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ISTITUTO NAZIONALE DI ASTROFISICA
NATIONAL INSTITUTE FOR ASTROPHYSICS

The Field Camera Unit for WSO/UV

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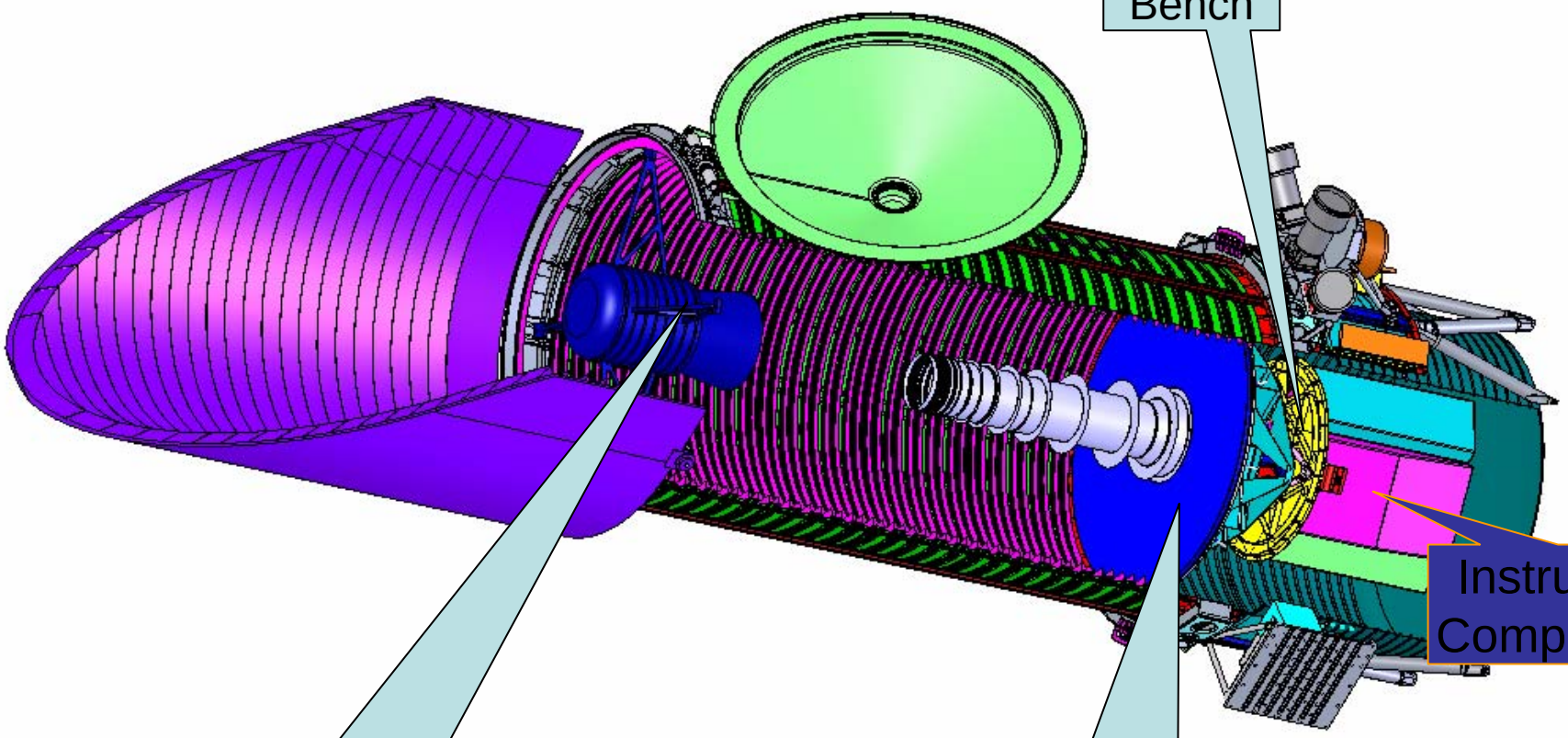
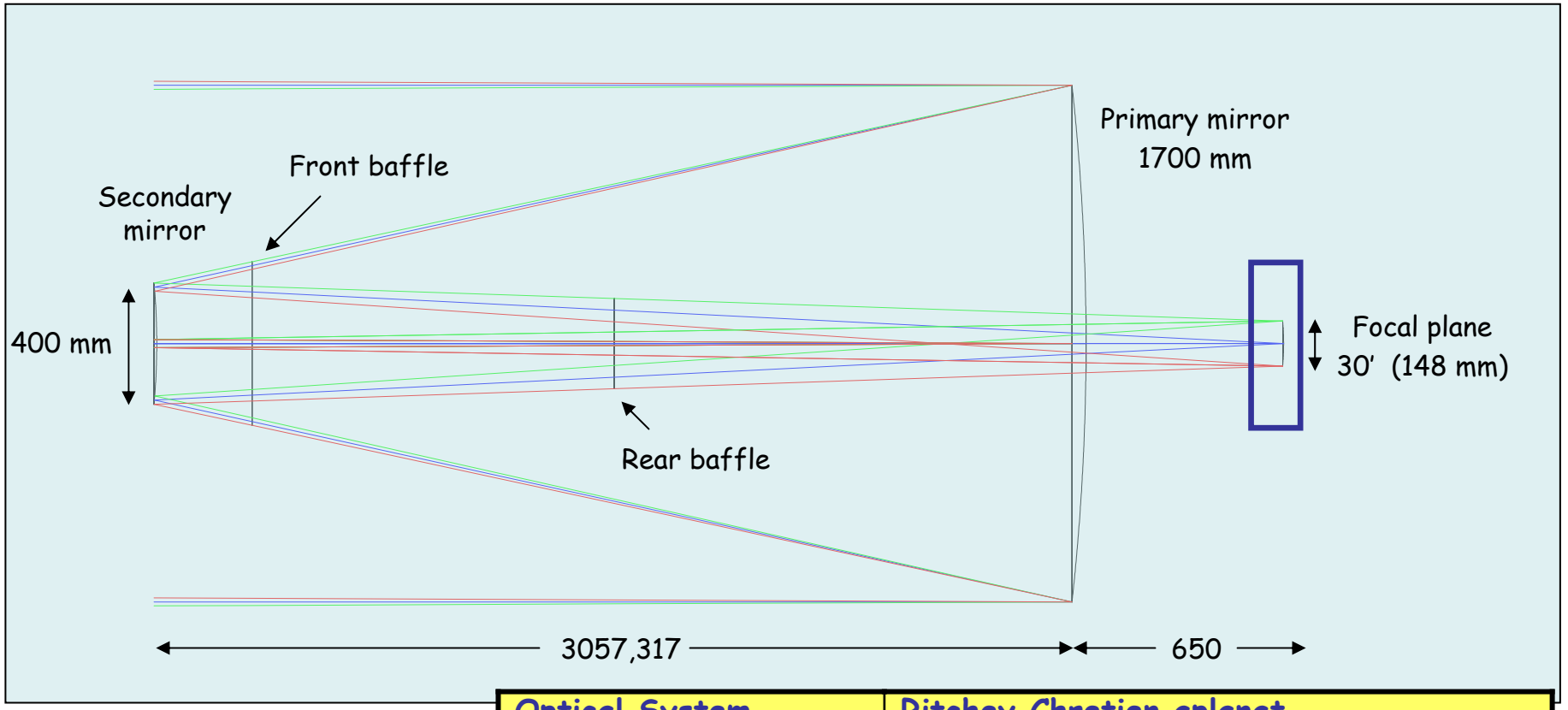
T-170M Telescope

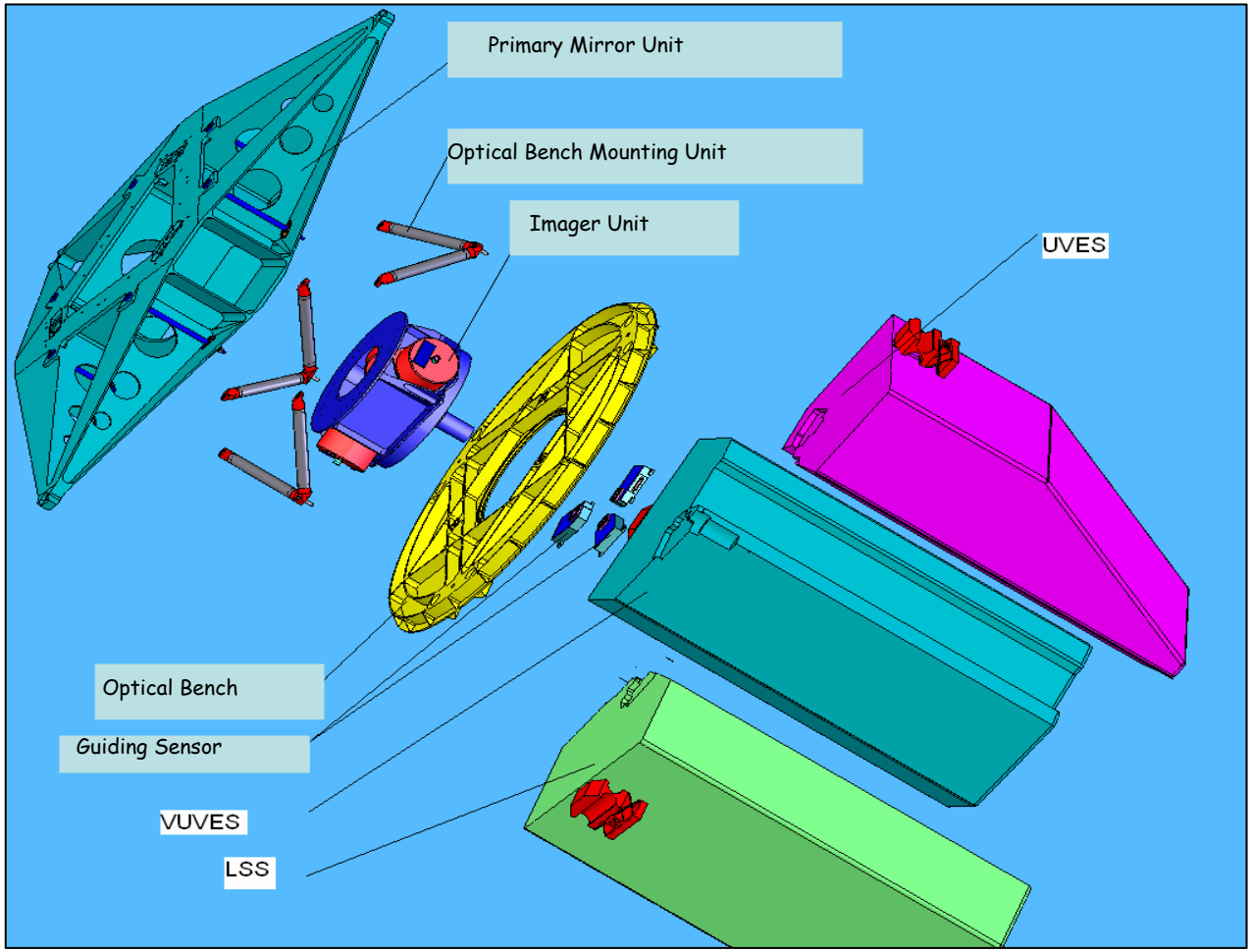


Telescope Optical Layout



Optical System	Ritchey Chretien aplanat
Aperture Diameter	1700 mm
F-number	10
FOV	0.5° (or 148 mm)
Wavelength range	100-350 nm (+visible)
Primary wavelength	200 nm
Optical Quality	Diffraction limited at FOV center

Field Camera Unit (FCU)



