

DAWN'S GAMMA RAY AND NEUTRON DETECTOR (GRAND)

CRUISE BUNDLE DESCRIPTION

Thomas H. Prettyman
Planetary Science Institute
8-Feb-2021

CONTENTS

- What's in the Cruise Bundle?1
 - Data Raw Collection.....1
 - Browse collection2
 - Document collection.....2
- Operations Summary2
- References3

WHAT'S IN THE CRUISE BUNDLE?

The Cruise bundle contains raw data products acquired during Dawn's cruise through interplanetary space, while en-route to Mars, Vesta, and Ceres. During this time, GRaND was operated periodically to assess instrument state of health and acquire background data. See the Operations Summary in this report for a description of instrument operations and performance during cruise. The data are accompanied by supporting documents and browse files, which provide a graphical overview. For further information on the GRaND archive and instrument, see [1-3].

DATA RAW COLLECTION

The Dawn GRaND Raw Collection for Cruse includes gamma ray and neutron counting data and histograms. These are an intermediate data product derived from spacecraft science and housekeeping telemetry using reversible process. All higher order data products included in the bundle were derived from the raw data. The data are grouped into directories by date range. These contain GRaND housekeeping (HK), gamma-ray (GAMMA), and neutron (NEUTRON) counting data and histograms. A detailed description of the format and contents of the raw data is provided by [2].

BROWSE COLLECTION

The browse collection contains graphical presentations of the data found in the raw collection for Vesta-Ceres Cruise. For each raw directory (GRD-L1A-Y1M1D1-Y2M2D2_YCMCDC), [2] an accompanying browse file provides statistics (records and gaps), instrument settings, strip charts of selected parameters, and pulse-height spectra.

DOCUMENT COLLECTION

The document collection contains the bundle description (this document). The collection also contains activity reports, which describe aspects of instrument performance and operation. These include:

- *GRaND operations during cruise: DC003 and DC014* [4]. Describes results of initial checkout (ICO) and Earth-Mars Cruise (DC014), including a preliminary characterization of SCLK regression in response to an Incident Surprise Anomaly. See [5] for a description of SCLK regression and operational mitigation.
- *DC034 Activity Report* [6]. Describes operations during a portion of Mars-Vesta Cruise (DC034), including optimization of instrument parameters and a preliminary assessment of the effect of radiation damage on the CZT array.
- *DC041 Activity Report* [7]. Describes continued operation during Mars-Vesta Cruise (DC041), including the first demonstration of the annealing capability to mitigate damage to the CZT sensors by space radiation. An analysis of the thermal characteristics of the instrument and a simple model of the annealing process are presented.

OPERATIONS SUMMARY

Cruise operations are divided into four phases summarized here. A detailed description of the raw data and instrument cruise operations through Mars-Vesta cruise provided by [3,8].

- Initial Checkout (ICO)

Following launch on 27-Sep-2007, GRaND was powered on and configured for science data acquisition for the first time in flight (Dawn spacecraft activity DC003). Initial power on and high voltage ramp up occurred via real time commanding starting on 16-Oct-2007. The instrument acquired background data (in NORMAL mode) from 17-Oct-2007 to 22-Oct-2007.

- Earth-Mars Cruise (EMC)

GRaND resumed operations on 1-Apr-2008, acquiring background data in interplanetary space (Dawn spacecraft activities DC014). During this time, coincidence counting windows were adjusted using a non-interactive payload commands (NIPC). The NIPC process was abandoned following Mars Gravity Assist when it was found that the NIPC process could cause the instrument to transition to standby. GRaND EMC operations concluded on 8-Apr2008 with a smooth high-voltage ramp down and power off. Note that GRaND was powered on ahead of Mars encounter during DC022, regarded as part of the cruise phase, and continued operations until after Mars Closest Approach. As a result, raw data acquired in DC022 can be found in the Mars bundle, including GRD-L1A-090120-090121_101026 and GRD-L1A-090121-090122_101026.

A detailed description of operations and interpretation of data acquired in ICO and EMC is provided by [4].

- Mars-Vesta Cruise (MVC)

GRaND was operated three times during Mars-Vesta cruise to continue to assess instrument state of health, acquire additional background data, test and exercise command sequences for annealing the cadmium zinc telluride (CZT) sensors, characterize the thermal attributes of the instrument, and look for possible interferences between GRaND and the ion propulsion system. The instrument was operated from 30-Nov-2009 to 7-Dec-2009 in DC034, from 19-Jul-2010 to 25-Jul-2010 in DC041, and from 14-March-2011 to 28-March-2011 in DC048. The outcome of the operations and analysis of the data is described in the DC034 and DC041 activity reports included in this bundle [6,7]. Results of a long anneal of the CZT sensors carried out in DC048 is described by [3].

- Vesta-Ceres Cruise (VCC)

GRaND was operated three times during Vesta-Ceres cruise for routine checkups of the instrument state of health and the acquisition of additional background data. These activities occurred in December of 2012, November of 2013, and June of 2014.

REFERENCES

- [1] Prettyman, T. H., Yamashita, N., Neese, C. & Stone, J. L. Dawn's Gamma Ray and Neutron Detector: Archive description. *Dawn Gamma Ray and Neutron Detector collection. PDS Small Bodies Node (SBN)*. doi:10.26033/9hqz-1v60 (2021).
- [2] Prettyman, T. H. Dawn's Gamma Ray and Neutron Detector: Raw data description. *Dawn Gamma Ray and Neutron Detector collection. PDS Small Bodies Node (SBN)*. doi:10.26033/1c9p-et44 (2021).
- [3] Prettyman, T. H. *et al.* Dawn's gamma ray and neutron detector. *Space Science Reviews* **163**, 371-459, doi:10.1007/s11214-011-9862-0 (2011).
- [4] Prettyman, T. H. *GRaND operations during cruise: DC003 and DC014* (LID: urn:nasa:pds:dawn-grand-cruise:document:dawn_grand_cruise_ops.pdf, 2008).
- [5] Prettyman, T. H. Dawn's Gamma Ray and Neutron Detector: Instrument description. *Dawn Gamma Ray and Neutron Detector collection. PDS Small Bodies Node (SBN)*. doi:10.26033/p9v5-ce07 (2021).
- [6] Prettyman, T. H. *Dawn Gamma Ray and Neutron Detector: DC034 Activity Report* (LID: urn:nasa:pds:dawn-grand-cruise:document:dawn_grand_dc034_activity_report.pdf, 2010).
- [7] Prettyman, T. H. & Pitman, K. M. *Dawn Gamma Ray and Neutron Detector: DC041 Activity Report* (LID: urn:nasa:pds:dawn-grand-cruise:document:dawn_grand_dc041_activity_report.pdf, 2010).
- [8] Prettyman, T. H. & Feldman, W. C. *PDS data processing: Gamma Ray and Neutron Detector* (LID: urn:nasa:pds:dawn-grand-mars:document:dawn_grand_data_processing.pdf, 2013).