# Chapter 7 - Data Return

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# Introduction to Chapter 7

This chapter is a report on the NIMS data return for the E4 orbit. Due to the low downlink data rates available for Galileo Jupiter Operations and other unforeseen and unpredictable events during the E4 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 E4 orbit was the third 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. Ten software reloads were inserted into the E4 command sequence to protect as many observations as possible. No unplanned processor halts were detected during the E4 Encounter. A large number of reloads spread throughout the encounter period is the best way to protect as many NIMS observations as possible.

Also, Detector 8 was still dead in E4 and was never recovered.

The plots on the pages 3, 4 and 5 show the geometry of the NIMS E4 observations using a north trajectory pole projection. The 'returned' observations are in Bold characters and the 'non-returned' in gray.

The text on page 6 gives a 'recap' of the E4 playback events which affected NIMS data return.

The spreadsheets on pages 7 to 10 summarize the NIMS E4 data return.

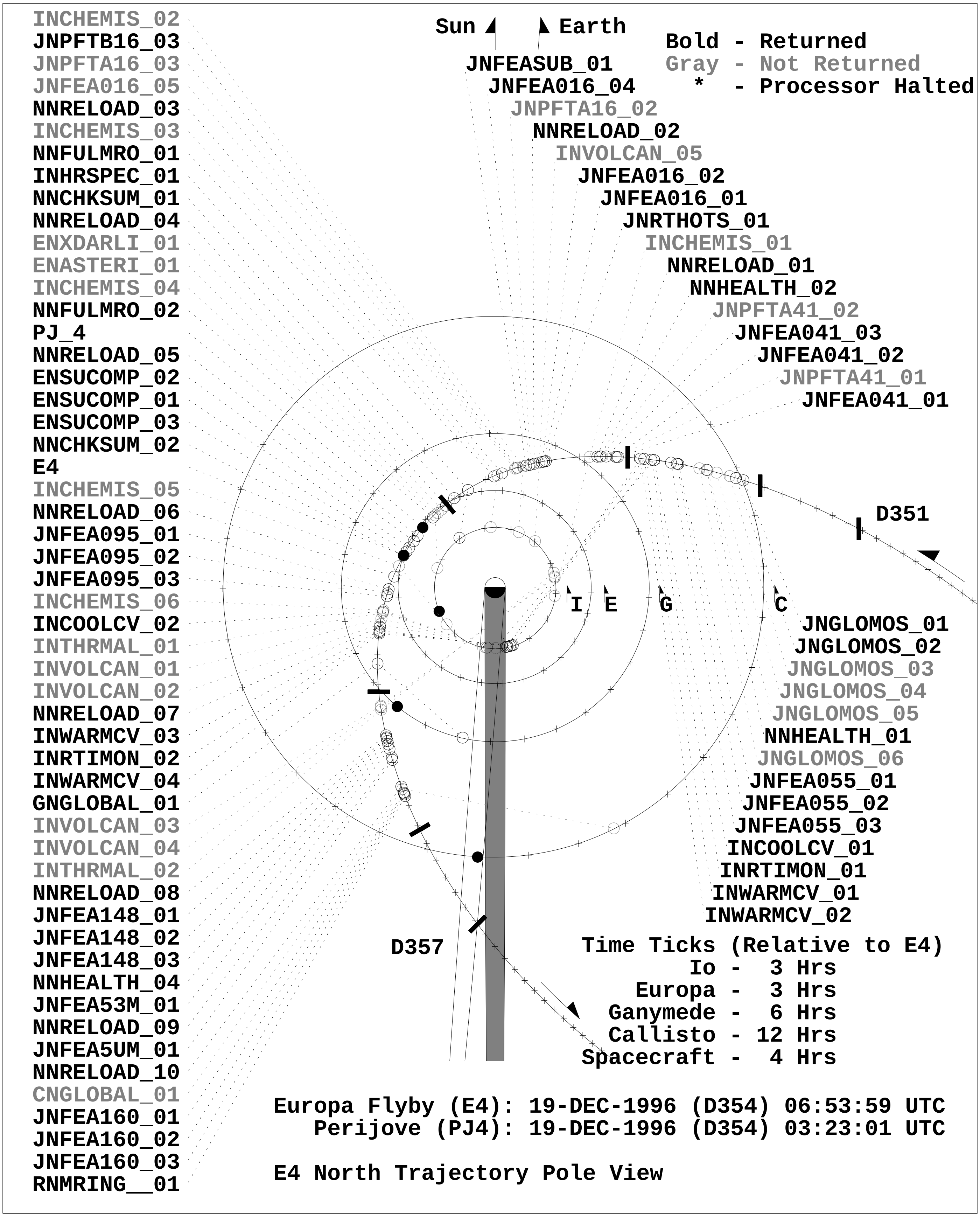
A Timeline of E4 playback events is on page 11.

The text on pages 12 and 13 describes the E4 NIMS Anomalies, both Processor Halts and Detector 8 failure.

The text on pages 14 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 15 and 16.

