

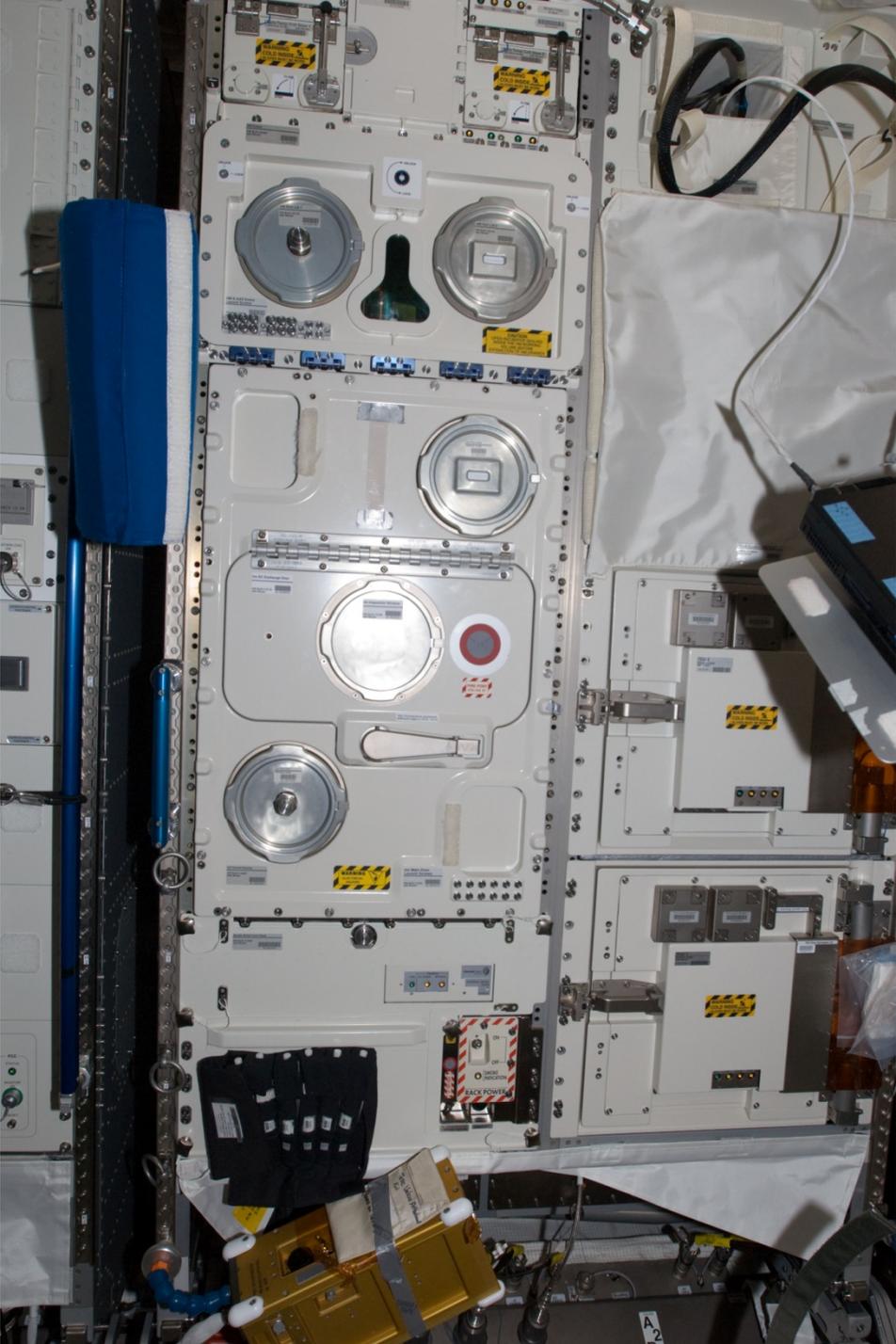


Update on NASA TEPC Activities September 08– September 09

Eddie Semones
Johnson Space Center



ISS020E038799





Outline

- Detector Description
- Recent Measurement Results
- Current ISS TEPC plans
- New ISS TEPC Detector Developments
- Exploration Developments

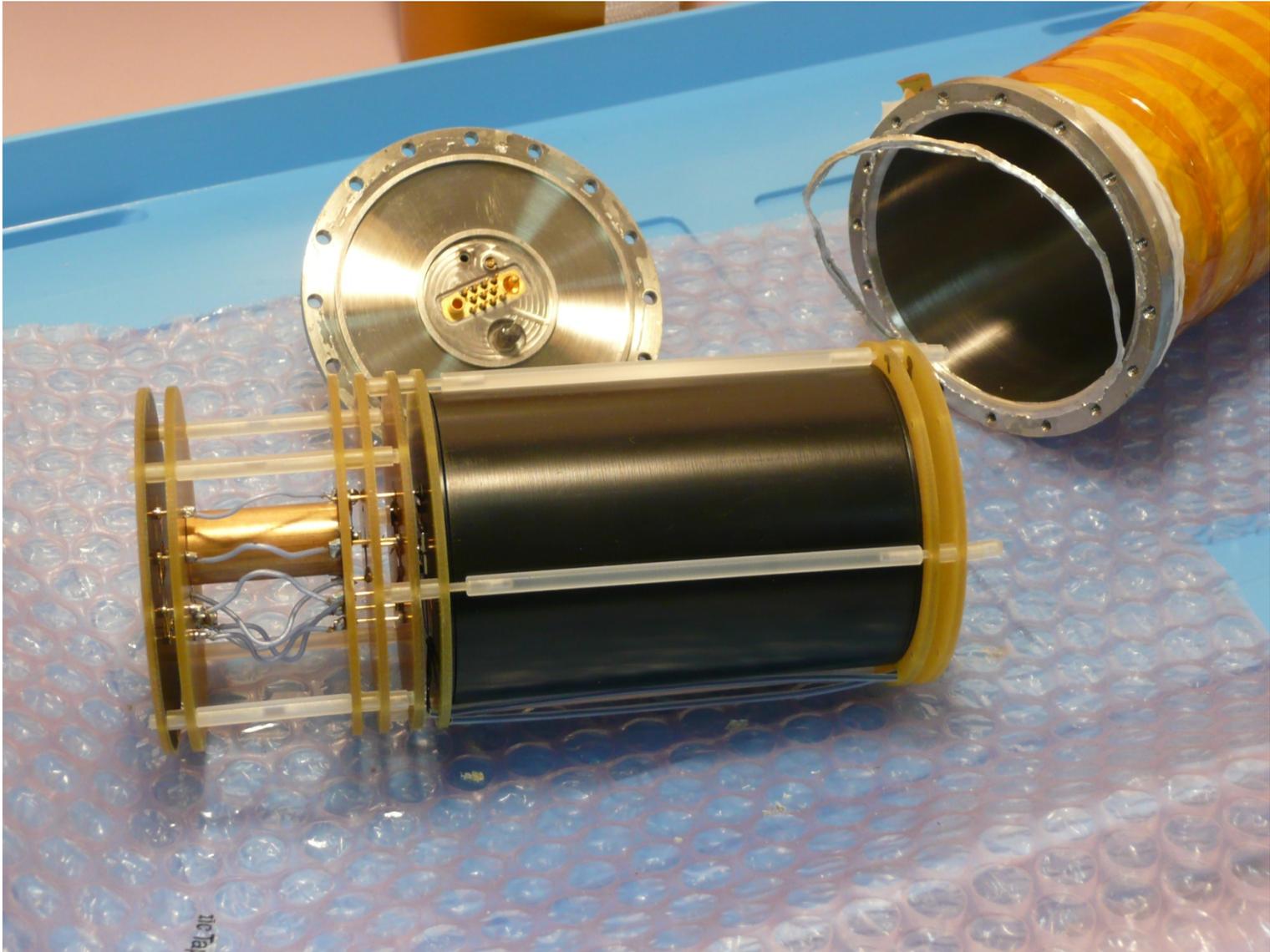


ISS TEPC Summary

- Right cylinder of A150 plastic – 5 cm x 5 cm
 - Gas is pure propane, simulating 2 μm of tissue
 - the projected area is 30 cm^2 and sensitive volume of the detector is 103 cm^3 for isotropic exposure.
- Current measurement location is Columbus
 - **12** locations surveyed in the past year :Node 2, SM, Columbus, and JPM
- Measures lineal energy (y) in the range 0.4 – 1000 $\text{keV}/\mu\text{m}$
 - y spectra recorded 1 per minute and dose rate/dose equivalent rate calculated every ~4 seconds
- Data sent to the ground every minute and has an alarm threshold of 0.05 mGy/min
- Currently used to officially track Expedition exposures
- This unit operational since 6/2007



ISS TEPC





[All Instruments](#)

Activity Date/GMT	Activity	Location	Position	Images			Notes	New Entry	
				1	2	3		Edit	Delete
08/21/2009 14:30	Location Change	COL1A3					TEPC relocated to Columbus and placed in Standby mode at 14:30. In Acquire mode at 15:36.	Edit	Delete
07/09/2009 09:50	Location Change	SM	P327 perpendicular to module x-axis				TEPC not placed in Standby prior to detector relocation. Subsequent brief data spike noted, instrument functionally normally. From email message 14 July 2009: In the mean time, I can tell you all that the Detector is in the exact position it was in after the February 2009 (GMT 044) relocation. -Will	Edit	Delete
06/17/2009 05:00	Location Change	SM	P327				GMT 2009/168: TEPC is located at SM 450, deployed at SM 327, and plugged into ChCS Outlet 5 on SM 450.	Edit	Delete
06/10/2009 09:05	Location Change	SM	P410 Perpendicular				Standby 161/00:36, Acquire 161/15:06	Edit	Delete
05/25/2009 14:22	Location Change	SM	P410 Parallel				Crew note from relocate activity: Panel 410 is rather a virtual location; there is no direct access to this, but best calculation places this behind the TORU control panel. Photos are available on SSC8; worked out this location with CDR. Nominal power up and start up.	Edit	Delete
04/27/2009 17:42	Location Change	LAB1	S4					Edit	Delete
03/30/2009 17:00	Location Change	JEM	1FD3				Relocation complete at 15:45. Instrument powered on and entered Standby mode at 16:21. Entered Acquisition mode at 17:33.	Edit	Delete
02/13/2009 07:27	Location Change	SM	P327				Relocation complete at 07:27. Instrument powered on and entered Standby mode at 12:08. Entered Acquisition mode at 13:22.	Edit	Delete
01/30/2009 22:00	Location Change	NOD2	Inside PortCQ					Edit	Delete
01/16/2009 20:15	Location Change	NOD2	Inside STDB CQ				This is an approximate time EJS	Edit	Delete
12/26/2008 12:14	Location Change	Node2/Port CQ	Outside CQ				12:14 is time back in acquire. SJ	Edit	Delete
11/27/2008 21:25	Location Change	SM	P327					Edit	Delete
11/10/2008 18:16	Location Change	NOD2PD						Edit	Delete
09/30/2008 12:13	Location Change	SM	P338					Edit	Delete
08/24/2008 19:00	Location Change	JPM	1A5					Edit	Delete
06/24/2008 13:21	Location Change	SM	STBD CQ				Panel 136	Edit	Delete



