

PDS4 NEAR GRS Bundle Overview

(urn:nasa:pds:near.grs)

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1. Introduction

This bundle contains all primary instrument data (raw and calibrated) returned from the NEAR gamma ray spectrometer (GRS) and archived in the PDS. Documentation for the instrument, calibration, and data set are also included.

The NEAR mission operated in the years 1996-2001 with the goal of characterizing the S-type near-Earth asteroid 433 Eros to determine its composition and structure. On the way to Eros, NEAR also made a reconnaissance of the main belt asteroid 253 Mathilde. At the end of orbital operations, the NEAR spacecraft touched down on the surface of Eros, obtaining some surface observations.

The NEAR GRS is part of the X-Ray/Gamma-Ray Spectrometer (XGRS) suite on the NEAR mission. It detects characteristic gamma rays in the 0.3- to 10-MeV range that are emitted from specific elements in the surface. Some of these emissions are excited by cosmic rays and some arise from natural radioactivity in the asteroid. The GRS uses a body-mounted passively cooled NaI scintillator detector with a bismuth germanate anti-coincidence shield that defines a 45 degree FOV, with an objective of measuring abundances of several important elements such as K, Si, and Fe in four quadrants of the asteroid.

2. Archive Contents and History

The NEAR GRS instrument data have been archived in PDS in the PDS3 archiving standard. In 2012 these data sets were reorganized so that X-ray and Gamma-ray data are now in separate volumes. Index files have been edited to reflect the new volume IDs. Table 1 shows the resulting PDS3 GRS data sets, which have been included in this bundle.

Table 1. PDS3 NEAR GRS included in this bundle

Data Description	PDS3 Data Set ID	Date archived	PDS node
NEAR GRS Cruise Phase 2 data	NEAR-A-GRS-2-EDR-CRUISE2-V1.0	2001-09-01	SBN
NEAR GRS Cruise Phase 3 data	NEAR-A-GRS-2-EDR-CRUISE3-V1.0	2001-09-01	SBN
NEAR GRS Cruise Phase 4 data	NEAR-A-GRS-2-EDR-CRUISE4-V1.0	2001-09-01	SBN
NEAR GRS Earth Phase data	NEAR-A-GRS-2-EDR-EARTH-V1.0	2001-09-01	SBN
NEAR GRS Eros Orbit data	NEAR-A-GRS-2-EDR-EROS/ORBIT-V1.0	2001-09-01	SBN

Data Description	PDS3 Data Set ID	Date archived	PDS node
NEAR GRS Eros Surface data	NEAR-A-GRS-2-EDR-EROS/SURFACE-V1.0	2001-09-01	SBN
NEAR GRS Eros Orbit Level 2 data	NEAR-A-GRS-3-EDR-EROS/ORBIT-V1.0	2001-09-28	SBN
NEAR GRS Eros Surface Level 2 & 3 data	NEAR-A-GRS-3-EDR-EROS/SURFACE-V1.0	2001-07-13	SBN

During 2022-2023, the PDS3 NEAR GRS holdings were migrated to the PDS4 archiving standard by the Small Bodies Node, using the On-Line Archiving Facility (OLAF). The data files are unchanged. This bundle contains the NEAR GRS Cruise Phase 2 data, the NEAR GRS Cruise Phase 3 data, the NEAR GRS Cruise Phase 4 data, NEAR GRS Earth Phase data, the NEAR GRS Eros Orbit data, the NEAR GRS Eros Surface data, the NEAR GRS Eros Orbit Level 2 data, and the NEAR Eros Surface Level 2 & 3 data, which were all separate PDS3 data sets.

During the PDS3 to PDS4 migration it should be noted that the keyword “Data Quality Index (DQI)” was not able to be fully understood by the migration team based on the documentation that was in the PDS3 archive. Although no changes were made to this keyword in the labels, and it was migrated into PDS4 normally, this was something the team felt should be noted to any future data users.

Document and metadata changes made during the migration of the data sets include:

- No primary data files were modified.
- Metadata in the PDS3 labels were migrated to PDS4 labels.
- A new NEAR mission dictionary was created to support PDS3 dataset keywords
- All PDS3 datasets were combined to create one NEAR GRS bundle
- Definitions documents were corrected to reflect the label contents correctly
- All documentation was moved to a new document collection
- A new bundle overview document (the one you are currently reading) was created
- PDS3 data documentation was restructured as needed to reflect the new PDS4 bundle organization.

3. NEAR Bundle Contents

The NEAR GRS bundle contains two data collections, a calibration collection, and a document collection:

The **data_raw** collection contains Gamma Ray Spectrometer (GRS) observations made during the NEAR mission and the NEAR XGRS observation log. The data are separated into subdirectories based upon mission phase, *cruise2*, *cruise3*, *cruise4*, *earth*, *eros orbit*, and *eros surface*, and then divided again based upon three different instrument sensors. The data are presented as FITS binary tables with detached PDS labels. (See section 4).

