NIC-FPS Preliminary Design Review

Dewar Mechanical Design

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CASA-ARL

Boulder, CO

Overview

- Requirements
- Instrument Structure
  - Front Assembly
  - Optical Bench
  - LN2 Reservoir
  - Insulating Blankets
- Maintenance Considerations
- Thermal Loads
- Overall Mass

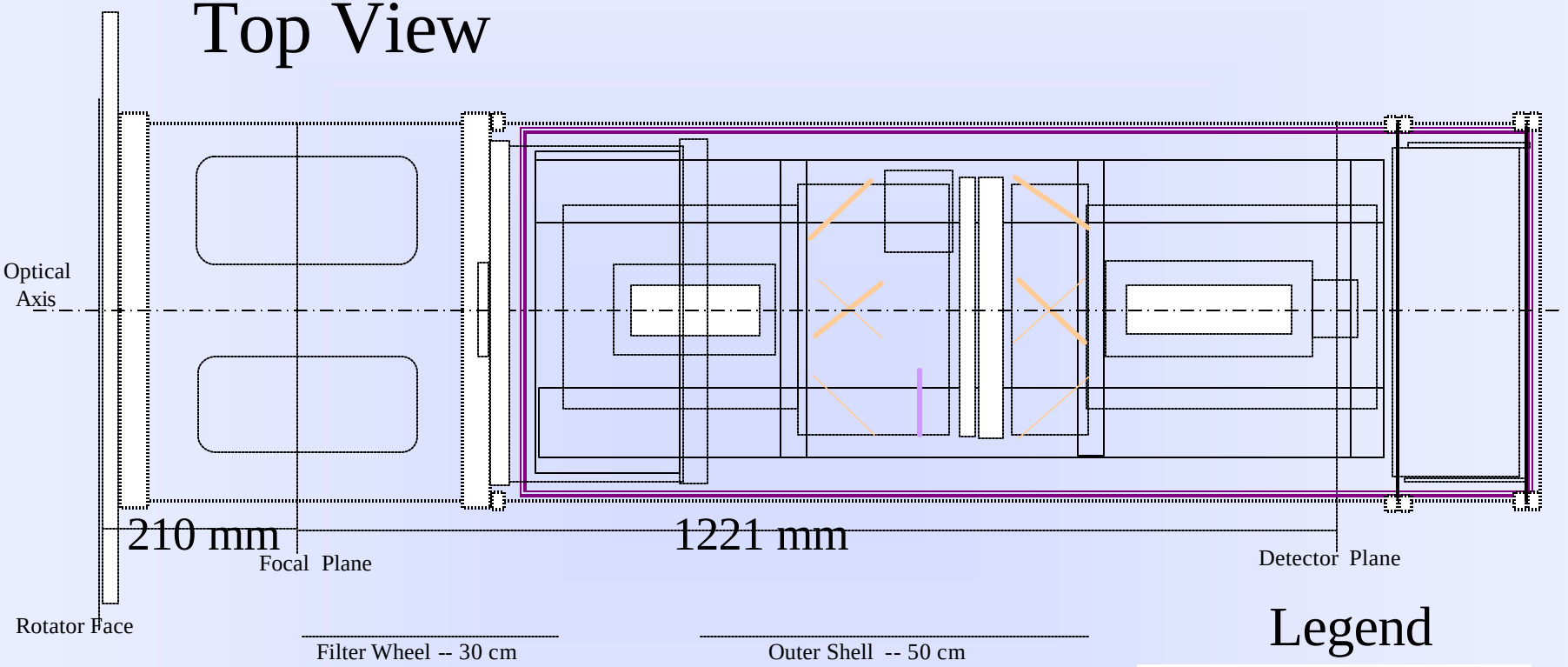
Requirements

- Mount instrument horizontally at Nasmyth 2 port (will also consider side port in structural design)
- Rotate plus or minus 270 degrees
- 24 hour minimum hold time; >48 hour target
- Structurally support instrument within tolerances
  - Image shift during integration, centering during rotation, image quality as discussed during Opto-Mechanical
  - Additional tolerances to be derived from optical design
- Ease of access/maintenance

