Telescope Overview

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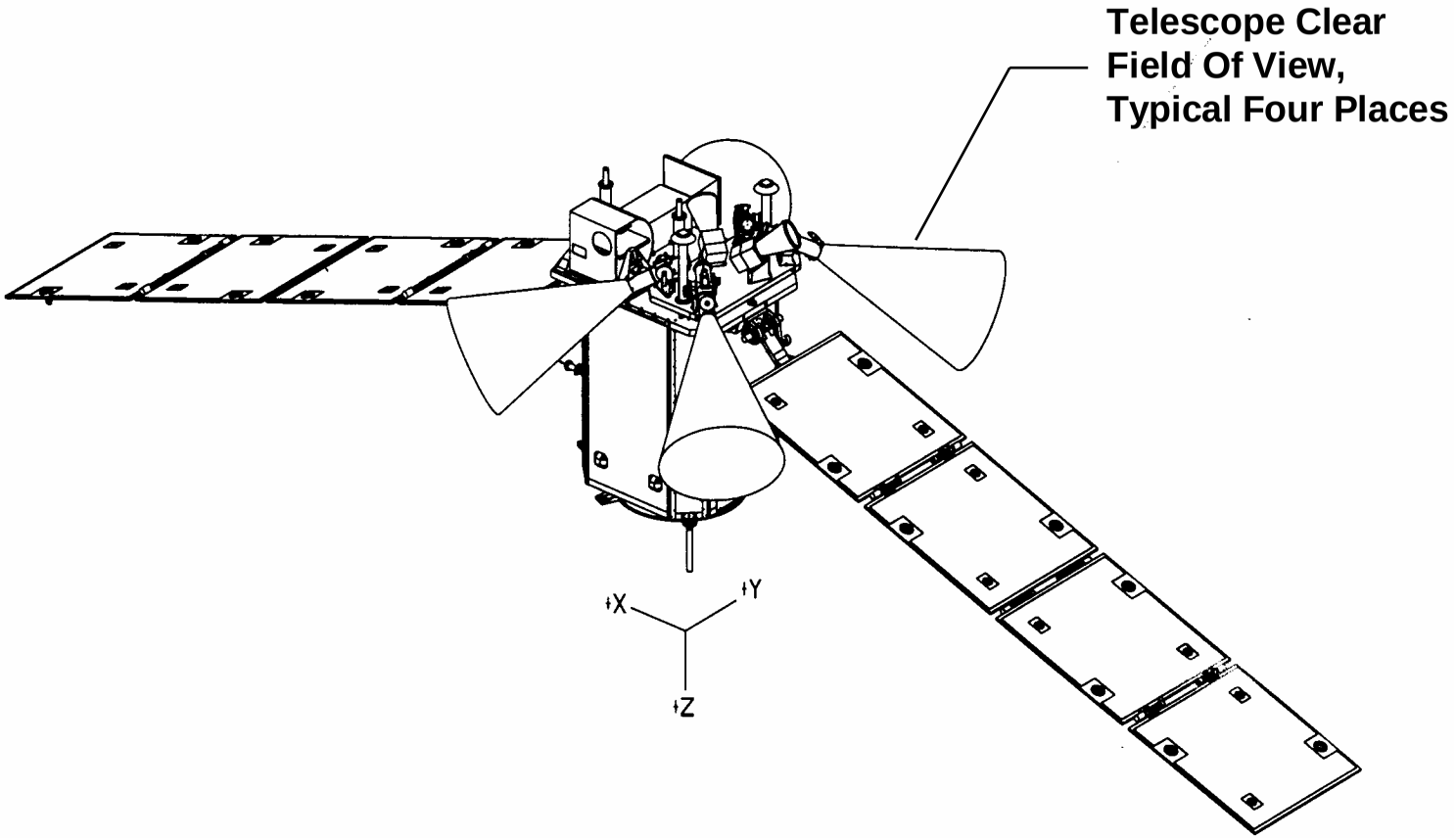
APL Telescope Lead Personnel

• Ted Sholar	Systems & Structural
• Keith Peacock	Optics
• Mike Kreitz	Mechanical
• Jack Ercol	Thermal
• Dave Lohr	Electrical
• Al Sadilek	Alignment & Purge
• Jim Hutcheson	Assembly Technician
• Rob Gold	Science
• Larry Mastracci	Product Assurance
• John Coopersmith	Contamination

