

space radiation analysis group

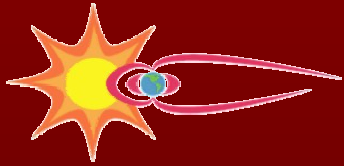


Lyndon B. Johnson Space Center

ISS Radiation Operational Support

Mark Weyland, Claire Dardano, Neal Zapp, Tad Shelfer, Edward Semones, Steve Johnson, Tom Lin, and Juan Garza
Lockheed Martin at NASA/Johnson Space Center

Michael Golightly and Gwyn Smith
NASA / Johnson Space Center



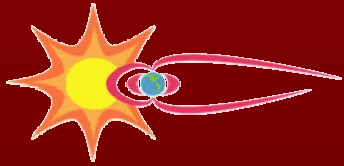
space radiation analysis group

PURPOSE



Lyndon B. Johnson Space Center

- Show day-to-day and contingency SRAG operations
- Demonstrate best methods to contact SRAG with concerns or questions
- SRAG “wish list” of products/services



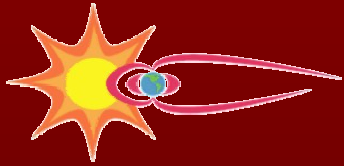
space radiation analysis group

BACKGROUND



Lyndon B. Johnson Space Center

- The SRAG was established at the NASA – Johnson Space Center in 1962
- SRAG provided 24-hour support for all manned missions until 1994
- Legal and moral reasons require NASA limit astronaut radiation exposures to minimize long-term health risks
- U.S. Occupational Safety and Health Administration officially classifies astronauts as “radiation workers” and are subject to the regulations that control occupational radiation exposure



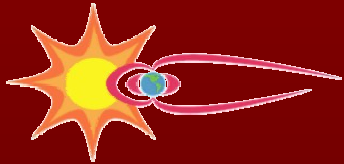
space radiation analysis group

BACKGROUND



Lyndon B. Johnson Space Center

- Adherence to ALARA (As Low As Reasonably Achievable) is recognized throughout NASA's manned spaceflight requirements documents
- Provide preflight crew exposure projections
- Provide real-time astronaut radiation protection support
- Provide radiation monitoring to meet medical and legal requirements
- Who are we?
 - » Health physicists, engineers, physicists, and programmers
 - » 5 Ph.D., 4 M.S.*, 3 B.S.
 - » 3 civil servants, 9 contractors



space radiation analysis group

PRE-FLIGHT/INCREMENT



Lyndon B. Johnson Space Center

SRAG Dose Calculations

Pre-Flight In-Flight PostFlight Individual Codes Exit

Pre-Flight Trapped Dose Calculations

 **Space Radiation Analysis Group**
Pre-Flight Dose Calculations
Trapped Radiation

Analyst
Zapp

Mission
STS-110

Mission Duration
10 days 15 hr. 0 min.

Launch Date
04-Apr-2002

SAA Drift Rate
0.28 */y West
0.00 */y North

Particle Model Designator
☒ AP8Max ☐ AP8Min

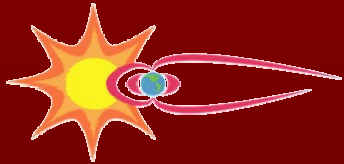
Groundtrack Filename
sts108.gtrk
sts109.gtrk
sts109-rev1.gtrk
sts110.gtrk
sts111.gtrk
sts112.gtrk

