

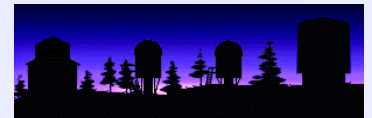


# *NIC-FPS 1-Year Review*

## *Thermal – Mechanical System Progress*

*Fred Hearty  
(CU-CASA)*

*4 April 2003  
CASA-ARL  
Boulder, CO*





# *NIC-FPS 1-Year Review*

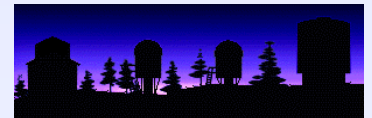
## Overview

- Purpose of Review – Identify “show stoppers”
- Dewar Design and Fabrication
- Dewar Issues & Actions
  - Cantilevered optical bench structural support
  - Thermal coupling bench to LN2 tank
  - ~1 year vacuum hold time
  - Floating thermal shield
  - Moisture retention in super-insulation
  - Structural analysis
- Present Integration and Test Plan



4 April 2003

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# *NIC-FPS 1-Year Review*

## Instrument Structure

- Front Assembly
  - Rigid support for Dewar assembly, minimizes Dewar volume
  - Warm telescope focal plane, field stop, entrance window on 5-inch snout
  - All electrical connections through front Dewar wall (Vacuum Bulkhead)
  - Dry nitrogen back-fill connection
  - Pressure detector (Ion Gauge), overpressure relief
  - Nitrogen boil-off across entrance window

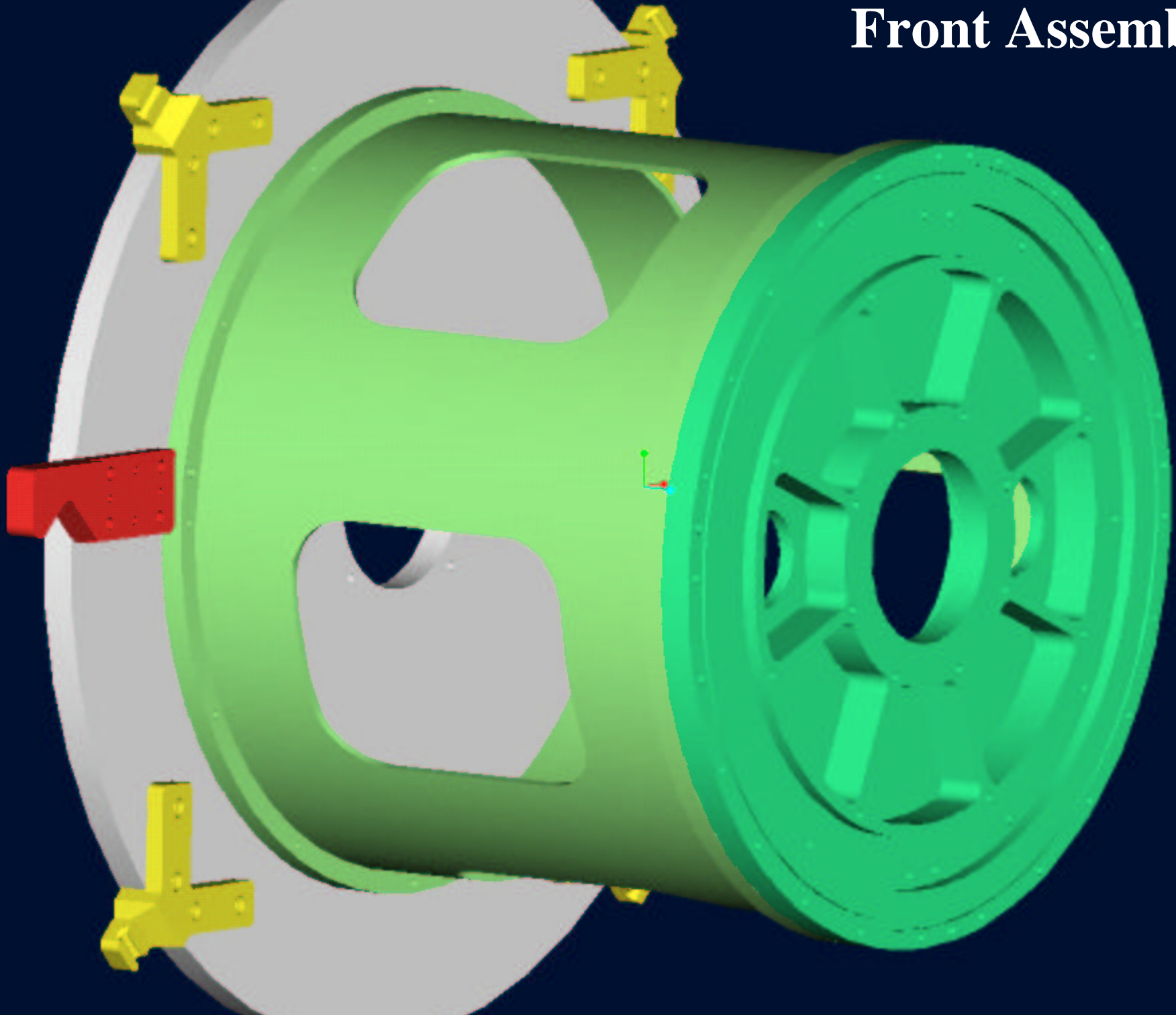


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# Front Assembly





# *NIC-FPS 1-Year Review*

## Instrument Structure (continued)

- Optical Bench Assembly
  - G-10 ring provides thermal barrier
  - Full cantilevered structure from Cold standoff
  - I-Beam and structural bench construction (~ 20-40 micron deflection)
  - Optical components all above plane of optical bench
  - Structure large enough to accommodate upgrade to 2k chip

