

New Horizons REX Data Set Review – KEM1 V2.0 Raw & Calibrated

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1. Executive Summary

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

- nh-a-rex-2-kem1-v2.0
- nh-a-rex-3-kem1-v2.0

The previous version of the dataset (v1.0) was reviewed in February 2020 which contained only a few files from REX Side-A (RCP) from the MU69 encounter. The dataset now contains a more complete set of data. These data are in good quality shape, as expected from the previous reviews. I believe the dataset is certifiable in its current state, however, a minor update to one document would be a useful quality-of-life improvement.

2. Review Details

Data

REX data come from the two sides of the instrument:

- Side-A, 0x7b1, Righthand Circularly Polarized
- Side-B, 0x7b3, Lefthand Circularly Polarized

The documentation for the dataset says the complete set of REX data for this mission duration are not all downlinked yet, however, this dataset contains a significantly larger amount of REX data than the previous version (V1.0):

Table 1. Data the reviewer was able to find in the dataset and correlate with the documentation.

Date	V2.0	Experiment	Comments
2018-09-09	New	Radio Path Characterization	Contain RCP only
2018-10-21	New	Radio Path Characterization	Contain both RCP and LCP
2019-01-01	Updated	MU69 radio brightness and ionosphere detection attempt	Data are longer in duration and now include both RCP and LCP
2019-01-02	Updated	Sky background radio brightness	Data are longer in duration and now include both RCP and LCP
2019-01-04	New	REX Test Patterns	Contain both RCP and LCP
2019-02-02	New	Radio Path Characterization	Contain RCP only
2019-03-21	New	Radio Path Characterization	Contain both RCP and LCP
2019-04-19	New	Radio Path Characterization	Contain both RCP and LCP
2019-05-07	New	Radio Path Characterization	Contain both RCP and LCP
2019-06-12	New	Radio Path Characterization	Contain both RCP and LCP
2019-07-10	New	Radio Path Characterization	Contain both RCP and LCP

I noticed no issues with the data in my review. I was able to extract In-phase and Quadrature (IQ) values from the FIT data and radiometer values from the FIT data. I examined the calibrated dataset in more detail than the raw dataset – both datasets contain the same number of data files.

Radio path characterization data are diagnostic in nature – attempted to produce frequency estimates from the IQ data stored in the FIT files for each of them. In some cases, there appeared to be no signal in the spectrum, and in others, a signal was present. This is consistent with the documentation that the radio path characterizations were irregular. An example is shown below of the 2019-03-21 data where there was a clear signal in the spectrum for RCP and LCP:

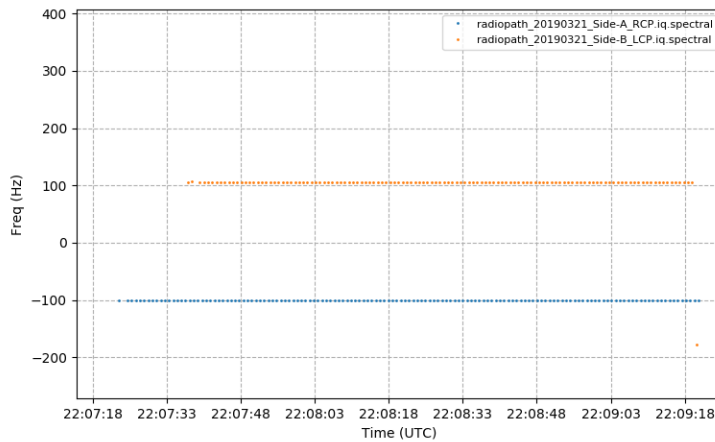


Figure 1. Frequency estimates from the IQ data at both RCP and LCP polarizations from REX during the 2019-03-21 Radio Path Characterization

During the MU69 encounter, I attempted to extract frequency estimates from the REX data but no uplink signals were present in the spectrum. It is possible the ionosphere detection experiment looking for uplink signals has not been downlinked yet, or the experiment did not yield any information.

There should be no signal detection during the radio brightness measurements, because there is no uplink from the DSN. The prime measurement is the radiometer data, which is consistent with the data from the previous version, but includes additional data points and the addition of the LCP data.

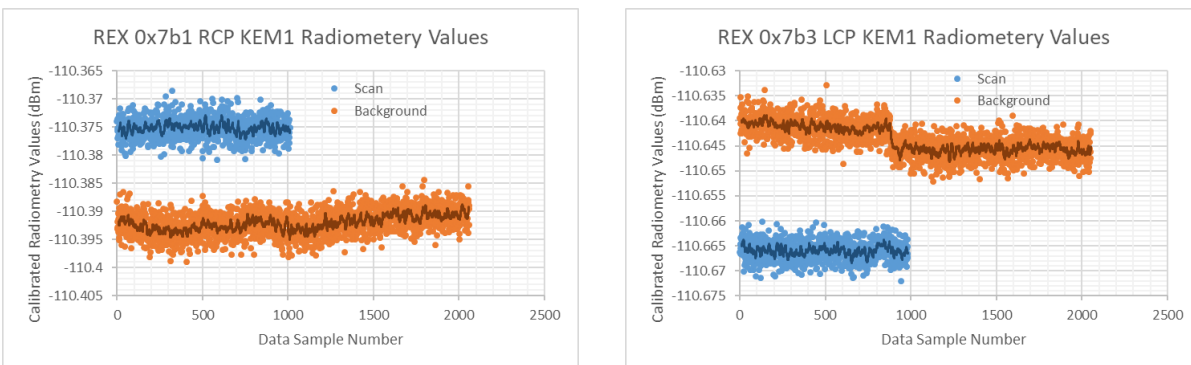


Figure 2. Radiometer values extracted from the calibrated dataset for Side A and Side B during MU69 encounter

Documentation

rex_activities_kem1.pdf—document describes the REX activities in more detail. However, it is missing the 2019-03-21, 2019-04-19, 2019-05-07, 2019-06-12, and 2019-07-10 radio path characterization activities which should be added such that the document better correlates with the *seq_rex_kem1.tab* file.