The **data_calibrated** collection contains two subdirectories organized by mission phase. The *eros_orbit* subdirectory contains daily time series of spectra collected by the instrument along with selected spacecraft engineering and instrument configuration and orbital ephemerides. The data are presented as binary tables with detached PDS labels. The *eros_surface* subdirectory contains the Reduced (integrated and corrected) Level 2 and Level 3 NEAR Gamma Ray Spectrometer observations taken during the Eros Surface phase of the mission. The data are presented as tabulated files with detached PDS labels. (See section 5).

The **calibration** collection contains the calibration tables for NEAR GRS taken from Evans et al. (2000). The calibration tables in this collection are presented as tabulated files. (See section 6).

Documents in the root of the **document** collection pertain to the whole bundle. There are six subdirectories the *data_raw_documents* subdirectory contains all the documentation for the data_raw data collection. The *data_calibrated_documents* subdirectory contains all of the documentation pertaining to the data_calibrated data collection. The *calibration_documents* subdirectory contains all documents related to the calibration collection. The *results* subdirectory contains the published Evans et al paper and four supplemental files pertaining to the paper. The *instrument* subdirectory contains all documentation pertaining GRS instrument. The *migration_information* subdirectory contains all the information pertaining to the 2023 PDS3 to PDS4 migration of the NEAR GRS data. (See section 7).

4. The data_raw Collection

The data_raw collection contains Gamma Ray Spectrometer (GRS) observations which are separated into six sub directories, each subdirectory contains data from one mission phase. Within each mission phase subdirectory (**cruise2, cruise3, cruise4, earth, eros_orbit, eros_surface**) the data is organized into three categories based upon the instrument sensor. All data in this collection is in FITS binary table format. The individual observations are combined into a single file per day for each sensor. The collection also contains in its main directory the observation log.

The Gamma Ray Full (**GRF**) data contains all observations taken from the GRF instrument sensor

The Gamma Ray Burst (**GRB**) data contains all observations taken from the GRB instrument sensor.

The Gamma Ray Summary (**GRS**) data contains all observations taken from the GRS instrument sensor.

The NEAR GRS observation log is contained in **xgrs_obslog.csv**. Documentation for the observation log can be found the document collection in the *data_raw_documents/observation_log* subdirectory.

5. The data_calibrated Collection

The data_calibrated collection contains the higher level GRS data products which are separated into two subdirectories by mission phase.

The **eros_orbit** subdirectory contains the GRS Level 2 integral data. These are binary files that describe the integrated composition of spectral, orbital ephemerides, instrument configuration

and derived products for each GRS integration period. The file name scheme is iyyymmdd.dat, where i is the instrument (g=grs) and yyyymmdd is the date of observation.

The **eros_surface** subdirectory contains both level 2 and level 3 data. The GRS on asteroid Level 2 data are contained in ASCII table files that contain corrected spectra. The GRS On-asteroid Level 3 corrected and summed spectra are provided as fixed-width ASCII table files.

A description of the content and format of the On-asteroid Level-2 record files is provided below

File Format:
 ONSURxtz.TAB" where
 ONSUR refers to on-surface observations
 x denotes (N=NAI, B=BGO, A=ANTI, 1=NAI 1, 2=NAI 2)
 t denotes (A=Ancillary, S=Spectrum)
 z denotes integration number (1, 2, 3, 4)".
 (and similar for level 3)

6. The calibration Collection

The **calibration** directory contains all of the calibration files for the GRS data collection in tabulated file format. These files contain the the data for figures in Evans et al. (2000).

File name	Description
grsfig05a.tab	SPECTRA (NAI AND ANTI_COINCIDENCE) TAKEN WITH A CR51 SOURCE
grsfig05b.tab	SPECTRA (NAI AND ANTI_COINCIDENCE) TAKEN WITH A CS137 SOURCE
grsfig05c.tab	SPECTRA (NAI, ANTI, BOTH ESCAPE) TAKEN WITH A CS137 SOURCE
grsfig05d.tab	SPECTRA (NAI,ANTI,BOTH ESCAPE)TAKEN WITH A PUC 6.13 MEV SOURCE
grsfig06.tab	MEASURED INTRINSIC PEAK EFFICIENCY OF CENTRAL DETECTOR
grsfig07.tab	MEASURED INTEGRAL LINEARITY WITH A LINEAR FIT TO THE DATA
grsfig08.tab	MEASURED INTEGRAL LINEARITY WITH A SECOND ORDER POLYNOMIAL FIT TO THE DATA.
grsfig09.tab	ENERGY RESOLUTION AS A FUNCTION OF ENERGY MEASURED WITH THE GROUND SUPPORT EQUIPMENT
grsfig10.tab	INTRINSIC FULL ENEGY PEAK EFFICIENCY FOR CENTRAL DETECTOR (WITHOUT PMT) - ORBITAL MEASUREMENTS
grsfig11.tab	RATIO OF ESCAPE PEAK EFFICIENCY TO FULL ENERGY PEAK EFFICIENCY.
grsfig12.tab	ESCAPE PEAK EFFICIENCY FOR ORBITAL MEASUREMENTS (FIRST AND SECOND ESCAPE INCLUDED).
grsfig13a.tab	GAMMA RAY SPECTROMETER ANGULAR RESPONSE AT 320 KEV.