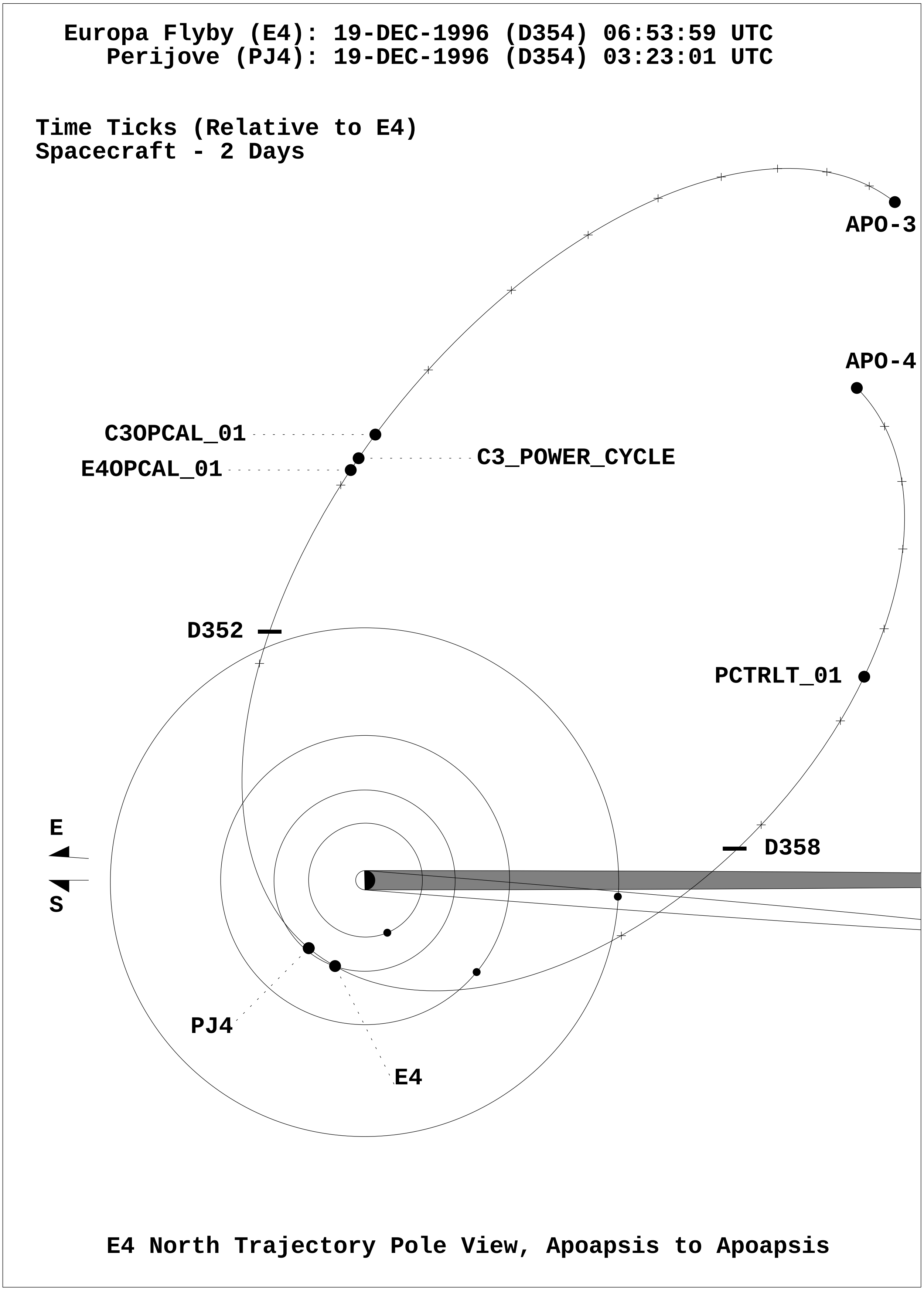
The text on page 17 is a guide to understanding the NIMS MASK.

