A 35 meter Telescope in Space

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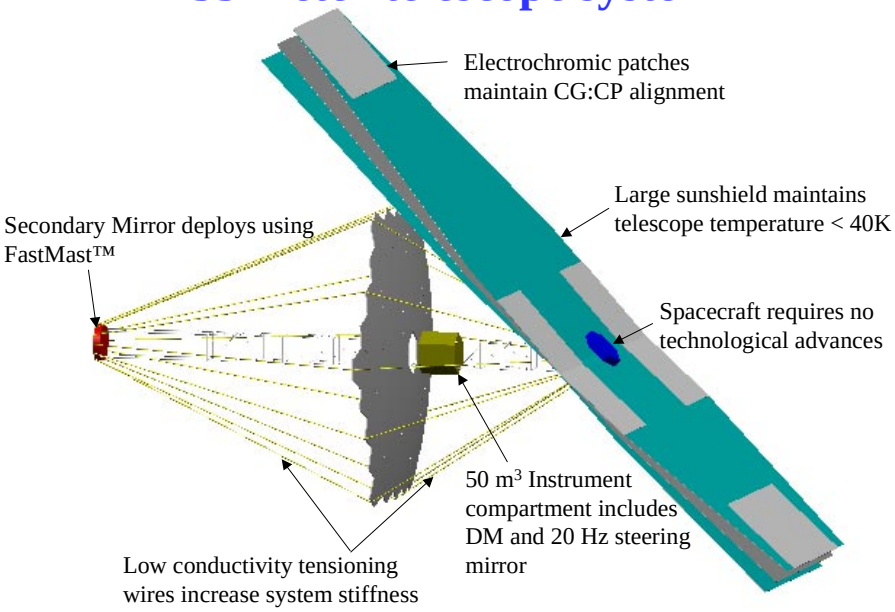
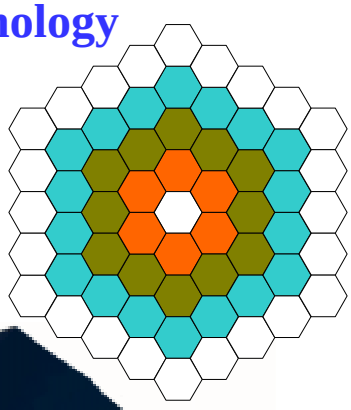
35 meter telescope system

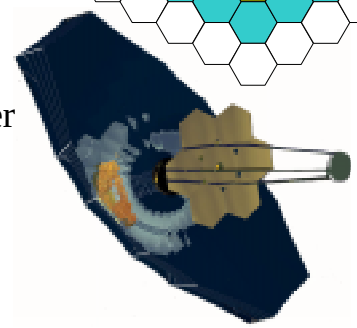


TRW's approach uses existing deployment technology

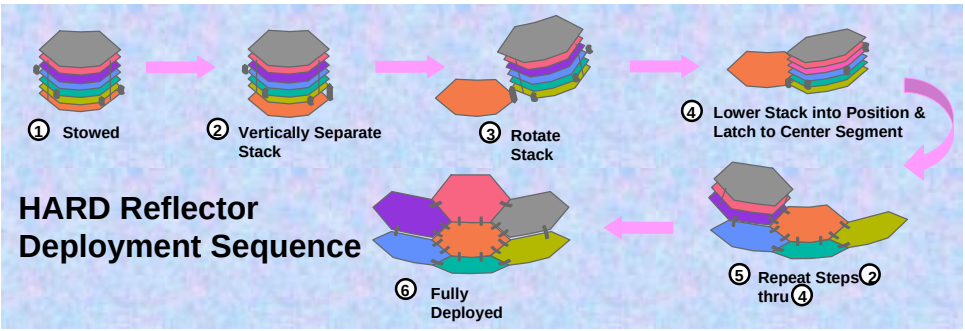
- Successive rings of hexagonal segments are deployed using High Accuracy Reflector Deployment (HARD)