FCU Project Development Plan

T_o = 18 Jan 2007

Time

Phase	Duration	Milestones	Dates
		Kick-off Meeting	18 Jan 2007
Phase A	1 months	RA1	12 Feb 2007
Phase A	5 months	PRR	12 Jul 2007
Phase B1	4 months	SRR	TBD

Imager requirements

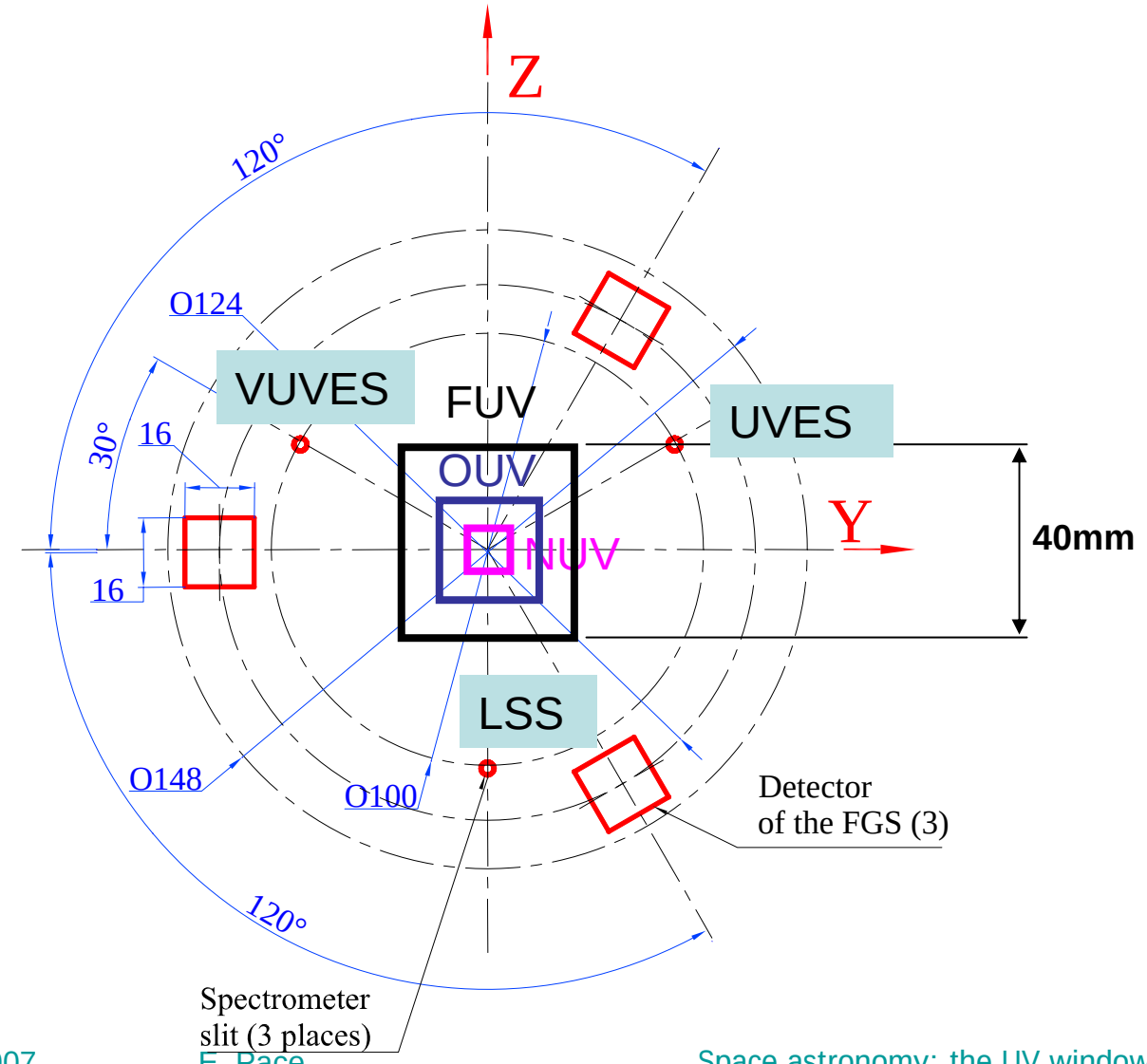
- Large wavelength coverage (115-700 nm)
- Large field of view
- High spatial resolution
  - Morphological studies (e.g. planets, planetary nebulae, star formation regions, external galaxies)
  - High accuracy stellar photometry
  - High accuracy stellar astrometry
  - Resolve stars in crowded fields (e.g. in star clusters, external galaxies, star formation in AGNs)
- High time resolution in the UV

FCU main characteristics

	Channel		
	Far-UV	**Near-UV**	**UV-Optical**
Spectral Range	115-190 nm	150-280 nm	200-700 nm
Field of View	6.6'x6.6'	1'x1'	4.7'
Scale			0.07"/pix
Pixel Size	20µm	20µm	15µm
Array Size	2kx2k	2kx2k	4kx4k
Detector	MCP (CsI)	MCP (CsTe)	CCD (UV optimized)
Filters, Polarizers, Dispersers	Up to 10	Up to 23	Up to 24
Slitless Spectroscopy	Yes	Yes	Yes
Polarimetry	No	Yes	Yes
Slitless Spectropolarimetry	No	Yes	No

Top level requirements

Focal Surface Layout



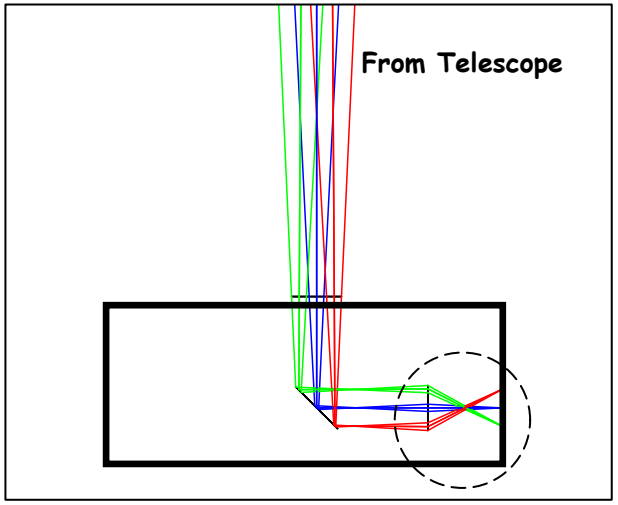
Optical Design Ideas

1. Plan to use the central Field of View
2. All reflective design
3. Pick Up Mirror
   - Rotating mirror
   - Pyramid mirrors
   - Fixed mirror + Dichroic beam splitter

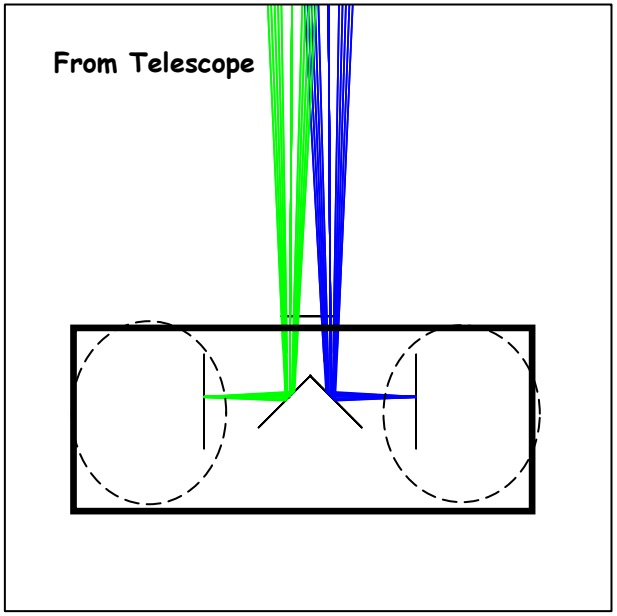
Poster Session: WSO-UV Field Camera Unit preliminary optical layout (Gambicorti et al.)

