Alpha Magnetic Spectrometer-02

Cryocooler Bracket
Preliminary Design Review

Goddard Space Flight Center

September 10, 2002

Cryocooler Bracket PDR Agenda

09:00 - 09:15	AMS-2 Overview (Breon)
09:15 - 09:45	Bracket Interfaces and Requirements (Shirey)
09:45 - 10:15	Mechanical Design of Bracket (Stouffer/Wagner)
10:15 - 10:30	Break
10:30 - 11:00	Structural Analysis of Bracket (Wagner)
11:00 - 11:15	Thermal Analysis of Bracket (Bugby)
11:15 - 11:30	Bracket Design Verification (Banks)
11:30 - 11:45	Mission Assurance (Breon)
11:45 - 12:15	Review Team Caucus (Cygnarowicz)
12:15 - 12:30	Wrap-up

Acronyms

ACC	Anti-coincidence Counter		LMSO	Lockheed Martin Space Operations
AMS	Alpha Magnetic Spectrometer		LSR	Lower Support Ring (vacuum case)
AMS-02	Alpha Magnetic Spectrometer-02 (ISS Mission)		M87N	Sunpower cryocooler model
APG	Annealed Pyrolitic Graphite		MIT	Massachusetts Institute of Technology
AWG	American Wire Gauge		MLI	Multi Layer Insulation
CFE	Customer Furnished Equipment		NASA	National Aeronautics and Space Administration
CGS	Carlo Gavazzi Space		NCRS	Non-conformance Reporting System
CM	Configuration Management		OF	Oxygen Free
CRES	Corrosion Resistant Engineered Solutions		OFHC	Oxygen Free High Conductivity
CSR	Center for Space Research		OSC	Orbital Sciences Corporation
DOE	Department of Energy		PDR	Preliminary Design Review
DT	Delta Temperature		PI	Principal Investigator
EM	Engineering Model		PIH	Payload Integration Hardware
ETH	Eidgerossische Technische Hochschule		PSD	Power Spectral Density
FEM	Finite Element Analysis		psi	Pounds per Square Inch
FMEA	Failure Modes and Effects Analysis		QA	Quality Assurance
GEVS	General Environmental Verification Specification		RICH	Ring Imaging Cherenkov Counter
GSFC	Goddard Space Flight Center		RMS	Root Mean Square
I/F	Interface		SCL	Space Cryomagnetics Limited
ICD	Interface Control Document		STS	Space Transportation System
IMTE	Inspection, Measuring, and Test Equipment		SVP	Structural Verification Plan
ISS	International Space Station		TOF	Time of Flight
ITAR	International Traffic in Arms Regulation		TRD	Transition Radiation Detector
JSC	Johnson Space Center		USR	Upper Support Ring (vacuum case)
ksi	Kilopounds per Square Inch		WOA	Work Order Authorization
LHP	Loop Heat Pipe			