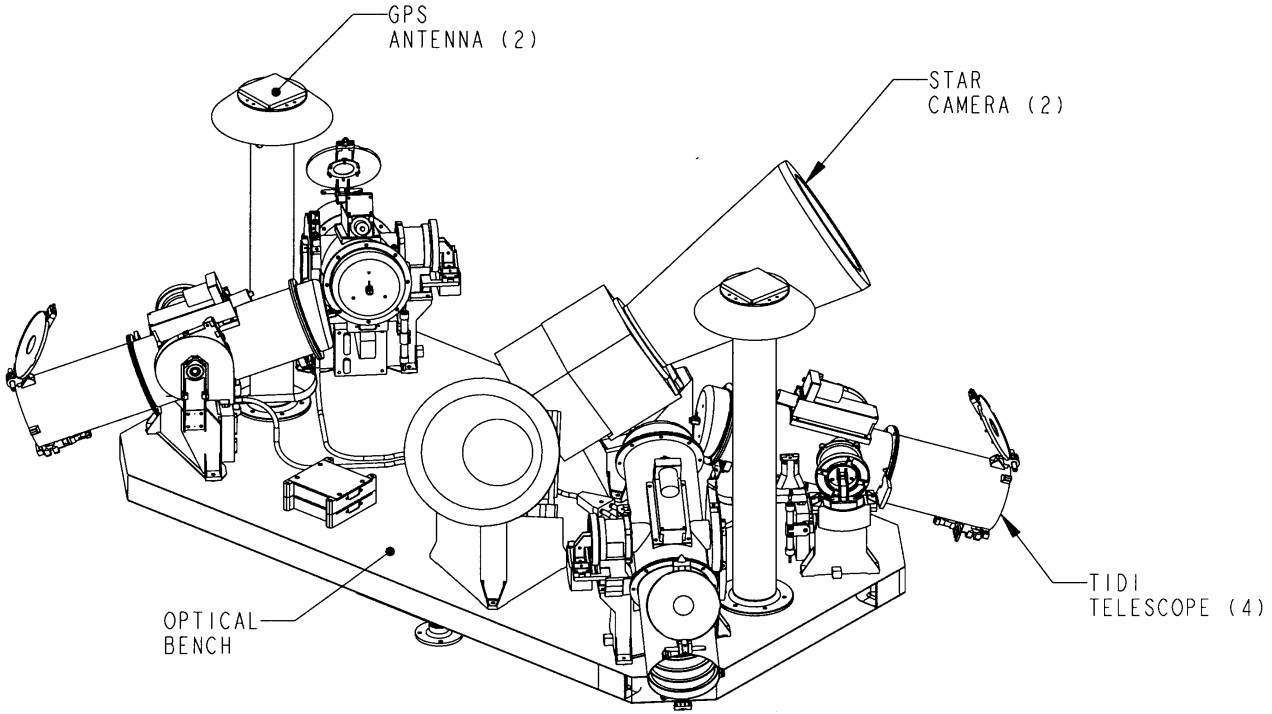
APL Task Summary

- APL responsible for designing, building and testing four earth limb scanning telescopes for the University of Michigan's Space Physics Research Laboratory (SPRL)
- SPRL is responsible for defining the top level telescope subsystem requirements which APL flows down into detailed engineering requirements
- SPRL supplies the telescope servo (scan drive actuator, position readout device, electronics and software)
- APL will build and test a flight like Engineering Model (EM) for design verification purposes
- In essence, this is an optomechanical task - no APL electronics or software development

