

D-2

Status of ADEOS-II

- Investigation Status of Anomaly -

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Summary

- ADEOS-II stopped transmitting data suddenly on 24 October, 2003.
- JAXA has formed “Anomaly Investigation Team” led by its president and investigated the anomaly cause.
- JAXA has analyzed a large amount of telemetry data with cooperation of sensor providers.
- JAXA has also performed laboratory tests to understand anomaly mechanism.
- The investigation progress has been reported to the Investigation Committee of the Space Activity Commission (SAC).
- The committee will issue the investigation report soon.

History

- 14/12/2002 :Launch ADEOS-II
- 14/04/2003 :Finish Initial Checkout
- 15/04/2003 :Start Operational Observation
 - Cal/Val for Sensors
 - On-orbit Evaluation for Bus
- 24/10/2003 :Anomaly, Form Anomaly Investigation Team
- 27/10/2003 :Hold 1st Investigation Committee of SAC
- 31/10/2003 :Stop Observation
- 31/03/2004 :Stop Command Operations after sending 450 thousand commands for recovery
- Investigation is in process up to date

Results of Mission Operations

Acquired Data

- GLI 1km :93,338 scenes
- GLI 250m :10,601 scenes
- AMSR :6,649 scenes
- ILAS-II :3,450 downlink segments
- SeaWinds :3,728 downlink segments
- POLDER :3,287 downlink segments

Data processing and scientific research are continuing.

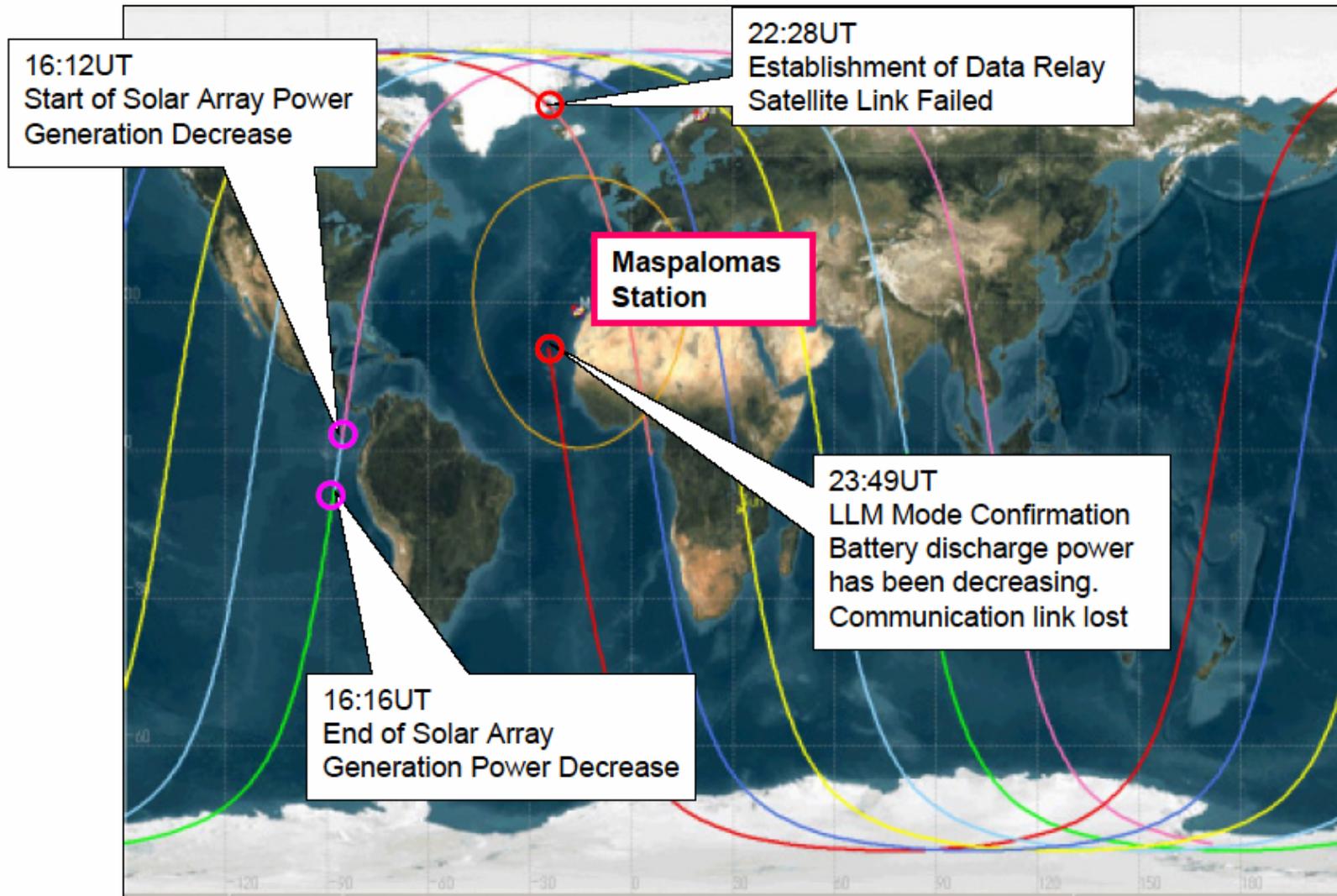
Scientific results can be seen in ;

<http://sharaku.eorc.jaxa.jp/ADEOS2/index.html>

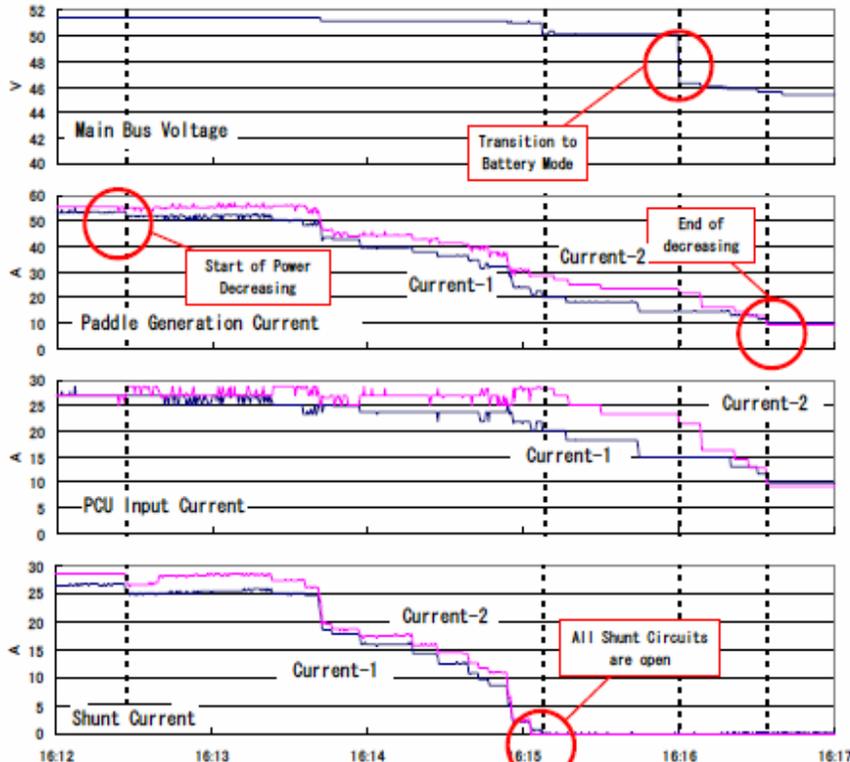
Cause Investigation Status

NOTE :SAC HASN'T APPROVED THIS RESULT AT PRESENT YET.

Time Sequence of Anomaly



Telemetry Data for Generation Power



Start of Power Decreasing Around 16:12:25

Main Bus Voltage is maintained by opening shunt circuits

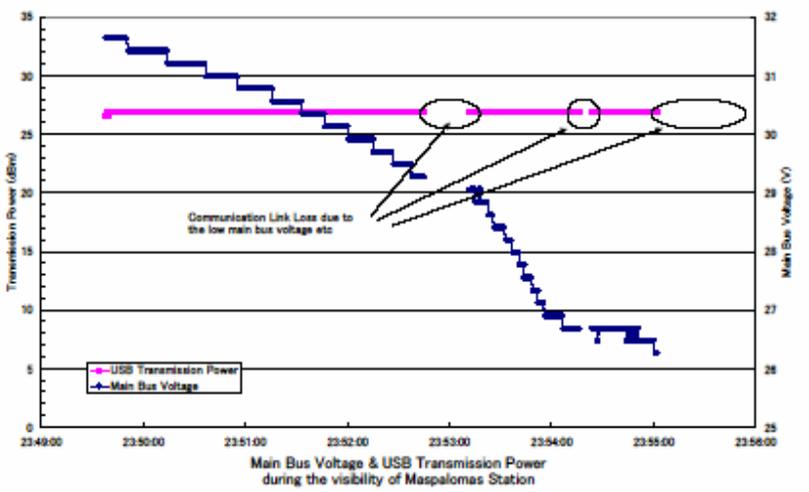
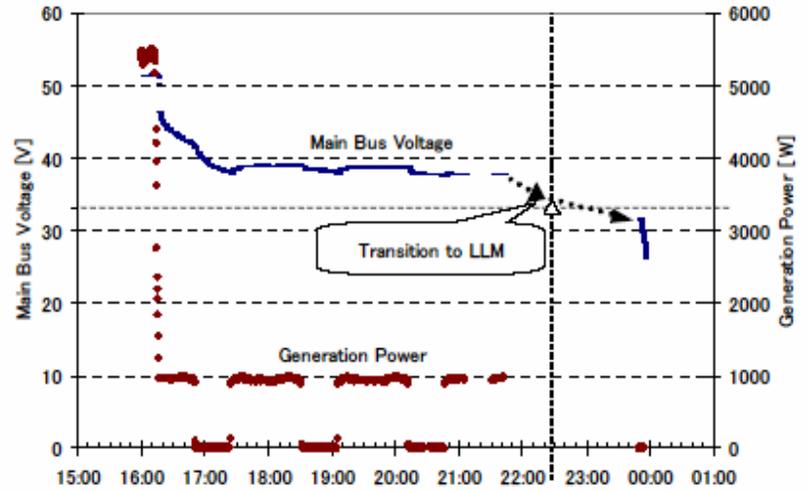
Around 16:15:10

