# Chapter 7 - Data Return

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## Introduction to Chapter 7

This chapter is a report on the NIMS data return for the G29 orbit. Due to the low downlink data rates available for Galileo Jupiter Operations and other unforeseen and unpredictable events during the G29 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.

There were thirty-six autonomous reloads of the NIMS RAM code from CDS during the G29 encounter, one just before each science observation. One software halt was inferred during G29. The approach that we are taking to avoid data loss due to processor halts has proven to be very successful.

The NIMS grating became stuck some time between C22 and I24. NIMS can now return only 17 (of 408) wavelengths. This has caused a drastic change in NIMS science capabilities. Detectors 1, 2 and 7 now have very low sensitivity. Detectors 3 and 8 are still not functioning. NIMS now returns only 12 useful wavelengths. Interesting science can still be carried out given the current condition of the insturment.

One observation (29JNGLOBAL06) took data in chopper 63Hz mode. The 37IST command which set the chopper mode failed to go from 63Hz to Reference mode. The 37IST command selected the gain state and chopper mode in the same command string.

The plots on the pages 3 and 4 show the geometry of the NIMS G29 observations using a north trajectory pole projection. The 'returned' observations are in Bold characters and the 'non-returned' in gray. The observations with an asterix were taken with the NIMS software halted.

The spreadsheets on pages 5 through 8 summarize the 'final' playback model for the G29 data returned.

The text on page 9 gives a 'recap' of the G29 playback events which affected which observations were returned.

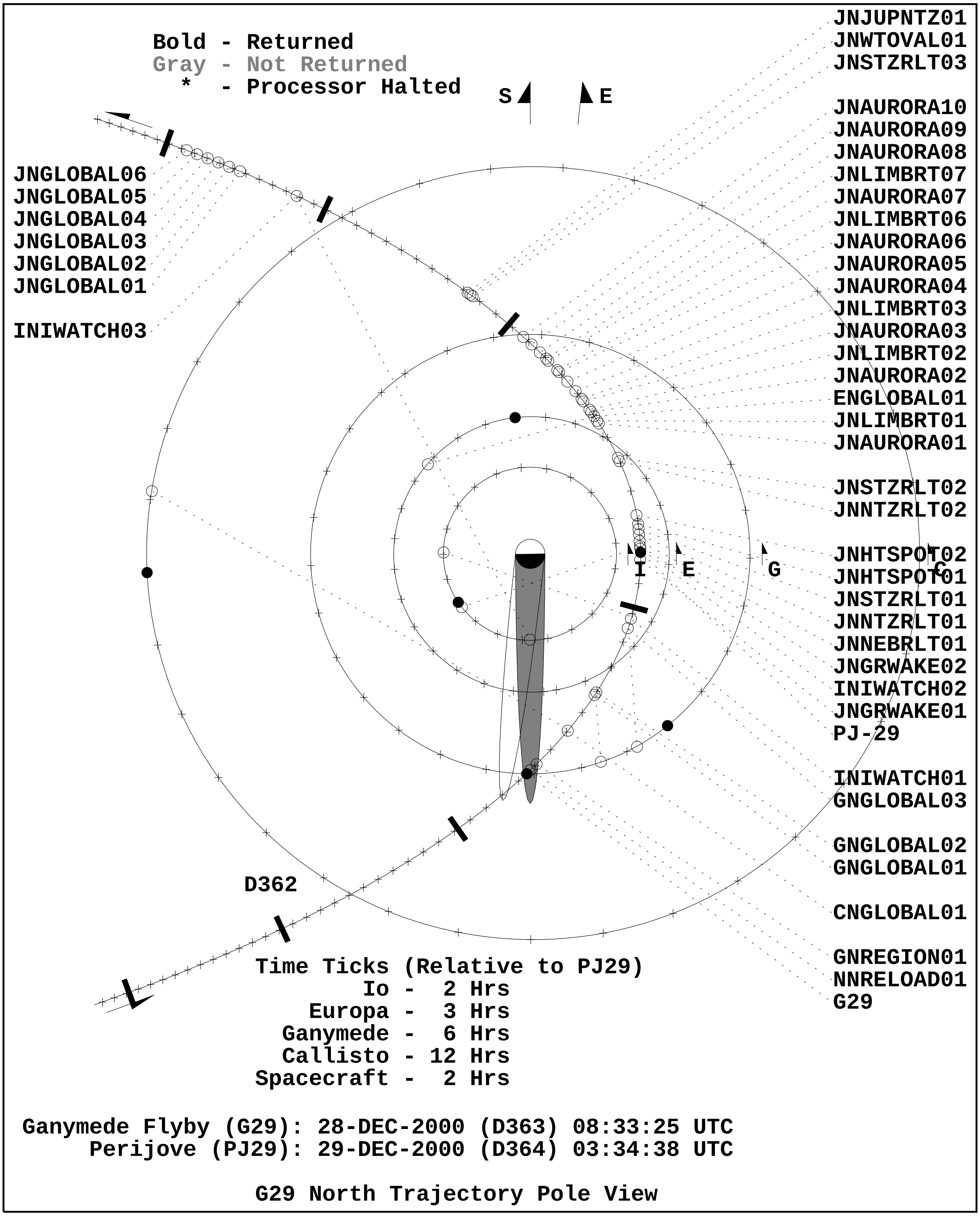
A Timeline of G29 playback events is on pages 9 through 22.

The text on pages 23 and 24 describes the G29 NIMS and Spacecraft Anomalies.

The text on page 25 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 26 and 27.

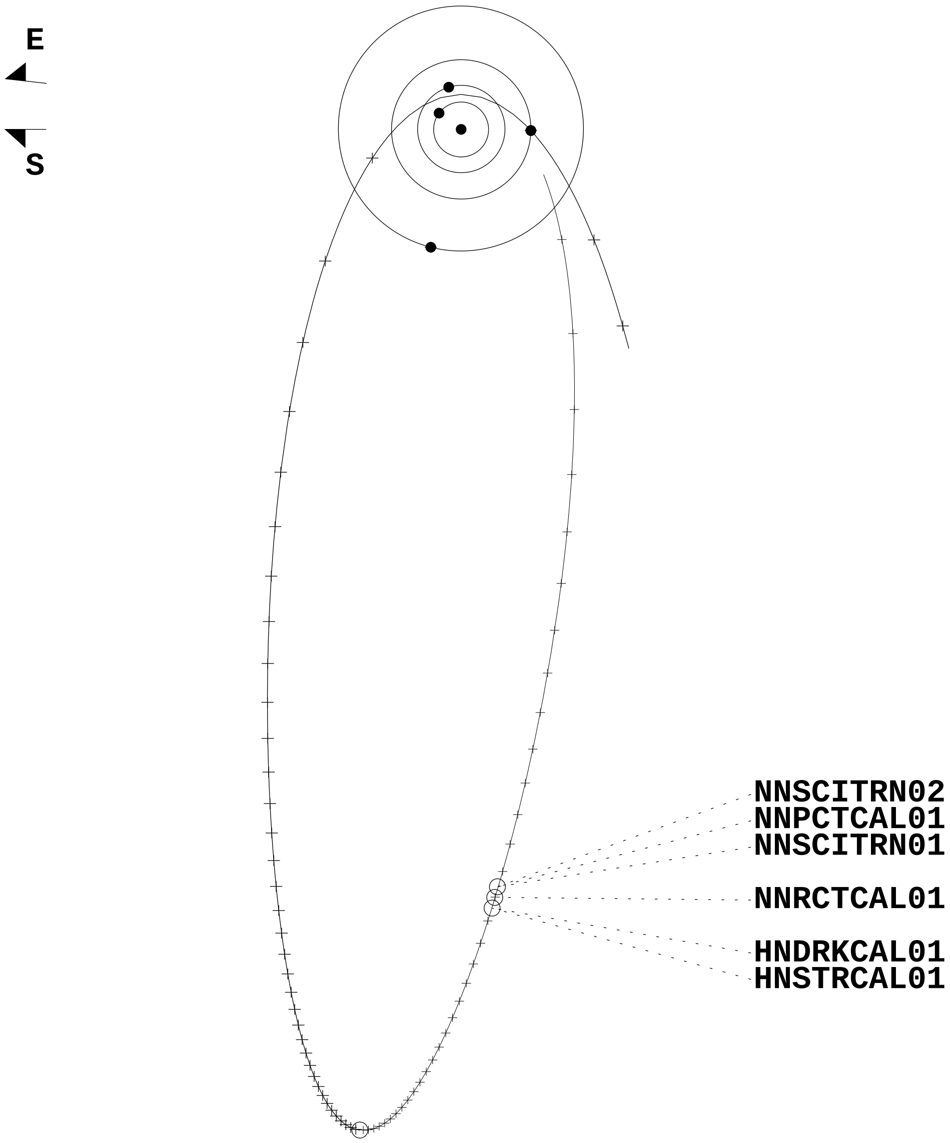
The text on page 28 is a guide to understanding the NIMS MASK.