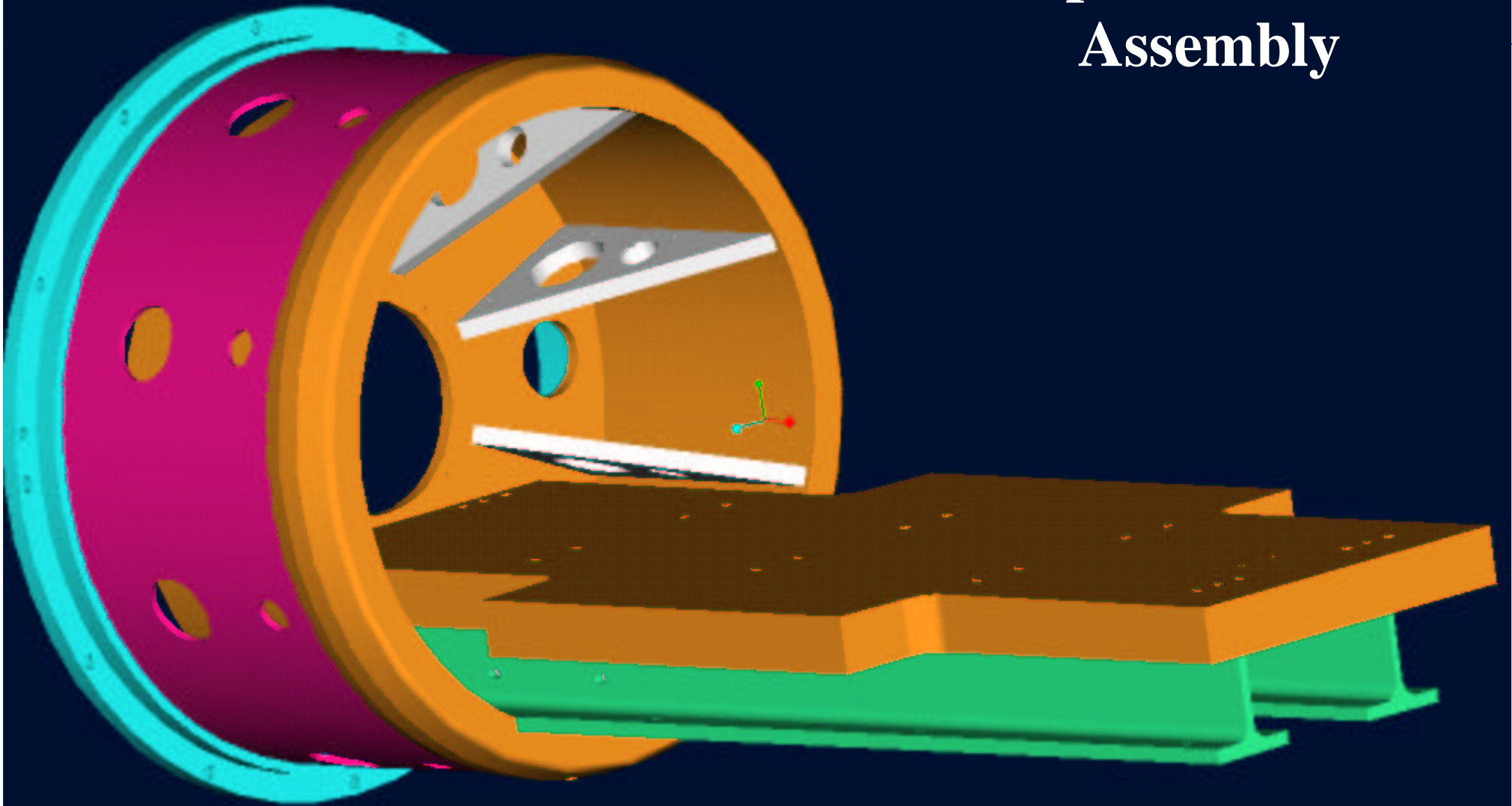


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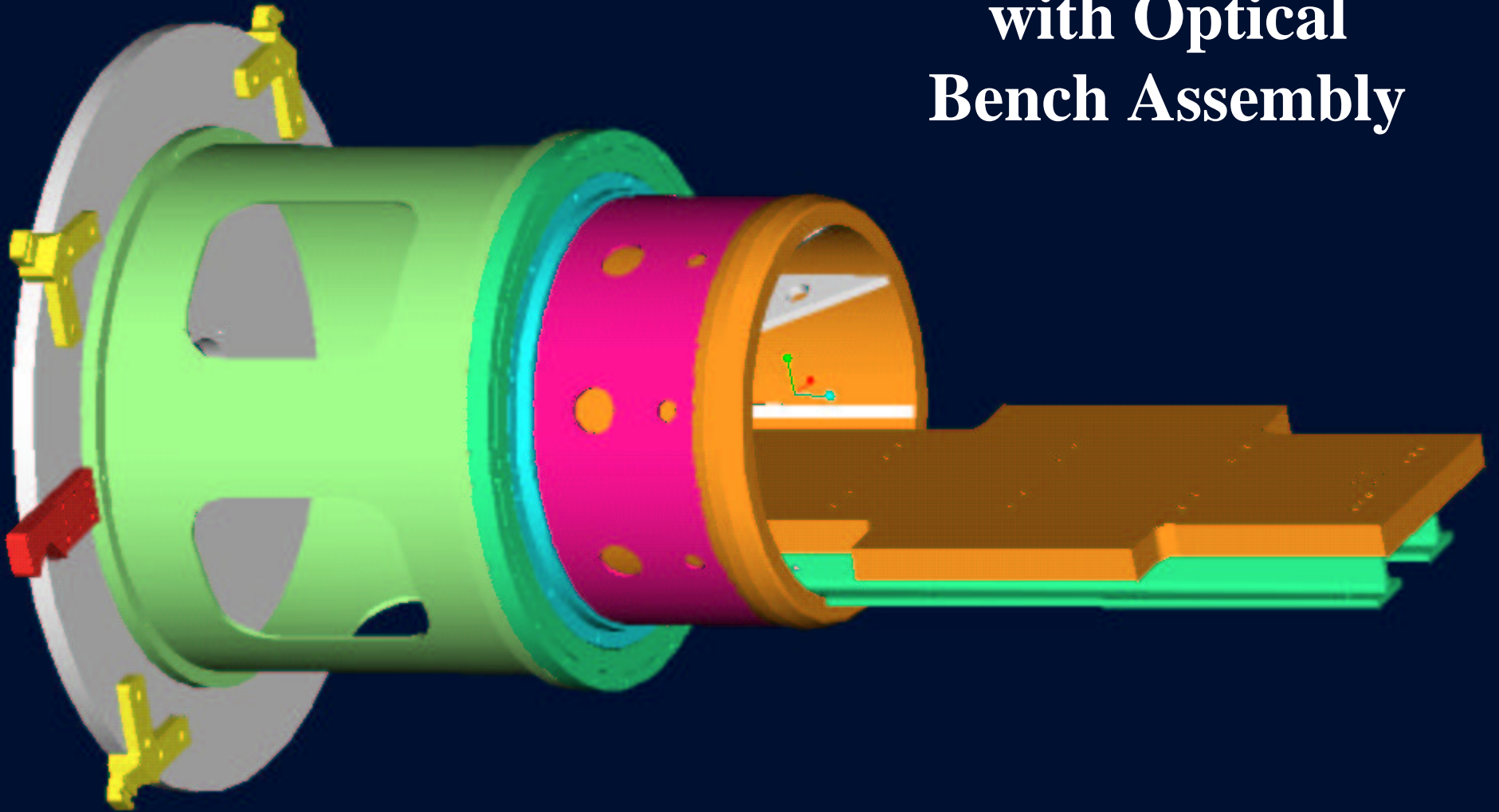