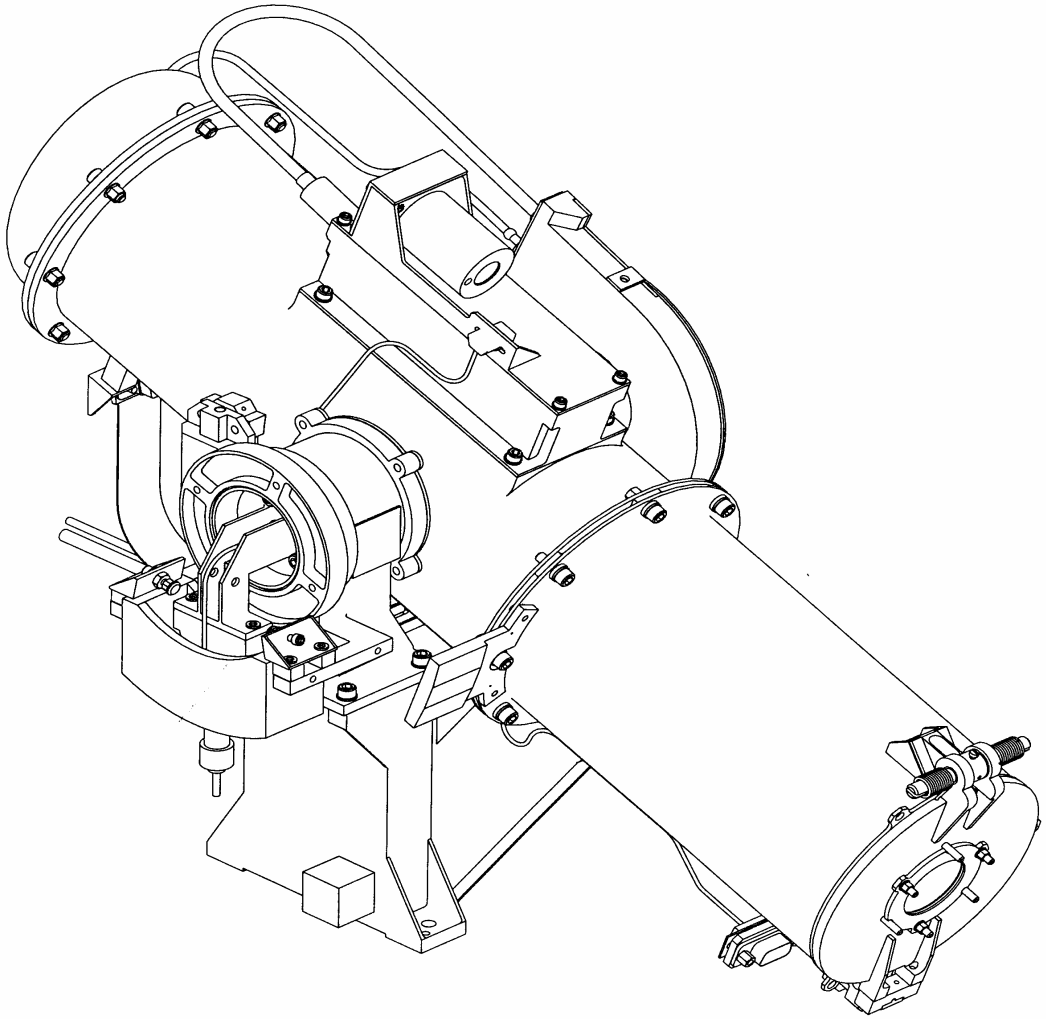
TIMED Spacecraft Configuration



Optical Bench Configuration



Telescope Configuration



SPACE PHYSICS RESEARCH LABORATORY

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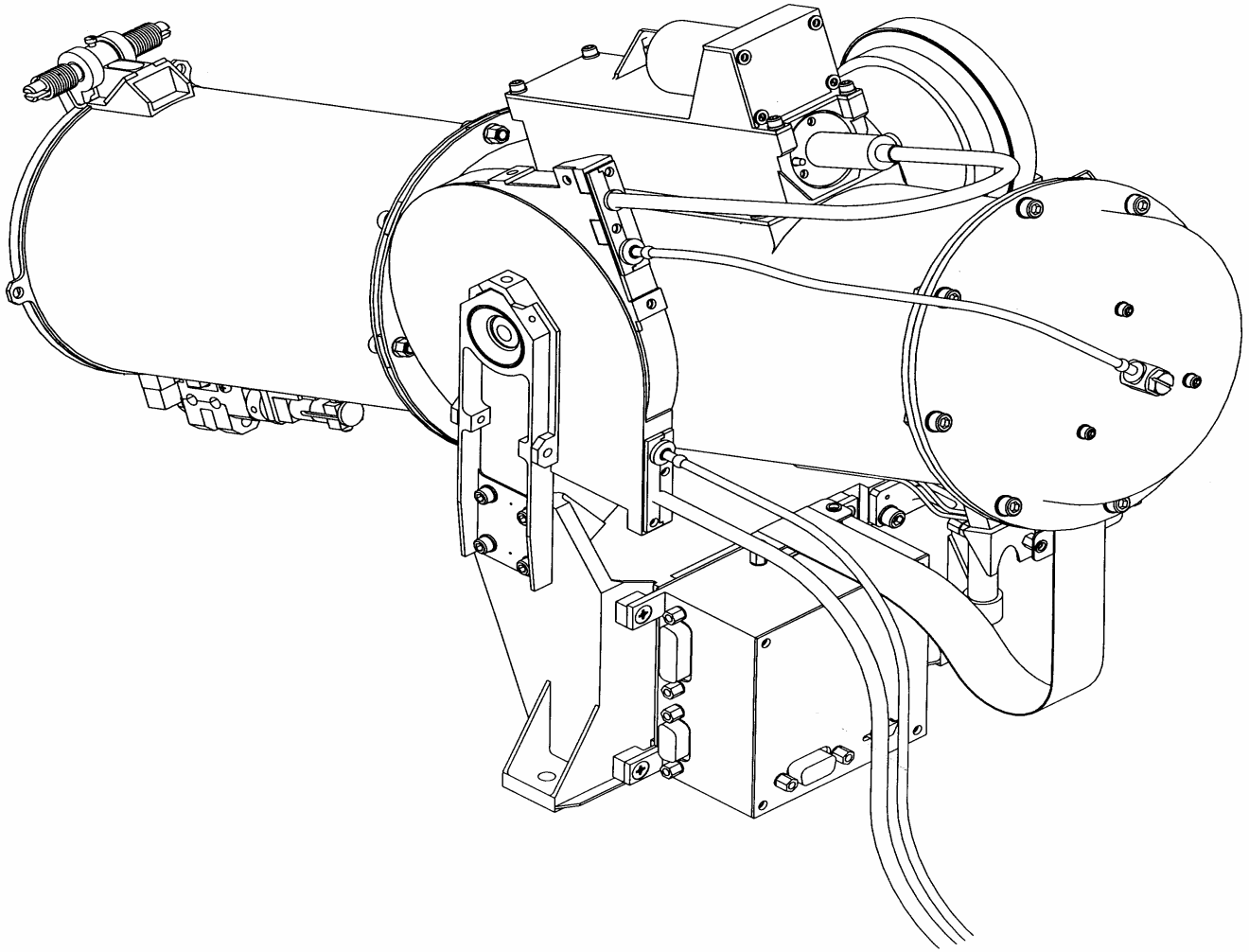
Telescope Configuration