Main Bus Voltage is maintained by reducing the battery charging current

End of decreasing Around 16:16:30

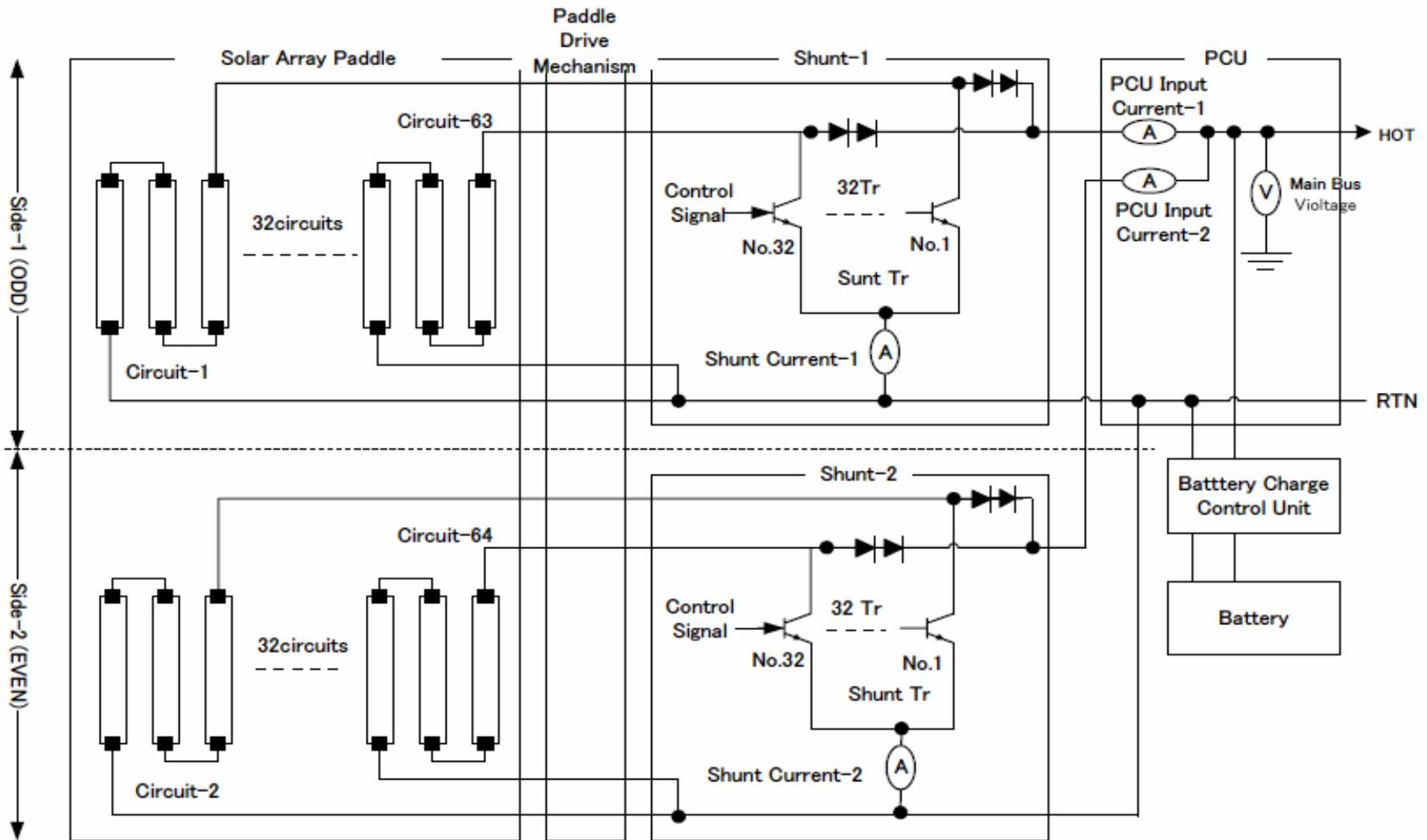
Battery Discharging (until communication link loss)

Around 16:16:00



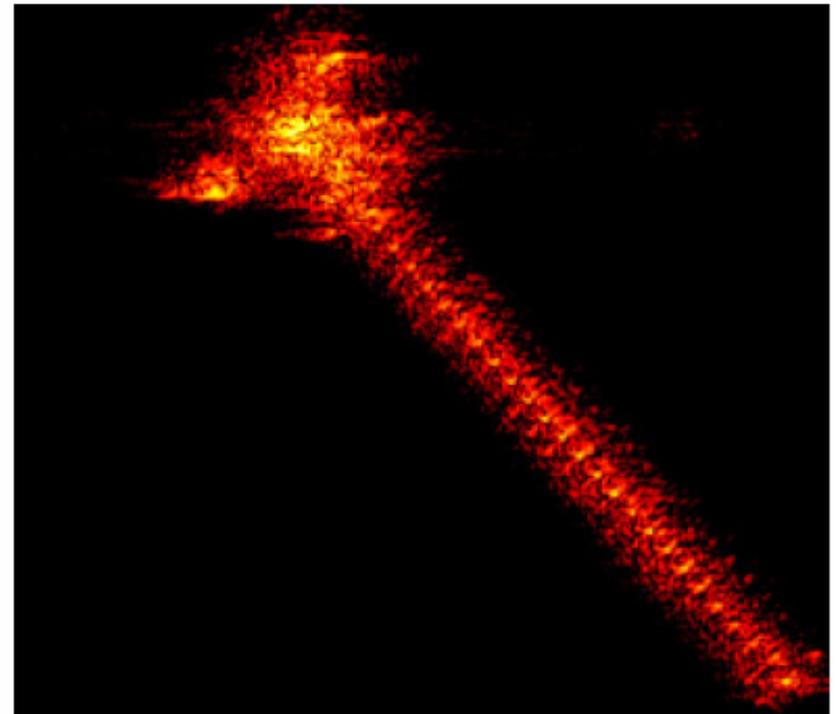
Main Bus Voltage & USB Transmission Power during the visibility of Maspalomas Station

