Update on Silmaril

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Introduction

Most sensitive is CLASSIC/CLIMB

- but MIRC-X/MYSTIC are closing the gap

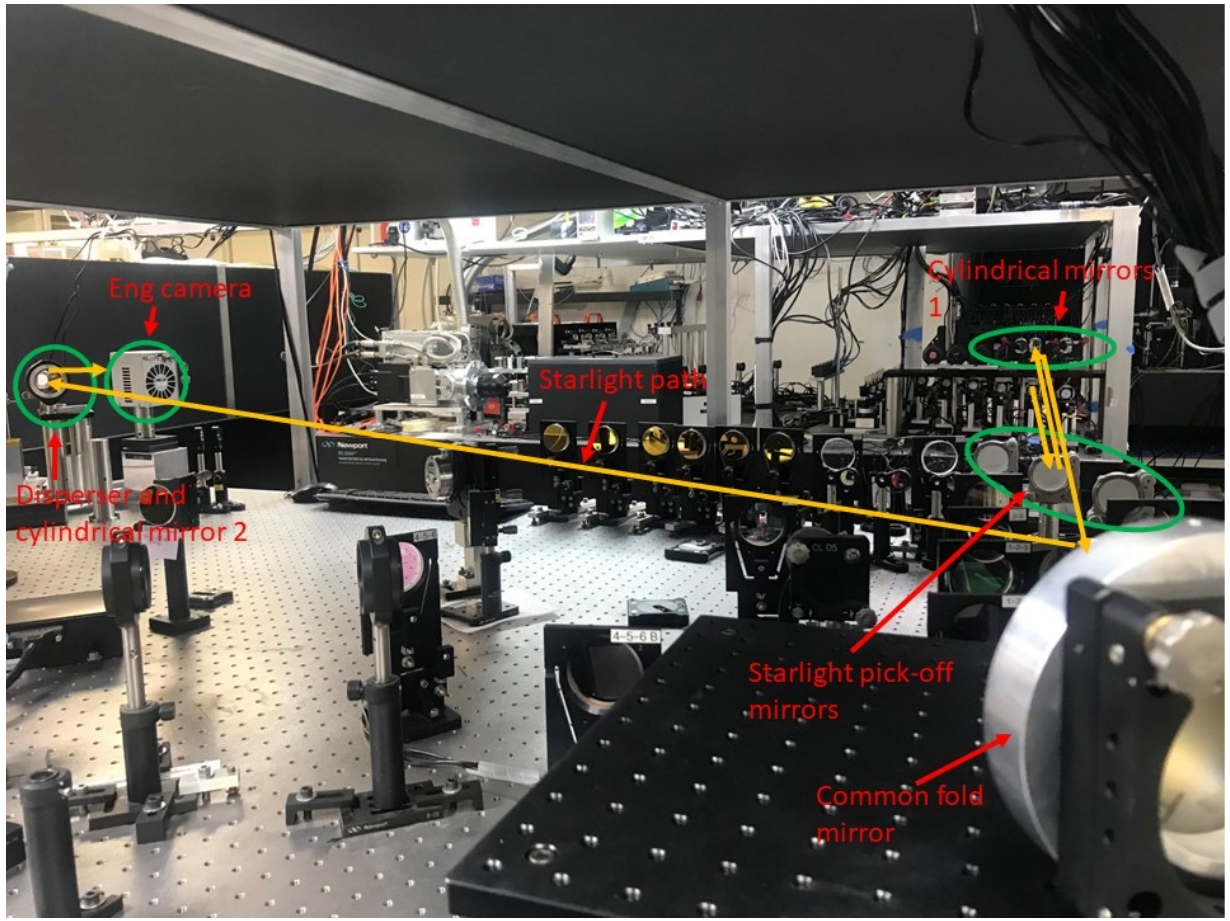
CLASSIC/CLIMB lost in attractiveness

⇒ Upgrade CLASSIC/CLIMB for sensitivity

Instruments	CLASSIC (CLIMB)	MIRC-X (MYSTIC)
# Telescopes	2 (3)	6
Spectral band	H/K	J/H (K)
Spectral resolution	Broad band	50
Limiting magnitude	H/K = 8.5 (7.0)	H (K) = 7.5