- Segments are latched together using latches developed for applications like NGST

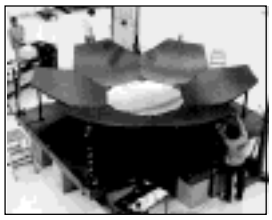


HARD is the basis for primary mirror deployment concept



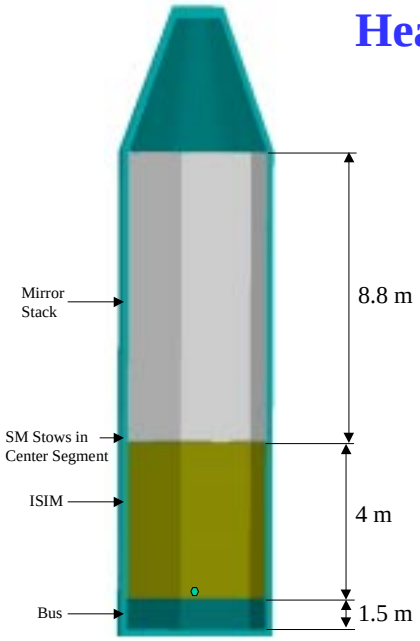
Stowed

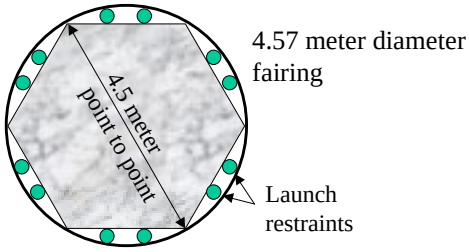
Deploying



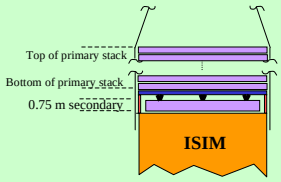
Deployed

35 meter telescope stows in EELV Heavy Fairing





Stowed Secondary Mirror



25 kg/m2 areal density and 6:1 aspect ratio make for stiff SM

Primary Mirror Configuration is based on EELV Heavy Capabilities

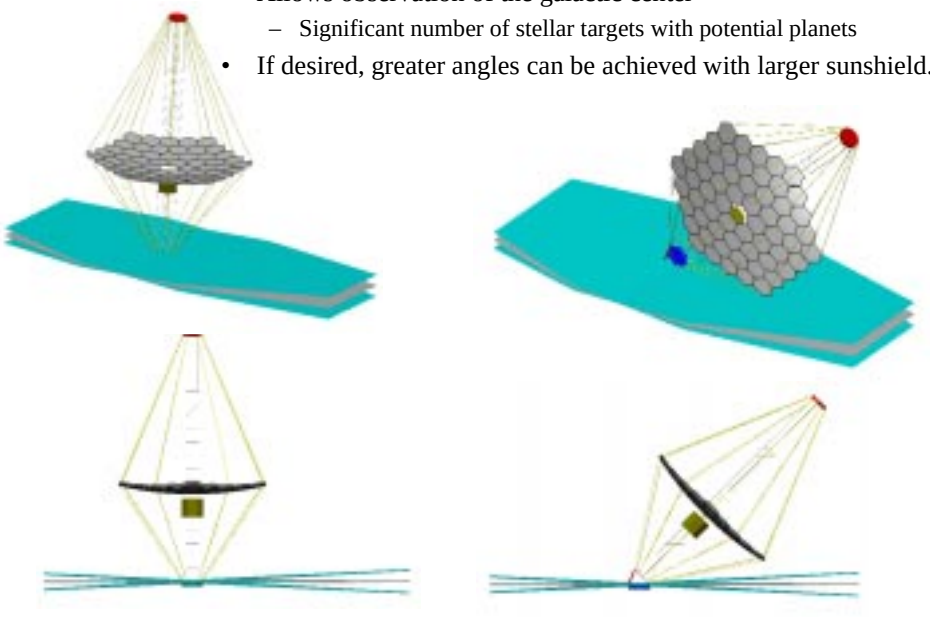
	Fairing Height (meters)	Mass (kg)
Spacecraft Bus	1.5	1042
Sunshield	Within Bus	734
Deployment mast	Within Bus	425
ISIM	4	2010
Secondary Mirror	1	482
Subtotal	**6.5**	**4693**
Launch Vehicle Capability	**15.3**	**9675**
Allocation for Primary Mirror	***8.8***	***4982***

