Project report 1/24/2013

- D Content:
  - 1 slide on telescope & detector temperature [slide 2]
  - WF imaging performance [slides 3..11]
  - GRS grism status [slide 12]
  - IFU design & packaging status [slide 13]
  - Stray light study status [14]
- J Kruk:
  - Filter set [15..17]

Telescope temperature and detector optical cutoff

- Baseline for the report is T = 270K, optical cut-off = 2.0 μm
  - These are separate topics
- Telescope: Potential post-study report activities at JPL and Exelis to determine if lower T operation is feasible:
  - Update thermal model to optimize for 250K
  - Update high fidelity model of the secondary mirror to incorporate additional construction features
  - Testing of composite coupons at 250K or below
  - Cold box testing of the 120 deg development models of the AMS/FMS and the SMSS (also an SMST if available). If all are available would encompass all the composite bonds and joints
    - NDE before and after; thermocouples and acoustic monitoring during testing
    - Need to select thermal profile: Example 2 cycles at 270, followed by cycles at 260, then 250 and perhaps down to 240 to develop margin
  - Model composite laminate and fittings to characterize performance at 250K
  - Develop overall thermal survival limits
  - Develop thermal stability requirements
- After report, studies of detector optical cutoff & FPA temperature will continue
  - General approach is to start with simpler and passive thermal solutions
- Solutions can be found in GEO for moving detector optical cutoff redward

Optics performance – wide field instrument

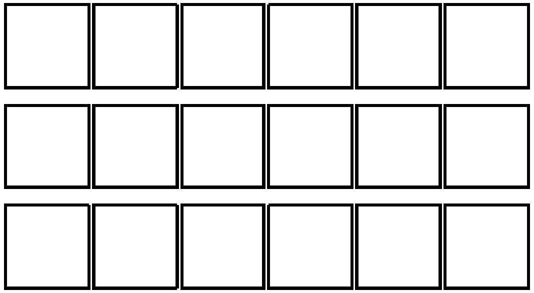
- Wide field imaging performance
  - layout
  - Optics description
  - Spot diagram (imaging)
  - Rms vs. wavelength
  - Diffraction encircled energy
  - Wavefront map
- Status of IFU
- Status of GRS grism
- Status of stray light study

Wide field focal plane layout

- Using realistic H4RG package spacings
  - 2.5mm in x
  - 8.564 mm in y
- Sapphire window in front of focal plane assembly (FPA)
  - Geo radiation environment
- Ea. active area is 0.1249 degrees (4088 pixels)
- 0.110”/pixel

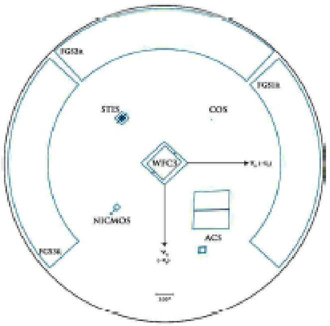
Channel field layout for AFTA-WFIRST wide field instrument

6x3 H4RG “packed” @ 0.11"/p, 0.281 sq.deg



0.427° high

0.788° wide



HST [all instruments]

