K Kissil 06 Structural ppt
12011

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Terrestrial Planet Finder Mission

TPF

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Mission

Configuration & Structural Design

Structural Details

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(with inputs from Tim Ho)

Presentation Overview

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- Materials Used
- Primary Mirror Design
- Secondary Tower Design

Materials Used

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ULE Glass (Ultra-Low Expansion Titanium Silicate Glass by Corning)

- Primary & Secondary Mirrors (good thermal stability)
- RT Properties: E= 68 Gpa, Density= 2200 kg/m^3, CTE= 30e-9 /C
  CTE variability will be addressed in analysis section

K1100/954 Carbon Fiber Composite

- Primary & Secondary Mirror Thermal Enclosures (high conductivity)
- RT Properties: E= 275 Gpa, Density = 1886 kg/m^3, CTE = -3.0e-7/C

S-Glass Fiberglass Composite

- AMS/secondary tower bracket & SMA isolators, launch struts (low conductivity)
- RT Properties: E= 47 Gpa, Density = 2000 kg/m^3, CTE = 8.0e-6/C

M55J/954 GrEp

- AMS, secondary tower & bracket (good thermal stability & stiffness)
- RT Properties: E= 110 Gpa, Density = 1633 kg/m^3, CTE = -1.8e-7/C

Materials Used

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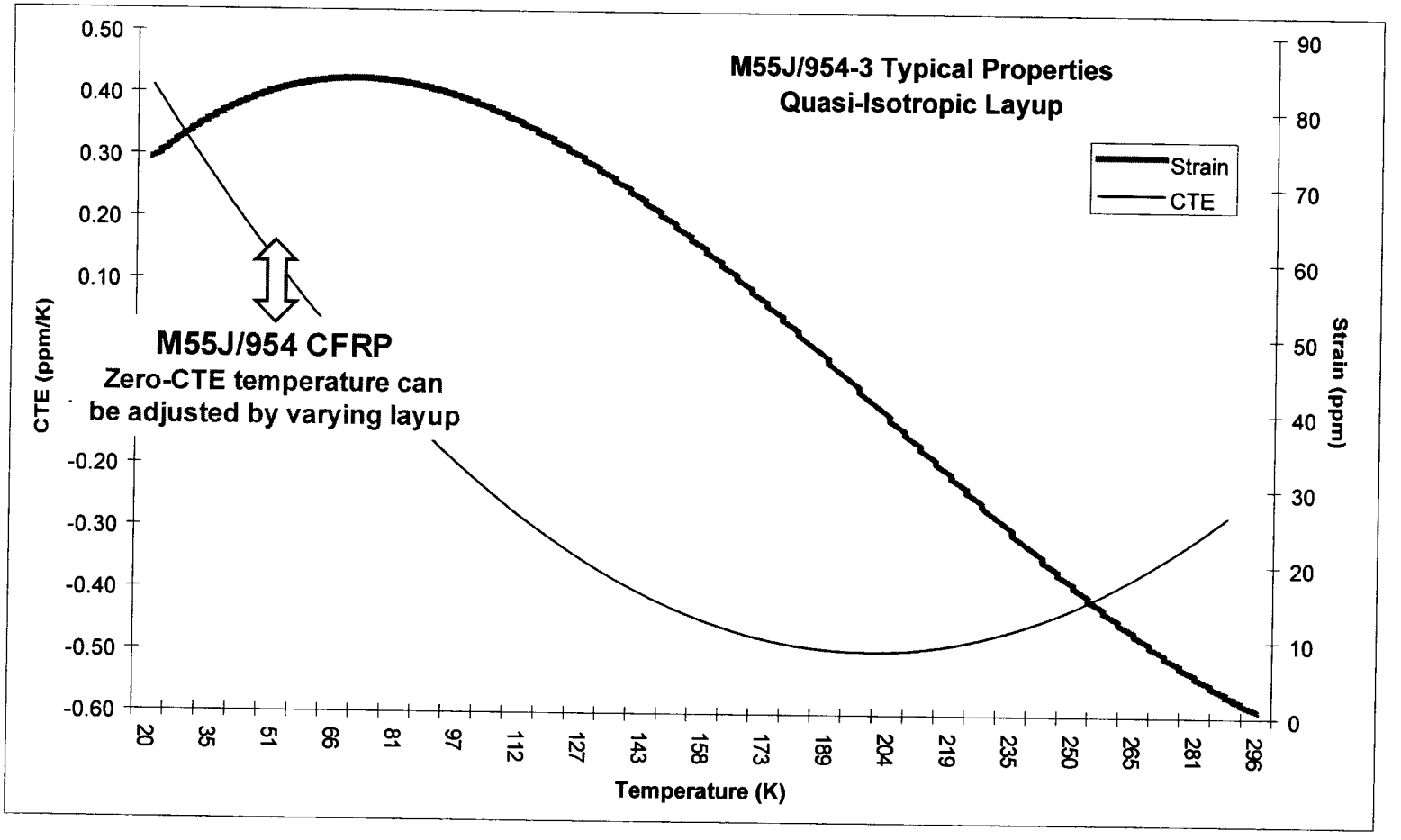