# NIMS G29 OBSERVATIONS




NIMS - FEL - 10/31/01

# NIMS G29 CALIBRATIONS




**Time Ticks (Relative to G29)**
**Spacecraft - 2 Days**

**Ganymede Flyby (G29): 28-DEC-2000 (D363) 08:33:25 UTC**
**Perijove (PJ29): 29-DEC-2000 (D364) 03:34:38 UTC**

**G29 North Trajectory Pole View**

**NIMS - FEL - 02/21/01**

# NIMS G29 DATA RETURN

| Activity ID | Observation Title | NIMS Edit Table | NIMS PB Table | Mode | Gain | Grating Start | Grating Offset | Record Format | PSID |
|---|---|---|---|---|---|---|---|---|---|
| 29GNREGION01 | Ganymede Region Obs | G29GLM442 | G29GLMFG288 | LM | 2 | 0 | 4 | MPW | DA |
| 29CNGLOBAL01 | Callisto Global Obs | G29CLM442 | G29CLMFG288 | LM | 4 | 0 | 4 | MPW | DB |
| 29GNGLOBAL01 | Ganymede Global Obs 01 | G29GLMFG252 | G29GLMFG252 | LM | 2 | 0 | 4 | LPU | DC |
| 29GNGLOBAL03 | Ganymede Global Obs 03 | G29GLMFG252 | G29GLMFG252 | LM | 2 | 0 | 4 | LPU | DE |
| 29INIWATCH01 | Io Monitoring 01 | G29ILM442 | G29ILMFG288 | LM | 2 | 0 | 4 | MPW | DF |
| 29INIWATCH02 | Io Monitoring 02 | G29ILM442 | G29ILMFG288 | LM | 2 | 0 | 4 | MPW | DH |
| 29JNGRWAKE02 | Jupiter GRS Wake Obs 02 | G29JLMFG240 | G29JLMFG48 | LM | 2 | 0 | 4 | LPU | DI |
| 29JNNEBRLT01 | Jupiter R/T NEB Obs 01 | | | LM | 2 | 0 | 4 | | DJ |
| 29JNNTZRLT01 | Jupiter R/T MTZ Obs 01 | | | LM | 2 | 0 | 4 | | DK |
| 29JNSTZRLT01 | Jupiter R/T STZ Obs 01 | | | LM | 2 | 0 | 4 | | DL |
| 29JNHTSPOT01 | Jupiter Hot Spot Obs 01 | G29JLMFG240 | G29JLMFG48 | LM | 2 | 0 | 4 | LPU | DM |
| 29JNNTZRLT02 | Jupiter R/T NTZ Obs 02 | | | LM | 2 | 0 | 4 | | DP |
| 29JNSTZRLT02 | Jupiter R/T STZ Obs 02 | | | LM | 2 | 0 | 4 | | DQ |
| 29JNAURORA01 | Jupiter Aurora Obs 01 | G29JLMFG240 | G29GLMFG72 | LM | 4 | 0 | 4 | LPU | DR |
| 29JNLIMBRT01 | Jupiter R/T Limb Obs 01 | | | LM | 4 | 0 | 4 | | DS |
| 29ENGLOBAL01 | Europa Global Obs | G29ELM442 | G29ELMFG288 | LM | 3 | 0 | 4 | MPW | DT |
| 29JNLIMBRT02 | Jupiter R/T Limb Obs 02 | | | LM | 4 | 0 | 4 | | DV |
| 29JNAURORA03 | Jupiter Aurora Obs 03 | G29JLMFG240 | G29GLMFG72 | LM | 4 | 0 | 4 | LPU | DX |
| 29JNLIMBRT03 | Jupiter R/T Limb Obs 03 | | | LM | 4 | 0 | 4 | | DY |
| 29JNAURORA04 | Jupiter Aurora Obs 04 | G29JLMFG240 | G29GLMFG72 | LM | 4 | 0 | 4 | LPU | DZ |
| 29JNAURORA06 | Jupiter Aurora Obs 06 | G29JLMFG240 | G29GLMFG72 | LM | 4 | 0 | 4 | LPU | ED |
| 29JNLIMBRT06 | Jupiter R/T Limb Obs 06 | | | LM | 4 | 0 | 4 | | EE |
| 29JNAURORA07 | Jupiter Aurora Obs 07 | G29JLMFG240 | G29GLMFG72 | LM | 4 | 0 | 4 | LPU | EF |
| 29JNLIMBRT07 | Jupiter R/T Limb Obs 07 | | | LM | 4 | 0 | 4 | | EG |
| 29JNAURORA08 | Jupiter Aurora Obs 08 | G29JLMFG240 | G29GLMFG72 | LM | 4 | 0 | 4 | LPU | EH |
| 29JNAURORA09 | Jupiter Aurora Obs 09 | G29JLMFG240 | G29GLMFG72 | LM | 4 | 0 | 4 | LPU | EK |
| 29JNSTZRLT03 | Jupiter R/T STZ Obs 03 | | | LM | 2 | 0 | 4 | | EP |
| 29JNWTOVAL01 | Jupiter white Oval Obs | G29JLMFG240 | G29JLMFG48 | LM | 2 | 0 | 4 | LPU | EQ |
| 29INIWATCH03 | Io Monitoring 03 | G29ILM442 | G29ILMFG288 | LM | 2 | 0 | 4 | MPW | ES |
| 29JNGLOBAL02 | Jupiter Global Map 02 | G29JXMFG10 | G29JXMFG9 | XM | 2 | 0 | 4 | LPU | EU |
| 29JNGLOBAL03 | Jupiter Global Map 03 | G29JXMFG10 | G29JXMFG9 | XM | 2 | 0 | 4 | LPU | EV |
| 29JNGLOBAL04 | Jupiter Global Map 04 | G29JXMFG10 | G29JXMFG9 | XM | 2 | 0 | 4 | LPU | EW |
| 29JNGLOBAL05 | Jupiter Global Map 05 | G29JXMFG10 | G29JXMFG9 | XM | 2 | 0 | 4 | LPU | EX |
| 29JNGLOBAL06 | Jupiter Global Map 06 | G29JXMFG10 | G29JXMFG9 | XM | 2 | 0 | 4 | LPU | EY |
| | | | | | | | | | |
| 29GNREGION01-gf | Ganymede REgion Obs | G29GLM442 | G29GLMFG288 | LM | 2 | 0 | 4 | MPW | DA |
| 29GNREGION01 | Ganymede REgion Obs | G29GLM442 | G29GLMFG144 | LM | 2 | 0 | 4 | MPW | DA |
| 29GNGLOBAL01-gf | Ganymede Global Obs 01 | G29GLMFG252 | G29GLMFG252 | LM | 2 | 0 | 4 | LPU | DC |
| 29GNGLOBAL02 | Ganymede Global Obs 02 | G29GLMFG252 | G29GLMFG126 | LM | 2 | 0 | 4 | LPU | DD |
| 29GNGLOBAL03-gf | Ganymede Global Obs 03 | G29GLMFG252 | G29GLMFG252 | LM | 2 | 0 | 4 | LPU | DE |
| 29JNGRWAKE01 | Jupiter GRS Wake Obs 01 | G29JLMFG240 | G29JLMFG48 | LM | 2 | 0 | 4 | LPU | DG |
| 29JNGRWAKE02-gf | Jupiter GRS Wake Obs 01 | G29JLMFG240 | G29JLMFG48 | LM | 2 | 0 | 4 | LPU | DI |
| 29JNHTSPOT01-gf | Jupiter Hot Spot Obs 01 | G29JLMFG240 | G29JLMFG48 | LM | 2 | 0 | 4 | LPU | DM |