# NIMS E4 OBSERVATIONS



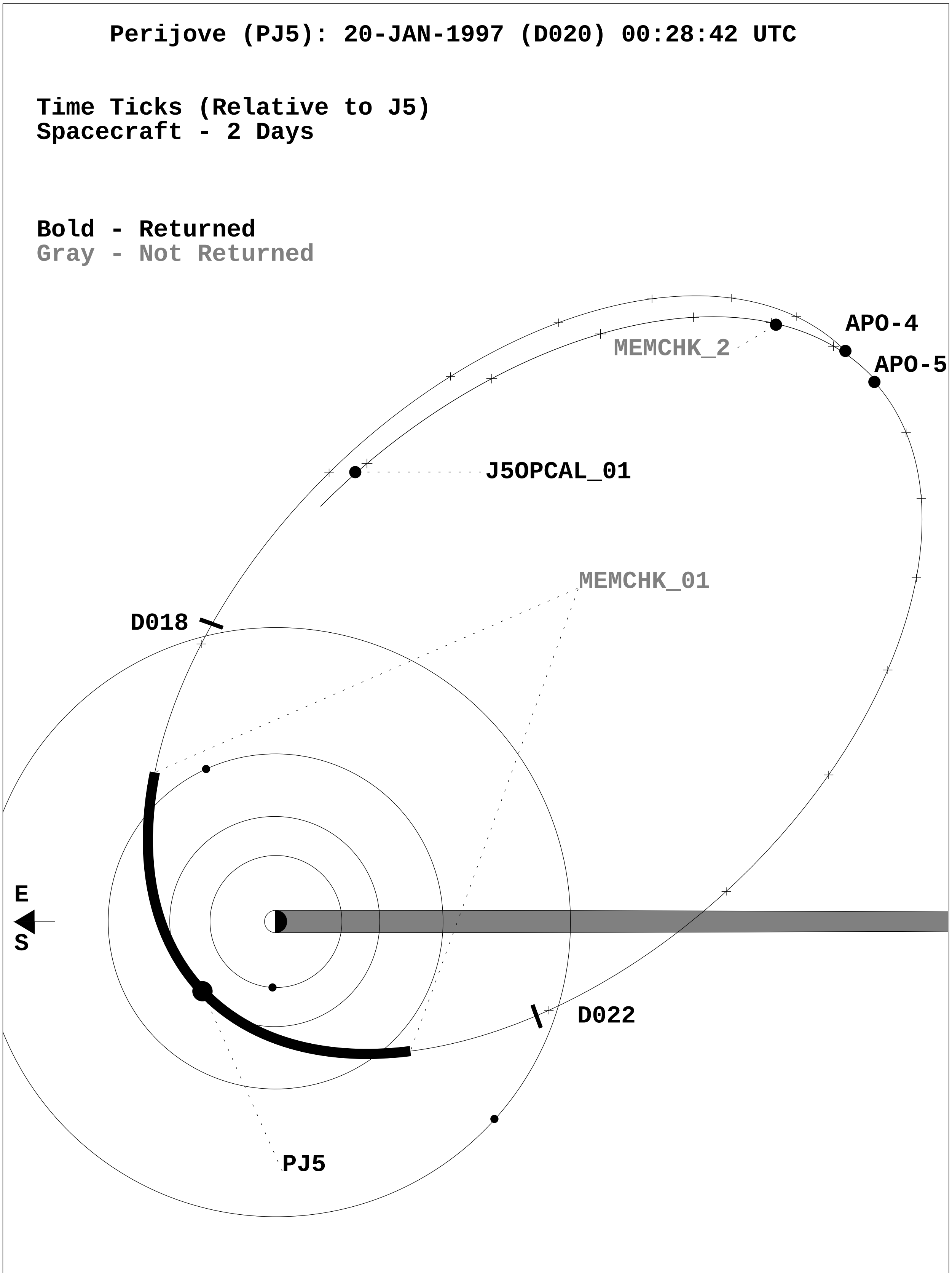

NIMS - FEL - 02/20/98

# NIMS E4 CALIBRATIONS




E4 North Trajectory Pole View, Apoapsis to Apoapsis

# NIMS J5 RADIATION STUDY




J5 North Trajectory Pole View, Apoapsis to Apoapsis

## Recap of E4 Playback Events

NIMS received a downlink allocation of less than 22 Megabits for E4 playback. As a result several recorded observations were not included in the playback plan, and others were reduced in spatial coverage.

The E4 playback period included solar conjunction, an interval of two weeks during which the spacecraft was effectively out of communication with the Earth. As the spacecraft approached and subsequently departed from this period, it was expected that data transmission quality would suffer due to the effects of variable solar activity. In general NIMS data quality was not significantly impacted due to the effects of solar conjunction. Commands to replay small portions of 1 observation (to fill data gaps) executed successfully in the later part of playback.

The initial playback plan showed downlink of the most crucial Europa closest-approach data occurring adjacent to the conjunction period. In order to protect this data as much as possible a different strategy was devised. This involved starting playback not with the first observations recorded, but with the Europa C/A observations. Thereafter two complete passes over the tape were made. Due to a quirk of the modeling software, the second pass over the Europa C/A data was designated "pass 3."

Although there were no NIMS instrument halts in E4 due to radiation hits, it was determined through realtime data that detector 8 (2.37-2.63 microns) was behaving erratically. During E4 playback, wavelengths from detector 8 were sampled at intervals to help assess and diagnose the problem. For the most part, however, detector 8 wavelengths were not returned. This was accomplished by uplinking new wavelength edit tables that did not specify return of detector 8 wavelengths.