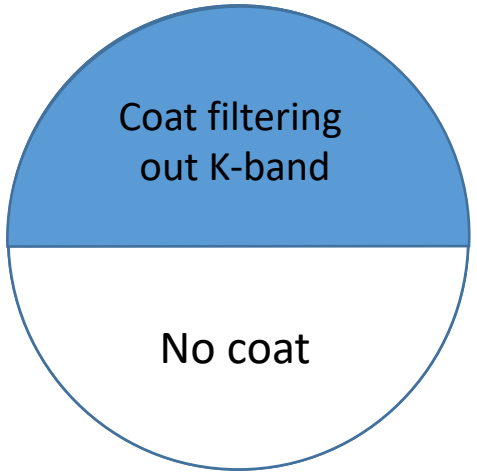
Key design points

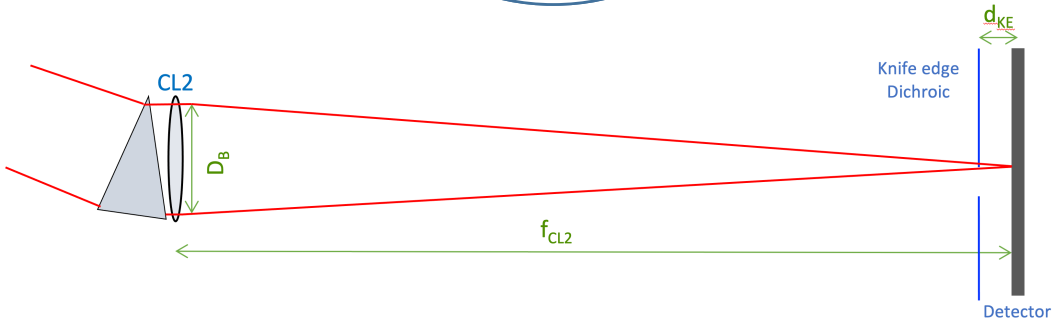
- Using a CRED ONE camera for 3-Telescope beam combiner
- Image plane
- Low resolution (R = 35)
- As few optics as possible
- Edge filter
  - Allowing H- and K-band observations simultaneously



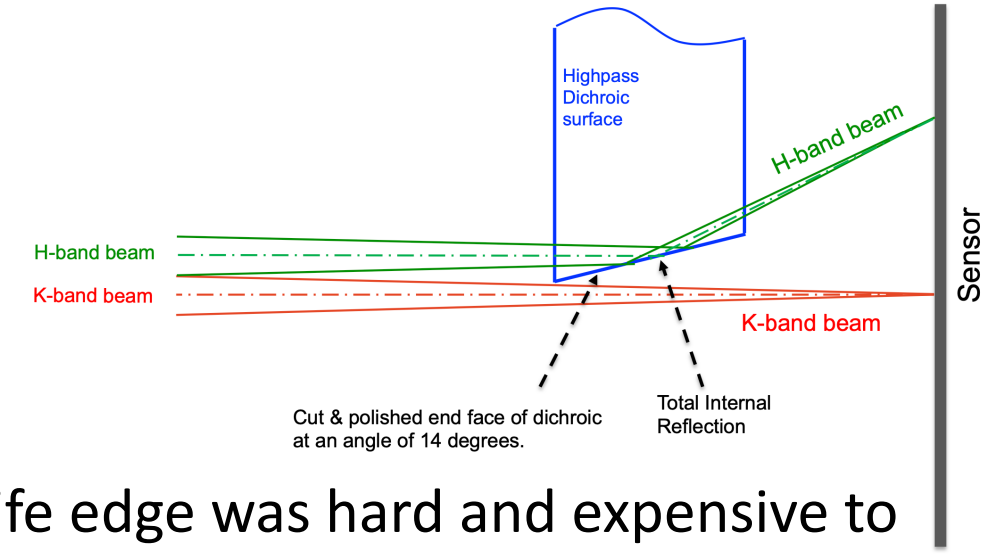
Edge filter design

Knife edge?





Internal reflection?