AMS–02 Cryocooler Bracket PDR

Project Overview

Presented by

Susan Breon

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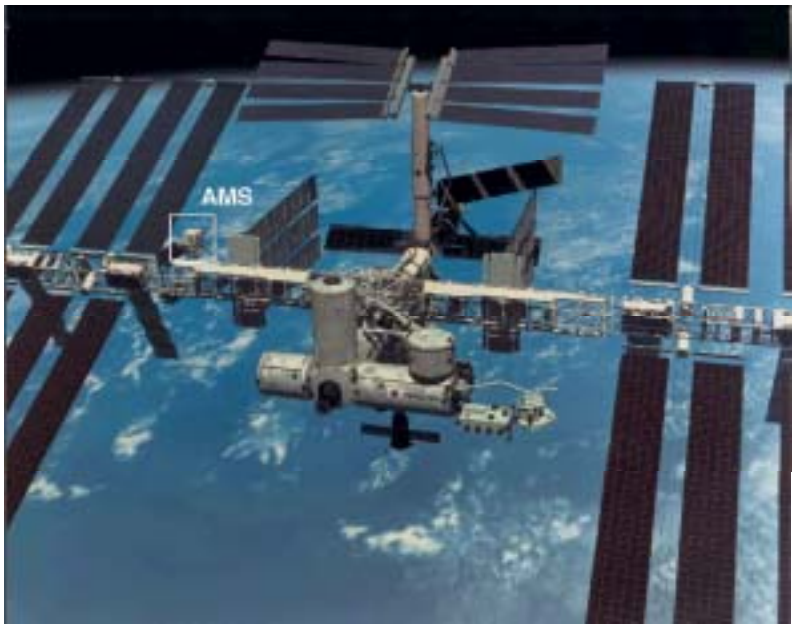
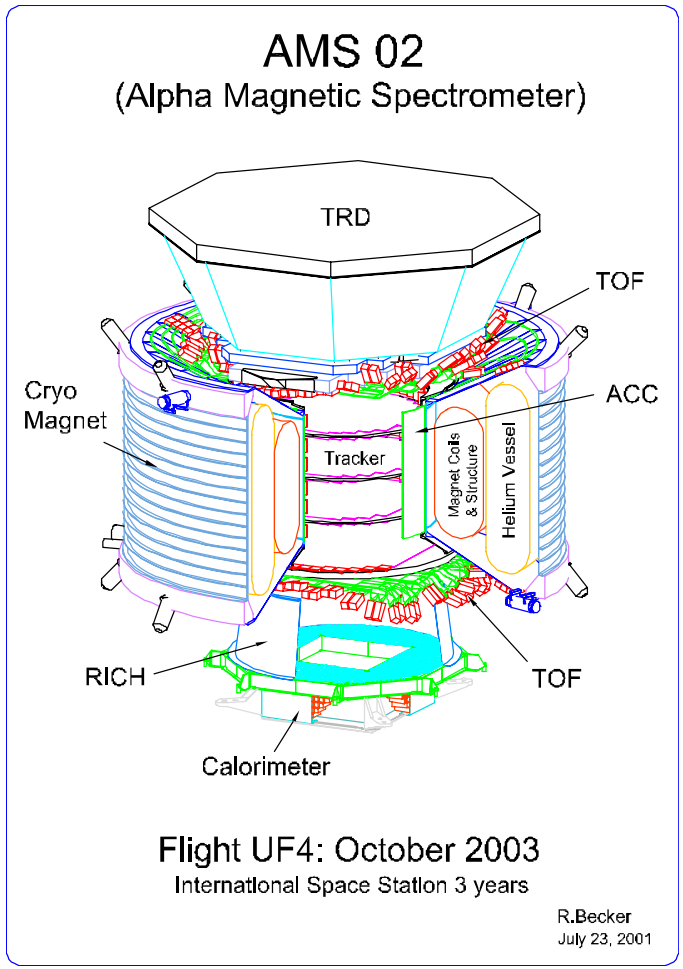
AMS–02



- Cosmic ray experiment to detect dark matter, anti-matter, and strange matter
- Shuttle-launched, Space-Station attached payload
- Launch July 2005
- PI–Dr. Samuel Ting, Nobel Laureate from MIT

