SALT RSS-NIR
MID-TERM REVIEW
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INTRODUCTION

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Overview

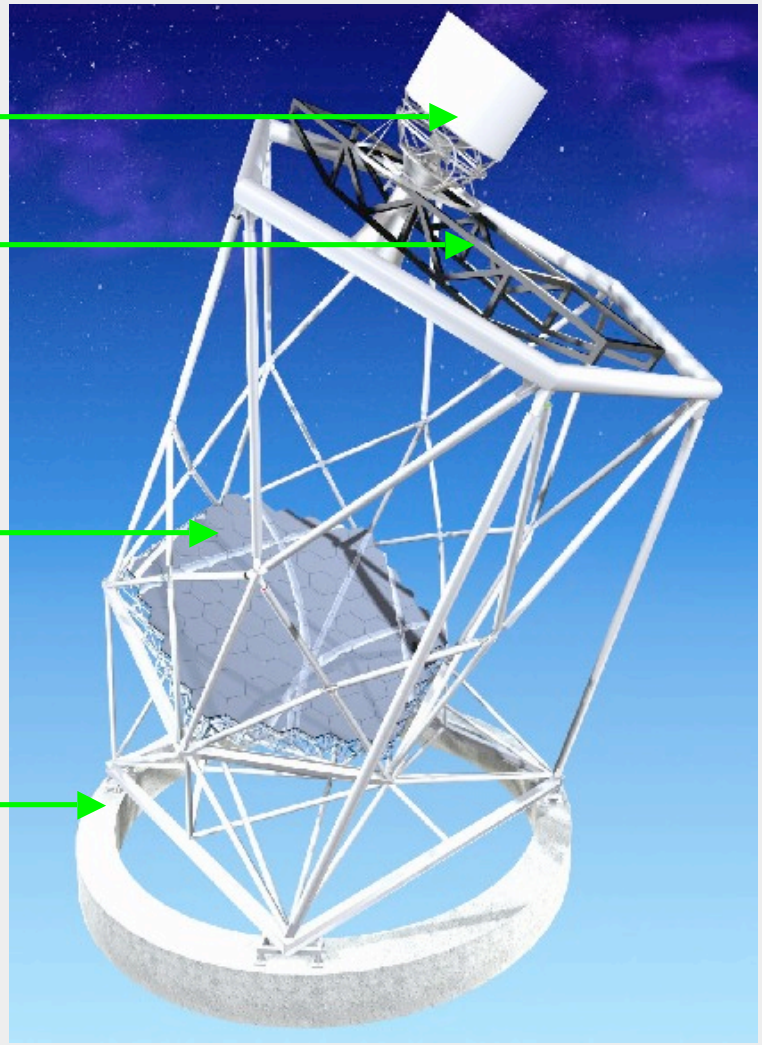
- semi-warm, near infrared spectrograph
- complement the RSS-Visible on SALT
- major upgrade anticipated since Day 1
- 2K x 2K Hawaii 2RG focal plane
- wavelength range from 0.85 to 1.7 μm
- resolution of up to 14,000 (0.5 arcsec slit)
- 5 Volume Phase Holographic gratings,
- 12 filters (FP order blocking filters and imaging filters)
- 3 cryogenic long wavelength blocking filters
- high-throughput, medium resolution multi-object spectroscopy
- Spectropolarimetry
- Fabry-Perot imaging

HISTORY

- Passed CoDR, May 2006, Capetown SA
  - SALT granted $145K to proceed to PDR
- Granted $3.3M from UW WARF Foundation, May 2008
  - Ramp up resources, partner with SSEC
- Officially Passed PDR July 2008
- Granted $2.0M, NSF MRI program 9/2008
  - Hire 2 ME, 1 postdoc
  - Major engineering effort
- Several concerns raised during PDR, panel requested an MTR before major purchases