Vehicle Shield Distribution Filename
dloc1_out.968

Body Shield Distribution Filename
1000_CAM_SKIN_SHIELDS.11

Run Description
STS-110 Preflight

Run Calculations **View Output** **Exit**



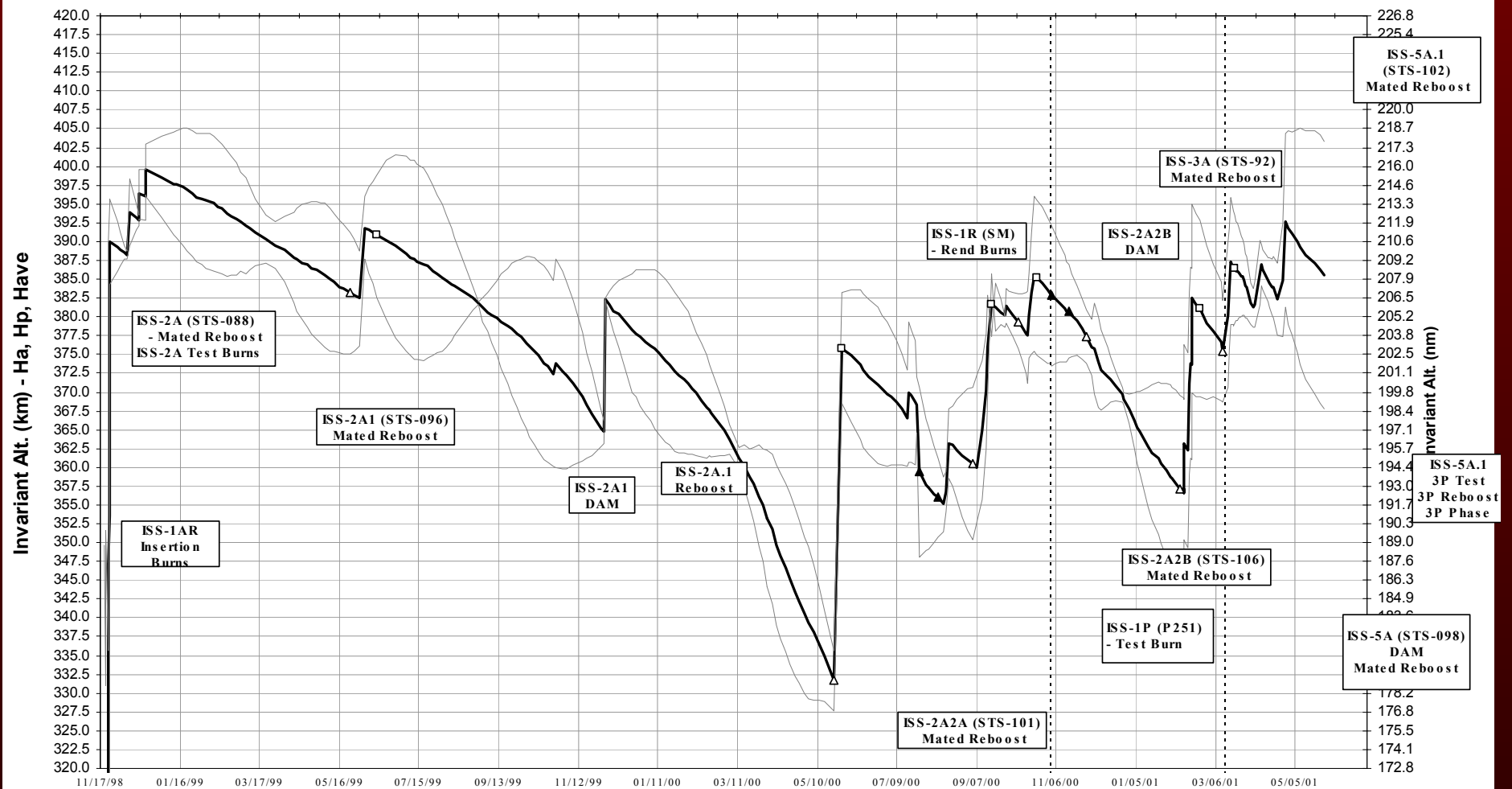
space radiation analysis group

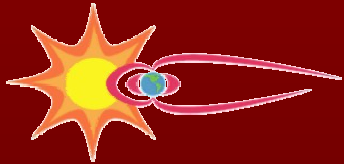
PRE-FLIGHT/INCREMENT



Lyndon B. Johnson Space Center

International Space Station As Flown Altitude Profile
(Based on MCC-M/USSP Tracked SV Data)





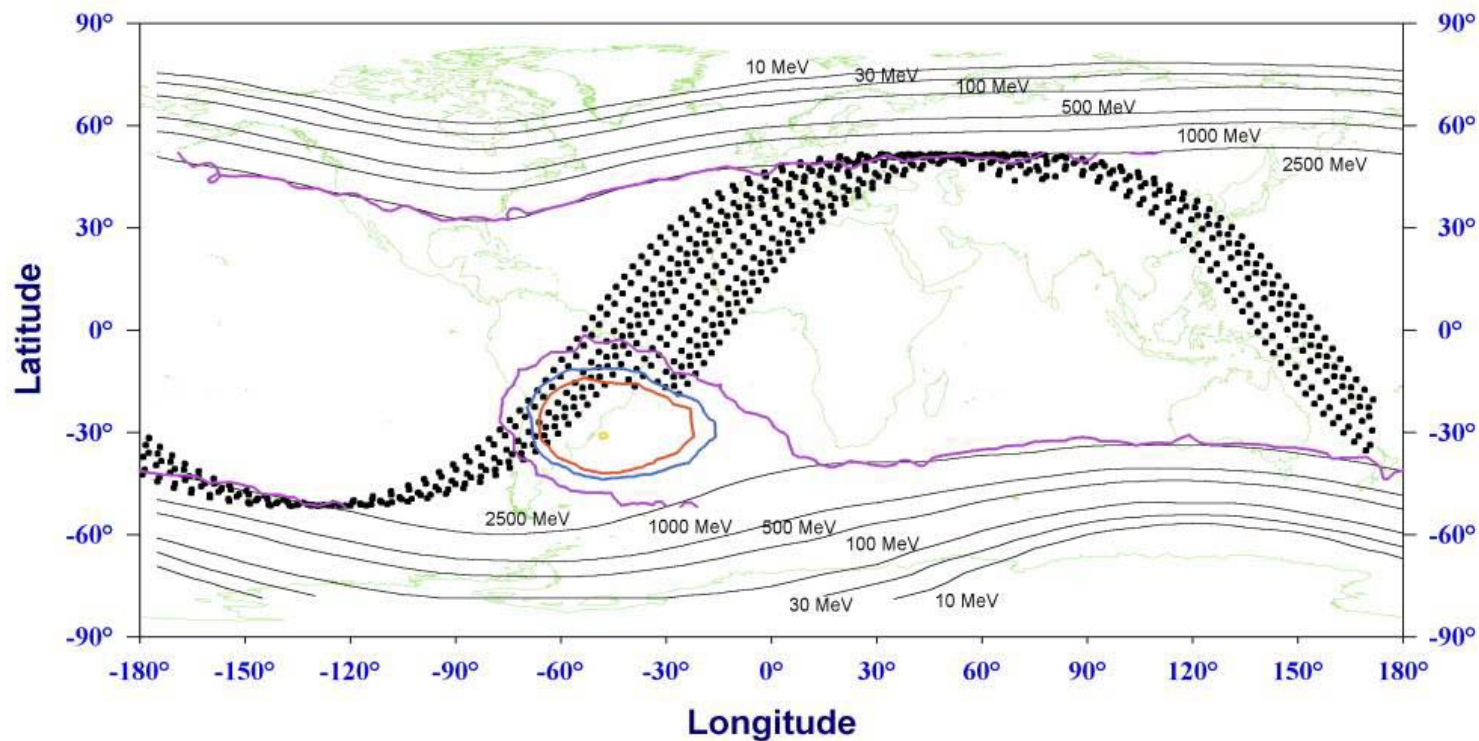
space radiation analysis group

PRE-FLIGHT/INCREMENT

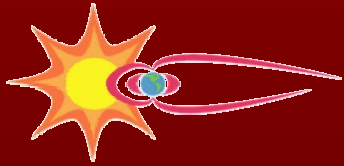


Lyndon B. Johnson Space Center

ISS Low Radiation 6 Hour EVA Start Locations (Nominal EVA Skin Dose <30 mrem)



Mark Weyland / Lockheed Martin JSC C23 / (281) 483-6193



space radiation analysis group

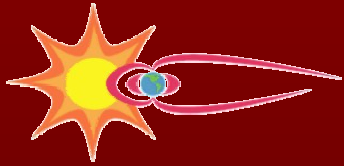
PRE-FLIGHT/INCREMENT



Lyndon B. Johnson Space Center

Prepare Work Start	
L-30D	Select/Anneal TLD Material
L-14D	Dosimetry Delivered to USA/FCE
	Irradiation of Calibration Dosimeters
	L A U N C H





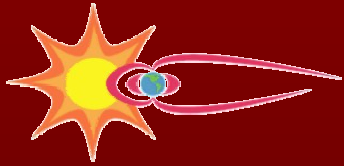
space radiation analysis group

PRE-FLIGHT/INCREMENT



Lyndon B. Johnson Space Center





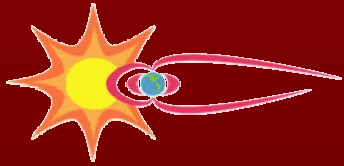
space radiation analysis group

PRE-FLIGHT/INCREMENT



Lyndon B. Johnson Space Center





space radiation analysis group

REAL TIME



Lyndon B. Johnson Space Center

- Nominal support on console from Mission Control Houston (MCC-H) is 4 hours per day
- In MCC-H continuously during significant space weather activity and all EVA's





space radiation analysis group

REAL TIME



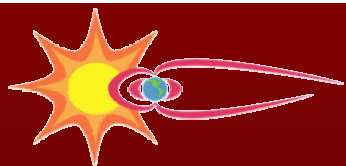
Lyndon B. Johnson Space Center

Status Indicator System

Console Manning		Space Environment Conditions	Crew Exposure Status
Support Schedule	Status		
 Nominal (8:30-12:30)	 On Console	 Nominal	 Unrestricted
 Contingency (Continuous)	 Off Console/ On Pager	 Alert	 Restricted
		 Contingency	 Violation