# NIMS G29 DATA RETURN

| Activity ID | Observation Title | NIMS Edit Table | NIMS PB Table | Mode | Gain | Grating Start | Grating Offset | Record Format | PSID |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| 29JNHTSPOT02 | Jupiter Hot Spot Obs 02 | G29JLMFG240 | G29JLMFG48 | LM | 2 | 0 | 4 | LPU | DN |
| 29ENGLOBAL01-gf | Europa Global | G29ELM442 | G29ELMFG288 | LM | 3 | 0 | 4 | MPW | DT |
| 29JNAURORA02 | Jupiter Aurora Obs 02 | G29JLMFG240 | G29GLMFG72 | LM | 4 | 0 | 4 | LPU | DU |
| 29JNAURORA05 | Jupiter Aurora Obs 05 | G29JLMFG240 | G29GLMFG72 | LM | 4 | 0 | 4 | LPU | EB |
| 29JNAURORA06-gf | Jupiter Aurora Obs 06 | G29JLMFG240 | G29GLMFG72 | LM | 4 | 0 | 4 | LPU | ED |
| 29JNAURORA08-gf | Jupiter Aurora Obs 08 | G29JLMFG240 | G29GLMFG72 | LM | 4 | 0 | 4 | LPU | EH |
| 29JNAURORA10 | Jupiter Aurora Obs 10 | G29JLMFG240 | G29GLMFG72 | LM | 4 | 0 | 4 | LPU | EL |
| 29JNWTOVAL01-gf | Jupiter White Oval Obs | G29JLMFG240 | G29JLMFG48 | LM | 2 | 0 | 4 | LPU | EQ |
| 29JNJUPNTZ01 | Jupiter NTZ Obs | G29JLMFG240 | G29JLMFG24 | LM | 2 | 0 | 4 | LPU | ER |
| 29INIWATCH03-gf | Io Monitoring 03 | G29ILM442 | G29ILMFG288 | LM | 2 | 0 | 4 | MPW | ES |
| 29JNGLOBAL01 | Jupiter Global Map 01 | G29JXMFG10 | G29JXMFG9 | XM | 2 | 0 | 4 | LPU | ET |
| 29JNGLOBAL02-gf | Jupiter Global Map 02 | G29JXMFG10 | G29JXMFG9 | XM | 2 | 0 | 4 | LPU | EU |
| 29JNGLOBAL03-gf | Jupiter Global Map 03 | G29JXMFG10 | G29JXMFG9 | XM | 2 | 0 | 4 | LPU | EV |
| 29JNGLOBAL04-gf | Jupiter Global Map 04 | G29JXMFG10 | G29JXMFG9 | XM | 2 | 0 | 4 | LPU | EW |
| 29JNGLOBAL06-gf | Jupiter Global Map 06 | G29JXMFG10 | G29JXMFG9 | XM | 2 | 0 | 4 | LPU | EY |
| | | | | | | | | | |
| 29GNREGION01-gf | Ganymede Region Obs | G29GLM442 | G29GLMFG288 | LM | 2 | 0 | 4 | MPW | DA |
| 29GNGLOBAL01-gf | Ganymede Global Obs 01 | G29GLMFG252 | G29GLMFG252 | LM | 2 | 0 | 4 | LPU | DC |
| 29GNGLOBAL02-gf | Ganymede Global Obs 02 | G29GLMFG252 | G29GLMFG126 | LM | 2 | 0 | 4 | LPU | DD |
| 29INIWATCH01-gf | Io Monitoring 01 | G29ILM442 | G29ILMFG288 | LM | 2 | 0 | 4 | MPW | DF |
| 29JNHTSPOT02-gf | Jupiter Hot Spot Obs 02 | G29JLMFG240 | G29JLMFG48 | LM | 2 | 0 | 4 | LPU | DN |
| 29JNAURORA10-gf | Jupiter Aurora Obs 10 | G29JLMFG240 | G29GLMFG72 | LM | 4 | 0 | 4 | LPU | EL |
| 29JNJUPNTZ01-gf | Jupiter NTZ Obs | G29JLMFG240 | G29JLMFG24 | LM | 2 | 0 | 4 | LPU | EP |
| | | | | | | | | | |
| 29HNSTRCAL01 | Star Calibration | G29HLMFG442 | G29HLMFG144 | LM | 4 | | | | DA |
| 29HNDRKCAL01 | Dark Calibration | G29HLMFG442 | G29HLMFG360 | LM | 1,2,3,4 | | | | DB |
| 29NNRCTCAL01 | RCT Calibration | G29HLMFG442 | G29HLMFG216 | LM | 1 | | | | DC |
| 29NNPCTCAL01 | PCT Calibration | G29HLMFG442 | G29HLMFG192 | LM | 4 | | | | DD |
| 29GNREGION01-gf | Ganymede Region Obs | G29GLM442 | G29GLMFG288 | LM | 2 | 0 | 4 | MPW | DA |
| 29GNGLOBAL01-gf | Ganymede Global Obs 01 | G29GLMFG252 | G29GLMFG252 | LM | 2 | 0 | 4 | LPU | DB |
| 29INIWATCH01-gf | Io Monitoring 01 | G29ILM442 | G29ILMFG288 | LM | 2 | 0 | 4 | MPW | DF |
| 29JNJUPNTZ01-gf | Jupiter NTZ Obs | G29JLMFG240 | G29JLMFG24 | LM | 2 | 0 | 4 | LPU | ER |
| 29JNGLOBAL01-gf | Jupiter Global Map 01 | G29JXMFG10 | G29JXMFG9 | XM | 2 | 0 | 4 | LPU | ET |
| 29JNGLOBAL04-gf | Jupiter Global Map 04 | G29JXMFG10 | G29JXMFG9 | XM | 2 | 0 | 4 | LPU | EW |
| 29JNGLOBAL06-gf | Jupiter Global Map 06 | G29JXMFG10 | G29JXMFG9 | XM | 2 | 0 | 4 | LPU | EY |
| 29HNDRKCAL01-gf | Dark Calibration | G29HLMFG442 | G29HLMFG360 | LM | 1,2,3,4 | | | | DB |
| 29NNRCTCAL01-gf | RCT Calibration | G29HLMFG442 | G29HLMFG216 | LM | 1 | | | | DC |
| 29NNPCTCAL01-gf | PCT Calibration | G29HLMFG442 | G29HLMFG192 | LM | 4 | | | | DD |
| | | | | | | | | | |
| | | Tables created for the NIMS fixed-grating | | | | | | | |
| | | case include the letters FG in the table name. | | | | | | | |

# NIMS G29 DATA RETURN

| Activity ID | Mode | Record Format | Wave-lengths Returned | Record Time (sec.) | PB time (sec) | Selected Bits to Tape sBOT (MBITS) | Bits to Tape BOT (Mbit) | Mode Cycle (sec) | AACS Mbits c 2.5 | Comp | Total BTG (Mbits) (w/4% ohead) | Data Reduct Factor (sBOT/BTG) | Pass |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 29GNREGION01 | LM | MPW | 288 | 900 | 479 | 5.52 | 10.37 | 8.667 | 0.03 | 1.79 | 1.850 | 2.98 | 1 |
| 29CNGLOBAL01 | LM | MPW | 288 | 125 | 123 | 1.42 | 1.44 | 8.667 | 0.01 | 1.76 | 0.483 | 2.93 | 1 |
| 29GNGLOBAL01 | LM | LPU | 252 | 600 | 588 | 3.63 | 3.70 | 8.667 | 0.03 | 1.52 | 2.340 | 1.55 | 1 |
| 29GNGLOBAL03 | LM | LPU | 252 | 475 | 463 | 2.86 | 2.93 | 8.667 | 0.03 | 1.34 | 2.090 | 1.37 | 1 |
| 29INIWATCH01 | LM | MPW | 288 | 185 | 180 | 2.07 | 2.13 | 8.667 | 0.01 | 1.44 | 0.864 | 2.40 | 1 |
| 29INIWATCH02 | LM | MPW | 288 | 190 | 188 | 2.17 | 2.19 | 8.667 | 0.01 | 1.27 | 1.023 | 2.12 | 1 |
| 29JNGRWAKE02 | LM | LPU | 48 | 860 | 848 | 5.23 | 5.30 | 8.667 | 0.05 | 1.32 | 0.740 | 7.07 | 1 |
| 29JNNEBRLT01 | LM | | 130 | | | 0.00 | 0.00 | 8.667 | 0.00 | | | | |
| 29JNNTZRLT01 | LM | | 130 | | | 0.00 | 0.00 | 8.667 | 0.00 | | | | |
| 29JNSTZRLT01 | LM | | 130 | | | 0.00 | 0.00 | 8.667 | 0.00 | | | | |
| 29JNHTSPOT01 | LM | LPU | 48 | 860 | 848 | 5.23 | 5.30 | 8.667 | 0.05 | 1.37 | 0.713 | 7.34 | 1 |
| 29JNNTZRLT02 | LM | | 130 | | | 0.00 | 0.00 | 8.667 | 0.00 | | | | |
| 29JNSTZRLT02 | LM | | 130 | | | 0.00 | 0.00 | 8.667 | 0.00 | | | | |
| 29JNAURORA01 | LM | LPU | 72 | 730 | 718 | 4.43 | 4.50 | 8.667 | 0.04 | 1.32 | 0.940 | 4.71 | 1 |
| 29JNLIMBRT01 | LM | | 80 | | | 0.00 | 0.00 | 8.667 | 0.00 | | | | |
| 29ENGLOBAL01 | LM | MPW | 288 | 180 | 178 | 2.05 | 2.07 | 8.667 | 0.01 | 1.45 | 0.848 | 2.42 | 1 |
| 29JNLIMBRT02 | LM | | 80 | | | 0.00 | 0.00 | 8.667 | 0.00 | | | | |
| 29JNAURORA03 | LM | LPU | 72 | 727 | 724 | 4.47 | 4.48 | 8.667 | 0.04 | 1.35 | 0.927 | 4.82 | 1 |
| 29JNLIMBRT03 | LM | | 80 | | | 0.00 | 0.00 | 8.667 | 0.00 | | | | |
| 29JNAURORA04 | LM | LPU | 72 | 780 | 726 | 4.48 | 4.81 | 8.667 | 0.04 | 1.41 | 0.890 | 5.03 | 1 |
| 29JNAURORA06 | LM | LPU | 72 | 780 | 608 | 3.75 | 4.81 | 8.667 | 0.04 | 1.68 | 0.625 | 6.00 | 1 |
| 29JNLIMBRT06 | LM | | 80 | | | 0.00 | 0.00 | 8.667 | 0.00 | | | | |
| 29JNAURORA07 | LM | LPU | 72 | 780 | 731 | 4.51 | 4.81 | 8.667 | 0.04 | 1.53 | 0.826 | 5.46 | 1 |
| 29JNLIMBRT07 | LM | | 80 | | | 0.00 | 0.00 | 8.667 | 0.00 | | | | |
| 29JNAURORA08 | LM | LPU | 72 | 780 | 734 | 4.53 | 4.81 | 8.667 | 0.04 | 1.49 | 0.851 | 5.32 | 1 |
| 29JNAURORA09 | LM | LPU | 72 | 780 | 776 | 4.79 | 4.81 | 8.667 | 0.04 | 1.49 | 0.900 | 5.32 | 1 |
| 29JNSTZRLT03 | LM | | 130 | | | 0.00 | 0.00 | 8.667 | 0.00 | | | | |
| 29JNWTOVAL01 | LM | LPU | 48 | 972 | 967 | 5.96 | 6.00 | 8.667 | 0.06 | 1.82 | 0.612 | 9.74 | 1 |
| 29INIWATCH03 | LM | MPW | 288 | 165 | 161 | 1.85 | 1.90 | 8.667 | 0.01 | 2.91 | 0.382 | 4.85 | 1 |
| 29JNGLOBAL02 | XM | LPU | 9 | 646 | 634 | 3.91 | 3.98 | 0.333 | 0.04 | 2.12 | 1.681 | 2.33 | 1 |
| 29JNGLOBAL03 | XM | LPU | 9 | 646 | 634 | 3.91 | 3.98 | 0.333 | 0.04 | 2.13 | 1.673 | 2.34 | 1 |
| 29JNGLOBAL04 | XM | LPU | 9 | 646 | 634 | 3.91 | 3.98 | 0.333 | 0.04 | 2.16 | 1.650 | 2.37 | 1 |
| 29JNGLOBAL05 | XM | LPU | 9 | 660 | 635 | 3.92 | 4.07 | 0.333 | 0.04 | 2.23 | 1.601 | 2.45 | 1 |
| 29JNGLOBAL06 | XM | LPU | 9 | 646 | 634 | 3.91 | 3.98 | 0.333 | 0.04 | 2.43 | 1.467 | 2.67 | 1 |
| | | | | | | | | | | | | | |
| 29GNREGION01 | LM | MPW | 288 | 900 | 10 | 0.12 | 10.37 | 8.667 | 0.00 | 1.8 | 0.038 | 3.00 | 2 |
| 29GNREGION01 | LM | MPW | 288 | 900 | 414 | 4.77 | 10.37 | 8.667 | 0.02 | 1.8 | 1.590 | 3.00 | 2 |
| 29GNGLOBAL01 | LM | LPU | 252 | 600 | 225 | 1.39 | 3.70 | 8.667 | 0.01 | 1.49 | 0.913 | 1.52 | 2 |
| 29GNGLOBAL02 | LM | LPU | 126 | 610 | 608 | 3.75 | 3.76 | 8.667 | 0.04 | 1.52 | 1.210 | 3.10 | 2 |
| 29GNGLOBAL03 | LM | LPU | 252 | 475 | 49 | 0.30 | 2.93 | 8.667 | 0.00 | 1.34 | 0.221 | 1.37 | 2 |
| 29JNGRWAKE01 | LM | LPU | 48 | 1557 | 1546 | 9.54 | 9.60 | 8.667 | 0.09 | 1.32 | 1.349 | 7.07 | 2 |
| 29JNGRWAKE02 | LM | LPU | 48 | 860 | 243 | 1.50 | 5.30 | 8.667 | 0.01 | 1.32 | 0.212 | 7.07 | 2 |
| 29JNHTSPOT01 | LM | LPU | 48 | 860 | 24 | 0.15 | 5.30 | 8.667 | 0.00 | 1.37 | 0.020 | 7.34 | 2 |