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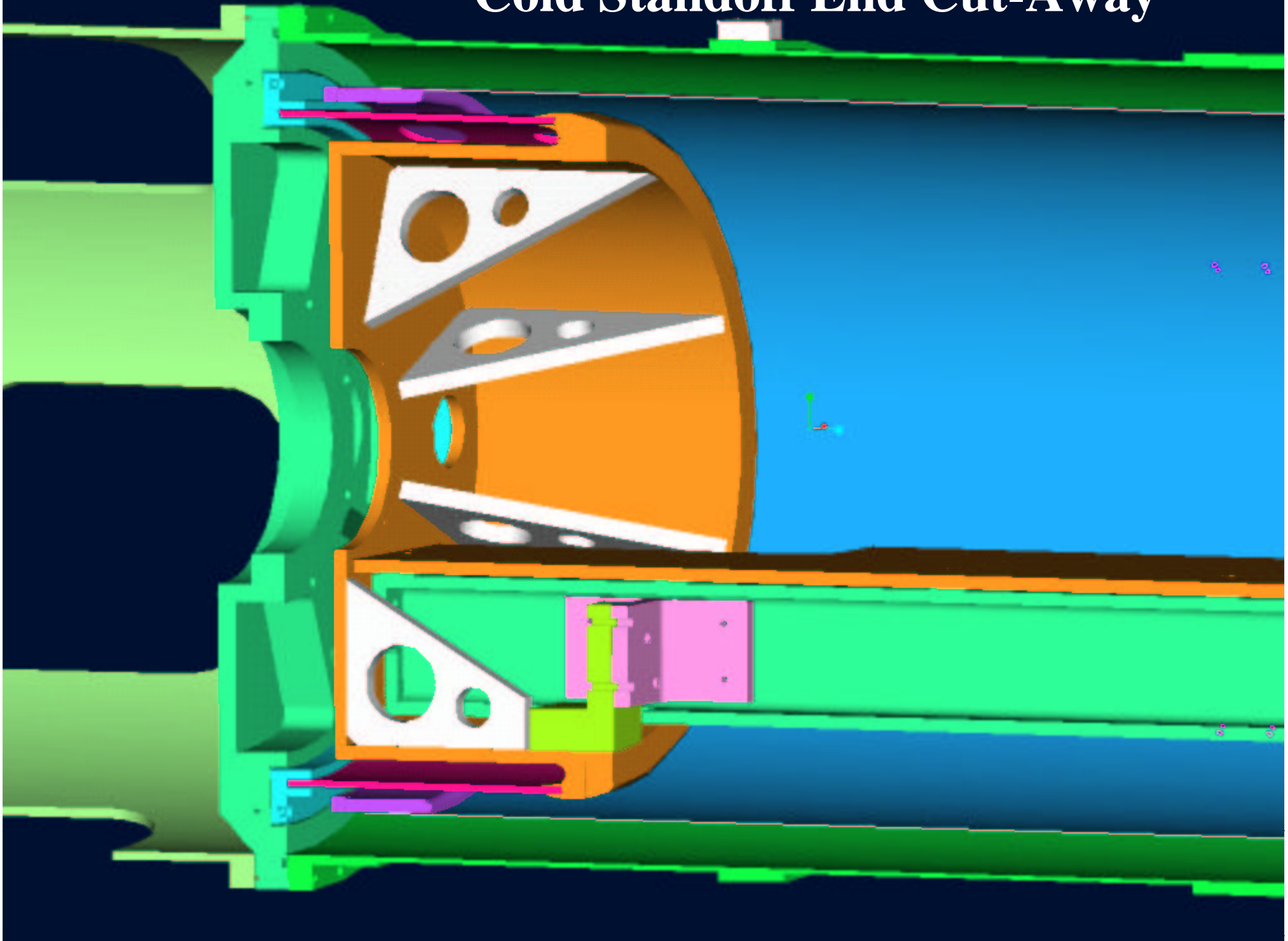
# Optical Bench Assembly