Current Conditions Since (GMT)

24-May-2002 0:10:31 2-Aug-2002 13:34:51 02-Aug-2002 06:23 8-Feb-2001 14:51:51



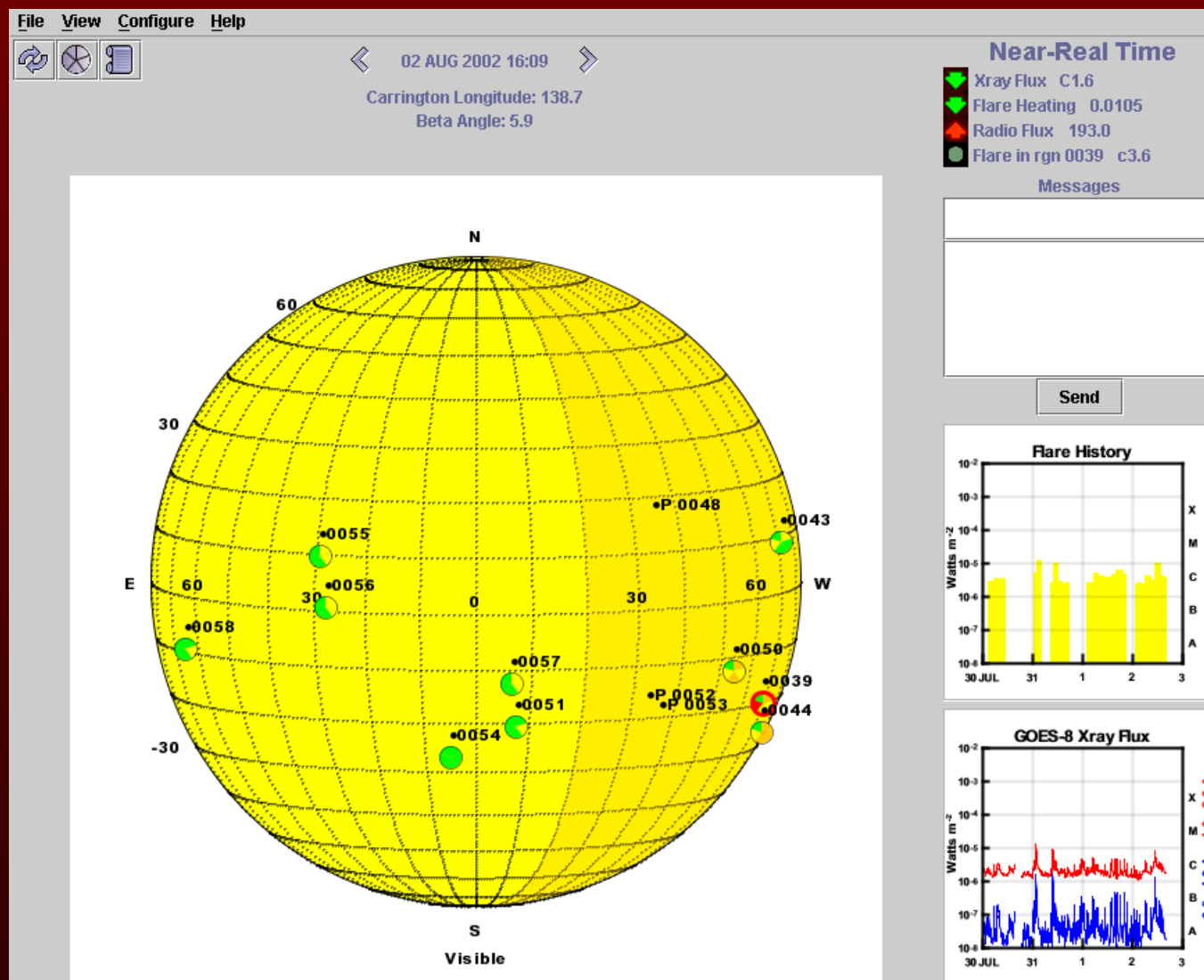
space radiation analysis group

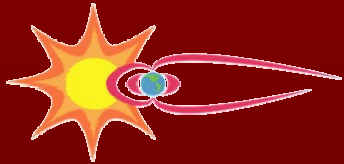
REAL TIME



Lyndon B. Johnson Space Center

Solar Active Region Display System



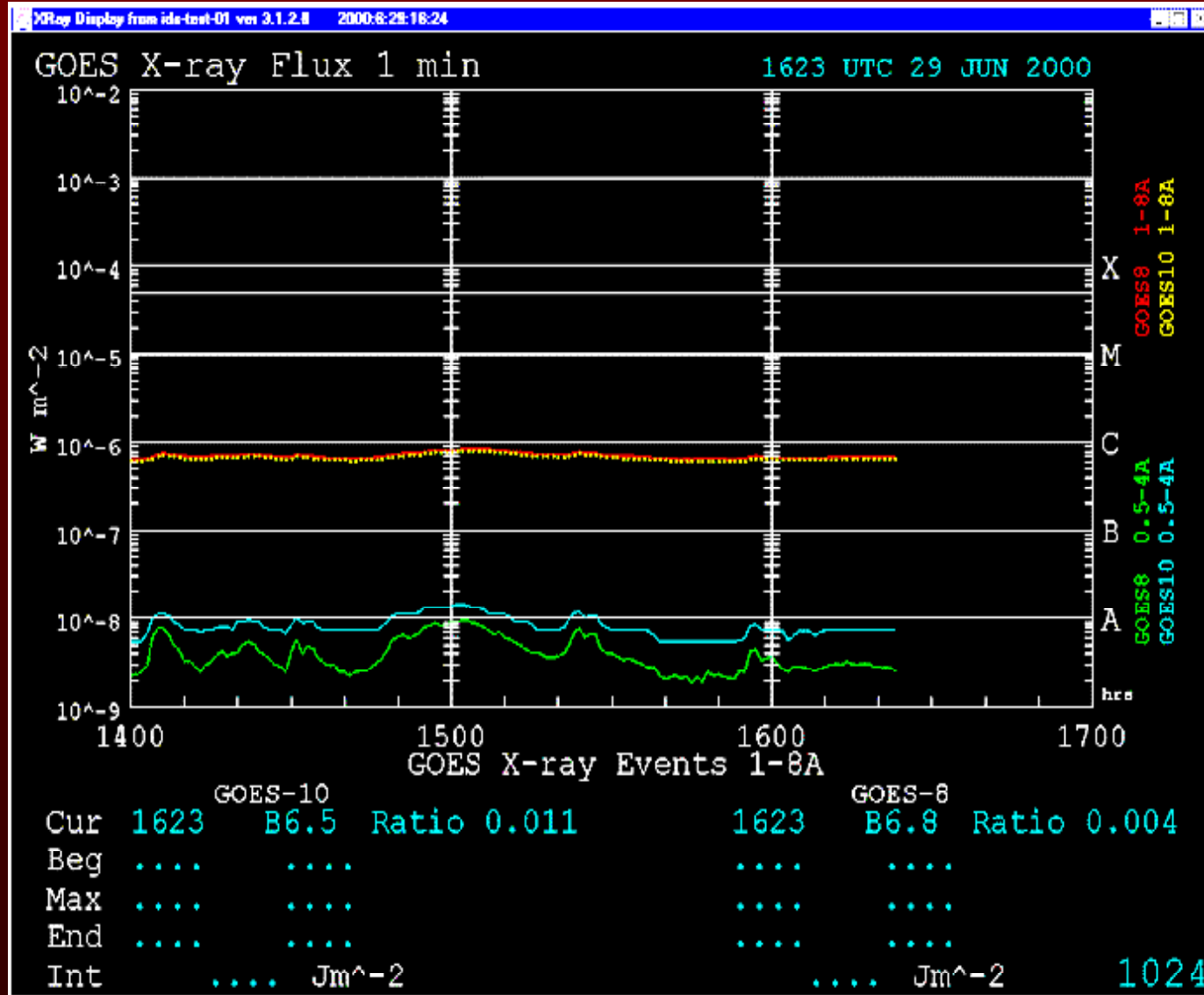


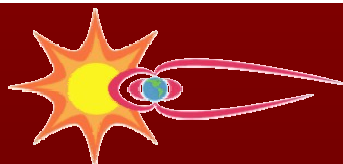
space radiation analysis group

REAL TIME



Lyndon B. Johnson Space Center





space radiation analysis group

REAL TIME



Lyndon B. Johnson Space Center

SRAG Electronic Flight Log

File Edit

Update

SPACE RADIATION ANALYSIS GROUP
Electronic Flight Log

Input By Smith, Gwyn **Local Time** 08/02/2002 10:29:01 **GMT** 08/02/2002 15:29:01

ISS-5 MET 0057/18:06:12

Initialization **Mission Startup Check List** **Shift Startup Check List** **Review & Input** **NOAA SEC Tagup**

Review Notes

Input By Semones, Ed **Local Time** 08/01/2002 11:58:28 **GMT** 08/01/2002 16:58:28

ISS-5 MET 0056/19:35:39

Note

Semones off console and on pager.

Keywords

Surgeon*