# NIMS E4 DATA RETURN

| Activity ID | Observation Title | Mode | Gain | Record Format | NIMS Edit Table | NIMS PB Table | Grating Start | Grating Offset |
|---|---|---|---|---|---|---|---|---|
| E4NNOPCAL_01- | OPCAL | LM | 4 | R/T | OPCAL120 | | 0 | 4 |
| E4JNGLOMOS01- | Jupiter Global Mosaic Prt 1 | XM | 2 | LPU | E4JGM10A | E4JGM05A | 5 | 4 |
| E4JNGLOMOS02- | Jupiter Global Mosaic Prt 2 | XM | 2 | LPU | E4JGM10A | E4JGM05A | 5 | 4 |
| E4JNGLOMOS02- | Jupiter Global Mosaic Prt 2 | XM | 2 | LPU | E4JGM10A | E4JGM05A | 5 | 4 |
| E4JNGLOMOS02- | Jupiter Global Mosaic Prt 2 | XM | 2 | LPU | E4JGM10A | E4JGM05A | 5 | 4 |
| E4NNHEALTH01- | E4 Health 1 | LM | 2 | R/T | E4RCVY3 | | 0 | 4 |
| E4JNFEA05501- | Jupiter Camp. feat. 55 deg. phase Prt 1 | SM | 2 | LPU | E4JFT68A | E4JFT05A | 1 | 4 |
| E4JNFEA05502- | Jupiter Camp. feat. 55 deg. phase Prt 2 | SM | 2 | LPU | E4JFT68A | E4JFT04A | 1 | 4 |
| E4JNFEA05503- | Jupiter Camp. feat. 55 deg. phase Prt 3 | SM | 2 | LPU | E4JFT68A | E4JFT04A | 1 | 4 |
| E4INCOOLCV01- | NIMS Io Eclipse Observation (ingress) | XM | 4 | LPU | E4IXM10B | E4IXM10B | 21 | 4 |
| E4INRTIMON01- | Real Time Io monoring | XM | 2 | R/T | E4IXM8RT | | 21 | 4 |
| E4INWARMCV01- | NIMS Io Eclipse Observation (egress) | XM | 2 | LPU | E4IXM10B | E4IXM10B | 21 | 4 |
| E4INWARMCV02- | NIMS Io Eclipse Obs. (post-egress) | XM | 2 | LPU | E4IXM10B | E4IXM10B | 21 | 4 |
| E4JNFEA04101- | Jupiter Camp. feat. 41 deg. phase Prt 1 | SM | 2 | LPU | E4JFT68A | E4JFT04A | 1 | 4 |
| E4JNFEA04102- | Jupiter Camp. feat. 41 deg. phase Prt 2 | SM | 2 | LPU | E4JFT68A | E4JFT04A | 1 | 4 |
| E4JNFEA04103-(A) | Jupiter Camp. feat. 41 deg. phase Prt 3 | SM | 2 | LPU | E4JFT68A | E4JFT04A | 1 | 4 |
| E4NNHEALTH02- | E4 Health 2 | LM | 2 | R/T | E4RCVY3 | | 0 | 4 |
| E4JNRTHOTS01- | Jupiter Real Time Hot Spot | LM | 2 | R/T | E4JFEA442A | Real Time | 0 | 4 |
| E4JNFEA01601- | Jupiter Camp. feat. 16 deg. phase Prt 1 | SM | 2 | LPU | E4JFT68C | E4JFT19A | 1 | 4 |
| E4JNFEA01602- | Jupiter Camp. feat. 16 deg. phase Prt 2 | SM | 2 | LPU | E4JFT68C | E4JFT25A | 1 | 4 |
| E4JNFEA01604- | Jupiter Camp. feat. 16 deg. phase Prt 4 | SM | 2 | LPU | E4JFT68C | E4JFT25A | 1 | 4 |
| E4JNFEASUB01- | Jupiter Campaign feature sub- specra | LM | 2 | LPU | E4JSB253A | E4JSB80A | 0 | 4 |
| E4JNFEASUB01- | Jupiter Campaign feature sub- specra | LM | 2 | LPU | E4JSB253A | E4JSB80A | 0 | 4 |
| E4JNPFTB1603 | Jup. partial feat. tr. for feat. B Prt 4 | SM | 2 | LPU | E4JFT68C | E4JFT19A | 1 | 4 |
| E4INHRSPEC01- | High Spatial & Spectral Obs. of Io | LM | 2 | LPU | E4ILM245 | E4ILM001 | 0 | 4 |
| E4INHRSPEC01- | High Spatial & Spectral Obs. of Io | LM | 2 | LPU | E4ILM245 | E4ILM96 | 0 | 4 |
| E4ENSUCOMP02- | Surface Composition / Dark Ice | LM | 3 | LPU | E4ELM245 | E4ELM192 | 0 | 4 |
| E4ENSUCOMP02- | Surface Composition / Dark Ice | LM | 3 | LPU | E4ELM245 | E4ELM192 | 0 | 4 |
| E4ENSUCOMP02- | Surface Composition / Dark Ice | LM | 3 | LPU | E4ELM245 | E4ELM192 | 0 | 4 |
| E4ENSUCOMP01- | Surface Composition / Light Ice | LM | 3 | MPW | E4ELM442 | E4ELM192 | 0 | 4 |