Block Diagram for Electrical System



FGAN Image

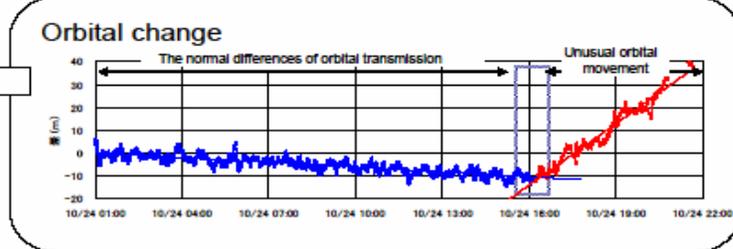
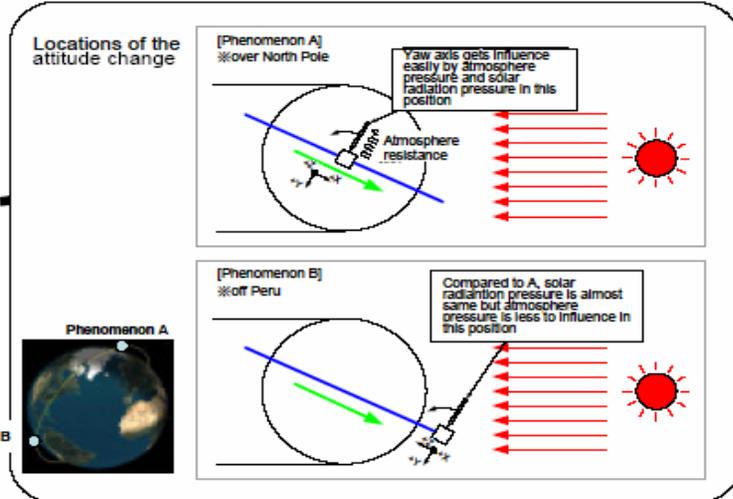
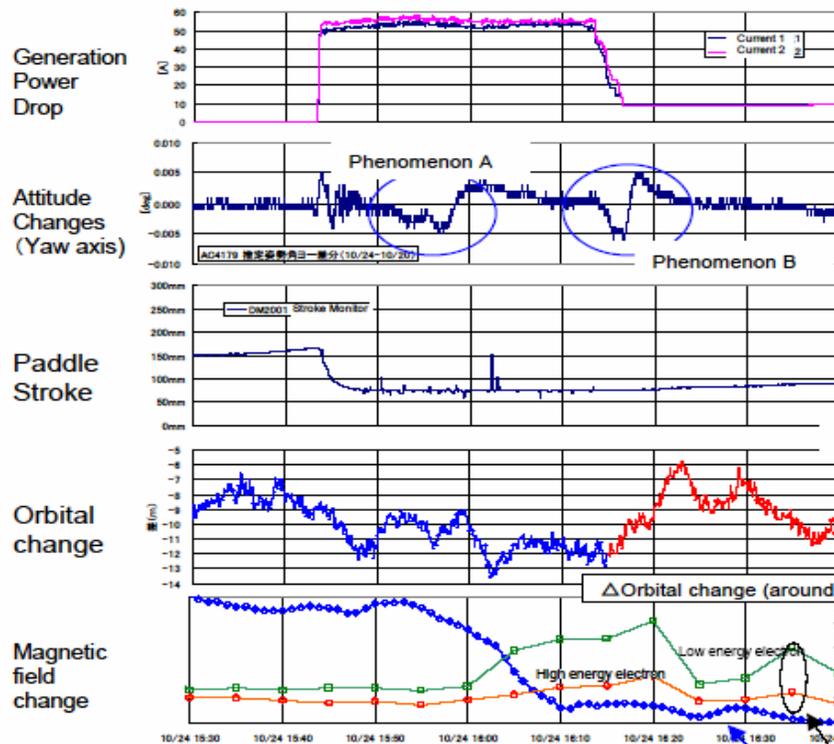
- ADEOS- II Image by Inverse Synthetic Aperture Rader (ISAR) with cooperation of FGAN



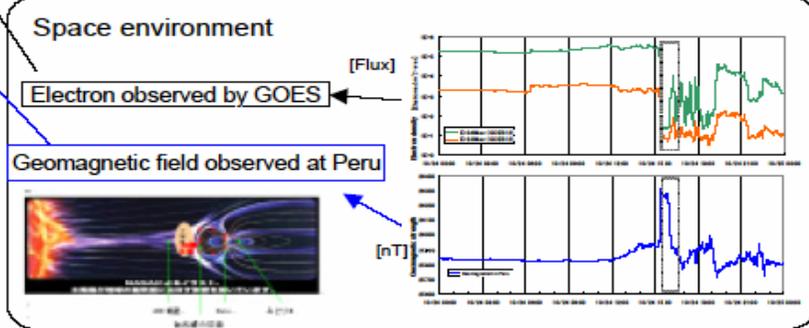
FGAN : Forschungsgesellschaft fuer Angewandte
Naturwissenschaften e.V.

FHR : Forschungsinstitut für
Hochfrequenzphysik und Radartechnik

Attitude and Orbit Changes



Related phenomena during the generation power drop



Fault Tree Analysis

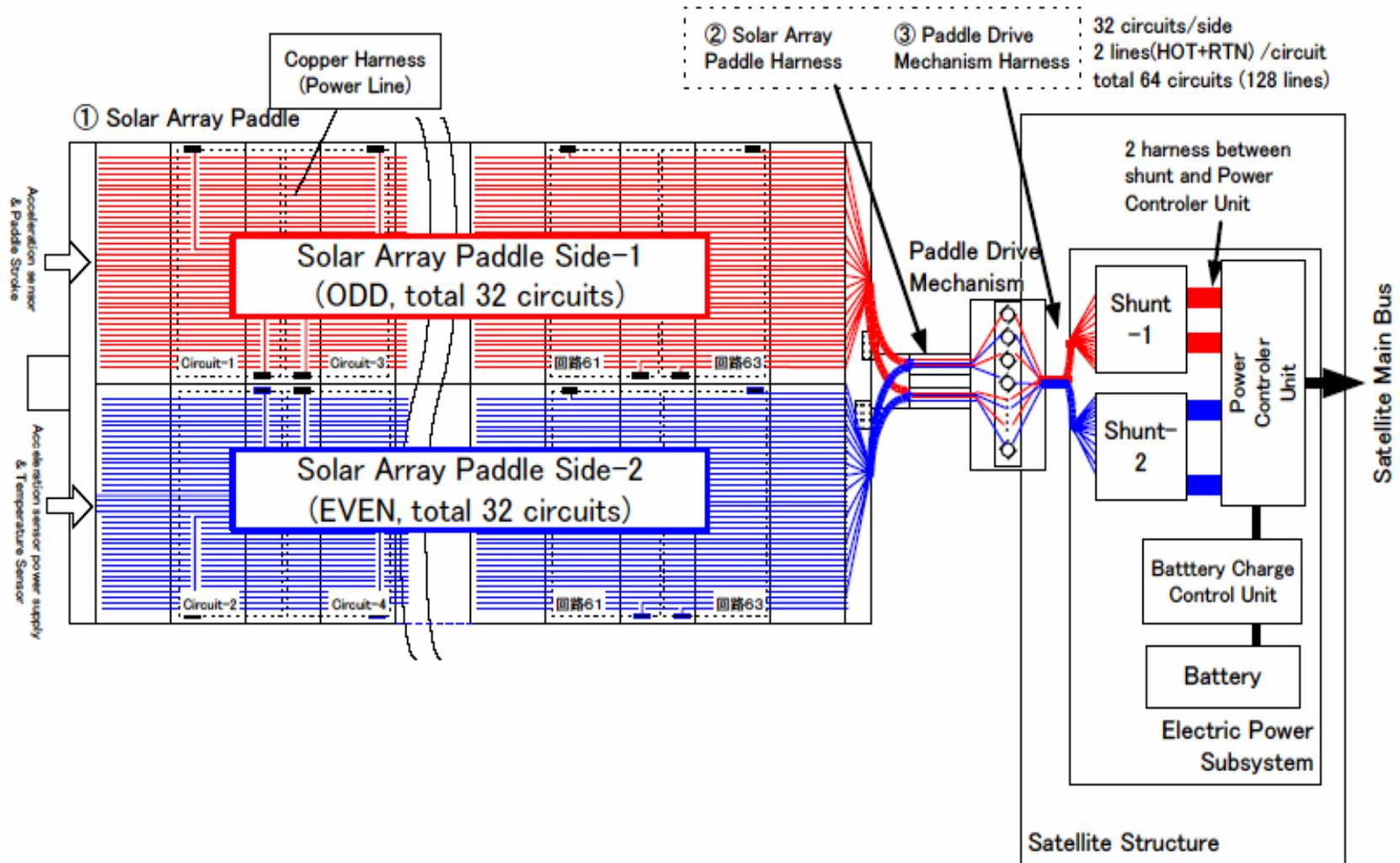
[FACTS]

- Generation power dropped by 100 W step
- Similar behavior in both power circuit sides
- Temperature decreased at PDM
- No anomaly in PDL stroke and tension telemetry

[FTA]

- Fault Tree Analysis has provided the possible locations;
 - 1) Solar Array Paddle
 - 2) Solar Array Paddle Harness

