

# The WFIRST Optical Design of the Phase-A Integrated Field Channel

Guangjun Gao

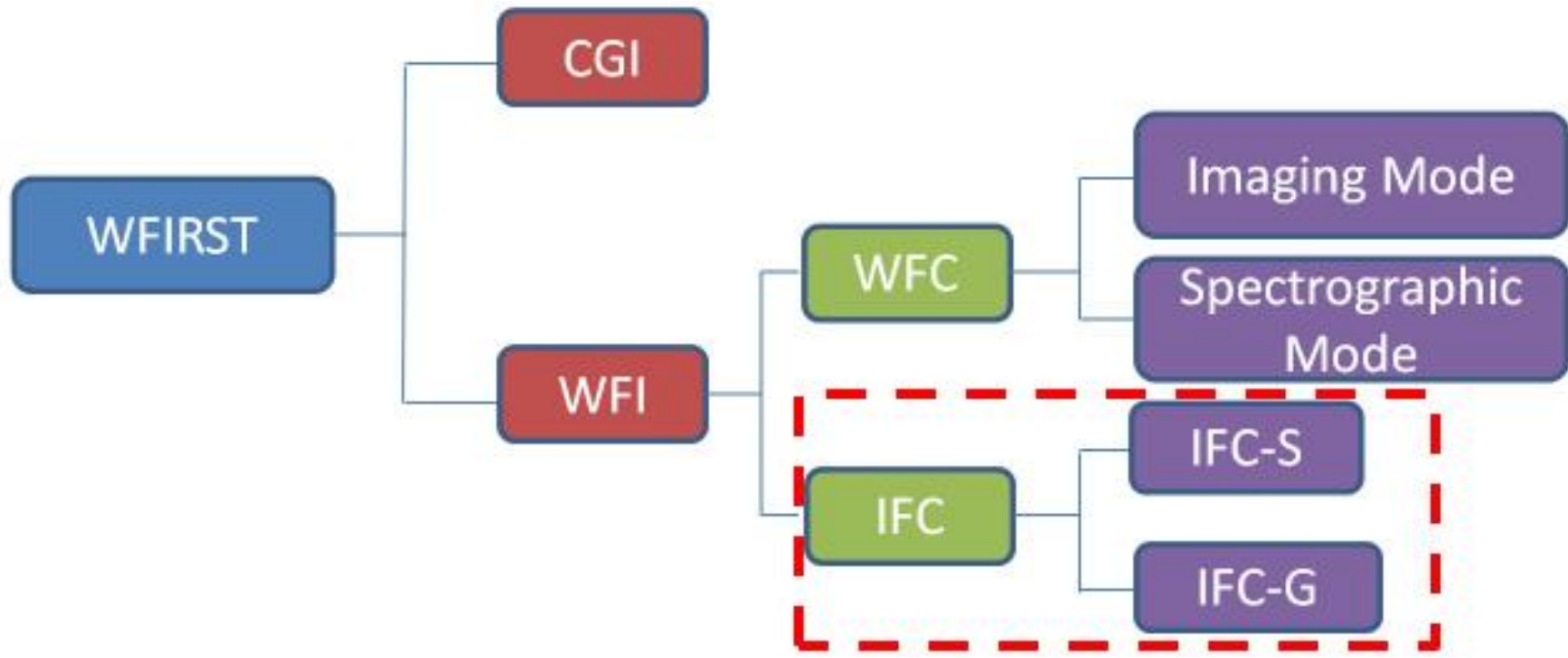
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- Introduction of WFIRST
- Overview of Integrated Field Channel (IFC)
  - 1) System-level description of IFC (Phase A)
  - 2) Changes of IFC since Mission Concept Review (MCR)
- Optical design of Phase-A IFC
  - 1) IFC Relay
  - 2) Receiving Optics
  - 3) Image Slicer
  - 4) Spectrograph
- Summary



