# Chapter 7 - Data Return

## Contents

## Introduction to Chapter 7

This chapter is a report on the NIMS data return for the G2 orbit. Due to the low downlink data rates available for Galileo Jupiter Operations and other unforeseen and unpredictable events during the G2 Encounter and Cruise, not all NIMS data recorded on the tape recorder or selected in real-time were returned. The previous 6 chapters nominally describe the planning and intention of the NIMS observations for this orbit, except the obstab section in chapter 4 which was updated to give the latest parameters for the data that were actually returned.

The G2 orbit was the first time that NIMS was able to reload its phase2 RAM software from CDS to restart NIMS after the processor had halted due to radiation hits. Three NIMS software reloads were inserted into the G2 command sequence to protect as many observations as possible. The NIMS processor did halt in the middle of the G2 encounter, but fortuitously only two and one half observations were lost, due to a timely reload of the NIMS software. The NIMS software halt was detected by monitoring the SCLK values returned in the NIMS engineering telemetry.

In G2, only two software reloads were originally in the encounter sequence, but it was realized that a third reload was needed close to perijove. This third reload was added at the end of the sequence generation process as an RBS (reserve box sequence). It was this third RBS reload that saved NIMS from losing a large number of post perijove observations (See the orbit plot on page 3 for the timing of the reloads).

The plots on the pages 3 and 4 show the geometry of the NIMS G2 observations using a north trajectory pole projection. The 'returned' observations are in Bold characters and the 'non-returned' in gray.

The spreadsheets on pages 5 to 8 summarize the 'final' playback model for the 'returned' data.

The text on page 9 gives a 'recap' of the G2 playback events which affected which observations were returned.

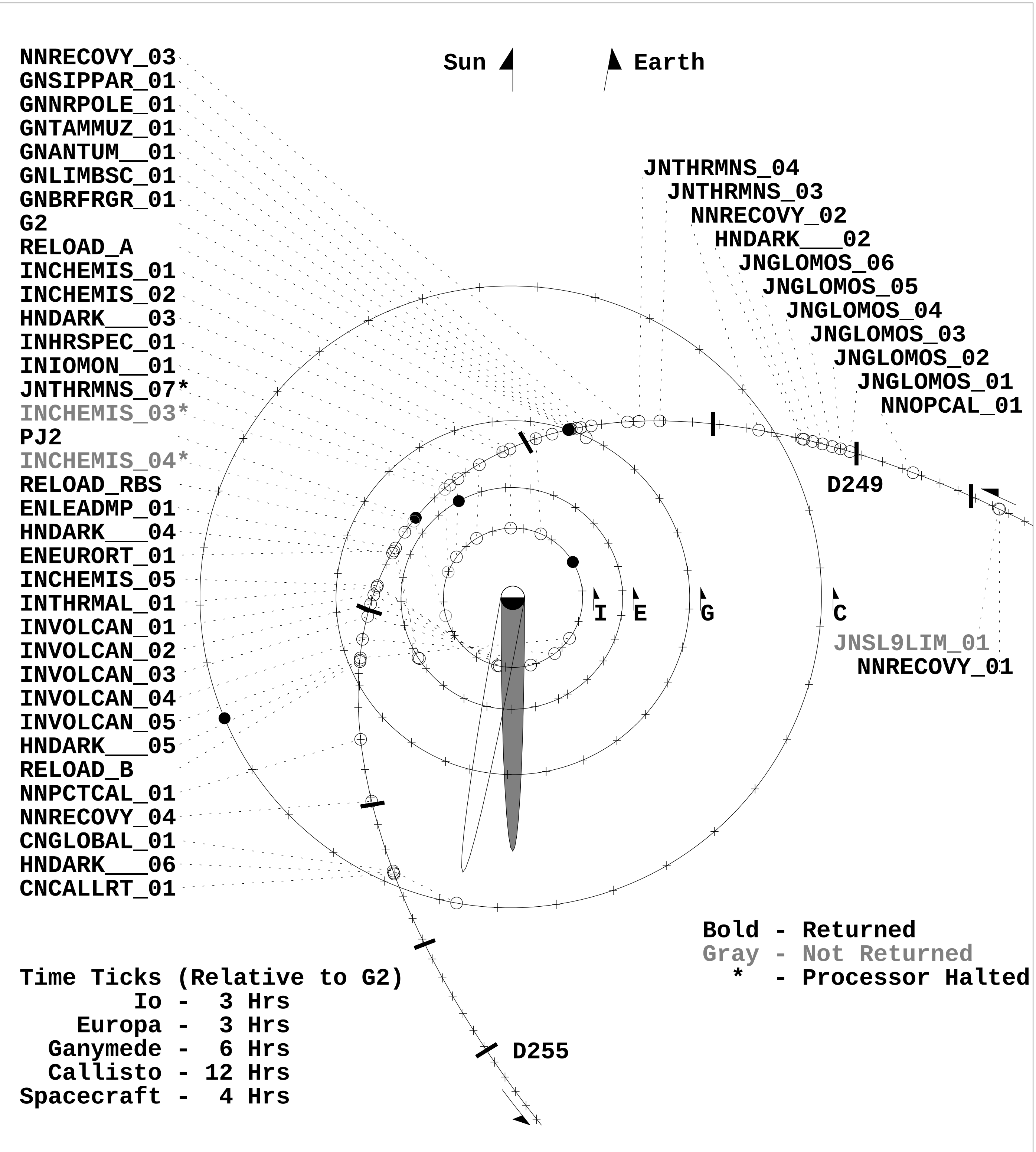
A Timeline of G2 playback events is on page 10.

