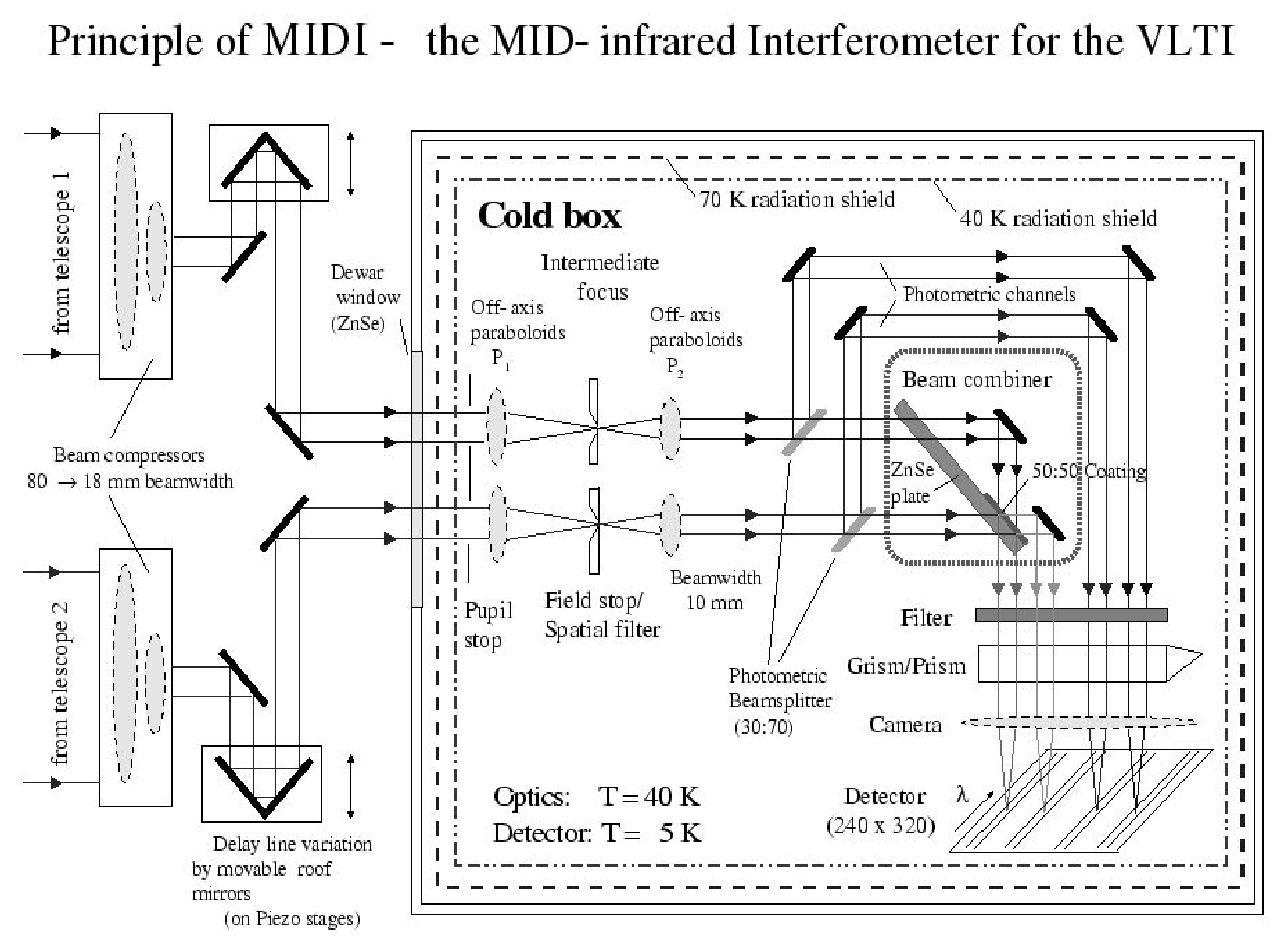
Calibration of MIDI data

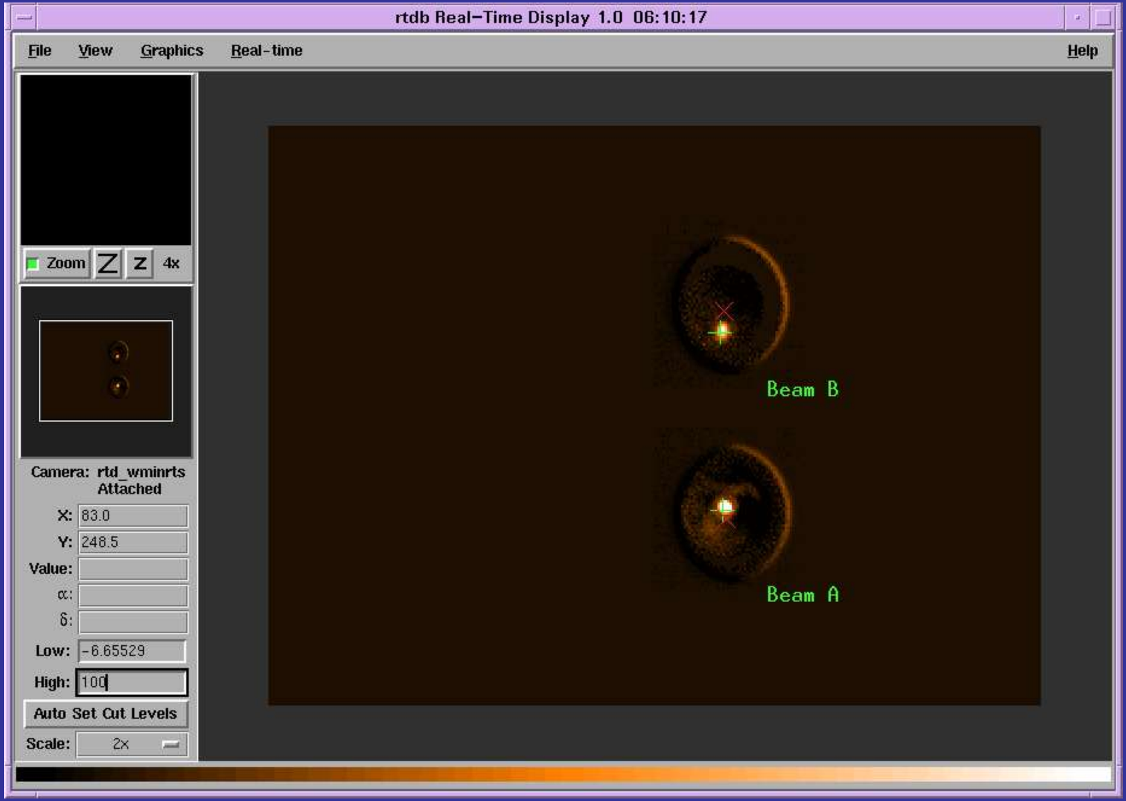
by W. Jaffe, with modifications by C. Hummel

MIDI schematic drawing



MIDI acquisition

- Acquisition uses chopping at 1-2 Hz
- Integration time 4 ms



Camera: rtd_wminrts Attached

X: 83.0

Y: 248.5

Value:

α:

δ:

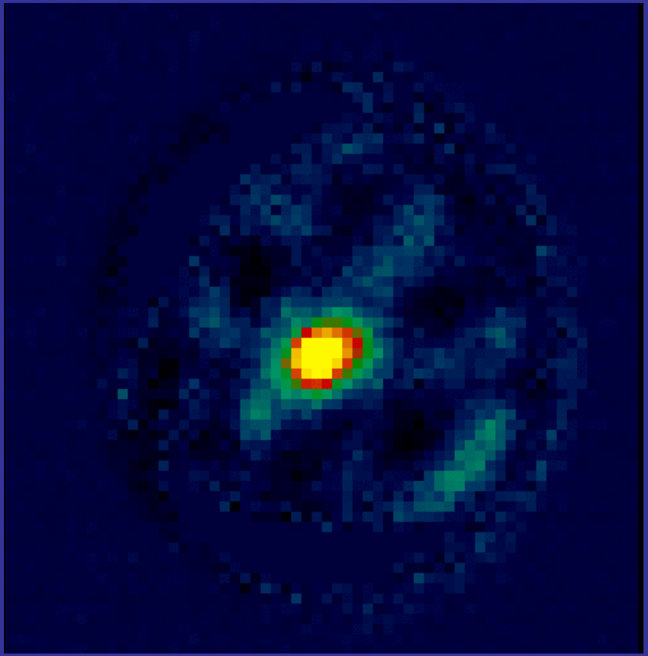
Low: -6.65529

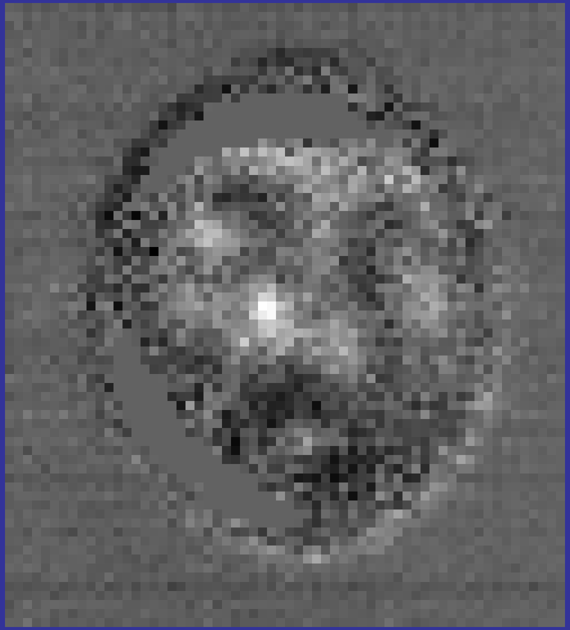
High: 100

Scale: 2x

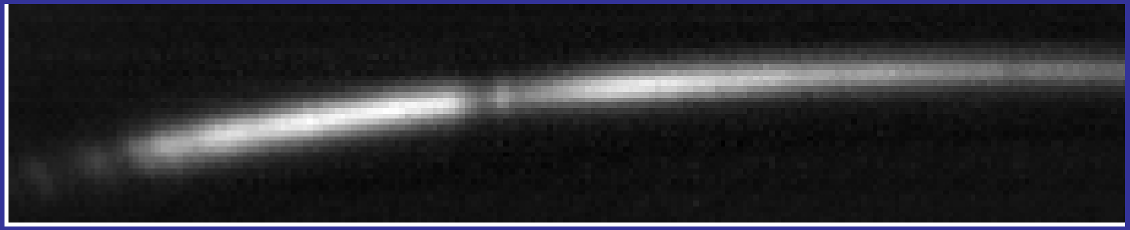
MIDI chopping beam A (UT3)