Field Axis

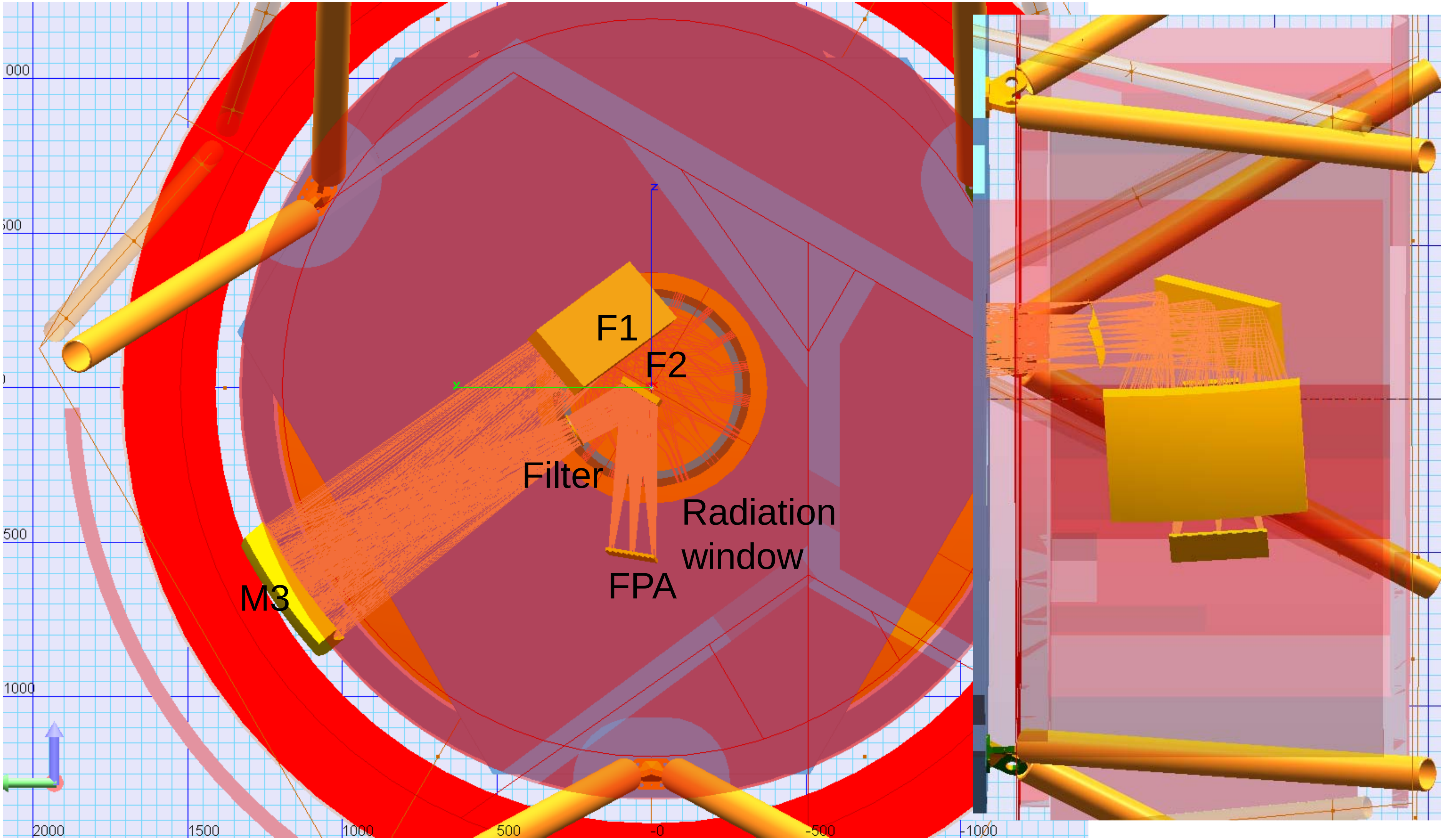
JWST [all instruments]

Moon (average size seen from Earth)

Wide Field layout table

packed & window		WideField
npix [1 side of SCA]		4088
pixel size	mm	0.010
x gap size	mm	2.500
y gap size	mm	8.564
pixel scale	"/p	**0.110**
nx		6
ny		3
total x	deg	**0.788**
total y	deg	**0.427**
active area	deg^2	0.281
focal length	m	18.75149
aperture	m	2.36
system f/#		7.946
obscured fraction		0.300
A	m^2	3.981
A - omega est.	m^2deg^2	1.118
Mpix		300.8
field size x	mm	257.78
field size y	mm	139.77
x gap angle	deg	0.0076
y gap angle	deg	0.0262
chip size	mm	40.88
chip angle	deg	0.1249