WFIRST: Wide Field Infrared Survey Telescope

CGI: Coronagraph Instrument

WFI: Wide Field Instrument

WFC: Wide Field Channel

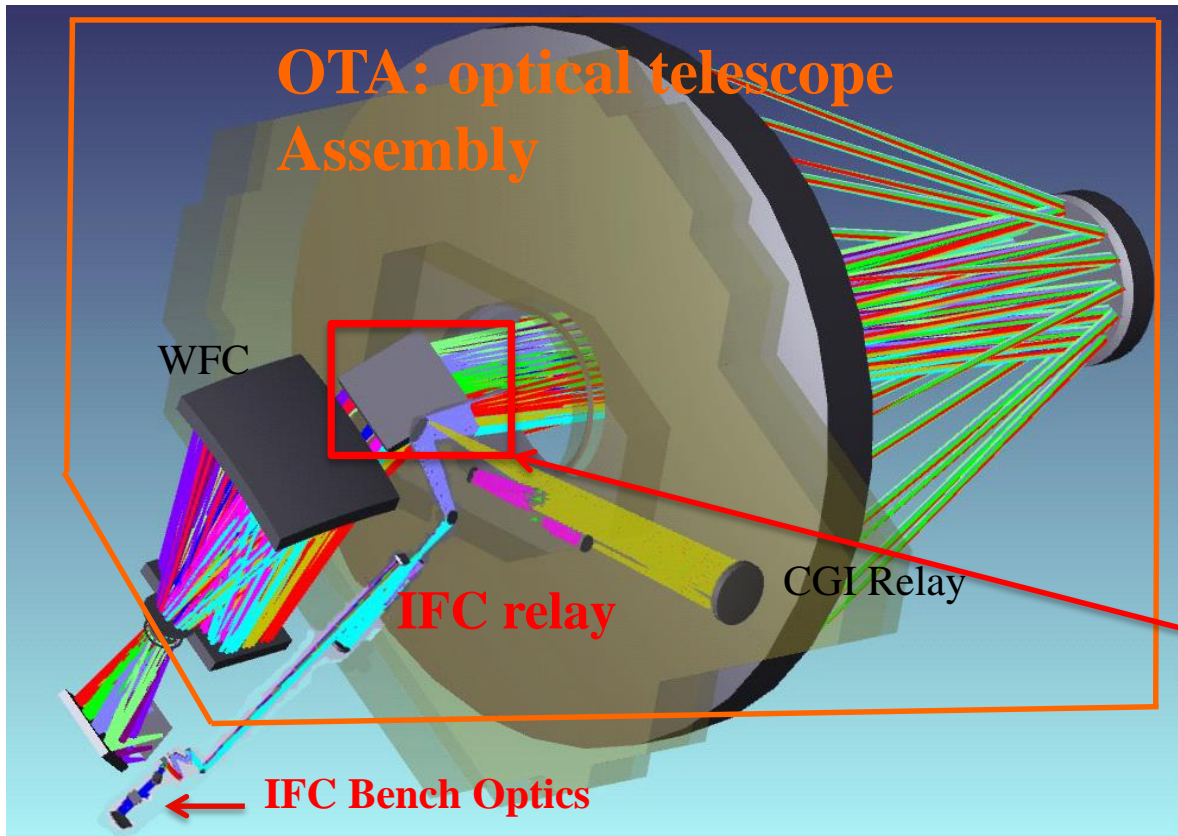
IFC: Integrated Field Channel

GRISM: Grating Prism

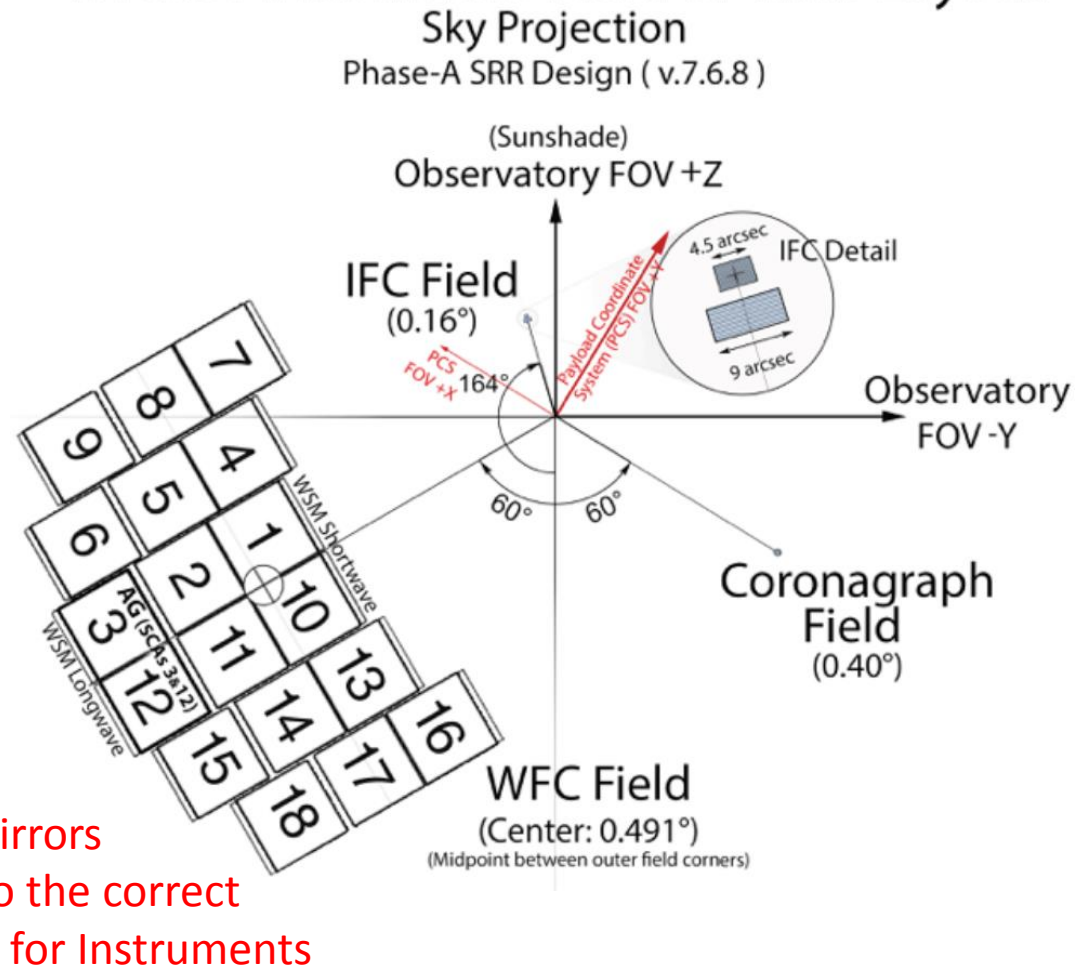
IFC-S: IFC Supernova

IFC-G: IFC Galaxy

- System-level description of IFC in WFIRST



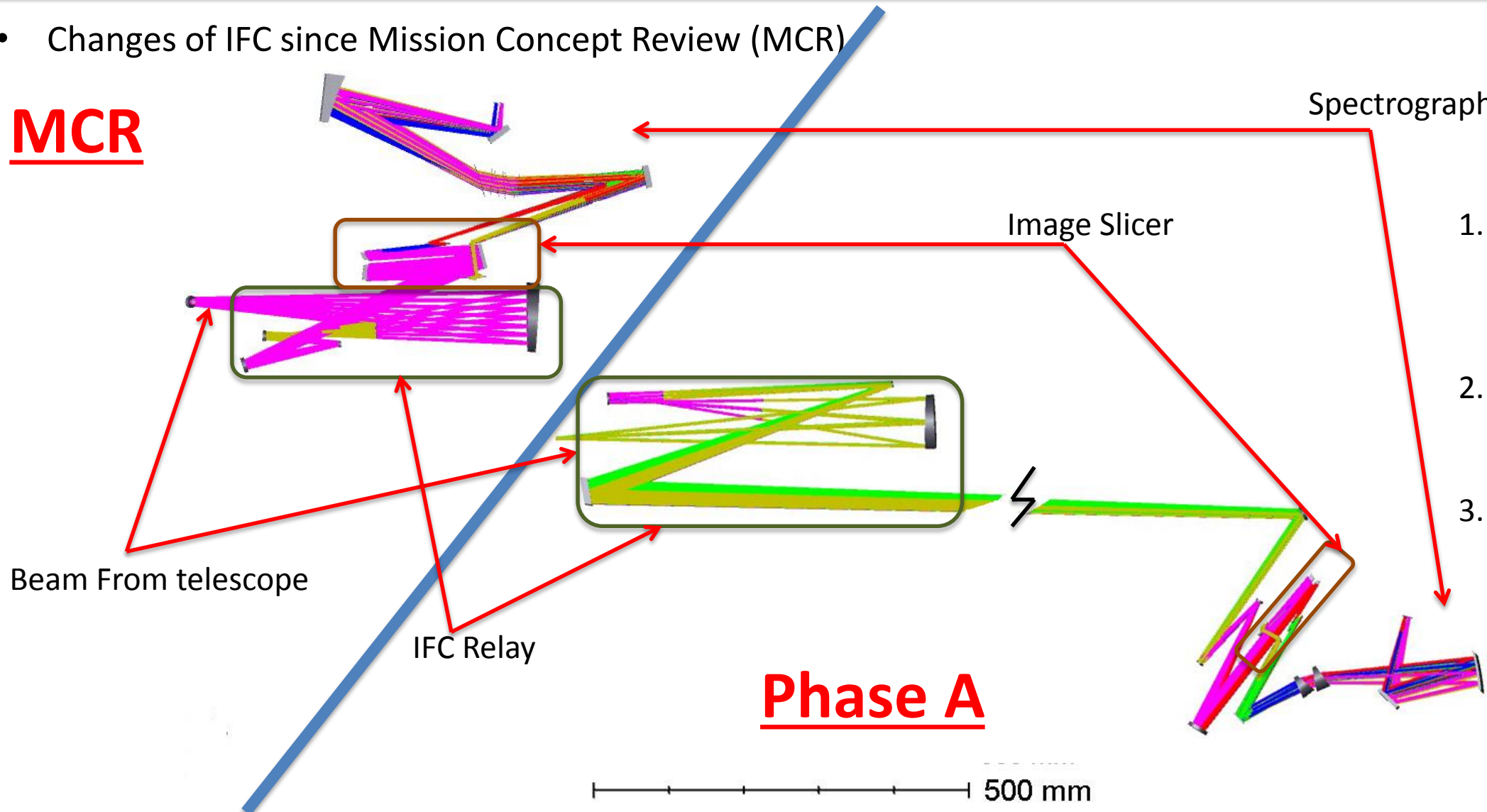
## WFIRST Instrument Field of View Layout