SM-P338

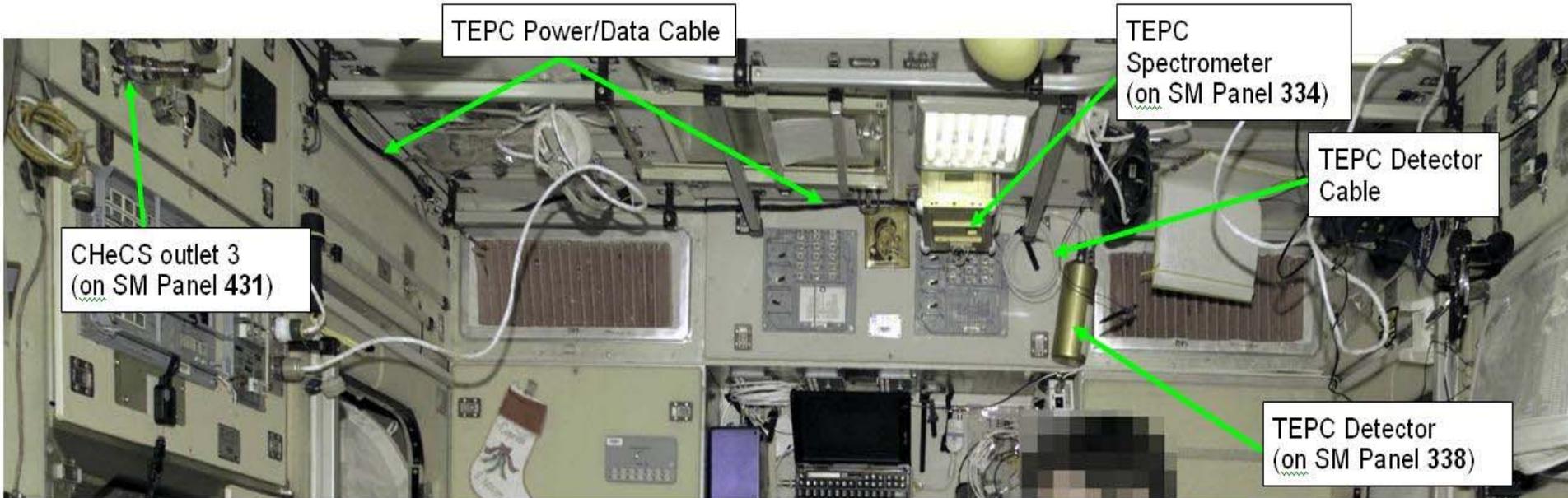


Figure 1.- View of Service Module (Facing AFT) Showing TEPC Detector Located on Panel 338