Input Notes

Secure Comm Check **Daily Flight Note** **Summary EMail to SA Rep** **NOAA**

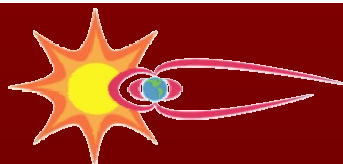
Note

Keywords

AFTAC
Alert
Altitude
Contingency
Crew Call-Down
Crew Exposure
DVIS
EV-CPDS
EVA
External Inquiry
Flight Inquiry
Geomagnetic Storm
Ground System
ISS TEPC
ISS TEPC Alarm
IV-CPDS

Add Attachment **Remove Attachment** **Save**

Repair EFL **Exit**



space radiation analysis group

REAL TIME



Lyndon B. Johnson Space Center

ISS TEPC 24-HOUR DISPLAY

Current

Current GMT	Instrument Mode	Alarm Status (Set Point: 5 mrad/min)
346/21:14:05	Data Acquisition	Nominal
Serial Number	Location	Position
1003	Service Module	Panel 325
GMT (Last Update)	Dose Rate (mrad/min)	Dose Eq. Rate (mrem/min)
346/21:11:13	0.028	0.362

Cumulative

	Total (Since Instrument Turned On)	Yesterday	Today	Last 24 Hours
	000/22:34:00	345	346	345-346 21:14:05
Dose (mrad)	18.8	3.9	18.2	19
Dose Eq. (mrem)	71.0	19	68	72

Instrument Status

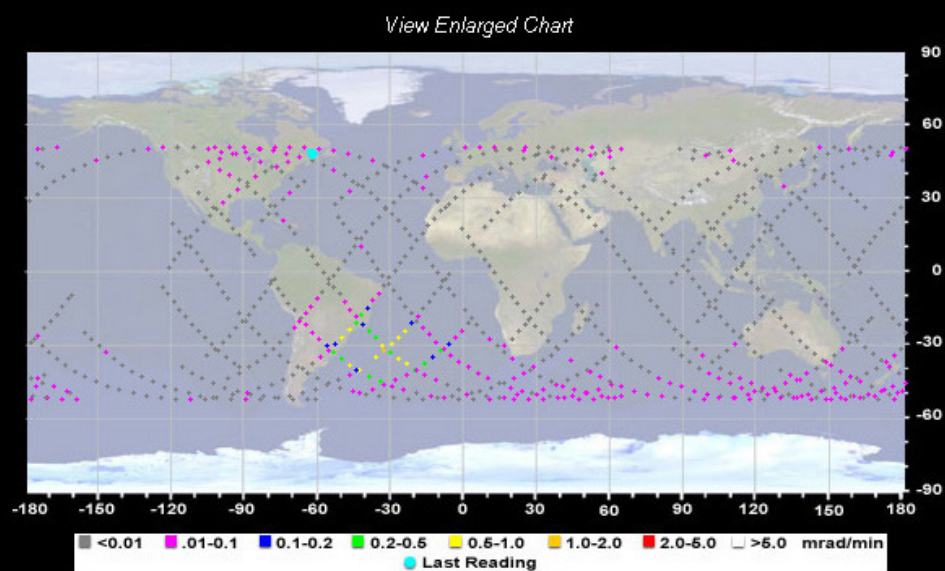
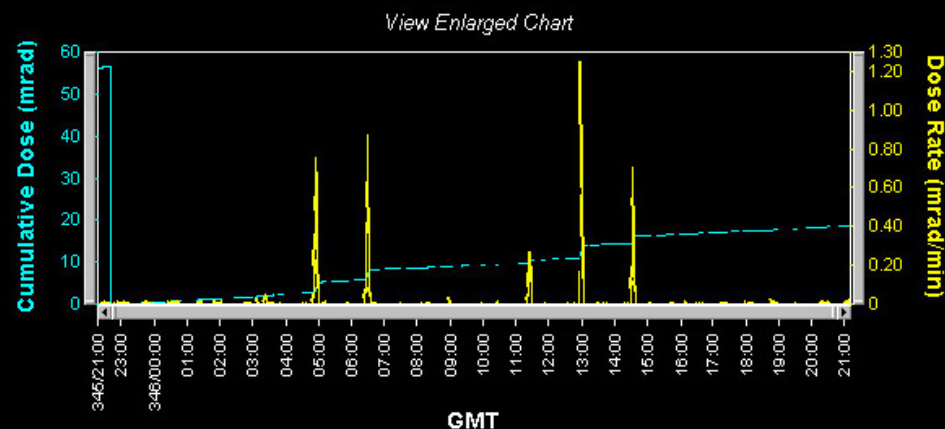
Power	1553	CPU
OK	OK	OK