Pick up Mirror Layouts

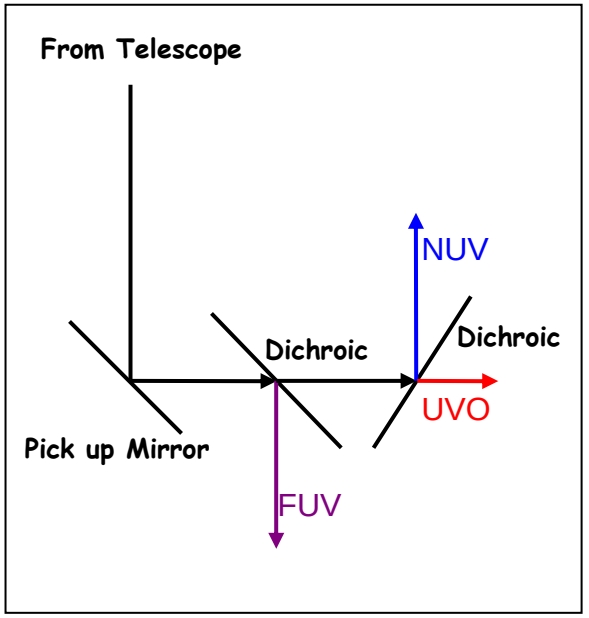
Rotating mirror



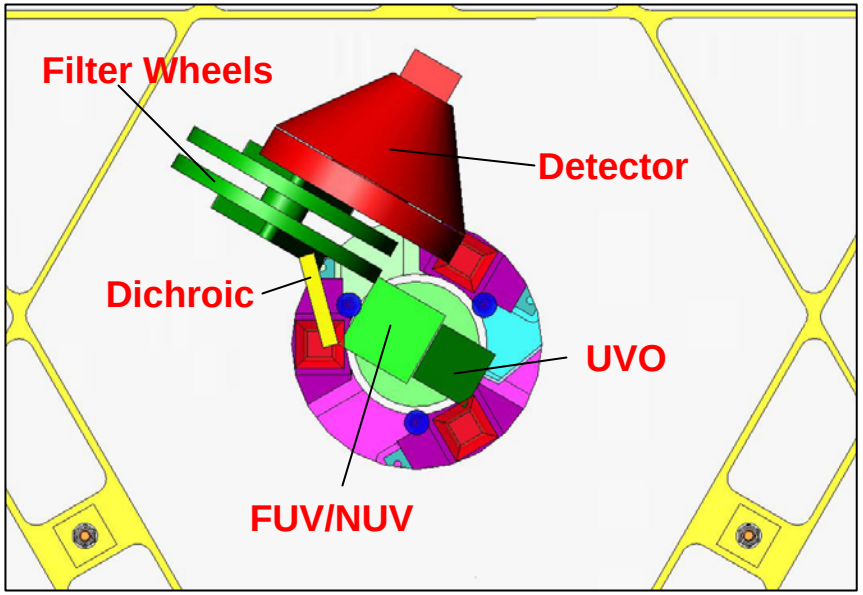
Pyramid

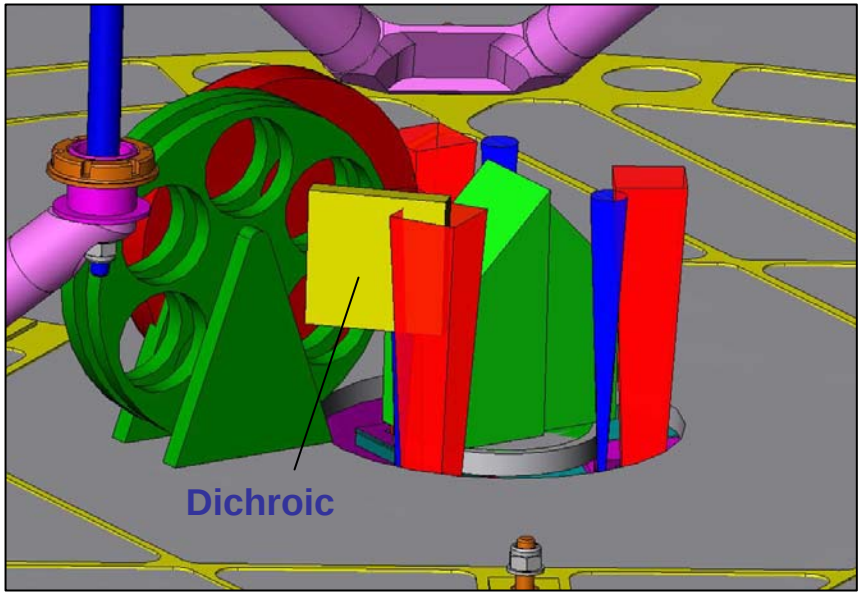


Dichroics



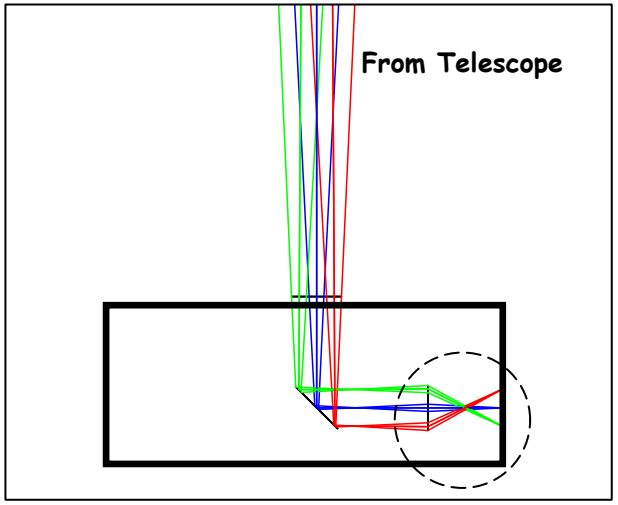
Dichroic Layout



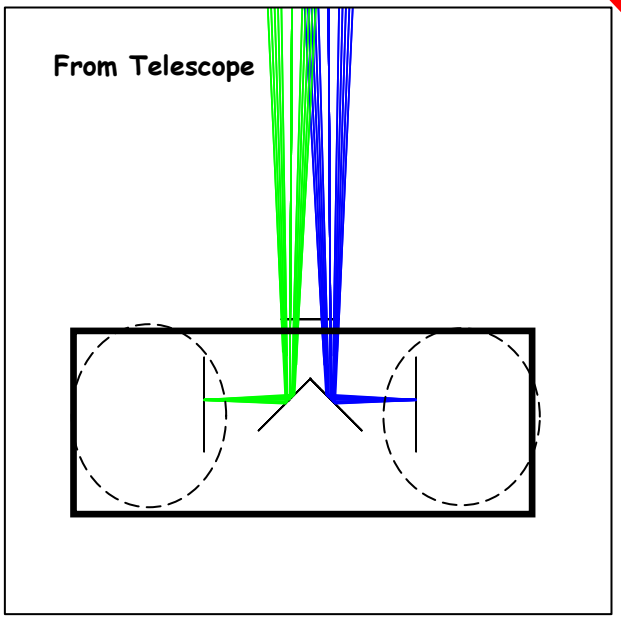


Pick up Mirror Layouts

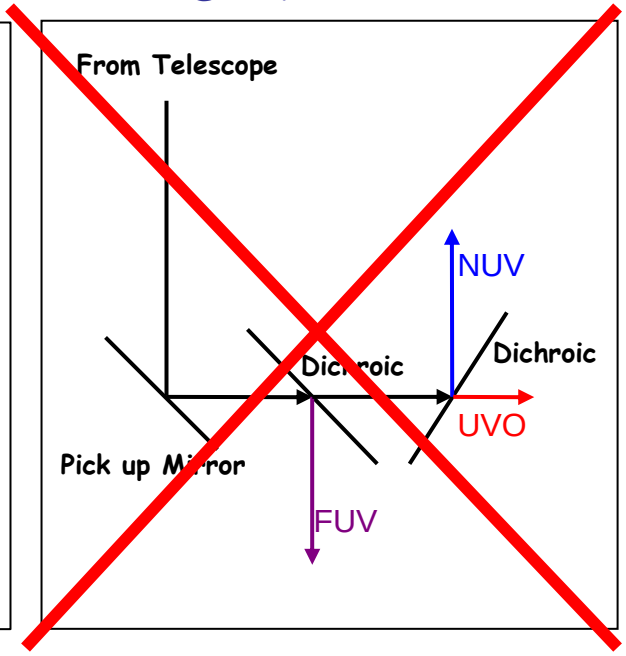
Rotating mirror



Pyramid

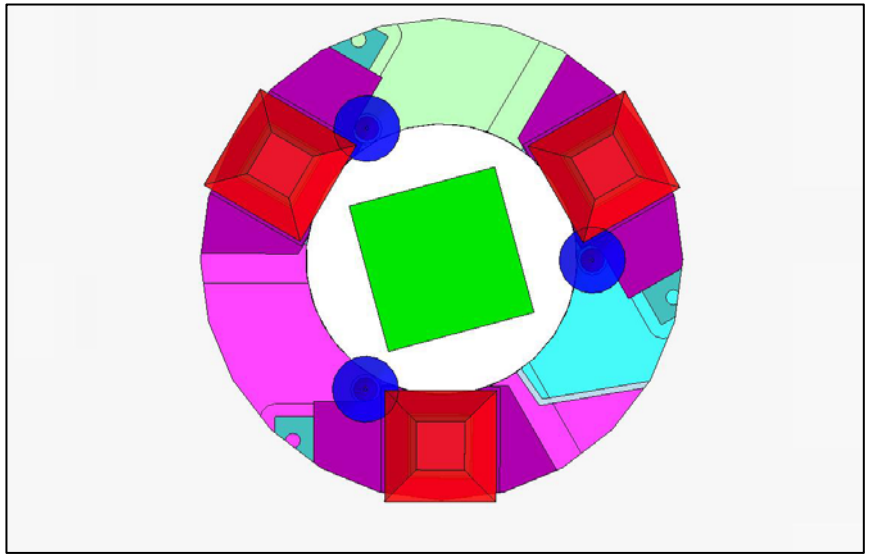


Dichroics

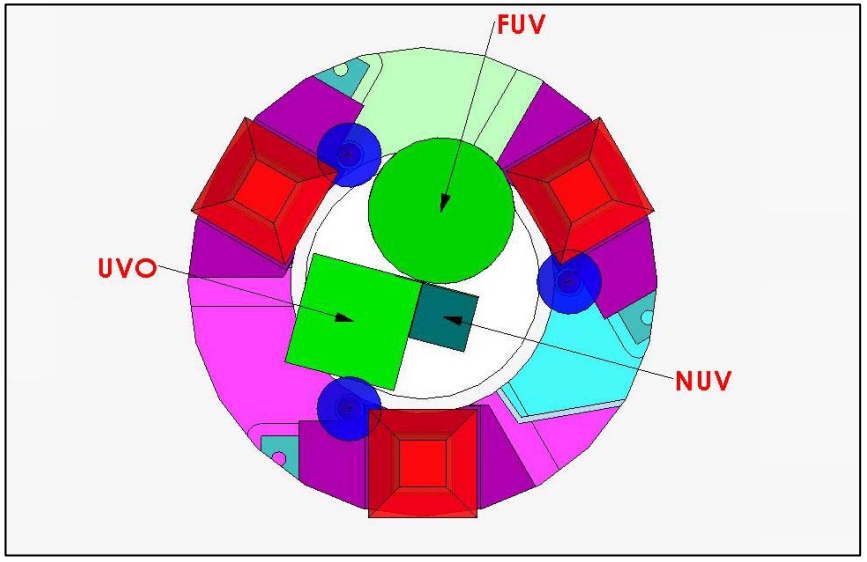


Opto-Mechanical Accomodation

Rotating mirror

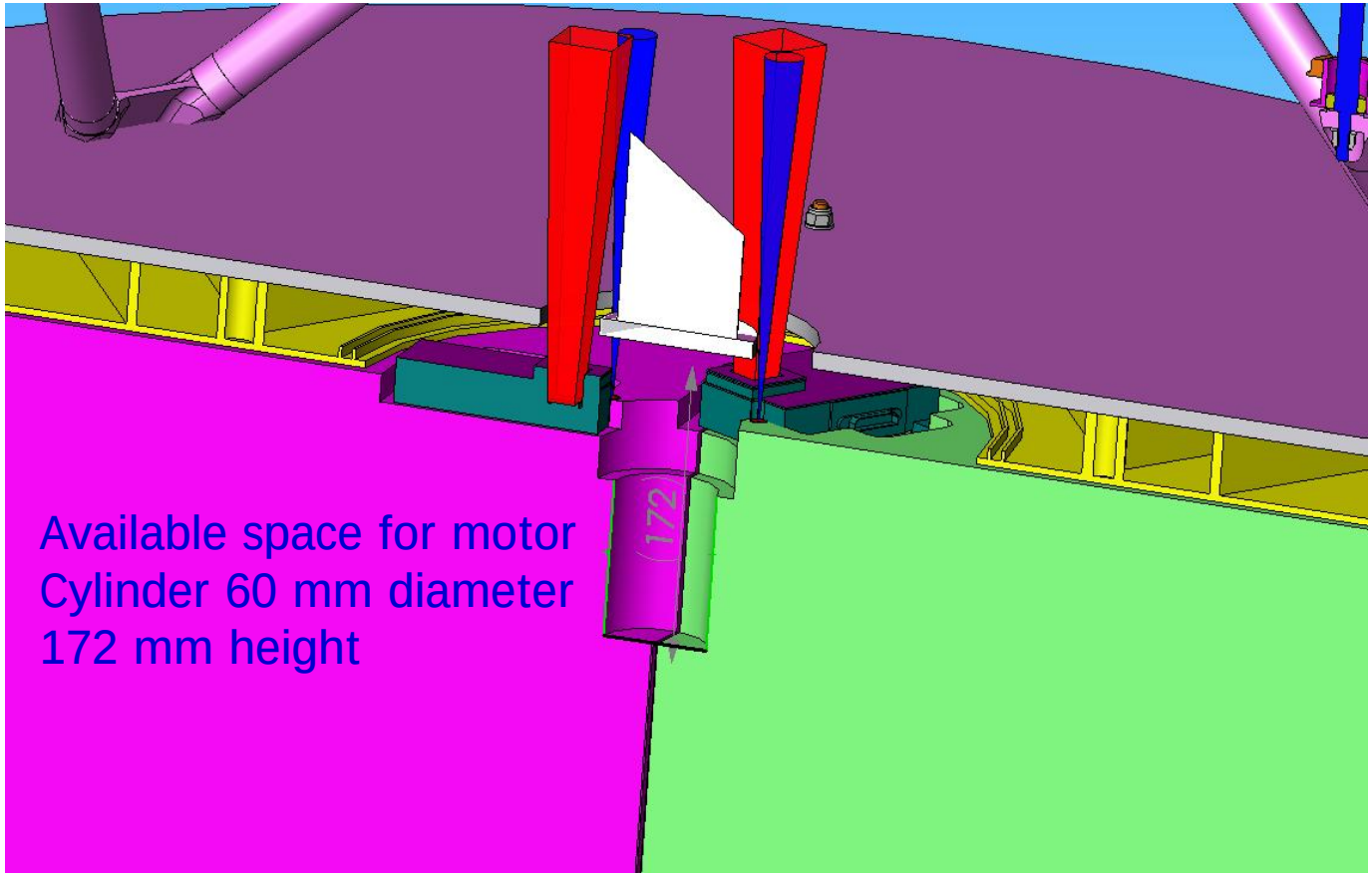


Pyramid



Field of View & Baffling

Rotating Mirror



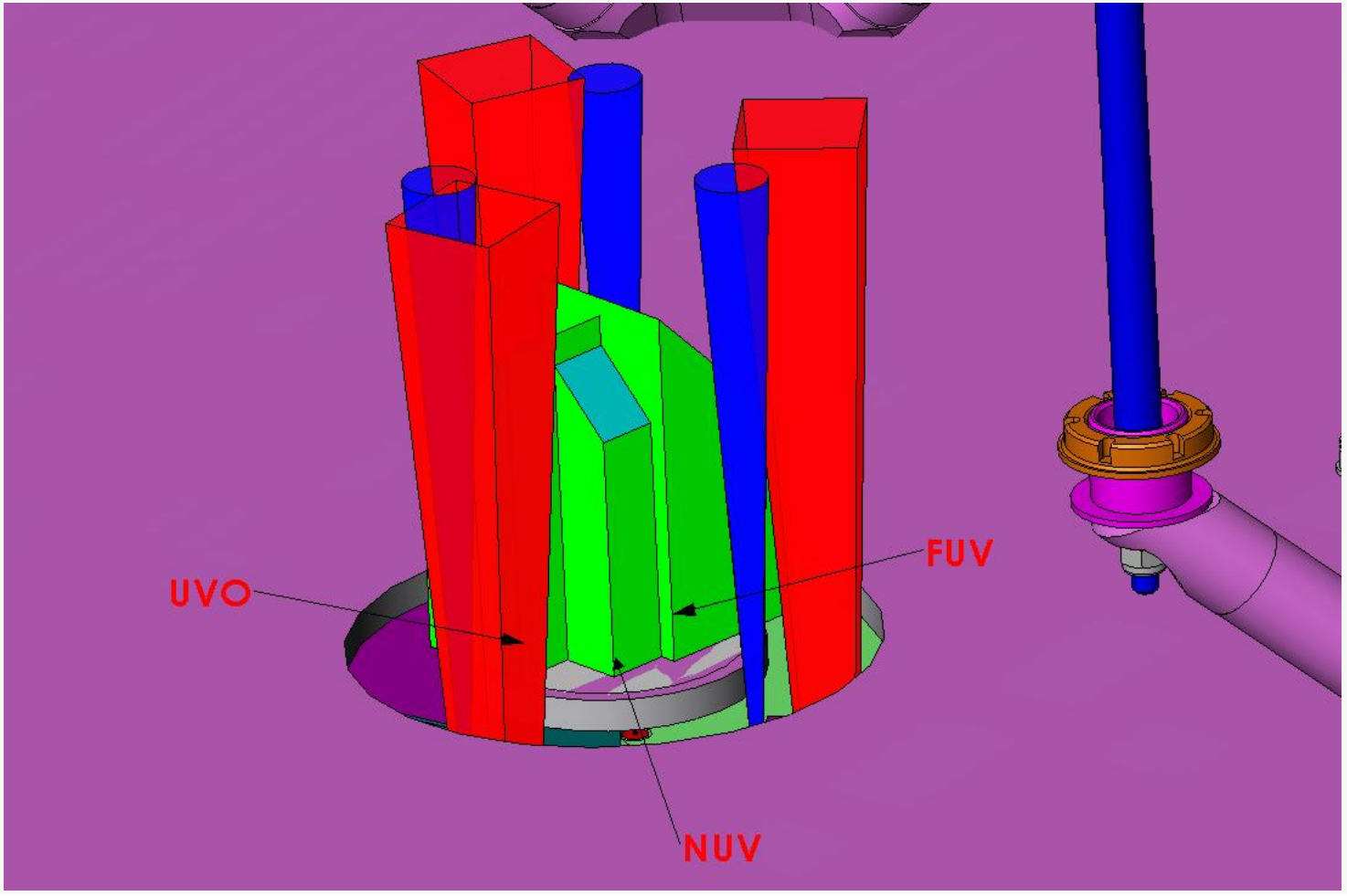
FUV NUV UVO

Field of View & Baffling

Pyramid Mirror

FUV
UVO
NUV

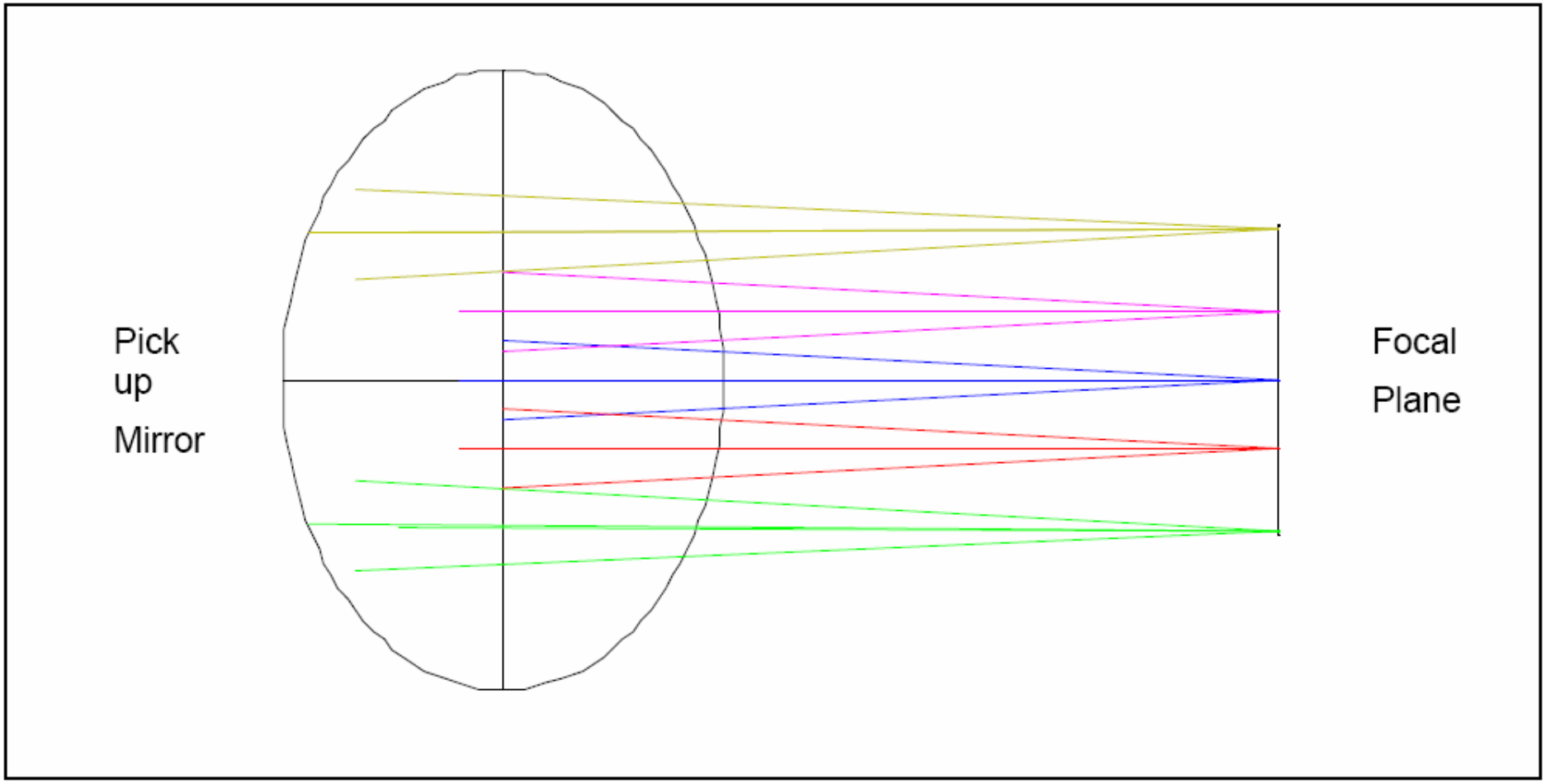
Cen
UVC
FUV
NUV



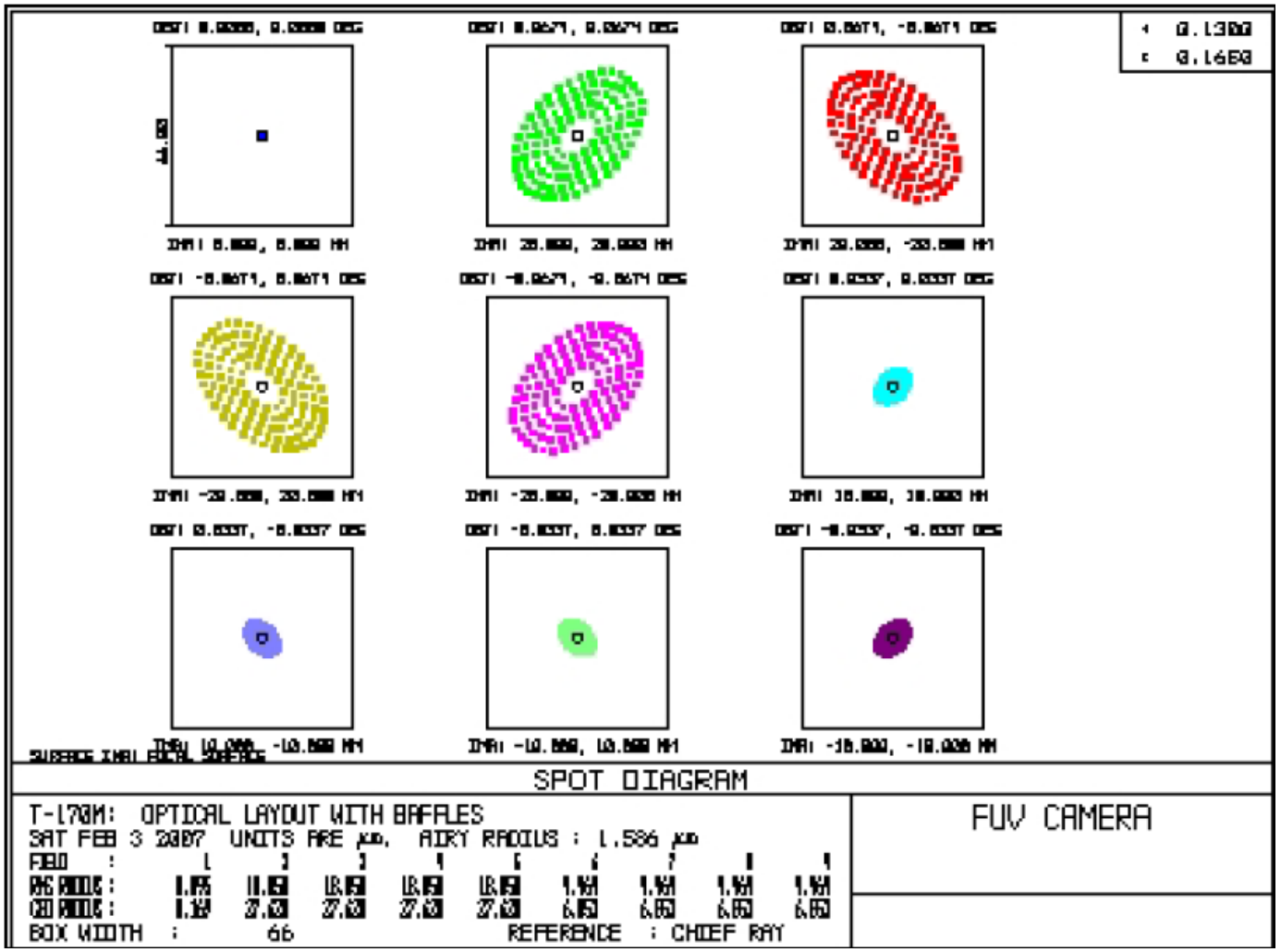
Layouts Trade-Off

Layout	Rotating Mirror	Pyramid
Optical Design		
Optical Quality	No difference	No difference
Field Distortion Stability	Requirements for high precision re-positioning	No Requirements
Complexity	Simpler	More Complex
Efficiency	3 reflections in NUV channel Mirror coating not specialized	4 reflections in NUV channel Mirrors coating specialized
Stray Light	Mirror pointing in one direction	3 mirrors always illuminated
Optics Manufacturing	TBD	TBD
Alignment	Pick up mirror flat	Pick up mirrors aspheric
Opto-Mechanical design		
Mechanism	Rotating mechanism single point failure	No mechanism
Accomodation	Redundant motor difficult to accommodate	Central Field of View very crowded
FCU Operations	One camera operating at a time	More cameras operating at same time (subject to restrictions from telemetry and power budget)
Telescope Operations	No particular requests on telescope	Require repointing if to observe same FoV with different camera

