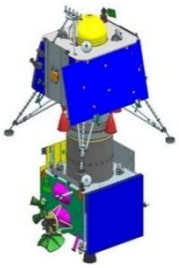

Chandrayaan-2
Imaging InfraRed Spectrometer (IIRS)
PDS4 Data Products (DP) and Archive Software Interface Specifications (SIS)

Planetary and Space Science Data Processing Division
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Space Applications Centre
Ahmedabad

DOCUMENT CONTROL AND DATA SHEET

1. Report No. & Date	**Chandrayaan-2/DP/SAC/SIPG/HRDPD/TR-07/August**
2. Title & subtitle	**Chandrayaan-2 – Imaging InfraRed Spectrometer (IIRS) PDS4 Data Products (DP) and Archive Software Interface Specifications (SIS)**
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9. Key Words	**Archive, PDS4, ISDA**
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Chandrayaan-2
Imaging Infrared Spectrometer (IIRS)
PDS4 Data Products (DP) and Archive Software Interface Specifications (SIS)

Document Change History

*A: Addition; M: Modification; D: Deletion

Version No.	Date	Section No.	A/M/D *	Description of change
V 1.0	July 27, 2020	All	A	Initial draft Version
V 2.0	October 28, 2020	6.5	M	Updated the file naming conventions table
		Appendix G	A	Added Bandwidth(FWHM)
V 3.0	December 8, 2020	Appendix F	M	▪ Added the gray value description ▪ Updated the table section ▪ Added no value description in SR under Max_SR value
		Appendix G	M	Updated table section under Appendix G
		1.3	A	Added the Appendix F and G description
		1.6	A	Added EOM and CODMAC in table 1 of page number 12
		6.4.3	M	updated with clear clarification on how dark data is used in the calibration process.
		6.4	M	Geometry description is updated under table 16 page number 32
		6.4.8	M	the geometry section is updated with clear clarification on geometry directory organization as per PDS
		Appendix H	A	Added Valid band list
		Appendix I	A	Added Local data dictionary
		3.3	A	Added Exposure duration information
V 4.0	July 6, 2021	4.2.1	A	Added the description about the dark data under the Raw Data Product section.
		4.2.2	A	Added the description about the dark data under the Calibrated Data Product section.
		4.2.2	A	Added the SPICE Archive related information under the Calibrated Data Product section.
		Appendix H	M	Updated the central wavelength column in the table 27

V 5.0	August 2, 2021	All	M	Added the header columns to the tables which exist in more than one pages
		4.2.1	M	Updated the Raw Data Product description
		4.2.2	M	Updated the Calibrated Data Product description in terms of data processing steps in generating the data
		Appendix F	M	Updated the data processing steps in generation of radiance data from input raw image qube count data
V 6.0	23 August 2021	4.3	A	Added data products acknowledgment statements
		Appendix H	M	Updated the section, with the same terminology - invalid used for near start, near end and invalid and also updated the band validity reason table 29
V 7.0	31 January 2022	5.3	M	Updated Data Release and Schedule Plan table by adding the information about the second imaging season Release
V 8.0	22 September 2022	5.3	M	Updated Data Release and Schedule Plan table by adding the information about the third, fourth, fifth and sixth imaging season Release
V 9.0	7 March 2023	5.3	M	Updated Data Release and Schedule Plan table by adding the information about the seventh imaging season Release
V 10.0	October 2023	5.3	M	Updated Data Release and Schedule Plan table by adding the information about the eighth imaging season Release
V 11.0	December 2023	Appendix-I	M	Added attributes and its value description
		Appendix-J	A	Added the Data Disclaimer
V 12.0	March 2024	5.3	M	Updated Data Release and Schedule Plan table by adding the information about the ninth imaging season Release
V 13.0	August 2024	5.3	M	Updated Data Release and Schedule Plan table by adding the information about the tenth imaging season Release