File Status

First File	Last File	Current File
1	372	0

Real Time Monitor

Code	Description
0.0	Nominal





space radiation analysis group

REAL TIME



Lyndon B. Johnson Space Center

SPERT DISPLAY

(Event Date = 20-Apr-2002, Shield File = smsafe.968)

Current GMT

08/02/02 15:34:27

Last GOES Update ΔT (min)

04/24/02 19:35 143759

Last SPE Dose Update ΔT (min)

04/24/02 19:39:00 143755

Latitude Longitude

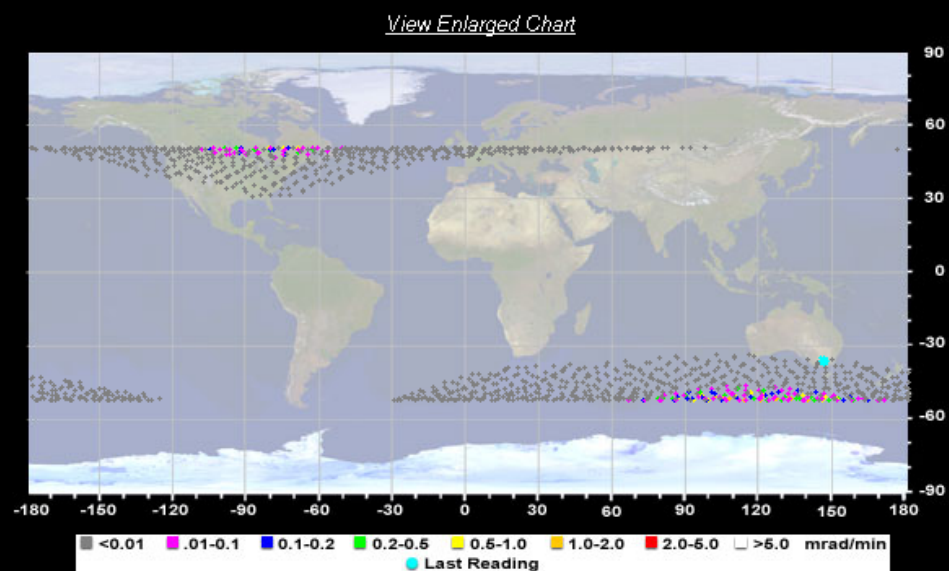
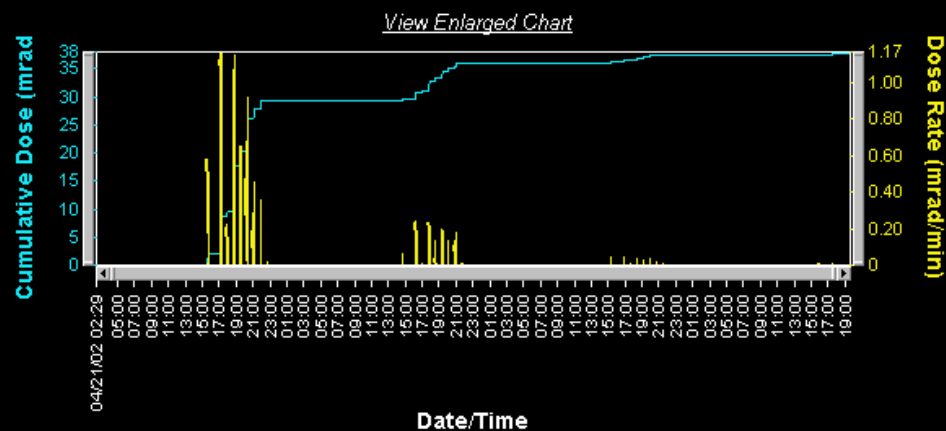
32.5 -155.9

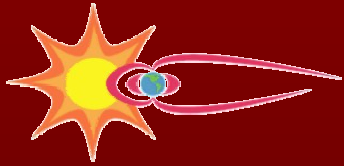
>30 MeV >100 MeV Cut-Off Model

2.177 0.02 6925.63

Dose Rate (mrad/min) Cumulative Dose (mrad)

