**New Horizons REX KEM2 Data Review – Radio Science**

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**Executive Summary**

The New Horizons REX KEM2 radio science bundle (urn:nasa:pds:nh\_rex) was reviewed. The contents include raw and calibrated REX files in the Flexible Image Transport System (FITS) format.

Two data sets from the New Horizons Radio Science Experiment (REX) were provided and reviewed:

* urn:nasa:pds:nh\_rex:kem2\_raw
* urn:nasa:pds:nh\_rex:kem2\_cal

Also, there is one document collection

* urn:nasa:pds:nh\_documents:rex

This was my first time reviewing New Horizons REX data.

1. I turned to overview.txt to determine what the data contained but could not find anything directly explaining what is contained in the .FIT files. Only by running PDS4 Viewer on one of the labels was I able to understand what was in the files.
2. I also had difficulty seeking particular observations based on the dates given in rex\_activities\_kem2.pdf.

**Documentation**

**overview.txt** in raw data directory**:**

1. “The main investigation is an occultation experiment which uses radio signals transmitted from Earth to probe the atmosphere and ionosphere of Pluto and Charon.” This sounds like boiler plate text, but this particular data set doesn’t cover Pluto and Charon.
2. The PDS4 version history and Filename/Product IDs sections refer to “thresholding,” but there is no description of what that is in this document. Only by going to section 4 of rex\_activities\_kem2.pdf does one find an explanation.
3. Instrument Description: Having trouble finding urn:nasa:pds:nh\_documents:rex:nh\_pepssi\_ti

Is it the one at <https://naif.jpl.nasa.gov/pub/naif/pds/data/nh-j_p_ss-spice-6-v1.0/nhsp_1000/data/ik/nh_pepssi_v110.ti> ?

1. Several references to PDS3 products:
	1. Ancillary Data: Replace INDEX/INDEX.TAB with rex\_activities\_kem2 perhaps
	2. CONFIDENCE\_LEVEL\_NOTE: Data Coverage and Quality: replace these PDS references
	3. “In addition, products with Time Tag anomalies are listed in file ERRATA.TXT provided with this data set.”
	4. (see REX.CAT for a brief discussion of such an issue related to compression)
	5. Observation descriptions in this data set catalog: “This data set follows the more common convention of placing those descriptions under the Data Set Description (above, if the user is reading this in the DATASET.CAT file) of this data set catalog.” – Replace with PDS4 location.

**Rex\_activities\_kem2.pdf** in rex documents directory:

1. I attempted to locate a particular observation based on the listings in this document but wasn’t sure how to. Referring to the naming convention in overview.txt:

 REX\_0123456789\_0X7B0\_ENG.FIT

 ^^^ ^^^^^^^^^^ ^^^^^ ^^^\\_\_/

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 | | | | |

 | | | | +--File type (includes dot)

 | | | | - .FIT for FITS file

 | | | | - .LBL for PDS label

 | | | | - not part of product ID

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 | | | +--ENG for CODMAC Level 2 data

 | | | SCI for CODMAC Level 3 data

 | | |

 | | +--Application ID (ApID) of the telemetry data

 | | packet from which the data come

 | | N.B. ApIDs are case-insensitive

 | |

 | +--MET (Mission Event Time) i.e. Spacecraft Clock

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 +--Instrument designator. Usually 'REX', but other values are

 possible based upon the ApID:

 - 0x7b4: RLM = Rex Logfile Missing error condition

 - 0x7b4: RFE = Rex Frame Error occurred on the spacecraft

 - 0x7b6/7: RBB = Rex BroadBand thresholding applied

 - 0x7b6/7: RNB = Rex NarrowBand thresholding applied

How can this be correlated with the listings in rex\_activities\_kem2? I eventually determined that using the start\_date\_time in the labels was the only way to match the data files with those found in the tables.

1. What is the meaning of the columns, especially the date that is given?



1. I eventually realized that the only difference between rex\_activities\_kem1.pdf and rex\_activities\_kem2.pdf are the addition of tables in section 4, starting with dates in 2023. These latter tables are the only ones corresponding to data in these collections. It would be nice if the start of KEM2 was marked in this document.
2. Along the same lines, although the title on page 1 makes it clear that this document covers KEM1 and KEM2, the name of the file itself suggests that it only covers KEM2.
3. In the label, I noticed:

 <Modification\_History>

 <Modification\_Detail>

 <modification\_date>2024-08-13</modification\_date>

 <version\_id>2.0</version\_id>

 <description>Updated version for K7 delivery that includes KEM2.</description>

 </Modification\_Detail>

 <Modification\_Detail>

 <modification\_date>2024-08-12</modification\_date>

 <version\_id>1.0</version\_id>

 <description>Backfilled KEM1 version. \*\*\*SBN TO CREATE/FILL IN\*\*\*</description>

 </Modification\_Detail>

 </Modification\_History>

Naming Conventions (overview.txt):

\*.fit files – consistent with data files

**Data**

Using the PDS4 Viewer, I plotted the I&Q data to see if they make sense.