File name	Description
grsfig13b.tab	GAMMA RAY SPECTROMETER ANGULAR RESPONSE AT 1115 KEV.
grsfig14.tab	SPECTRUM TAKEN WITH A LARGE SOIL SAMPLE AND A 14 MEV NEUTRON SOURCE (NAI ANTI_COINCIDENCE)
grsfig15a.tab	NAI LOW LEVEL DISCRIMINATOR CALIBRATION
grsfig15b.tab	BGO LOW LEVEL DISCRIMINATOR CALIBRATION
grsfig16.tab	HIGH VOLTAGE SETTINGS VS GAIN (DURING CRUISE)

7. The document Collection

The document collection contains documentation in the root directory as well as six subdirectories.

Root Directory

The **grs_bundle_overview.pdf** which is the document you are reading now.

The **references.txt** document contains references for published papers referred to in the GRS bundle.

The **acronyms.txt** document contains all of the acronyms used in the NEAR GRS instrument bundle.

The **erratum.txt** document describes the erratum in the NEAR GRS data bundle.

The instrument documents

The **command_data_handling.pdf** document provides an overview of the command and data and data handling system for NEAR.

The **goldsten_1998.pdf** published document provides an overview of the The NEAR X-Ray/ Gamma-Ray Spectrometer.

The **grs_instrument_info.txt** document is the NEAR GRS instrument information catalog file.

The data_raw documents

The **data_raw_collection_description.txt** document describes the GRS data raw collection and its contents.

The **definitions_documents** subdirectory contains the keyword definitions documents for each data type and mission phase of the data_raw collection.

The **observation_log** subdirectory contains documentation used to describe the GRS observation log contents.

- The **obs_log_info.txt** provides an overview of the Near Earth Asteroid Rendezvous Gamma-Ray Level 2 Observation Log archive.
- The **xgrs_command_description.txt** document describes the Observation Log macro names and configuration parameters.
- The **xgrs_instrument_users_guide.txt** document describes the commanding and CAS generation for instrument and commanding of spacecraft. Lists formats and other higher level issues for team members to build instrument control macros.
- The **xgrs_users_guide_fig1-3.pdf** document contains the three figure images accompanying the XGRS Instrument User Guide Document

The data calibrated documents

The **data_calibrated_collection_description.txt** document describes the GRS data calibrated collection and its contents.

The **grs_reqs_7_2.pdf** document elaborates the formats and derivations of all of the parameters required for GRS Level-2 analysis.

The calibration documents

The **grs_calibration_process.txt** document contains a summary of the calibration process and use of data.

The **grs_calibration_info.txt** document describes the contents of the calibration collection.

The results documents

The **evans_etal_2001.pdf** document describes elemental composition and ratios derived from gamma-ray measurements collected by the NEAR-Shoemaker spacecraft while on the surface of 433 Eros. This document also describes the performance of the gamma-ray spectrometer (GRS) during cruise and orbit.

The **grs_results_summary.txt** document discusses the results of the GRS observations made during the course of the NEAR mission

The **evans_figures_10_11_summary.txt** document describes the two ancillary products **mapsgrsfig_10.txt** and **mapsgrsfig_11s.txt** which were used to generate figures in Evans, et al. (2001).

mapsgrsfig10.txt shows the calculated total efficiencies for the NaI photopeak, first escape and second escape spectra. **mapsgrsfig11s.txt** contains the data points used to generate Figure 11 of Evans, et al. (2001).

The migration information documents

The **fits_standard.pdf** document provides all the information on the FITS data standard that was used during the NEAR GRS PDS3 dataset archiving.

The **migration_report.txt** describes the findings made during the NEAR GRS PDS3 to PDS4 migration.

The **migration_column_information.pdf** contains the table created for reference during migration that displays the PDS4 label values for the GRS raw data in comparison to the PDS3 archived FITS headers, labels, and documentation.

8. References

Evans, L. G., "Calibration of the NEAR Gamma-Ray Spectrometer", *Icarus*, vol. 148, no. 1, pp. 95–117, 2000. doi:10.1006/icar.2000.6461.

Evans, L.G., Starr, R.D., Bruckner J., Reedy, R.C., Goldsten, J.O., Masarik, J., Boynton, W.V., Trombka, J.I., Nittler, L.R., McCoy, T.J., Elemental Composition from Gamma-Ray Spectroscopy of the NEAR Shoemaker Landing Site on 433 Eros, *Meteoritics and Planetary Science*, July 2001.