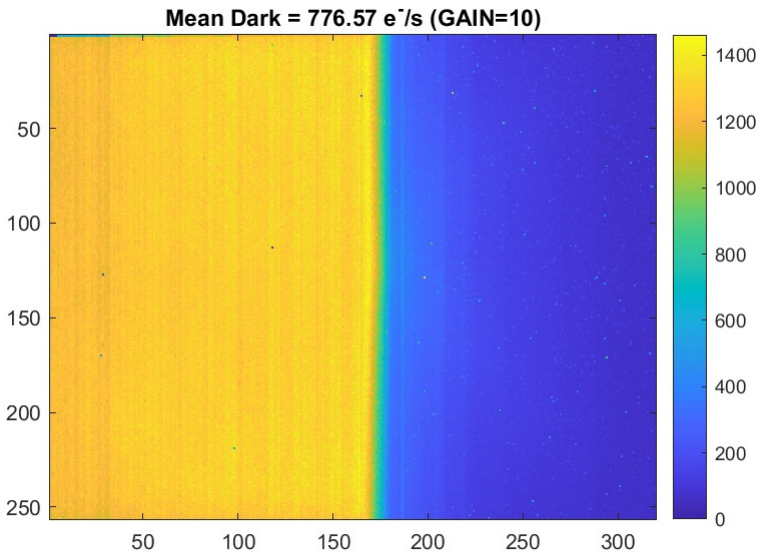
- Knife edge was hard and expensive to manufacture
- internal was fast and relatively cheap

⇒ Using internal reflection due to time constrain

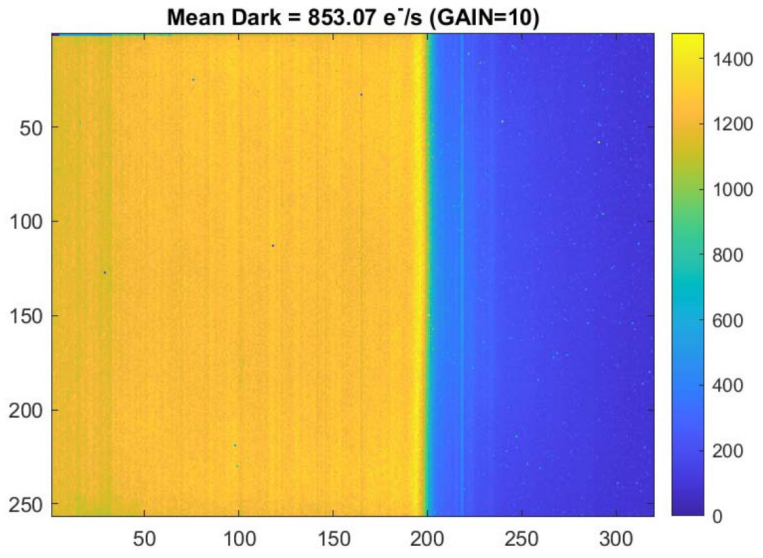
CRED ONE performance

- Simulated edge filter
  - warm half: 1278 e^-/s
  - cold half: 119 e^-/s
- Reflection edge filter
  - warm half: 1232 e^-/s
  - cold half: 178 e^-/s
- edge not completely centered