This results in a range of possible aperture configurations

# of rings (excluding center)	# of segments	PM aperture (meters)	Total Collecting Area (m^2)	Segment thickness (mm)	Areal density (kg/m^2)
1	**7**	9.0	92	1260	50
2	**18 or 19**	16.2	250	464	18.4
3	**36**	27.4	487	245	9.4
4	**60**	35	802	147	5.7

Pointing from anti-sun to 45 deg

- Allows observation of the galactic center
  - Significant number of stellar targets with potential planets
- If desired, greater angles can be achieved with larger sunshield.



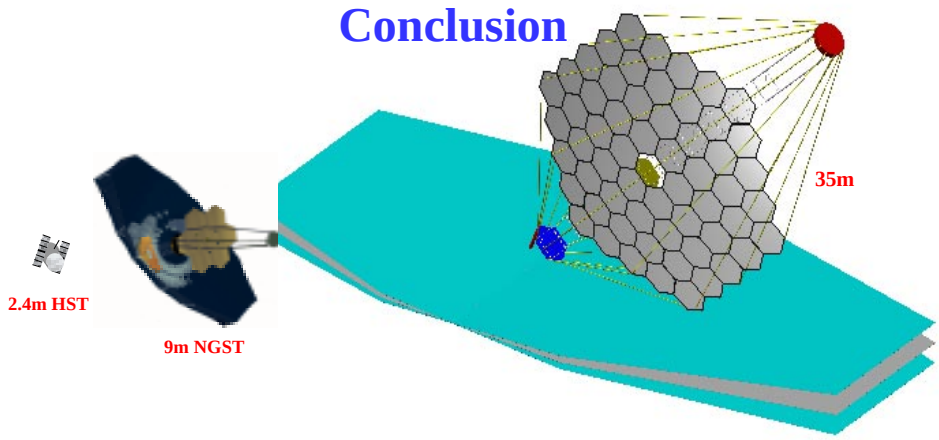
Primary Mirror Considerations

- Cost is a major concern
  - 500 to 800 m2 area is too expensive with conventional approaches
  - Replication is a way to keep costs down
    - Spherical primary means a single mandril
      - Diffraction limited performance over narrow field (< 1 arcmin)
      - Reduced performance over broader field adequate for spectroscopy
    - Parabolic primary requires 3 or 4 more complex mandrils
- Active control limited to rigid body correction
  - To minimize primary mirror complexity
  - Remaining figure corrected with deformable mirror at pupil
    - Segmented DM provides optimum correction

Technology Development is Required

- Primary Mirror (obviously)
  - 4.5 meter replicated segments with ~0.2 microns RMS
  - Withstand launch environment
  - 5.7 kg/m^2 => 35m aperture; 9.4 kg/m^2 => 27m aperture
- Sunshield
  - ISIS: ~70 - 100 m^2
  - NGST: ~200 - 300 m^2
  - 35m: ~2000 - 3000 m^2
- Detectors with desired format
  - Si:As ideal for 10-20 micron observations
  - 13 x 13 mosiac of 512 x 512 arrays of 55 micron pixels
  - NGST is developing 512 x 512 arrays of 27 micron pixels
- Segmented Deformable Mirror
  - Provides best solution for figure correction
  - Actuator density based on RoC correction
  - Actuator throw based on magnitude of distortion expected

Conclusion



- A 35 meter aperture telescope in space is feasible
  - Some technology development required
  - 5 to 10 kg/m2 areal density over 4.5m segment is the challenge
  - Nothing is vapor-ware