# NIMS E4 DATA RETURN

| ACTID | Obs Cost Tics | Wave- lengths ret | Record Time (sec) | PB Time (sec) | Sel Bits of Tape sBOT (Mbits) | Total Bits of Tape BOT (Mbits) | Mode cycle time (sec) | Thold | Comp | Total BTG Mbits (4% ohead) | Data Reduct Factor (sBOT/BTG) | Pass |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E4NNOPCAL_01- | | 120 | | | | | | | | | | |
| E4JNGLOMOS01- | 64.7568 | 5 | 272 | 94 | 0.58 | 1.68 | 0.333 | 0 | 1.97 | 0.15 | 3.89 | 2 |
| E4JNGLOMOS02- | 64.7568 | 5 | 272 | 270 | 1.67 | 1.68 | 0.333 | 0 | 1.78 | 0.47 | 3.52 | 2 |
| E4JNGLOMOS02- | 64.7568 | 5 | 272 | 38 | 0.23 | 1.68 | 0.333 | 0 | 1.97 | 0.06 | 3.89 | 3 |
| E4JNGLOMOS02- | 64.7568 | 5 | 272 | 12 | 0.07 | 1.68 | 0.333 | 0 | 1.71 | 0.02 | 3.38 | 3 |
| E4NNHEALTH01- | | 3 | | | | | 8.667 | 0 | | | | 2 |
| E4JNFEA05501- | 95.2288 | 5 | 402 | 397 | 2.45 | 2.48 | 2.33 | 0 | 1.65 | 0.11 | 22.80 | 2 |
| E4JNFEA05502- | 95.6976 | 4 | 404 | 397 | 2.45 | 2.49 | 2.33 | 0 | 1.60 | 0.09 | 27.64 | 2 |
| E4JNFEA05503- | 95.2288 | 4 | 402 | 397 | 2.45 | 2.48 | 2.33 | 0 | 1.63 | 0.09 | 28.16 | 2 |
| E4INCOOLCV01- | 64.7568 | 10 | 272 | 47 | 0.29 | 1.68 | 0.333 | 2 | 3.10 | 0.09 | 3.06 | 2 |
| E4INRTIMON01- | | 8 | | | | | 0.333 | 0 | | | | 2 |
| E4INWARMCV01- | 90.3064 | 10 | 381 | 64 | 0.39 | 2.35 | 0.333 | 2 | 5.56 | 0.07 | 5.49 | 3 |
| E4INWARMCV02- | 19.9864 | 10 | 81 | 20 | 0.12 | 0.50 | 0.333 | 2 | 3.60 | 0.03 | 3.55 | 2 |
| E4JNFEA04101- | 95.2288 | 4 | 402 | 397 | 2.45 | 2.48 | 2.33 | 0 | 2.03 | 0.07 | 35.06 | 2 |
| E4JNFEA04102- | 7.3288 | 4 | 27 | 27 | 0.17 | 0.17 | 2.33 | 0 | 2.00 | 0.00 | 34.55 | 2 |
| E4JNFEA04103-(A) | 95.6976 | 4 | 404 | 310 | 1.91 | 2.49 | 2.33 | 0 | 2.00 | 0.06 | 34.55 | 2 |
| E4NNHEALTH02- | | 3 | | | | | | 0 | | | | |
| E4JNRTHOTS01- | | 3 | | | | | 8.667 | 0 | | | | 2 |
| E4JNFEA01601- | 19.9864 | 19 | 81 | 81 | 0.50 | 0.50 | 2.33 | 0 | 1.91 | 0.07 | 6.95 | 2 |
| E4JNFEA01602- | 169.2992 | 25 | 718 | 357 | 2.20 | 4.43 | 2.33 | 0 | 1.85 | 0.43 | 5.11 | 2 |
| E4JNFEA01604- | 169.2992 | 25 | 718 | 297 | 1.83 | 4.43 | 2.33 | 0 | 1.74 | 0.38 | 4.81 | 2 |
| E4JNFEASUB01- | 339.0048 | 80 | 1442 | 688 | 4.24 | 8.89 | 8.667 | 0 | 1.74 | 0.76 | 5.59 | 2 |
| E4JNFEASUB01- | 339.0048 | 80 | 1442 | 749 | 4.62 | 8.89 | 8.667 | 0 | 1.83 | 0.79 | 5.88 | 3 |
| E4JNPFTB1603 | 7.3288 | 19 | 27 | 27 | 0.17 | 0.17 | 2.33 | 0 | 1.70 | 0.03 | 6.18 | 2 |
| E4INHRSPEC01- | | 1 | 1317 | 61 | 0.38 | | 8.667 | 2 | 1.25 | 0.00 | 100.00 | 2 |
| E4INHRSPEC01- | | 96 | 1317 | 325 | 2.00 | | 8.667 | 2 | 1.03 | 0.73 | 2.76 | 3 |
| E4ENSUCOMP02- | 264.9344 | 192 | 1126 | 390 | 2.41 | 6.95 | 8.667 | 0 | 1.26 | 1.43 | 1.69 | 1 |
| E4ENSUCOMP02- | 264.9344 | 192 | 1126 | 178 | 1.10 | 6.95 | 8.667 | 0 | 1.30 | 0.63 | 1.74 | 3 |
| E4ENSUCOMP02- | 264.9344 | 192 | 1126 | 551 | 3.40 | 6.95 | 8.667 | 0 | 1.30 | 1.95 | 1.74 | 3 |
| E4ENSUCOMP01- | 975.0634 | 192 | 1106 | 250 | 2.88 | 12.74 | 8.667 | 0 | 1.29 | 0.89 | 3.23 | 1 |