The SALT Telescope

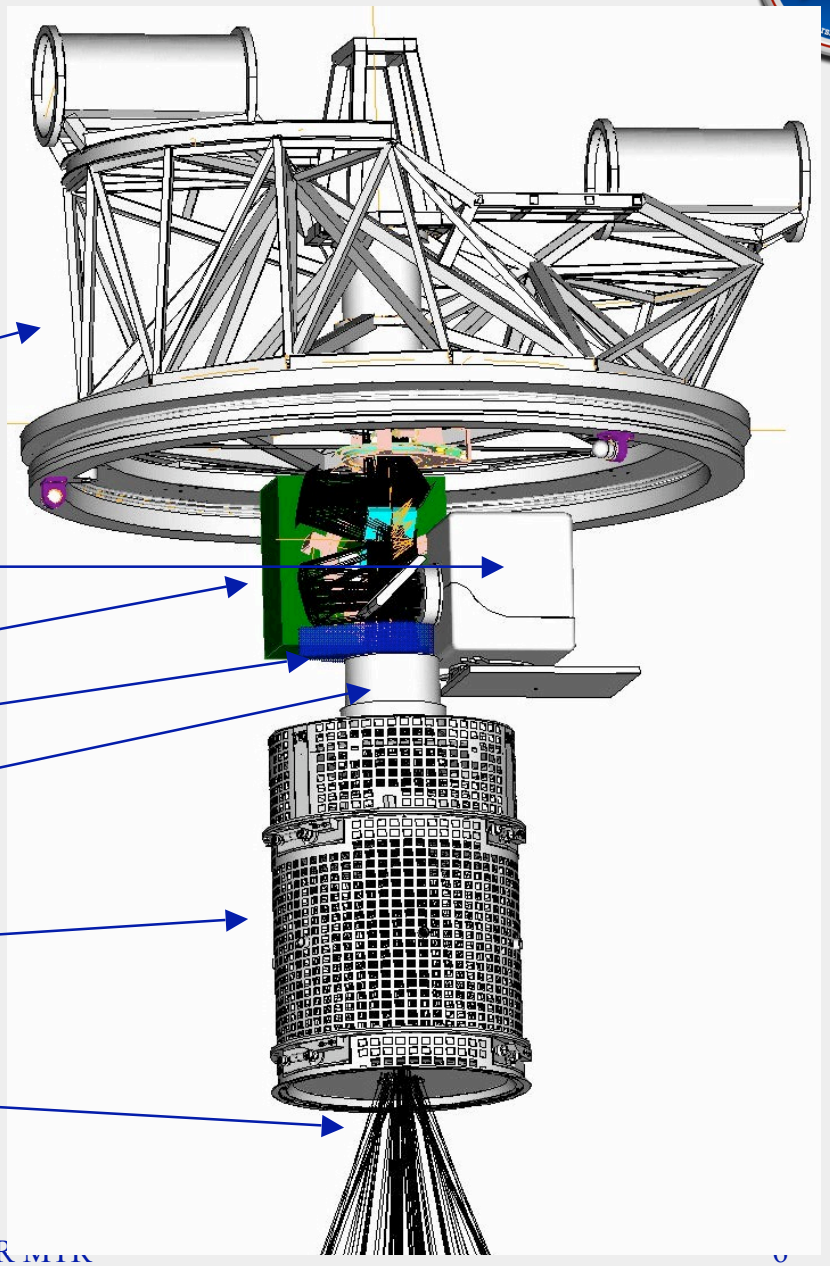
- 10m-class Optical Telescope
- Fixed Elevation
- 91 segments make up the spherical primary mirror
- Tracker performs all precision motions



