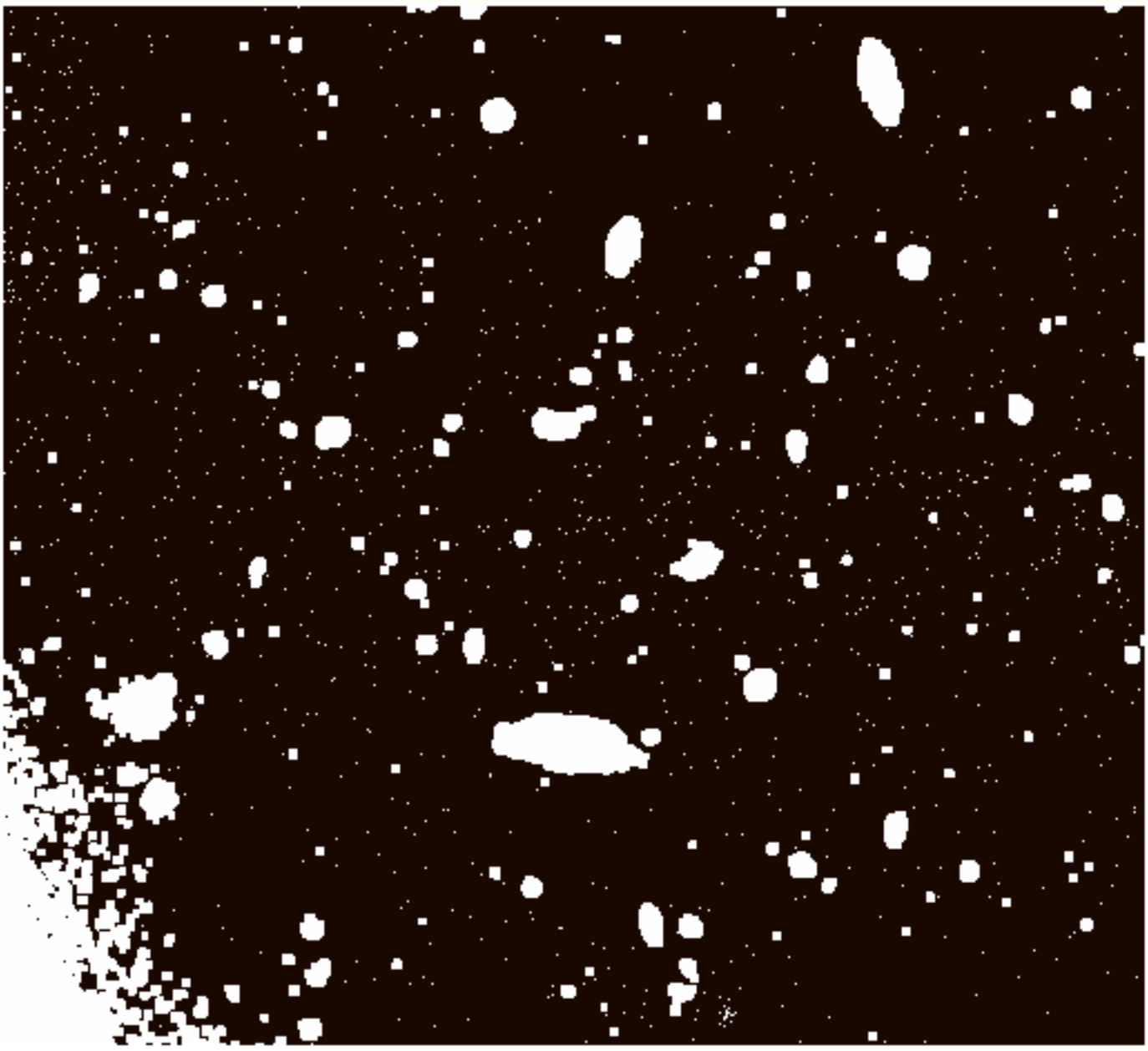
- now without any cosmic ray contamination or source light