# NIMS E4 DATA RETURN

| Activity ID | Observation Title | Mode | Gain | Record Format | NIMS Edit Table | NIMS PB Table | Grating Start | Grating Offset |
|---|---|---|---|---|---|---|---|---|
| E4ENSUCOMP01- | Surface Composition / Light Ice | LM | 3 | MPW | E4ELM442 | E4ELM192 | 0 | 4 |
| E4ENSUCOMP03- | Surface Composition of Double Linea Area | LM | 3 | MPW | E4ELM442 | E4ELM384 | 0 | 4 |
| E4ENSUCOMP03- | Surface Composition of Double Linea Area | LM | 3 | MPW | E4ELM442 | E4ELM384 | 0 | 4 |
| E4JNFEA09501- | Jupiter Camp. feat. 95 deg. phase Prt 1 | SM | 2 | LPU | E4JFT68A | E4JFT04A | 1 | 4 |
| E4JNFEA09502- | Jupiter Camp. feat. 95 deg. phase Prt 2 | SM | 2 | LPU | E4JFT68A | E4JFT04A | 1 | 4 |
| E4JNFEA09503- | Jupiter Camp. feat. 95 deg. phase Prt 3 | SM | 2 | LPU | E4JFT68A | E4JFT05A | 1 | 4 |
| E4INCOOLCV02- | NIMS Io Eclipse Observation (ingress) | XM | 4 | LPU | E4IXM10B | E4IXM10B | 21 | 4 |
| E4INWARMCV03- | NIMS Io Eclipse Observation (egress) | XM | 2 | LPU | E4IXM10B | E4IXM10B | 21 | 4 |
| E4INRTIMON02 | Real Time Io Monitoring | XM | 2 | R/T | E4IXM8RT | | 21 | 4 |
| E4INWARMCV04- | NNIMS Io Eclipse Obs. (post-egress) | XM | 2 | LPU | E4IXM10B | E4IXM10B | 21 | 4 |
| E4GNGLOBAL01- | Ganymede Global Map | LM | 3 | MPW | E4GLM442 | E4GLM204 | 0 | 4 |
| E4JNFEA14801- | Jupiter Camp. feat. 148 deg. phase Prt 1 | SM | 2 | LPU | E4JFT68B | E4JFT15A | 1 | 4 |
| E4JNFEA14802- | Jupiter Camp. feat. 148 deg. phase Prt 2 | SM | 2 | LPU | E4JFT68B | E4JFT15A | 1 | 4 |
| E4JNFEA14803- | Jupiter Camp. feat. 148 deg. phase Prt 3 | SM | 2 | LPU | E4JFT68B | E4JFT15A | 1 | 4 |
| E4NNHEALTH04- | E4 Health 4 | LM | 2 | R/T | E4RCVY3 | | 0 | 4 |
| E4JNFEA53M01-(A) | Jupiter Campaign feature 5 & 3 um maps | LM | 4 | LPU | E4J35160 | E4J35160 | 0 | 4 |
| E4JNFEA53M01-(A) | Jupiter Campaign feature 5 & 3 um maps | LM | 4 | LPU | E4J35160 | E4J35160 | 0 | 4 |
| E4JNFEA5UM01- | Jupiter Campaign feat. 5 micron map # 2 | LM | 4 | LPU | E4J5M253B | E4J5M80B | 0 | 4 |
| E4JNFEA5UM01- | Jupiter Campaign feat. 5 micron map # 2 | LM | 4 | LPU | E4J5M253B | E4J5M80B | 0 | 4 |
| E4JNFEA16001- | Jupiter Camp. feat. 160 deg. phase Prt 1 | SM | 2 | LPU | E4JFT68A | E4JFT04A | 1 | 4 |
| E4JNFEA16002- | Jupiter Camp. feat. 160 deg. phase Prt 2 | SM | 2 | LPU | E4JFT68A | E4JFT04A | 1 | 4 |
| E4JNFEA16003- | Jupiter Camp. feat. 160 deg. phase Prt 3 | SM | 2 | LPU | E4JFT68A | E4JFT04A | 1 | 4 |
| E4RNMRING 01- | Main Ring Observation | FM | 4 | LPU | E4RFM126 | E4RFM001 | 0 | 4 |
| E4RNMRING 01- | Main Ring Observation | FM | 4 | LPU | E4RFM126 | E4RFM96 | 0 | 4 |
| E4NNPCTCAL01- | NIMS PCT Calibration | LM | 4 | R/T | E4PCT252 | | 0 | 4 |
| J5NNOPCAL_01- | OPCAL | LM | 4 | R/T | OPCAL48 | | 0 | 4 |