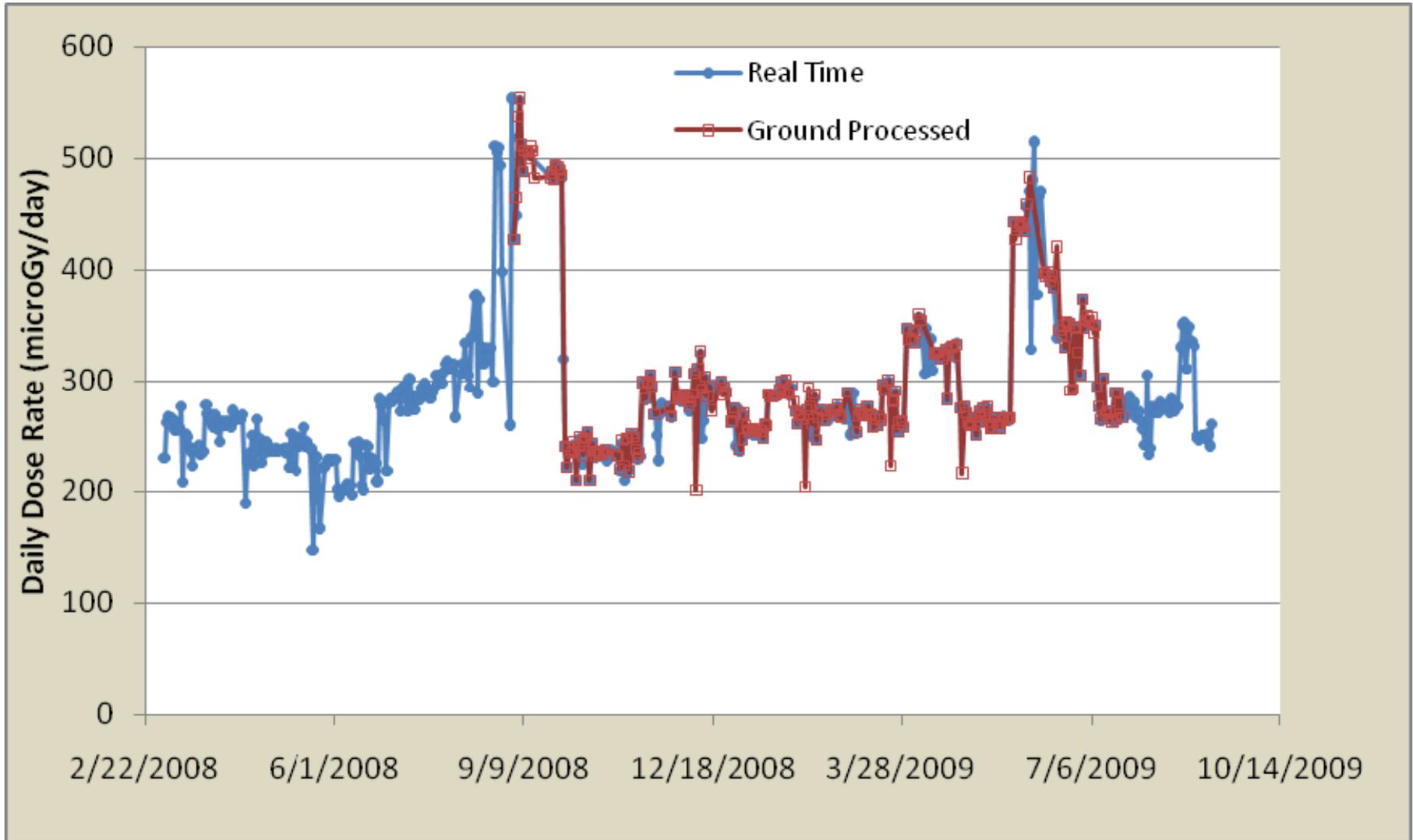
Node2 CQ

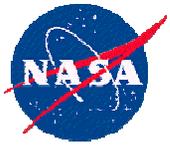


ISS018E015690

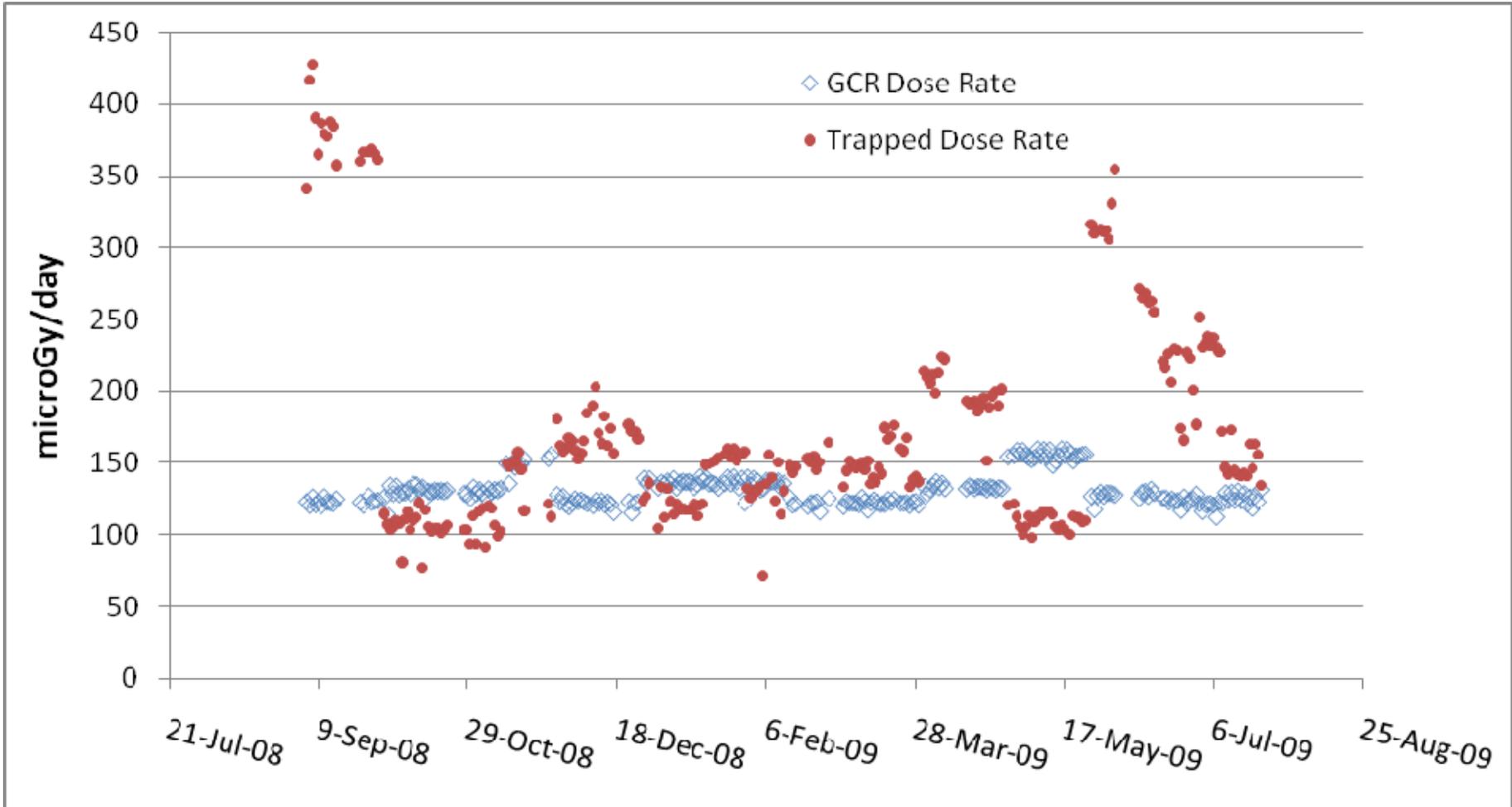


ISS TEPC Long Term Dose Rate



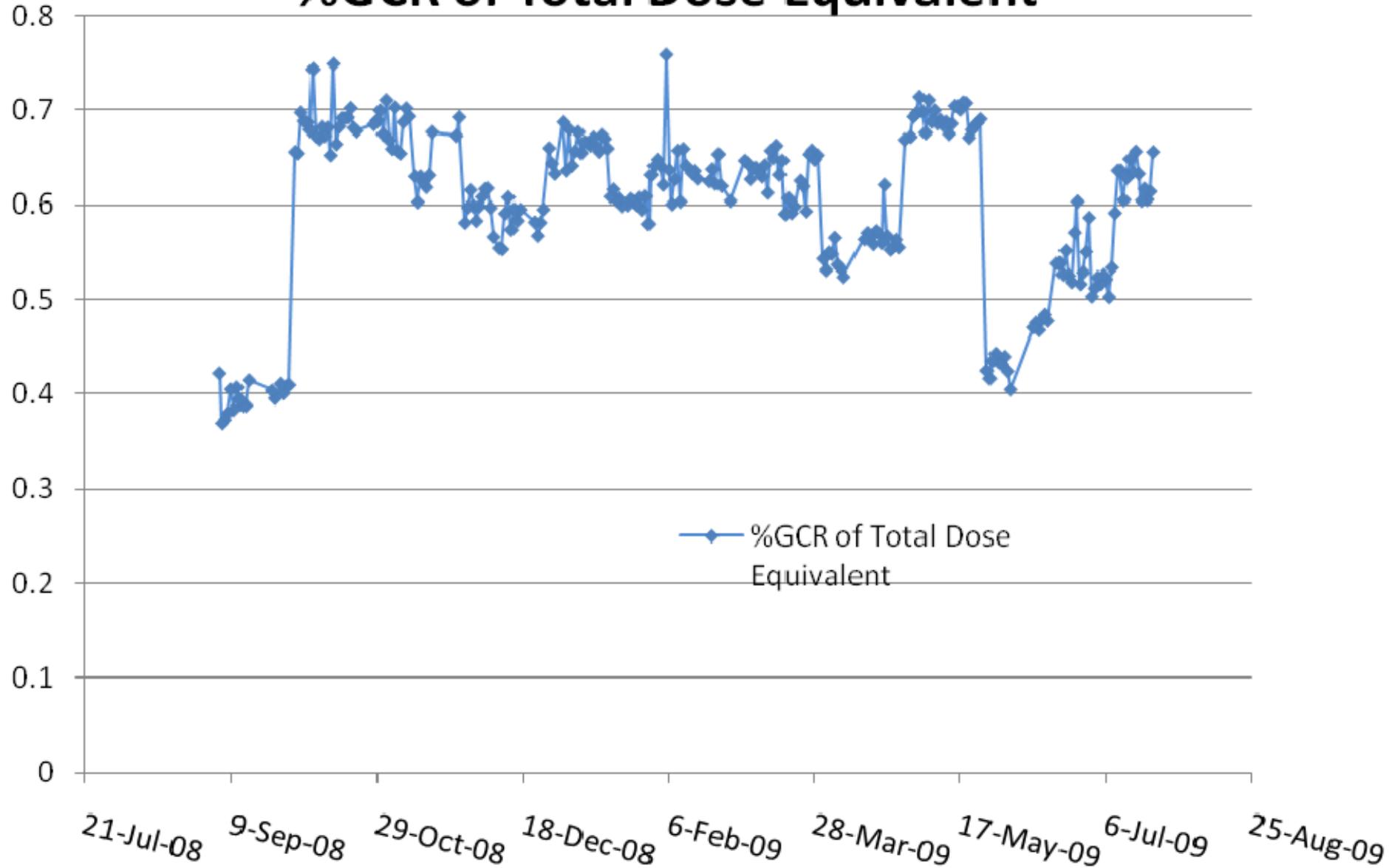


GCR - Trapped



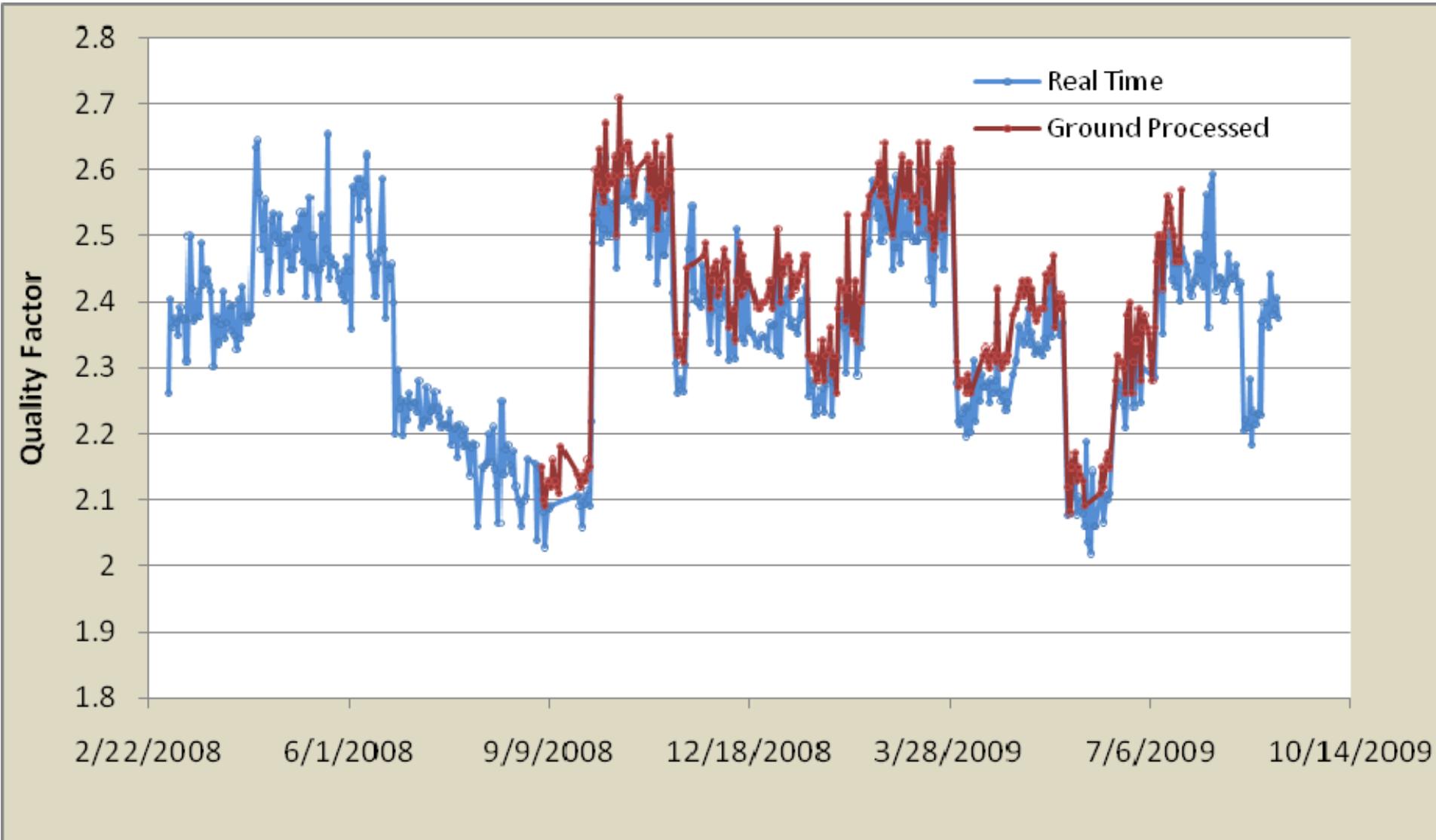


%GCR of Total Dose Equivalent





Daily Quality Factor



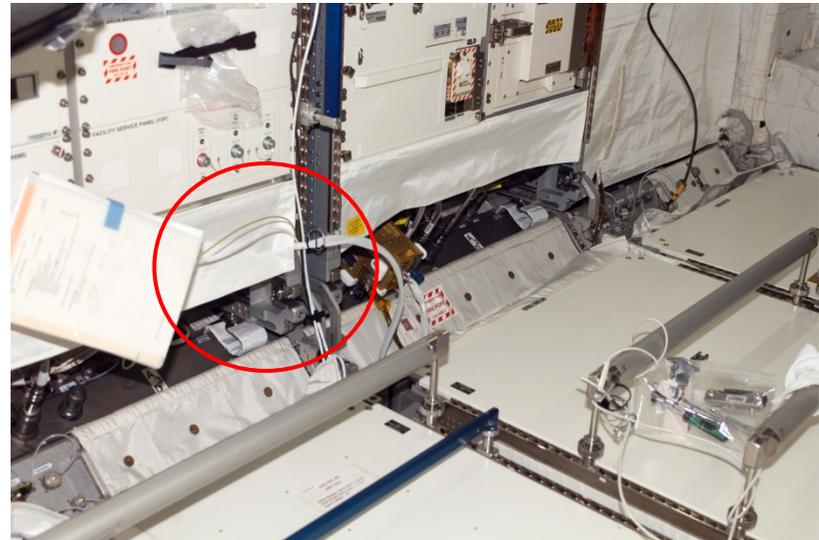
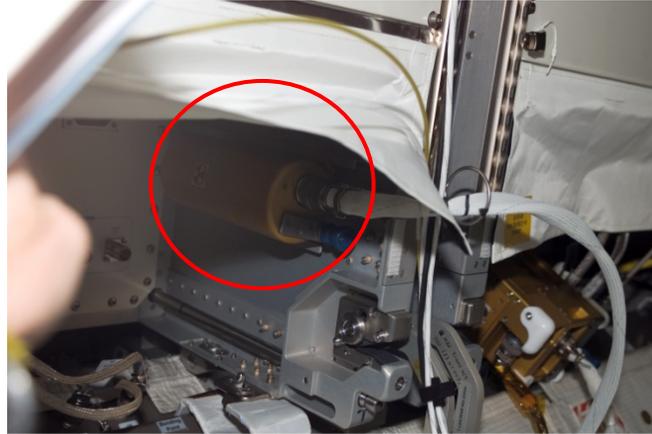


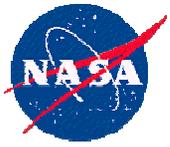
Columbus Module

- The NASA ISS TEPC has completed 2 measurement campaigns in the Columbus Module.
- We moved the detector on March 3, at ~10:43 GMT to the Columbus EPM Rack COL1A3. The measurement period ended on 4/14/08.
 - We have 42 days of monitoring data available.
- We moved the detector on Aug 21 to the Columbus EPM Rack COL1A3. The measurement period is still ongoing
 - 17+ days

