**Lucy Mission Pipeline Review – Radio Science**

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**Executive Summary**

The Lucy radio science bundle (urn:nasa:pds:lucy.rss::1.0) was reviewed. The contents include DSN tracking files (TRK-2-34), ionosphere calibration files (ION), small forces files (SFF), and sky frequency files (skyfreq). There is no SIS provided for radio science at this time.

The files are readable and well documented. The main items that should be addressed are as follows:

1. A placeholder exists for the Radio Science Bundle and Collection Information SIS.
2. Editorial corrections and questions about the labels

**Documentation**

**A placeholder exists for the Radio Science Bundle and Collection Information SIS.** This document is expected to contain information about the antennae characteristics and the radio comm system.

**Data**

TRK-2-34

Using the PRRSG’s software tools, summary information and data (uplink ramps and sky frequency) were extracted from a sample file as follows:

[kahan@chiron data\_cruise1\_trk234]$ trk234\_info2 -p -m lucy\_2022\_285\_104518\_2022\_285\_165503\_53.tnf

 0% 100%

 \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

 Report for File: lucy\_2022\_285\_104518\_2022\_285\_165503\_53.tnf

 Generation Date: 2023-317T06:08:23

 Start Time: 2022-285T11:45:18

 End Time: 2022-285T16:55:03

 Spacecraft ID: 49

 Downlink DSS ID: 53

 Downlink Bands: X

 Doppler Count Time: 10.0

 Uplink DSS ID: 53

 Uplink Bands: X

 Tracking Mode: None, 1W, 2W

 Number of Records: 49013

 Data Description IDs: C123, C125, C124

 Available Data Types: 0, 1, 2, 3, 7, 9, 11, 16, 17

 00: Uplink Carrier Phase - 18581

 01: Downlink Carrier Phase - 14561

 02: Uplink Sequential Ranging Phase - 12848

 03: Downlink Sequential Ranging Phase - 29

 07: Sequential Ranging - 29

 09: Ramps - 26

 11: DRVID - 29

 16: Carrier Observable - 1455

 17: Total Phase Observable - 1455

 DSS-53 X-band Downlink:

 1W @ 2022-285T12:45:06 - 2022-285T12:51:08 (Final Loop BW = 3.0 Hz)

 2W @ 2022-285T12:51:53 - 2022-285T16:40:18 (Final Loop BW = 3.0 Hz)

 1W @ 2022-285T16:40:41 - 2022-285T16:45:21 (Final Loop BW = 3.0 Hz)

Ramp Frequency Ramp Rate



Sky Frequency



I ran the pds4.tranform tool on the TRK-2-34 data and was able to verify correspondence between the major fields and the output of transform.

The collection CSV and label look good.

Sky Frequency

The sky frequency files contain information that would be needed for gravity science investigation, and the label clearly identifies the relevant fields.

The table descriptions in the label are consistent with the fields in the data file.

The collection CSV and label look good.

Some questions and minor corrections follow for L25TNFXL02\_DPX\_220820628\_00.xml:

1. <Observation Area><Primary\_Result\_Summary><description>

*skyfrequency 🡪 sky frequency*

1. “The SOURCE\_PRODUCT\_ID mentioned in the label header above links to the different data files used for processing of the DOPPLER output file. …” *Where is this?*

 <Field\_Character>

 <name>TRANSMIT FREQUENCY RAMP REFERENCE TIME</name>

 <field\_number>6</field\_number>

 <field\_location unit="byte">86</field\_location>

 <data\_type>ASCII\_Date\_Time\_YMD</data\_type>

 <field\_length unit="byte">23</field\_length>

 <field\_format>%23s</field\_format>

 <description>The time (t0) at which the transmitted frequency would have been

 f\_0 using the coefficients f\_0 (column 7) and df (column 8). At any time t

 within the interval when those coefficients are valid, the transmitted

 frequency f\_t may be calculated from </description> *Text leaves off abruptly*

 </Field\_Character>

1. Field 10 <description>

Earths neutral atmosphere. 🡪 *Earth’s*

the calculation include 🡪 calculation *includes*

Earths ionosphere 🡪 *Earth’s* ionosphere

ION

The file is in the expected \*.CSP format. The label lid\_reference refers to the necessary documentation.

The collection CSV and label look good.

SFF

The values in the table match the descriptions provided in the label.

The collection CSV and label look good.

Some questions and minor corrections follow for lcy\_r\_230216\_230217\_v01.xml:

1. “The Small Forces File (SFF) provides to JPL's Orbit Determination Program (ODP)…” *This the old program. Either add or update to MONTE.*
2. DMASS – *it isn’t defined what this variable actually is. Like the missions listed, will it always be zero for Lucy?*

 <Field\_Delimited>

 <name>DMASS</name>

 <field\_number>7</field\_number>

 <data\_type>ASCII\_Real</data\_type>

 <unit>kg</unit>

 <description>Always zero for MPL, GNS, M01, DIF, MRO, PHX, Juno, GRA, GRB,

 MAVEN, and ORX files.</description>

 </Field\_Delimited>

1. ACS1\_ACC\_ON\_TIME – *only for thruster 1?*

 <Field\_Delimited>

 <name>ACS16\_ACC\_ON\_CMDS</name>

 <field\_number>30</field\_number>

 <data\_type>ASCII\_Real</data\_type>

 <description>Number of firings during the accumulation period for ACS Thruster

 16</description>

 </Field\_Delimited>

 <Field\_Delimited>

 <name>ACS1\_ACC\_ON\_TIME</name>

 <field\_number>31</field\_number>

 <data\_type>ASCII\_Real</data\_type>

 <unit>ms</unit>

 <description>Accumulated ON time during the accumulation period for the ACS

 Thruster 1</description> *Remove “the”*

 </Field\_Delimited>