# Front Assembly with Optical Bench Assembly



# Cold Standoff End Cut-Away





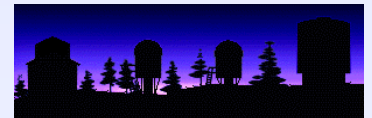


# *NIC-FPS 1-Year Review*

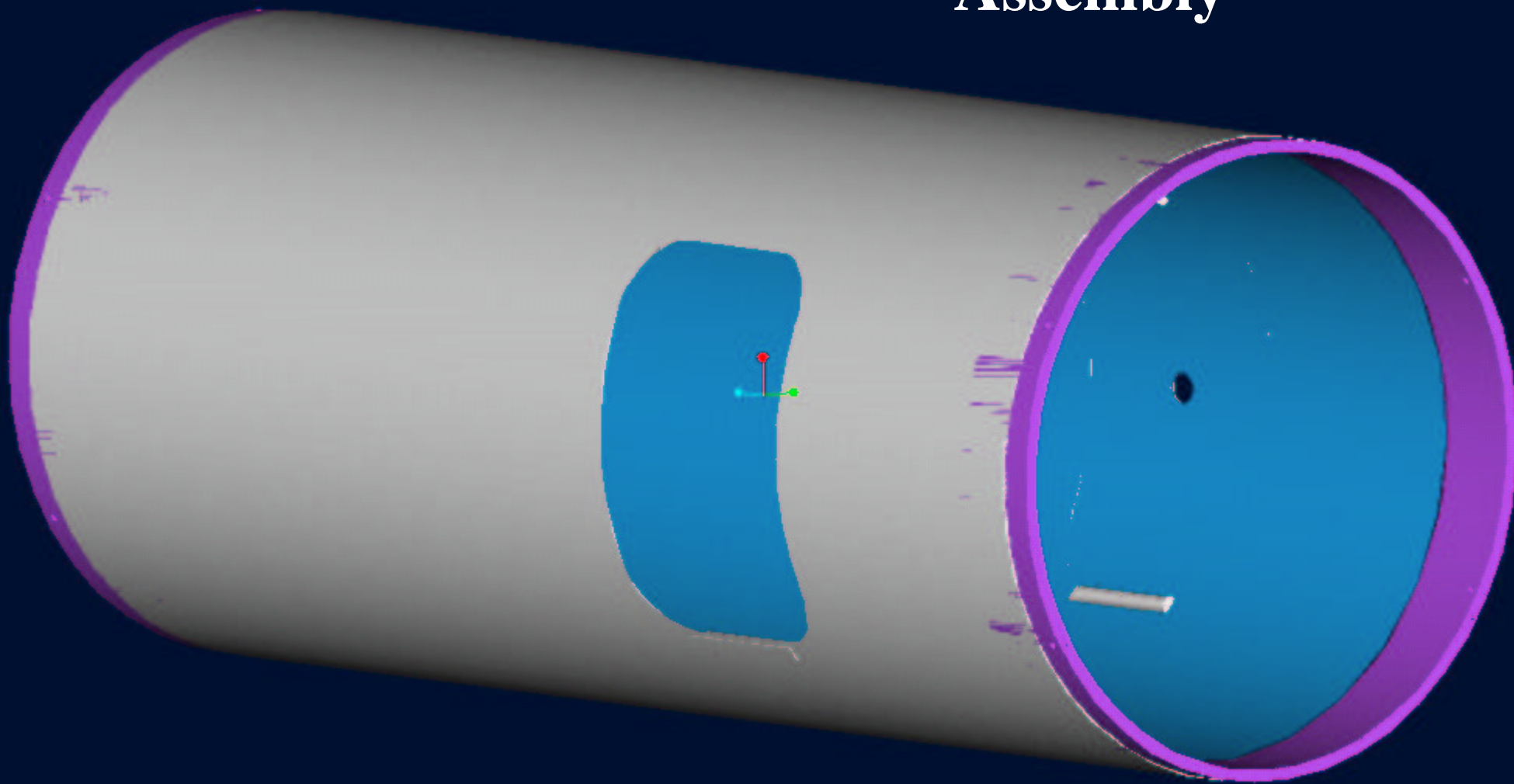
## Instrument Structure (continued)

- Thermal Shielding
  - Can-in-a-can design with PriMirror11 shield
  - Active shield (thermal straps plus radiation coupling)
  - Multi-layered insulation (MLI--mylar plus bridal veil) wrap
  - Remove with vacuum chamber shell
  - Separate front end shield, MLI blanket
  - LN2 tank shield, MLI blanket
  - Near 100% coverage (less entrance window, end annuli)
  - Approximately 12 layers in two removable blankets

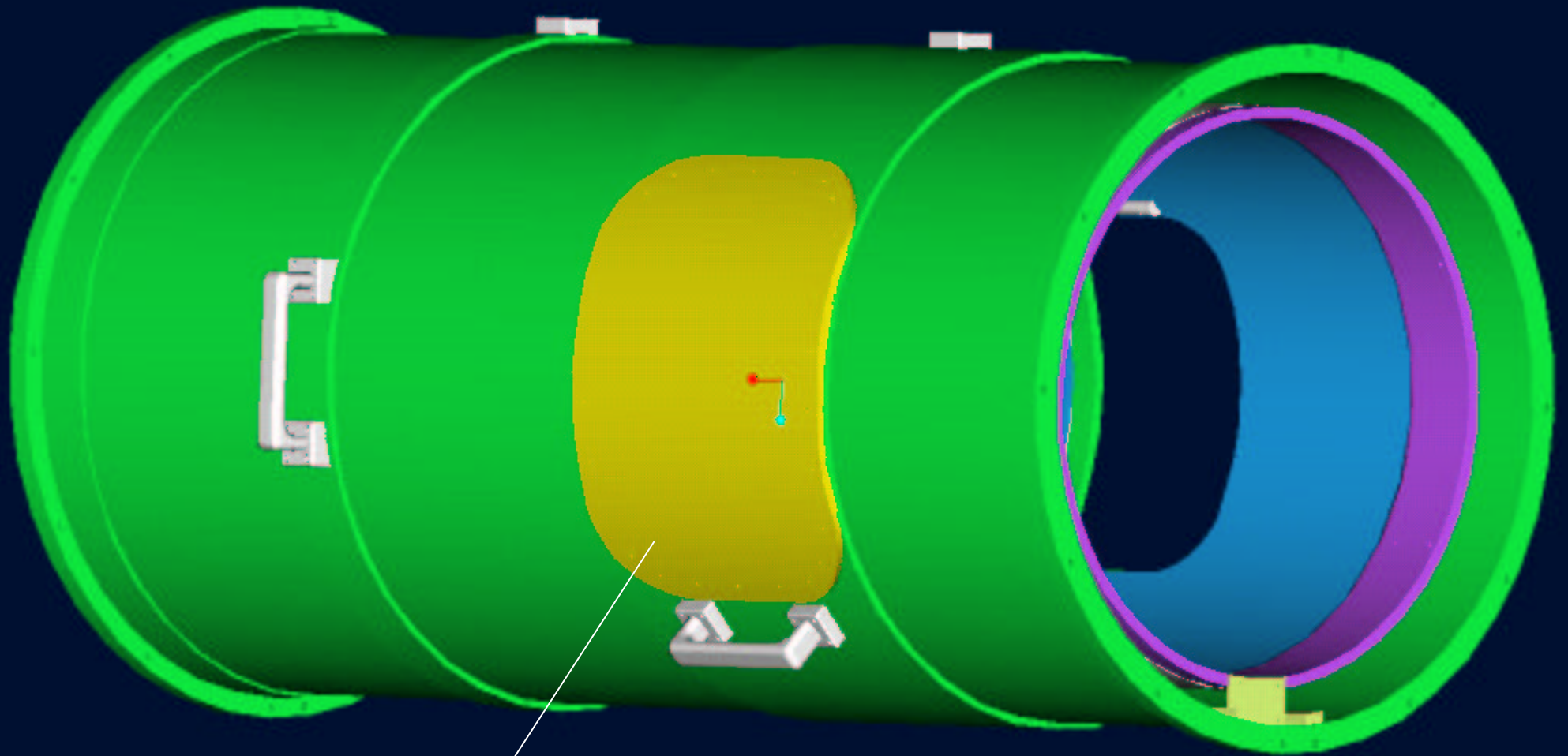
**Retain option to use single or double thermal shield  
without MLI**