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Technical Content Approvals

		Name & Function
	Reviewed & Approved by	Amitabh Head PSPD DPD (Optical P/L DP) Chandrayaan-2 Arup Banerjee DPD (Payload IIRS) Satadru Bhattacharya PI, IIRS, Chandrayaan-2

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1. Introduction

1.1 Purpose

The Data Products and archive Software Interface Specifications (DPSIS) describes the data products, format and content of the Imaging Infrared Spectrometer (IIRS) Planetary Data System (PDS) data archive bundles in which data products with associated meta data, documentation and supporting materials are stored. This document is intended to provide enough information to enable users to read and understand the IIRS data products stored in PDS.

1.2 Scope

The specifications in this document apply to all IIRS data products submitted for archival to the ISRO Science Data Archive (ISDA), for all the mission phases of the Chandrayaan-2.

1.3 Data Products and archive SIS (DPSIS) content overview

Section 2 of this document describes the mission overview while Section 3 provides the characteristics of IIRS instrument. Section 4 gives an overview of data organization and data flow while Section 5 describes data archive generation, delivery and validation. Section 6 contains the archive structure and archive production responsibilities and Section 7 describes the file formats used in the archive, including the data product record structures. Individuals involved in generating the archive volumes are listed in Appendix A, while Appendix B contains sample bundle label. Appendix C contains sample calibration collection label while Appendix D Appendix E contain sample data product labels and visualization of PDS4 data products respectively. The formula for conversion of count to radiance is given in Appendix F. The central wavelength and bandwidth for each band of IIRS are given in Appendix G. Appendix H contains bands validity list while Appendix I contains local data dictionary attributes defined for IIRS.

1.4 Users

This document serves both as a Software Interface Specifications (SIS), and Interface Control Document (ICD). It describes the archiving procedure and responsibilities as well as the data archive conventions and format. It is designed to be used both by the instrument data processing team in generating the archive, and by those wishing to understand the format and content of the IIRS PDS data product archive collection. Typically, these individuals would include scientists, data analysts and software

engineers.

1.5 **Applicable Documents**

[1] Chandrayaan-2 Sequence of Events (ISRO-URSC-CHANDRAYAAN-2-PR-3171)

[2] Chandrayaan-2 Configuration Summary Document (ISRO-URSC-CHANDRAYAAN-2-PR-3172)

[3] Chandrayaan-2 Preliminary Design Review Data Products, Processing and Dissemination Plan - Volume 3A (Optical Payloads) (CHANDRAYAAN-2/DP/SAC/SIPG/HRDPD/TR-04/MAY 2017)

[4] Incremental-Preliminary Design Review Document on Imaging Infrared Spectrometer (IIRS), (SAC-SEDA-CH2-04-JUL14)

[5] Chandrayaan-2 Science data management and Archive plan (Chandryaan-2/DP/SAC/SIPG/HRDPD/TR-06/July 2018)

[6] Chandrayaan-2 SAC DP – ISSDC Interface for Archival (Chandrayaan-2/DP/SAC/SIPG/HRDPD/TR-13/Dec. 2018)

[7] PDS4 Concepts Data Design Working Group October 1, 2018 version 1.11.0

[8] Planetary Data System Standards Reference Version 1.11.0 October 1, 2018, JPL

[9] The PDS4 Data Provider's Handbook Guide to Archiving Planetary Data Using the PDS4 Standard Version 1.11.0 October 1, 2018

[10] PDS4 Data Dictionary Abridged – Version 1.11.0.0

[11] List of Supplemental Formats (Approved by PDS Management Council: 2017-08-30)

1.6 Abbreviations, Acronyms and Description

The list of definitions, acronyms and abbreviations used in this document are given in **Table 1**.