# NIMS E4 DATA RETURN

| ACTID | Obs Cost Tics | Wave-lengths ret | Record Time (sec) | PB Time (sec) | Sel Bits of Tape sBOT (Mbits) | Total Bits of Tape BOT (Mbits) | Mode cycle time (sec) | Thold | Comp | Total BTG Mbits (4% ohead) | Data Reduct Factor (sBOT/BTG) | Pass |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E4ENSUCOMP01- | 975.0634 | 192 | 1106 | 864 | 9.95 | 12.74 | 8.667 | 0 | 1.30 | 3.06 | 3.25 | 3 |
| E4ENSUCOMP03- | 677.9952 | 384 | 768 | 192 | 2.21 | 8.85 | 8.667 | 0 | 1.31 | 1.35 | 1.64 | 1 |
| E4ENSUCOMP03- | 677.9952 | 384 | 768 | 587 | 6.76 | 8.85 | 8.667 | 0 | 1.30 | 4.16 | 1.63 | 3 |
| E4JNFEA09501- | 95.2288 | 4 | 402 | 399 | 2.46 | 2.48 | 2.33 | 0 | 1.61 | 0.09 | 27.81 | 1 |
| E4JNFEA09502- | 95.2288 | 4 | 402 | 399 | 2.46 | 2.48 | 2.33 | 0 | 1.73 | 0.08 | 29.88 | 1 |
| E4JNFEA09503- | 7.3288 | 5 | 27 | 27 | 0.17 | 0.17 | 2.33 | 0 | 1.48 | 0.01 | 20.45 | 1 |
| E4INCOOLCV02- | 80.1100 | 10 | 338 | 51 | 0.31 | 2.08 | 0.333 | 2 | 1.64 | 0.19 | 1.62 | 1 |
| E4INWARMCV03- | 117.9656 | 10 | 499 | 96 | 0.59 | 3.08 | 0.333 | 2 | 2.50 | 0.24 | 2.47 | 3 |
| E4INRTIMON02- | | 8 | | | | | 0.333 | 0 | | | | |
| E4INWARMCV04- | 32.8784 | 10 | 136 | 53 | 0.33 | 0.84 | 0.333 | 2 | 2.50 | 0.13 | 2.47 | 1 |
| E4GNGLOBAL01- | 210.4204 | 204 | 236 | 90 | 1.04 | 2.72 | 8.667 | 2 | 2.35 | 0.19 | 5.53 | 1 |
| E4JNFEA14801- | 58.8968 | 15 | 247 | 243 | 1.50 | 1.52 | 2.33 | 0 | 2.63 | 0.12 | 12.11 | 1 |
| E4JNFEA14802- | 58.8968 | 15 | 247 | 243 | 1.50 | 1.52 | 2.33 | 0 | 2.66 | 0.12 | 12.25 | 1 |
| E4JNFEA14803- | 58.8968 | 15 | 247 | 243 | 1.50 | 1.52 | 2.33 | 0 | 2.63 | 0.12 | 12.11 | 1 |
| E4NNHEALTH04- | | 3 | | | | | | 0 | | | | |
| E4JNFEA53M01-(A) | 338.5360 | 160 | 1440 | 61 | 0.38 | 8.88 | 8.667 | 0 | 1.44 | 0.16 | 2.31 | 1 |
| E4JNFEA53M01-(A) | 338.5360 | 160 | 1440 | 607 | 3.74 | 8.88 | 8.667 | 0 | 1.40 | 1.66 | 2.25 | 3 |
| E4JNFEA5UM01- | 453.3920 | 80 | 1930 | 122 | 0.75 | 11.90 | 8.667 | 0 | 1.23 | 0.19 | 3.95 | 1 |
| E4JNFEA5UM01- | 453.3920 | 80 | 1930 | 345 | 2.13 | 11.90 | 8.667 | 0 | 1.23 | 0.54 | 3.95 | 3 |
| E4JNFEA16001- | 28.8936 | 4 | 119 | 115 | 0.71 | 0.73 | 2.33 | 0 | 1.88 | 0.02 | 32.47 | 1 |
| E4JNFEA16002- | 29.8312 | 4 | 123 | 119 | 0.73 | 0.76 | 2.33 | 0 | 1.91 | 0.02 | 32.99 | 1 |
| E4JNFEA16003- | 25.1432 | 4 | 103 | 99 | 0.61 | 0.64 | 2.33 | 0 | 1.95 | 0.02 | 33.68 | 1 |
| E4RNMRING 01- | 431.5928 | 1 | 1837 | 61 | 0.38 | 11.33 | 4.333 | 0 | 0.96 | 0.00 | 123.35 | 1 |
| E4RNMRING 01- | 431.5928 | 96 | 1837 | 61 | 0.38 | 11.33 | 4.333 | 0 | 2.30 | 0.12 | 3.08 | 3 |
| E4NNPCTRLT01- | | 252 | | | | | 8.667 | | | | | |
| J5NNOPCAL_01- | | 48 | | | | | | | | | | |
| | | | | | | | | | | | | |
| Total | | | | | 50.36 | 148.79 | | | | 17.52 | As Modeled | |
| Allocated | | | | | | | | | | 21.72 | Allocation | |
| Oversubscribed | | | | | | | | | | -4.20 | Over/under | |

## E4 Playback Events Timeline (10-30-96 to 2-16-97)

10-30-96: Strategy to begin playback with Europa close-approach observations is instigated.

11-12-96: NIMS playback table includes original estimates for data compression values.

12-04-96: New playback table reflects G1-G2 experience for compression values. Estimated downlink bits for Europa goes from 10 to 16 Mb. Although 6 Jupiter GLOMOS observations are to be recorded, downlink constraints dictate that only 1 (E4JNGLOMOS02) be brought down.

12-14-96: Tests (including power-cycling) indicate that the health of detector 8 remains poor.