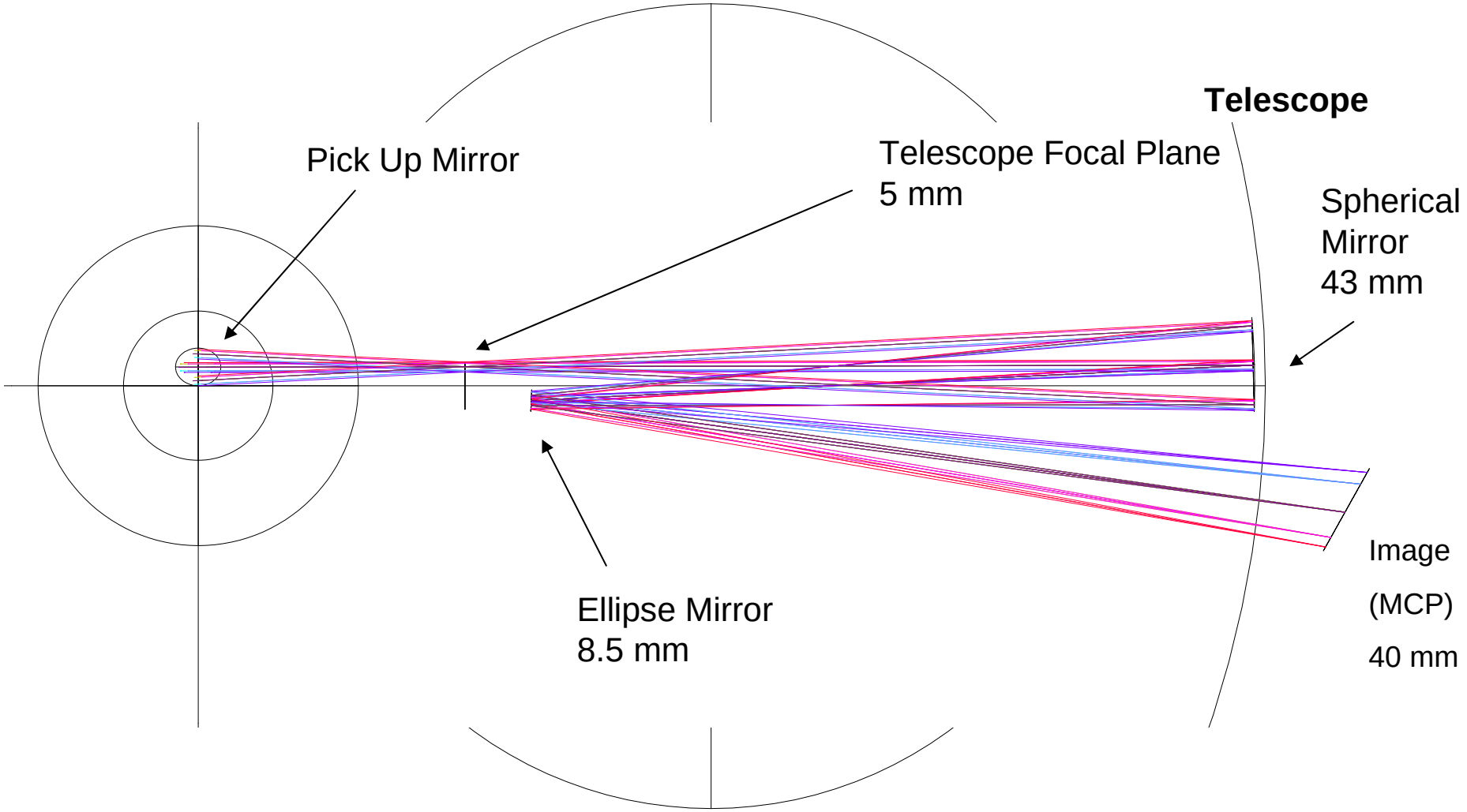
FUV camera layout



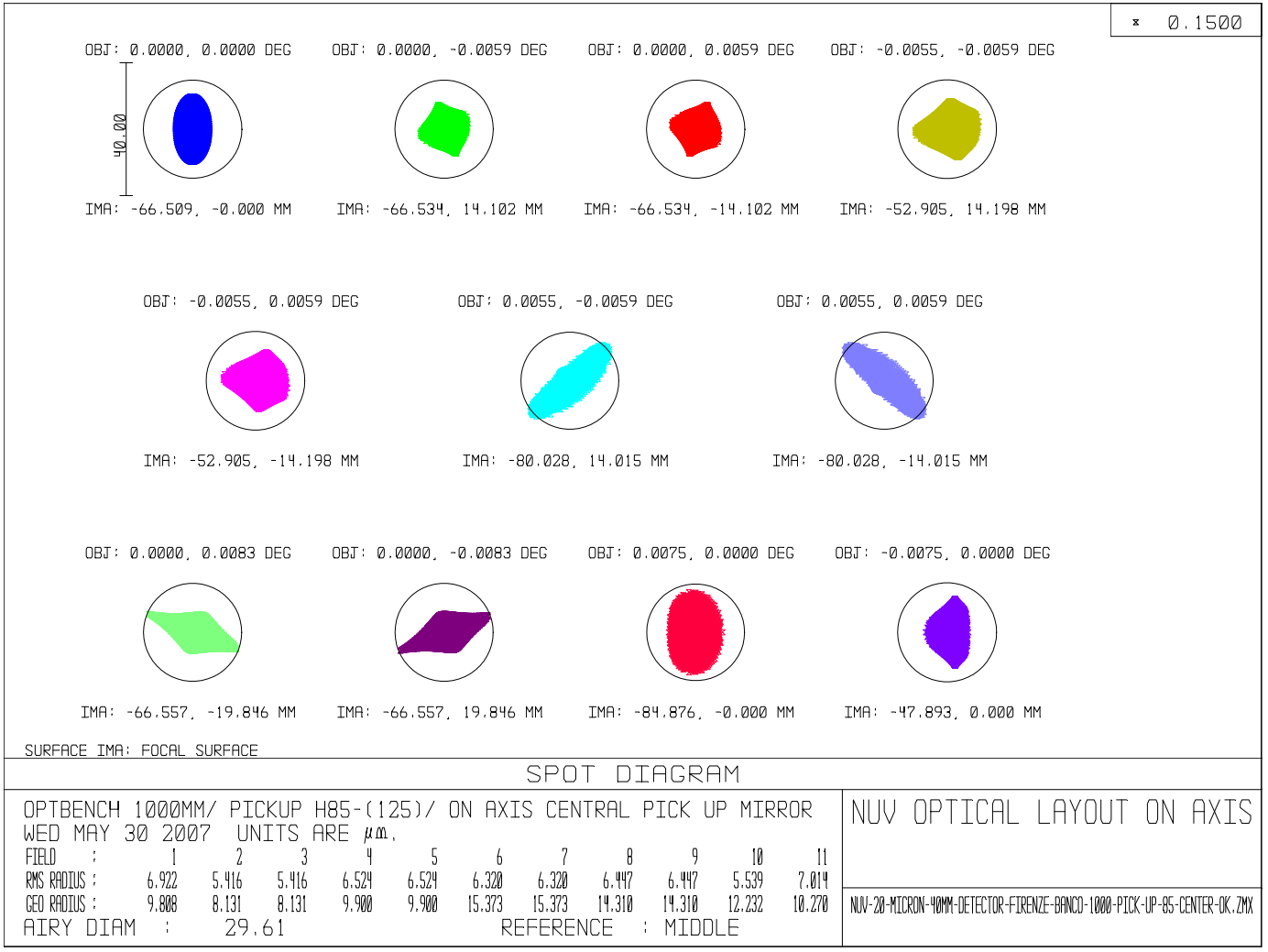
FUV Spot Diagrams



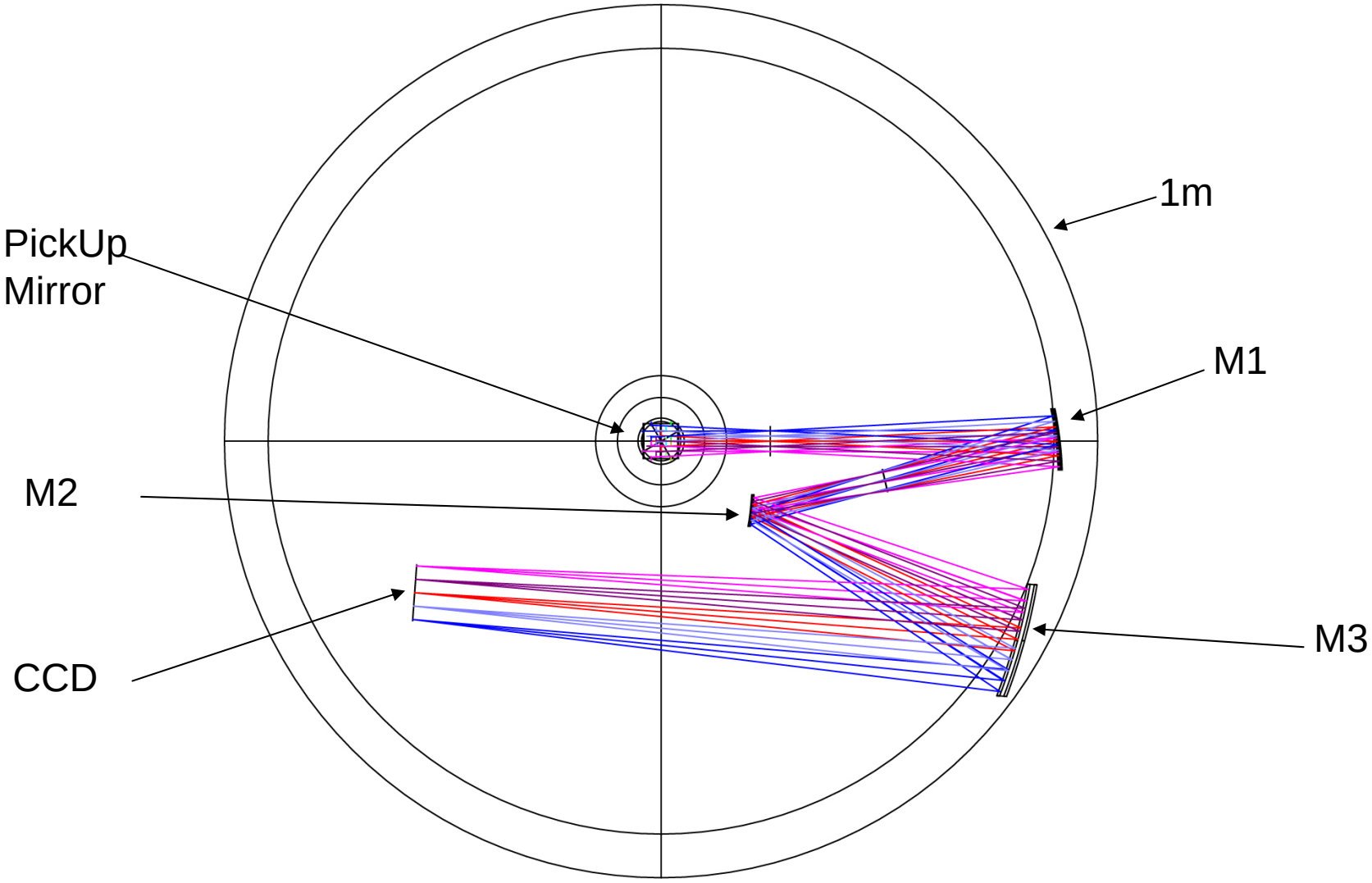
NUV Camera layout



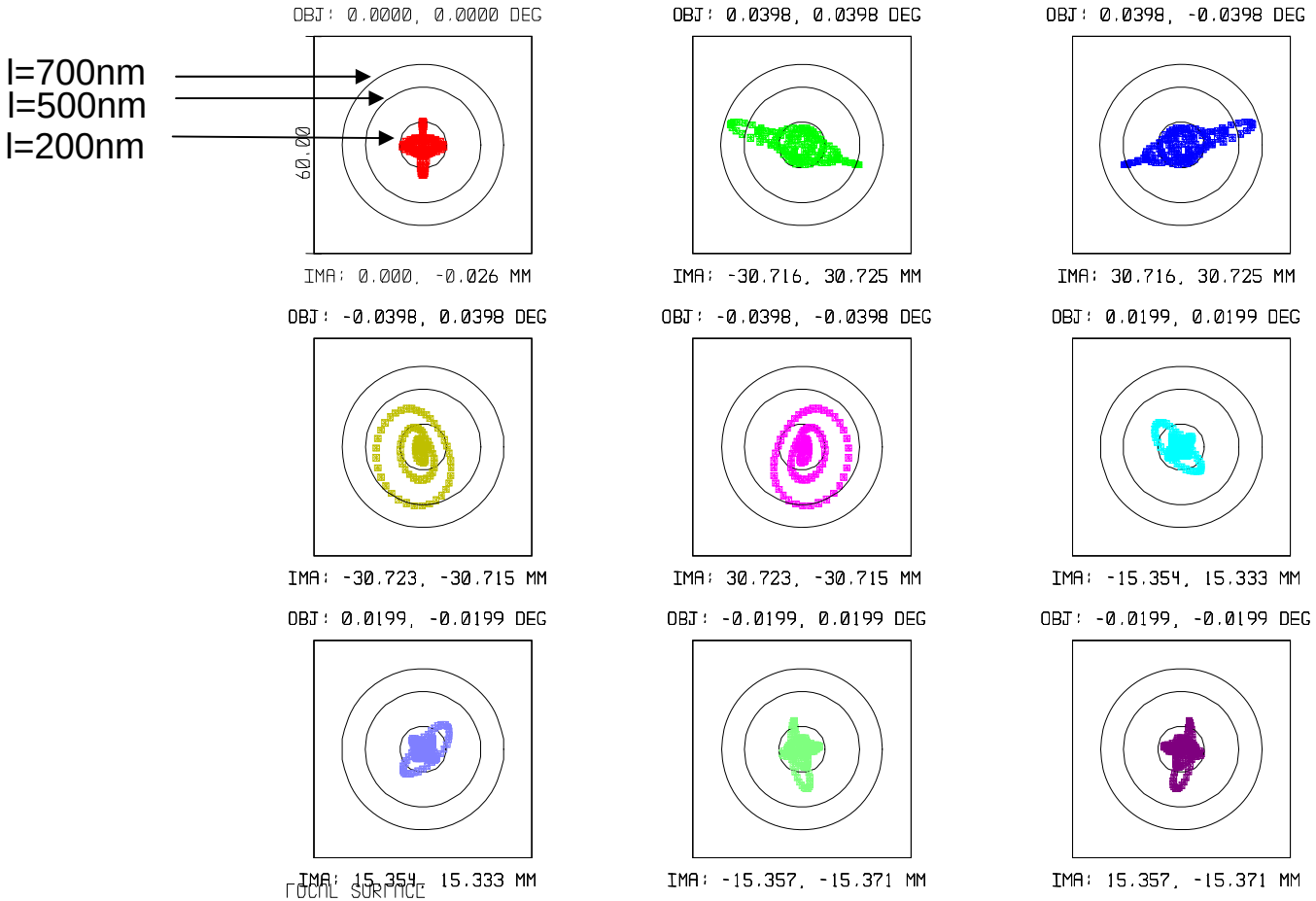
NUV Spot Diagrams