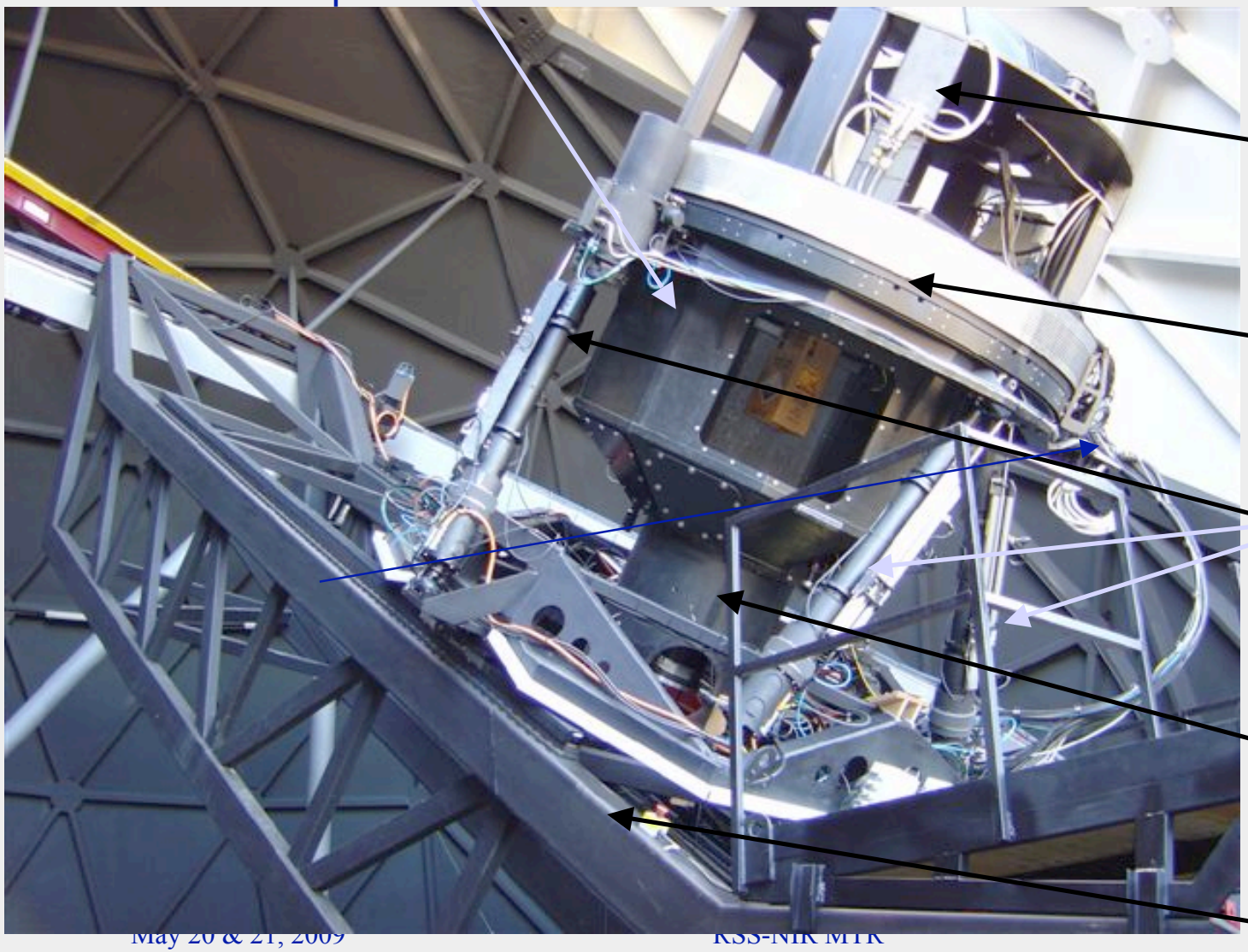
SALT Payload Details:

Prime Focus Payload mounts via hexapod to tracker bridge and comprises:

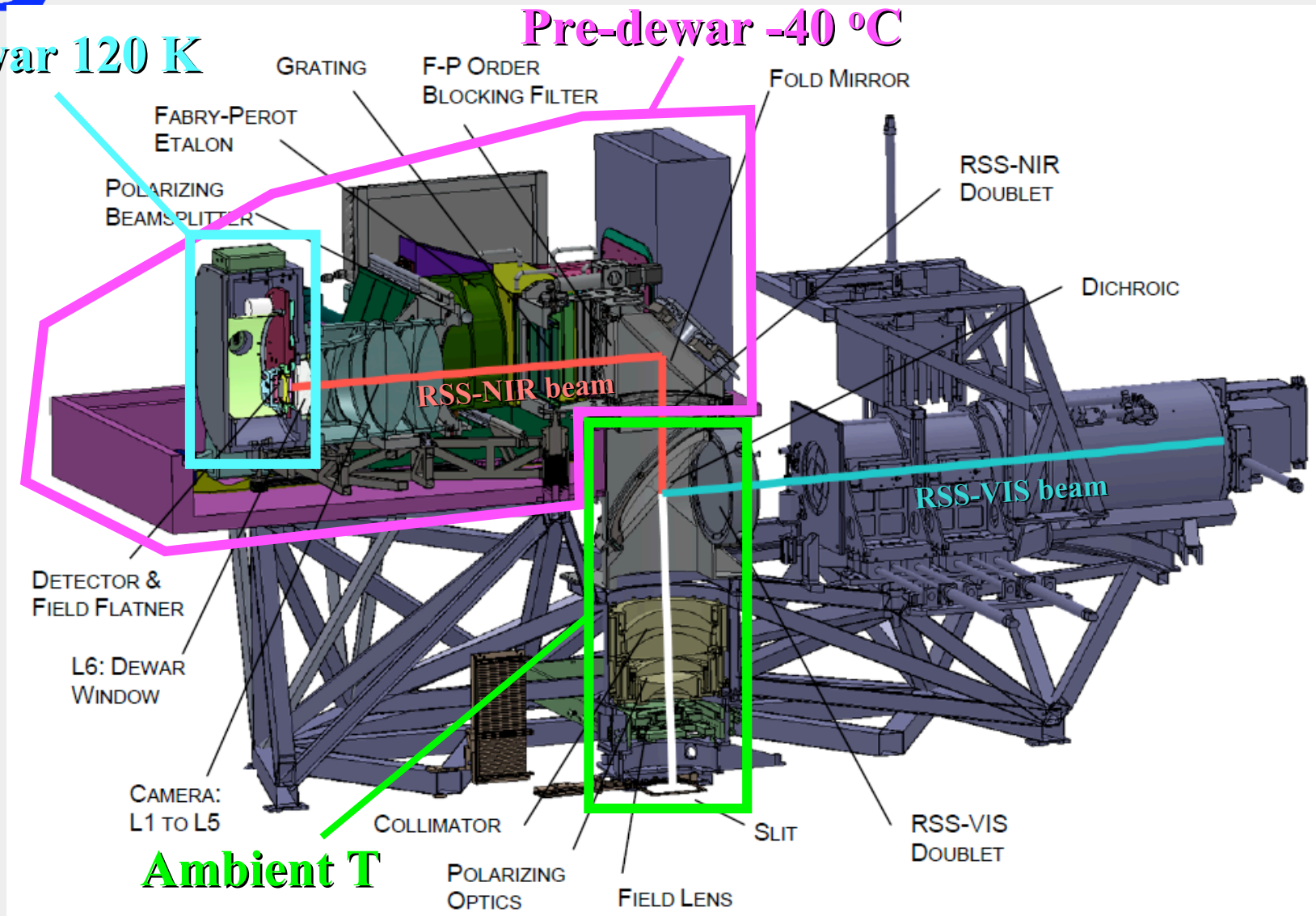
- Prime Focus Imaging Spectrograph (PFIS/RSS)
- Acquisition camera
- Guidance & focus System
- Optical fiber feed
- Pupil baffle
- Atmospheric dispersion corrector (ADC)
- Spherical aberration corrector
- Calibration system
- 4 instrument foci fed by 45 deg “fold” mirrors



Payload structure (rotating & non-rotating components) made of carbon composite



Optical layout/Components



Definitions

- RSS-Vis: Robert Stobie Spectrograph (visible side) for SALT formerly Prime Focus Imaging Spectrograph (PFIS)
- RSS-NIR: Robert Stobie Spectrograph for SALT (NIR side)
- Pre-Dewar: -40C cooled enclosure for RSS-NIR
- Cryogenic Dewar: 120K cooled enclosure for detector, 3 blocking filters and field flattener
- Camera: focussing optics and housing not located in Dewar