Metal blank



Edge filter

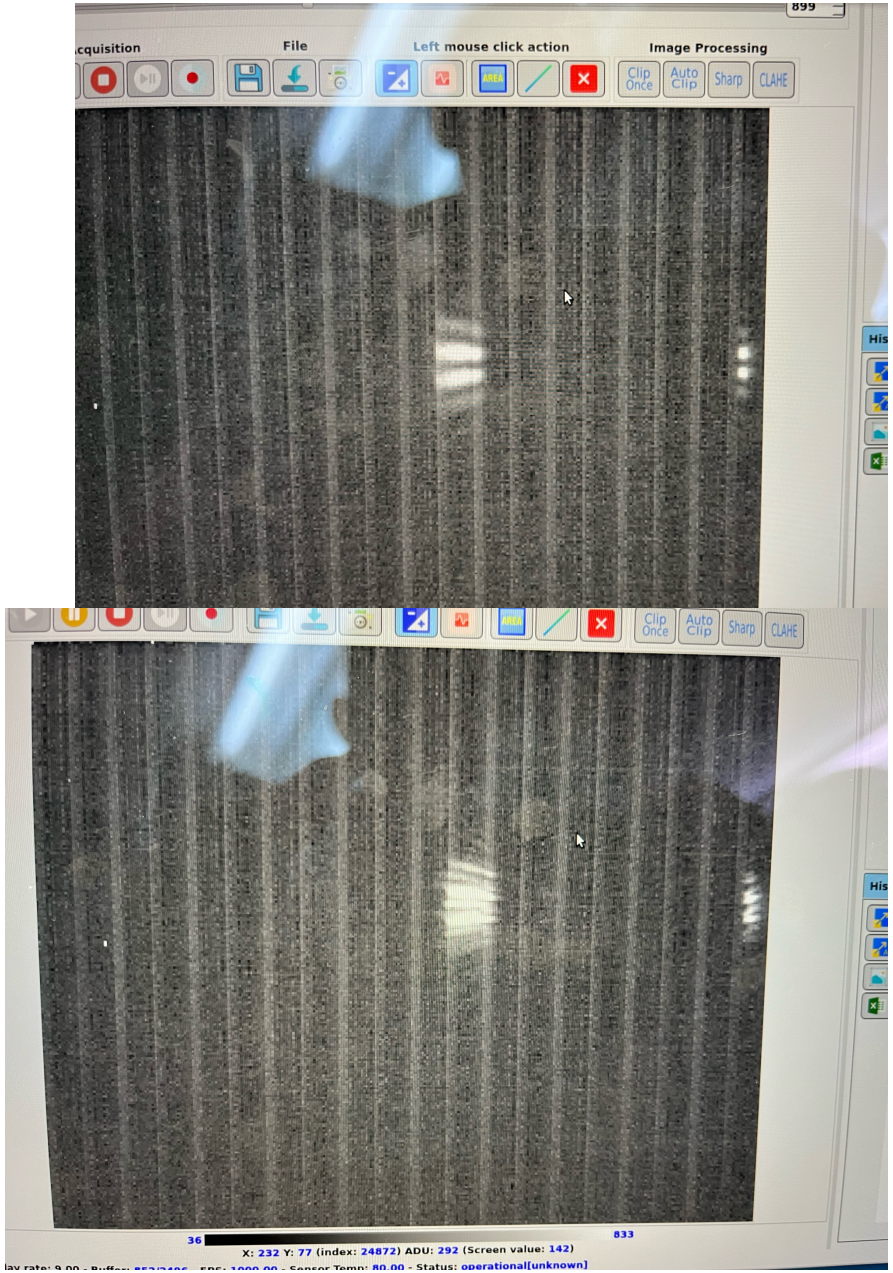


Lab fringes

- Due to edge not centered: H-band reflection close to detector limit
- reflected H-band may be not full H-band (smaller). Need try-and-error to align to the best

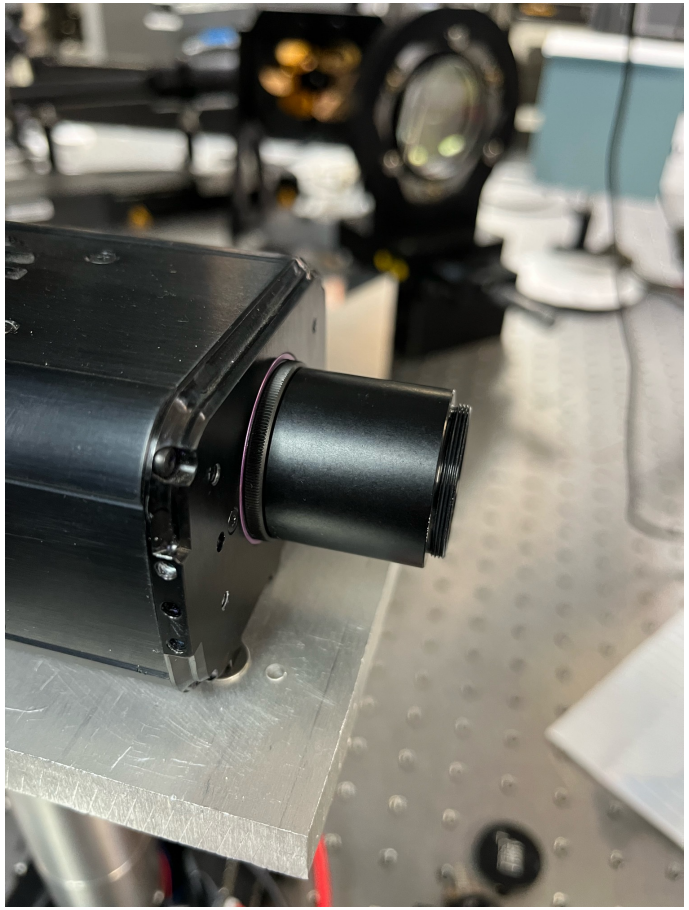
⇒ Internal reflection edge filter works

- CRED ONE could not be used with IOTA read mode (over illumination safety triggered)
  - CREDONE sent back to FLI for diagnose and repair