- Changes of IFC since Mission Concept Review (MCR)

## MCR

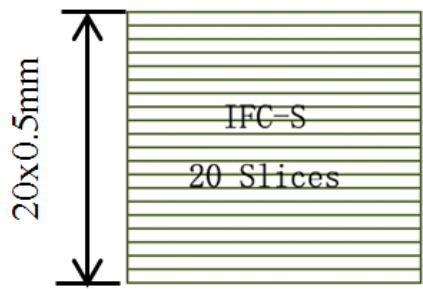


1. Relay subsystem is separated from IFC Bench and merged into OTA;
2. Receiving Optics added before image slicer;
3. Image slicer parameter changed.

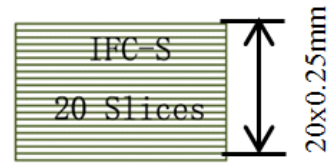
## Phase A



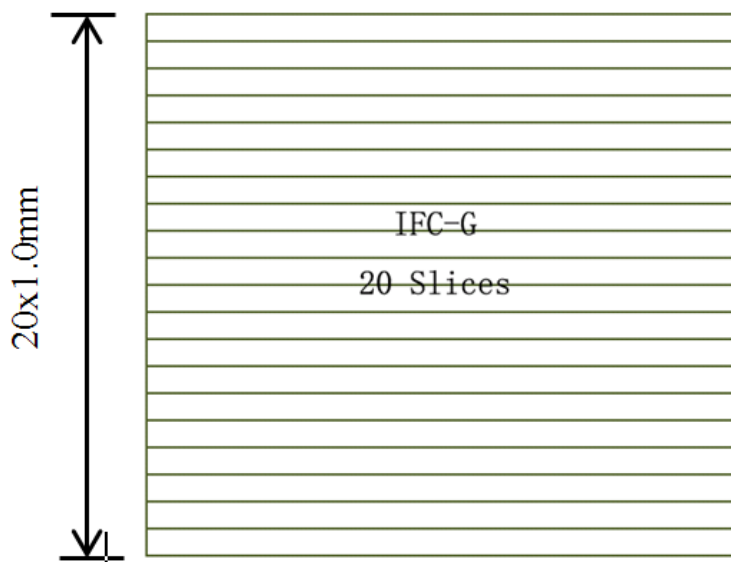
Slice Aspect Ratio 20:1



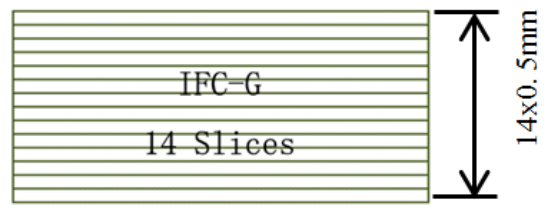
Slice Aspect Ratio 30:1



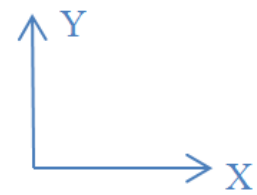
## Comparison of Image Slicer: MCR vs. Phase A



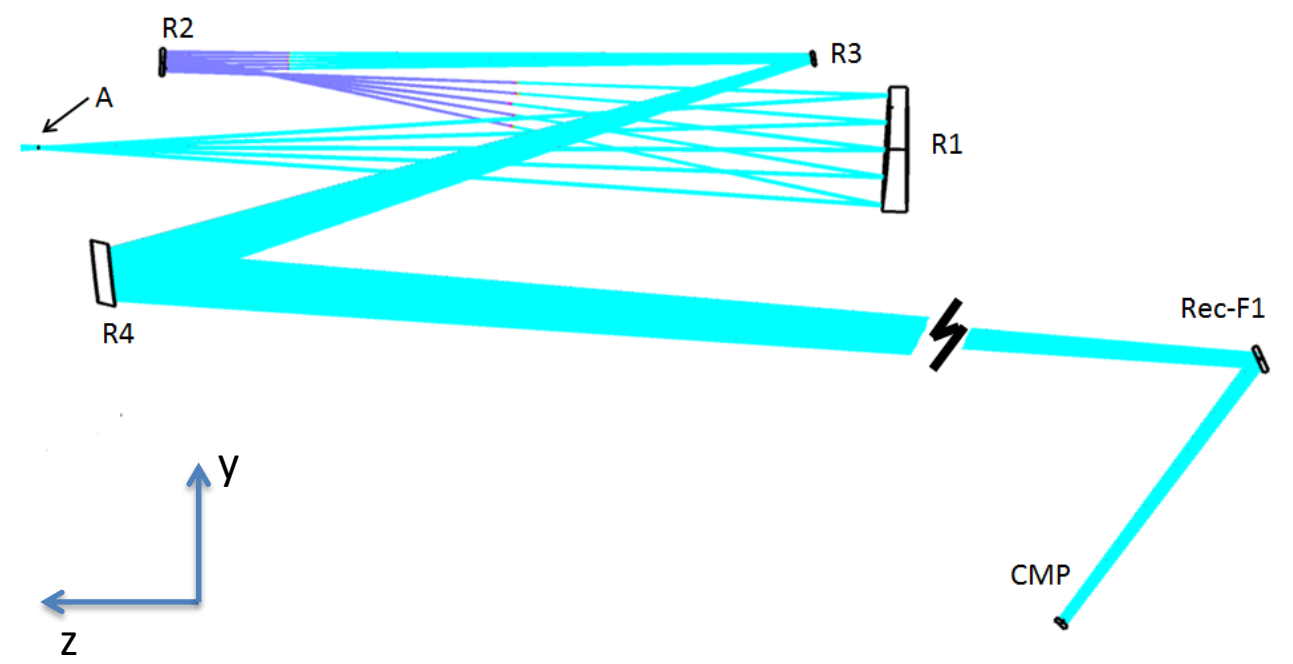
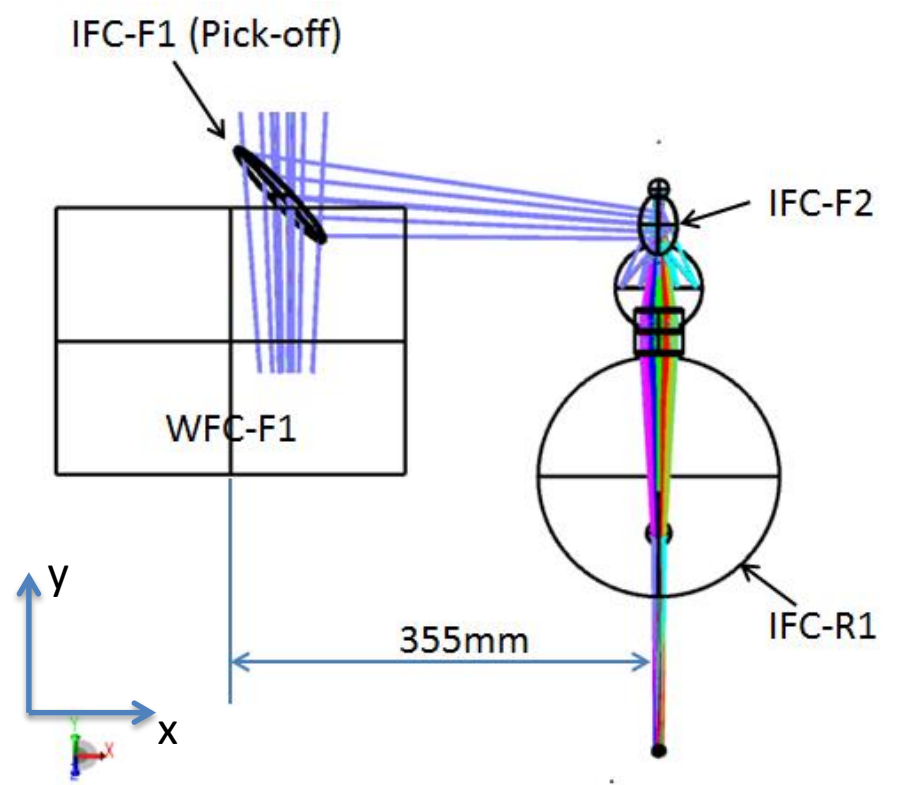
MCR