The text on pages 11 to 12 describe the G2 NIMS Anomaly.

The text on pages 13 gives a brief discussion of the NIMS data files. Additional information about NIMS data formats, data types, data labels and data access is given on pages 14 and 15.

The text on page 16 is a guide to understanding the NIMS MASK.

# NIMS G2 OBSERVATIONS

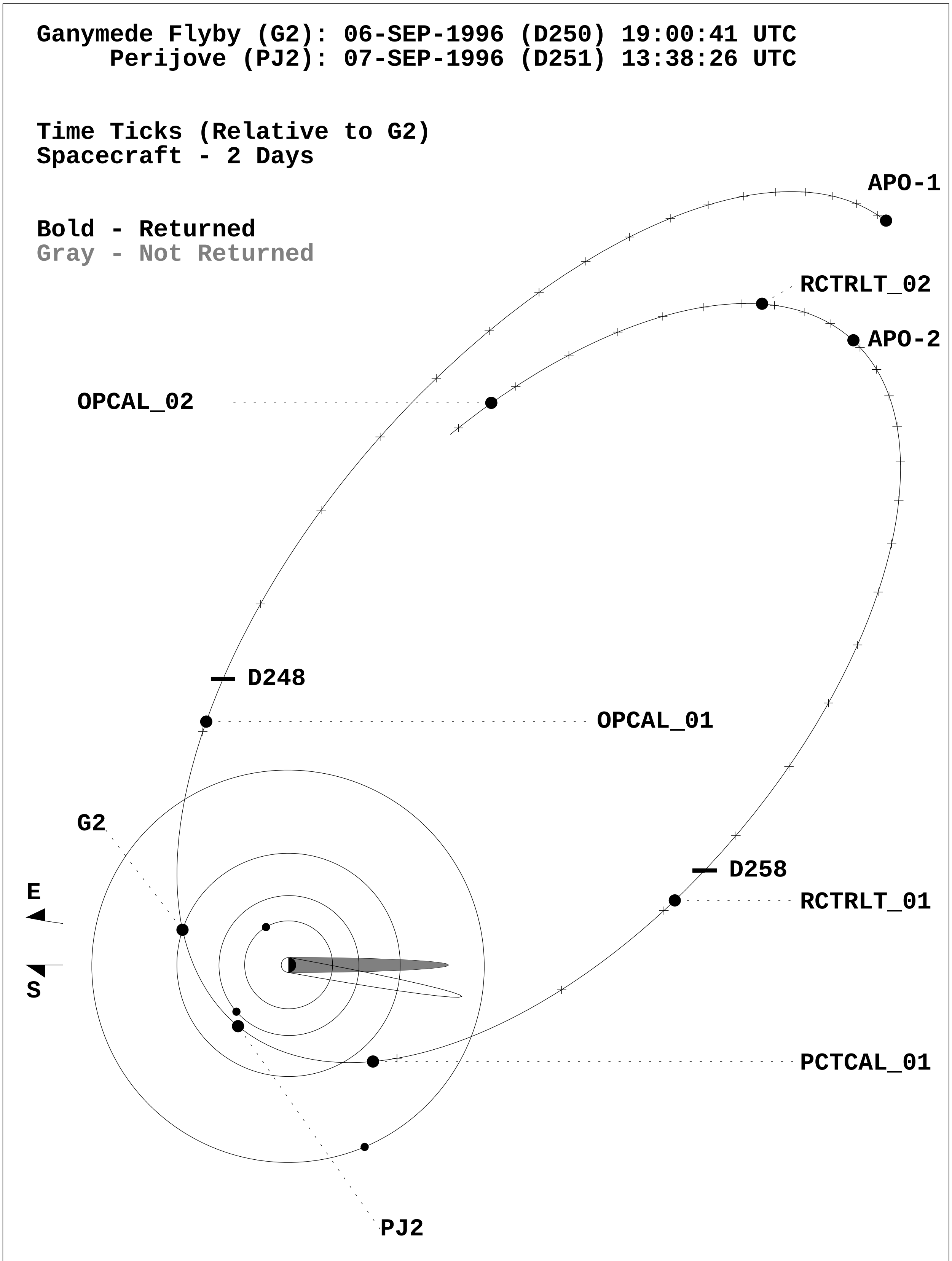



Ganymede Flyby (G2): 06-SEP-1996 (D250) 19:00:41 UTC
Perijove (PJ2): 07-SEP-1996 (D251) 13:38:26 UTC