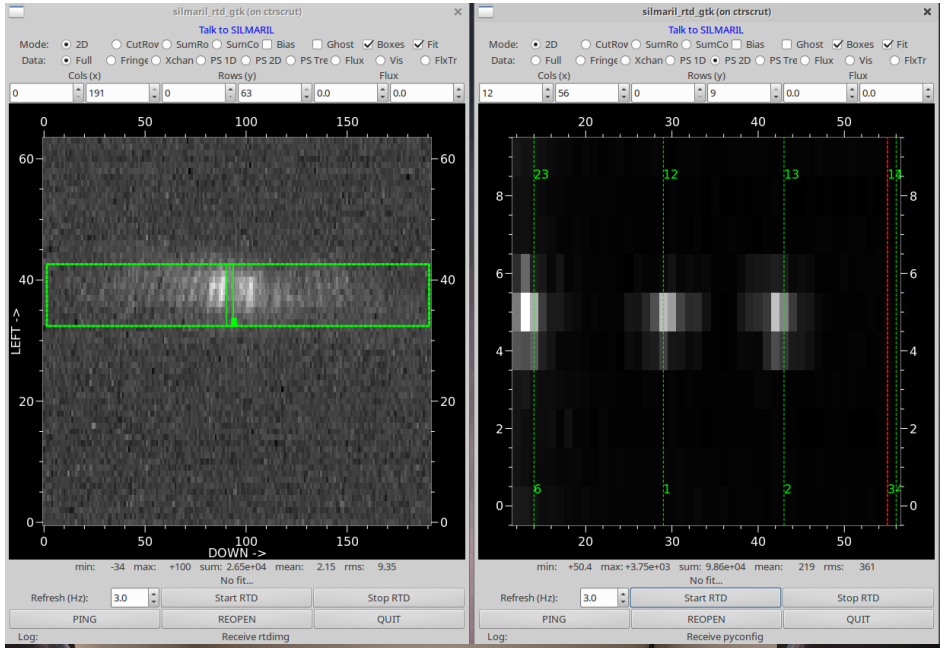
CRED 2

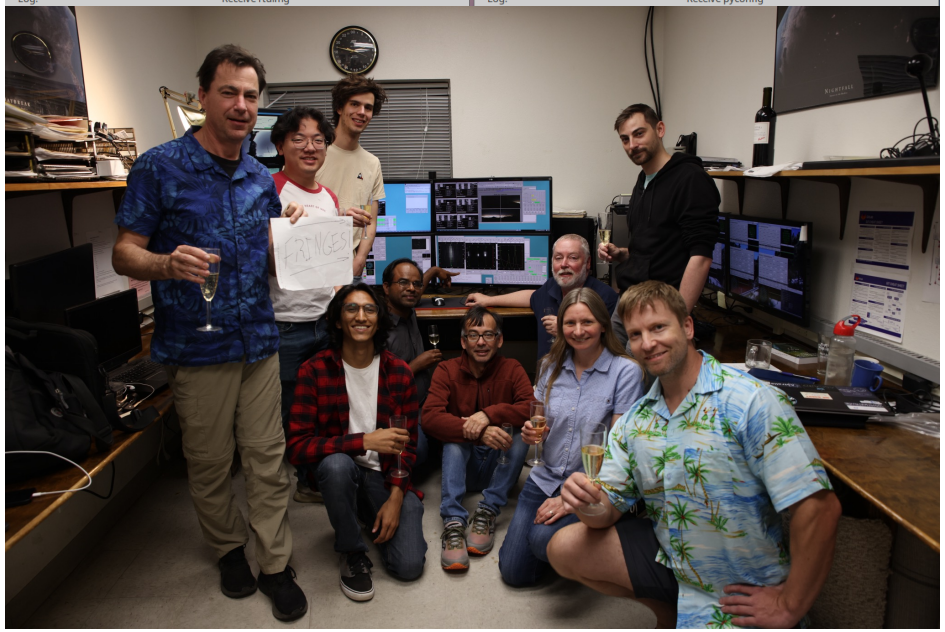
- CRED 2 was used for on-sky tests and first commissioning
- Spare H-filter used to filter out J-band