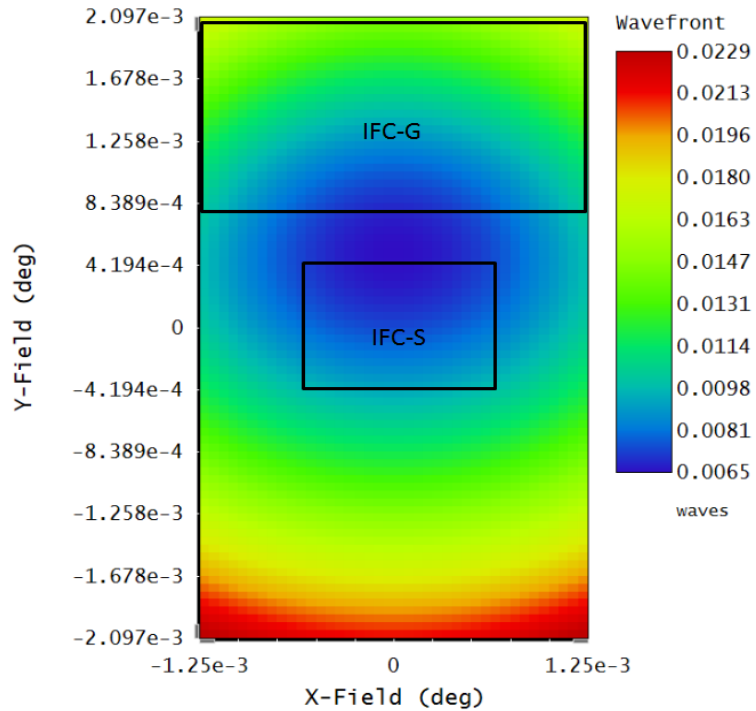
Phase-A



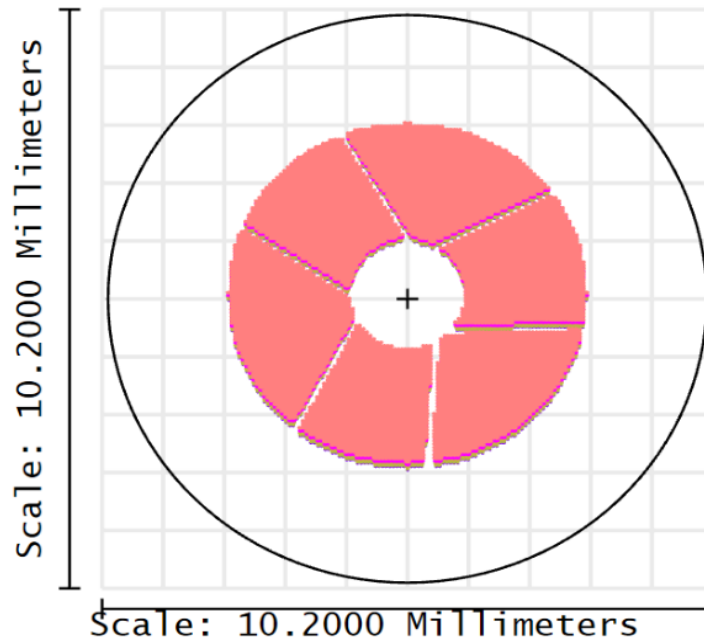
	MCR		Phase A	
	IFC-S	IFC-G	IFC-S	IFC-G
Slice Width (mm)	0.5	1.0	0.25	0.5
Slice Quantity	20	20	20	14
Fov Area covered (arc sec sq.)	3x3	6x6	3x4.5	4.2x9
F-number at slice mirror	291	291	145.5	145.5
Magnification Ratio	5:1	10:1	4:1	8:1