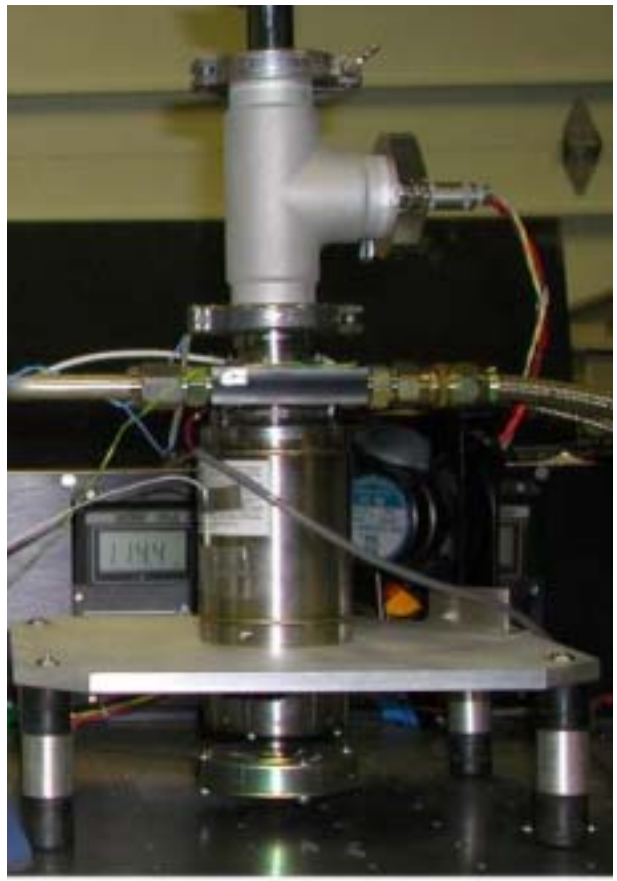
AMS–02 Collaboration



- DOE-sponsored payload, high energy physics experiment
- International collaboration led by PI
  - Not standard NASA project structure
  - NASA/JSC/LMSO responsible for safety and for STS and ISS accommodations and attachment hardware
  - ETH-Zürich responsible for “science instrumentation”
    - Includes cryocoolers

AMS–02 Cryocoolers

- Cryocoolers needed to extend mission lifetime
- Lifetime requirement is 3 years
- Sunpower coolers chosen by ETH-Zürich and MIT
- GSFC was asked to qualify coolers and develop support bracket