First on-sky fringes

- Spent 2 nights working on obtaining on-sky fringes
- Got 3 telescopes fringes on July 6
- Observed Iota Peg for data reduction tests
- Faintest fringes obtain on a H = 4.8 (SNR ~50)





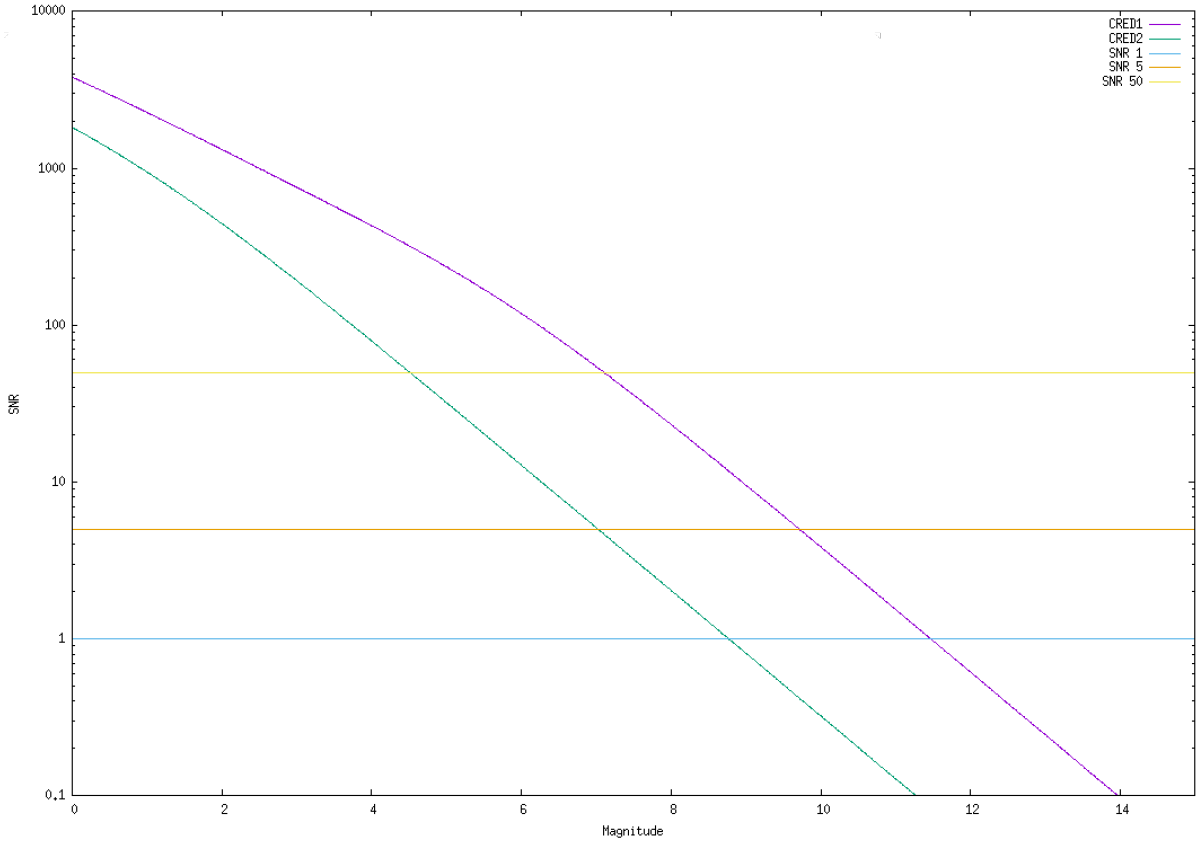
Expected final on-sky performance

Simulated performance extrapolated from CRED2 on-sky results

- SNR = 5 (MIRC-X typical fringe tracking): CRED ONE limit H ~ 9.7
- SNR = 1 (special observing strategy for on good nights): CRED ONE limit H ~ 11.5