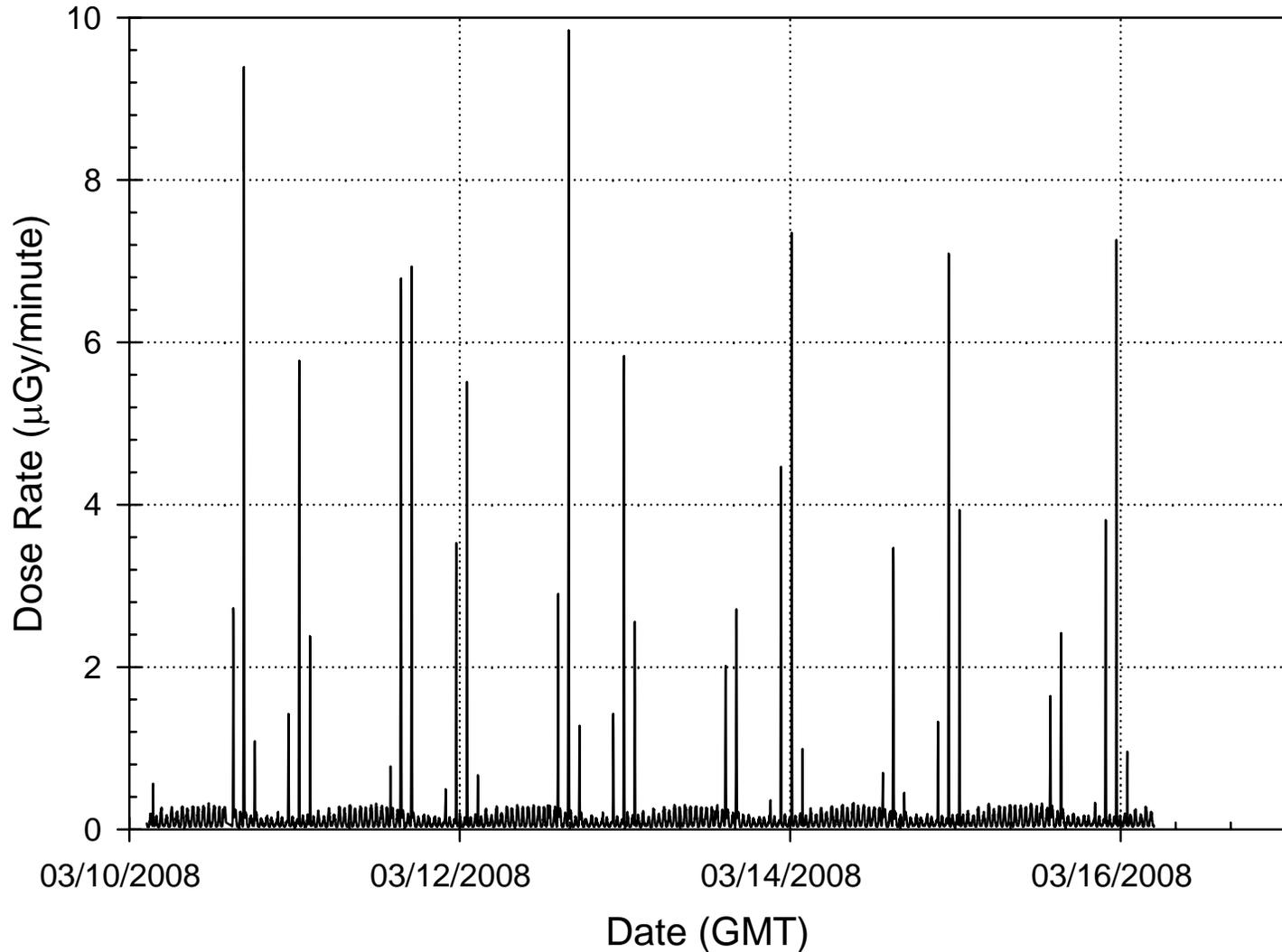


TEPC Location in Columbus



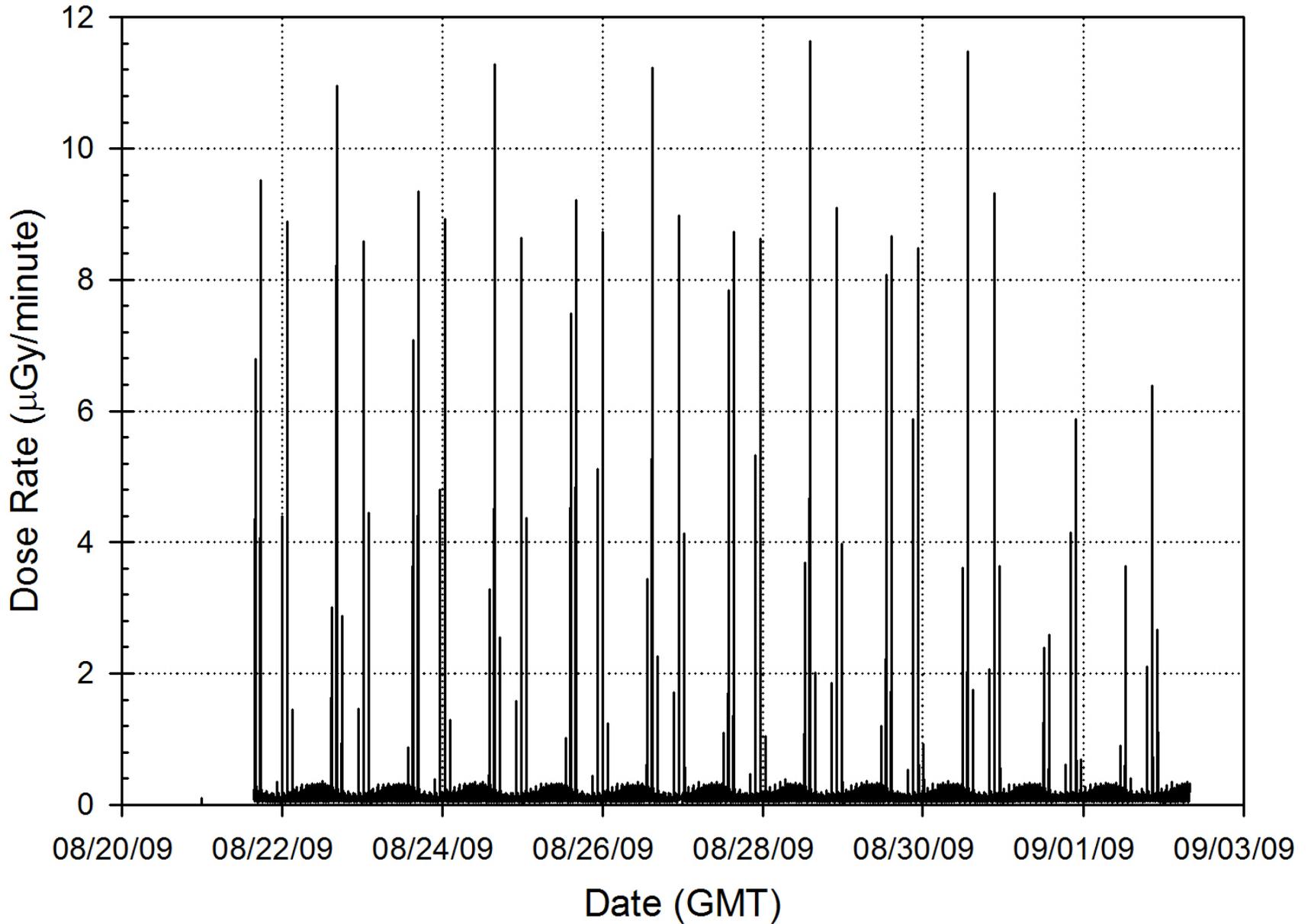


March 18, 2008 - Files 51-100



August 21 - September 2, 2009

Dose Rate





Columbus Results 2009

	ISS	GCR	Trapped	Total
Dose (μGy)		1836.707	1916.766	3753.474
Dose Equivalent(ICRP-60, μSv)		5214.418	3406.494	8620.911
Particles Count		33798603	30921890	64720493
Time (minutes)		15671	1091	16762
Dose Rate($\mu\text{Gy/day}$)		157.789	164.667	322.456
Dose Equivalent Rate(ICRP-60, $\mu\text{Sv/day}$)		447.963	292.647	740.61



Columbus Results

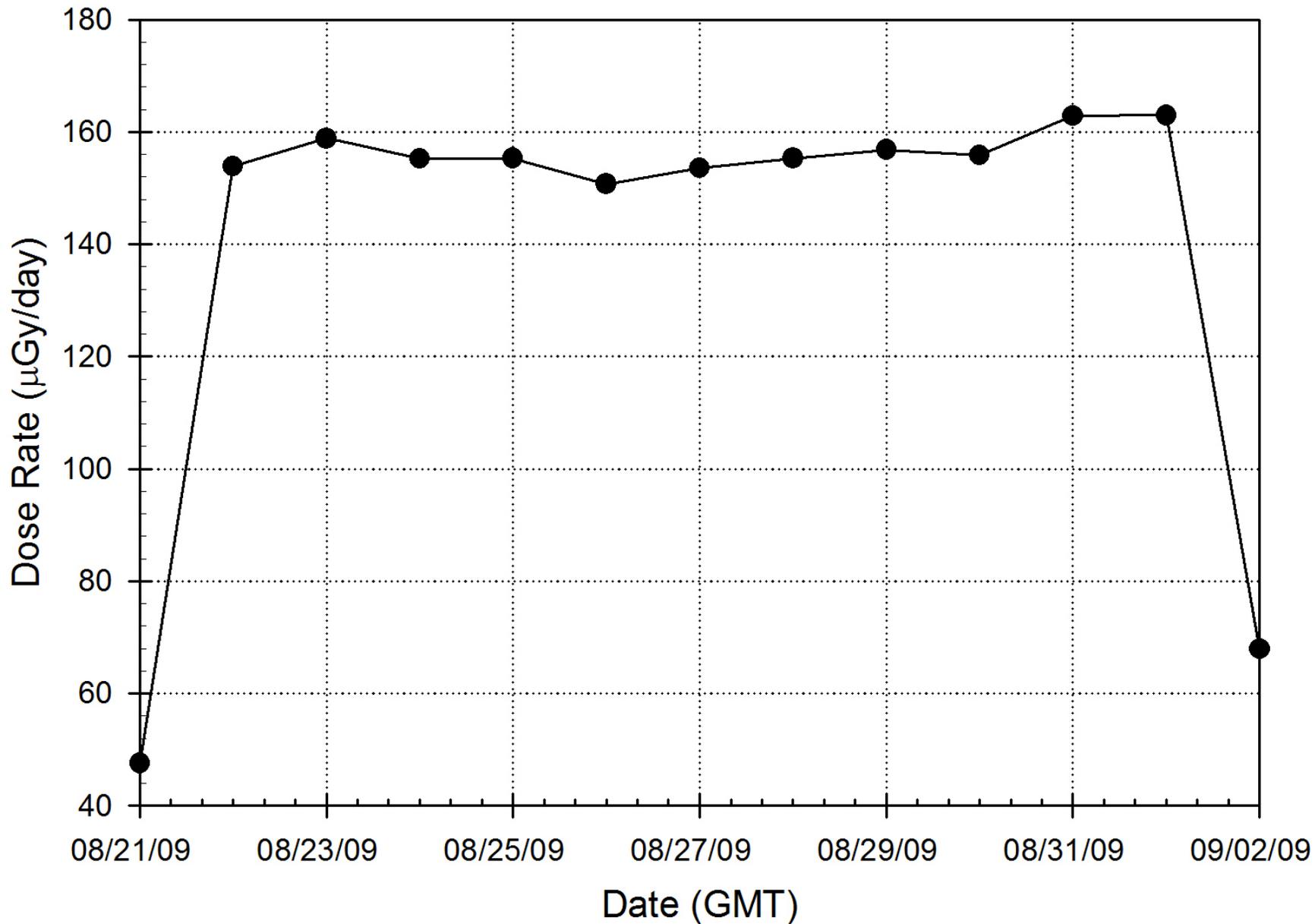
March 4 – 10, 2008

	GCR	Trapped	Total
Dose (μGy)	922.506	790.482	1712.988
Dose Eq (μSv)	2768.831	1413.807	4182.638
Particles Count	16883289	12613729	29497018
Time (minutes)	8816	626	9442
$\mu\text{Gy/day}$	140.691	120.556	261.248
$\mu\text{Sv/day}$	422.275	215.62	637.894

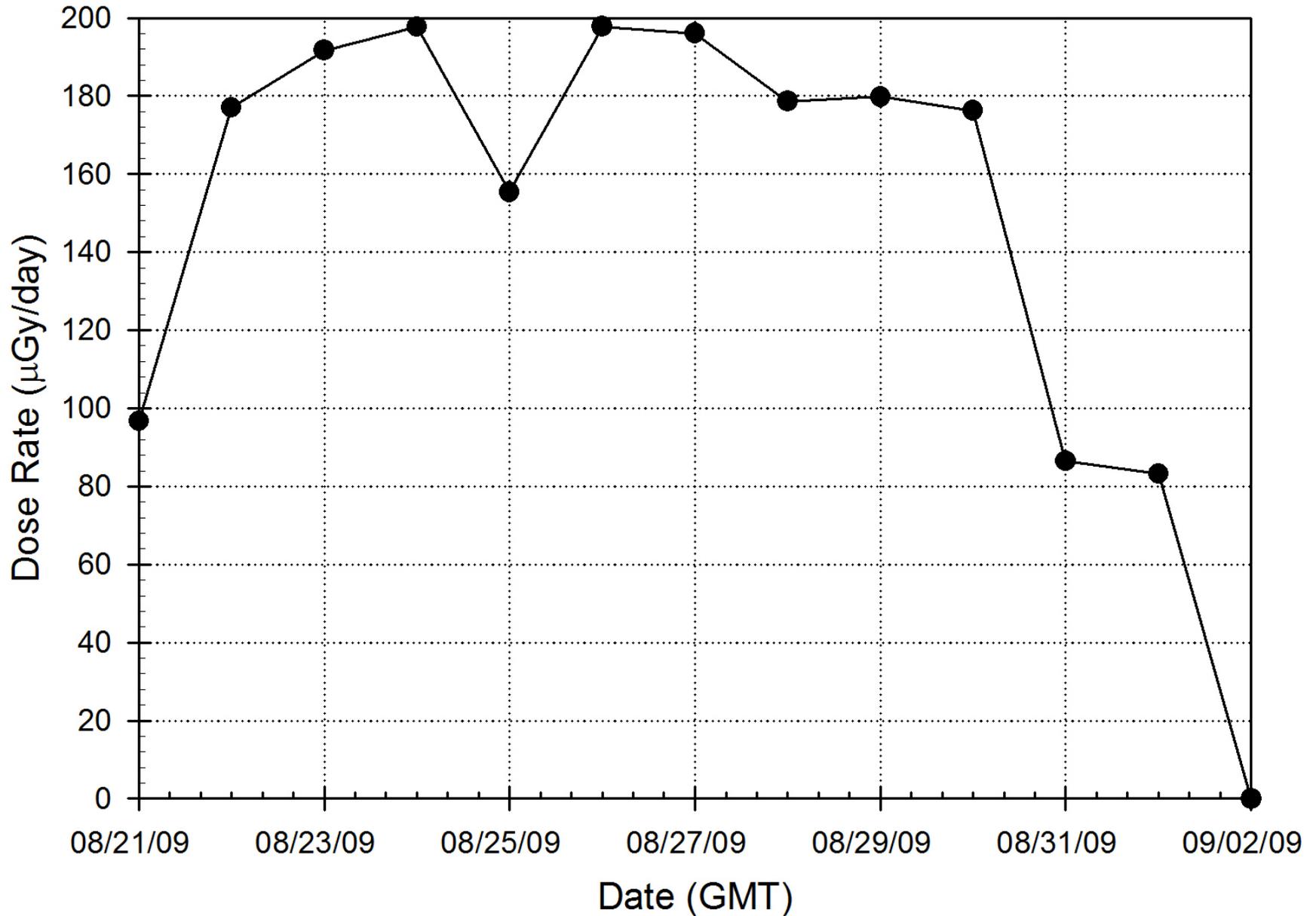
March 18 – 24, 2008

	GCR	Trapped	Total
Dose (μGy)	872.357	592.419	1464.776
Dose Eq (μSv)	2571.033	1067.608	3638.642
Particles Count	16168033	9620668	25788701
Time (minutes)	8232	502	8734
$\mu\text{Gy/day}$	143.828	97.674	241.502
$\mu\text{Sv/day}$	423.894	176.02	599.913