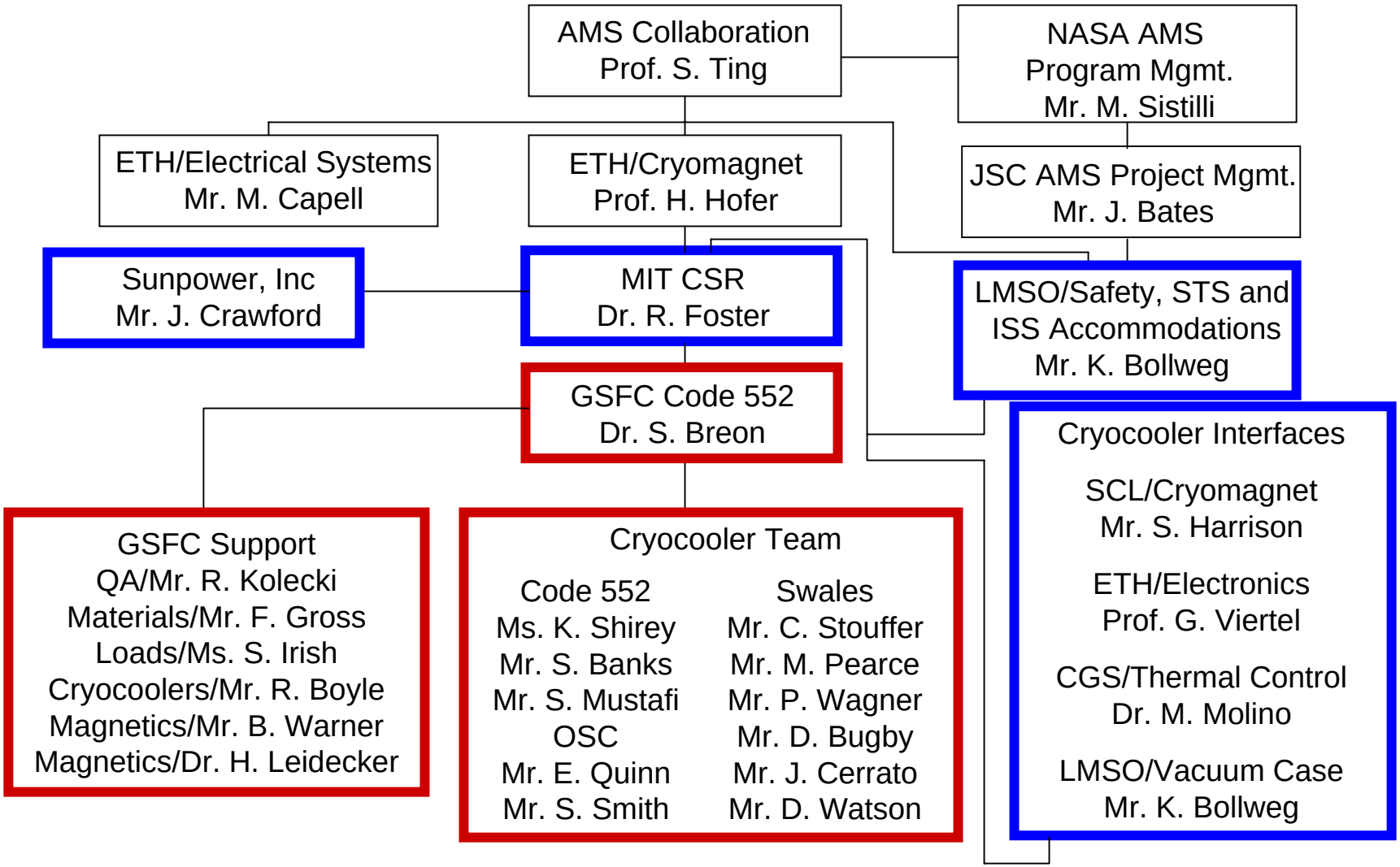


MIT/GSFC Space Act Agreement

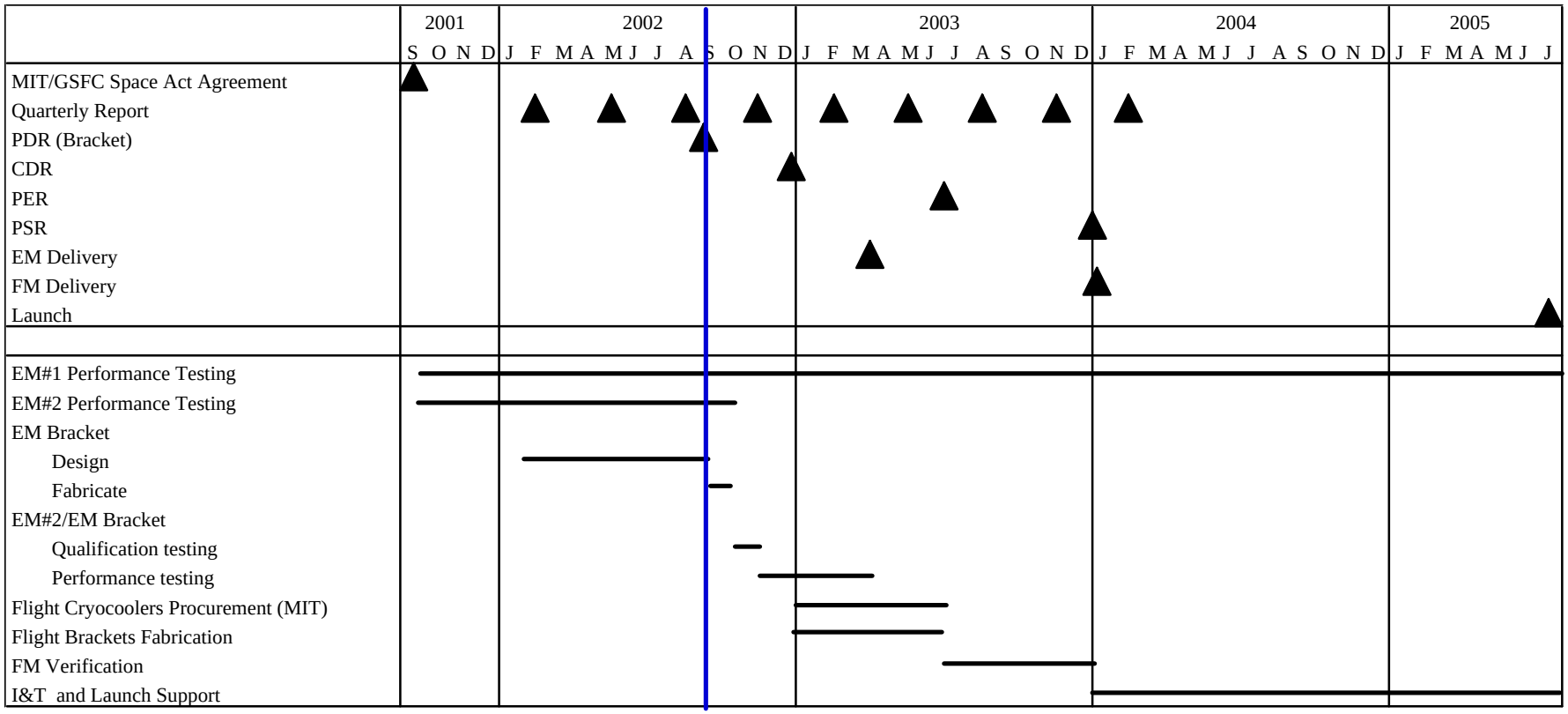
- MIT to provide Sunpower M87 cryocoolers to Goddard as CFE
  - 2 engineering model coolers
  - 4 flight coolers and 2 flight spares