G2 North Trajectory Pole View

NIMS - FEL - 08/14/98

# NIMS G2 CALIBRATIONS




G2 North Trajectory Pole View, Apoapsis to Apoapsis

# NIMS G2 DATA RETURN

| Activity ID | Observation Title | Mode | Gain | Record Format | NIMS Edit Table | NIMS PB Table | Extra Det | Grating Start | Grating Offset |
|---|---|---|---|---|---|---|---|---|---|
| G2NNRECOVY01- | G2 RECOVERY (Health) 1 | LM | 2 | R/T | G2RCVY3 | | | 0 | 4 |
| G2NNOPCAL_01- | OPCAL #1 | LM | 4 | R/T | G2OPCAL48 | | | 0 | 4 |
| G2JNGLOMOS01- | JUPITER GLOBAL MOSAIC PART 1 | XM | 2 | LPU | G2JGM10A | G2JGM05A | | 5 | 4 |
| G2JNGLOMOS02- | JUPITER GLOBAL MOSAIC PART 2 | XM | 2 | LPU | G2JGM10A | G2JGM05A | | 5 | 4 |
| G2JNGLOMOS03- | JUPITER GLOBAL MOSAIC PART 3 | XM | 2 | LPU | G2JGM10A | G2JGM05A | | 5 | 4 |
| G2JNGLOMOS04- | JUPITER GLOBAL MOSAIC PART 4 | XM | 2 | LPU | G2JGM10A | G2JGM05A | | 5 | 4 |
| G2JNGLOMOS05- | JUPITER GLOBAL MOSAIC PART 5 | XM | 2 | LPU | G2JGM10A | G2JGM05A | | 5 | 4 |
| G2JNGLOMOS06- | JUPITER GLOBAL MOSAIC PART 6 | XM | 2 | LPU | G2JGM10A | G2JGM05A | | 5 | 4 |
| G2HNDARK 02- | DARK OBSERVATION NO. 2 | LM | 2 | LPU | G2DRK34 | G2DRK34 | | 0 | 4 |
| G2NNRECOVY02- | G2 RECOVERY (Health) 2 | LM | 2 | R/T | G2RCVY3 | | | 0 | 4 |
| G2JNTHRMNS03- | JUPITER NORTH/SOUTH STRIPES 3 | LM | 2 | LPU | G2J5M253A | G2J5M80A | | 0 | 4 |
| G2JNTHRMNS04 | JUPITER NORTH/SOUTH STRIPES 4 | LM | 2 | LPU | G2J5M253A | G2J5M80A | | 0 | 4 |
| G2NNRECOVY03- | G2 RECOVERY (Health) 3 | LM | 2 | R/T | G2RCVY3 | | | 0 | 4 |
| G2GNSIPPAR01 | Ganymede Regional Map of Sippar | LM | 2 | LPU | G2GLM245B | G2GLM204 | | 0 | 4 |
| G2GNNRPOLE01- | North Pole Region Map | FM | 3 | MPW | G2GFM221 | G2GFM204 | | 0 | 4 |
| G2GNTAMMUZ01- | TAMMUZ BRIGHT RAYED CRATER | LM | 2 | LPU | G2GLM245C | G2GLM204 | | 0 | 4 |
| G2GNANTUM 01- | ANTUM DARK RAYED CRATER | FM | 2 | MPW | G2GFM221 | G2GFM204 | | 0 | 4 |
| G2GNLIMBSC01+ | LIMB SCAN FOR ATMOSPHERE | XS | 4 | MPW | G2GXS17 | G2GXS003 | | 1 | 4 |
| G2GNBRFRGR01- | BRFRGR BRIGHT FROST GROOVES | FM | 3 | MPW | G2GFM221 | G2GFM204 | | 0 | 4 |
| G2INCHEMIS01- | MONITORING OF IO'S DAYSIDE | LM | 2 | MPW | G2ILM245 | G2ILM228 | 9,10 | 0 | 4 |
| G2INCHEMIS02- | MONITORING OF IO'S DAYSIDE | LM | 2 | LPU | G2ILM245 | G2ILM228 | 9,10 | 0 | 4 |
| G2HNDARK 03- | DARK OBSERVATION NO. 3 | LM | 3 | MPW | G2DRK34 | G2DRK34 | | 0 | 4 |
| G2INHRSPEC01- | MONITORING OF IO'S DAYSIDE | LM | 2 | MPW | G2ILM442 | G2ILM408 | | 0 | 4 |