Electrical Systems



Hypotheses

1) Solar Array Paddle

1-1) Short between Cell and Harness

1-2) Short in Blanket joints

1-3) Open in Blanket joints

1-4) Short between Cells

2) Solar Array Paddle Harness

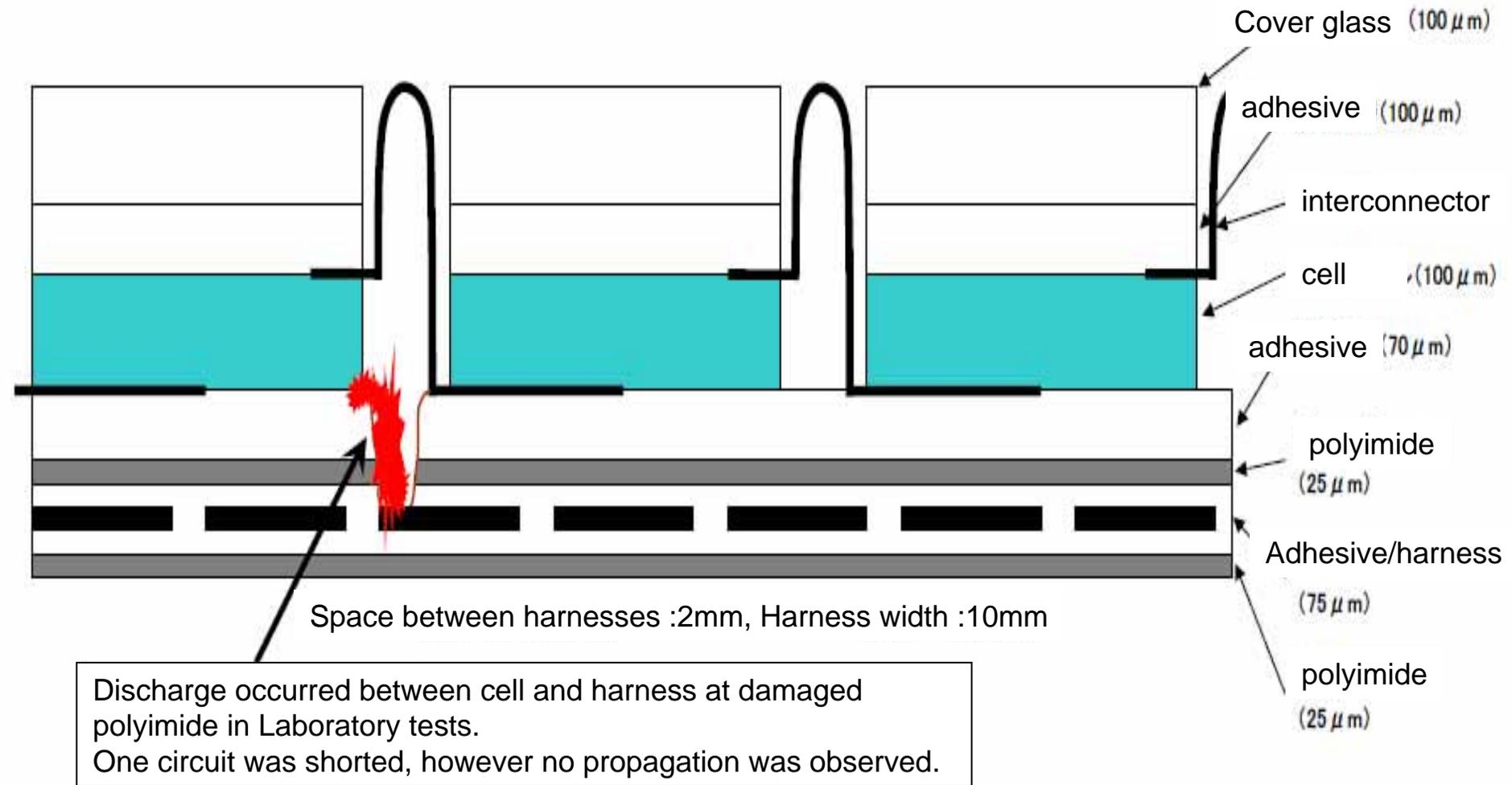
2-1) Short in Harness by discharge

2-2) Open in Harness by discharge

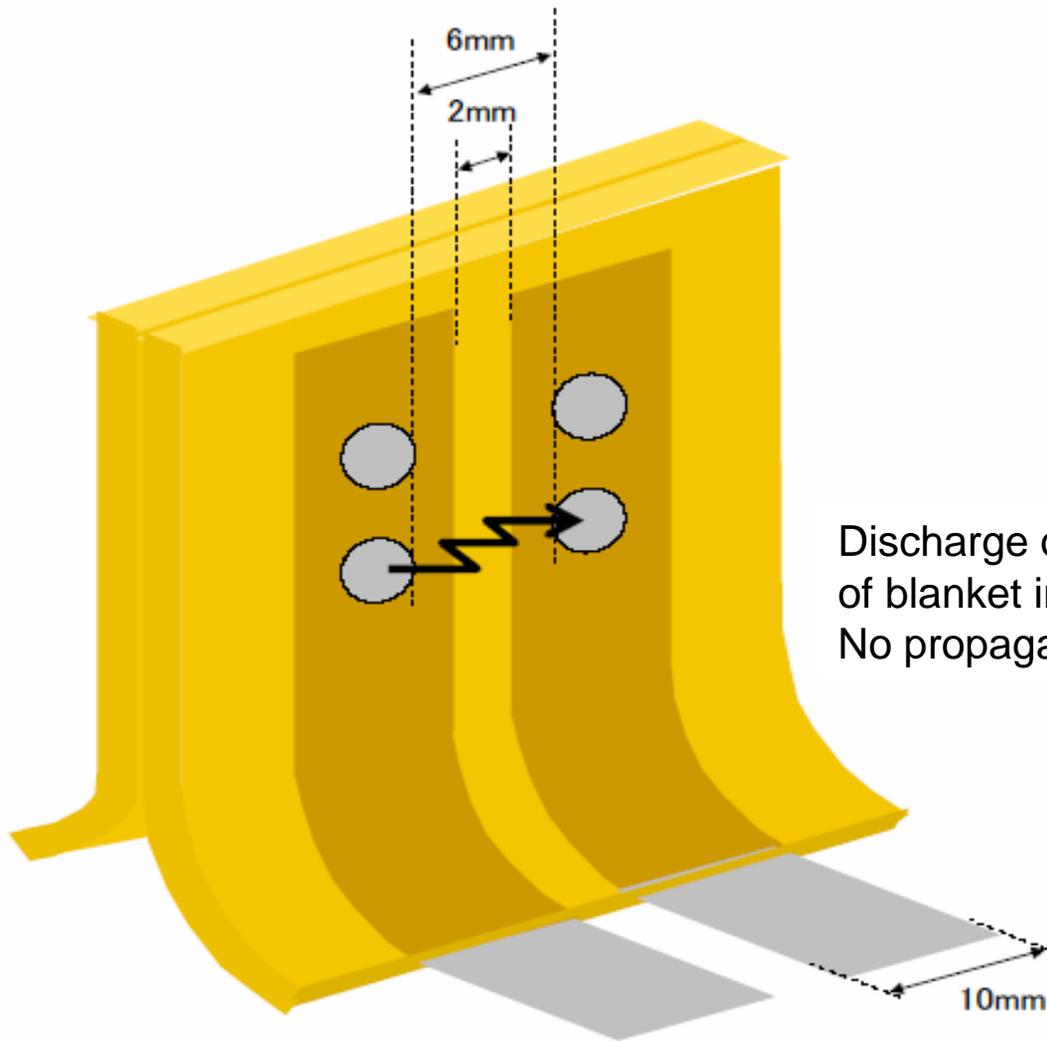
2-3) Short in Harness by mechanical reasons