UVO Optical Layout



UVO Spot Diagrams

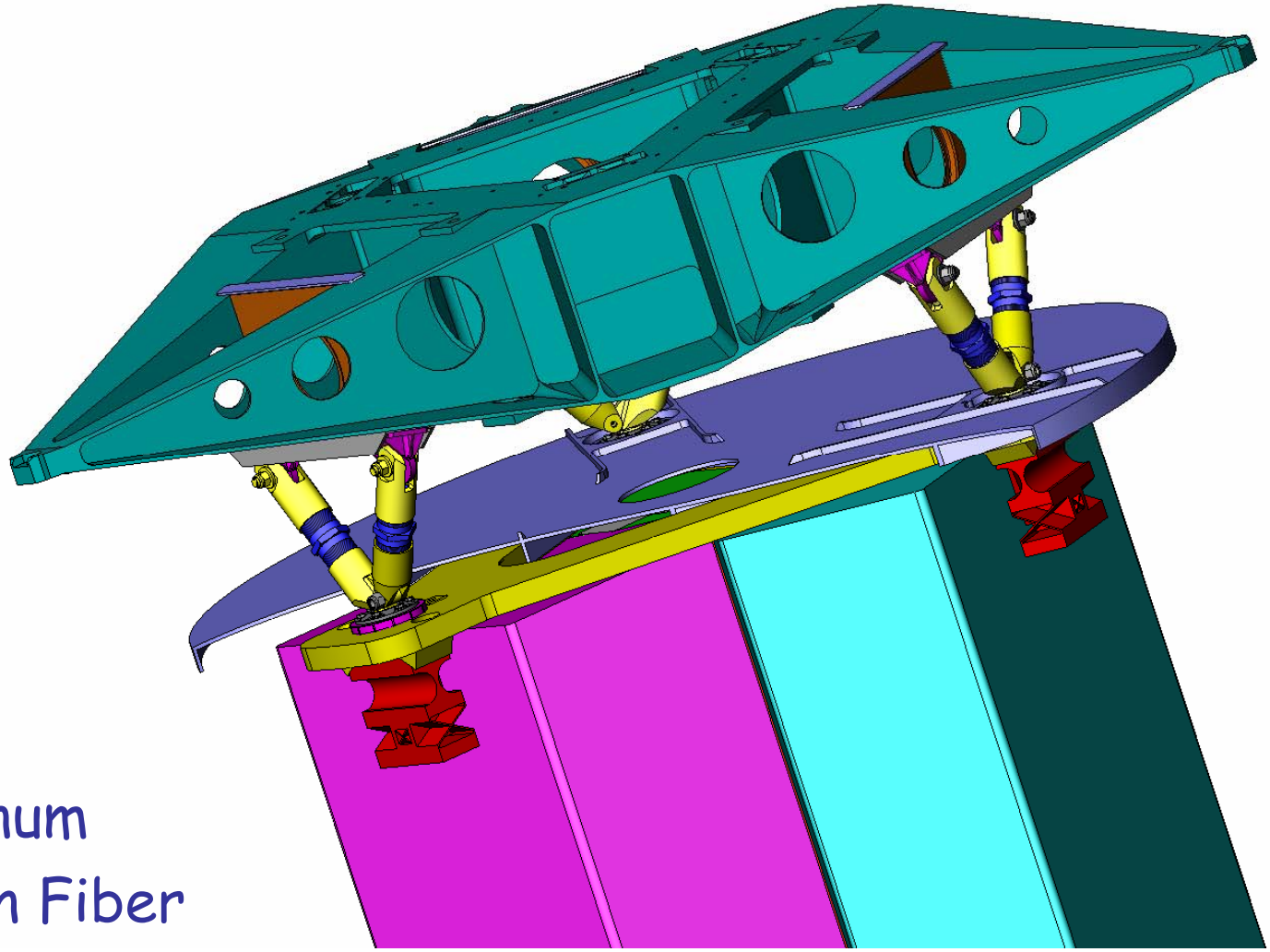


SPOT DIAGRAM

FIELD	1	2	3	4	5	6	7	8	9
RMS RADIUS :	4.237	9.007	9.007	7.452	7.452	4.322	4.322	4.850	4.850
GEO RADIUS :	8.324	20.353	20.353	16.299	16.299	9.197	9.197	10.964	10.964