# Thermal Shield Assembly

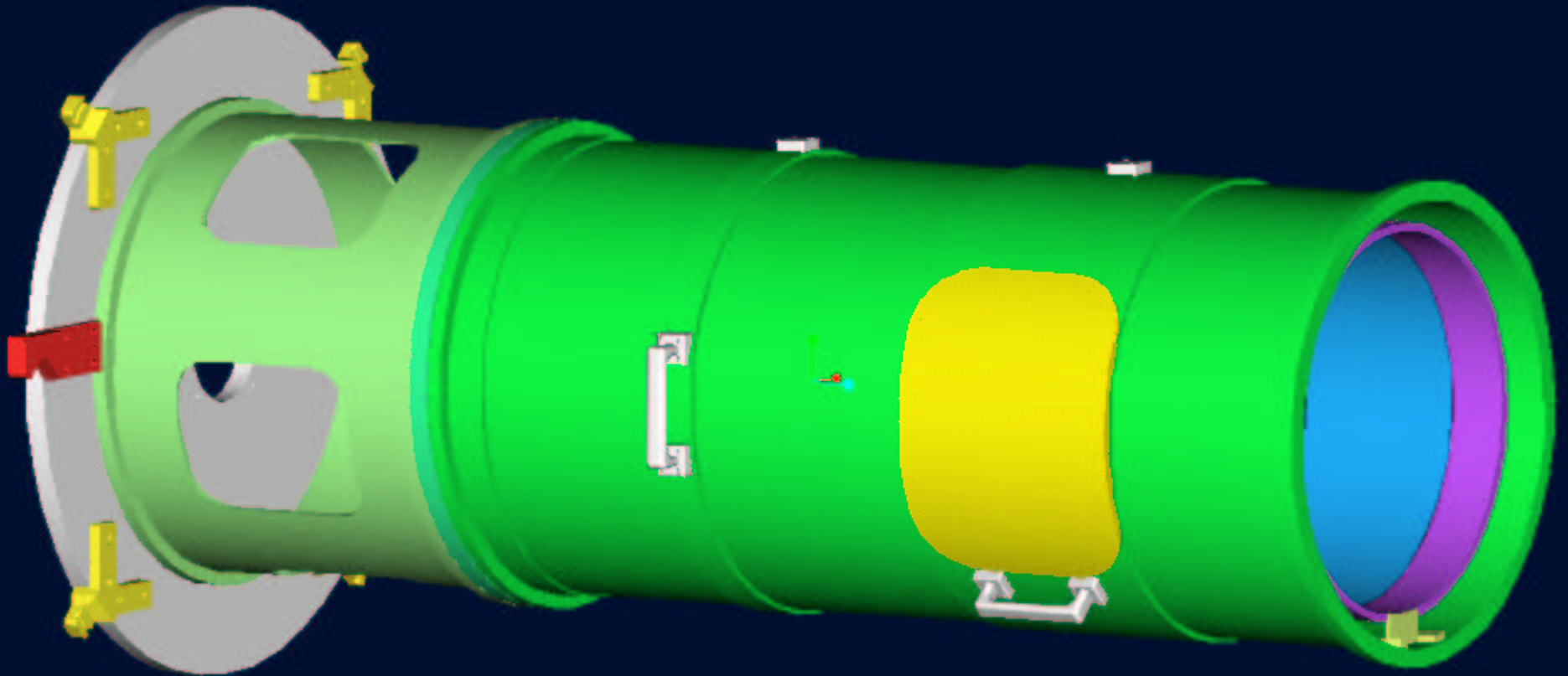


# Vacuum Shell and Thermal Shield Assembly