2-4) Open in Harness by mechanical reasons

Hypothesis 1-1

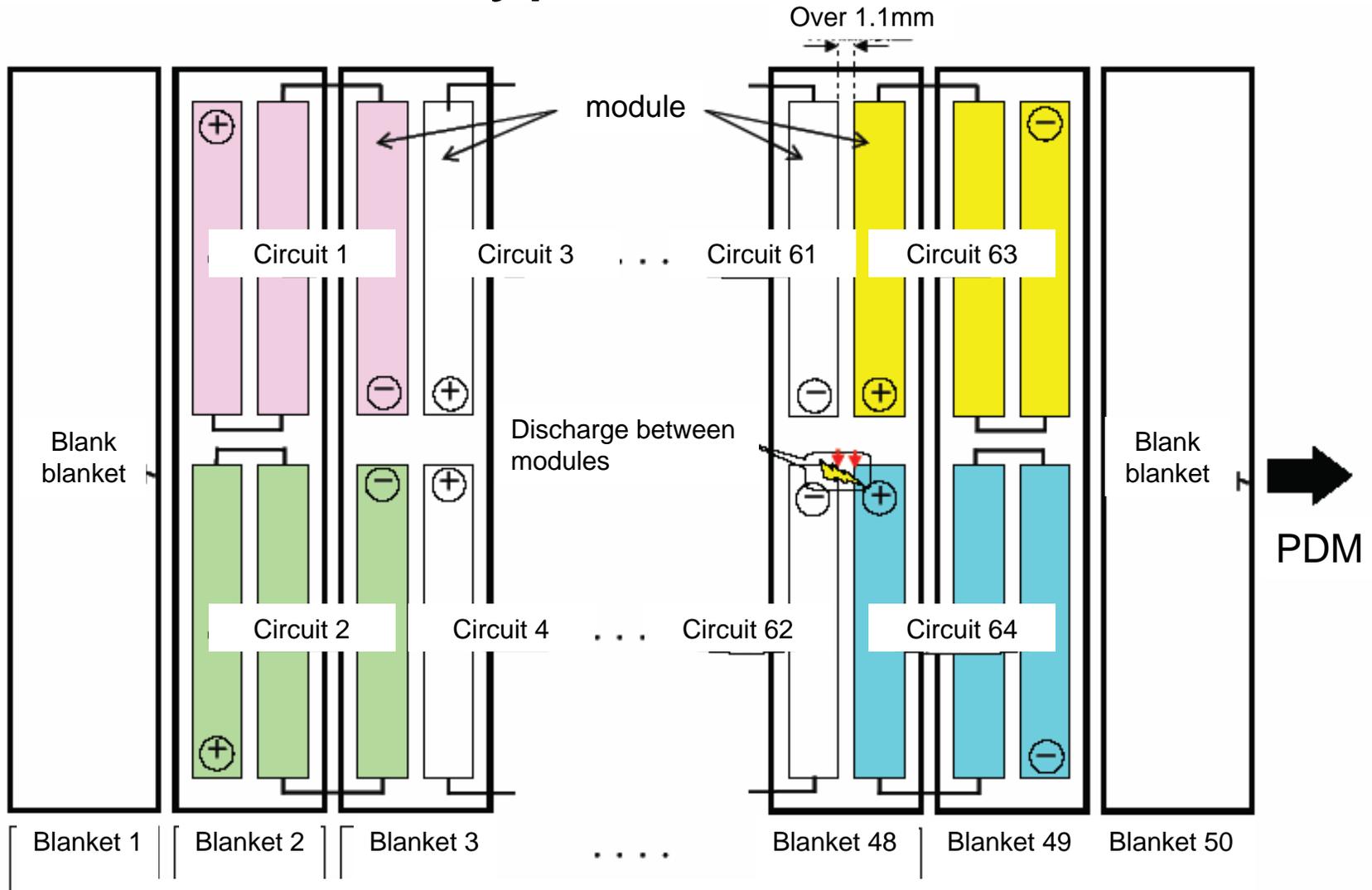


Hypothesis 1-2 and 1-3



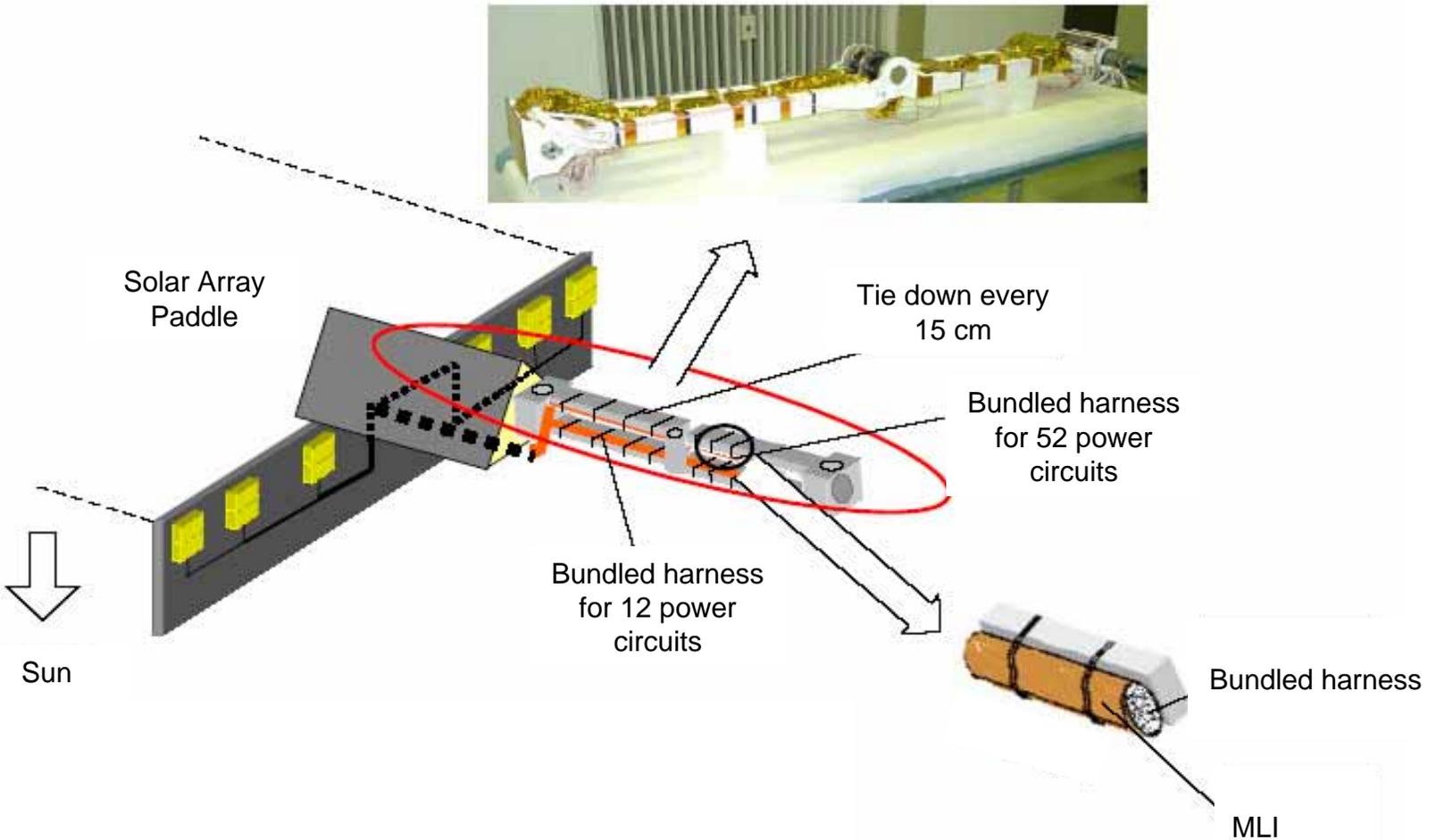
Discharge occurred between lands in joint of blanket in laboratory tests.
No propagation observed.

Hypothesis 1-4



Discharge occurred between modules in laboratory tests when voltage potential was greater than 130V. No propagation was observed. .

Hypothesis 2-1 to 2-4

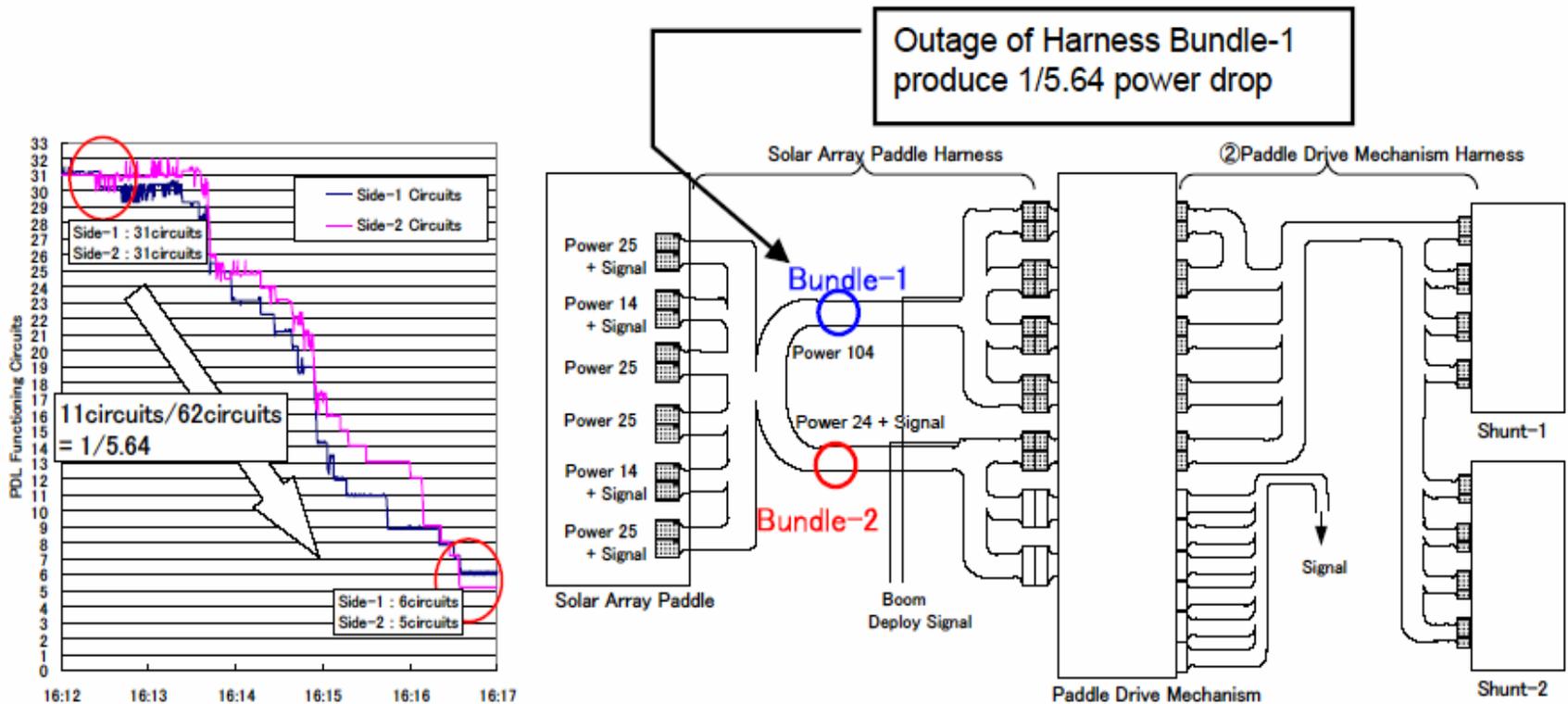


MLI surrounding harness did NOT ground. MLI might be charged up when spacecraft passed auroral bands.