12-16-96: A playback table update cycle was permitted during encounter week. As a science decision, an internal NIMS trade transferred 5 Mb of allocation from Io to Europa to enable return of the high-resolution surface composition observations. Small detector 8 monitoring playbacks of E4INHRSPEC01 and E4RNMRING01 were commanded. Some detector 8 wavelengths remain in playback commands for E4JNFEA05501 and E4JNGLOMOS01.

12-21-96: Start playback.

12-30-96: Playback is running 24 hours behind scheduled due to SSI undercompression. Europa SUCOMP data received in good shape.

01-10-96 Start Solar conjunction. No data playback occurs.

01-22-97: Playback table update during conjunction. E4ENASTERI01 is deleted from playback plan in order to get 100% of the area coverage of E4ENSUCOMP03. Small replays of data for E4JNGLOMOS02 are commanded to fill gaps in the data received.

01-28-96 End Solar conjunction. Restart data playback.

01-31-97: Playback table update. Playback of E4JNFEA5UM01 increased slightly.

02-05-97: Poor compression on E4JNFEASUB01 forces cut in spatial coverage of E4JNFEA01602.

02-10-97: Commands to playback E4ENXDARLI01 are tacked on to the end of the playback sequence just in case any bits remain after all planned data return is completed. Partial playback of E4INHRSPEC01 (96 wavelengths) is reinstated.

02-16-97: Playback is terminated. Failure by DSN personnel to send up the latest version of the playback table results in not receiving any data from E4ENXDARLI01.

## NIMS Anomaly Report - E4 Sequence

There weren't any unplanned processor halts detected during the E4 Encounter. The lack of halts is partially due to the 10 reloads commanded throughout the encounter period. Detector 8 was tested and monitored for signs of life to no avail.

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### Processor Halts

**Facts:**

0. There were 6 realtime observations and ten reloads during the E4 Encounter.

1. Two NIMS processor halts were detected at SCLKs 03746396 and 03746572 from the analysis of the NIMS SCLK engineering telemetry channels S-1931 and S-1932. These both occurred during commanded processor halts in E4NNCHKSUM01 and E4NNFULMRO02. A table of the NIMS engineering SCLK values near the time of the Halts follows (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 |
|---|---|---|---|
| 03746396 | 03746400.40 | 1996-353T23:03:59.965 | 1996-353T23:53:05.952 |
| 03746572 | 03746585.05 | 1996-354T02:10:39.959 | 1996-354T03:04:15.128 |

2. No unplanned processor halts were detected in the NIMS SCLK engineering or in the data.

3. Checksums of NIMS RAM and MROs of NIMS RAM were performed while the spacecraft was near perijove to try to catch NIMS in a halt state to help diagnose what causes the processor to halt. The activities were E4NNFULMRO01, E4NNCHKSUM01 and E4NNFULMRO02. The processor was not halted at the time of these activities, so nothing unusual was observed.

4. A Radiation study (MEMCHK01) during J5 was designed to continuously monitor the NIMS processor status over +/- 1 day of perijove. Checksums of NIMS RAM were made which were then written to NIMS RAM 1800 - 18FF. After solar conjunciton was over these locations were MRO'd to Earth. Unfortunately the MROs were not received because of a ground station problem. A subsequent NIMS reload wiped out the stored checksums.

**Timing:**

| SCLK | Comments |
|---|---|
| 03746397:06 | 37PL Halts the processor |
| 03746400.40 | Anomalous 03746396 SCLK reported |
| 03746473:06 | 37MN Restarts the processor |
| 03746573:06 | 37PL Halts the processor |
| 03746585.05 | Anomalous 03746572 SCLK reported |
| 03746730:06 | 37MN Restarts the processor |
| 03746802.58 | Good SCLK 03746800 reported |

## NIMS Anomaly Report - E4 Sequence

**Summary:**

1. No unplanned processor halts were detected during the E4 Encounter.

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

3. The 10 NIMS software reloads from CDS seemed to have protected all of the NIMS observations in this encounter.

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

6. The error avoidance measures applied to the E4 Encounter as determined in the analysis of the G1, G2 and C3 processor halts, especially the 10 reloads, were shown to be the proper response for dealing with the inevitable occurrence of radiation-induced NIMS processor halts.

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### Detector 8 Failure

1. Detector 8 was observed to have unusual behavior in the two C3 outbound data and cruise calibrations.

2. Near the end of C3 Cruise, NIMS' power was turned off, then on, using 37AR and 37A commands. This was followed by a RAM reload. This was done to see if Detector 8 could be reset by a power cycle.

3. After the reload a modified OPCAL was performed which included detectors 1, 2, 7, 8 and 9. This was done to observe Detector 8's dark values compared to its neighboring detectors.

4. Detector 8 still returned alternating 0s and 1023s as before.

5. During playback some observations were returned with detector 8 selected for monitor purposes. Detector 8 still did not return any reasonable DN values.

6. The following observations have detector 8 selected:

| | | |
|---|---|---|
| E4NNOPCAL_01_R | E4JNFEA05501_A | E4INRTIMON01_R |
| E4JNRTHOTS01_R | E4JNFEA09503_A | E4INRTIMON02_R |
| E4GNGLOBAL01_A | E4NNPCTRLT01_R | |

7. The following observations have only detector 8:

E4INHRSPEC01_A     E4RNMRING_01_A

## 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.

## 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.**