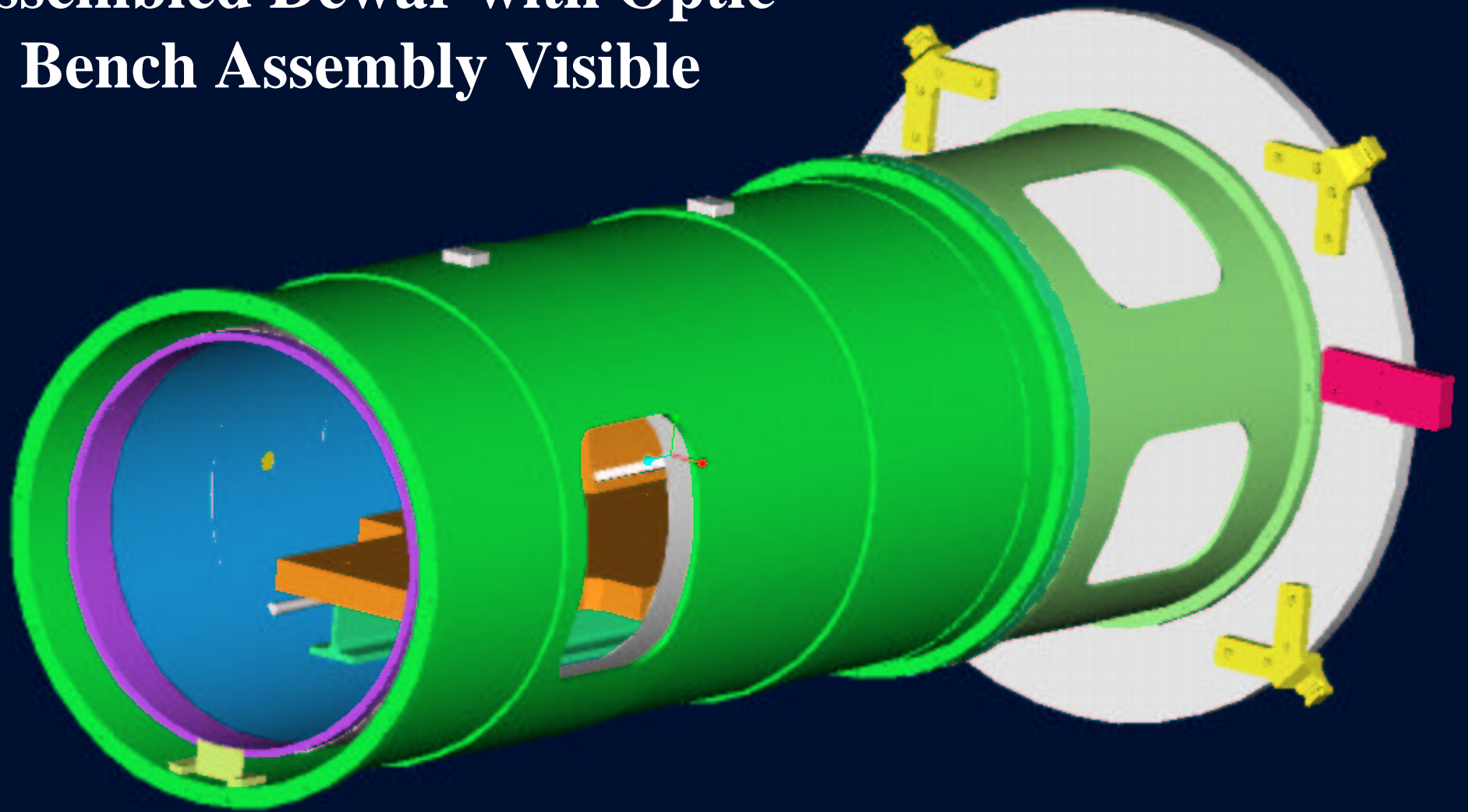


Access door (1 of 2)

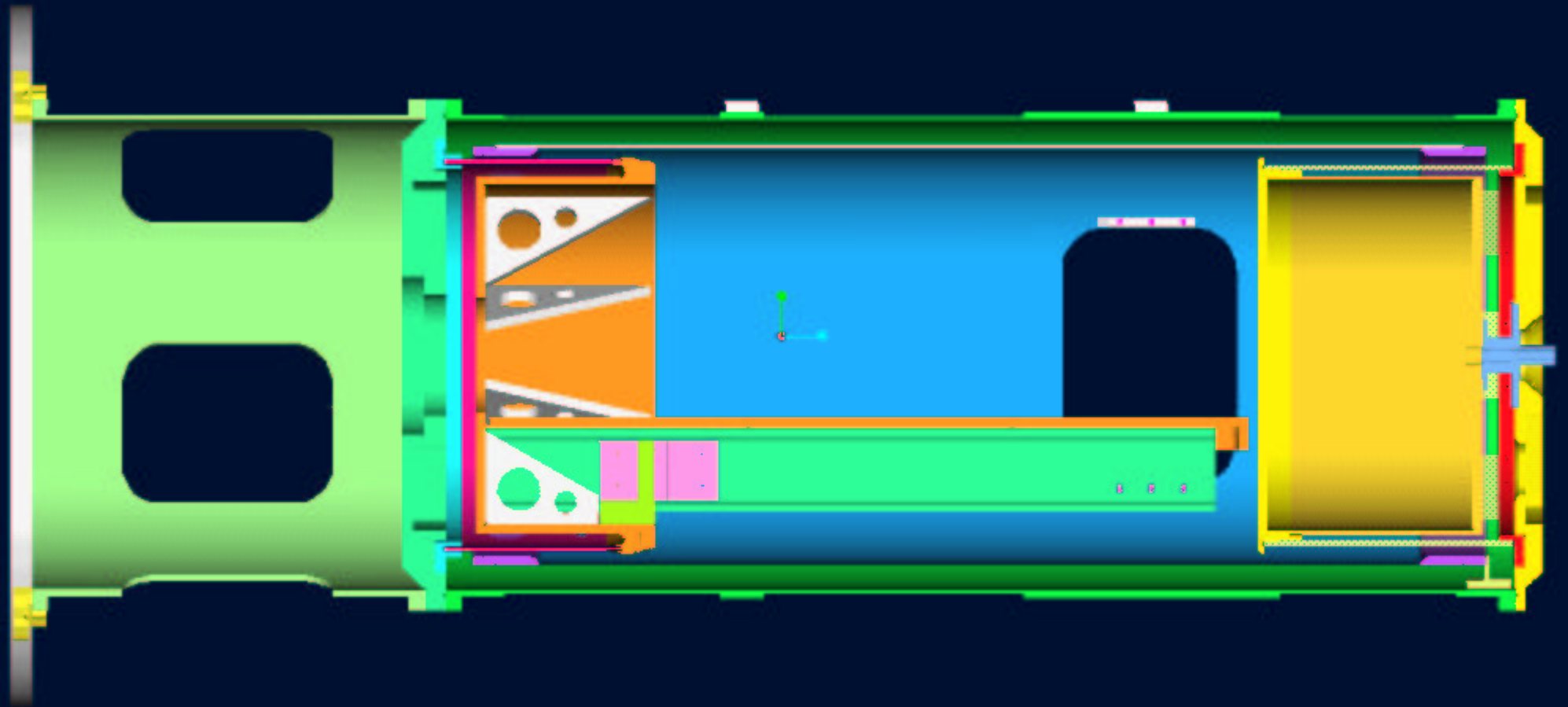
# Assembled Dewar without LN2 Tank Assembly