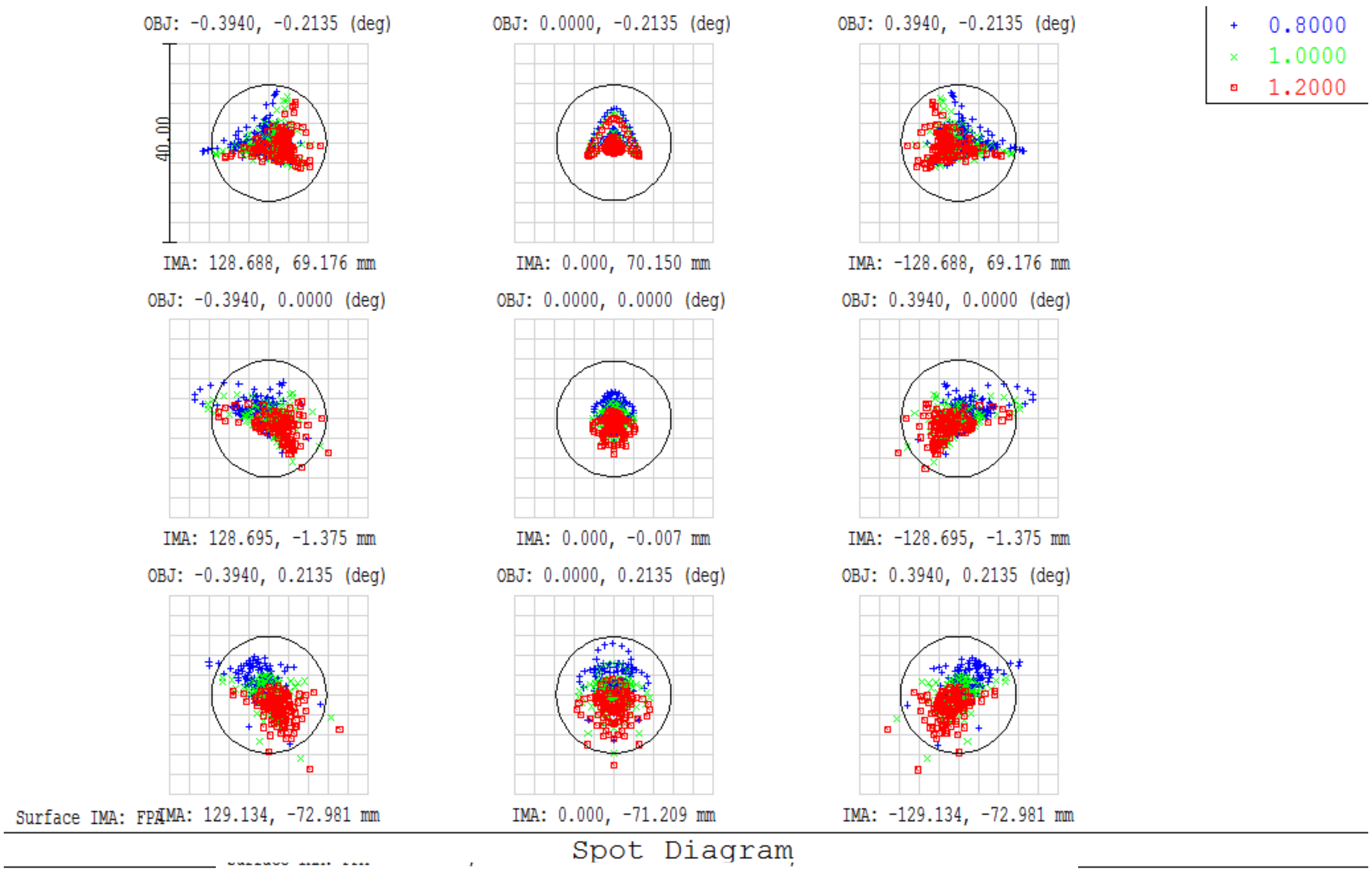
Wide field layout



Optics description

- Instrument optics: F1, M3, filter, F2, detector window
  - M3 and filter are only non-flat optics
  - M3 is off axis anamorphic asphere
    - Same form as HST/Costar corrector mirrors; larger
  - Filter S1 has Zernike correction terms (plus sphere)
    - S2 is pure sphere
  - Detector window (sapphire) is radiation shield
    - Also limits thermal parasitic input to FPA
- Filter wavelengths not settled;
  - Y, Z, J, H, Kshort, Wide filters plus GRS grism
  - 0.8-1.2um (over wide, R2.5) ‘example’ bandpass used in baseline design