# NIMS G2 DATA RETURN

| ACTID | Obs Cost Tics | Wave-lengths ret | Record Time (sec) | PB Time (sec) | Sel Bits of Tape SBOT (Mb) | Total Bits of Tape BOT (Mbits) | Mode cycle time (sec) | R/T BTG Mbits | Thold | Comp | Total BTG Mbits (4% ohead) | Data Reduct Factor (SBOT/BTG) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| G2NNRECOVY01- | | 3 | | | | | 8.667 | 0.00 | | | | |
| G2NNOPCAL_01- | | 48 | | | | | 8.667 | 0.00 | | | | |
| G2JNGLOMOS01- | 139.6145 | 5 | 591 | 589 | 3.64 | 3.65 | 0.361 | | 0 | 2.11 | 0.805 | 4.52 |
| G2JNGLOMOS02- | 139.6145 | 5 | 591 | 589 | 3.64 | 3.65 | 0.361 | | 0 | 2.11 | 0.805 | 4.52 |
| G2JNGLOMOS03- | 139.6145 | 5 | 591 | 590 | 3.64 | 3.65 | 0.361 | | 0 | 1.98 | 0.858 | 4.24 |
| G2JNGLOMOS04- | 139.6145 | 5 | 591 | 590 | 3.64 | 3.65 | 0.361 | | 0 | 1.96 | 0.867 | 4.20 |
| G2JNGLOMOS05- | 139.6145 | 5 | 591 | 590 | 3.64 | 3.65 | 0.361 | | 0 | 1.98 | 0.858 | 4.24 |
| G2JNGLOMOS06- | 139.6145 | 5 | 591 | 590 | 3.64 | 3.65 | 0.361 | | 0 | 1.95 | 0.872 | 4.17 |
| G2HNDARK 02- | 16.1579 | 34 | 65 | 65 | 0.40 | 0.40 | 8.667 | | 0 | 3.52 | 0.015 | 26.61 |
| G2NNRECOVY02- | | 3 | | | | | 8.667 | 0.00 | | | | |
| G2JNTHRMNS03- | 351.9671 | 80 | 1497 | 353 | 2.18 | 9.24 | 8.667 | | 0 | 1.44 | 0.470 | 4.63 |
| G2JNTHRMNS04- | 350.4177 | 80 | 1491 | 27 | 0.16 | 9.19 | 8.667 | | 0 | 2.49 | 0.021 | 8.00 |
| G2NNRECOVY03- | | 3 | | | | | 8.667 | 0.00 | | | | |
| G2GNSIPPAR01- | 157.4245 | 204 | 667 | 118 | 0.73 | 4.12 | 8.667 | | 0 | 2.26 | 0.256 | 2.85 |
| G2GNNRPOLE01- | 1025.4771 | 204 | 1163 | 340 | 3.93 | 13.44 | 4.333 | | 0 | 1.70 | 1.959 | 2.01 |
| G2GNTAMMUZ01- | 129.9200 | 204 | 550 | 545 | 3.36 | 3.39 | 8.667 | | 0 | 2.32 | 1.151 | 2.92 |
| G2GNANTUM 01- | 255.5379 | 204 | 287 | 286 | 3.31 | 3.32 | 4.333 | | 0 | 2.14 | 1.309 | 2.53 |
| G2GNLIMBSC01+ | | 3 | 182 | 181 | 2.10 | 2.10 | 0.167 | | 0 | 2.27 | 0.299 | 7.01 |
| G2GNBRFRGR01- | 147.7434 | 204 | 165 | 161 | 1.86 | 1.90 | 4.333 | | 2 | 1.59 | 0.990 | 1.88 |
| G2INCHEMIS01- | 183.1745 | 228 | 205 | 199 | 2.30 | 2.37 | 8.667 | | 2 | 1.25 | 0.870 | 2.64 |
| G2INCHEMIS02- | 58.5061 | 228 | 245 | 243 | 1.50 | 1.51 | 8.667 | | 0 | 1.15 | 1.155 | 1.30 |
| G2HNDARK 03- | 59.8358 | 34 | 65 | 65 | 0.75 | 0.75 | 8.667 | | 0 | 1.85 | 0.029 | 26.20 |
| G2INHRSPEC01- | 252.6076 | 408 | 284 | 283 | 3.27 | 3.28 | 8.667 | | 0 | 1.12 | 2.471 | 1.32 |

# NIMS G2 DATA RETURN

| Activity ID | Observation Title | Mode | Gain | Record Format | NIMS Edit Table | NIMS PB Table | Extra Det | Grating Start | Grating Offset |
|---|---|---|---|---|---|---|---|---|---|
| G2INIOMON_01 | Io Monitoring in Real Time | XM | 2 | R/T | G2IXM8RT | | | 21 | 4 |
| G2JNTHRMNS07- | JUPITER NORTH/SOUTH STRIPES 7 | LM | 2 | LPU | G2J5M253A | G2J5M80A | | 0 | 4 |
| G2ENLEADMP01- | EUROPA LEAD MAP | LM | 3 | LPU | G2ELM245 | G2ELM204 | | 0 | 4 |
| G2HNDARK 04- | DARK OBSERVATION NO. 4 | LM | 3 | MPW | G2DRK34 | G2DRK34 | | 0 | 4 |
| G2ENEURORT01 | Europa Monitoring in Real Time | LM | 3 | R/T | G2ELM442 | | | 0 | 4 |
| G2INCHEMIS05- | MONITORING OF IO'S DAYSIDE | LM | 2 | MPW | G2ILM442 | G2ILM102 | | 0 | 4 |
| G2INTHRMAL01- | MONITORING OF IO'S NIGHTSIDE | LM | 4 | LPU | G2ILMDK245 | G2ILMDK10 | | 0 | 4 |
| G2INVOLCAN01- | MONITORING OF SELECTED VOLCANICS | LM | 2 | LPU | G2ILMDK245 | G2ILMDK10 | | 0 | 4 |
| G2INVOLCAN02- | MONITORING OF SELECTED VOLCANICS | LM | 2 | LPU | G2ILMDK245 | G2ILMDK10 | | 0 | 4 |
| G2INVOLCAN03- | MONITORING OF SELECTED VOLCANICS | LM | 2 | LPU | G2ILMDK245 | G2ILMDK10 | | 0 | 4 |
| G2INVOLCAN04- | MONITORING OF SELECTED VOLCANICS | LM | 2 | LPU | G2ILMDK245 | G2ILMDK10 | | 0 | 4 |
| G2INVOLCAN05- | MONITORING OF SELECTED VOLCANICS | LM | 2 | LPU | G2ILMDK245 | G2ILMDK10 | | 0 | 4 |
| G2HNDARK 05- | DARK OBSERVATION NO. 5 | LM | 2 | LPU | G2DRK34 | G2DRK34 | | 0 | 4 |
| G2NNPCTCAL01 | PCT Calibration | LM | 4 | LPU | G2PCT252 | G2PCT180 | | 0 | 4 |
| G2NNRECOVY04- | G2 RECOVERY (Health) 4 | LM | 4 | R/T | G2RCVY3 | | | 0 | 4 |
| G2CNGLOBAL01- | G2 CALLISTO GLOBAL COVERAGE | LM | 4 | MPW | G2CLM442 | G2CLM408 | | 0 | 4 |
| G2HNDARK 06- | DARK OBSERVATION NO. 6 | LM | 4 | LPU | G2DRK34 | G2DRK34 | | 0 | 4 |
| G2CNCALLRT01 | Callisto Monitoring in Real Time | LM | 4 | R/T | G2CLM442 | | | 0 | 4 |
| G2NNRCTRLT01 | RCT Calibration | LM | 1 | R/T | G2RCT252 | | | 0 | 4 |
| G2NNRCTRLT02- | RCT Calibration | LM | 1 | R/T | G2RCT252 | | | 0 | 4 |
| G2NNOPCAL_02- | OPCAL #2 | LM | 4 | R/T | G2OPCAL48 | | | 0 | 4 |