# Assembled Dewar with Optic Bench Assembly Visible



# Assembled Dewar Cut-Away

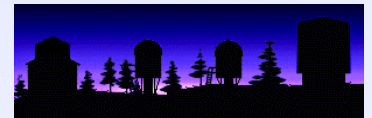




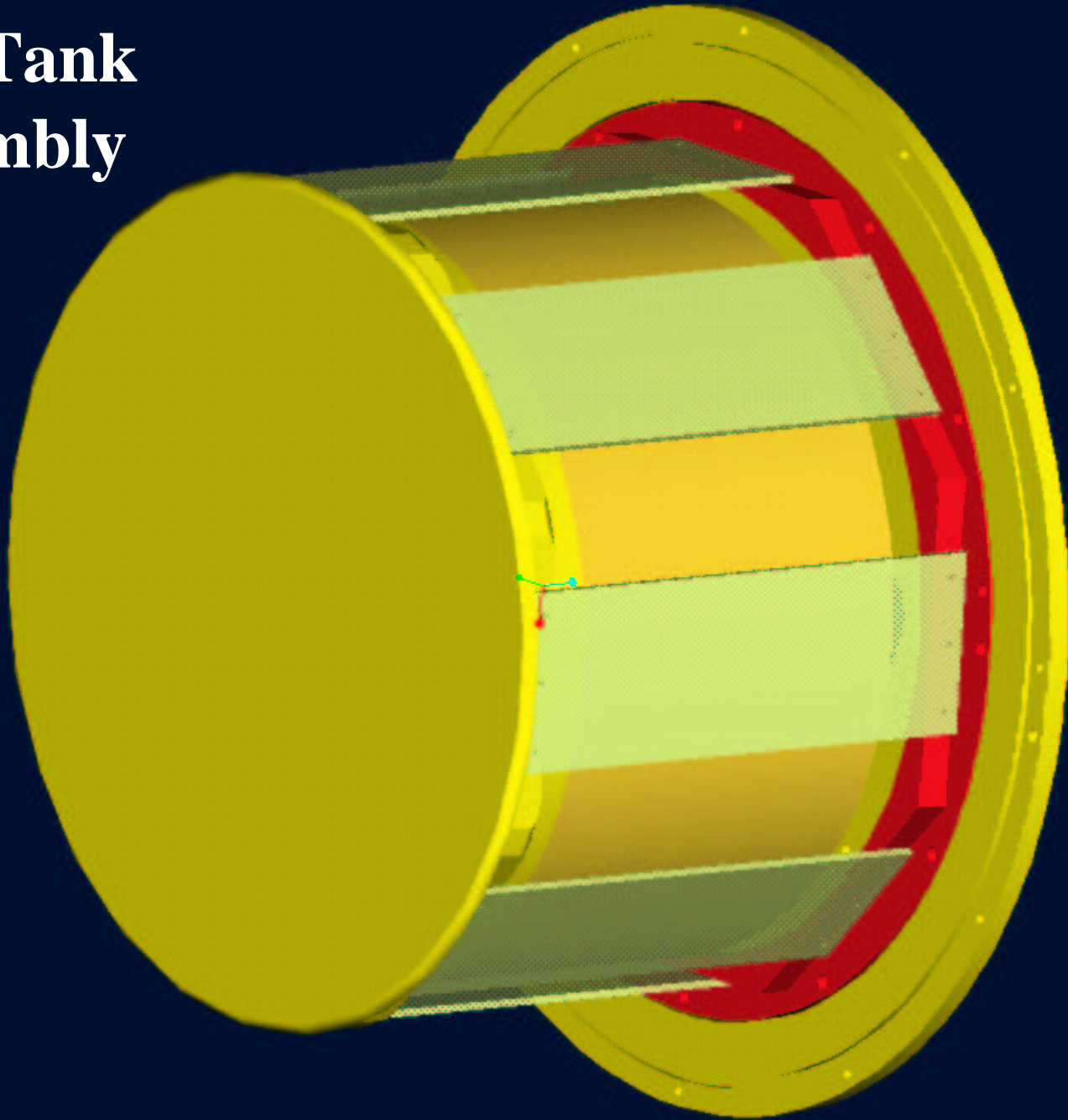
# *NIC-FPS 1-Year Review*

## Instrument Structure (continued)

- LN2 Tank Assembly
  - Positioned beyond focal plane array
  - Independent of optical components/alignment
  - G-10 thermal standoff (plates)
  - Fill/vent connections through Rear Bulkhead, bellows assembly
  - Centerline vent, maximum half full for nasmyth mounting
  - Capacity 18.25 liters (~60 hrs hold time)
  - Cryo-sorption pump (zeolite/activated charcoal mix) close to tank
  - Thermal straps hard-mounted to tank face