Photo of Solar Array Harness



Bundled Harness

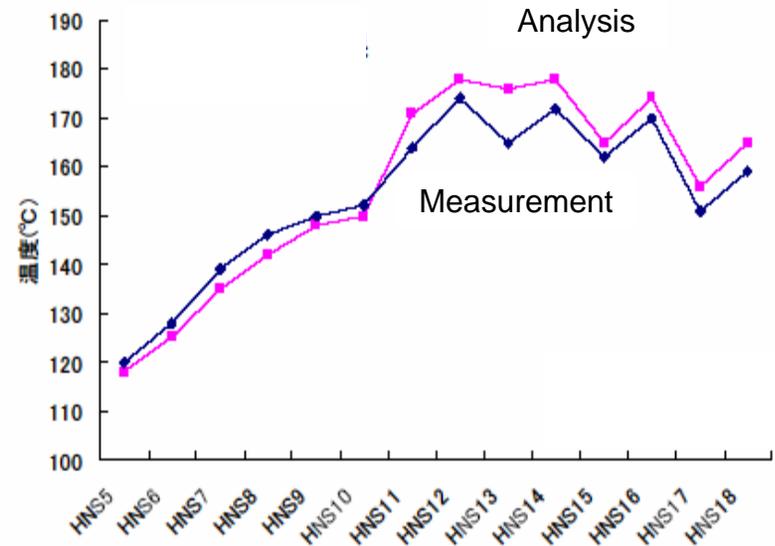
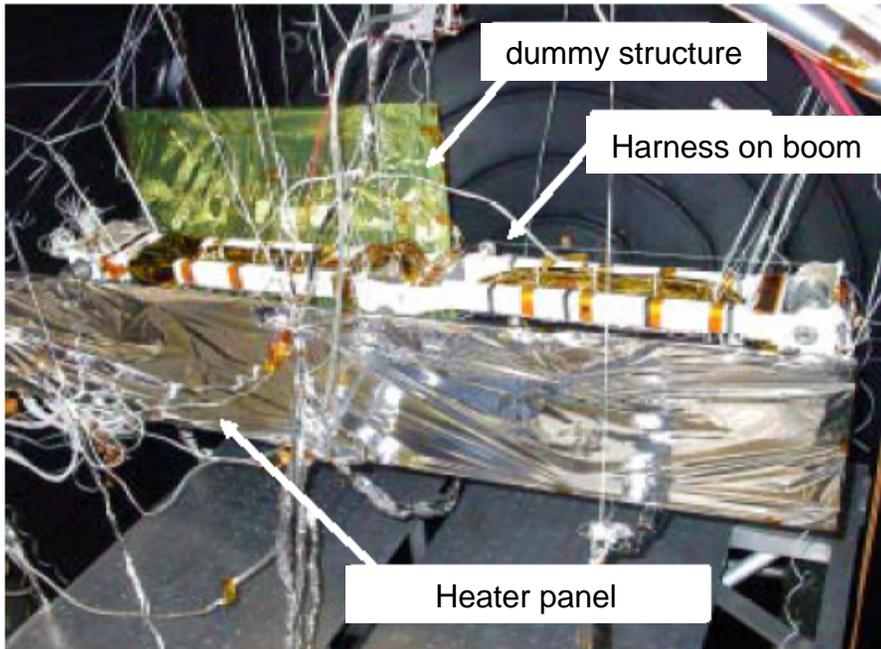


Solar Paddle Harness outage is considered to have the highest possibility.
 → Anomaly on the one of two bundled harness can explain TLM behavior very well.

Scenario for Hypothesis 2-1 and 2-2

- 0) Cracks on Harness insulator
- 1) MLI was charged up
- 2) Trigger arc between MLI and Harness
- 3) Sustained arc (arc tracking) between Harnesses
- 4) Heat propagated in bundle
- 5) Short or Open circuit of power line

Temperature of Harness



Highest temperature of the harness might be 245 degree C. Temperature rating for the harness is 200 degree C.

High temperature produced outgas and discharge might occur easily.

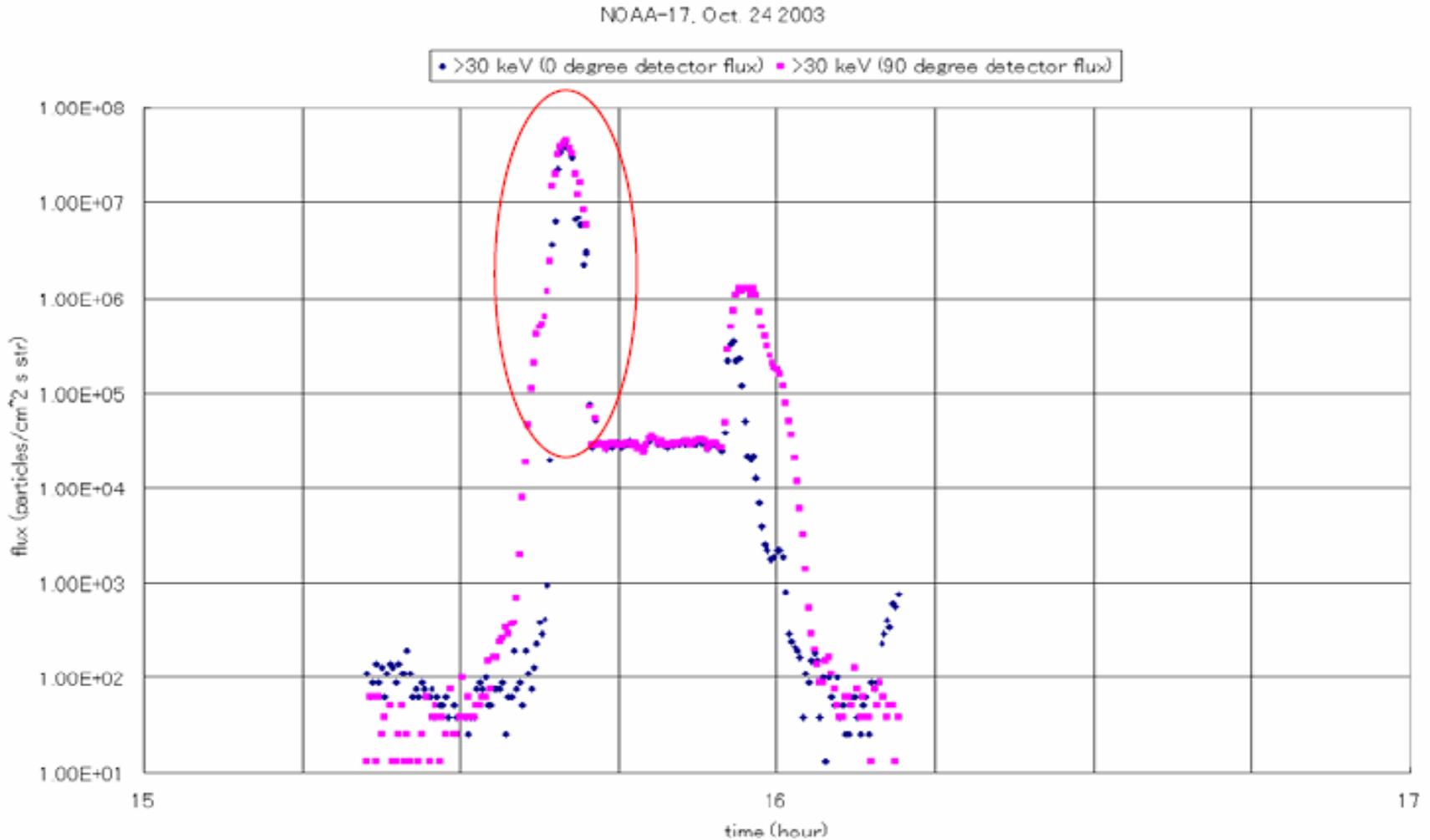
High temperature might produce insulator cracks. 21