# NIMS G29 DATA RETURN

| Activity ID | Mode | Record Format | Wave-lengths Returned | Record Time (sec.) | PB time (sec) | Selected Bits to Tape sBOT (MBITS) | Bits to Tape BOT (Mbit) | Mode Cycle (sec) | AACS Mbits c 2.5 | Comp | Total BTG (Mbits) (w/4% ohead) | Data Reduct Factor (sBOT/BTG) | Pass |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 29JNHTSPOT02 | LM | LPU | 48 | 972 | 960 | 5.92 | 6.00 | 8.667 | 0.06 | 1.38 | 0.801 | 7.39 | 2 |
| 29ENGLOBAL01 | LM | MPW | 288 | 180 | 12 | 0.14 | 2.07 | 8.667 | 0.00 | 1.45 | 0.057 | 2.42 | 2 |
| 29JNAURORA02 | LM | LPU | 72 | 790 | 778 | 4.80 | 4.87 | 8.667 | 0.04 | 1.34 | 1.003 | 4.78 | 2 |
| 29JNAURORA05 | LM | LPU | 72 | 780 | 776 | 4.79 | 4.81 | 8.667 | 0.04 | 1.57 | 0.854 | 5.60 | 2 |
| 29JNAURORA06 | LM | LPU | 72 | 780 | 44 | 0.27 | 4.81 | 8.667 | 0.00 | 1.68 | 0.045 | 6.00 | 2 |
| 29JNAURORA08 | LM | LPU | 72 | 780 | 20 | 0.12 | 4.81 | 8.667 | 0.00 | 1.49 | 0.023 | 5.32 | 2 |
| 29JNAURORA10 | LM | LPU | 72 | 780 | 774 | 4.77 | 4.81 | 8.667 | 0.04 | 1.54 | 0.868 | 5.50 | 2 |
| 29JNWTOVAL01 | LM | LPU | 48 | 972 | 66 | 0.41 | 6.00 | 8.667 | 0.00 | 1.82 | 0.042 | 9.74 | 2 |
| 29JNJUPNTZ01 | LM | LPU | 24 | 1928 | 1924 | 11.87 | 11.89 | 8.667 | 0.11 | 1.9 | 0.583 | 20.35 | 2 |
| 29INIWATCH03 | LM | MPW | 288 | 165 | 13 | 0.15 | 1.90 | 8.667 | 0.00 | 2.91 | 0.031 | 4.85 | 2 |
| 29JNGLOBAL01 | XM | LPU | 9 | 646 | 634 | 3.91 | 3.98 | 0.333 | 0.04 | 2.1 | 1.697 | 2.30 | 2 |
| 29JNGLOBAL02 | XM | LPU | 9 | 646 | 90 | 0.56 | 3.98 | 0.333 | 0.01 | 2.12 | 0.239 | 2.33 | 2 |
| 29JNGLOBAL03 | XM | LPU | 9 | 646 | 46 | 0.28 | 3.98 | 0.333 | 0.00 | 2.13 | 0.121 | 2.34 | 2 |
| 29JNGLOBAL04 | XM | LPU | 9 | 646 | 38 | 0.23 | 3.98 | 0.333 | 0.00 | 2.16 | 0.099 | 2.37 | 2 |
| 29JNGLOBAL06 | XM | LPU | 9 | 646 | 50 | 0.31 | 3.98 | 0.333 | 0.00 | 2.4 | 0.117 | 2.63 | 2 |
| | | | | | | | | | | | | | |
| 29GNREGION01 | LM | MPW | 288 | 900 | 15 | 0.17 | 10.37 | 8.667 | 0.00 | 1.8 | 0.058 | 3.00 | 3 |
| 29GNGLOBAL01 | LM | LPU | 252 | 600 | 42 | 0.26 | 3.70 | 8.667 | 0.00 | 1.5 | 0.169 | 1.53 | 3 |
| 29GNGLOBAL02 | LM | LPU | 126 | 610 | 34 | 0.21 | 3.76 | 8.667 | 0.00 | 1.52 | 0.068 | 3.10 | 3 |
| 29INIWATCH01 | LM | MPW | 288 | 185 | 62 | 0.71 | 2.13 | 8.667 | 0.00 | 1.44 | 0.298 | 2.40 | 3 |
| 29JNHTSPOT02 | LM | LPU | 48 | 972 | 23 | 0.14 | 6.00 | 8.667 | 0.00 | 1.4 | 0.019 | 7.50 | 3 |
| 29JNAURORA10 | LM | LPU | 72 | 780 | 475 | 2.93 | 4.81 | 8.667 | 0.03 | 1.54 | 0.533 | 5.50 | 3 |
| 29JNJUPNTZ01 | LM | LPU | 24 | 1928 | 155 | 0.96 | 11.89 | 8.667 | 0.01 | 1.9 | 0.047 | 20.35 | 3 |
| | | | | | | | | | | | | | |
| 29HNSTRCAL01 | LM | MPW | 144 | 360 | 193 | 2.22 | | 8.667 | | 2.49 | 0.268 | 8.30 | 1 |
| 29HNDRKCAL01 | LM | MPW | 360 | 360 | 240 | 2.76 | | 8.667 | | 4.26 | 0.487 | 5.68 | 1 |
| 29NNRCTCAL01 | LM | MPW | 216 | 606 | 604 | 6.96 | | 8.667 | | 4.32 | 0.725 | 9.60 | 1 |
| 29NNPCTCAL01 | LM | MPW | 216 | 606 | 306 | 3.53 | | 8.667 | | 2.52 | 0.629 | 5.60 | 1 |
| 29GNREGION01 | LM | MPW | 288 | 900 | 18 | 0.21 | 10.37 | 8.667 | 0.00 | 1.8 | 0.069 | 3.00 | 2 |
| 29GNGLOBAL01 | LM | LPU | 252 | 600 | 8 | 0.05 | 3.70 | 8.667 | 0.00 | 1.5 | 0.032 | 1.53 | 2 |
| 29INIWATCH01 | LM | MPW | 288 | 185 | 33 | 0.38 | 2.13 | 8.667 | 0.00 | 1.44 | 0.158 | 2.40 | 2 |
| 29JNJUPNTZ01 | LM | LPU | 24 | 1928 | 155 | 0.96 | 11.89 | 8.667 | 0.01 | 1.9 | 0.047 | 20.35 | 2 |
| 29JNGLOBAL01 | XM | LPU | 9 | 646 | 40 | 0.25 | 3.98 | 0.333 | 0.00 | 2.1 | 0.107 | 2.30 | 2 |
| 29JNGLOBAL04 | XM | LPU | 9 | 646 | 59 | 0.36 | 3.98 | 0.333 | 0.00 | 2.16 | 0.154 | 2.37 | 2 |
| 29JNGLOBAL06 | XM | LPU | 9 | 646 | 50 | 0.31 | 3.98 | 0.333 | 0.00 | 2.4 | 0.117 | 2.63 | 2 |
| 29HNDRKCAL01 | LM | MPW | 360 | 360 | 52 | 0.60 | | 8.667 | | 4.2 | 0.107 | 5.60 | 2 |
| 29NNRCTCAL01 | LM | MPW | 216 | 606 | 12 | 0.14 | | 8.667 | | 4.3 | 0.014 | 9.56 | 2 |
| 29NNPCTCAL01 | LM | MPW | 216 | 606 | 38 | 0.44 | | 8.667 | | 2.5 | 0.079 | 5.56 | 2 |
| | | | | | | | | | | | 42.295 | **Total** | |
| | | | | | | | | | | | 42.373 | **Allocation** | |
| | | | | | | | | | | | -0.078 | **Over/Under** | |