Second Iteration Shift Determination

- now without any cosmic rays

Finally Co-add

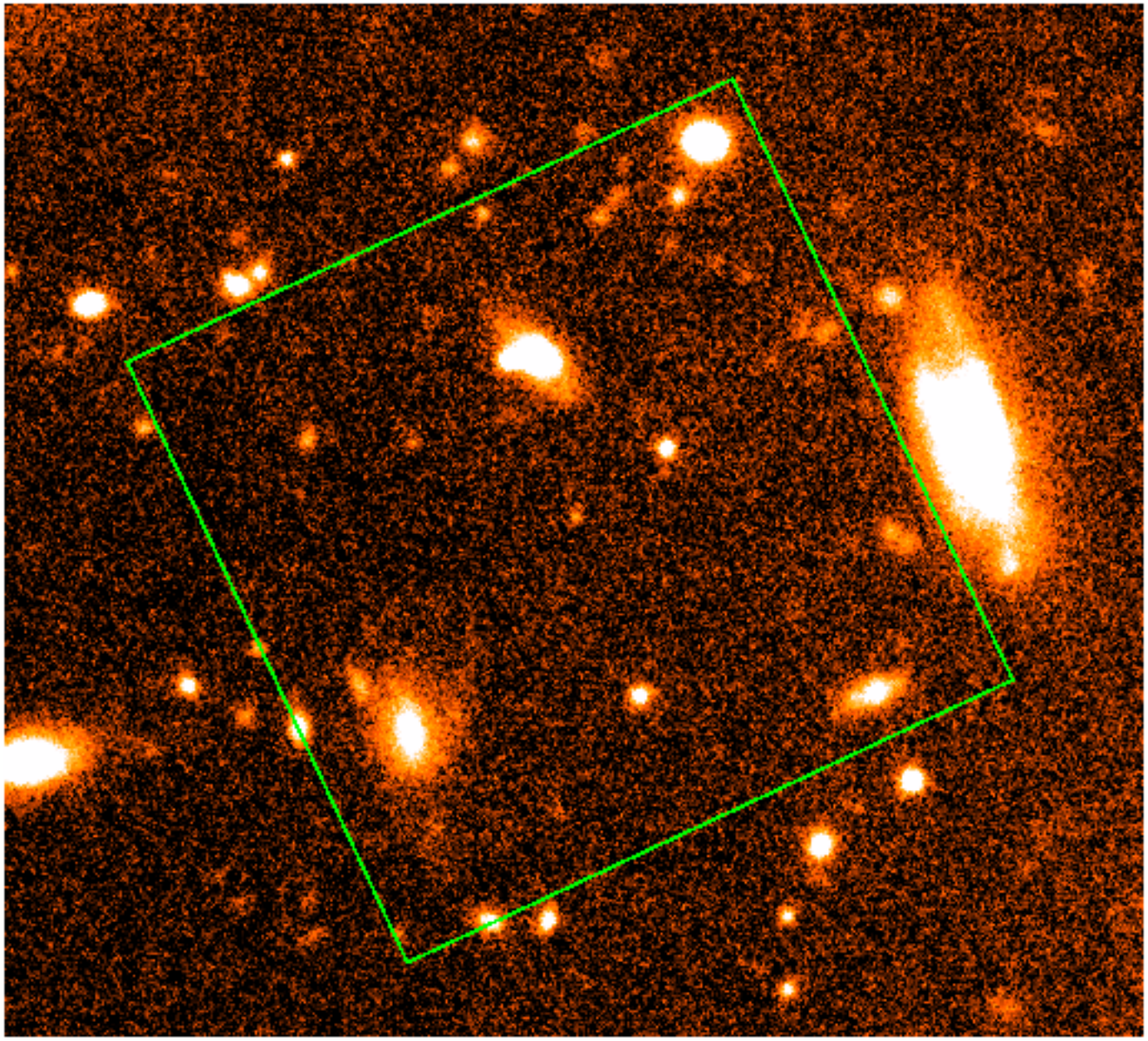
- discounting bad pixels
- sky-subtracted and co-added within nights first