August 21 - September 2, 2009 GCR Dose Rate



August 21 - September 2, 2009 Trapped Dose Rate





Orientation Issues



ISS019E019297

5/25/09 - 0.44 mGy/day

SM-P410- Near DB8

6/10/09 – 0.39 mGy/day





Near Term Plans

- **9/12:** TEPC 1001/1002 will be relocated to the SM-SP327 on
- **9/14 :** Activation and Checkout (ACO) of TEPC S/N 1003.
- **9/18 :** TEPC 1003 will be shut off and stored in the CHeCS rack. TEPC 1001/1002 will be reactivated at SM 327.
- **9/28 :** TEPC 1001/1002 will be relocated from SM panel 327 to ??????.



Next Generation ISS TEPC Motivation

- ISS Tissue Equivalent Proportional Counter
 - Current on-orbit unit functioning nominally (since 2007)
 - Identical Backup flight unit just launched on STS-128
 - Minimize/eliminate gap in TEPC monitoring through delivery of replacement hardware
- Current TEPC first flown in 2000, developed in late 1990s.
 - Hardware exceeding design life
 - Replacement parts not available
- **Shuttle Retirement /Solar Max/Larger Crew/Long Development Time**
 - **No return mass for repair post Shuttle retirement**
- **Need to Support ISS operations to 2020**



New TEPC Schedule

- Fall: TEPC Engineering Unit ready
- Oct – Jan 2009: TEPC box-level testing (functional, environmental, radiation measurements)
- Jan 28, 2010: Critical Design Review (CDR)
- Feb – Sept 2010: Qualification phase
- July – Feb 2011: Acceptance phase
- Mar 31, 2011: H/W Delivery (IV-TEPC)



Spherical TEPC Geometry

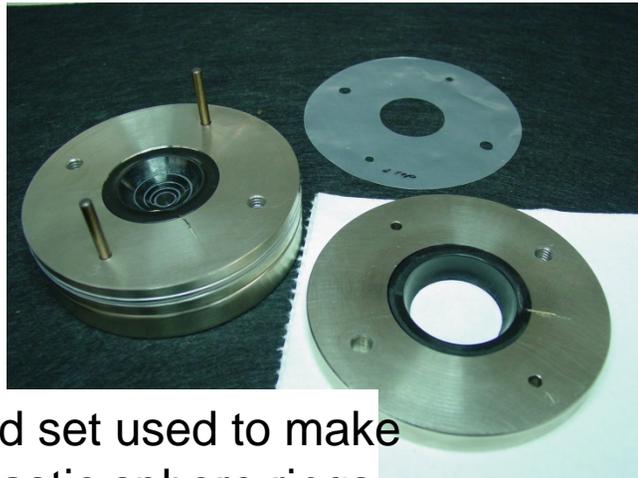
Different voltages on each layers of the detector



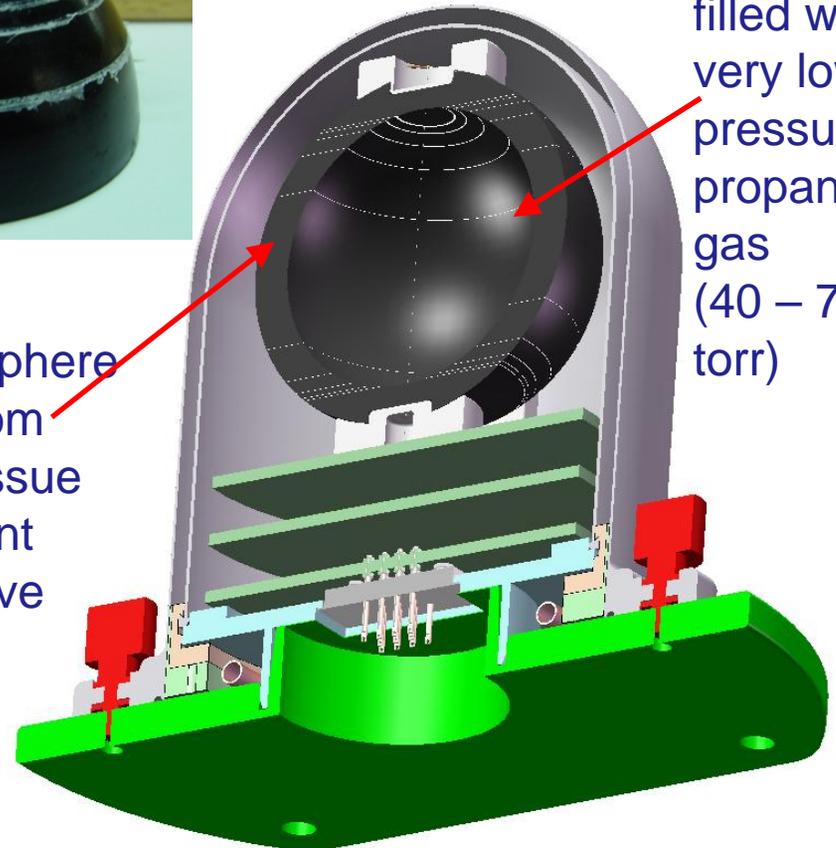
Development of spherical TEPC detectors to replace cylindrical detectors currently onboard ISS

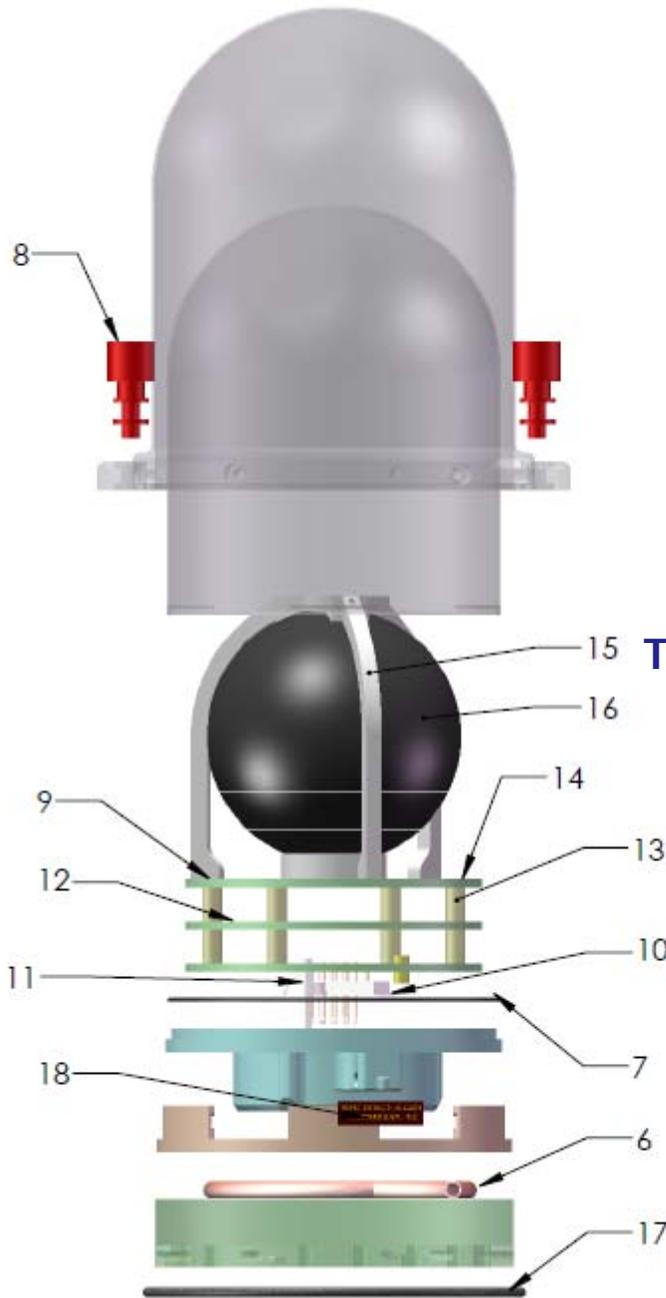
Inside chamber is filled with very low-pressure propane gas (40 – 70 torr)

Hollow sphere made from A-150 tissue equivalent plastic



Mold set used to make plastic sphere rings





PARTS NOT FEATURED IN DRAWINGS

ITEM NO.	PART NAME / DESCRIPTION
6	1/8" COPPER TUBE
7	INDIUM WIRE GASKET
8	CAPTIVE SCREWS
9	CIRCUIT BOARD 1
10	HMM11P / 11 PIN CONNECTOR
11	TF312 / SINGLE TERMINAL FEED THRU
12	CIRCUIT BOARD 2
13	KEL-F RODS
14	CIRCUIT BOARD 3
15	KEL-F SPIDER
16	1.89 IN. TISSUE EQUIVALENT SPHERE
17	SPRINGMESH EMI MESH GASKET
18	LABEL / SDG33120967-003

Thin walled vacuum chamber - 0.020 inches (0.5 mm)

TEXAS A&M UNIVERSITY		
DEPARTMENT OF NUCLEAR ENGINEERING		
TITLE :	TEPIC DETECTOR ASSEMBLY	
AUTH. :	DR. L.A. BRABY	
REV. :	DRAFT	2/24/2009
SIZE: A	SCALE: 3:4	SHEET 2 OF 23



Specific Requirements

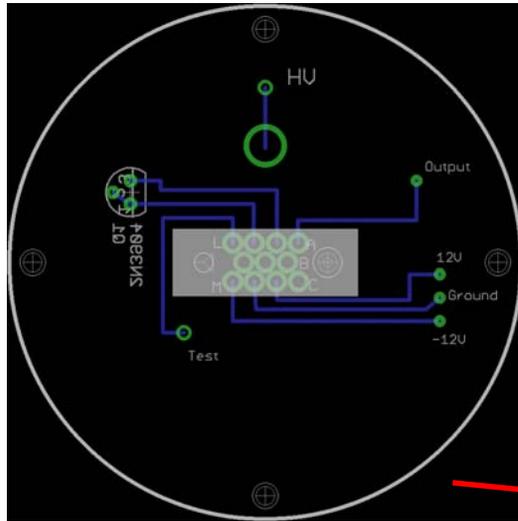
<u>Description</u>	<u>Requirement</u>
• Lineal Energy Range	0.2 to 1,000 keV/um
• Lineal Energy Resolution	0.2-20 keV/um : 0.1keV/um (8 bit) 14-1,000 keV/um: 2 keV/um (9 bit)
• Resolution Overlap	14-20 keV/um, match +/- 10%

2 Detectors:

Two different diameter detectors have been designed: a
1.27 cm internal diameter detector with 3 mm wall thickness
3.81 cm internal diameter detector with a 5 mm wall thickness.