Instrument Structure

- Front Assembly
  - Rigid support for dewar assembly, minimizes dewar volume
  - Warm focal plane, field stop, entrance window
  - Calibration unit and injection mirror
  - All electrical connections through front dewar wall (unless warm detector electronics need to be close to focal plane array)
  - Vacuum pump-down connection
  - Dry nitrogen back-fill, vent connections
  - Possible warm air, dry nitrogen, nitrogen boil-off across entrance window

Top View



Legend

- Optical bench
- Optical component
- LN2 volume
- Insulating blankets
- Stand-offs
- Mirrors

Instrument Structure (continued)

- Optical Bench
  - Cantilevered structure from G-10 standoff
  - Filter wheel extends below optical bench
  - Beam and frame construction being evaluated
  - Full cantilever, end-support options
  - Greatest structural challenge

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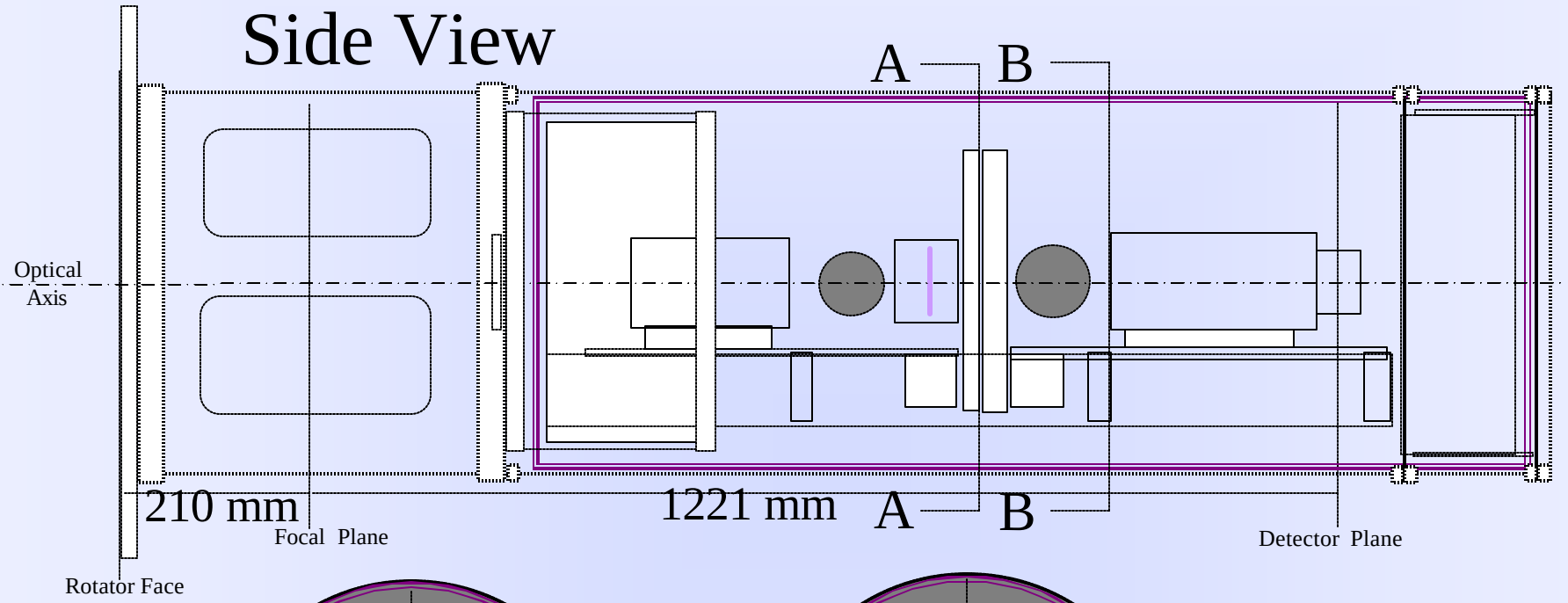