### Image Quality of IFC Relay

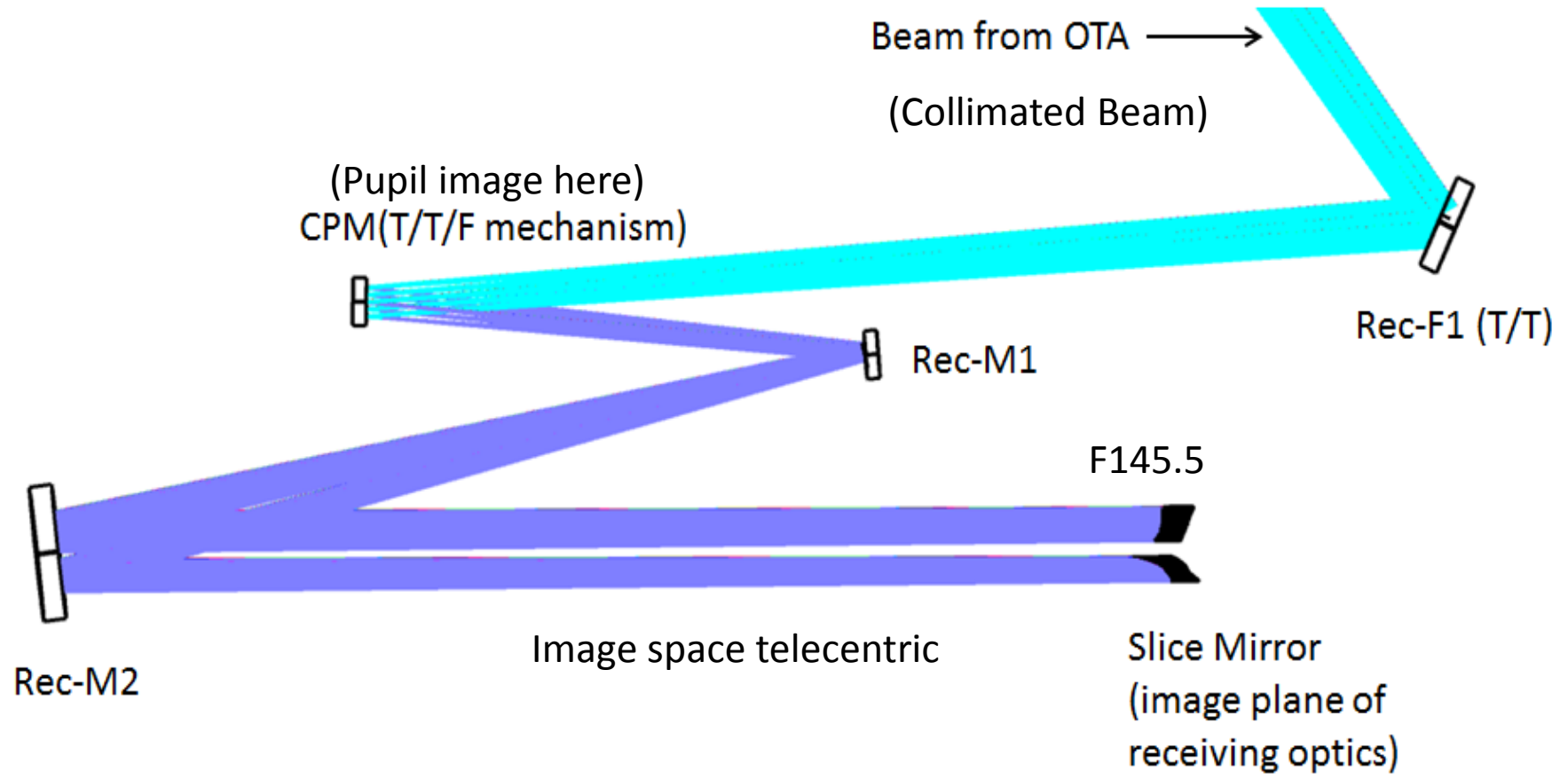


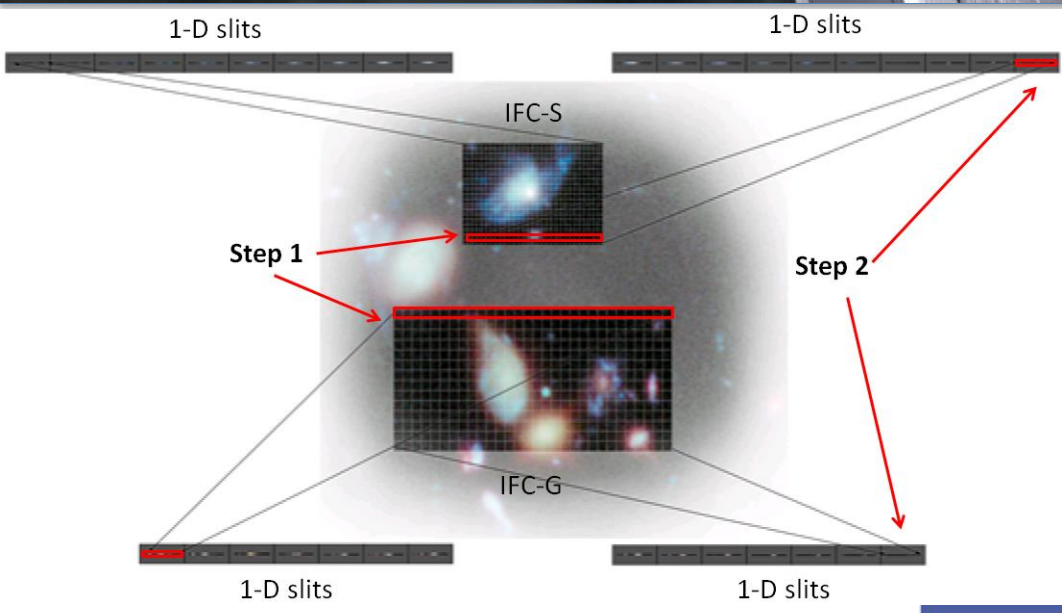
RMS WFE IFC-S: 6~10nm  
IFC-G: <16nm



Pupil image on the Cold Pupil Mirror (CPM)