Table 1. Abbreviations, Acronyms and Description

Acronyms/ Abbreviations	Description
PDS	Planetary Data System
ISRO	Indian Space Research Organization
ISSDC	Indian Space Science Data Centre
ISDA	ISRO Science Data Archive
SAC	Space Applications Centre
DP	Data Processing
IIRS	Imaging InfraRed Spectrometer
SPICE	Spacecraft Planet Instrument Camera Event
ICD	Interface Control Document
Kernel	Primary SPICE data sets
DPD	Deputy Project Director
PI	Principal Investigator
CODMAC	Committee on Data Management And Computation
EOM	Electro Optical Module
MTF	Modulation Transfer Function
SNR	Signal-to-Noise Ratio
OSF	Order Sorting Filter
GSD	Ground Sampling Distance

1.7 Glossary

The glossary of terms used in PDS4 domain is given in **Table 2.**

Table 2. PDS4 Glossary

Terms	Definition
Archive	A place in which public records or historical documents are preserved; this term is also used for the preserved material– often used in plural. The term may be capitalized when referring to all of PDS holdings – the PDS Archive.
Basic Product	The simplest product in PDS4; one or more data objects (and their description objects), which constitute (typically) a

Terms	Definition
	single observation, document, etc. The only PDS4 products that are not basic products are collection and bundle products
Bundle Product	A list of related collections. For example, a bundle could list a collection of raw data obtained by an instrument during its mission lifetime, a collection of the calibration products associated with the instrument and a collection of all documents relevant to the first two collections.
Class	The set of attributes (including a name and identifier) which describes an item defined in the PDS Information Model. A class is generic – a template from which individual items may be constructed.
Collection Product	A list of closely related basic products of a single type (e.g. observational data, browse, documents etc.). A collection is itself a product (because it is simply a list, with its label), but it is not a basic product.
Data Object	A generic term for an object that is described by a description object. Data objects include both digital and non-digital objects.
Description Object	An object that describes another object. As appropriate, it will have structural and descriptive components. In PDS4 a 'description object' is a digital object – a string of bits with a predefined structure.
Digital Object	An object which consists of real electronically stored (digital) data.
Identifier	A unique character string by which a product, object, or other entity may be identified and located. Identifiers can be global, in which case they are unique across all of PDS (and its federation partners). A local identifier must be unique within a label.
Label	The aggregation of one or more description objects such that the aggregation describes a single PDS product. In the PDS4 implementation, labels are constructed using XML. Label contains the metadata information.
Logical Identifier (LID)	An identifier which identifies the set of all versions of a product.
Versioned Logical Identifier (LIDVID)	The concatenation of a logical identifier with a version identifier, providing a unique identifier for each version of product.

Terms	Definition
Manifest	A list of contents.
Metadata	Data about data – for example, a 'description object' contains information (metadata) about an 'object.'
Non-Digital Object	An object which does not consist of digital data. Non-digital objects include both physical objects like instruments, spacecraft and planets and non-physical objects like missions and institutions. Non-digital objects are labeled in PDS in order to define a unique identifier (LID) by which they may be referenced across the system.
Object	A single instance of a class defined in the PDS Information Model.
PDS Information Model	The set of rules governing the structure and content of PDS metadata. While the Information Model (IM) has been implemented in XML for PDS4, the model itself is implementation independent.
Product	One or more tagged objects (digital, non-digital, or both) grouped together and having a single PDS-unique identifier. In the PDS4 implementation, the descriptions are combined into a single XML label. Although it may be possible to locate individual objects within PDS (and to find specific bit strings within digital objects), PDS4 defines 'products' to be the smallest granular unit of addressable data within its complete holdings.
Tagged Object	An entity categorized by the PDS Information Model, and described by a PDS label.
Registry	A database that provides services for sharing content and metadata.
Repository	A place, room or container where something is deposited or stored (often for safety).
XML	eXtensible Markup Language.
XML schema	The definition of an XML document specifying required and optional XML elements, their order and parent-child relationships.