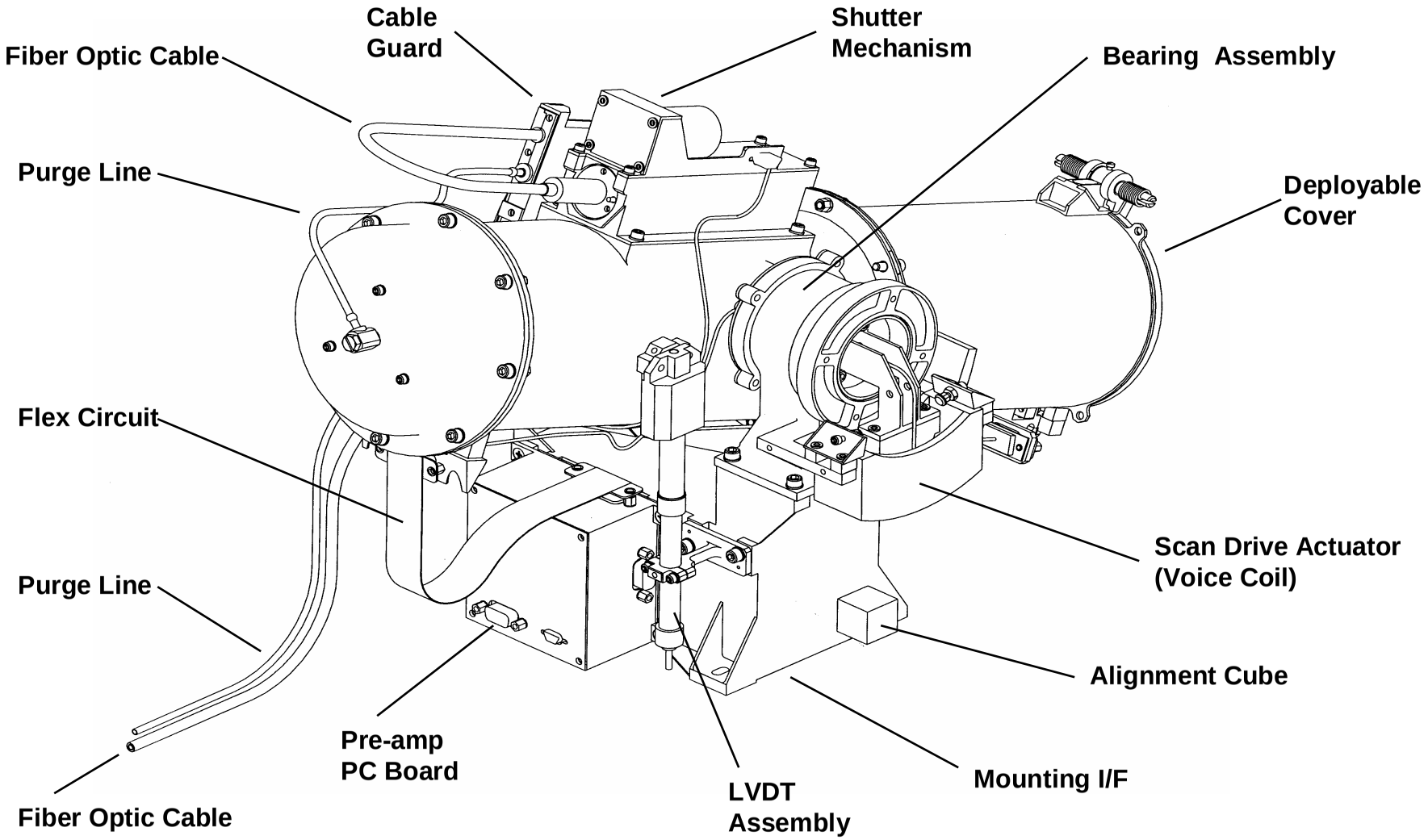
Design Drivers

- Optical collection area and Field Of View (FOV)
- Minimize stray/scattered light reaching fiber optic bundle (focal plane)
- Keep subsystem drag torque under 5 ounce inches
- Max weight of 4.6 kg (10.14 lbs) per telescope
- End to end alignment knowledge error not to exceed 80 arc-sec azimuth and 100 arc-sec elevation
- No mechanical launch lock - utilize static balance