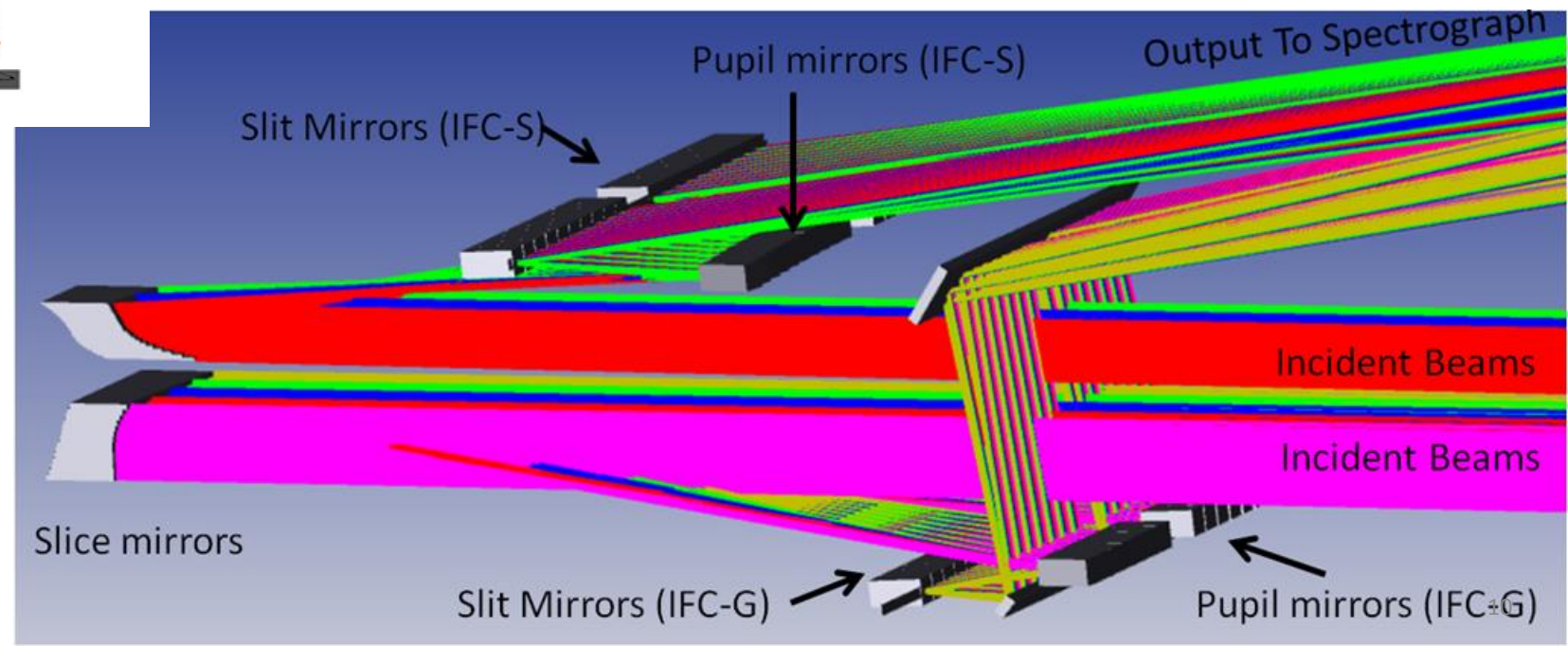


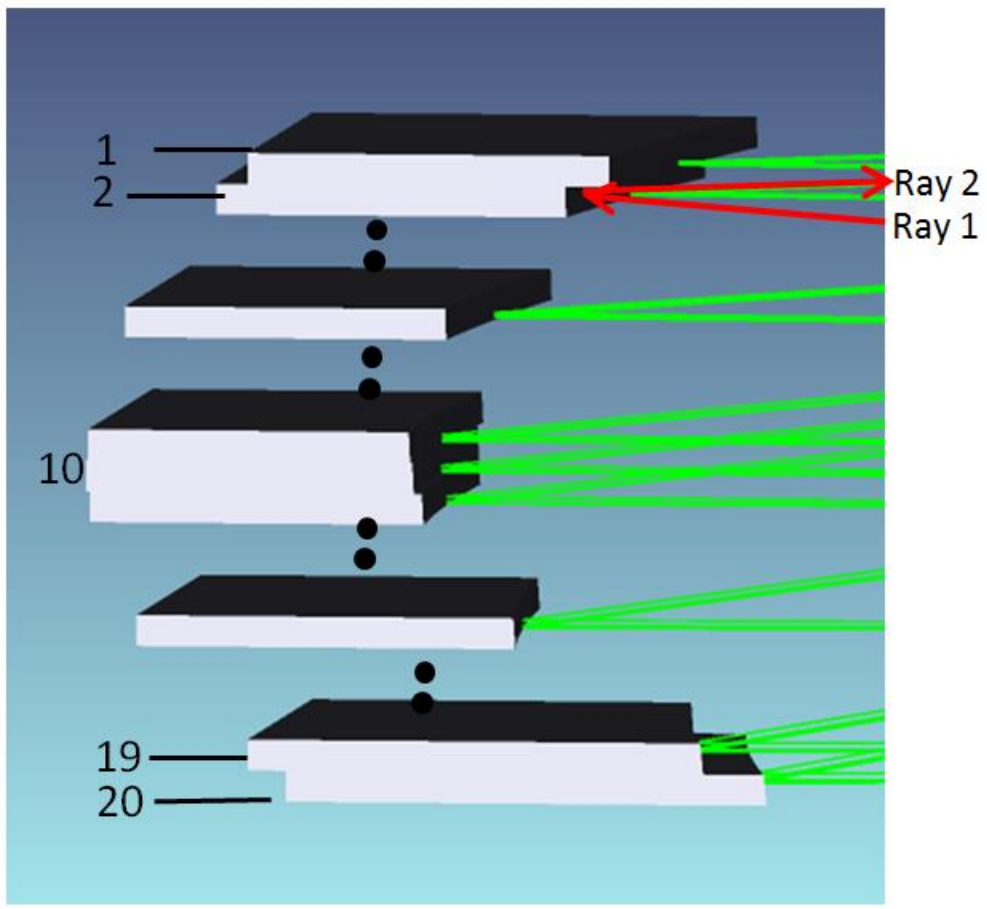




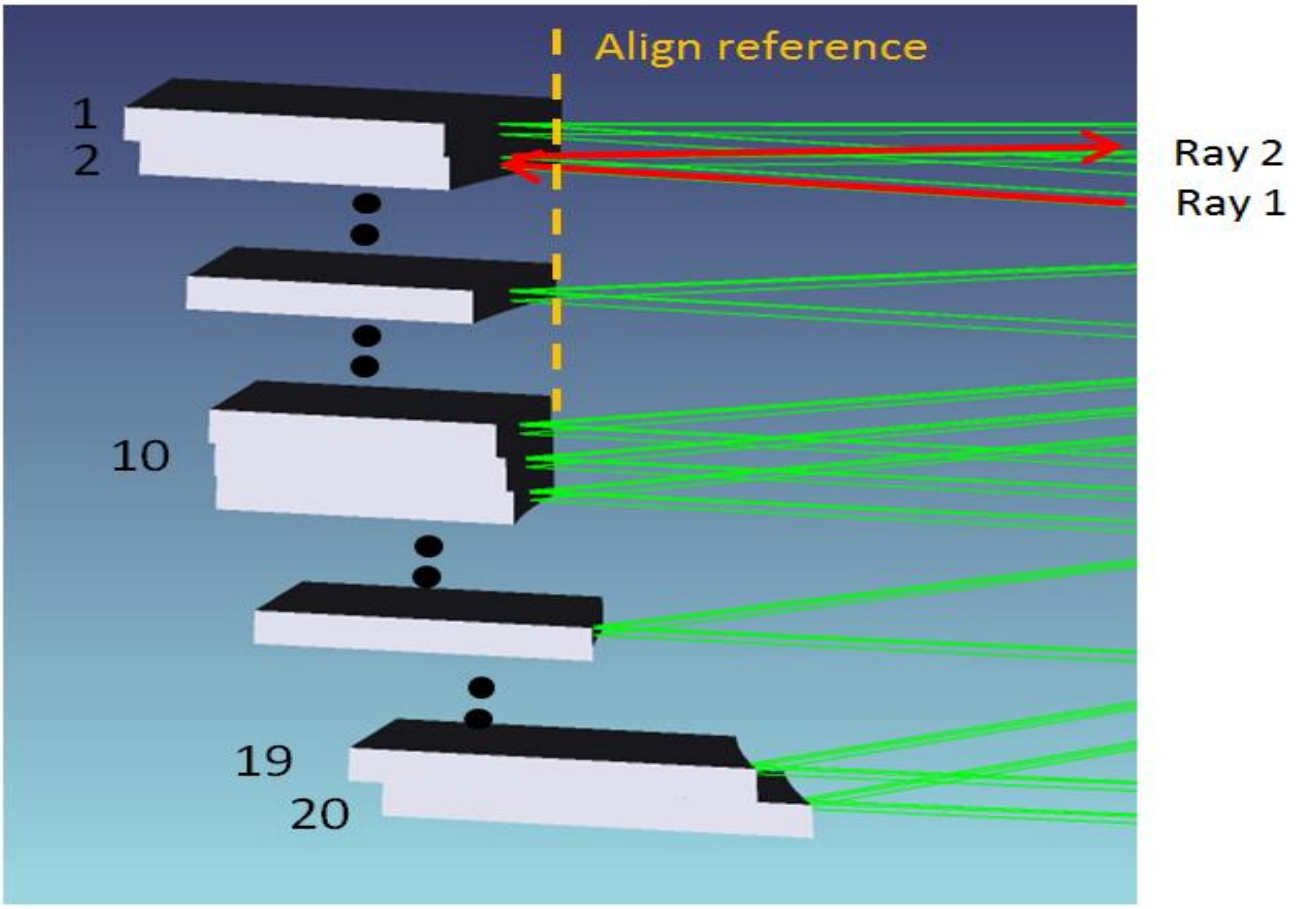
Step1: on the slice mirror, image of receiving optics is “cut” by slice mirrors;  