Spot diagram



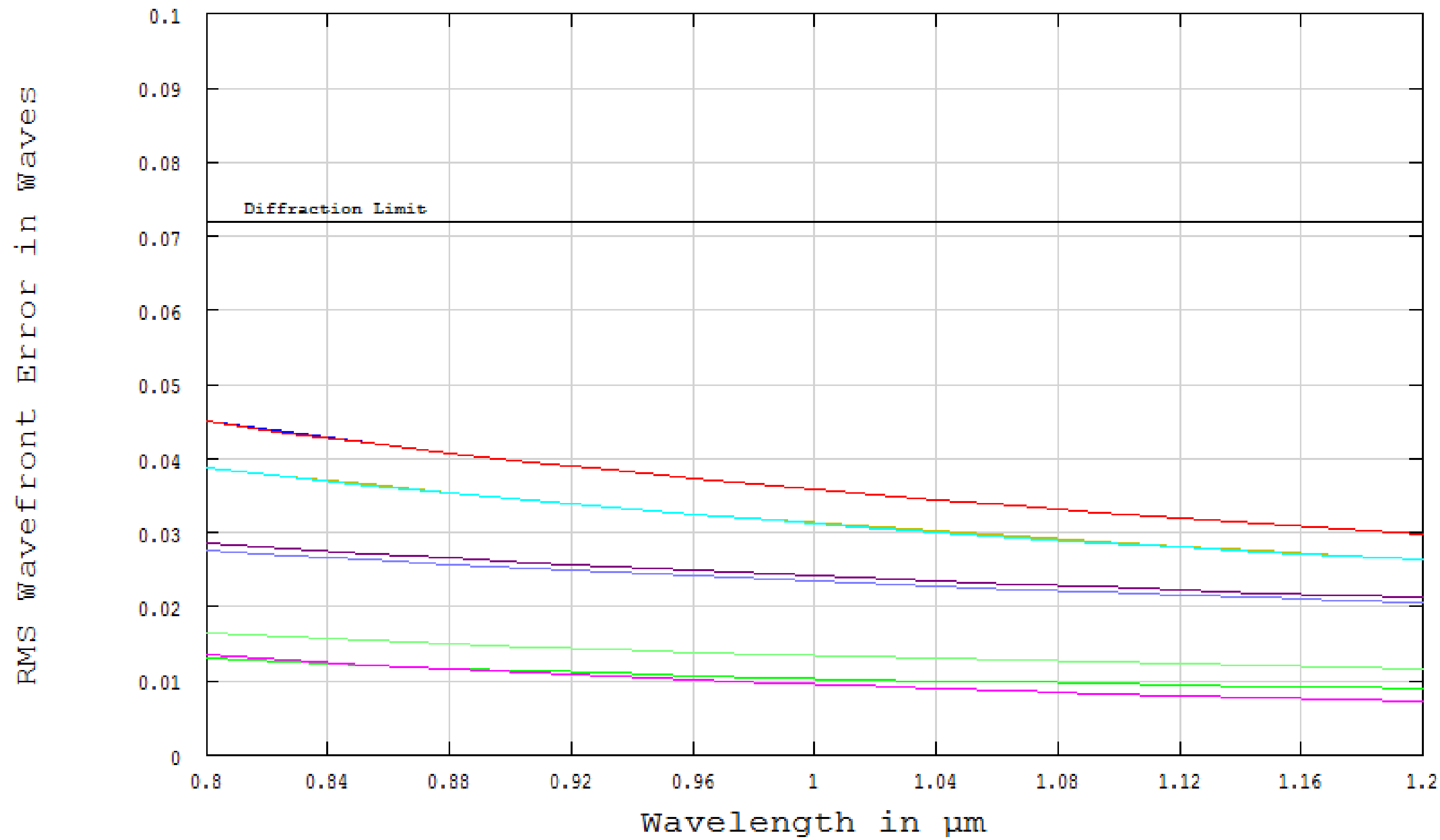
Spot Diagram

1/22/2013 Units are µm. Airy Radius: 11.59 µm

Field :	1	2	3	4	5	6	7	8	9
RMS radius :	4.819	2.621	4.806	5.081	2.812	5.079	5.059	4.645	5.056
GEO radius :	13.343	6.922	13.292	15.687	7.174	15.792	17.057	14.071	17.171