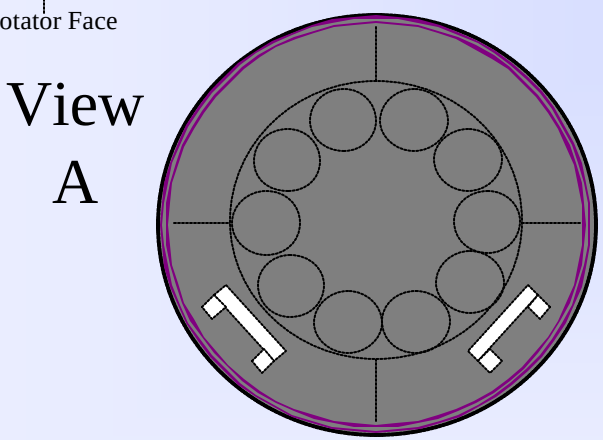

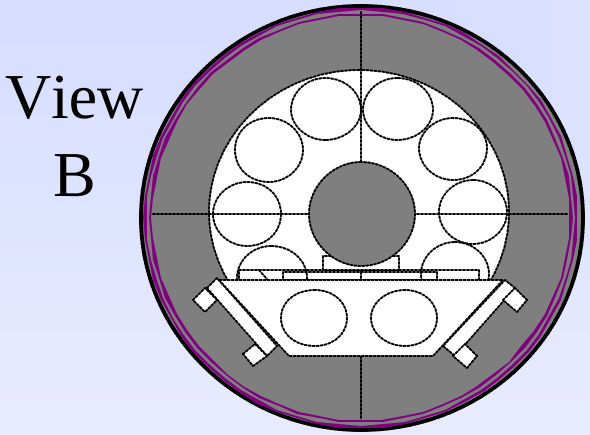

Legend

- Optical bench
- Optical component
- LN2 volume
- Insulating blankets
- Stand-offs
- Mirrors

Instrument Structure (continued)

- LN2 reservoir
  - Positioned beyond focal plane array
  - Independent of optical components/alignment
  - Thermal standoff of G-10
  - Fill/vent connections through end plate, bellows assembly
  - Centerline vent, maximum half full
  - Removes with far end of vacuum chamber
  - Thermal connection with copper tabs
  - Cryo-sorption pump (probably activated charcoal) attached to tank
  - Volume 10-15 liters as determined by thermal design (6.25 liters per 10 cm of tank width)

Instrument Structure (continued)

- Insulation blankets
  - Can-in-a-can design, multi-layered mylar plus spacer
  - Remove with vacuum chamber shell
  - Separate front end blanket, LN2 tank insulation
  - Near 100% coverage (less entrance window)
  - Number of layers to be dictated by thermal design

Maintenance Considerations

- Access sequence
  - Supports/strap at front assembly
  - Remove LN2 end bell -- access FPA
  - Disconnect end support (if option incorporated)
  - Remove vacuum shell -- access all optical bench
  - No connections broken; minimal impact on optical alignment
- Filter changes/additions
  - Use above sequence
  - No access through wall
- Optic bench locked during transport
  - Minimize effect of shocks on thermal standoff

Thermal Loads

- Standoffs
  - For 20 cm length, 40 cm diameter, G-10 -- .25 W/mm thickness
  - Front end standoff, ~1.5 W; far end, ~.5 W
- Shell radiation load
  - 2.3 m^2 surface area, approximately 0.5 W/ m^2
- Entrance window (largest heat load)
  - 3-5 W, based on OSIRIS design and in-house calculation
  - Baffle arrangement, reflective shutter, other options need to be considered
- Other penetrations(LN2 tubes, electrical, etc.)
  - Approximately 2 W total

Total -- Approximately 10 W (~5.4 liters LN2/day)

Overall Mass

- Optic bench with optics, detector/electronics, and standoff -- ~50 kg
  - Approximately 50 liters of LN2 to cool
- LN2 tank, full (half-fill configuration) -- ~20 kg
- Shell, front assembly with components -- ~80 kg

Total -- Approximately 150 kg (~330 pounds) without mounting plate