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Variation of CTE Properties for M55J/954-3 as a Function of Temperature

Primary Mirror Design

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Design Drivers: Stability & Weight

Mirror Aberration during Observation:

- Stability in **Thermal** Environment
  - 20 deg Dither maneuver needs ~2hrs of observation w/o DM adjust
  - Minimize thermal gradients (& delta gradients)
    - **Silicon Carbide** (to be investigated)
  - Minimize sensitivity to gradients (& delta gradients)
    - **ULE** Glass selection (Baseline design)
- Stability in **Dynamic** Environment
  - Reaction Wheel Jitter
  - Micro-dynamic noise (sunshield, joints, etc.)
  - High frequency desired (want > 35 Hz for launch)

Primary Mirror Design

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Description of Current Primary Mirror Point-Design:

Size: 6m by 3.5 m ellipse, with thickness= 0.25m (9.8in)

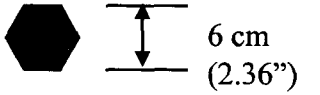
Material: ULE Glass

Light-weighted (~7% mass of solid):

Honeycomb Sandwich: 6 cm core hexagonal cell size (flat-flat)
(100 cells across 6m dia)

1.4 mm cell wall Thickness

6 mm front & 3 mm back face-sheet thickness

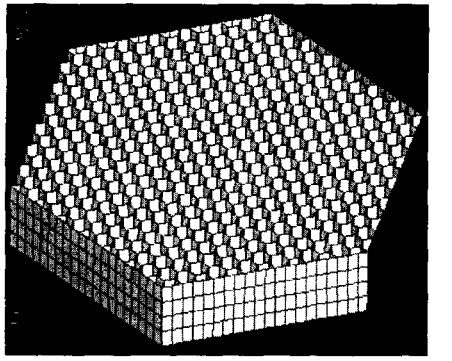


Mass Properties: 754 kg, 45 kg/m^2 (16.6 m^2)
(Hubble 2.4m PM was 180 kg/m^2)

Mounted Frequencies:

32 Hz 1st mode, 35 Hz 2nd mode (fixed at base of 3 bipods)

43 Hz 1st mode, 46 Hz 2nd mode (pinned at mount pads)



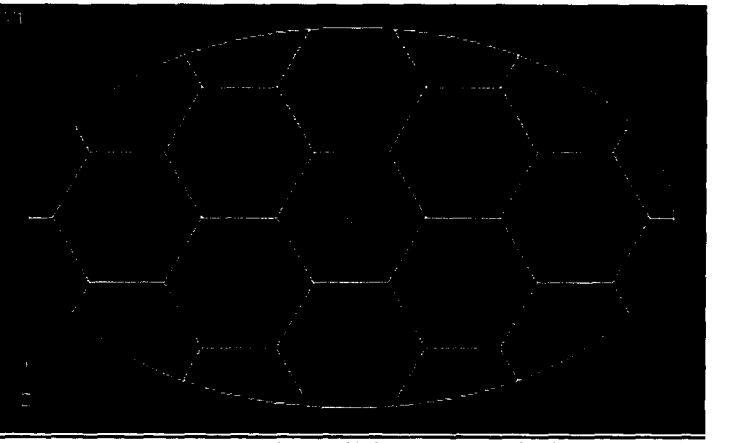
Segmented Core:

Total of 21 hex shaped core segments

Each segment would be ~1.2m (flat-flat)

Core comprised of 2 boules stacked & fused

Edge-wall around periphery of each segment



Assembly:

Core segments would be fused to front & back face-sheets

Core segments are adjacent but not attached to each other (except through face-sheet)

Edge-wall encompasses entire outer edge of mirror

Secondary Tower Design

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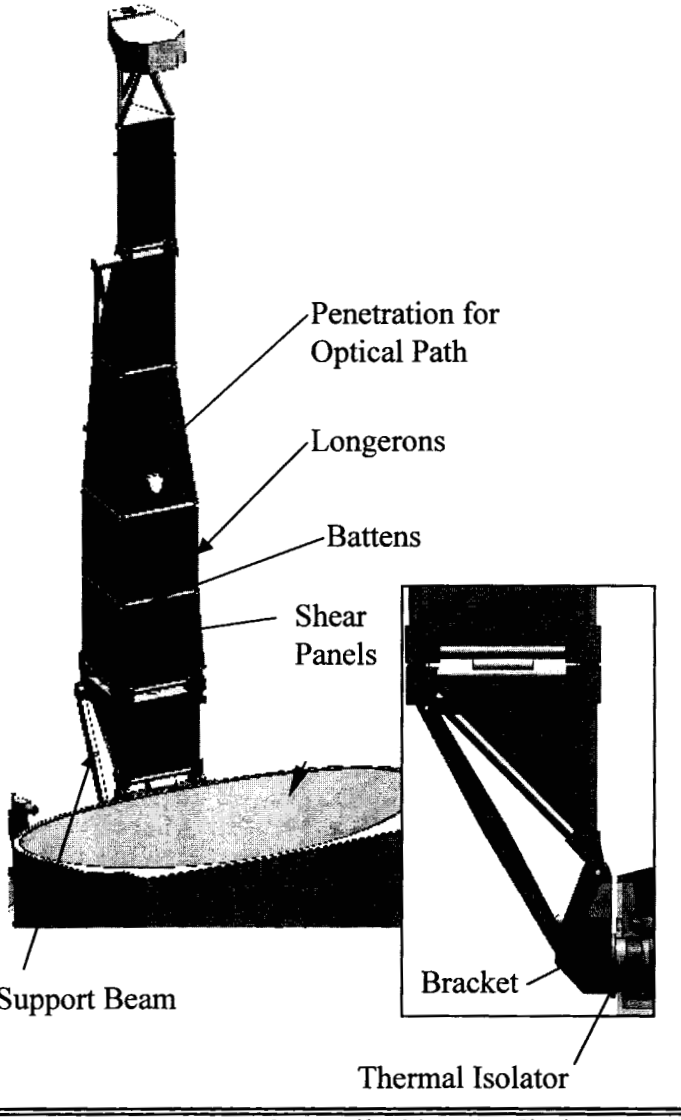
Design Drivers: Stability & Packaging

- Minimize thermal distortion – low CTE
  - Some distortion compensated with secondary mirror hexapod
- High Frequency desired for vib isolation
  - Looked at various designs: truss, circular & triangular x-sections
  - Rectangular x-section near base was best for given packaging constraints
  - Tower freq is ~20 Hz fixed at bracket
  - Thermal Isolator between bracket & AMS reduces 1st mode to ~13 Hz



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