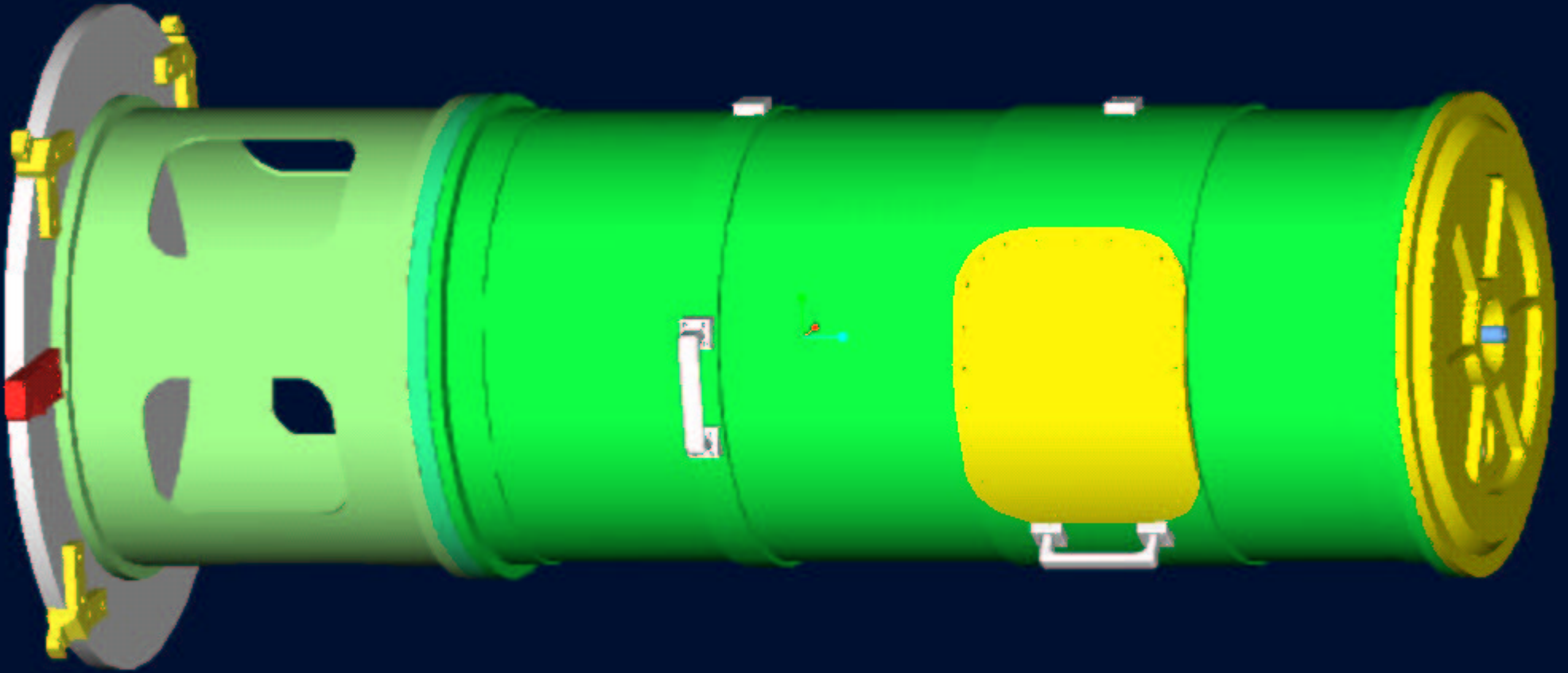


# LN2 Tank Assembly

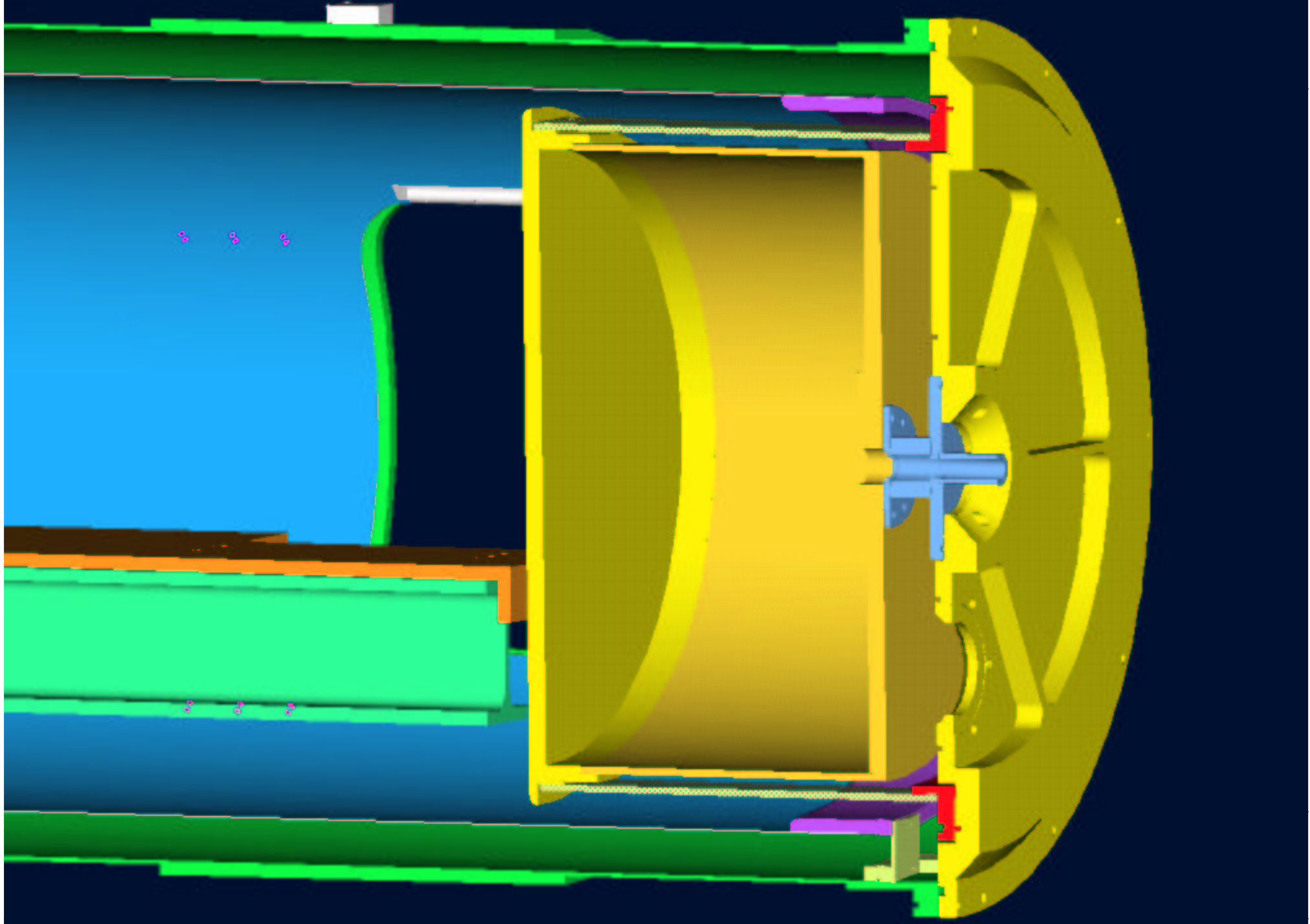




# Assembled Dewar with LN2 Tank Assembly



# LN2 Tank End Cut-Away

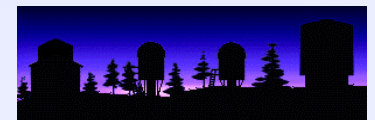




# *NIC-FPS 1-Year Review*

## Dewar Issues & Actions

- Cantilevered optical bench structural support
  - Two-point support with cold standoff
  - Structural bench, thermal gradients minimized
  - Expect 8-10 degree  $\Delta T$  end-to-end; measure during I&T
  - Deflections 20-40 microns on bench per mini-FEM, plus same order deflection due to thermal standoff
- Thermal coupling bench to LN2 tank
  - Thermal straps with access through housing access doors
  - Over-cool bench, regulate cooldown component-by-component
  - Characterize thermal performance during I&T
  - Expect 1-2 degree  $\Delta T$  Optical bench to LN2 Tank





# *NIC-FPS 1-Year Review*

## Dewar Issues & Actions (continued)

- One year vacuum hold time
  - Zeolite/charcoal mix getter (cryo-sorption pump) with option for ion pump
  - Single piece shell (no aluminum welds under vacuum)
  - Will characterize during I&T
  - Expect greater than 6 month hold time, one year is still possible
- Floating thermal shield
  - Standoff design allowing for axial/radial thermal contraction
  - Selected PriMirror 11 for shield
  - Considering two standoff design options (for can-in-a-can design)
  - Will test with and without MLI blankets during I&T





# *NIC-FPS 1-Year Review*

## Dewar Issues & Actions (continued)

- Moisture retention in MLI
  - Removable blankets (using Velcro fasteners) that can be thermal-vac'd
  - Dry Nitrogen or zeolite dried storage of blankets when not installed
  - Will characterize during I&T
  - Option to do without MLI and use single/double shield layer
- Structural analysis
  - Finite element analysis performed on bench
  - Hand (computer) calculations performed for major structures
  - Hand calculations for thermal performance
  - No formal thermal/mechanical modeling – risk issue
  - Will measure deflections using retro-reflection during I&T
  - Economizing on weight still possible (50-100 pound reduction)