 Step2: on the mini slit, the image slices are imaged by pupil mirrors and realigned into 1-D image slit arrays.

Spatial mapping from slice mirrors to slit mirrors



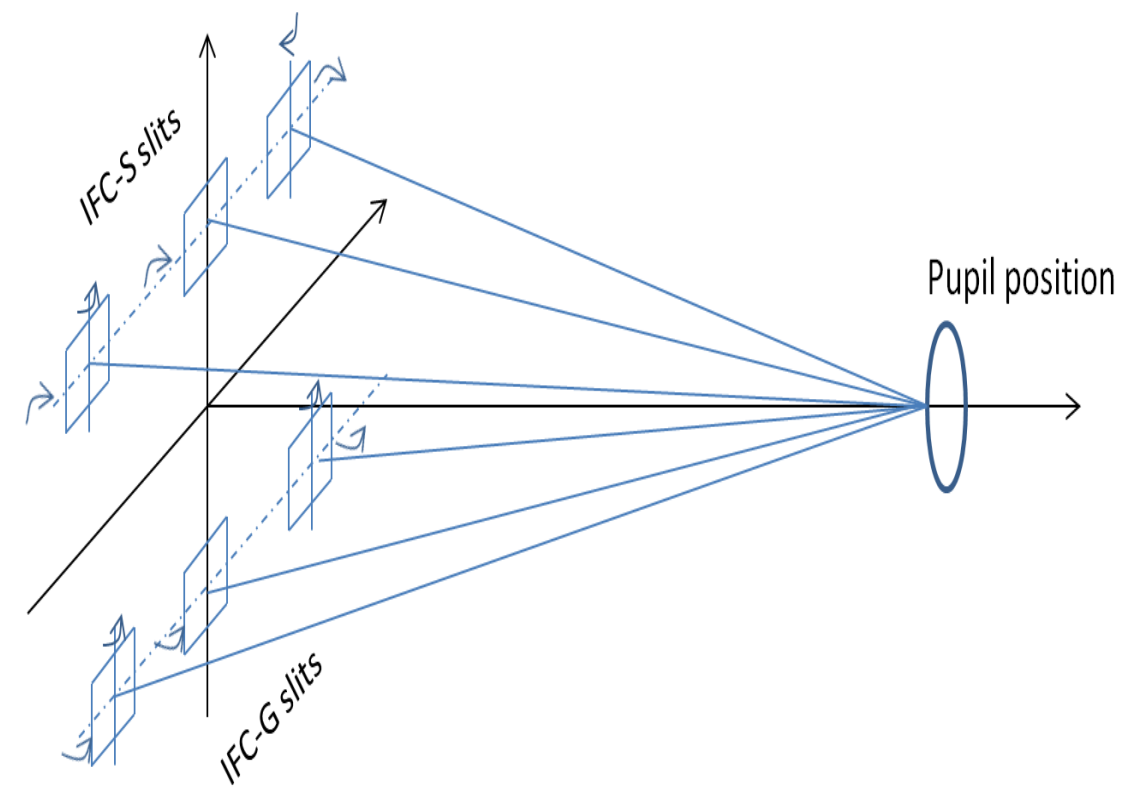
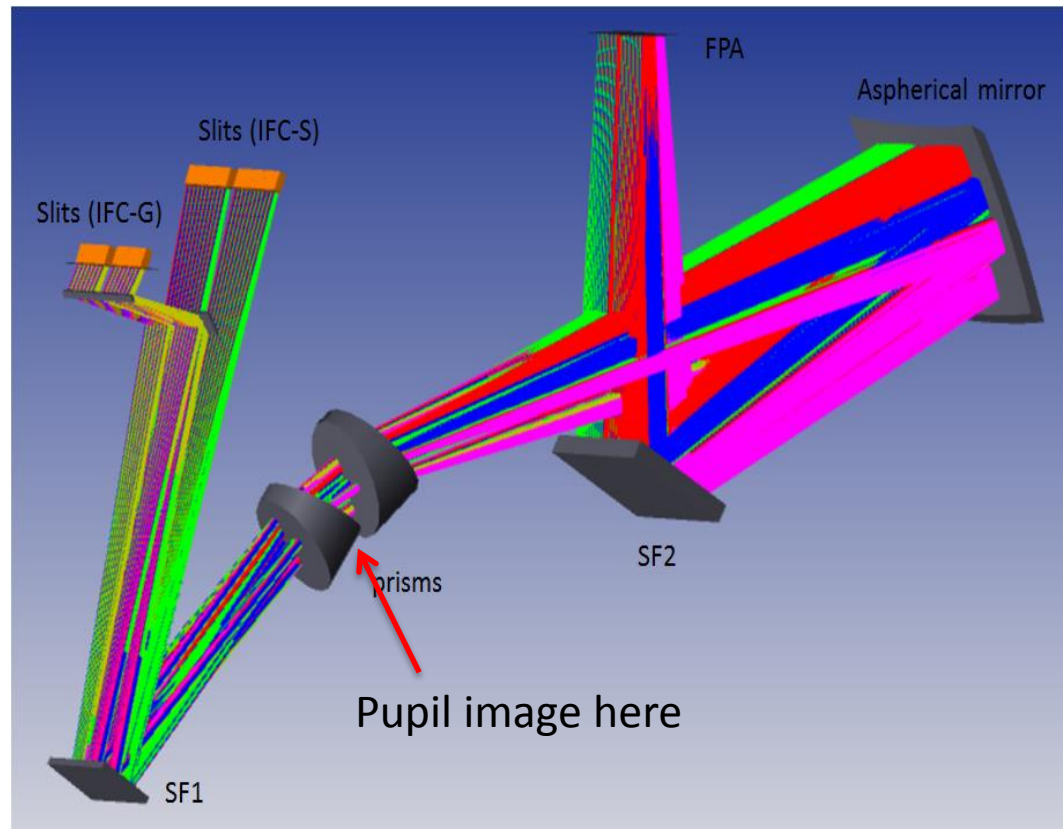