- Goddard responsibilities
  - Sunpower M87 design qualification
  - Flight cryocooler verification
  - Cryocooler bracket design and verification
  - Hardware integration and launch support

AMS–02 Cryocooler Organization



Cryocooler Schedule



AMS-02 Cryocooler Bracket PDR

Bracket Interfaces & Requirements

Presented by
Kimberly Shirey

Bracket Purpose

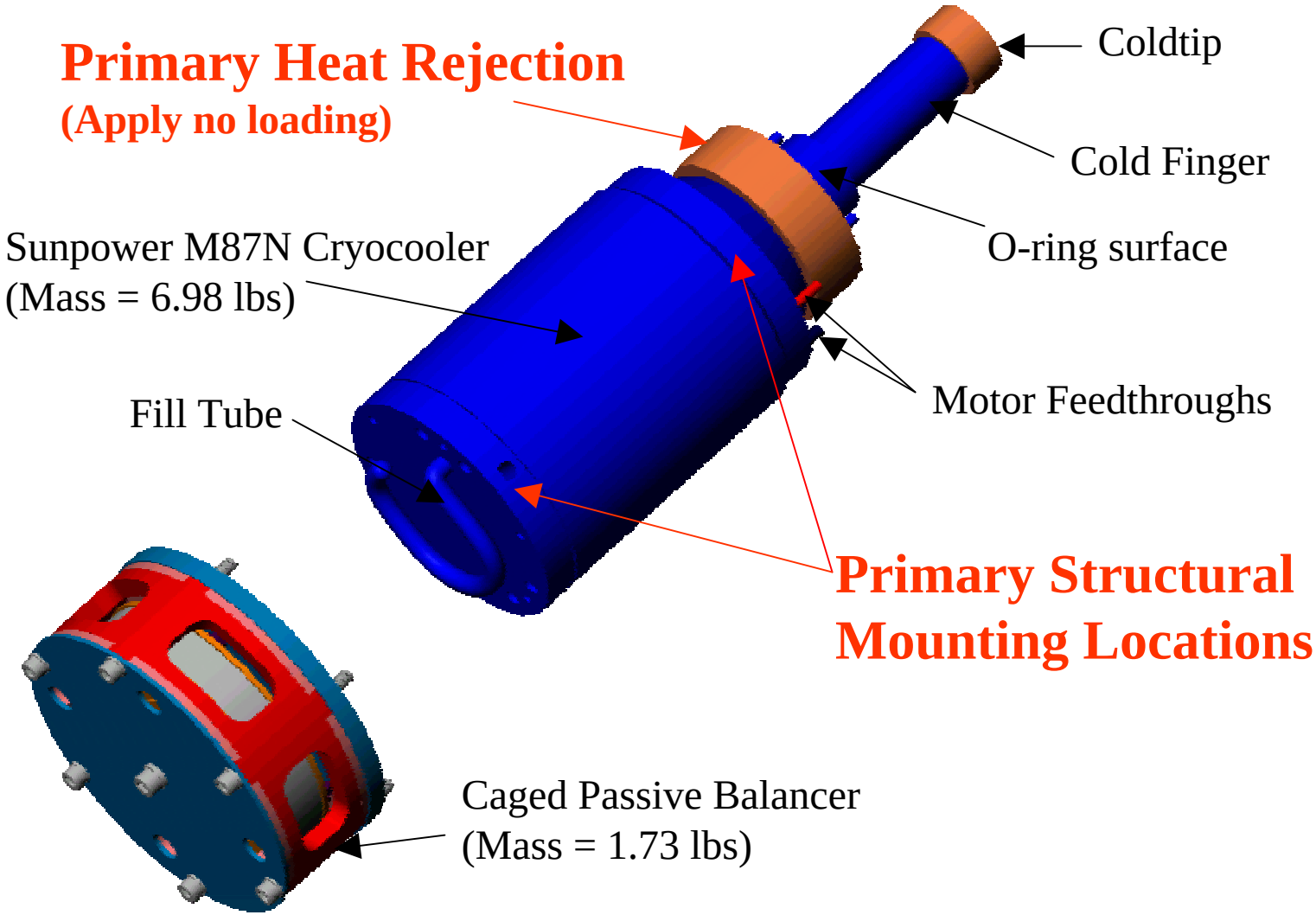
- Structurally support cryocooler
- Allow force attenuation using passive balancer
- Provide vacuum seal
- Thermally isolate cryocooler from vacuum case
- Reject heat to TCS (LHP → radiator)
- Support connectors & LHP
- Accommodate all wires & sensors