## RECAP OF G29 PLAYBACK EVENTS

The G29 orbit was very successful, particularly for NIMS Jupiter observations. Dounlink resources were relatively abundant, with NIMS returning more than 42 Mbits of data during the playback period. A new software patch enabled the use of LPU record mode for the first time since C22.

The Cassini spacecraft traversed the Jovian system during G29, giving rise to opportunities for collaborative observations.

Playback strategies were relatively complex. There were three passes over the tape for standard data return, and there were an additional two passes for return of calibration data recorded during G29 cruise. Although there were a large number of gaps due to DSN outages, a high percentage of these were successfully filled.

One despun bus reset occurred during the encounter, and this was handled successfully by the onboard software. No NIMS software halts were detected. SSI experienced hardware problems which resulted in the loss of some of their observations.

The following timeline details the most signifigant events of the G29 playback period. Most of the text below is excerpted from messages issued at the time.

### G29 Playback Events Timeline (12-05-00 to 05-15-01)

12-05-00: The initial version of the NIMS G29 playback table was delivered today. G29 is comparable in complexity to a Prime Mission orbit. Some good news is that MWG released some 40 Mbits of surplus downlink allocation back to SPOT, of which we received 11.5 Mbits. This is a significant addition to our prior total of 26.9. The table delivered today commands playback of about 43 Mbits of data, so we are significantly over our allocation at this point.

12-26-00: G29 encounter begins at 22:30 UTC.

12-28-00: Ganymede close approach occurs at 08:33 UTC.

12-28-00: (J. Erickson) The Galileo spacecraft is operating normally, and all activities appear to be as planned. Close approach to Ganymede was at 4:00 a.m. PST on 12/28 (Earth Received Time), and at an altitude of 2,337.4 kilometers (1,452.4 miles). All planned Ganymede observations to date appear to have been recorded successfully. Jupiter close approach will be at 8:02 p.m. PST tonight (12/28), shortly before the expected peak of the radiation flux.

**G29 Playback Events Timeline (12-05-00 to 05-15-01)**

**12-29-00:** Perijove occurs at 03:34 UTC.

**12-29-00:** A despun bus reset event occurs at 04:35, which is handled by onboard software.

**12-29-00:** (J. Erickson) Galileo Ganymede 29 Status Report #2 - 10:00 p.m. PST The Galileo spacecraft is operating normally (except for the SSI camera - see below), and all activities appear to be as planned. The current status is from the DSS 14 pass at 9:30 p.m. PST on 12/28. The spacecraft has now passed Jupiter close approach and the peak of the radiation expected for this encounter. All observation recording is proceeding according to plan. The expected end of the radiation danger is at 3:05 p.m. PST on 12/29. Earlier, at 1:30 p.m. PST Earth Receive Timed, an alarm was received from the Solid State Imaging Camera. It seems to indicate a re-occurrence of a problem with the light flood LED turning on continuously. Commands were sent to disable the LED and this appears to have had no effect. The incident occurred during a quiescent period for the camera, hours after the previous observation. Additional observations will begin Friday, 12/29. Continued analysis is in progress.

**12-29-00:** (M. Segura) I've done analysis on the engineering telemetry for the instrument up to the moment. It appears that we've made it thru perijove without Spacecraft or NIMS problems thus far. We will have good data up thru the first STZ realtime observation.
At this point, the sequence is clocking out for NIMS and we're about 40 minutes away from the execution of the Jupiter HotSpot01 observation. The LPU patch is working flawlessly.
SSI has had some difficulties. It appears that they are experiencing a "flood-mode" problem as in G28. A command was sent to turn flood-mode off and the telemetry indicated no change. This approach worked as a resolution in G28 but seems to not have done so this time. Analysis is ongoing with a number of options to be attempted to recover before the IO observations due to execute around 9 am tomorrow morning.

**12-29-00:** (R. Mehlman) Packets from the first three realtime observations are down. DNs appear to be reasonable at first glance, but as no doubt expected, detector 7 data is, let's say, subdued. No bad SCLKs received. Good ones are from between GNGLOBAL02 and 03, right after INIWATCH01, and after JNNEBRLT01. Hardware status words since NIMS observations began are as expected, showing proper chopper mode and gain state. (There's a possible chopper mode anomaly before that, which would affect only early SSI ridealong, if we ask for it.)

**<u>G29 Playback Events Timeline</u> (12-05-00 to 05-15-01)**

**12-29-00:** **(M. Segura) Just to let you know that things are going well for NIMS this orbit... Even the bus reset did not have any effect on our data set thus far.**

**12-30-00:** **(R. Mehlman) Engineering data has been scarce over the last 24 hours, but the few temperatures and hardware status words received appear normal. All the SCLKs we got have been good. Everything appears to be OK, but of course the proof will be in the playback.**

**12-30-00:** **(J. Erickson) The Galileo spacecraft is operating normally, and all activities appear to be as planned. The SSI camera was power cycled and it's memory reloaded late last night. At approximately 11:30 p.m. PST 12/29, verification was received from the spacecraft that this had eliminated the anomalous engineering readings from the SSI camera. This was in time to pick up the observations on 12/30, including the subsequent Io eclipse recordings.**

**01-02-01:** **(E. Theilig) The Galileo spacecraft is operating normally at the end of the encounter observations. The current status is from the DSS 63 pass at 12:30 p.m. PST on 1/2. All encounter recording went according to plan with the possible exception of the SSI camera.**
**Three times during the encounter anomalous engineering readings were received from the SSI camera. The first incident cleared when commands were sent to power-cycle the instrument and reload its memory. The second and third incidents cleared autonomously. Some of the Io Eclipse and Jupiter atmospheric feature track observations occurred during the periods of anomalous engineering readings. The impact of these readings on the images is unknown at this time.**

**01-05-01:** **(J. Erickson) This was another successful encounter, with a single area of concern. Close approach to Ganymede was at 1:00 a.m. PST on 12/28 (Earth Received Time), and at an altitude of 2,337.4 kilometers (1,452.4 miles). Remote sensing observations and fields and particles recordings of Ganymede were completed as planned. The DSN successfully recorded the Radio Science Jupiter Occultation over DSS-14 (Goldstone, California), between 8:23 p.m. (12/27) and 12:10 a.m. (12/28) PST.**
**Jupiter close approach was at 8:02 p.m. PST 12/28. Playback will begin 6/15/00. Playback is delayed to allow an opportunity for another cross sectional mapping of Jupiter's magnetosphere.**
**Radiation levels were significantly below average, with no problems identified. The peak radiation level was around 420 (measured by the star scanner in pulse counts), significantly lower than the maximum of 1400 seen in previous GEM orbits.**

<u>G29 Playback Events Timeline</u> (12-05-00 to 05-15-01)

During the encounter a single standard bus reset occurred and was handled normally by the on-board recovery software without any effect on the planned sequence. This occurred at 12:35 a.m. on 12/29/2000 PST, ground receipt time.

01-09-01: A new pre-uplink version of the NIMS G29 playback table was delivered today. This incorporates a number of timing corrections and modified wavelength tables for a few observations. Wavelength selections for playback of a number of Jupiter observations still need to be specified. The "preview" playback of SSI observations to assess the effects of the light flood LED staying on did not go well. The tape recorder (DMS) appears to have gone into search mode during playback.

01-12-01: (E. Theilig) The Galileo spacecraft is operating normally, following the Ganymede 29 encounter. The primary activity over the past week has been the continuation of a 100-day magnetospheric survey by the fields and particles instruments, in collaboration with the Cassini mission. Although playback of G29A data has not begun, a few early reports based on RTS data have come in. NIMS reports receipt of all but a few packets of their real time observations. PWS real time data from Ganymede is causing the PWS to further consider their high-rate data from G28. Ganymede and its magnetosphere look more and more like a completely unique environment in our solar system. The DDS team has had a quick look at dust data from both Galileo and Cassini during the encounter period and have been able to identify the same "packets" of dust particles as they passed by each spacecraft. This will allow the DDS Team to better understand the details of how the magnetosphere transports these dust particles from the vicinity of Io, through the magnetosphere, and out into the solar wind.