BOX WIDTH : 60 REFERENCE : CHIEF RAY

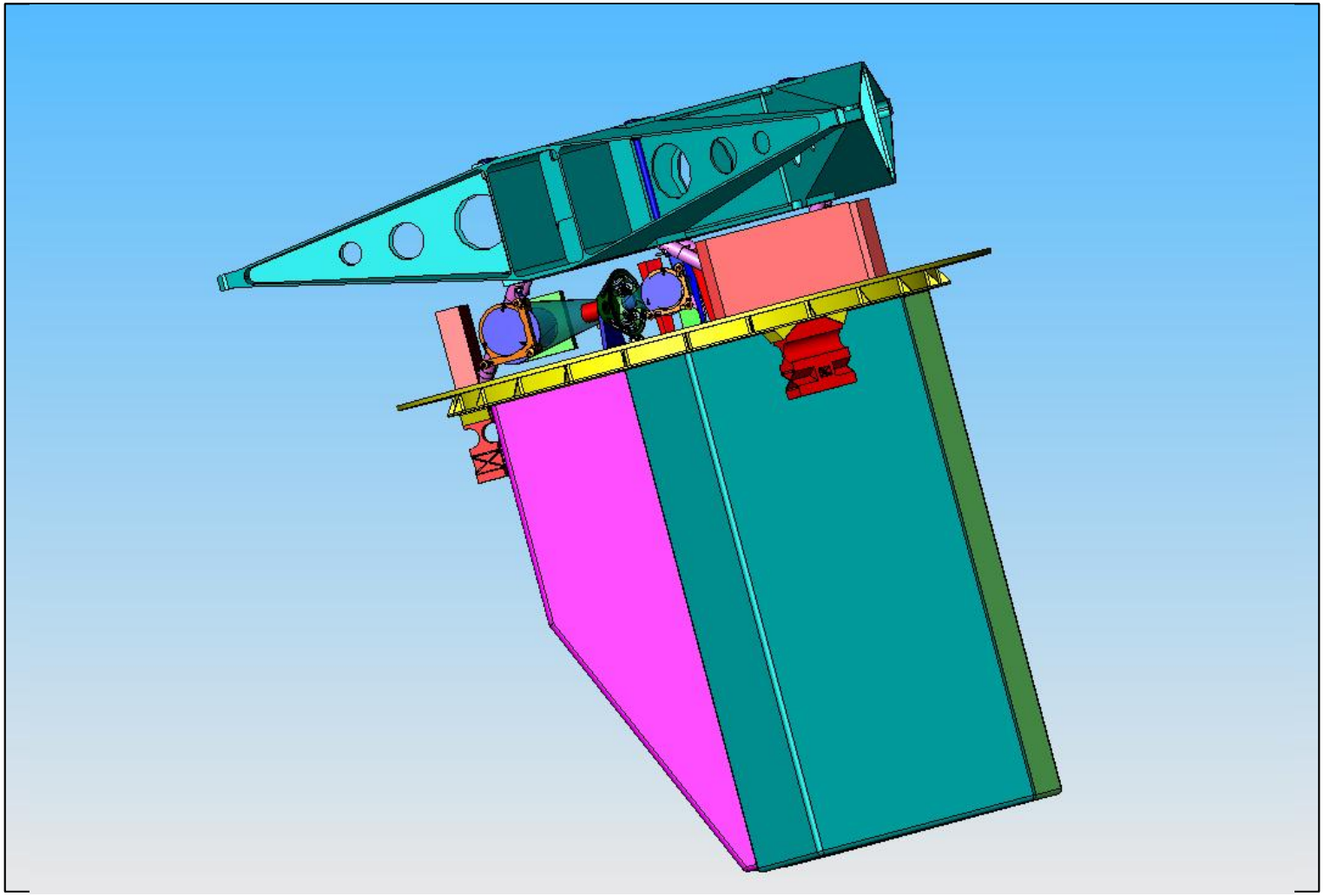
Optical Bench



and LSS

- CeSiC
- Aluminum
- Carbon Fiber

Opto-Mechanical Layout



FCU Detectors

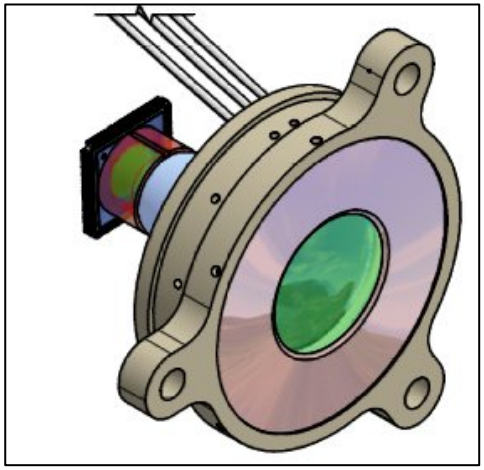
FUV & NUV Channel: MCP-based detector in sealed configuration

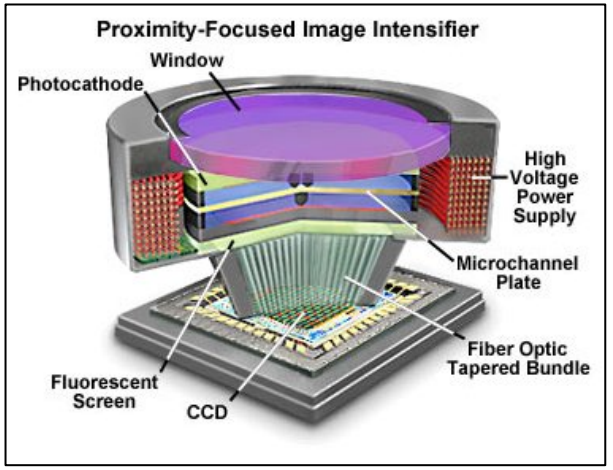
Format: 2kx2k (40mm)

Read-out system: CCD

Photocathodes: CsI (FUV)

CsTe (NUV)





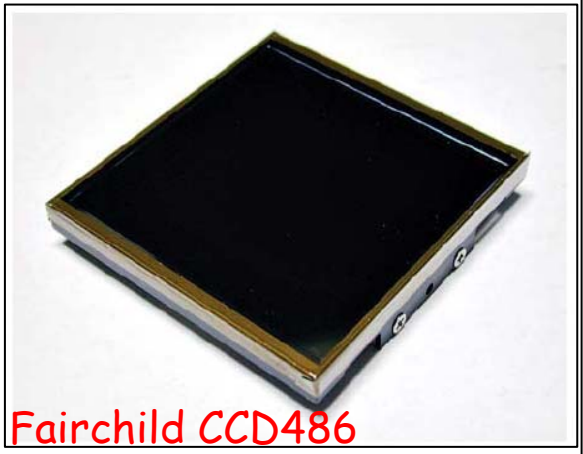
UVO Channel: CCD

Format: 4k x 4k (61mm)

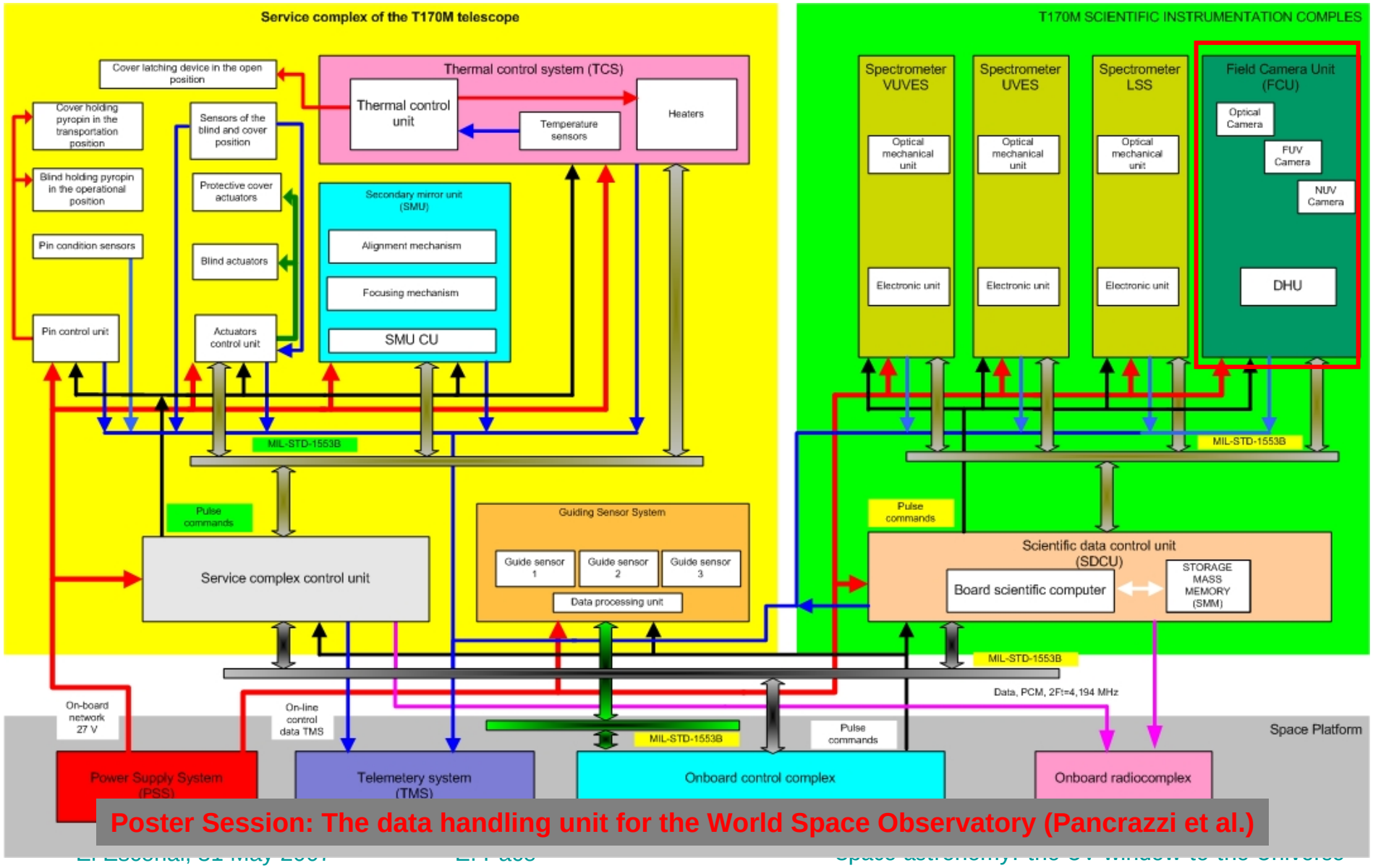
Pixel size: 15 μm

Back illuminated

MPP (TBD)

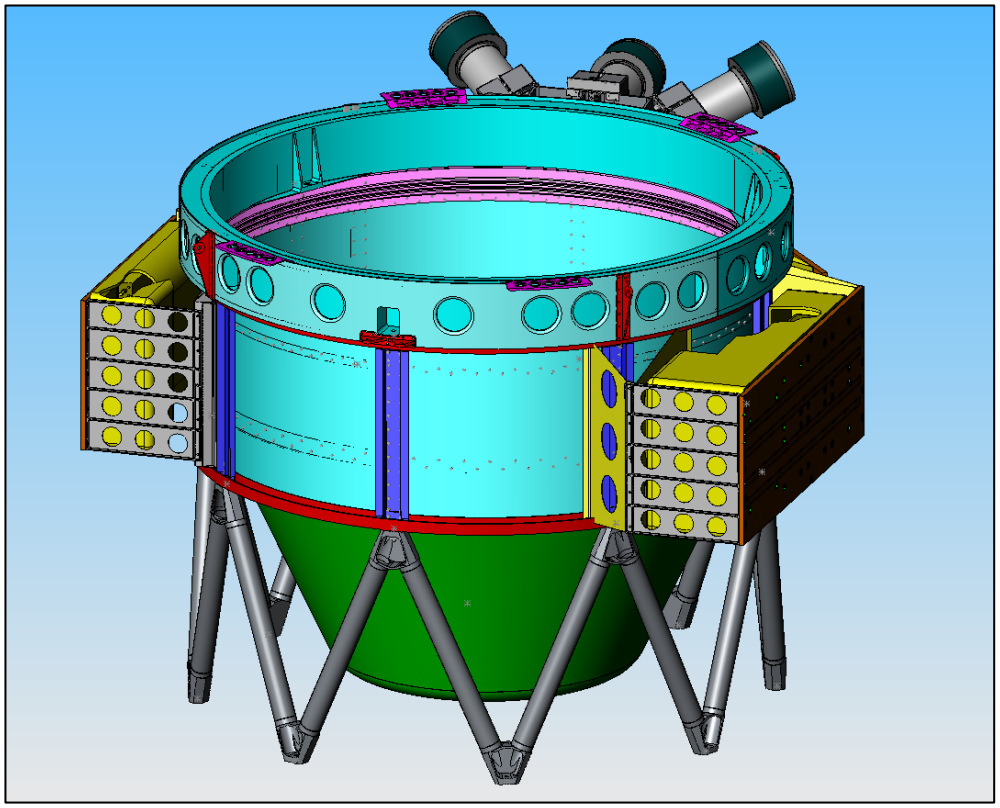


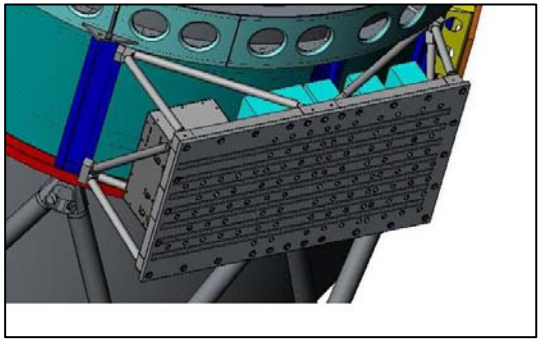
Architecture of information links

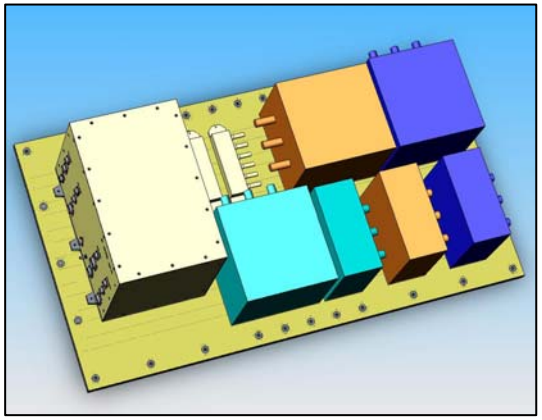


Poster Session: The data handling unit for the World Space Observatory (Pancrazzi et al.)