0.0 37.78





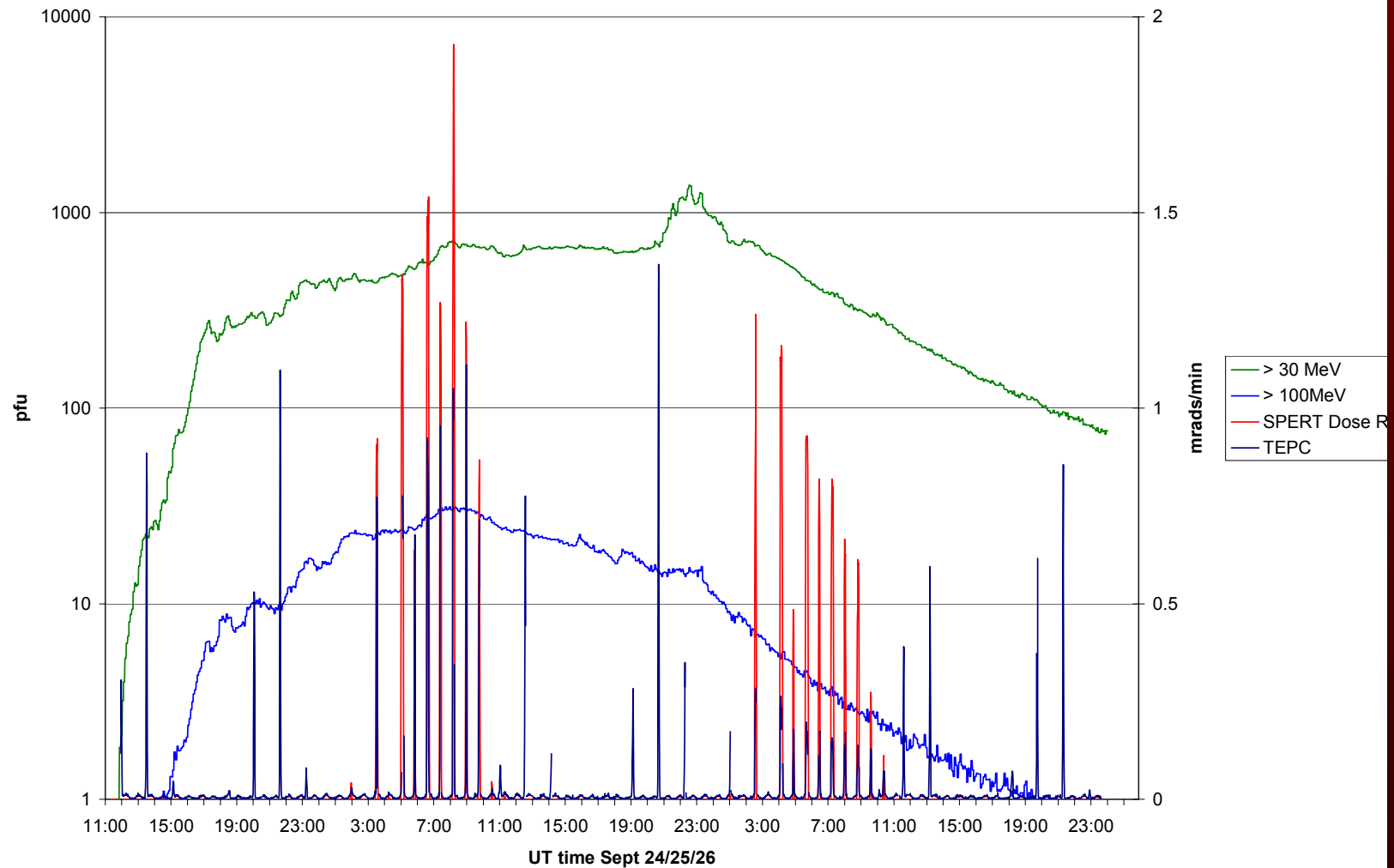
space radiation analysis group

REAL TIME



Lyndon B. Johnson Space Center

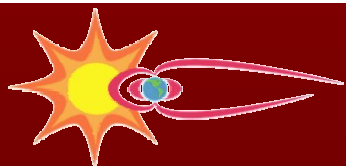
Sept 24, 2001 SPE (+42 minutes!)





Lyndon B. Johnson Space Center



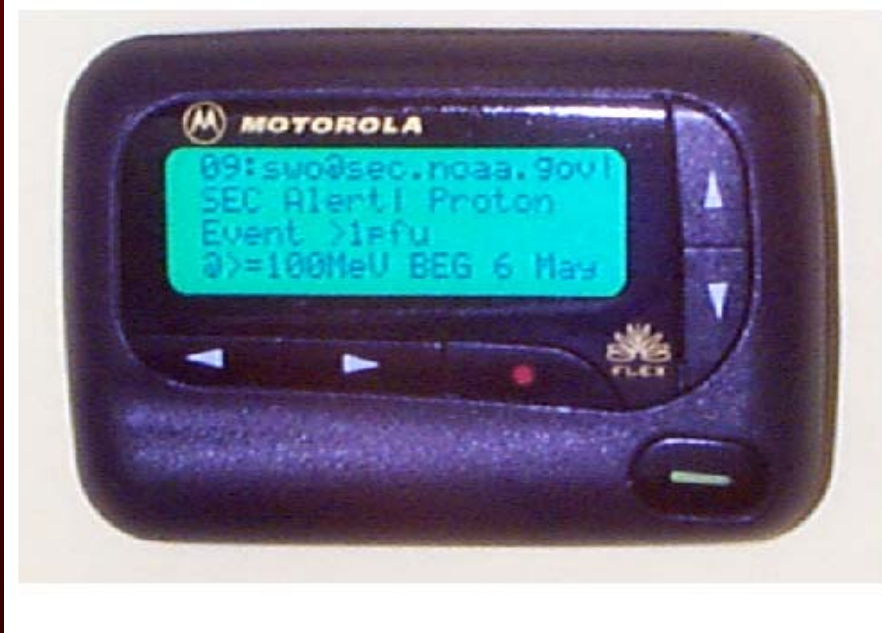
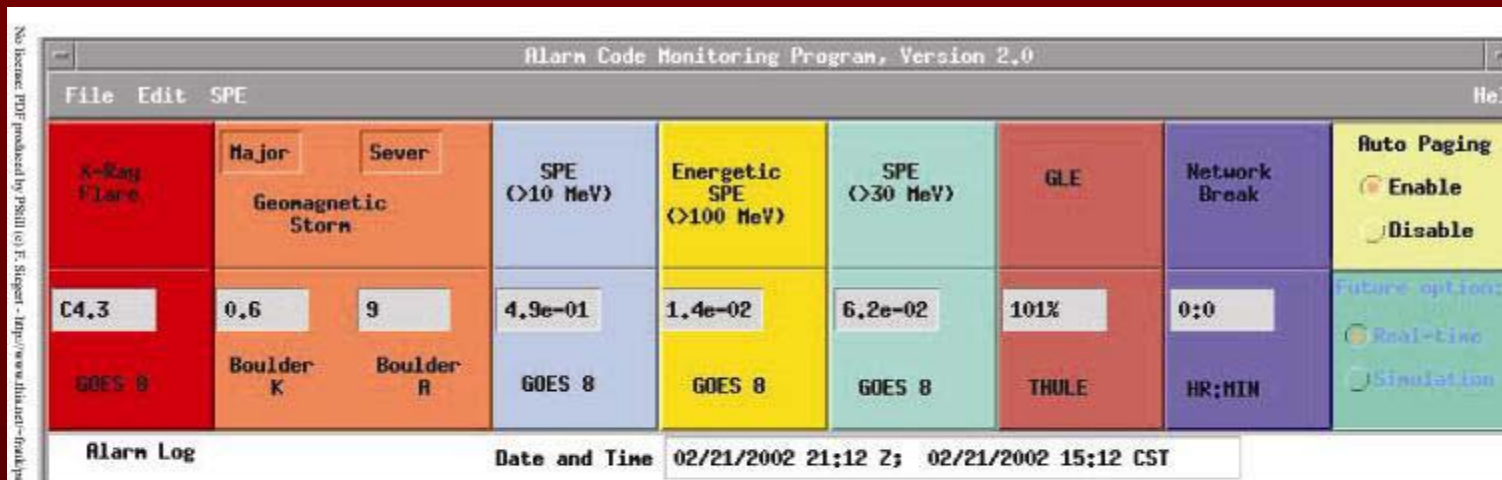