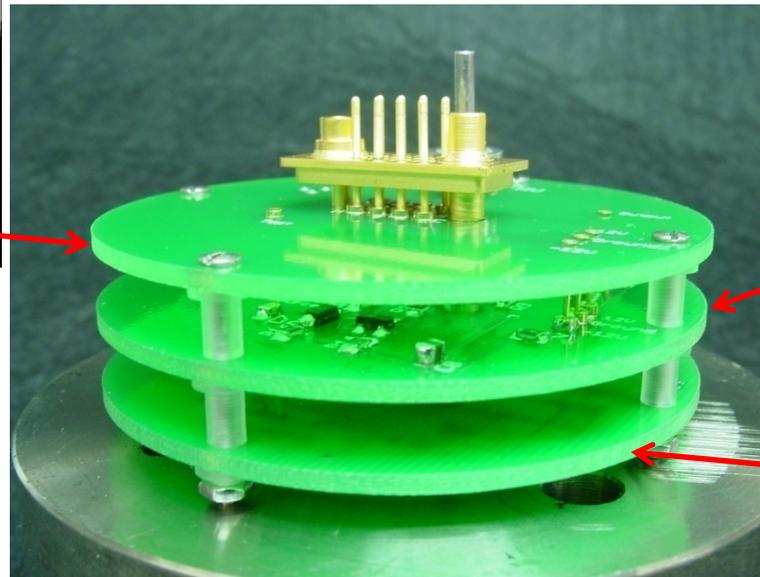
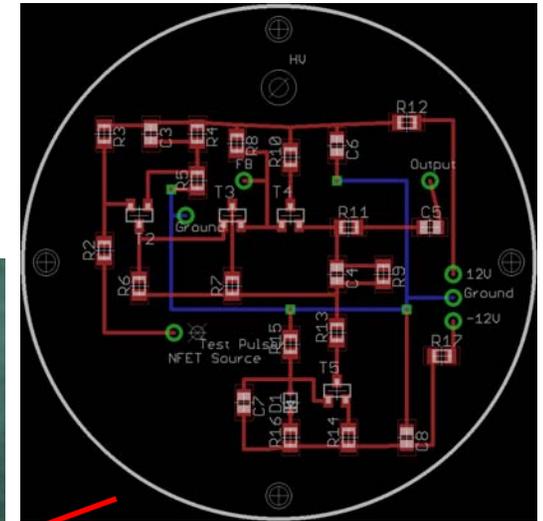


Prototype Electronic Circuit Boards

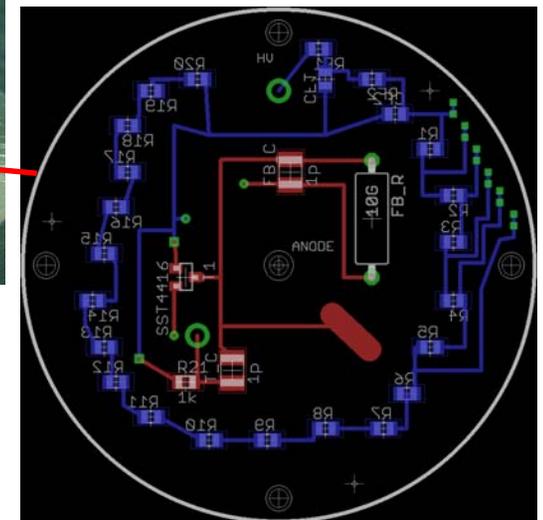


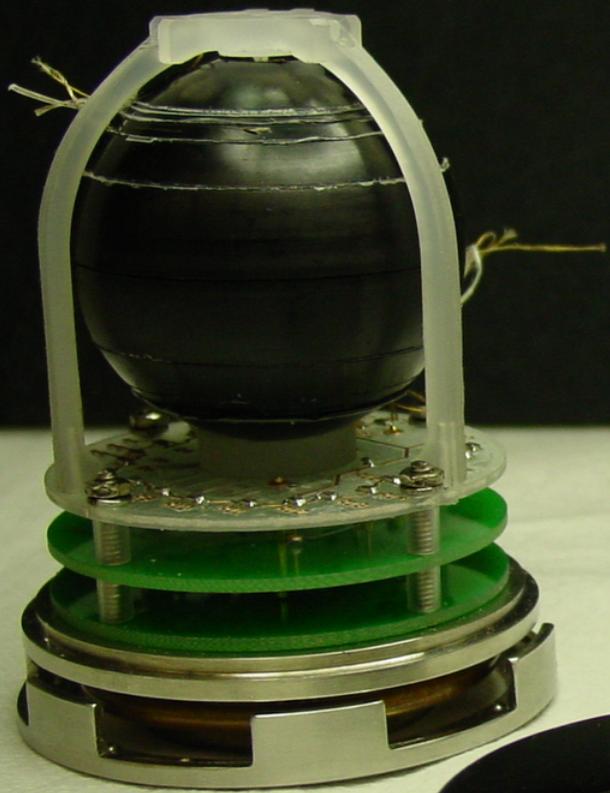
First board layout, connects the feed-throughs with the electronics

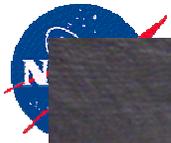
Second board layout, contains most of the preamplifier



Third board layout, contains the high-voltage divider and the first preamplifier stage





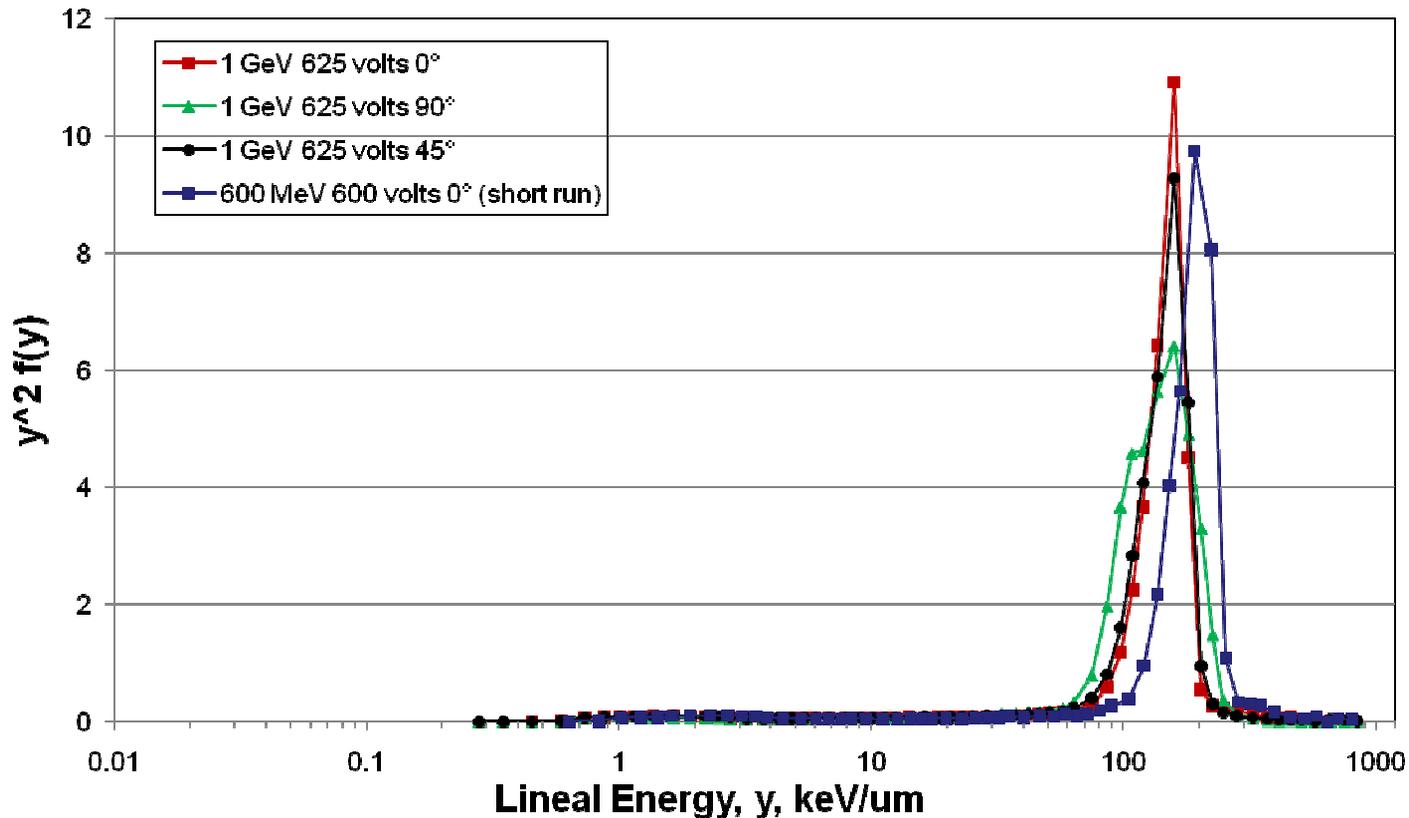


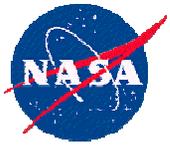


Prototype Detector Test Data

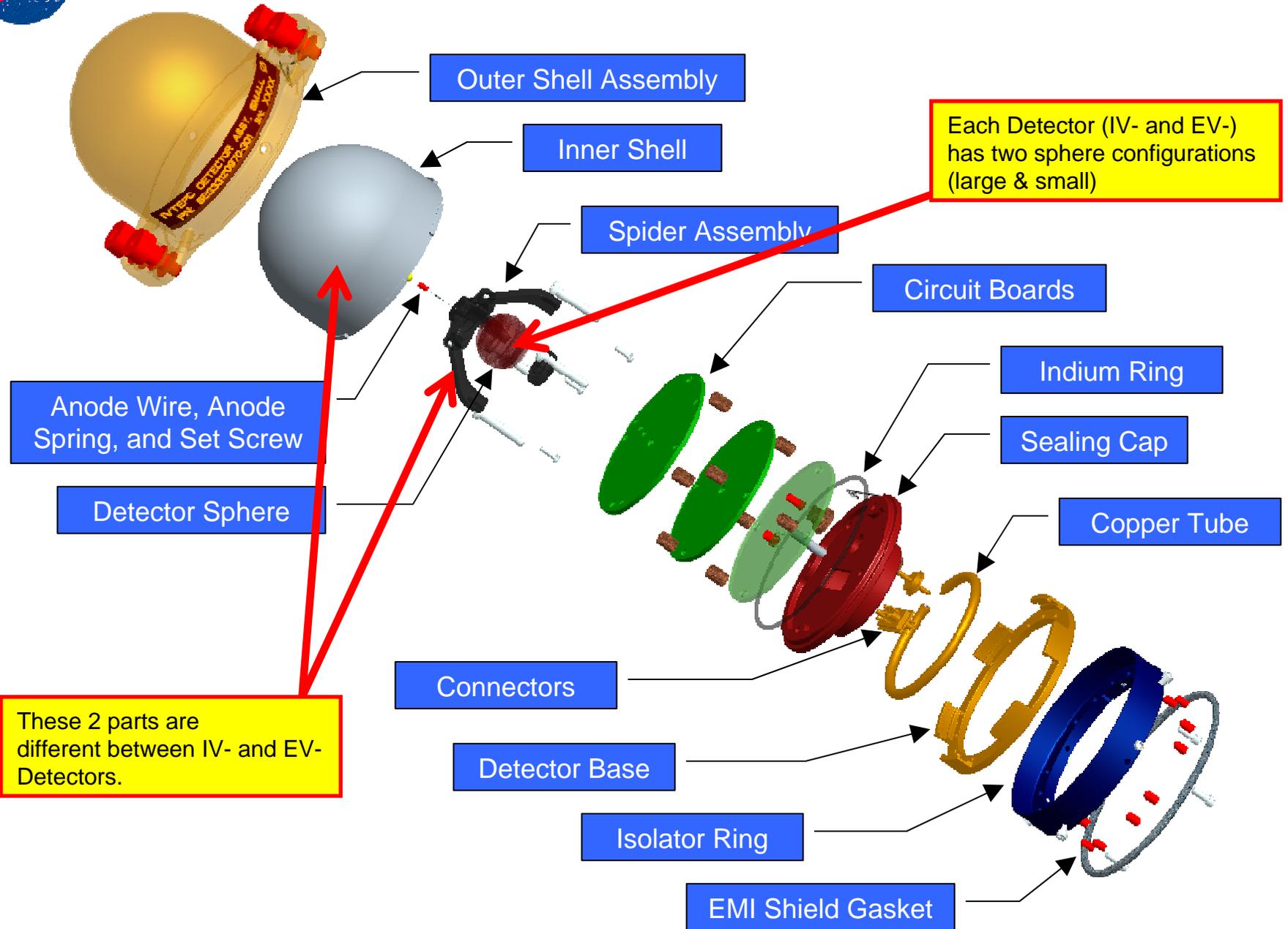
* Preliminary radiation characterization was performed at the NASA Space Radiation Lab in Fall 2008. Next test trip is scheduled for April 9-10, 2009.