# NIMS G2 DATA RETURN

| ACTID | Obs Cost Tics | Wave-lengths ret | Record Time (sec) | PB Time (sec) | Sel Bits of Tape SBOT (Mb) | Total Bits of Tape BOT (Mbits) | Mode cycle time (sec) | R/T BTG Mbits | Thold | Comp | Total BTG Mbits (4% ohead) | Data Reduct Factor (SBOT/BTG) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| G2INIOMON_01- | | 408 | | | | | | 0.03 | | | | |
| G2JNTHRMNS07- | 785.3024 | 80 | 3346 | 1697 | 10.47 | 20.64 | 8.667 | | 0 | 1.23 | 2.649 | 3.95 |
| G2ENLEADMP01- | 43.0420 | 204 | 179 | 179 | 1.10 | 1.11 | 8.667 | | 2 | 1.77 | 0.494 | 2.23 |
| G2HNDARK 04- | 59.8358 | 34 | 65 | 65 | 0.75 | 0.75 | 8.667 | | 0 | 1.59 | 0.033 | 22.52 |
| G2ENEURORT01- | | 408 | | | | | | 0.02 | 2 | | | |
| G2INCHEMIS05- | 125.4659 | 102 | 139 | 87 | 1.01 | 1.61 | 8.667 | | 2 | 1.55 | 0.137 | 7.32 |
| G2INTHRMAL01- | 13.3454 | 10 | 53 | 53 | 0.32 | 0.32 | 8.667 | | 2 | 2.20 | 0.006 | 56.54 |
| G2INVOLCAN01- | 8.6574 | 10 | 33 | 33 | 0.20 | 0.20 | 8.667 | | 2 | 2.20 | 0.004 | 56.54 |
| G2INVOLCAN02- | 8.6574 | 10 | 33 | 33 | 0.20 | 0.20 | 8.667 | | 2 | 3.50 | 0.002 | 89.95 |
| G2INVOLCAN03- | 8.6574 | 10 | 33 | 33 | 0.20 | 0.20 | 8.667 | | 2 | 3.30 | 0.002 | 84.81 |
| G2INVOLCAN04- | 8.6574 | 10 | 33 | 33 | 0.20 | 0.20 | 8.667 | | 2 | 4.10 | 0.002 | 105.37 |
| G2INVOLCAN05- | 8.7352 | 10 | 33 | 33 | 0.20 | 0.20 | 8.667 | | 2 | 4.10 | 0.002 | 105.37 |
| G2HNDARK 05- | 16.1579 | 34 | 65 | 65 | 0.40 | 0.40 | 8.667 | | 0 | 2.53 | 0.021 | 19.12 |
| G2NNPCTCAL01- | 132.4512 | 180 | 563 | 186 | 1.15 | 3.47 | 8.667 | | 0 | 2.00 | 0.402 | 2.86 |
| G2NNRECOVY04- | | 3 | | | | | 8.667 | 0.00 | 0 | | | |
| G2CNGLOBAL01- | 547.3379 | 408 | 619 | 617 | 7.13 | 7.16 | 8.667 | | 2 | 2.26 | 2.673 | 2.67 |
| G2HNDARK 06- | 16.1579 | 34 | 65 | 65 | 0.40 | 0.40 | 8.667 | | 0 | 3.50 | 0.015 | 26.46 |
| G2CNCALRT_01- | | | | | | | | 0.02 | | | | |
| G2NNRCTRLT01- | | 252 | | | | | 8.667 | 0.04 | | | | |
| G2NNRCTRLT02- | | 252 | | | | | 8.667 | 0.04 | | | | |
| G2NNOPCAL_02- | | 48 | | | | | 8.667 | 0.00 | | | | |
| **Total** | **5608.92** | | | Alloc > | | 113.77 | Alloc > | **0.15** | | 19.03 | 22.500 | < As Modeled |



1/27/04

J. Shirley

## Recap of G2 Playback Events

NIMS data playback during G2 was affected mostly by the amount of time available for playback, the compressibility of the data and the fact that only one pass through the tape was allowed for playback in G2. Problems with the CDS software for NIMS playback had been successfully resolved during G1 Cruise so that this problem was no longer a constraint on NIMS playback.