01-16-01: (Y. Anderson) For this G29 playback allocation update, the allocations for SSI, NIMS and PPR are essentially unchanged from before. However, there are several significant changes in the process of coming up with these numbers.

1) We realized that the total BTG we were using (215 MB) is incorrect. That number has 80 MB of the 116.9 of the MWG BTG residing in Load A, not during playback. Therefore, these MBTG should not be considered when making up the allocations.

   As a result, the G29 OAP bit to Ground Allocations are updated as:

| | | |
|---|---|---|
| SSI | 61.2 MB | 45.33% |
| NIMS | 26.9 MB | 19.93% |
| PPR | 5.0 MB | 3.70% |
| UVS/EUV | 5.0 MB | 3.70% |
| MWG | 36.9 MB | 27.33% |
| Total | 135.0 MB | 100.0% |

   Inefficiency 5.2 MB
   SPOT margin 34.0 MB

2) Current G29 Science BTG is estimated as 207 MB (with 167 MB for Load B and 40 MB for Load C). This gives the BTGs for each team, using the percentages above:

| | | |
|---|---|---|
| SSI | 75.611 | MB |
| NIMS | 33.234 | MB |
| PPR | 6.177 | MB |
| UVS/EUV | 6.177 | MB |
| WMG | 45.589 | MB |
| Inefficiency | 6.21 | MB |
| SPOT margin | 34.0 | MB |
| Total | 207 | MB |

3) SPOT releases 17 MB margin to teams to make up the difference, so BTG for the teams are essentially unchanged at this point. Of 17 MB, 5 MB goes to MWG, and the rest is distributed among SSI, NIMS and PPR based on their relative percentages (65.7% for SSI, 28.9% for NIMS, and 5.4% for PPR).

4) UVS/EUV releases its 6.177 MB and the number is redistributed among SSI, NIMS and PPR, based on the relative percentages.
Finally, we have

| | | |
|---|---|---|
| SSI | 87.553 MB | |
| NIMS | 37.057 MB | (1.43 MB AACS charges have been deducted) |
| PPR | 7.159 MB | |
| UVS/EUV | 0.000 | |
| MWG | 25.180 MB | (0.339 MB AACS charges, 5.07 MB DDS charges, and 20 MB of Buffer Dumps have been deduced) |
| DDS | 5.070 MB | |
| AACS | 1.769 MB | |
| BDT | 20.000 MB | |

G29 Load B&C Total Allocation: 183.79 MB
(excluding SPOT margin 17 MB and inefficiency 6.21 MB)

01-17-01: (to the Ganymede investigators) We do not have enough downlink allocation in G29 to play back all of the data we have on tape. The Jupiter data volume is being reduced by about 60%. We need to make sure that what we bring down for Ganymede is useful.
For Ganymede we have 1 REGION observation recorded with all wavelengths and 3 GLOBALs (in LPU mode) recording 252 wavelengths. For these we take data from 12 detectors, excluding 1, 2, 3, and 7, 8. We essentially get 24 DNs for each spatial pixel, for all detectors except 15-17, where we get 12 DNs per scan/instrument cycle. Thus we have lots of redundancy and should get excellent low noise images at each band.

To save bits at this point I propose we return data for only the 12 "good" detectors for 29GNREGION01. Does anyone have a good reason to look at the nearly-nonexistent signal from detectors 1, 2, or 7? If so let me know.
If more drastic cuts turn out to be necessary I think we could cut back to 12x redundancy for the GLOBALs, without doing great harm to the science.

01-17-01: (R. Mehlman) We would like to receive Jupiter global observations 04, 05, and 06 sooner rather than later. We think 05 is in chopper reference and 06 in 63 hertz, but we don’t know what mode 04 is in. We hope to determine that from the data by comparing all three.

01-17-01: Priorities for the Jupiter G29 observations playback:
Here is an overview of the situation. There are 3 categories to talk about, the globals, the auroras and the miscellaneous others. We have 24 Mbits or so to use. The division of the pie was made arbitrarily and can be changed easily. In all cases we recorded data for 10 detectors, 4-5-6-7 10-11 13 15 16 17. Globals: Now at 9 Mbits with only 7 detectors selected to come down. Fixed map mode, no redundant data. Kevin gives these high priority in connection with Cassini science and wants all detectors, or all except det 7.
Question: will we get anything useful from det 7 (1.8 microns but "blocked")?
Aurora: Current plan is 5 samples for each of 10 detectors (50 "wavelengths" of possible 240). Currently 10 observations, 5 Mbits total. Cutting det 7 saves 10%.
Want to oversample 4.1 microns (det 15)? Are all detectors equally valuable or could some be deselected for playback?
Others: Dayside hotmats (2), GRS wake (2), and a white oval and a north temperate zone. All budgeted for either 5x redundancy or 10 x redundancy (5 or 10 samples from each of the 10 detectors).

01-18-01: The newest G29 playback table is resident on LIVELY in [JSHIRLEY]G29NIMS_010118.PBT. A few changes were made to deselect times of pass 2 observations to conform to DMS rules. 29JNGLOBAL05 was moved from pass 2 to pass 1, to investigate a possible chopper anomaly noted in telemetry data by Bob Mehlman. And, the number of detectors selected for the 3 IOWATCH observations, and for 29GNREGION01, was reduced from 15 to 12. However, the wavelength selections for the Jupiter observations are yet to be finalized. This will occur before the next update.

01-25-01: I have moved a new G29 playback table over to LIVELY. This has newly-created wavelength selections implemented for all the Jupiter observations. The globals will come down with 9 detectors/wavelengths. The aurora have 72 "wavelengths" selected, and the others have 48 (HOTMAPs, WHTOVL, etc.).

G29 Playback Events Timeline (12-05-00 to 05-15-01)

**01-29-01:** (Y. Anderson) Here is the updated playback allocation from the last merge (delivered by 1/18/01):

| | MBTG(%) | Total | ActualUsage | UnusedBTG |
|---|---|---|---|---|
| SSI | 49.531% | 87.553 | 42.714 | 44.839 |
| NIMS | 20.859% | 36.872 | 37.076 | -0.204 |
| PPR | 4.050% | 7.159 | 6.482 | 0.677 |
| MWG | 14.245% | 25.180 | 18.553 | 6.627 |
| AACS | 0.000% | 0.000 | 1.955* | -1.955 |
| BDT | 11.314% | 20.000 | 21.550 | -1.550 |
| Total | 100.0% | 176.766 | 128.330 | 48.436 |

AACS usage includes 1.615 MB from NIMS and 0.339MB from MWG.

**01-30-01:** The final pre-uplink NIMS G29 Playback table was delivered Friday. With predicted compression values we are very close to our downlink bits allocation of about 37 Mbits.
Following discussions with Kevin and Bob, a strategy for prioritizing Jupiter data return was identified (and implemented in this delivery). The Jupiter global observations which have about 4x better spatial resolution than their Cassini VIMS counterparts have high priority and are selected in full (all spatial coverage with 9 detectors). (Note: The wavelength record tables for this orbit included detector 7, which currently shows very low signal levels. The data for detector 7 is not planned for playback in any Jupiter observations). The auroral observations will be played back with 100% of the recorded data for detector 13 (where auroral emissions are seen), and with 25% of the total recorded data for the other 8 detectors. Lastly, the remaining observations (HOTSPOTs, WHTOVL, GRWAKE01-02, NTZ) will be returned with 25% of the recorded data, for 8 detectors (this selection does not include detectors 7 and 13).
The Ganymede global observations (LPU mode) will come down with all recorded wavelengths, while the GNREGION observation and the various distant Io, Europa, and Callisto observations are being returned with 12 detectors selected.
We expect to need additional allocation bits to return gap-fill. If we receive a windfall, we will be able to add some additional commands to return data recorded during SSI observations, and we will be able to expand the percent data returned for some of the Jupiter observations.

**02-01-01:** (Y. Anderson) Playback initiates Monday February 5 at 12:59 PM PDT. (01-036/20:59 SCET-UTC).
Playback terminates at the end of the C-load, around DOY 01-142/16:00 (TBD)

**02-13-01:** (Y. Anderson) G29 Playback Allocation Update
The changes from last G29 playback allocation are:
1. SPOT released 3.0 MB overhead inefficiency. It was redistributed to SSI (2.084) and NIMS (0.916) based on the allocation percentage.
   This cut the inefficiency holding to 3.292 MB.

2. A total of 2.5 MB downlink capability was deducted due to the calibration activities in the C-load. This deduction was charged from SSI (1.737) and NIMS (0.763) based on the allocation percentage.

02-14-01: Only two changes were made for this delivery. Both of these will result in improvements in playback efficiency, resulting in reduced amounts of "fill" coming down in the downlink stream at the beginning of the second pass over the tape. The second scan of 29GNREGION01 was moved to pass 2 (PSID=EZ), along with the entire playback of 29GNGLOBAL02. Playback is currently running about 1.5 days ahead of schedule.

