# DAWN'S GAMMA RAY AND NEUTRON DETECTOR (GRAND)

MARS BUNDLE DESCRIPTION

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## WHAT'S IN THE MARS BUNDLE?

The Cruise bundle contains raw and calibrated data products acquired during Dawn's flyby of Mars in 2009. During the encounter, GRaND was configured for science data acquisition and measured gamma-rays and neutrons from Mars during the 30 minutes Dawn was closest to Mars. A detailed account of the operations and analysis of the data is provided by [1,2]. Cross calibration of the data acquired by GRaND during Mars encounter was used by [3] to estimate the concentration of hydrogen in Vesta's regolith. 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 [2,4,5].

### DATA RAW COLLECTION

The Dawn GRaND Raw Collection for Mars 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 [5].

## DATA CALIBRATED COLLECTION

The calibrated data consist of a time-series of gamma-ray spectra, gamma-ray and neutron count rates as well as information needed to perform corrections for quantitative analyses of the data. Data reduction and analysis methods are described by [1], which also compares corrected GRaND and Mars Odyssey counts with latitude. Two types of time series are presented:

- CMA: A central moving average of counting rates using a sliding time window;
- DTS: A decimated time series in which counts are averaged over successive time windows that do not overlap.

For each type of time series (CMA or DTS), the counting data and data needed for their interpretation are provided in four files:

- BGO: Corrected pulse height spectra corrected for differential nonlinearity and gain.
- GCR: Net peak areas (counting rates) for selected gamma-ray peaks extracted from pulse height spectra acquired by the BGO scintillator. These include the 511 keV annihilation gamma ray, the 2.2 MeV gamma ray from neutron inelastic scattering with Al, the 4.44-MeV gamma ray from the first excited state of 12C, the 6.1-MeV gamma ray from neutron inelastic scattering with O, and the 7.6 MeV gamma ray from neutron capture with Fe.
- NCR: Thermal, epithermal, and fast neutron counting rates.
- EPM: Ephemeris, pointing, and geometry data needed for the analysis of the data. The data include live time, the position of the spacecraft in the Mars fixed frame, the velocity of the spacecraft in the instrument frame (needed to correct for kinematic ram effects), and solid angle subtended at the spacecraft by Mars, and the triples and higher interaction counting rate needed for cosmic ray corrections.

## DOCUMENT COLLECTION

The document collection contains the bundle description (this document), charts describing preliminary results of Mars Gravity Assist, and a detailed description of processing steps used to produce calibrated data found in the Mars bundle [1]. The processing steps for the raw data are described elsewhere [5].

# OPERATIONS SUMMARY

A detailed description of GRaND Mars operations is provided by [1,2]. GRaND was powered and configured for science data acquisition ahead of Mars encounter on 20-Jan-2009. Operations during Mars approach included a parametric study of instrument time settings (22-Jan to 25-Jan). On 16-Feb, TELREADOUT was reduced from 210s to 70s and then to 35s the following day to ensure adequate sampling of latitude during Mars Closest Approach (MCA). The instrument was powered off by the spacecraft when it went into safe mode following MCA. GRaND was powered back on and collected background data from 2-March-2009 to 27-March-2009. The instrument transitioned to standby on 27-March. This anomaly was the result of the use of a non-interactive payload command (NIPC). As a result, NIPC was not used in subsequent operations.

## REFERENCES


[1] 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).

[2] 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).

[3] Prettyman, T. H. *et al.* Elemental mapping by Dawn reveals exogenic H in Vesta's regolith. *Science* **338**, 242-246, doi:10.1126/science.1225354 (2012).

[4] 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).

[5] 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).