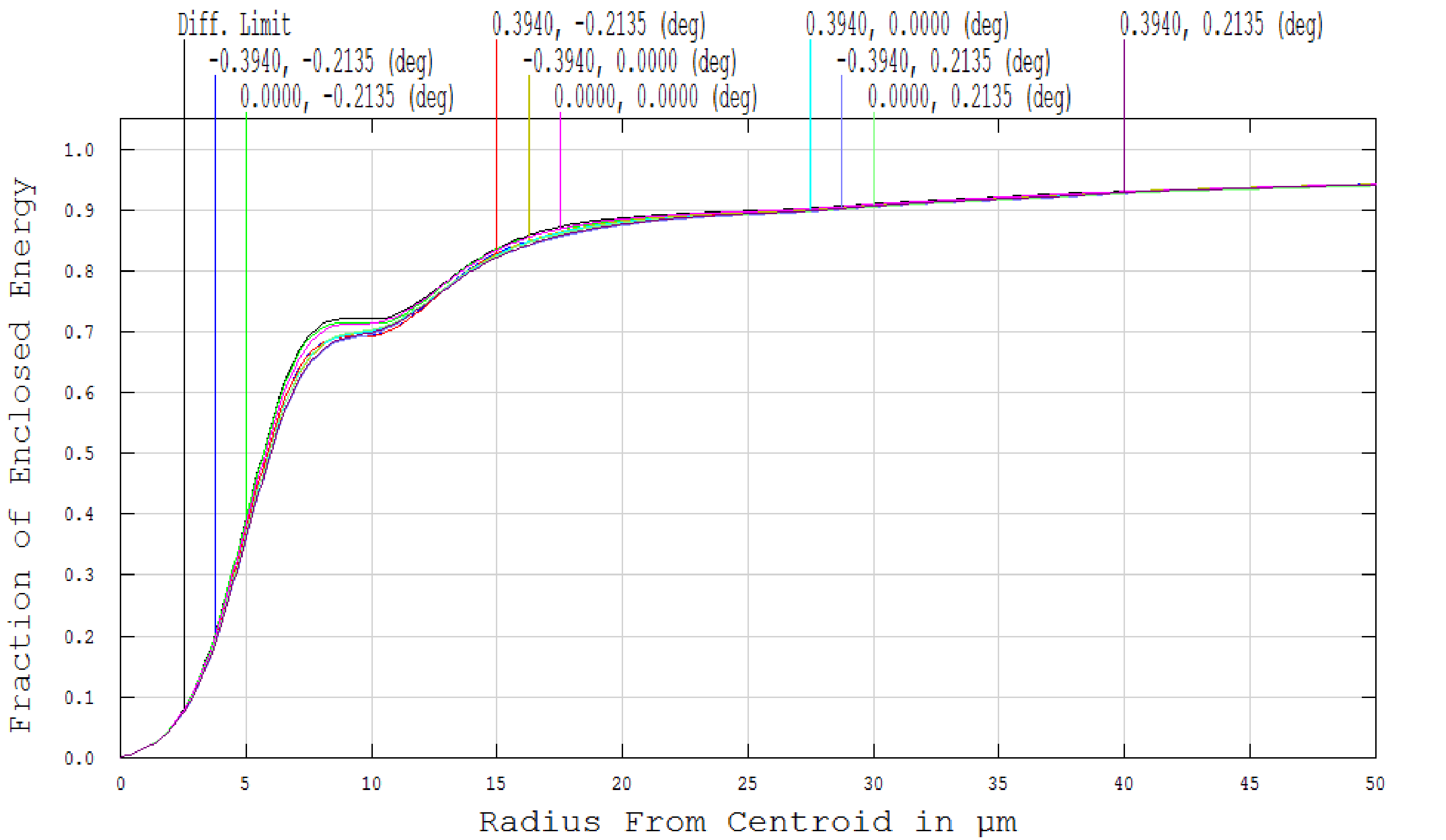
Scale bar : 40 Reference : Centroid

RMS wavefront error for 9 field points vs. wavelength



RMS Wavefront Error vs Wavelength

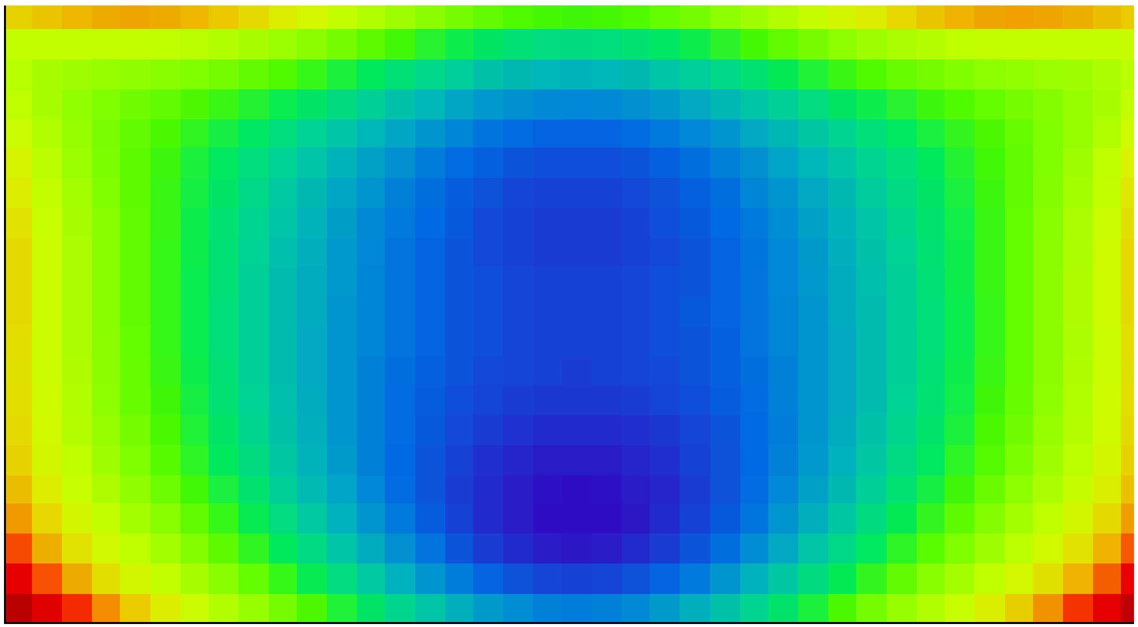
Diffraction encircled energy

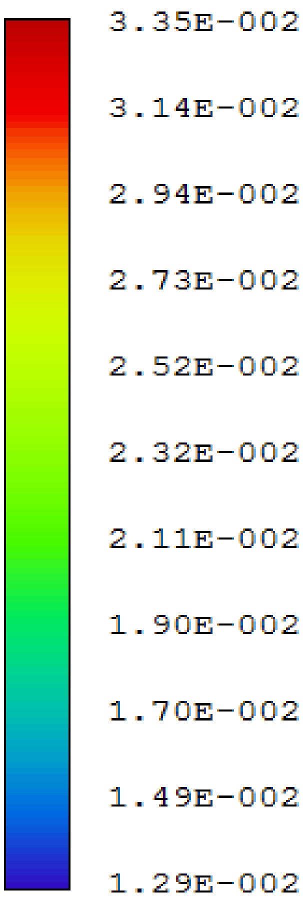


FFT Diffraction Encircled Energy

Wavefront map – 1.0um

Sampled ea. 0.02x0.02°; meets goal of max 0.035λ rms





GRS grism status

- Initial design in hand, poor imaging performance
  - Several times diffraction limit at some wavelengths and field points
  - 1.3-2.0um bandpass
  - Some ideas for improvement, in work
- May need to limit wavelength range, combination of field and bandpass limiting performance
  - Recall this is orders of magnitude more field, and higher dispersion than prior (e.g. HST) slitless dispersion modes

IFU design & packaging status

- Working to SNAP specifications
- 20 0.15” x 3” slices
- Effectively 20x20 samples, 0.15”x0.15”, 3x3” FOV
- 0.6-2.0um
- R(2pixel) ~100

- Optical train breaks down into modules:
  - Telescope & relay (increase f/# to feed slicer)
  - Slicer at relayed focal plane
  - Pupil imaging mirrors relay to pseudoslit focal plane
  - Spectrograph: entrance slit, collimator, prism assembly, camera mirror, FPA (could be 1k x 1k)