space radiation analysis group

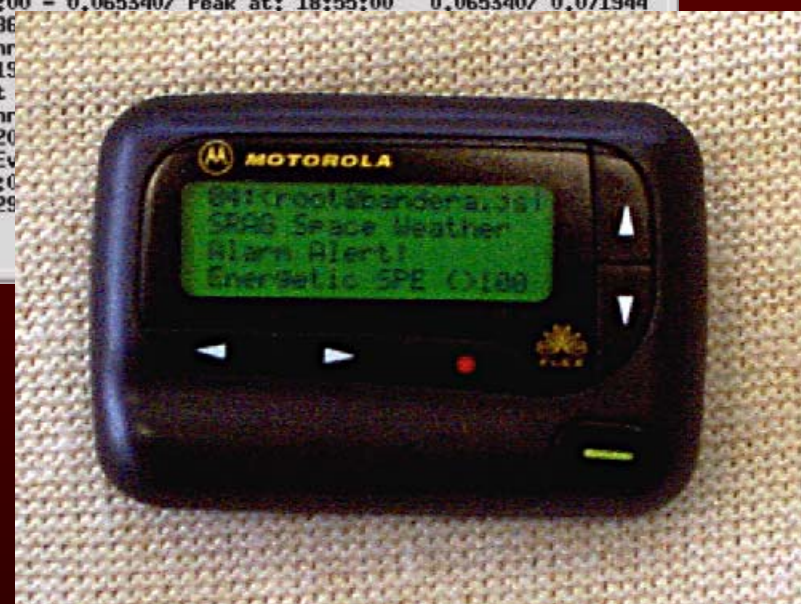
REAL TIME



Lyndon B. Johnson Space Center



Threshold): 18:50:00 0.032264; pager called
nt Start; pager called
5:00 - 0.065340/ Peak at: 18:55:00 0.065340/ 0.071944
986
Thr
15
nt
Thr
20
Ev
5:0
529





space radiation analysis group

REAL TIME



Lyndon B. Johnson Space Center

**SRAG ALERT/WARNING SYSTEM**
Input / Modify Events

Search Events

Update Distribution List

Open Events

Event	Title	Distribution Status	Entry Date	Mission	New Event					
60-2	10Apr102 X rayt Event	Mailed	10-Apr-2002	STS-110/Increment 4	View Record	New Revision	Correction	Modify Record	Delete Record	Close Event

Input New Event

Event #: 61

Revision #: 1

Title:

Author:

Date/Time (GMT): 12-Apr-2002 20:24:07

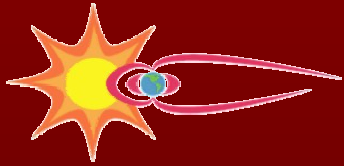
Mission/Increment:

Type: ☒ Warning (conditions favorable for future changes in near-Earth space environment)
☐ Alert (changes detected in near-Earth space environment)
☐ ISS TEPC Alarm

Alert/Warning Condition:

Space Weather
☐ X-Ray Flare
☐ Solar Particle Event
☐ Energetic Solar Particle Event
☐ Geomagnetic Storm
☐ Electron Belt Enhancement
☐ Additional Belt Formation

Spacecraft Exposure Monitoring
☐ High ISS TEPC Dose Rate
☐ High ISS TEPC Daily Dose



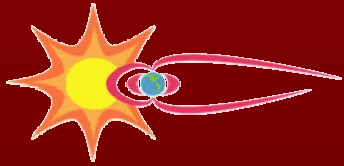
space radiation analysis group

REAL TIME



Lyndon B. Johnson Space Center

- [as soon as a flare occurs] “Is there any impact to the crew/vehicle?”
- [as soon as SPE starts] “Are we going to exceed any crew exposure limits?”
- “How long is this event going to last?”
- “How reliable is that forecast/projection?”
- “What’s the solar forecast during tomorrow’s EVA?”
- “Are you go for EVA?”
- “Can you make a picture of that for my post-shift briefing?”
- “What is the probability a solar flare will occur during an EVA?”
- “What is the probability we’ll have to postpone/cancel an EVA?”



space radiation analysis group

REAL TIME



Lyndon B. Johnson Space Center

- We saw an anomaly on the XYZ hardware/system at MET XXX:XX:XX. Was this caused by solar activity?”
- “Is our bad downlink/bad comm today caused by solar activity?”
- “Do I need to shutdown any systems?”
- “When do I need to shutdown systems?”
- “Are we going to exceed crew limits for this 90 day (90-360 day) mission?”
- “I just heard on CNN about a big solar storm. How come you didn’t warn me? What is the impact to crew safety?”
- “Do the International Partners know about this?”



space radiation analysis group

REAL TIME



Lyndon B. Johnson Space Center

srag.jsc.nasa.gov



- **About SRAG**
- **Space Radiation FAQ**
- **E-Mail & Paging System**
- **Console Shift Schedule**
- **Page Console Duty Person**
- **Planned Shuttle Missions**
- **Publications**
- **Help/Feedback**
- **Internal Site**

Responsible NASA Official: [Michael J. Golightly](#) Web Curator: [Claire Dardano](#) Last Update: July 24, 2002

[NASA JSC Web Policies](#)



space radiation analysis group

REAL TIME



Lyndon B. Johnson Space Center



SRAG E-Mail

Name	Org.	Work	P
Cucinotta, Frank	NASA	281.483.0968	281.5
Dardano, Claire	Lockheed Martin	281.483.5329	281.5
Garza, Juan	Lockheed Martin	281.483.6194	281.5
Golightly, Mike	NASA	281.483.6190	281.5
Johnson, Steve	Lockheed Martin	281.483.5323	281.5
Jones, Pat	Lockheed Martin	281.483.5011	281.5
Lin, Tom	Lockheed Martin	281.483.5322	281.5
Riman, Fadi	Lockheed Martin	281.483.6199	281.5
Saganti, Prem	Lockheed Martin	281.483.5168	281.5
Semones, Edward	Lockheed Martin	281.244.5107	281.5
Shelfer, Tad	Lockheed Martin	281.483.5509	281.5
Smith, Gwyn	NASA	281.483.1213	281.5
Weyland, Mark	Lockheed Martin	281.483.6193	281.5
Zapp, Neal	Lockheed Martin	281.483.2244	281.5