02-20-01: (Y. Anderson) The only change in allocation from last G29 playback allocation is: SPOT released 10.0 MB margin to the teams. It was redistributed to SSI (6.947) and NIMS (3.053) based on their OAP allocation percentages. This cut the SPOT margin to 7.0 MB.

| | MBTG | Total | ActualUsage | Unused BTG |
|---|---|---|---|---|
| SSI | 50.020% | 95.510 | 49.343 | 46.167 |
| NIMS | 21.128% | 40.343 | 37.392 | 2.951 |

02-21-01: (M. Segura) G29 calibration record and playback: The wavelength edit tables are just the default. We are recording all the calibrations in MPW with ALL detector data going to tape - even the non-functional 3 and 8. I suggest that we remove those 2 detectors in the actual playback table we uplink. Leave the rest with all the overlap (yep, even with 1,2, and 7 questionable) unless absolutely necessary. We should have on the order of 10 mbits to use for the return of the cals. I estimated that the total cost of 360 wavelength return at 1.2 compression would cost about 13 mbits with every last tic of tape returned.

02-28-01: G29 playback is on schedule. The NIMS Ganymede and Callisto observations from the first pass over the tape are down. Compression is somewhat lower than predicted (about 1.7 versus 2.0). We have lost a significant amount of data due to DSN station problems (weather and so on). Roughly half of 29GNGLOBAL01 and 29GNGLOBAL03 will have to be replayed in pass 2 at a cost of roughly 2 Mbits. We received about 3 Mbits of new allocation last week through a SPOT margin release, so we are within our allocation now.

03-06-01: (Y. Anderson) Since SSI needs to update the tail end of pass 1 (29RSRINGS_03, -04, and -05), we will have an update this week! If you've known of ANY changes that you need to make in the current playback table for the remaining pass 1 and pass 2, please include them in this week's playback delivery file.

<u>G29 Playback Events Timeline</u> **(12-05-00 to 05-15-01)**

**03-07-01:** There are very many changes to the playback table due to new data on actual compression performance of pass 1 observations, and due to the need to fill a dozen significant gaps. We are temporarily above our playback bits allocation of 40.25 Mbits. We have plenty of time to rectify the situation. If we do not receive any additional margin bits, we will have to cut back on the number of wavelengths returned in some of our pass 2 observations.
Today Herb showed a new SSI global image of the northern hemisphere of Io, revealing an extremely large apparent plume deposit "bulls-eye", centered near Tvashtar, that has not been in evidence before.

**03-14-01:** (Y. Anderson) G29 Playback Allocation Update -
The latest G29CHA orpro indicates that the total capability is down ~4 MB from the previous one (from 200.4 MB to 196.3 MB). The capability from resuming playback after load-C calibrations to the end of the sequence is now 40.8 MB only (down from previous 44.4 MB).
To compensate this cut in capabilities, SPOT released 4.0 MB margin to the teams. It adds 2.779 MB to SSI and 1.221 MB to NIMS. The SPOT margin is now 3.0 MB. At present, NIMS is about 4% over their allocation, and this does not count the BTG needed for their calibration data playback.

**03-14-01:** Here's the situation. From now till the end of playback we have about 12.2 Mbits of allocation. The data currently selected for playback amounts to 13.6 Mbits. To playback all of the calibration data with 12 detectors fully selected requires about 6.2 Mbits. So, we are over by about 7.2 Mbits
The times of the calibrations are
STARCAL  6 minutes
DARKCAL  6 minutes
RCT CAL 10 Rims
PCTCAL1  2 Rims
PCTCAL2 10 Rims
All are in MPW.
Please let me know how much data is required from each of these to accomplish the goals. How many grating steps per detector required as a minimum; which detectors are superfluous; and where the duration could be cut down.

**03-14-01:** NIMS G29 Calibrations Playback Commands
A mini-pbt was delivered today containing only 5 sets of singles, for returning recorded calibration data at the end of the playback period. Due to a number of factors we are now considerably over our downlink allocation.

<u>G29 Playback Events Timeline</u> **(12-05-00 to 05-15-01)**

**All of the calibrations except the RCTCAL are returning all grating positions for 12 detectors. Playback times have been cut back significantly from the record times. We will get half the recorded data for the STRCAL and the PCTCALs, and 4 (of 6) RIMS of the DRKCAL (1 RIM for each gain state). The RCTCAL was not cut back in duration. The current plan requires about 3.8 Mbits for playback of calibrations only.**

**03-21-01: The table delivered today has 10 new sets of commands for filling gaps in our pass 1 observations. In addition, there were a number of changes in data reduction factors (to reflect actual compression values). We had some very good news in the actual compressions for the Jupiter global observations. These compressed with ratios of 2.1-2.4, significantly better than expected. As a result we were not forced to make as many cuts to our wavelengths coverage for Jupiter observations as I anticipated last week.**
**Due to the bits savings from good compression noted above, I did not change the playback commands for the 3 remaining aurora observations, or for 29JNGRWAKE01 or for 29JNHTSPOT02. I did have to cut back 29JNJUPNTZ01 (the last to be returned) to 24 from 48 wavelengths. This has enhanced redundancy for detectors 11 and 16 as requested by Kevin.**
**All of the calibrations have new wavelength selections, as follows:**
**29HNSTRCAL01: detectors 4,5,6,9,10,11 (6x24=144)**
**29HNDRKCAL01: 15 detectors (360 wavelengths)**
**29HNRCTCAL01: detectors 9-17 (9x24=216)**
**29HNPCTCAL01: detectors 1,2,4,5,6,7,9,10 (8x24=192)**

**03-22-01: (Y. Anderson) Currently running ahead of the schedule (G29PEM) about 2.5 days. We are playing back 29MBBFRDMP18 in Segment 10. Track 4, tic 805 (as of 10 PM 3/21/01). Playback is currently about 53% complete.**

**03-26-01: (Y. Anderson) Just wanted to remind you that we will have an EARLY update this week. The pb files are due to 3pm tomorrow (Tue., 3/27). The update will be for segment 13, 14, 15, and 16. These are all relatively short segments. Next week we will update segment 17 and 18, which will end the pre-calibration data playback. Therefore, for G29A encounter data we only have two updates, this week and next week. PPR released their 1.652 MB: 0.81 MB applied to covering the station loss, and the rest 0.842 MB released to SSI and NIMS. MWG also released their 1.328 MB to SSI and NIMS. SPOT released 1.0 MB margin and 2.0 MB inefficiency to SSI and NIMS. Currently, SPOT holds 2.0 MB for margin and 1.139 MB for inefficiency.**

**03-27-01:** An early update was completed yesterday. A number of minor changes were made. We received donations of downlink bits allocations from PPR and MWG, and there was a small SPOT release of margin bits, totaling about 1.7 Mbits for us. On the down side, there is a labor dispute going on at the DSN station in Canberra. If this continues indefinitely there will be a significant impact on our remaining playback capability. In this update the time of playback was increased for 29HNDARKCL01, and playback of detector 11 data was added for 29NNPCTCAL01. Some of our new allocation was used to restore full data density playback for the second part of 29GNREGION01.

**04-02-01:** (D. Bindschadler) - Here's the (new) basic order by which PB will proceed:
PBT #1 Pass 1 - complete
Pass 2 - in progress
Pass 3 - for gap-fill, may only get Trk 1 & 2 data?
PBT #1 will end with a TPB command, probably early on DOY 112.
PBT #2 Pass 1 - return DOY 112-113 calibration data
Pass 2 - gap-fill, Track 2 onward.
Note that there are no guarantees as to how far Pass 3 or PBT #2's Pass 2 will get through the tape.
- If you are participating in the 2nd (Calibration data) playback, please deliver two separate PBT's, one for Passes 1 through 3 through the G29 data, and a second for return of calibration data and remaining gap-fill from G29. Teams (e.g., PPR?) who are not returning calibration data only need deliver a single PBT.
- The purpose of this week's updates is (in part) to give us two shots at getting this new strategy done correctly. If you are pressed for time, please concentrate your efforts on Pass 3 data return -- we have more time to work on PBT #2.

**04-04-01:** Due to problems at the DSN, particularly Canberra, we have been forced to adopt a new strategy for the balance of G29 playback. As a result there are now two G29 playback tables. Due to DSN problems there are significant gaps in our data. The project has decided to approve a third pass over the early parts of G29 recording in order to recover some of the data.
The calibrations, which will be performed April 22-23, were formerly included in the G29 table and given pass numbers of 3. However, now they are in their own table (G29NIMS_010404_CAL) with pass numbers = 1.
We will proceed as far as possible into the 3rd pass of G29 encounter playback, before a terminate playback command goes active prior to the calibrations. We (NIMS) have one set of commands in this third pass, to return a large gap in 29INWATCH01. This gap fill was dropped from last week's table due to an error (duplicate PSID).