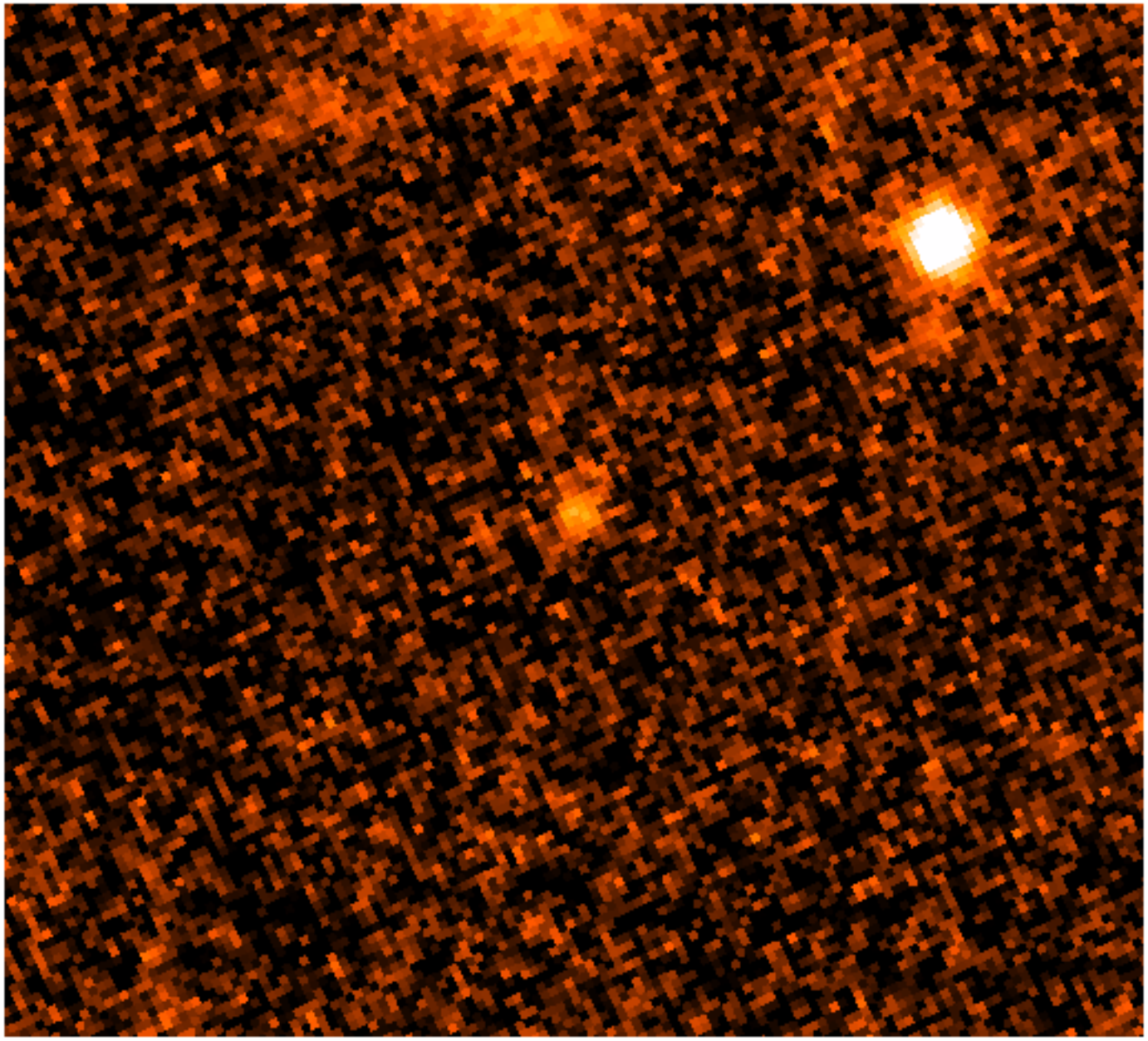


Data Processing

Final Summed Image - 9 Hours

- used nightly co-adds to get shifts between 4 nights for final co-add (see figure →)
- FWHM more narrow than data fully reduced with IRAF GEMINI package
- do not have preliminary measurements, because have not done standard star photometry





Data Processing

Possible Problems to be Solved

- can see images are not dark subtracted or flattened well
- effect comparable to the sky noise level; perhaps
  local sky-subtraction around source works
- could build sky-flats with subsets of the data in each night
- may require some iterative process which minimizes the
  sky-residuals while allowing a scale factor on
  the dark and flat-field to vary
- but still how to know the image zeropoints are accurate?
  there are few standard star observations.
  (many nights, in fact, have none)
- reliable geometric distortion correction would require work
  may not be necessary if hostless
  (see figure →)