The NIMS processor halted once during the G2 Encounter, just before G2 perijove. This event occured in the middle of G2JNTHRMNS07. Two subsequent NIMS observations, G2INCHEMIS03 and G2INCHEMIS04, were also lost. The NIMS reload that occurred after G2INCHEMIS04 restarted NIMS and the encounter ended without any more halts. The approximate time of the processor halt was determined before the start of data playback by monitoring the SCLK bits returned in the NIMS engineering telemetry so that no playback bits were wasted in returning 'bad' data from when the NIMS processor was halted.

In G2 the compression estimate for NIMS Io data was greatly over-estimated by almost a factor of two. The compressibility of NIMS Io data was not determined in G1 since the G1 Io data were returned as 'garbled' data and had a compression of 0.97. To meet the NIMS play-back allocation, the number of wavelengths returned in some of the Io observations and the PCT calibration were trimmed.

The fact that only one pass through the tape was allowed during G2 playback caused the project to waste about 1.5 Mbits of downlink capability. This underflow was mostly due to underestimates of PLS and MAG compression.

## G2 Playback Events Timeline (09-01-96 to 10-29-96)

**09-01-96:** G2 encounter starts.

**09-04-96:** Observation G2JNSL9LIM01 is deleted from plan due to insufficient downlink allocation.

**09-07-96:** NIMS processor halts halfway through G2JNTHRMNS07. Observations G2INCHEMIS03, G2INCHEMIS04 are not recorded.

**09-10-96:** Playback begins.

**09-14-96:** First NIMS (G2JNGLOMOS01) observation comes down.

**09-17-96:** PPR releases their allocation, NIMS receives 1 Mb.

**09-18-96:** Updated playback table delivered with increased playback of G2INCHEMIS05 wavelengths.

**09-25-96:** Compression for G2JNTHRMNS03 is much lower than expected at 1.4.

**10-01-96:** Allocation has increased to 19.06 Mb. Ganymede playback nearly complete; actual and predicted btg in good agreement.

**10-08-96:** Playback is on schedule. Last Ganymede has come down (G2GNBRFRGR01) with compression at 1.58. No Io observations yet received.

**10-15-96:** Compression of about 1.2 for G2INCHEMIS01 and 02 forces revisions of the playback plan. These account for about 1 Mb of increased btg, and following G2INHRSPEC01 is projected to increase 1 Mb also. The only remaining large Io observation is G2INCHEMIS05; this is reduced from 408 to 102 wavelengths and spatial coverage is cut by 35%. Also, wavelengths for the G2NNPCTCAL01 are cut from 252 to 180. This is sufficient (with released office margin) to produce a playback table - plan that is within allocation.

**10-21-96:** No modifications to playback table required although G2JNTHRMNS07 compresses even more poorly than 04 (at 1.23).

**10-29-96:** Playback terminates early via CDS autonomous pause. About 1.56 Mb of capability is wasted. Cause is better than expected PLS and MAG compression, and lower than expected data returned in two "buffer dumps."

## NIMS Anomaly Report - G2 Sequence

The NIMS processor halted once during the G2 Encounter. Certain precautions taken in G2 based on lessons learned in G1 helped to lessen the effects of the NIMS processor halt. In the following discussion this NIMS processor halt will be referred to as 'the G2 Halt'.

### Facts:

0. Between the start of the G2 Encounter and the G2 Halt NIMS returned 5 realtime observations and successfully reloaded NIMS from CDS once. The NIMS SCLK engineering channels were continuously monitored without detecting a NIMS processor halt.

1. A NIMS processor halt was detected at SCLK 03600290 from the analysis of the NIMS SCLK engineering telemetry channels S-1931 and S-1932. This occurred near the middle of the NIMS observation G2JNTHRMNS07. The SCLK channels reported correct times after a subsequent NIMS reload. The last 'good' pre-halt SCLK, the anomalous Halt SCLK values and the first post-reload 'good' SCLK follow (Note that the NIMS engineering SCLK value is normally 2 Rims behind the CDS SCLK Rim when it is reported):

| NIMS SCLK | CDS SCLK | CDS SCET | GROUND ERT |
|---|---|---|---|
| 03600213 | 03600215.05 | 1996-251T07:34:25.425 | 1996-251T08:55:22.725 |
| 03600290 | 03600432.58 | 1996-251T11:14:25.417 | 1996-251T12:00:21.464 |
| 03600290 | 03600597.43 | 1996-251T14:01:05.411 | 1996-251T14:41:35.081 |
| 03600290 | 03600630.40 | 1996-251T14:34:25.409 | 1996-251T16:25:33.763 |
| 03600813 | 03600815.05 | 1996-251T17:41:05.402 | 1996-251T18:39:35.692 |

2. A NIMS reload from CDS occurred at SCLK 03600271. Two MROs of NIMS RAM space starting at locations 1030 and 142E were returned prior to the reload. The two MROs targeted NIMS memory locations that were found to have miscompares with the original code after the G1 Halt. The G2 MROs found no miscompares with the original code. Addresses changed after the G1 Halt were NOT changed by the G2 Halt. The subsequent reload precluded any chance of dumping other NIMS memory locations via MRO. A NIMS memory checksum after the reload confirmed that NIMS had reloaded properly.