⇒ Consistent with previous estimations

⇒ H > 10.5 should be achievable

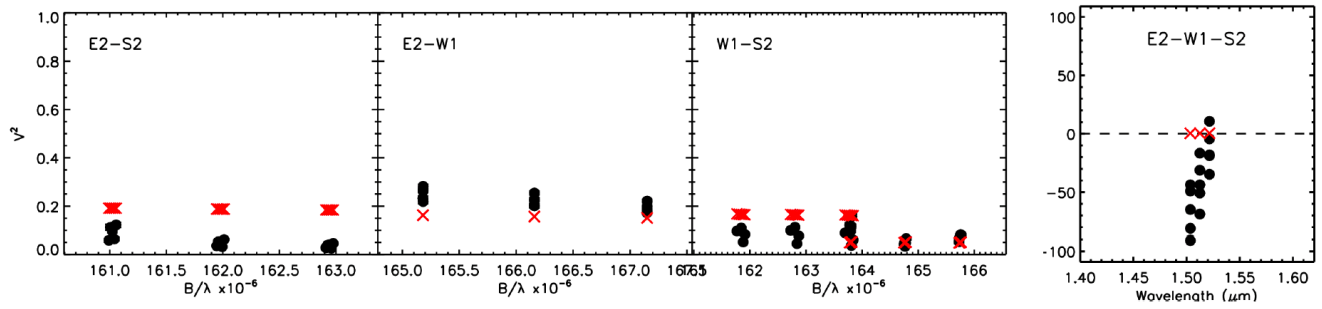


Calibrator HD 886

First reduced data

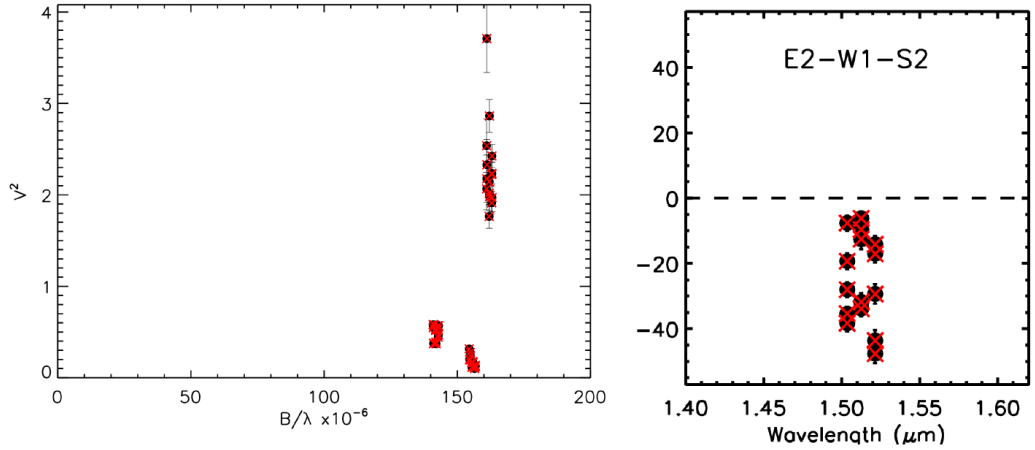
Iota peg:

- black: measured by Silmaril
- red: model prediction from MYSTIC solution

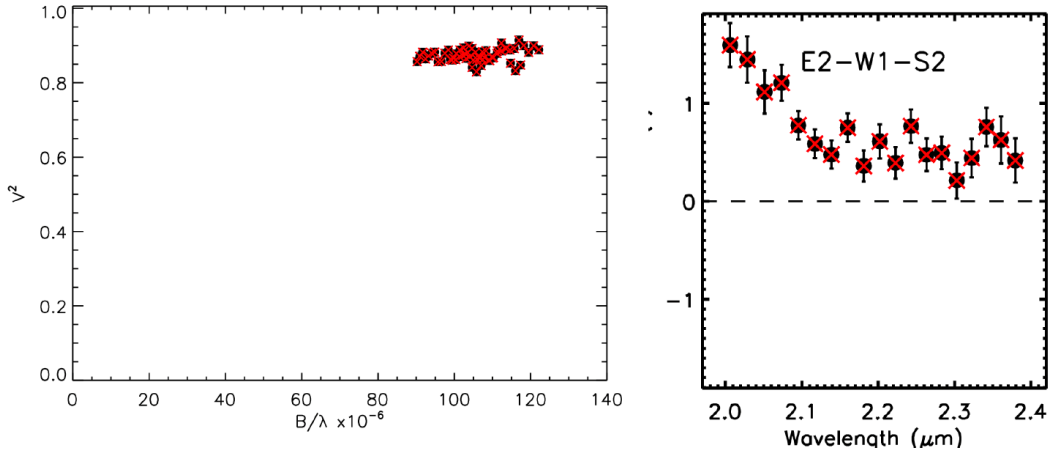


⇒ Obvious data reduction issues

Silmaril:



MYSTIC:



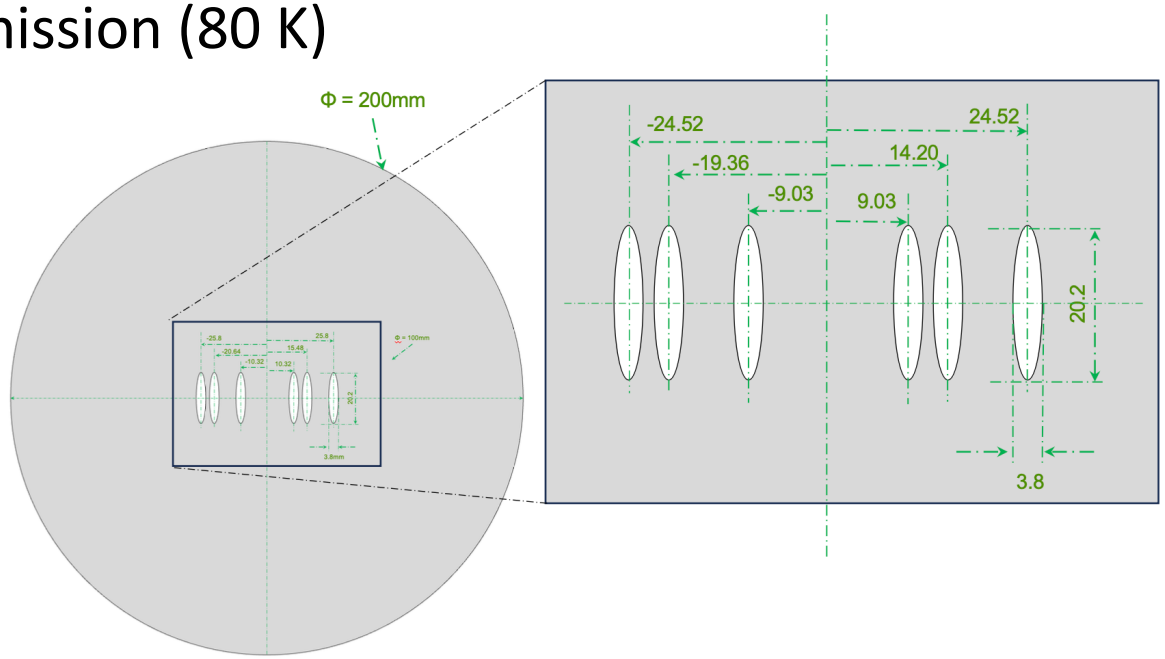
Data reduction improvement

- Currently data reduction pipeline based mostly on MIRC-X/MYSTIC pipeline
  - measuring wavelength calibration (pupil) on the whole night
  - beams are moving, introducing error in closure phase measurement: similar to CLIMB
- Working on:
  - measuring wavelength calibration on shorter dataset through the night
  - software tools to ease on-sky alignment while observing
  - using a data reduction process similar to CLIMB
- In the future:
  - adding tip/tilt correction?
  - adding photometry using CLIMB camera?

Narcissus mirror

In place of a full cold dewar in front of the camera

The camera look at its own thermal emission (80 K)



- Pros:
  - cheaper
  - easier to implement and maintain
- Cons:
  - efficiency still to be proven
  - clipping/tolerance issue due to beam instability

Conclusion

- CRED ONE not working properly, waiting for FLI to fix it (in progress)
- Internal reflection edge filter working
- On-sky test with CRED 2 confirm expected on-sky final performance
  - H = 10.5 achievable
- Data reduction pipeline needs improvement

In the future:

- Adding second set of 3 beams
- Thermal background reduction with Narcissus mirror
- Adding photometry?
- Adding tip/tilt correction?