Interfaces

- **S/C Interfaces:** Three point bolted mount
  Clear Field Of View
  Electrical Connections
  Purge line
- **SPRL Interfaces:** Scan drive actuator (voice coil)
  LVDT assembly
  LVDT pre-amp electronics
  Fiber Optic Cable (FOC)
  Electrical Connections

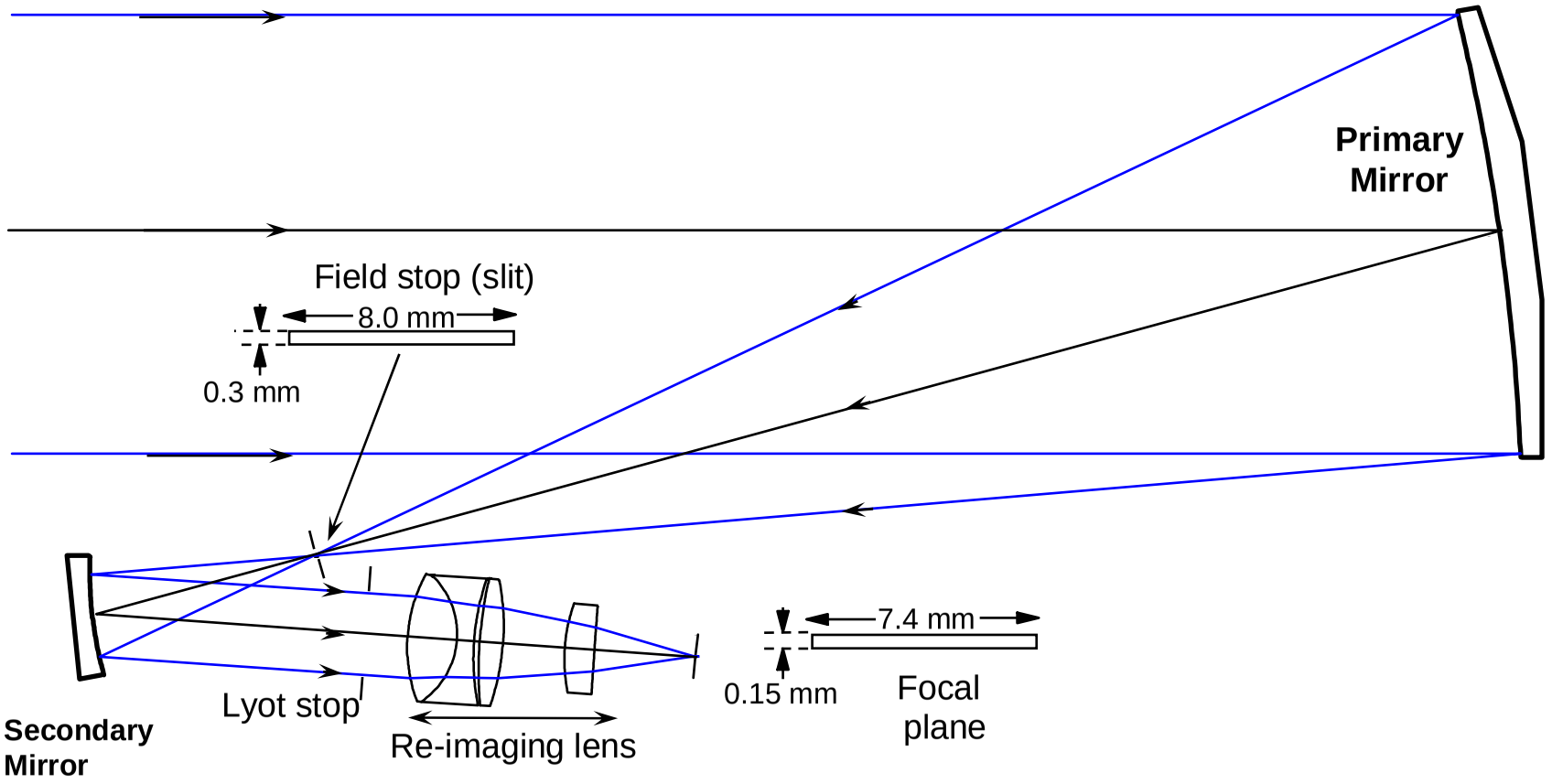
Interfaces


Fiber Optic Cable
Cable Guard
Shutter Mechanism
Bearing Assembly
Purge Line
Deployable Cover
Flex Circuit
Purge Line
Scan Drive Actuator (Voice Coil)
Alignment Cube
Pre-amp PC Board
LVDT Assembly
Mounting I/F
Fiber Optic Cable