- In work, front end most critical to define overall payload configuration (wide field, coronagraph interfaces)

Stray light study status

- Picking up from prior telescope plus initial instrument concept stray light work
- Confirmed initial results
- Adding mirror scatter (3nm rms for T1,T2)
  - Typical clean-room (but not ‘heroic’ level) particulate contamination model will also be included here
- Moving to new instrument configuration as described above

Filter Set

Jeff Kruk/Chris Hirata

Filter questions

- Strawman filter set (next slide) is a compressed version from DRM1/2.
- Adjust overlap for photo-z precision?
  - Save this optimization for after this report?
- Add new filters based on WFC3 experience?
  - Main difference based on Jason's statistics was use of 'medium' width filters
  - Would mean adding a second wheel
  - Are there compelling scientific arguments to make at this time, or defer this to a later report?

Strawman filter set

Filter	λmin	λcenter	λmax	Δλ	R	Overlap
Z	0.760	0.869	0.977	0.217	4	0.050
Y	0.927	1.06	1.192	0.265	4	0.061
J	1.131	1.293	1.454	0.323	4	0.074
H	1.380	1.577	1.774	0.394	4	0.091
Ksuprshort	1.683	1.842	2.0	0.317	5.81	0.111
W	0.927	1.485	2.0	1.03	1.44	
GRS grism	1.3	1.65	2.0	0.7		
blank						