Console Shift Schedule

Blue: SEO-Primary
Red: SEO-Backup
Green: SEO-Training
Purple: Duty RHO

September 2002						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1 Daily Shift Gwyn Smith Neal Zapp	2 Daily Shift Gwyn Smith Neal Zapp	3 Daily Shift Steve Johnson Gwyn Smith	4 Daily Shift Steve Johnson Gwyn Smith	5 Daily Shift Steve Johnson Gwyn Smith	6 Daily Shift Steve Johnson Gwyn Smith	7 Daily Shift Steve Johnson Gwyn Smith
8 Daily Shift Steve Johnson Gwyn Smith	9 Daily Shift Gwyn Smith Mark Weyland	10 Daily Shift Gwyn Smith Mark Weyland	11 Daily Shift Gwyn Smith Mark Weyland	12 Daily Shift Gwyn Smith Mark Weyland	13 Daily Shift Gwyn Smith Mark Weyland	14 Daily Shift Gwyn Smith Mark Weyland
15 Daily Shift Gwyn Smith Mark Weyland	16 Daily Shift Edward Semones Tad Shelfer	17 Daily Shift Edward Semones Tad Shelfer	18 Daily Shift Edward Semones Tad Shelfer	19 Daily Shift Edward Semones Tad Shelfer	20 Daily Shift Edward Semones Tad Shelfer	21 Daily Shift Edward Semones Tad Shelfer
22 Daily Shift Edward Semones Tad Shelfer	23 Daily Shift Mark Weyland Steve Johnson	24 Daily Shift Mark Weyland Steve Johnson	25 Daily Shift Mark Weyland Steve Johnson	26 Daily Shift Mark Weyland Steve Johnson	27 Daily Shift Mark Weyland Steve Johnson	28 Daily Shift Mark Weyland Steve Johnson
29 Daily Shift Mark Weyland Steve Johnson	30 Daily Shift Gwyn Smith Neal Zapp					Notes/Activities

September 2002 GO

Responsible NASA Official: [Michael J. Golightly](#)

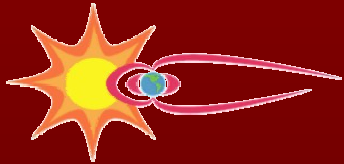
Responsible NASA Official: [Michael J. Golightly](#)

Web Curator: [Claire Dardano](#)

Last Update: July 24, 2002

[NASA JSC Web Policies](#)

[NASA JSC Web Policies](#)

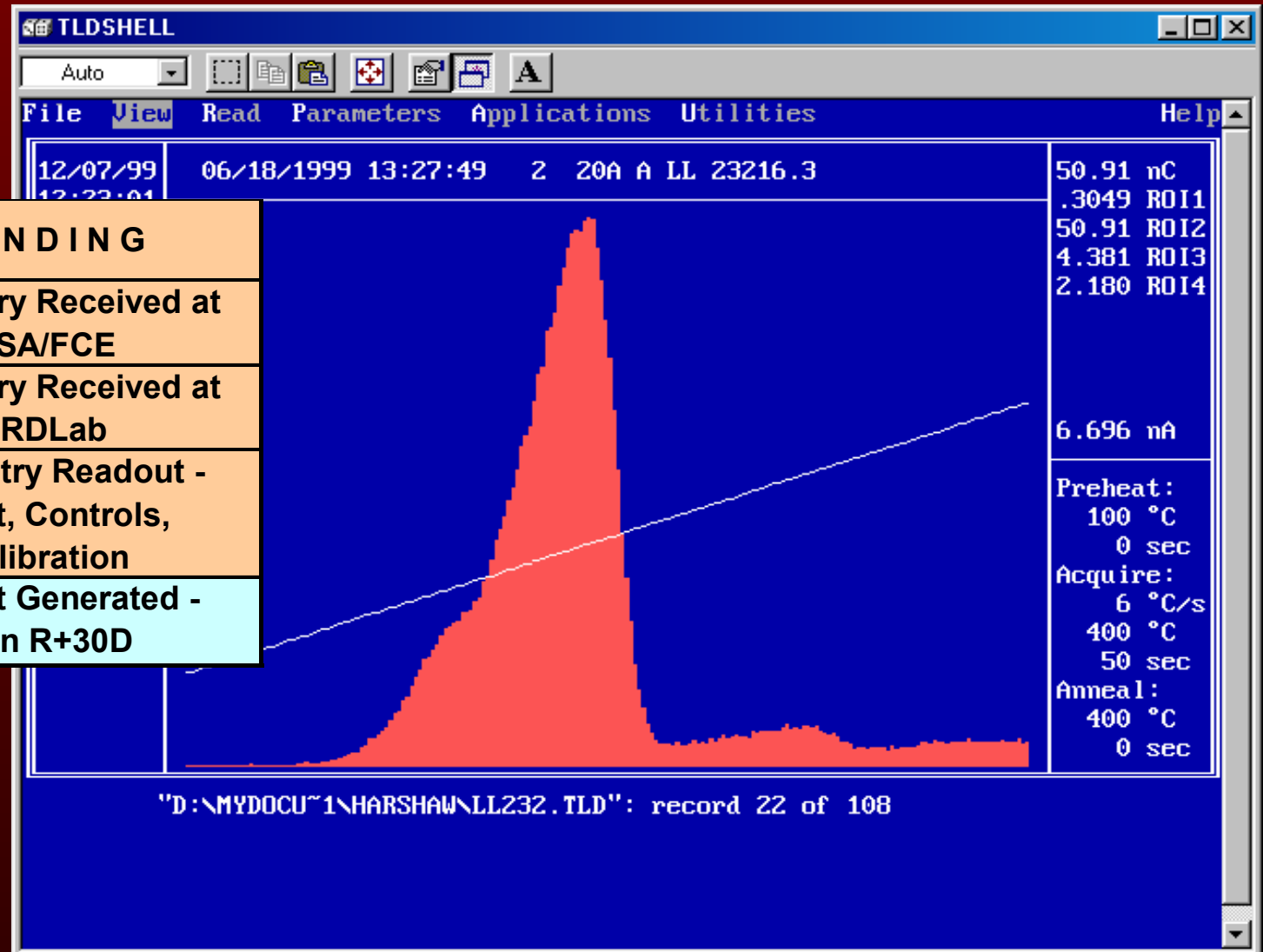


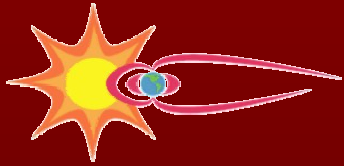
space radiation analysis group

POST FLIGHT



Lyndon B. Johnson Space Center





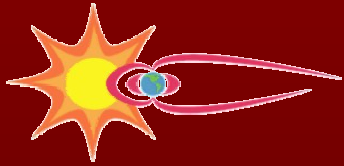
space radiation analysis group

WISH LIST



Lyndon B. Johnson Space Center

- Maintain current space weather support capabilities into the future
- Fix short comings in our current monitoring (neutrons, electrons outside the vehicle)
- Expand our crew exposure projection capabilities
- Realistic space weather simulation system
 - » required to test user real-time systems and train new flight controllers
 - » driven by historical data and/or model output
 - » data accessible by same mechanism as “real” data--same format and cadence
- Maintain operations of most promising space weather sciences sensors/missions until operational versions are available (e.g., SOHO, ACE)



space radiation analysis group

WISH LIST



Lyndon B. Johnson Space Center

- “All clear” forecast for next 24-72 hours
- Geomagnetic storm forecasts
 - » important as in input to dynamic electron belt enhancement and geomagnetic cutoff models
- Dynamic geomagnetic cutoff model and/or real-time measurements of cutoff location