Cracks on Harness Insulator



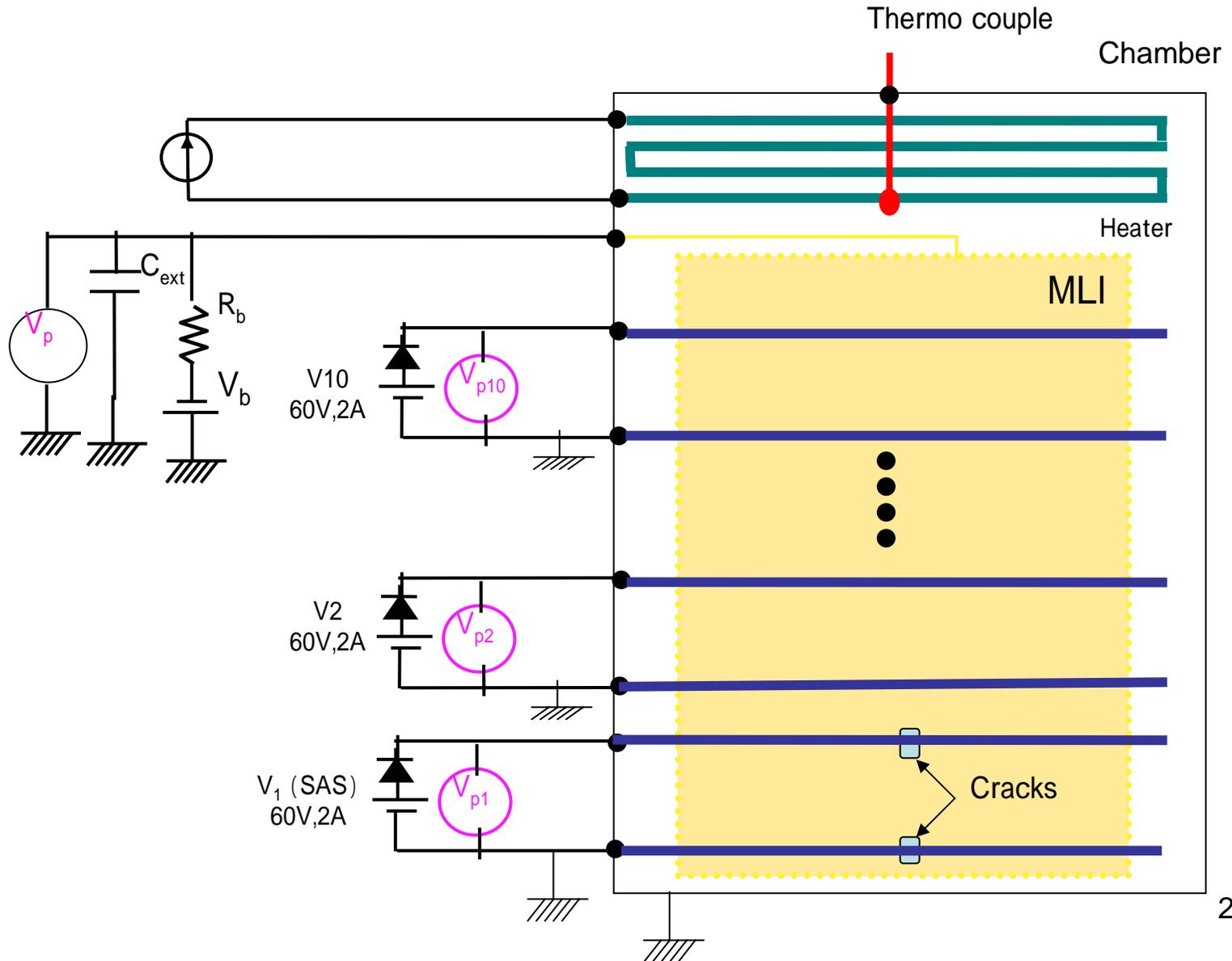
Cracks were found on harness insulator after thermal cycle laboratory test. (100 – 250 degree C)
Another possibility is that space debris made cracks on-orbit.

Energetic Electron on 24/10/2003

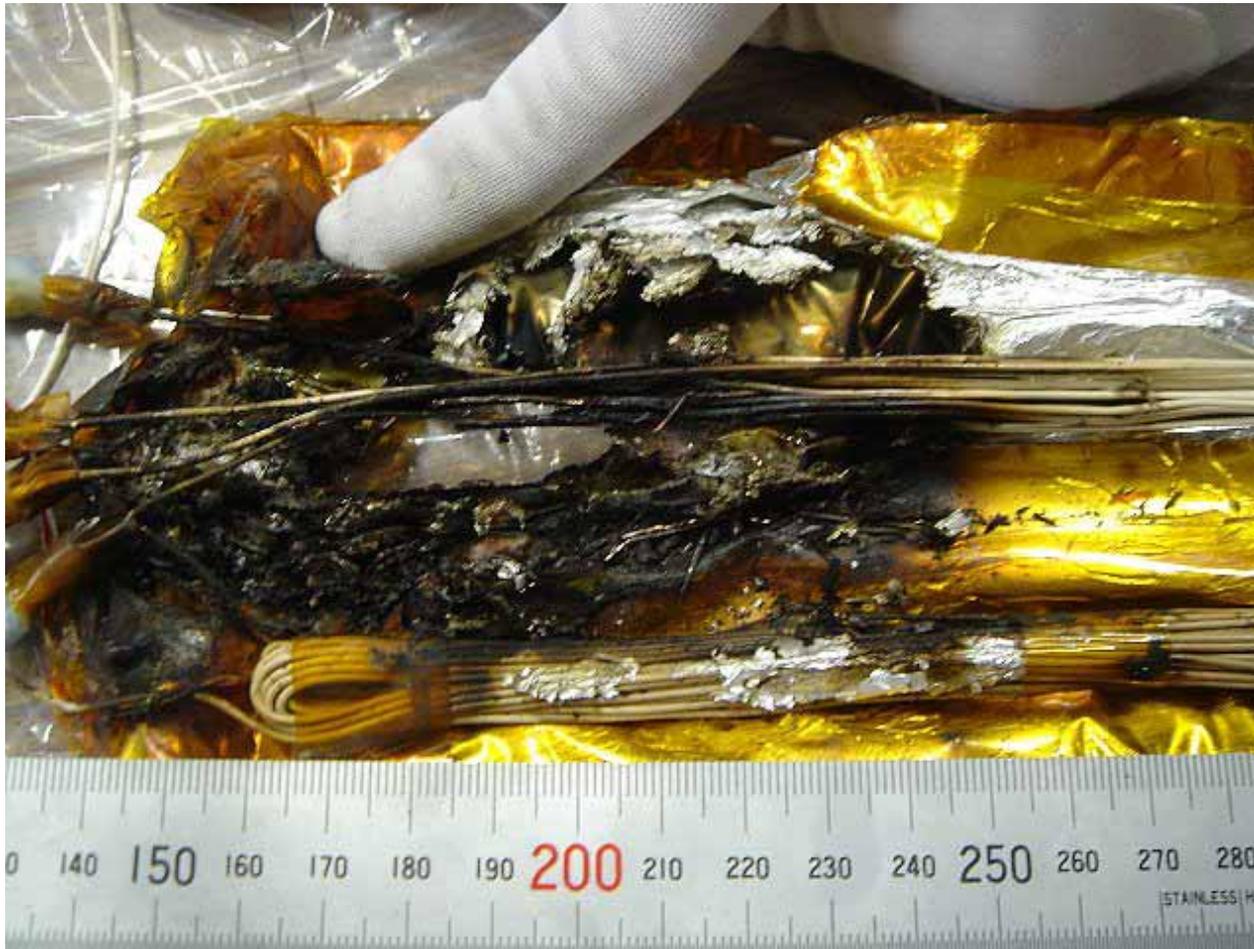


High electron flux might make MLI charged up.