"C" shape design (with vignette)



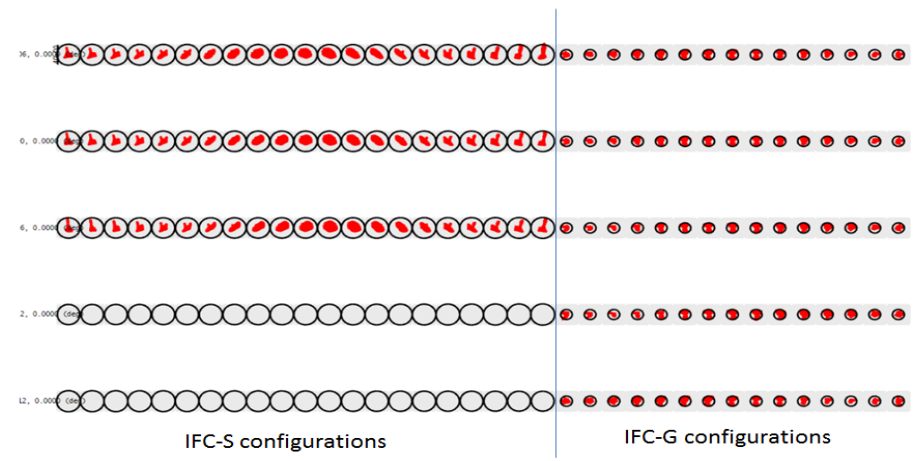
Hybrid design (without vignette)



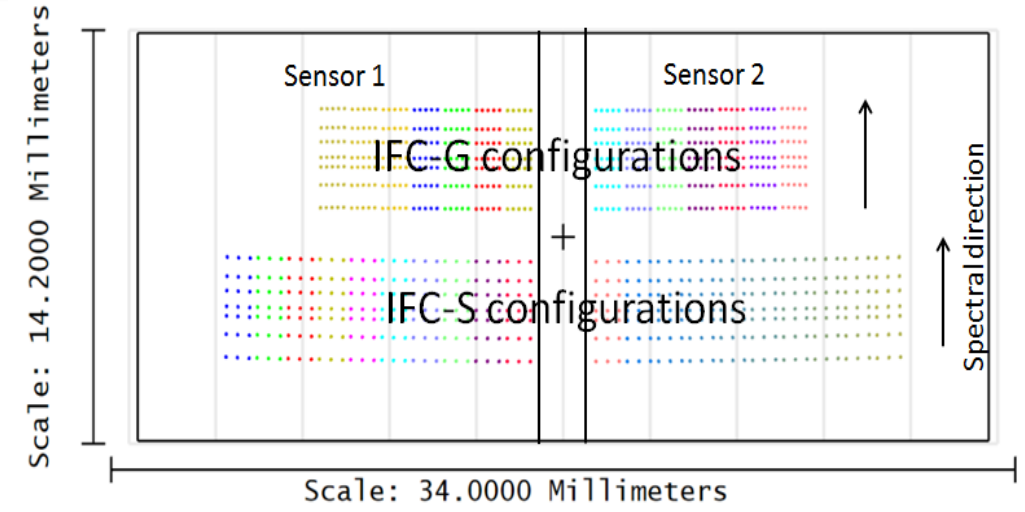


By tilting the tip/tilt of mini slit mirrors, a slicer exit pupil is directly formed at prism position.

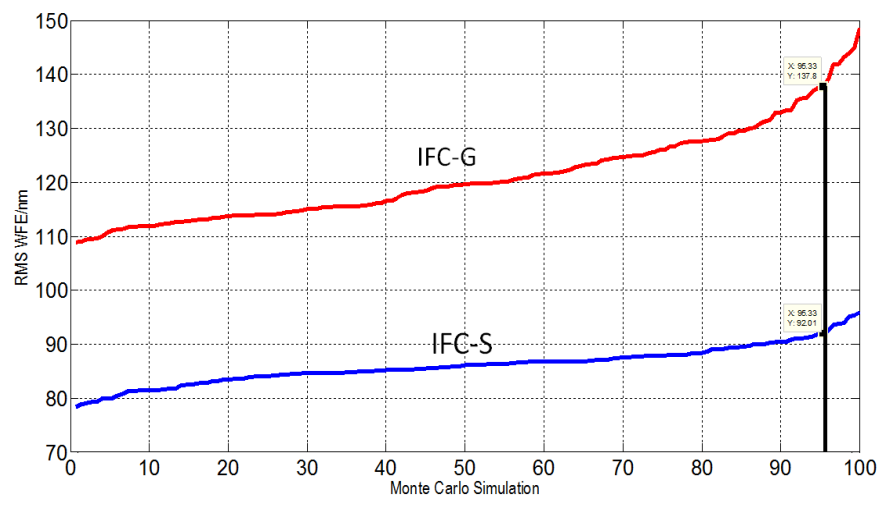




Spot diagram on FPA (wave: 1.0um)



Footprint on the FPA

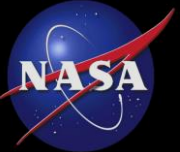


Cumulative probability curve of 100 MC simulations

- From MCR to Phase A, IFC was changed and re-designed in order to reduce the fabrication/integration cost and instrument size;
- IFC Relay system balances the optical aberration of telescope and outputs collimated beam, and project the exit pupil on the Cold Pupil Mirror (CPM);
- Slice mirrors with “hybrid” mode can effectively remove the vignette between two neighboring slices;
- By adjusting the tip/tilt of mini-slit mirrors, a “pupil image” can be directly formed on prism;
- we got good image quality for both IFC-S and IFC-G on the FPA surface.



Thank You!



# Questions & Answers

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