No magnetic shielding except through material selection

Applicable Documents

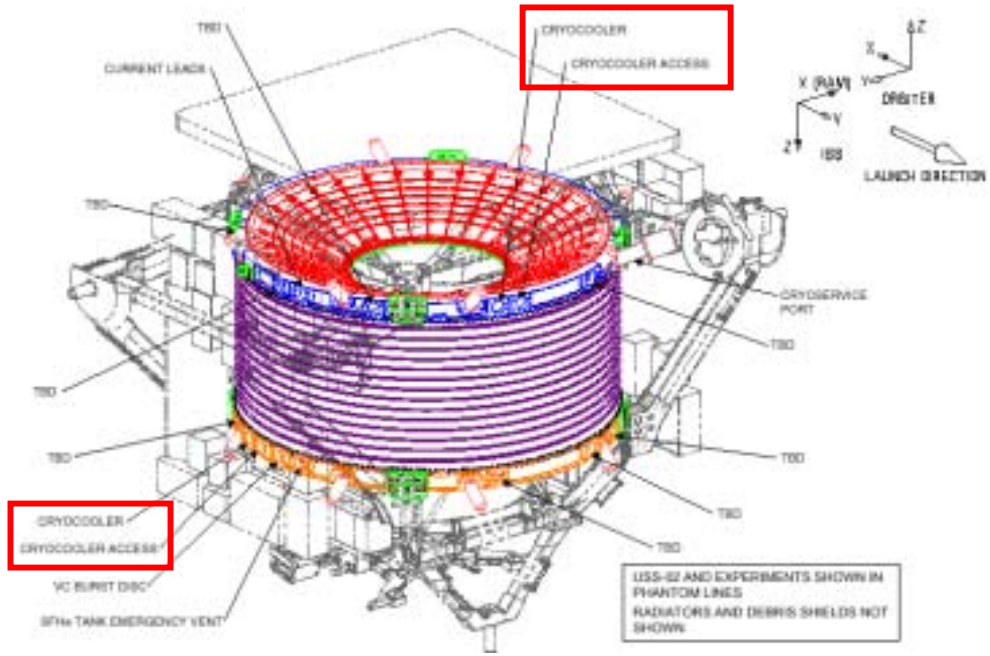
- AMS-552-SPEC-003 (Bracket Design Guidelines)
  - JSC-29202 (AMS-02 Experiment Vacuum Case PIH Interfaces)
  - JSC-28792 (AMS-02 SVP for the STS and the ISS)
  - AMS-ICD-001 CGS (AMS-02 Thermal Control System ICD)

Support Cryocooler



Support Cryocooler (cont.)

- 4 mounting locations on AMS-02 Vacuum Case
  - 2 on USR, 2 on LSR
  - Maintain keep-in zone
  - Position coldtip at thermal strap interface
- All 4 brackets → Identical



Milestone Schedule

- Begin initial bracket design → 11/01
- Design put on hold pending magnetic testing → 2/02
- Resume bracket design → 7/02
- PDR → 9/10/02
- Released drawings → 2 weeks post PDR
- Assembly procedures/drawings → 2 weeks post PDR
- Structural analysis reports → 1 month post PDR
- Support through fabrication & testing → 12/02
- CDR → 12/02