External Instrumental Panel







Summary of the Spectrum-UV/WSO-UV Space complex and its components
112110-T170M-4-06

FCU Operating Modes

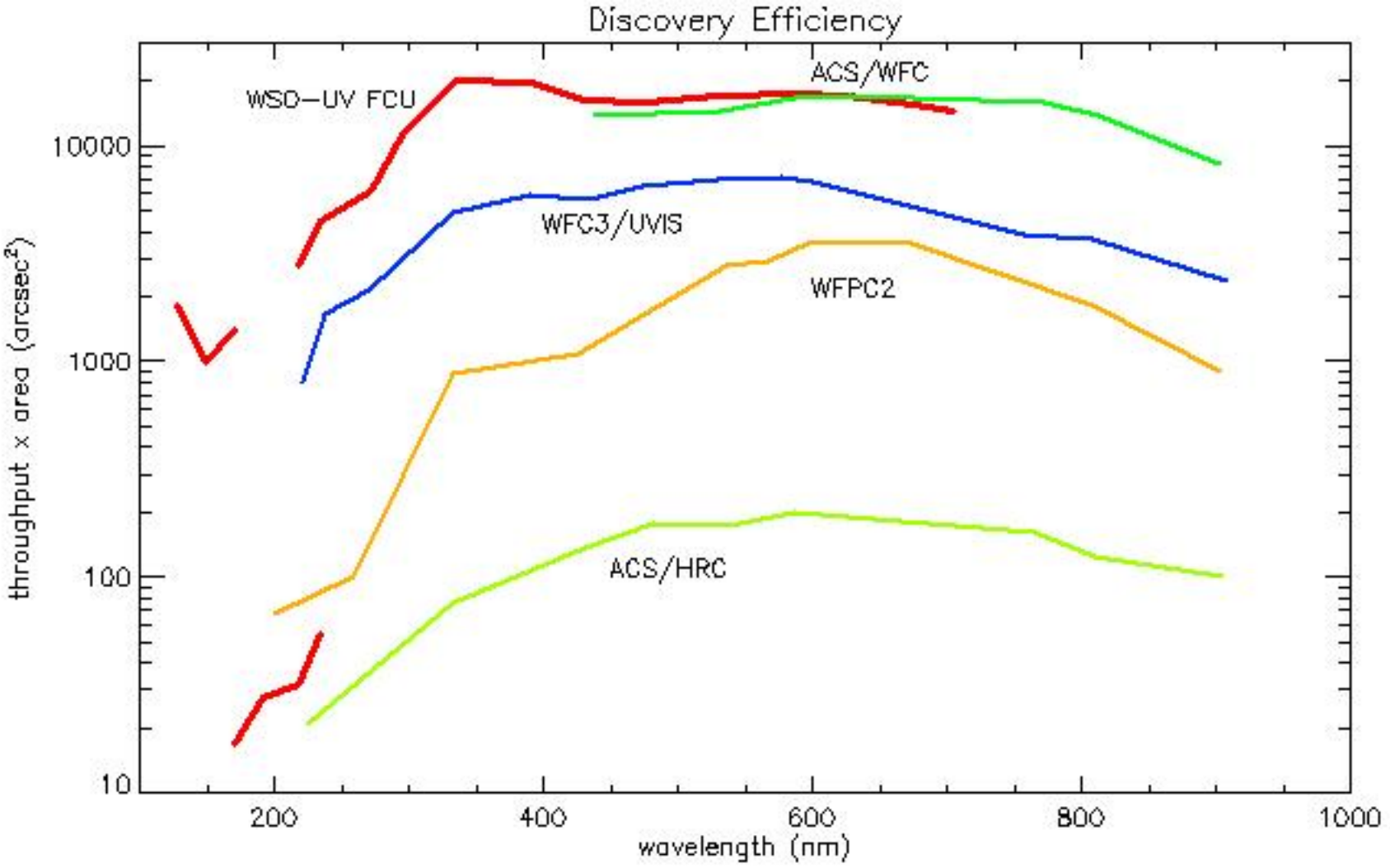
- **Optical Mode**
  - Imaging (FUV, NUV, UVO)
  - Slitless spectroscopy (FUV, NUV, UVO)
  - Polarimetry (NUV, UVO)
  - Slitless spectro-polarimetry (NUV)
- **Parallel Observing Mode**
  - 2 FCU channels (not possible for rotating pick up mirror)
  - One Channel of FCU & one spectrograph
- **High Temporal Resolution Mode**
  - Time Tag (MCP)
  - Windowing (CCD, MCP)
- **Calibration Mode**

How WSO-UV FCU compares with HST Imagers?

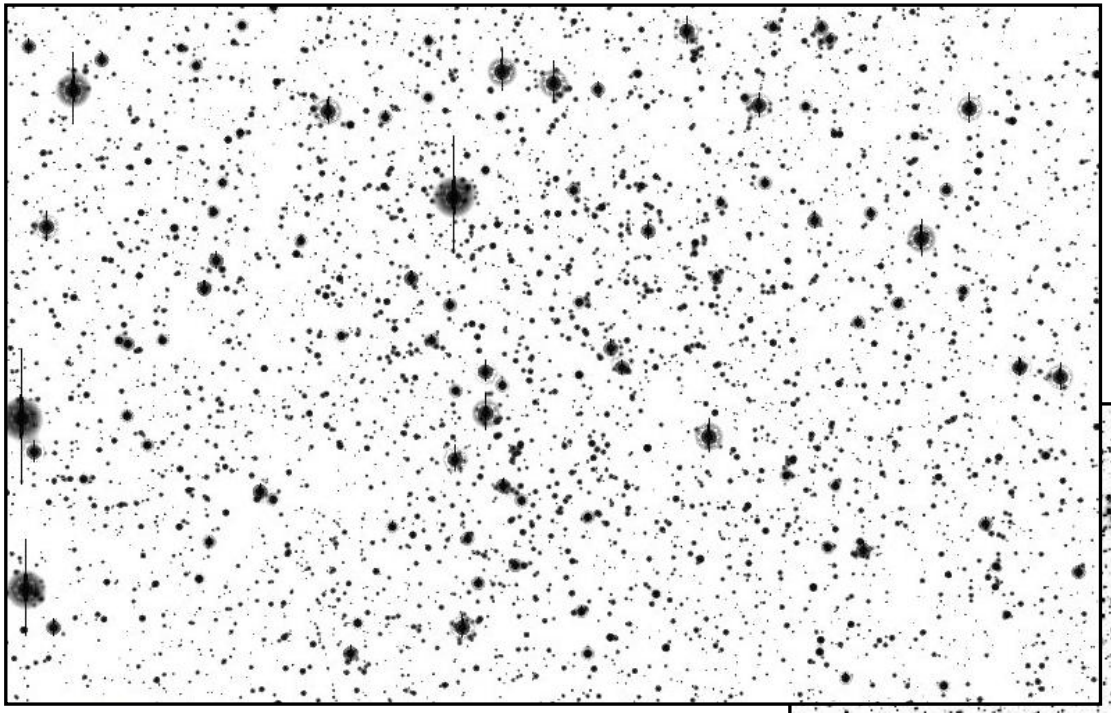
WSO-FCU vs HST ACS & WFPC3

	WSO-UV	HST	
	FCU-FUV	ACS-SBC	
Range	115-190 nm	115-170 nm	
FoV	6.6'x6.6'	31"x35"	
Scale	0.2"/pix	0.032"/pix	
	FCU-NUV	ACS-HRC	
Range	150-280 nm	200-1100 nm	
FoV	1'x1'	26"x29"	
Scale	0.03"/pix	0.027"/pix	
	FCU-OUV	ACS-WFC	WFPC3-UVIS
Range	200-700 nm	370-1100 nm	200-1000 nm
FoV	4.7'x4.7'	3.4'x3.4'	2.7'x2.7'
Scale	0.07"/pix	0.05"/pix	0.04"/pix

FCU Performances

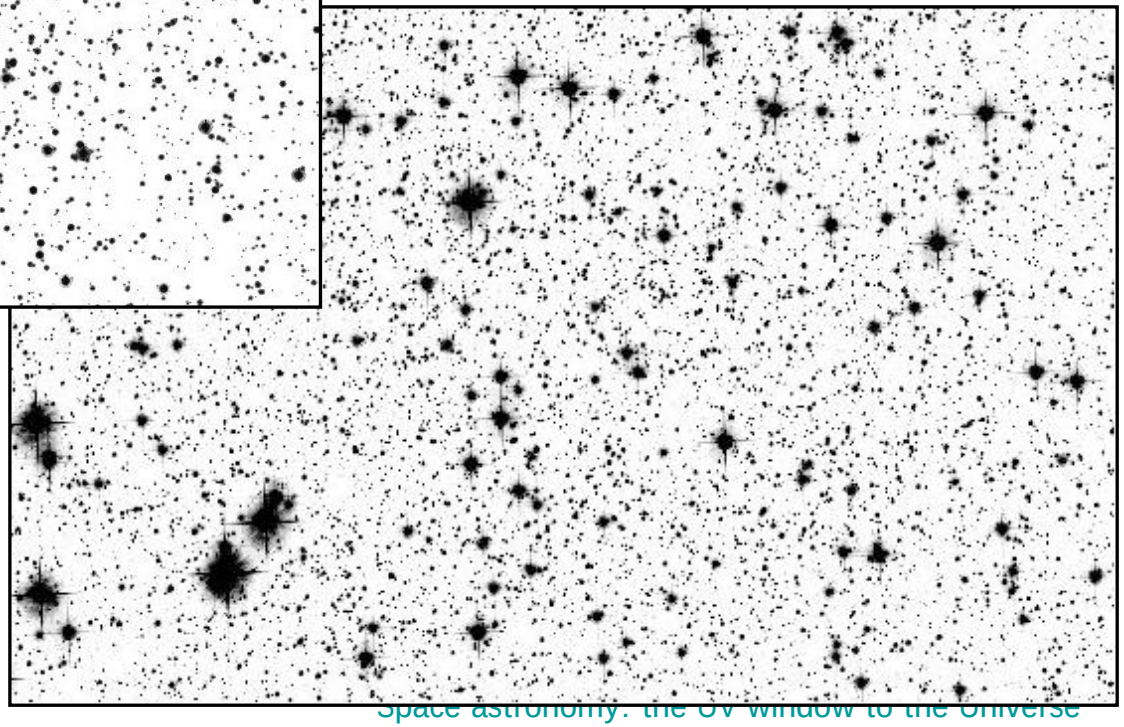


FCU Simulated Performance



WSO/FCU-UVO
(V filter)

Simulation of a real field:
the core of the globular cluster
NGC 6101



HST/ACS-HRC
(I filter)

Italian WSO/UV webpage

http://www.oact.inaf.it/wso/