3. The repeating SCLK value of 03600290 in the above table was assumed to be the time of the Halt for two reasons: 1) The NIMS SCLK values are more than 2 Rims different from the CDS SCLK values. 2) The NIMS SCLK repeats until the time of the next reload. NIMS data from the observation G2JNTHRMNS07 were returned up to SCLK 03600291:53 to try to catch the point at which the NIMS processor actually halted. The NIMS data start to become nonsense at 03600291:05.5 in agreement with the repeating SCLK.

4. The two NIMS observations between the times of the Halt and the reload which are presumably lost are G2INCHEMIS03 and G2INTHRMAL04.

5. The NIMS realtime observation G2ENEURORT01 at SCLK 3600807 confirmed that NIMS had restarted and was returning 'good' data.

6. No other NIMS anomalies were detected in G2.

Timing:

| SCLK | Comments |
|---|---|
| 03600263:56 | Start of NIMS observation G2JNTHRMNS07 |
| 03600291:05 | Estimated time of NIMS processor halt |
| 03600318:68 | End of NIMS observation G2JNTHRMNS07 |
| 03600432.58 | Anomalous 03600290 SCLK reported |
| 03600517:77 | Start of NIMS observation G2INCHEMIS03 |
| 03600583:45 | END of NIMS observation G2INCHEMIS03 |
| 03600597.43 | Anomalous 03600290 SCLK reported |
| 03600599:35 | Start of NIMS observation G2INCHEMIS04 |
| 03600603:19 | End of NIMS observation G2INCHEMIS04 |
| 03600630.40 | Anomalous 03600290 SCLK reported |
| 03600705:16 | MROH of NIMS memory location 1030 |
| 03600711:70 | MROH of NIMS memory location 142E |
| 03600721:16 | Start of NIMS CDS Reload |
| 03600727:16 | NIMS restarted. |
| 03600785:07 | Start of NIMS observation G2ENLEADMP01 |
| 03600798:00 | Start of NIMS observation G2HNDARK__02 |
| 03600807:00 | NIMS realtime observation G2ENEURORT01 |
| 03600815.05 | First correct SCLK after reload (03600813) |

Summary:

1. A single NIMS processor halt (anomaly) occurred during the G2 Encounter.

2. Continous monitoring of the NIMS SCLK channels led to a rapid identification that a NIMS processor halt had occurred.

3. The 3 NIMS software reloads from CDS greatly lessened the potentially disastrous effects of the G2 Halt and protected most of the NIMS observations in the encounter.

4. Checksums of NIMS memory space verified that NIMS had reloaded properly.

5. Analysis of the MRO data showed that the NIMS memory locations affected in the G1 Halt were not affected by the G2 Halt.

6. Frequent NIMS realtime observations, both science observations and instrument health monitoring observations, verified that NIMS was functioning normally at various time points throughout the encounter.

7. The error avoidance measures applied to the G2 Encounter as determined in the analysis of the G1 processor halt (points 2, 3, 4, 5 and 6 above) were shown to be the proper response for dealing with the inevitable occurrence of radiation-induced NIMS processor halts.

## NIMS Archived EDRs and CUBEs

The NIMS data are stored in EDRs (Experimental Data Records) produced by JPL-MIPS (Multi-mission Image Processing System). The NIMS Phase2 EDR is described in the NIMS EDR SIS (Software Interface Specification) Number 232-08. The same information is available in both human and machine-readable form in the PDS (Planetary Data System) structure files EDRHDR.FMT and EDRDATA.FMT in the LABEL directory of the NIMS EDR CD-ROM. Each observation has at least one EDR. The EDR file name is derived from the 12 character observation name plus a single character which allows an observation to be broken up into multiple EDRs. The EDRs have a Vicar label, followed by a PDS/ISIS label, binary header records and the data records. For archiving on CD-ROM, the Vicar labels are detached from the EDR (but kept separately on CD) and the file is renamed so as to conform to the 8.3 DOS file-naming convention. The 8.3 EDR name consists of a 2 character orbit identifier, a single character target identifier, a 3 digit counter and the suffix EDR. For example, the MIPS EDR G1GNGLOBAL01A.1 becomes G1G001.EDR. More information about NIMS EDRs can be found in the VOLINFO.TXT file on the EDR CD-ROM.

NIMS EDR data typically require considerable processing before they are readily amenable to science analysis. Normally, the EDRs are processed into spectral image cubes by one of several sets of software. MIPS systematically processes the EDRs into CUBEs (band sequential image files) and MASKs (spatial/spectral summary images) which are distributed on the NIMS CUBE CD-ROMs. Information about the structure of the NIMS CUBEs can be found in the VOLINFO.TXT file on the CUBE CD-ROM. The name of the CUBE file is derived from the input EDR filename. For archiving on CD-ROM, the CUBE files are renamed so as to conform to the 8.3 DOS file-naming convention. The 8.3 CUBE name consists of a 2 character orbit identifier, a single character target identifier, a 3 digit counter, a single character cube-type identifier, a single character data unit-type (DN, radiance or IOF) and the suffix QUB. For example, the MIPS IOF radiance cube for the observation G1GNGLOBAL01A.1 (G1G001) becomes G1G001CR.EDR. The summary MASKs on the CD-ROM have the same 6 character name as the EDR name with the suffix JPG or GIF to denote its graphics format.