- Movie shows all ON and OFF frames with mean sky subtracted

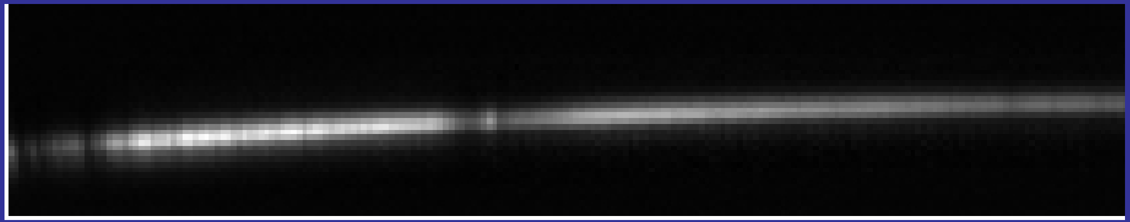




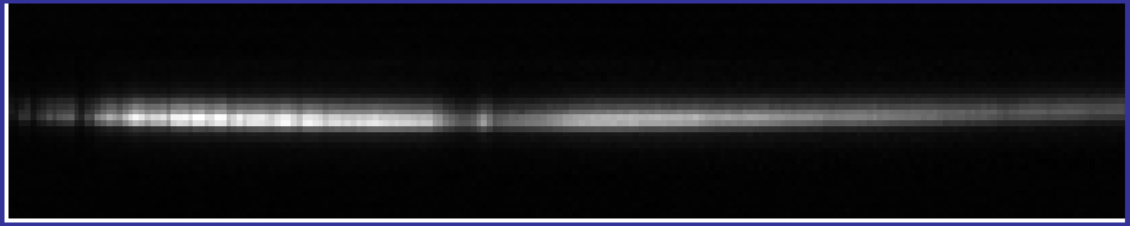
MIDI detector windows



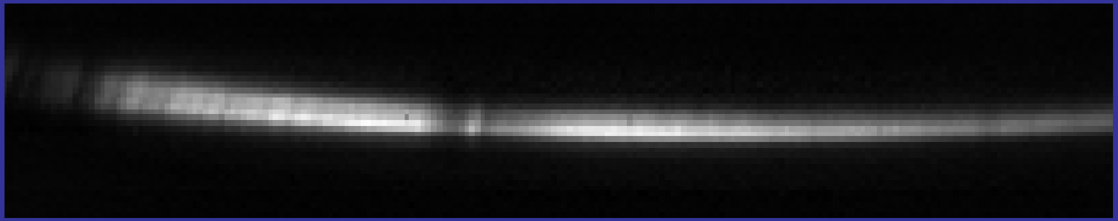
PA



I1

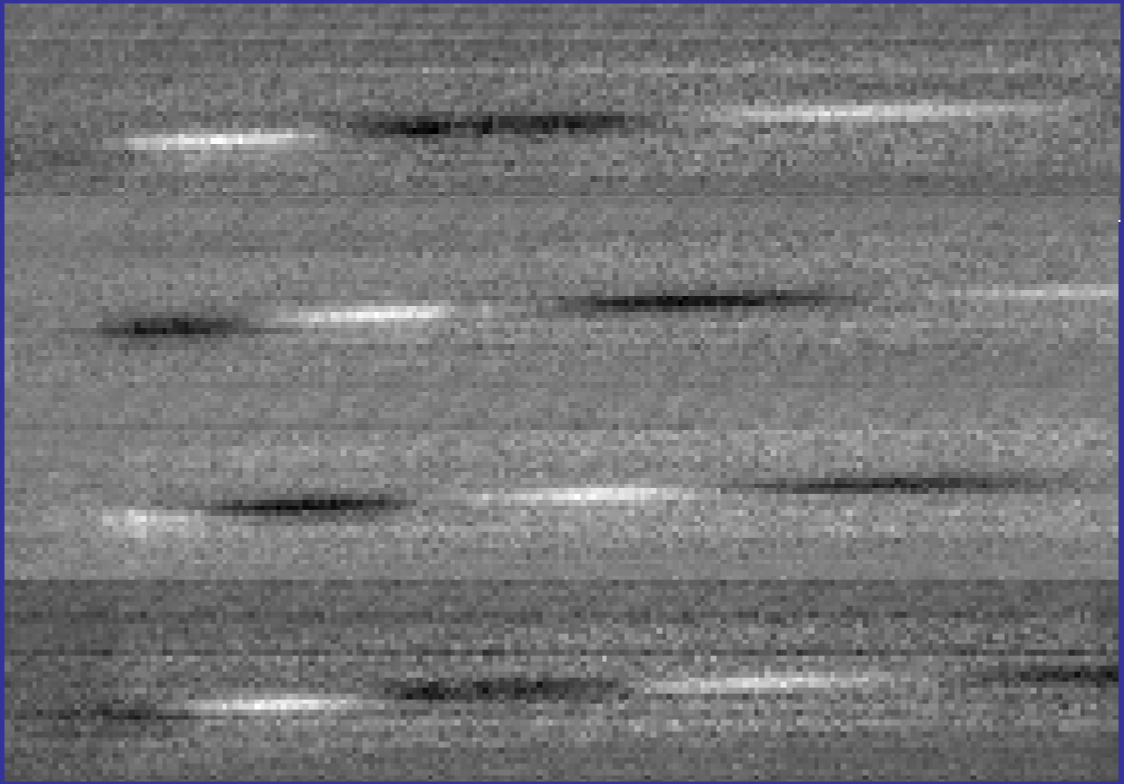


I2

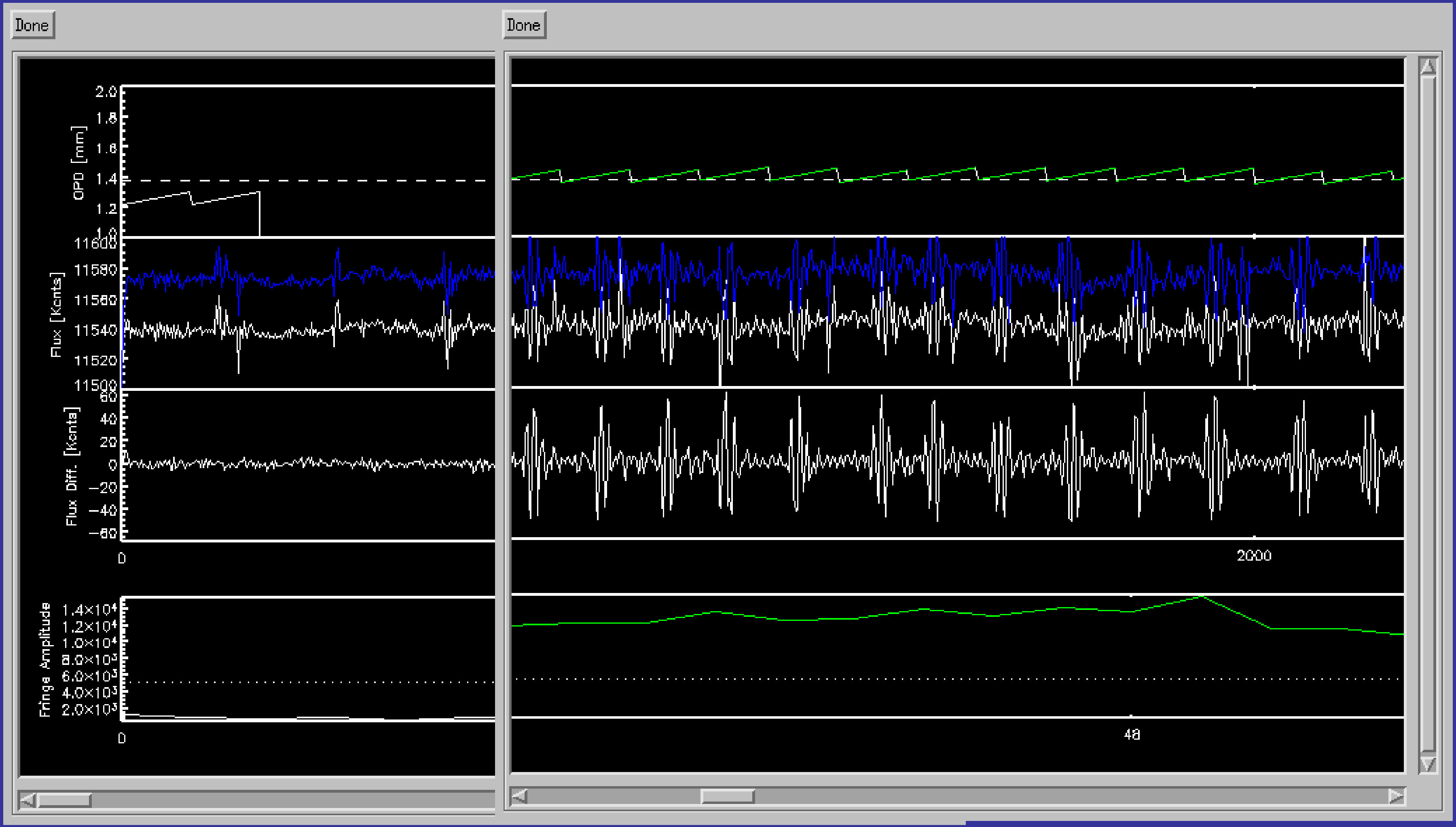


PB

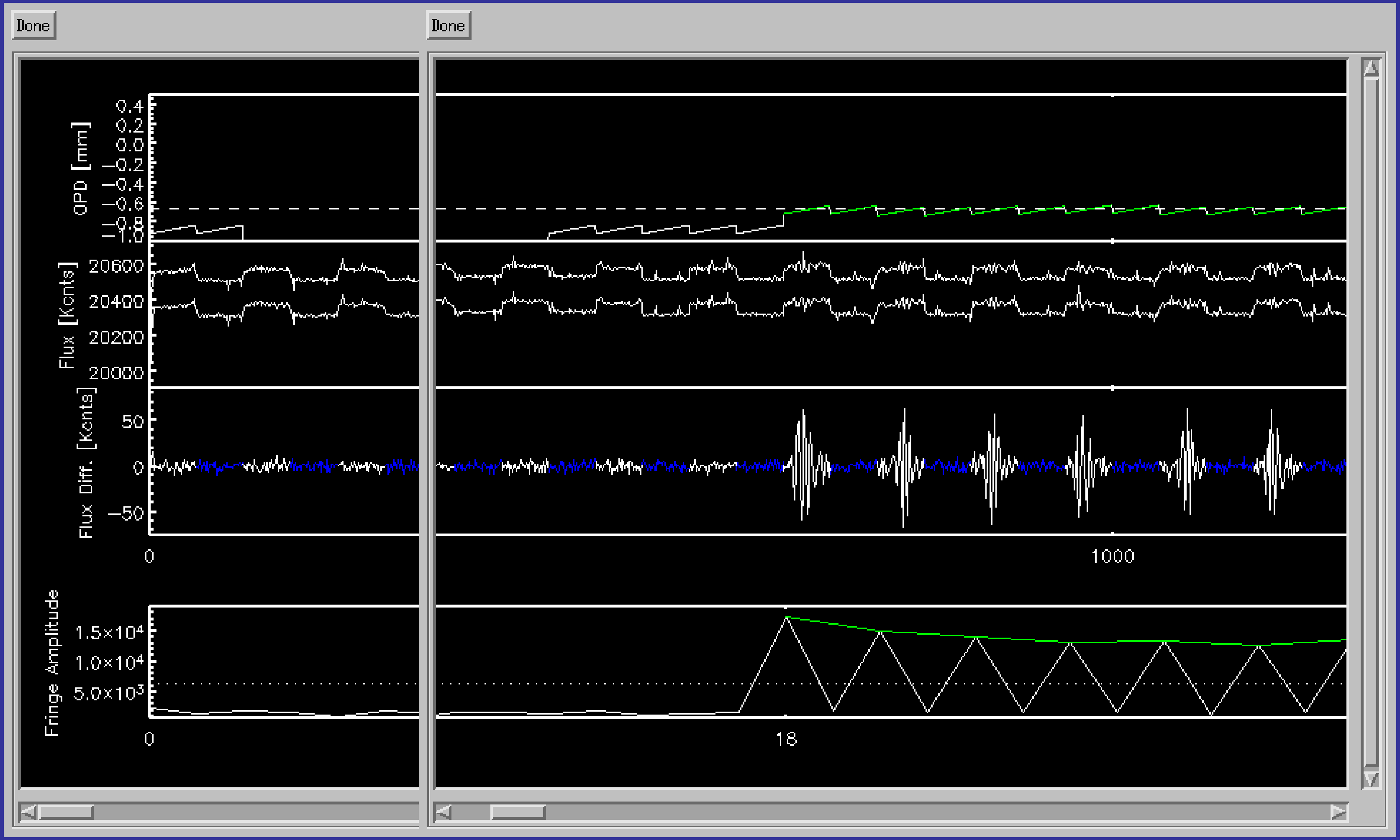
Channeled spectrum



HIGH-SENS


Done
Done
OPD [mm]
2.0
1.8
1.6
1.4
1.2
1.0
Flux [Kcnts]
11600
11580
11560
11540
11520
11500
Flux Diff. [Kcnts]
60
40
20
0
−20
−40
−60
0
2000
Fringe Amplitude
1.4×10⁴
1.2×10⁴
1.0×10⁴
8.0×10³
6.0×10³
4.0×10³
2.0×10³
0
48

SCI_PHOT


Done
Done
OPD [mm]
0.4
0.2
0.0
−0.2
−0.4
−0.6
−0.8
−1.0
Flux [Kcnts]
20600
20400
20200
20000
Flux Diff. [Kcnts]
50
0
−50
0
1000
Fringe Amplitude
1.5×10⁴
1.0×10⁴
5.0×10³
0
18

Observing modes

- Outputs:
  - Correlated flux
  - Visibility = Correlated Flux/Total Flux

- Modes:
  - High sensitivity (= HIGH_SENS)
  - High accuracy (= SCI_PHOT)

- Difficult Target types:
  - Weak but high visibility (=> photometry poor)
  - Strong but low visibility (or high accuracy)

MIDI calibrations

- Few lab or daytime calibrations (talk by S. Morel)
- Instrument is physically very stable but external optical train (incl. atmosphere) quite unstable at up to 100 Hz
- Main effects:
  - Beam overlap from 2 telescopes varies
  - Seeing/Strehl ratio varies
  - Atmospheric/Telescope transmission and backgrounds vary
- Detector electronics not so stable: e.g. no point in flat fields (…?)

Current practice

- Mostly High-Sens mode; nonsimultaneous interferometry and photometry; nonsimultaneous target and calibrator
- Typical accuracies of visibilities ~5-10%, for limiting weak sources 10-20%

- Techniques:
  - Photometry: Standard midIR spectroscopy with chopping. Backgrounds quite high limiting accuracy to ~400 mJy. No flat, no bias
  - Interferometry: No chopping necessary. Same pixels as Photometry. Limit ~100 mJy. No flat fields no bias

Calibration of correlated flux

- Fc(Tar) = Fc(Cal) * Fi(Tar)/Fi(Cal)

- Very simple calibration
- Fc(Cal) from Cohen models or black bodies

- Limitations:
  - Knowledge of Fc(Cal) for nearby calibrators
  - Changes of seeing Tar/Cal
  - Difference in overlap Tar/Cal

Calibration of visibility

- V(Tar) = V(Cal) * (Fi(Tar)/Pi(Tar) /(Fi(Cal)/Pi(Tar))

- Need more good observations for good answer
- Less sensitive to changes in seeing between Tar and Cal, but just as sensitive to changes between Interf and Phot.
- A single measurement of V can be interpreted physically.

- Limitations:
  - Sensitive to changes in Phot/Interf
  - Poor Phot for weak sources

SCI_PHOT mode

- With beam splitter measure Interf & Photom simultaneously
- Solves problem of seeing changes and overlap between Interf and Photom
- But: Requires transfer of calibration between different parts of detector -> Needs both “cross-coupling coefficient” (flat field) + curvature corrections
- Optical quality of photometric channels inferior
- Systematic effects ~5%, not understood
- Under good conditions accuracy ~< 1%

Wavelength calibration

- No arc lamps. There are 3 narrow band filters but these are inadequate for PRISM
- Interferometric channels can be calibrated relatively by fringes. Absolute scale is then determined by sky lines (O3)
- Transfer to photometric channels can be difficult