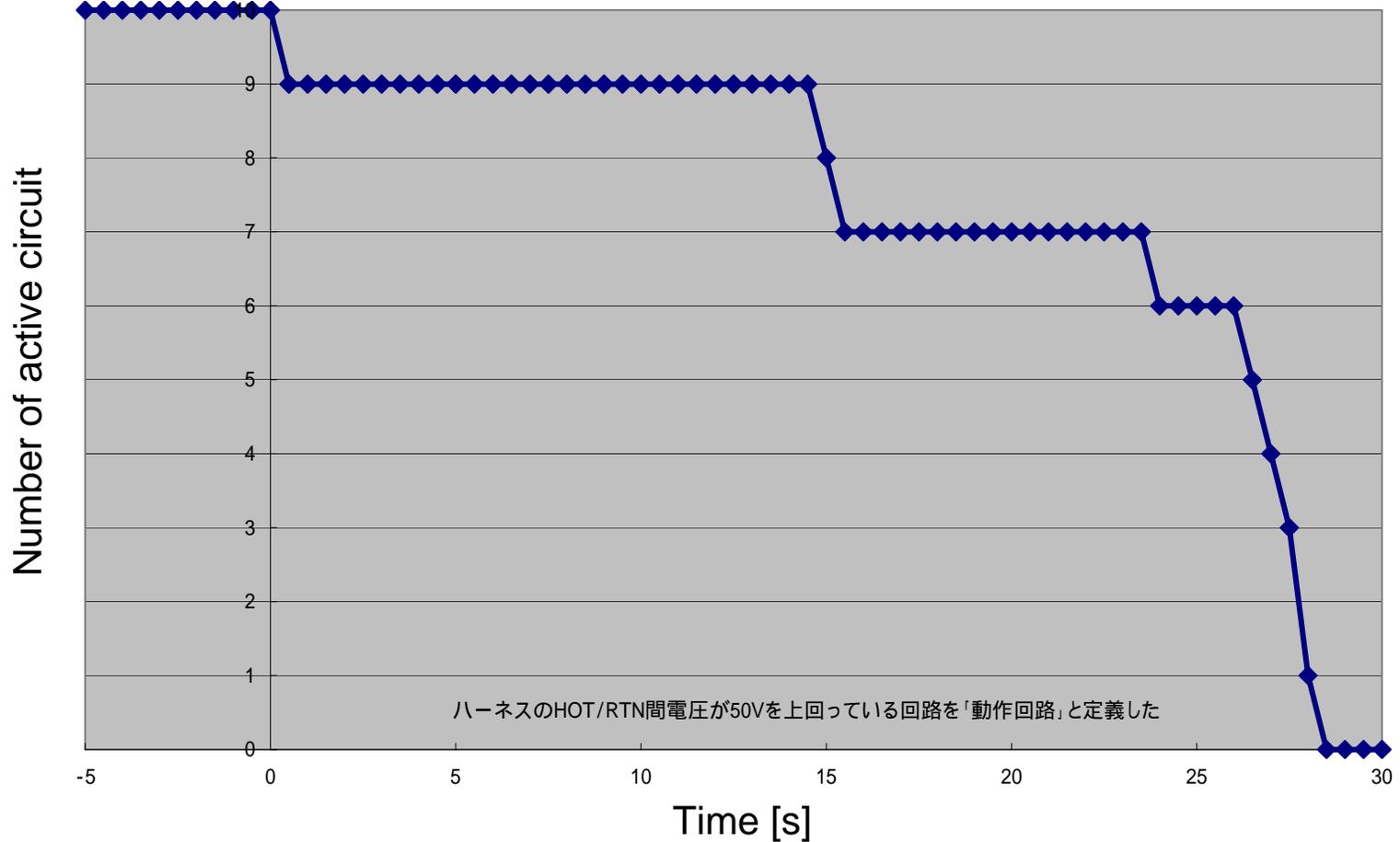
Laboratory Discharge Test Configuration



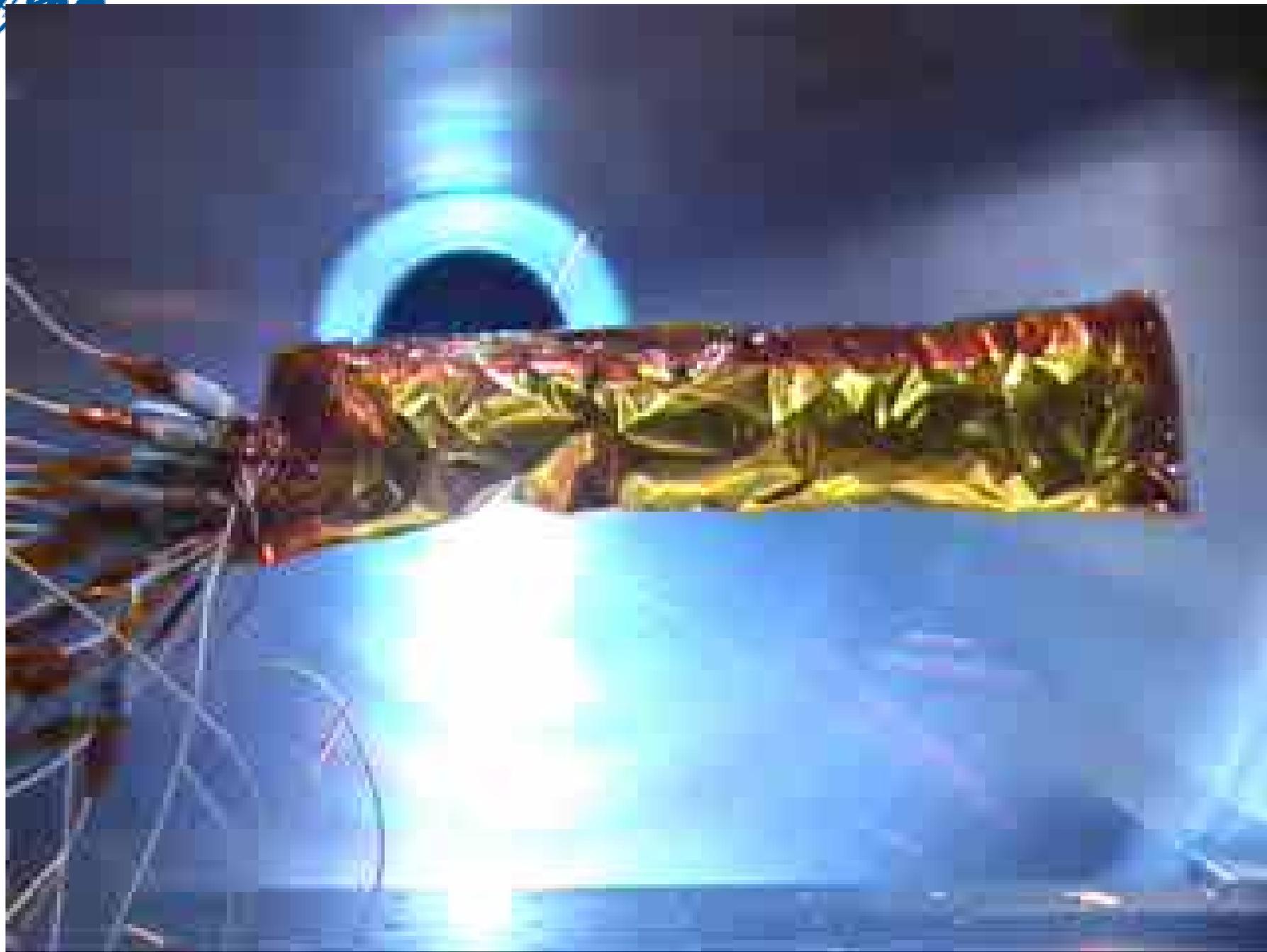
Laboratory Discharge Test Photo



Laboratory Discharge Test Result



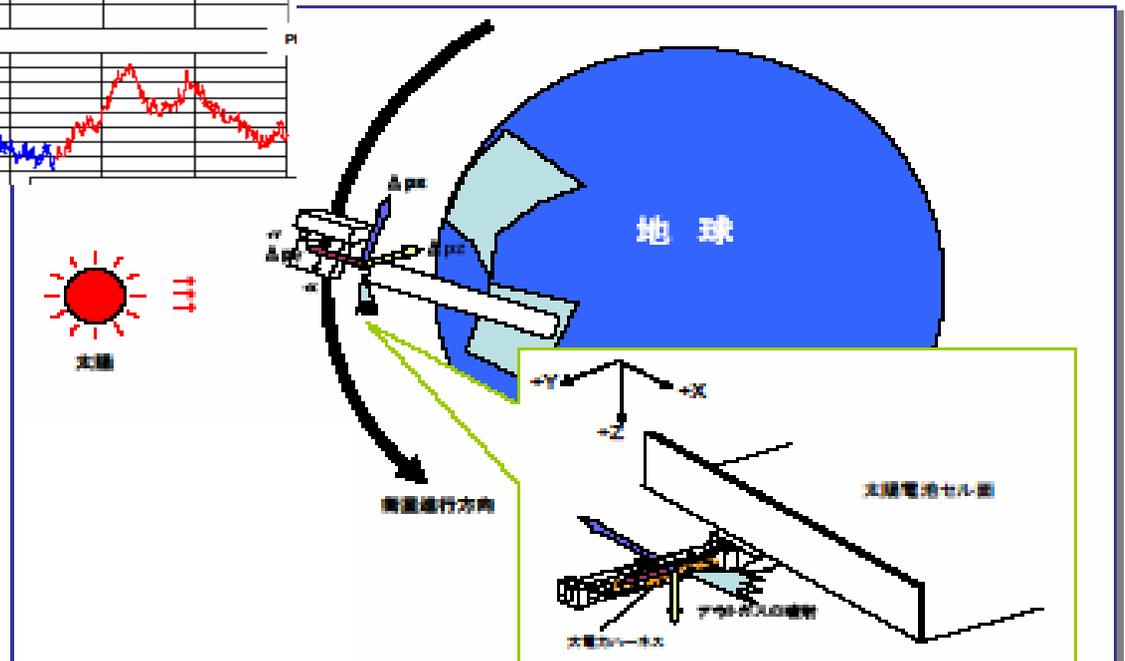
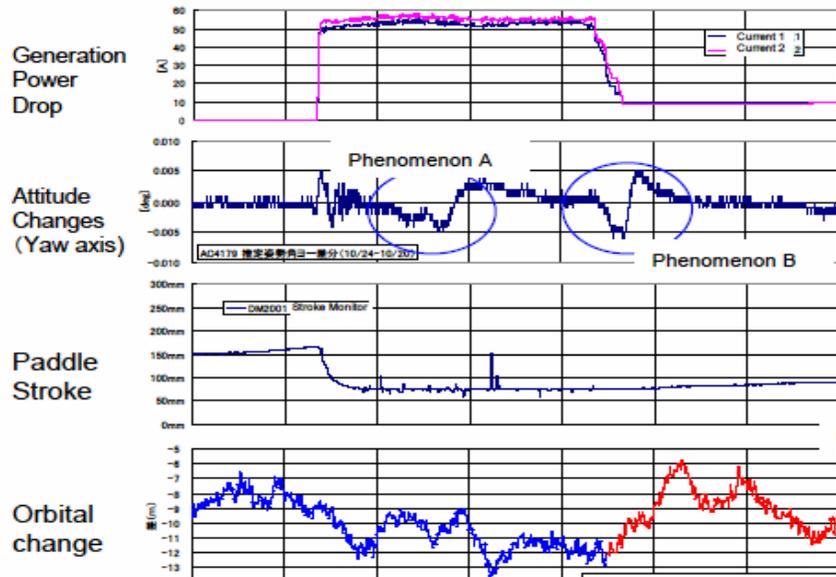








Outgas from Harness



Outgas from harness can explain attitude and orbit changes.

Hypothesis 2-3 and 2-4

- If a pair of wires are close each other and electrical resistance becomes as low as tracking, arc tracking occurs and heat may propagate in bundle.

Conclusion

- Discharge in Solar Array Paddle Harness is the most possible scenario.
- Floating MLI and hot harness might produced the anomaly.
- It is new knowledge that sustained arc could occur on 60 V harness.
- Another scenarios also have possibility.
- Investigation report will be issued soon and JAXA's following programs will reflect the suggestions in the report.