## NIMS Data Format - Data types - Data Labels - Data Access

### Data Format

All data files have PDS labels. The raw data (EDR) file contains time-sequential, 16 bit integers. Reduced data files (TUBES and CUBES) may be viewed as images or spectra. They contain VAX real numbers, are band sequential (BSQ - the images are stacked in band order) and have geometry information appended as backplanes after the last NIMS band.

### Data Types

Mask files contain summary images (3 band BSQ) and spectra of up to six selected regions that provide a quick indication of data location, data quality and spectral content. A Guide to understanding the NIMS mask is available.

Cube files contain data that have been projected and resampled. The core data are BSQ - spatial in the first two dimensions, and spectral in the third. Cubes of the satellites are projected in point-of-view, and, with few exceptions have no photometric correction applied. Cubes of Jupiter are (generally) projected as simple cylindrical. Cubes of Europa, Ganymede, and Callisto have been despiked. The cubes are available both in radiance and I/F (intensity divided by flux) form.

Tube files contain data in (almost) time order and normally have a NIMS-related 20 pixel spatial dimension (20 x n or n x 20). Projection coordinates are contained in backplanes, but the data have not been resampled. The data are in units of radiance and no despiking has been applied. All data in cubes are also available in tube form. Some data (such as spatially undersampled data) appear in tube form only.

A spike file contains a list of pixels that have been identified as spikes, but not replaced, in the tube. Spike files can be used to remove spikes from both tube and EDR files.

EDR files contain the most primitive form of the data available. They should be used only for advanced data analysis. The format is complex and the files do not form images or spectra without prior processing.

## Data Labels

A data label (PDS form) is attached to the front of each file (except masks, which have an attached VICAR label and a detached PDS label). The labels are in ASCII keyword=value format and contain pointers to various data objects in the file, descriptions of the data objects and descriptions of the observation associated with the file. A history object in similar format follows and describes the processing steps that produced the file. Much of this information is necessary for understanding and viewing the cube. In particular, the label contains the offset to the cube, the dimensions of the cube, axes labels, and explicit wavelength information.

## Data Access

Software for processing this data is called ISIS and is available for DEC VAX VMS, SUN Solaris, DEC Alpha Digital Unix, Silicon Graphics Unix and PC LINUX systems. The Unix versions are available from the USGS Astrogeology team. Images from NIMS cubes and tubes can be viewed with any image display program which allows an offset from the beginning of the file to the selected image. Packages tested include ISIS, VICAR, ENVI, SAO IMAGE, and NASAVIEW. ISIS and ENVI (and soon NASAVIEW) additionally display spectra. The ISIS viewer is named CV (UNIX) or QL3 (VMS).

Labels may be displayed with some editors (eg DOS edit), and with most "type" and "search" functions. Some editors do not recognize the PDS line termination conventions. The label may be listed by the ISIS function LHLIST (VMS) or LABEL (UNIX).

Software for converting EDRs to cubes exist in both ISIS (DEC VAX VMS) and VICAR (DEC Alpha VMS) versions only. A primitive list of values in an EDR may be obtained with the program EDRDMP2.

## Understanding the NIMS Mask

The NIMS mask is designed to provide a quick summary of the contents of a NIMS data cube (or tube). It displays a view of both the spatial and spectral content of the data.

The mask has four regions. Starting from the upper left and proceeding clockwise: a spatial display; six or fewer representative spectra; annotation; and a spectral histogram.

The spatial display of an observation which has been projected and resampled (a cube) has a maximum size of 600x600 pixels. This is overlaid with surface coordinates and is embedded in a 700x700 grid of pixel coordinates. It is accompanied by two 1-dimensional histograms describing the raw image and the image stretched for display. The data image can range from a simple combination of up to 3 NIMS bands displayed in the RGB planes, to complicated arithmetic functions of NIMS bands displayed in the RGB planes. (The formulas appear as annotation below the histograms.) The graphics directly below the image show the input and output data histograms for the three color planes. The "shortest" color for each bin displays in front. The image also contains from one to six numbered rectangles, which show the from which averaged spectra (displayed on the right) were taken.

The spatial display of an observation in time sequence (a tube) is a graphic showing a footprint of the observation over a grid of surface coordinates on the target body. Numerals 1-6 on the graphic mark the locations of the average spectra displayed on the right.

The spectra to the right of the image may display either BDRF or radiance (or both). If both are displayed, then a vertical "radiance fence" line will appear where the breakpoint occurs. This permits display of both atmospheric data, which have significant reflectance and thermal components, and I/F satellite surface data which have strong absorptions at longer wavelengths (such as water spectra.) The spectra are labelled with wavelength in microns and location in both pixel and latitude-longitude space.

The annotation provides information about the observation, including its name, a brief description, its geometry, instrument and projection parameters. TCA is the time from Galileo's closest approach to the target body.

The 2-dimensional spectral histogram in the lower left corner shows the number of pixels at a given radiance for each wavelength. If a surface contains spatial mixtures with significantly different spatial fractions for several components, the spectra of the components will be evident in this display.