* Event size distributions for iron ion irradiation as a function of detector orientation and ion energy.



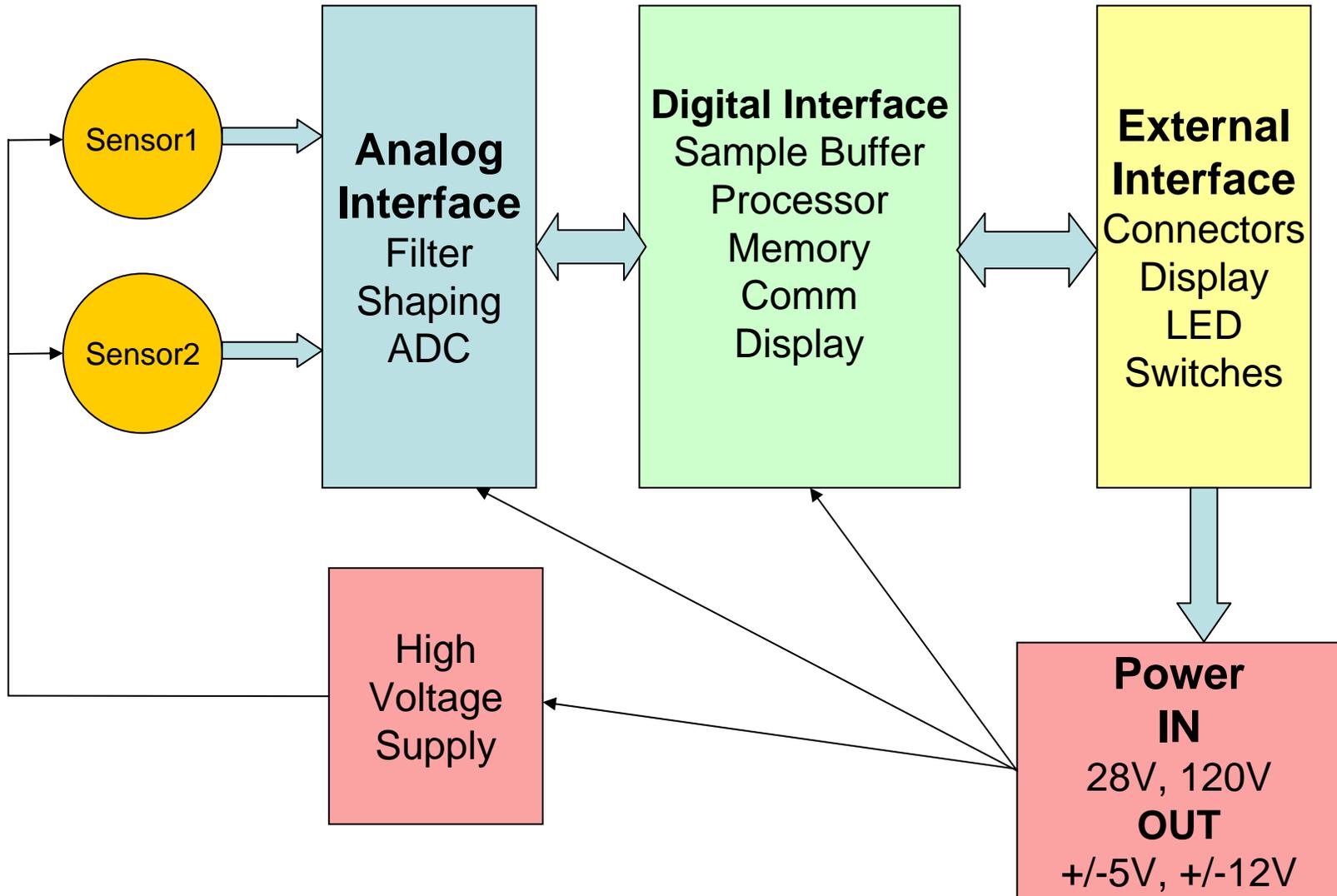


NASA TEPC Detector (Exploded View)





TEPC System Description



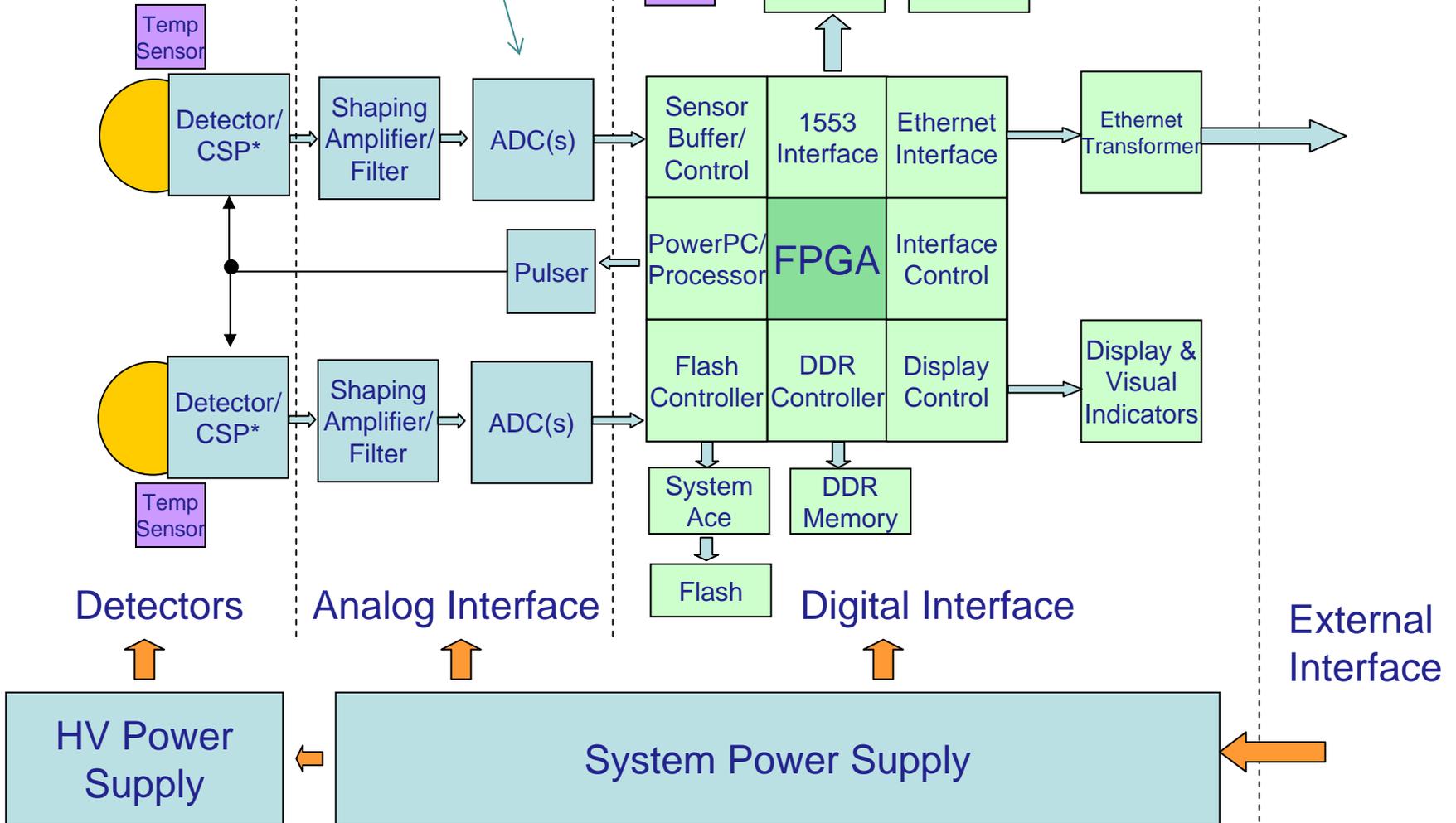


TEPC System Description

Texas Instruments
ADS7229

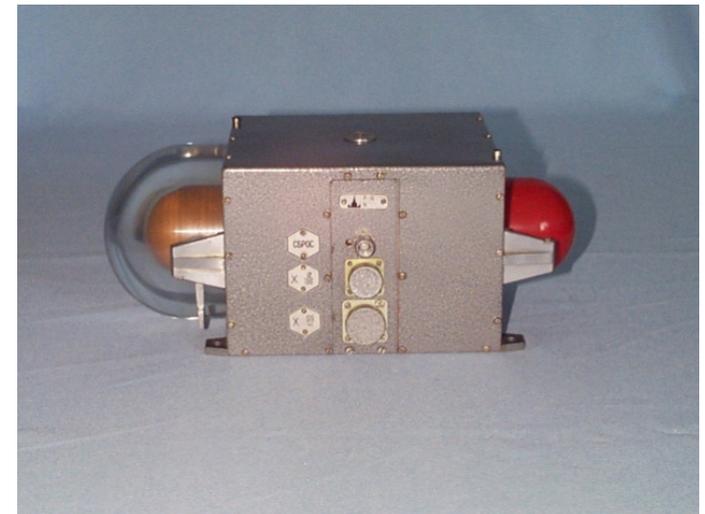
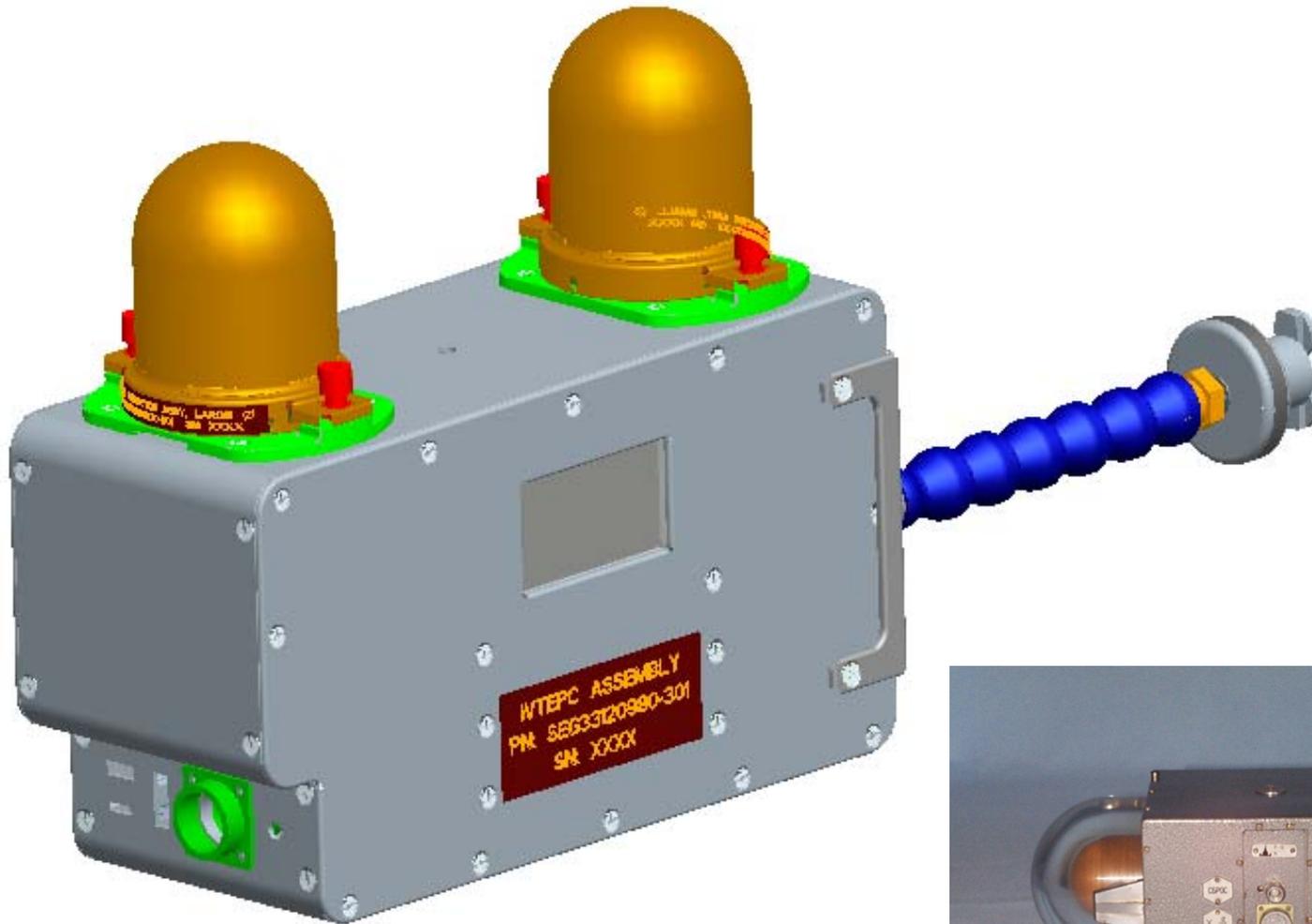
Detectors Designed by Texas A&M