**G29 Playback Events Timeline (12-05-00 to 05-15-01)**

**Following a first pass through the calibrations data, there will be another opportunity to request gap fills for the G29 encounter data that is not overwritten by calibration recording. Thus the "cal" pbt will likely include some gap fill commands later on.**

**The following information is included to help the playback coordinator estimate bits requirements and model the playback process from this time forward. These numbers reflect our best current knowledge regarding data compression, etc.**

| | |
|---|---|
| **NIMS data returned in pass 1:** | **25.975 Mbits** |
| **NIMS data commanded for passes 2-3:** | **12.568 Mbits** |
| **NIMS calibration data total bits:** | **3.202 Mbits** |

**The total (41.75 Mbits) is 0.63 Mbits UNDER our current allocation. It is likely that we will experience more data losses in the period prior to calibrations recording. Hopefully there will be sufficient flexibility in the playback update process for us to successfully adapt to changes over the next few weeks.**

**04-01-01: (D. Bindschadler) Please note the DSS 63 outage yesterday caused us to drop approximately 44 telemetry frames. DSS 63 had some significant problems but should be back online today. DSS-14 began tracking early and managed to capture 17 frames (or the loss would have been 61).**

**Please be sure to factor in this outage into your plans for the PBT update this week, at least to the extent possible. These data will not be recovered in post-pass processing. This update is your likely to be the best chance we have of recovering the data that were lost.**

**04-11-01: The table delivered today includes 8 new sets of commands for returning gap-fill. This has been the "gappiest" orbit in memory. For 29GNGLOBAL01, we are even attempting to fill gaps in our gap fill, i.e., we are making a SECOND attempt to recover data that was not captured by ground stations in pass 1 OR pass 2.**

**The largest gap involves about 0.5 Mbits of data for 29JNAURORA10. Fortunately we had nearly enough remaining allocation to cover this, together with our other gaps. We are over by about .13 Mbits at present, but since there are large uncertainties regarding SSI playback between now and the termination prior to calibrations, we are being allowed this small overage. Playback is currently a little ahead of schedule. The third pass playback should begin on Sunday.**

**G29 Playback Events Timeline (12-05-00 to 05-15-01)**

**04-25-01:** Although the nominal delivery date for this table is Friday (04-27), no new information affecting NIMS playback is expected, and so I have delivered our file today.
In addition to our playback commands for calibration data return, this table includes 7 sets of gap-fill commands for G29 encounter data on tracks 2, 3, and 4. There is considerable uncertainty regarding whether or not we will receive this data, due to unknowns linked with the SSI calibrations compression and strategy. There will be at least one more update cycle.
The NIMS calibrations are scheduled to come down from the middle to the end of next week. If there are significant gaps, we will try to fill them in yet another pass over the tape.
The gap-fill data commanded amounts to about 0.7 Mbits, which will put us somewhat over our allocation. However, unless the current one-pass-for-calibrations strategy changes, these bits can be regarded as either "packing out" the bitter end of the playback period, or as data that will to some extent prevent us from returning excessive amounts of fill while we slew over several tracks of encounter data prior to a second pass over the calibrations. It should still be possible to remove these, or cut them back, if the need arises, in the next update cycle.

**05-04-01:** (E. Theilig) The Galileo spacecraft is operating normally. Playback of Ganymede 29 encounter data and calibrations performed last week is 87% complete and is scheduled to terminate on 5/21/2001.
On Monday, 4/30/2001, the SSI instrument engineer presented his final analysis and test report on the camera BLS anomaly. The anomalous behavior, characterized by increased baseline stabilization voltage, increased SSI input current, and saturated images, was first seen July 2000 and recurred during the Ganymede 29 encounter in December 2000. In two cases the behavior cleared by commanding; however, in another 7 cases, it cleared autonomously. The failure has been localized to the sample and hold circuitry, either in an opamp or a JFET, and was most likely induced by radiation. The cause of the failure and the exact trigger to go into or out of the anomalous state remains unknown.

**05-07-01:** (R. Mehlman) Looks like the missing half-RIM at the end of the PCTCAL showed up, as did the single missing packet in the RCTCAL. But the larger gaps in the DRKCAL are still there, just as before.

## <u>G29 Playback Events Timeline</u> (12-05-00 to 05-15-01)

**05-07-01:** I delivered the final playback table for G29 this afternoon (G29NIMS_CALIB_010507.PBT). The only changes were to add 4 gap-fill singles for calibration data. Playback will end on 21 May. We had good compression on our calibrations, with ratios above 4 in some cases. This is contributing to playback running a little ahead of schedule.
The calibrations gap fills are not likely to be returned. They fall after any SSI gap fills, and the schedule shows only a tiny bit of capability after our encounter gap fills are returned. We will lose at least .5 Mbit of capability while slewing around to the beginning of calibration recordings.
Late breaking news: Besting this afternoon (after file delivery) shows that the missing RCT and PCT data have turned up. The somewhat earlier DARK cals gaps are still there. Thus the singles in today's table with PSIDs of FK, FL are redundant and could be deleted.

**05-15-01:** (F. Leader) The latest G29 encounter gap-fill playback is down (and bested) several days ahead of schedule. But calibration gap-fill is not yet down. Most of the requested gap-fill made it, but there are a few gaps in it, including one 27-packet gap, no hope of filling that.

**05-21-01:** Playback of G29 calibrations is terminated.

The NIMS grating became stuck prior to the I24 encounter. The grating continued to be stuck for the G29 encounter. This development caused a drastic change in NIMS operations. Detectors 1, 2 and 7 now have very low sensitivity. Detectors 3 and 8 are still not functioning. NIMS now returns only 12 useful wavelengths.

The NIMS processor may have halted once during the G29 Encounter as a result of a CDS Bus Reset (BURP) event. No NIMS observations were lost due to this halt.

The NIMS instrument may have taken science data in Chopper 63Hz mode instead of Chopper Reference mode. This happened when the 37IST command selected gain state and chopper mode in the same command string. The returned data for 29JNGLOBAL06 appear to be taken in Chopper 63Hz mode.

The spacecraft did not safe during the G29 Encounter but did suffer one Bus Reset which precipitated the NIMS halt.

Stuck Grating (from the I24 NIMS Guide)

At I24, NIMS experienced a fundamental change in the way that it operates. Sometime between C22 and I24, the NIMS grating became stuck at a position corresponding to a pshift of about 14.5. This unusual grating position produces wavelengths for each detector far shorter than previously used. With the stuck grating, NIMS is permanently in a "fixed grating" mode. At this new grating position, Detectors 1, 2 and 7 return very low DN, as their new wavelengths are outside of the passband of their blocking filters and therefore are of minimal use. As before, detectors 3 and 8 are still not functioning.

There is no ground calibration for the wavelengths corresponding to this pshift. Flight calibration was derived from the I24 RCT and PCT calibrations. Details of this new flight calibration will be discussed in the as yet unpublished NIMS calibration report.

The spectral capability of the NIMS instrument shrank from 408 wavelengths to 17 wavelengths with the stuck grating. Now all commanded modes, Long Map, Full Map, Short Map or Fixed Map, select the same 17 wavelengths. Two effects of the stuck grating have been put to good use: spatial editing and noise reduction.

Even though the grating is stuck, the grating cycle still plays an important role. The playback edit table can now be used for spatial data editing. In Long Map mode, each mirror scan can be selected or deselected using the playback edit table. This allows a range of spatial density versus areal coverage choices.

If an observation is performed in Long Map mode at the Long Map scan rate, the 24 mirror scans over a single grating cycle can be averaged together to increase the signal to noise level. The adverse effects of the high levels of radiation-induced noise encountered close-in to Jupiter are greatly alleviated by this averaging.

**NIMS Anomaly Report - G29 Sequence**

**Response to Stuck Grating Anomaly (G29)**

At G29 the cause of the stuck grating was not known (and is still not clearly understood). No attempts were made during G29 to unstick the grating.

**Processor Halts**

There was one NIMS processor halt during G29. The halts were inferred from the occurance of a CDS Bus Reset. In the CDS recovery process from the bus interrupts, NIMS loses RTI synch with CDS, causing NIMS to halt. This halt was not detected in the NIMS Engineering telemetry but was assumed to have occurred from past behavior. The Bus Reset occurred outside of NIMS observations. Each NIMS observation was preceded by a NIMS Software reload so that no NIMS observations were lost due to the halts.

**NIMS Chopper Anomaly**

NIMS appears to have taken science data in 29JNGLOBAL06 while in chopper 63Hz mode. The NIMS engineering hardware status word twice returned a value of 0, indicating chopper 63Hz mode, after the reload which preceded this observation. In the reload, both the gain state and chopper mode were selected in the same 37IST command string:

05845504:80:0 00-366/20:50:34.333 CMD,37IST,... 1,2,0,OFF,0,1,0;

The data values returned for this observation were consistent with the instrument being in chopper 63Hz mode. The chopper 63Hz calibration correction derived for the Earth 1 and 2 encounters was applied to the I24 calibration for this observation.

A hardware status word also return a value of 0 after the first reload of the encounter. The gain state and chopper mode were also selected together in this instance.

Gain state and Chopper mode have been selected in the same command string in the past without the instrument staying in chopper 63Hz mode. This is something new for NIMS, perhaps a sign of radiation damage.

**Spacecraft Anomaly**

During the G29 encounter a single standard bus resets occurred and was handled normally by the on-board recovery software without any effects on the planned sequence. The BURP event occurred at about D364/08:35.

**Anomaly Timing:**

| | | |
|---|---|---|
| 5840534 | 00-363/09:04:27 | 37IST 29NNRELOAD01 (Gain State & Chopper Ref) |
| 5840608 | 00-363/10:20:07 | Chopper 63Hz ENGR |
| 5840620 | 00-363/10:31:24 | 37IST 29NNREGION01 (Chopper Ref only) |
| 5840793 | 00-363T13:26:47 | Chopper Ref ENGR |
| 5841929 | 00-364/08:35:00 | BURP reported |
| 5842217 | 00-364T13:26:47 | 5842214 SCLK reported (just after RELOAD) |
| 5845505 | 00-366/20:50:41 | 37IST 29NNGLOBAL06 (Gain State & Chopper Ref) |
| 5845593 | 00-366T22:20:07 | Chopper 63Hz ENGR |
| 5846411 | 01-001T12:06:47 | Chopper 63Hz ENGR |

## 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.