Features - Optical

- Off-axis unobscurred primary mirror
- Field stop and Lyot stop for stray light control
- Re-imaging optics to fiber optic bundle
- Radiation resistant glass re-imaging lenses
- Light-weight aluminum primary and secondary mirrors
- Low scatter gold coating on mirror reflecting surfaces

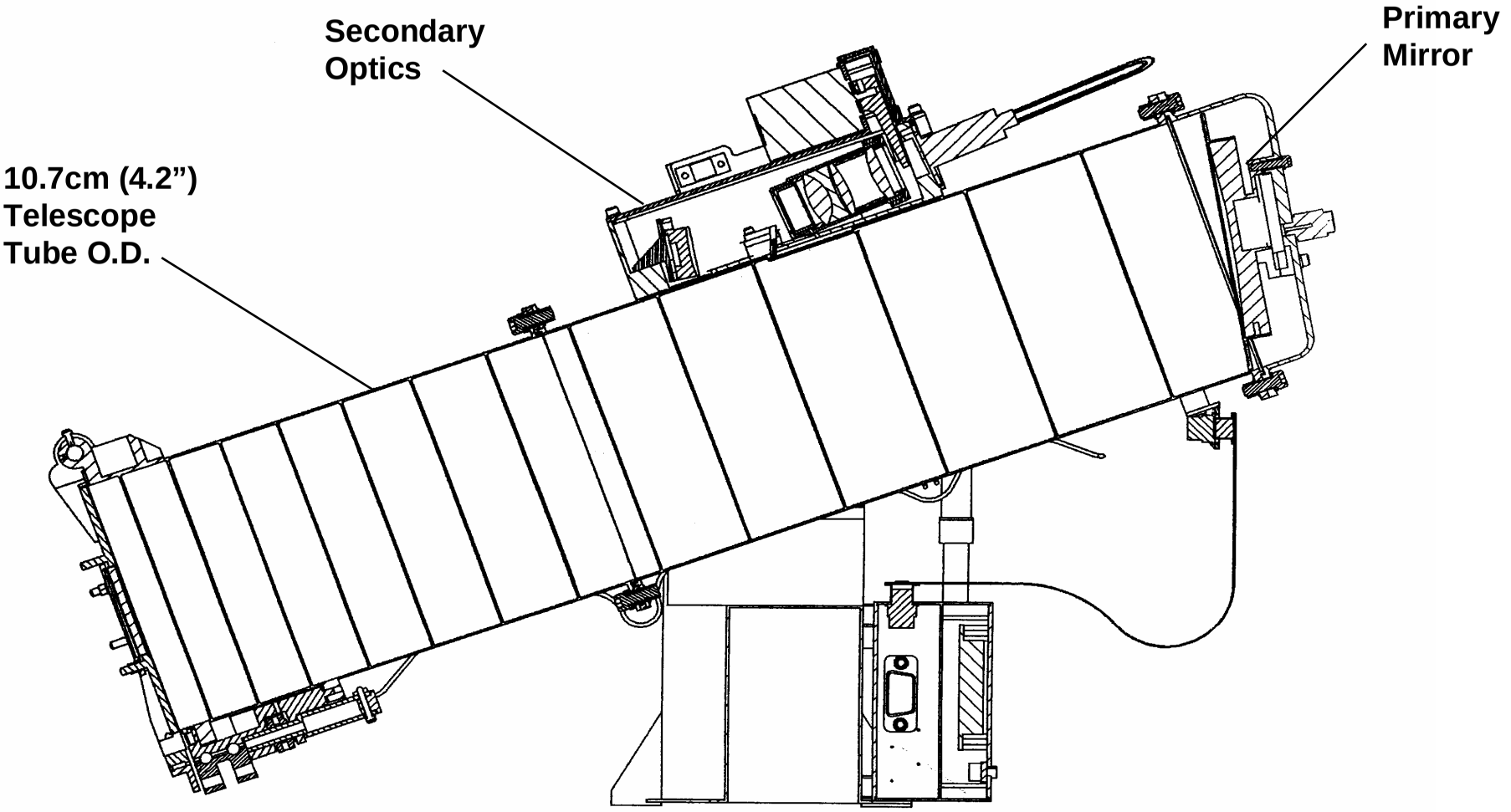
Features - Optical



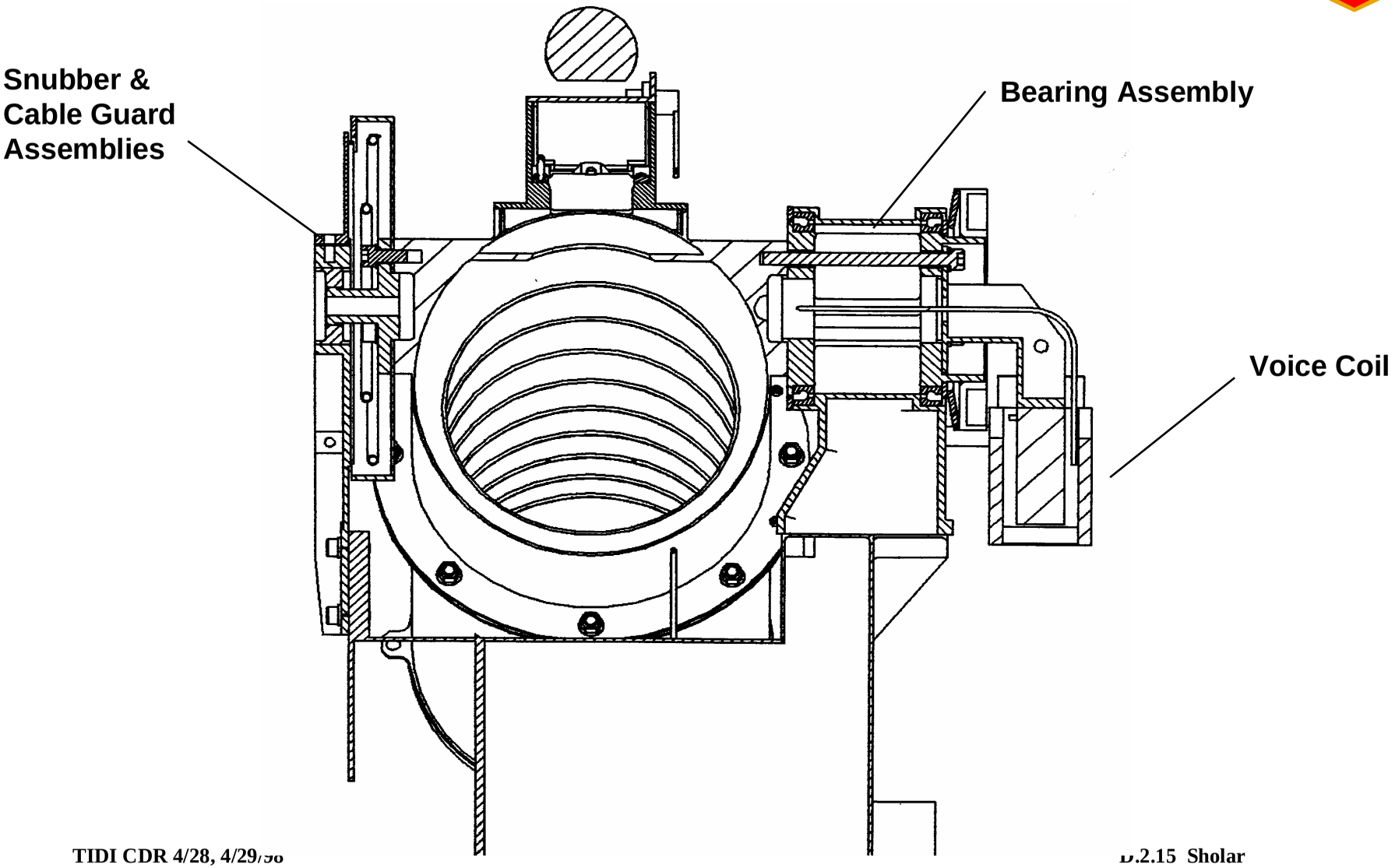
Features - Mechanical

- Nominal 20.35^{o} look down angle from S/C horizontal
- $\pm$ 5^{o} operational scan range with a $\pm$ 11^{o} over scan capability for bearing lubrication
- Baffled telescope housing and sunshade for stray light
- Single use deployable cover and continuous purge of primary mirror for contamination control
- Shutter mechanism in line with fiber optic bundle
- Aluminum telescope assembly mounted to a titanium bearing assembly and support base
- Operationally, telescope is cantilevered from a single pair of angular contact bearings - snubber/bushing support required to survive launch