Definitions

- Doublet: last two collimator optics before collimated space, one each for visible and NIR
- F-P: Fabry-Perot etalon
- Filters: J,H, line and order blocking filters at -40C
- Dichroic: dichroic beamsplitter, reflecting visible < 0.85 transmitting NIR >0.85
- Polarizing beamsplitter: Wollaston prism array for polarization studies

System Specs

Optical	
Telescope Aperture	11 meters
Telescope focal ratio	f/4.18
Collimator Focal Length	302 mm
Camera Focal Length	220 mm
Image space F/#	1.4289
Efl	15718.39 mm
Plate scale	76.205 μm/arcsec
Plate scale	4.233 pixels per arcsec (18 μm pixels)
Image Quality	Pixel limited in all modes , 2 pixels =0.5 arcsec
Field of View	8 arcmin dia (imaging), 8 x 8 arcmin (spectroscopic)

System Specs

Spectroscopy	
Wavelength Coverage	0.9 – 1.7 μm, $\Delta\lambda$ = 0.8 μm
Gratings	4 articulated VPHGs, 1 conventional low R grating
Spectral Resolution	800, 2000-7000 (1arcsec slit)
Free Spectral Range (FSR) in one grating setting	FSR ~ 0.13 μm @ R ~ 2000 FSR ~ 0.11 μm @ R ~ 4000 FSR ~ 0.09 μm @ R ~ 7000 R~800 conventional grating to cover entire range, FSR = 0.8 μm
Pixel Scale	0.24
Field of View	8 x 8 arcmin
Multiplex	laser-cut MOS masks, up to 40 slits per mask
Throughput	45%, not including telescope
Detector	2048 x 2048 Teledyne Hawaii 2RG and ASIC, 18 μm pixels, long-wavelength cutoff @1.7 μm

System Specs

Fabry-Perot Imaging	
Spectral Resolution	2500
Field of View	8 arcmin dia
Etalon Finesse	50
Order Blocking Filters	R ~ 50, 12 filters covering discrete atmospheric windows in J and H bands
Spectropolarimetry	
Polarization Measurements	linear, circular, all stokes
Instrument Modes	imaging, spectroscopy
Field of View	4 x 8 arcmin
Imaging	
Field of View	8 arcmin dia
Broadband Filters	Y, J, H

Major Risks

- Thermal background
- Flexure
- Thermal enclosure
  - Cool down
  - ~~Access~~
- Test and integration
  - Limited access to real system
- ~~Detector~~
- Reliability
- ~~Polarizing Beamsplitter~~

Minor Risks

- Optical Fabrication
- ~~Focusing mechanism~~
- Can't test the Collimator until Cape Town
- ~~Astigmatism introduced by the Dichroic~~
- Will Tracker mods meet the RSS-NIR Weight
- ~~Sealing the pre-Dewar~~
- ~~Condensation issues~~
- ~~Index matching fluid in Doublet at -40C~~
- Slit mask reliability

PDR Concerns

- Re-consider the moving seal
- Investigate allowing space for more filters
- Re-visit beam-size as part re-evaluation of optical design
- Investigate re-engineering the slit-mask and initial collimator elements to allow cooling to -20−C to enable full H-band performance
- Concern at the understanding of FP implementation issues
- Mechanical design not fully developed to appropriate level for PDR
- SALT should provide a better ICD protocol for weight
- 3-element ADC design:
- ASAP modeling should be performed at warmer ambient temperatures and include possible long wavelength tail on detector QE response

PDR Concerns continued

- Flexure control via articulation of the folding flat mirror
- filter/grating exchange mechanism design not mature
- Number of cryogenic blocking filters, not fully determined
- Delivered finesse of cooled FP
- SALT deliverables: 3 element ADC and AR coating and Calibration Unit
- Optical/NIR simultaneity not well justified
- Slit and collimator emissivity mitigation not fully analyzed
- No exchangeable dichroic
- FP design optimization in context of OH lines

PDR Concerns continued

- No tilting of Interference Filters
- Filter Exchange Box design very conceptual:
- Justification of nodding fold mirror required
- IQ specs for optics
- Faster f-ratios to give a better matching of the pixel-size
- Incomplete Collimator design
- Grating mount flexure
- Mechanical tolerancing incomplete.