*CSP – Charge Sensitive
Preamplifier





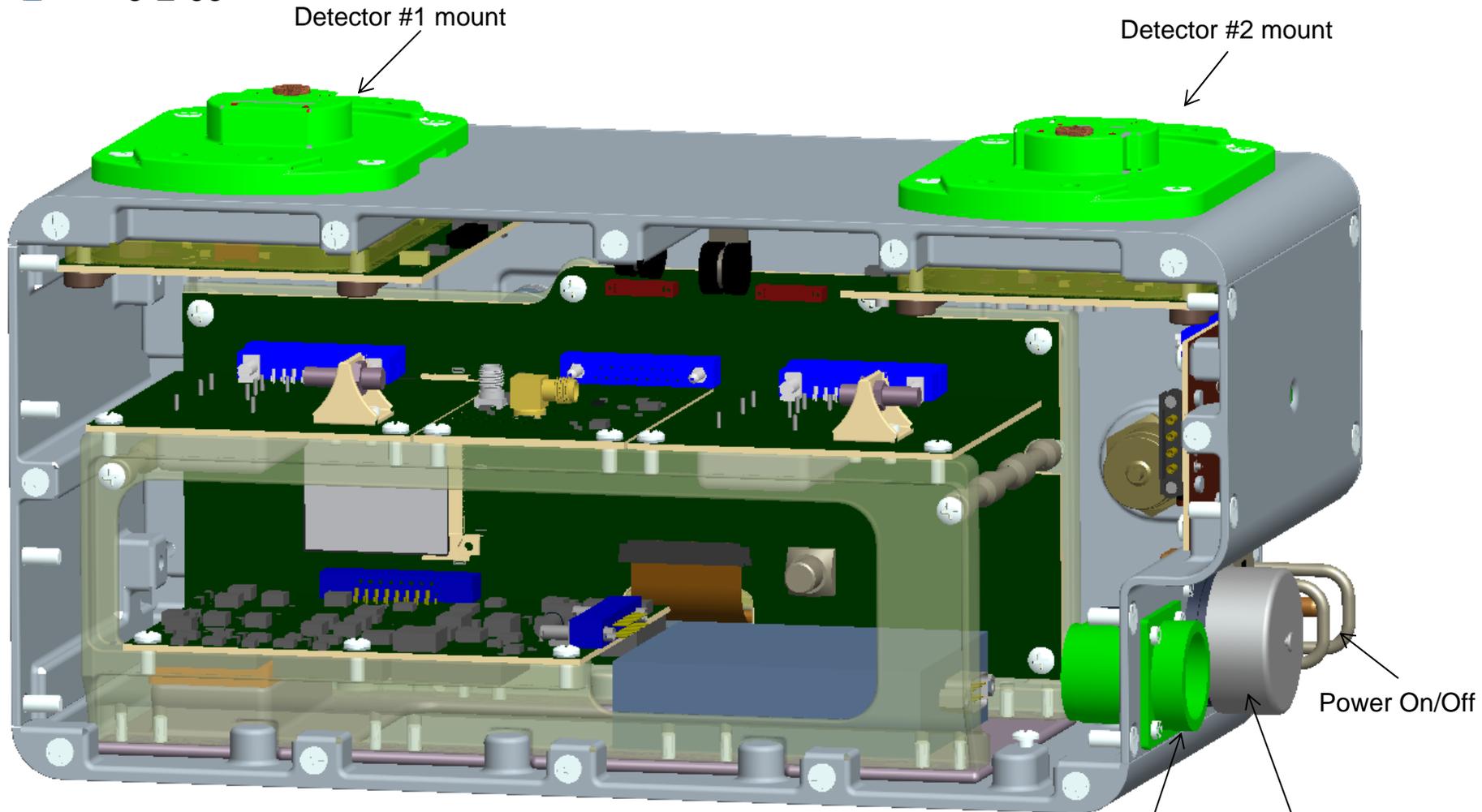
Complete Instrument





IV-TEPC Packaging Update

9-2-09



30 cm x 14 cm x 14 cm

Power/1553 Data
(UOP connector)

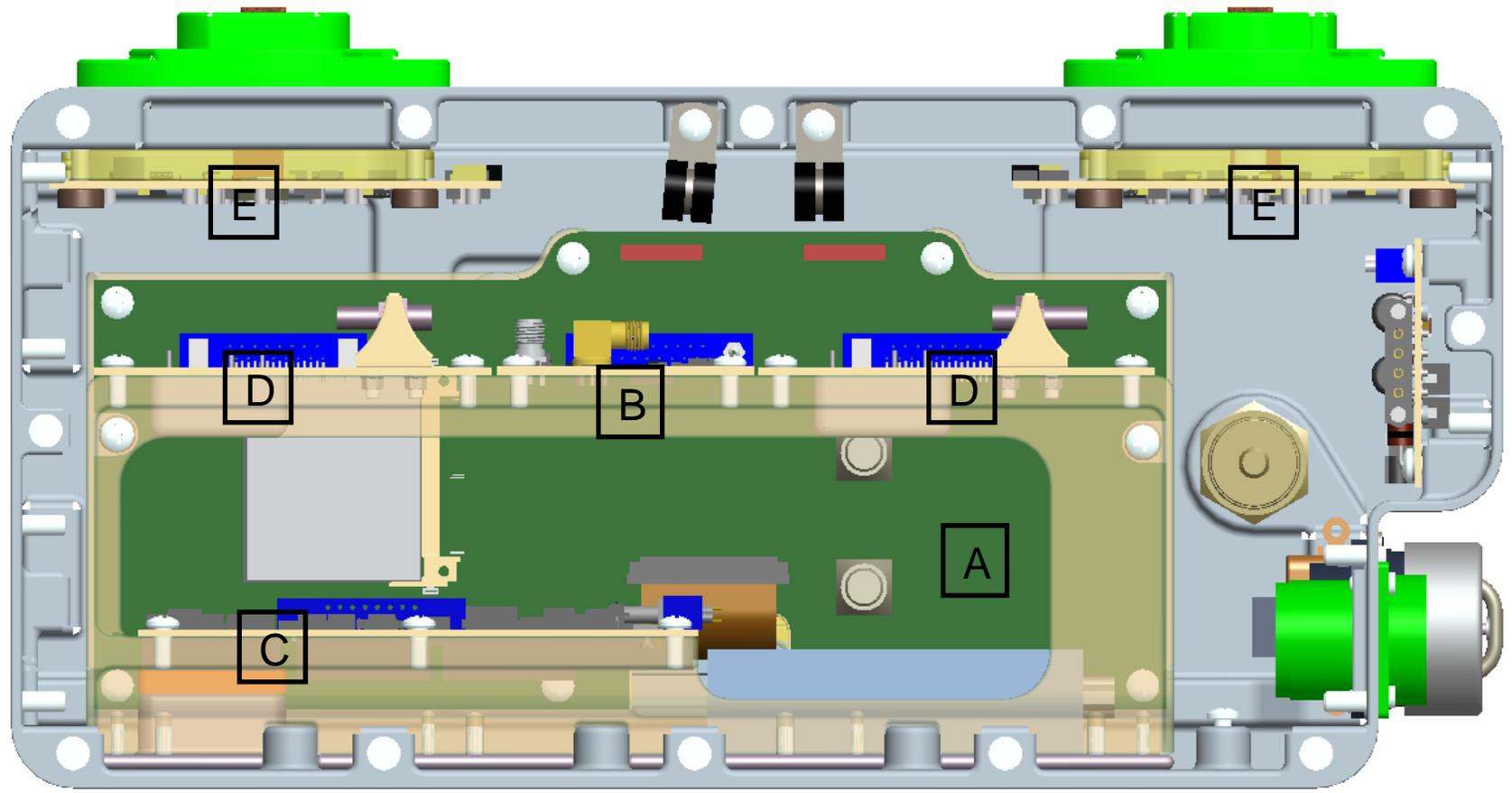
Ethernet RJ-45
(SSC and GSE)

Power On/Off



IV TEPC Packaging Update

9-2-09



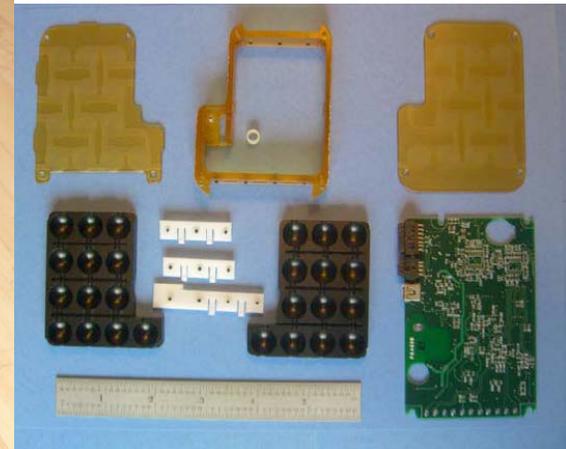
- A = Processor/1553 board
- B = Pulser board
- C = System Power board
- D = High-Voltage Power board (qty=2)
- E = Analog board (qty=2)



Exploration Activities



T. Borak, L. Braby, T. Straume
- EVA Dosimeter



LVI Systems – T Conroy – Low
mass microdosimeter



Summary

- Dose & Dose Eq Range
 - **0.20-0.55** mGy day⁻¹
 - **0.51-1.15** mSv day⁻¹
- Q factor range
 - 2.07 – 2.71 , Average = 2.4
- GCR/Trapped ratio
 - 60% Dose Eq is GCR
- ISS TEPC operating well
 - Backup will be immediately available assuming successful activation and checkout



Summary

- Next generation TEPC project progressing well
 - Testing upcoming at NSRL and HIMAC
- NASA continuing to support microdosimeter projects to find solution for Exploration missions