Features - Mechanical



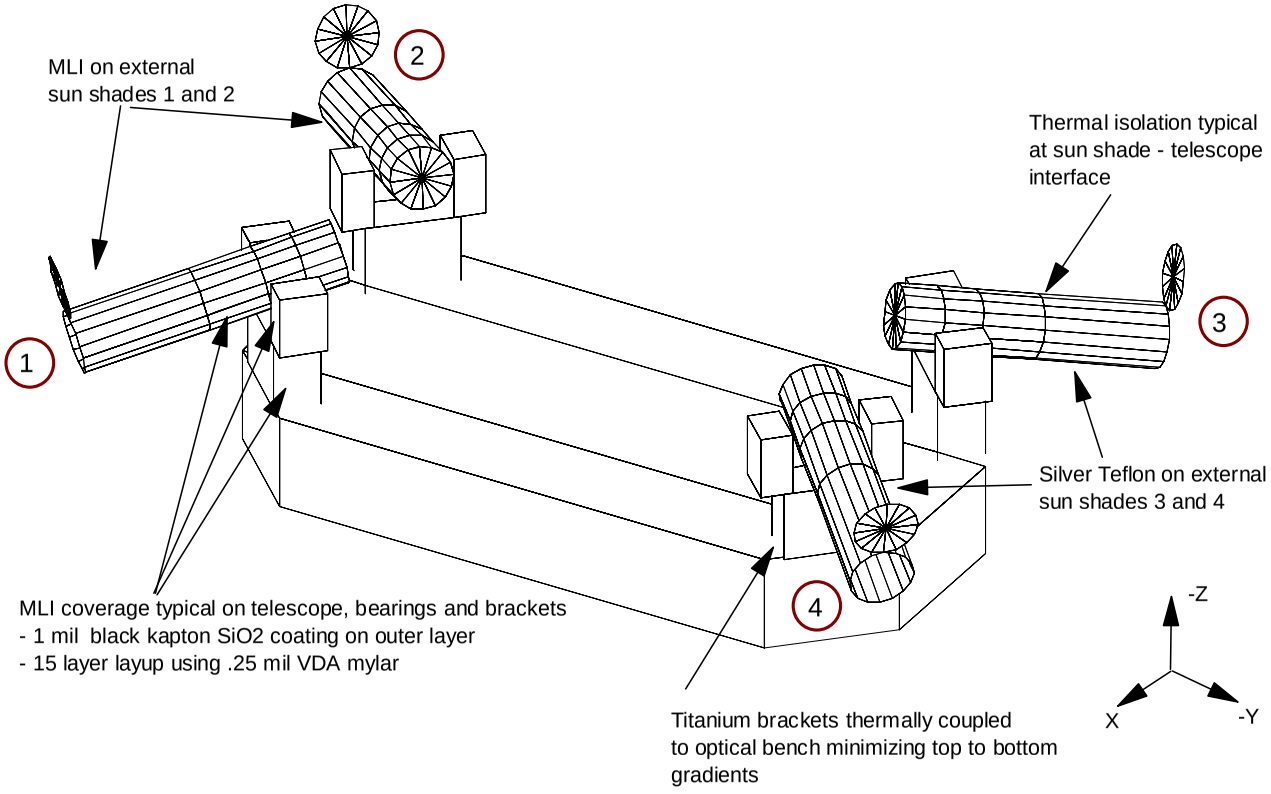
Features - Mechanical



Features - Thermal

- Four telescopes thermally configured in pairs: sun side (-Y) & anti-sun side (+Y)
- A single non-redundant dual element heater for both operational and survival modes
- Operational temperatures maintained with a programmable setpoint electronic thermostat
- Survival temperatures maintained with a non-redundant mechanical thermostat
- Operational design range of -20°C to +50°C, survival design range of -40°C to +50°C
- At certain Beta angles, available power may limit desired operating temperature

Features - Thermal



Test Plan - Engineering Model

- Ambient & cold drag torque determination
- Alignment error over temperature
- Component level sine and random vibration:
  - Alignment launch shift
  - Drag torque variation
  - No launch lock verification
- Alignment launch shift due to 1g release
- Deployable cover release
- Thermal balance - two configurations
- Life cycles in vacuum

Test Plan - Flight Units

- Component level optical measurements
- Deployable cover release
- Ambient & cold drag torque determination
- Subsystem optical measurements - ambient
- Subsystem optical measurements - in vacuum and over temperature (includes alignment)
- LVDT calibration over temperature
- Light leak check
- Component level sine and random vibration

Schedule Summary / Status

• Optics Procurement	February 23, 1998
• Began EM Testing	February 23, 1998
• Flight Fabrication	April 3, 1998
• Instrument CDR	April 28, 1998
• Telescope CDR	May 7, 1998
• Complete EM Testing	June 26, 1998
• Begin Flight Assembly	July 24, 1998
• Begin Flight Testing	September 25, 1998
• Delivery	December 10, 1998

EM Test Result Summary

- **Drag Torques: Cold testing varifies that 5 oz-in requirement will be met for operational scan range but may be exceeded during overscans**
- **Alignment Over Temperature: Initial testing indicated substantial movement - additional testing planned to verify problem and correct if legitimate**
- **Vibration: Structural integrity verified, alignment shift acceptable, drag torque variation acceptable and no launch lock verified**
- **1 g Release: Alignment shift is acceptable**
- **Weight: Current mass margin is greater than 10%**

Concerns

- Alignment errors
- Stray/scattered light
- Bearing torque spikes
- Focused sunlight on slit