2. Mission overview

Chandrayaan-2, the second Indian mission to the Moon, was launched on 22nd July 2019 with Orbiter, Lander and Rover configuration. This is a highly complex mission, which represents a significant technological leap as compared to the previous missions of ISRO. This advanced mission was launched for in situ exploration of the South Pole of Moon. The mission is designed to expand the lunar scientific knowledge through detailed study of topography, seismography, mineral identification and distribution, surface chemical composition, thermo-physical characteristics of top soil and composition of the tenuous lunar atmosphere, leading to better understanding of the origin and evolution of the Moon.

After the injection of Chandrayaan-2, a series of maneuvers were carried out to raise its orbit. On August 14, 2019, following Trans Lunar Insertion (TLI) maneuver, the spacecraft escaped from the Earth's orbit and followed a path that took it to the vicinity of the Moon. On August 20, 2019, Chandrayaan-2 was successfully inserted into lunar orbit. While orbiting the moon in a 100 km lunar polar orbit, on September 02, 2019, Vikram Lander was separated from the Orbiter in preparation for landing. Subsequently, two de-orbit maneuvers were performed on Vikram Lander so as to change its orbit and begin circling the Moon in a 100 km x 35 km orbit. Vikram Lander descent was as planned and normal performance was observed up to an altitude of 2.1 km. Thereafter, communication from lander to the ground stations was lost.

The data obtained from the orbiter instruments will enrich our understanding of the Moon's evolution through the mapping of minerals and hydration over lunar surface, using its eight state-of-the-art scientific instruments. The Imaging InfraRed Spectrometer (IIRS) is one of these instruments which is intended for the mineralogical and lunar hydration studies. The precise launch and mission management has ensured a potentially long life of almost seven years instead of the planned one year.

2.1 Mission objective

To expand the lunar scientific knowledge through detailed study of topography, mineralogy, surface chemical composition, thermo-physical characteristics and tenuous lunar atmosphere leading to a better understanding of the origin and evolution of the Moon.

2.2 Payload science objectives

IIRS has following primary science objectives:

- Global mineralogical and volatile mapping of the Moon in the spectral range of ~0.8-5.0 µm for the first time, at high spectral resolution of ~20-25 nm.
- Complete characterization of water/hydroxyl feature near 3.0 µm for the first time at high spatial (~80 m) and spectral (~20 nm) resolutions
- To understand the sources and processes (endogenic/exogenic) responsible behind the presence of OH/H_2O on the Moon.

3. Instrument overview

The Imaging InfraRed Spectrometer (IIRS) is an advanced version of the spectrometers (HySI, M3 and SIR-2) flown onboard Chandrayaan-1. It has high spatial and spectral resolution in spectral range covering NIR (near Infrared) to MIR (Mid Infrared) which is required to meet the science objectives as mentioned in Section 2.2. The payload features of IIRS are highlighted in **Table 3**.

Table 3. IIRS payload features

S. No.	Parameter	Value
1	GSD	80 m × 80 m through pixel binning of 40 m × 40 m
2	Swath	20 km
3	Spectral range	0.8-5 µm
4	Spectral resolution	~20-25 nm
5	Noise equivalent Differential Radiance (NedR)	≤0.005 $mWcm^{-2}sr^{-1}\mu m^{-1}$
7	No. of spectral bands	256 (250 usable)
8	Quantization	14 bit
10	Unregulated raw power	~50W (first 15 minutes) ~36W (Imaging 20 minutes)
11	Weight EOM + Electronics packages Thermal Control System	 ~6.5 kg ~4 kg

The GSD of IIRS is 40 m x 40 m at 100 km altitude. The pixel binning (not sacrificing spectral resolution) is incorporated onboard to convert to GSD of 80 m x 80 m meeting the SNR requirements.

3.1 Payload configuration

There are primarily three basic optical segments in an imaging spectrometer (refer **Figure 1**), namely, fore optics, dispersing element and focusing elements. Convex Grating based single spectrometer with reflective fore optics (Three Mirror Astigmat) configuration is selected to cover wide wavelength range of 0.8-5 µm. Detector is selected to have requisite response in 0.8-5 µm.

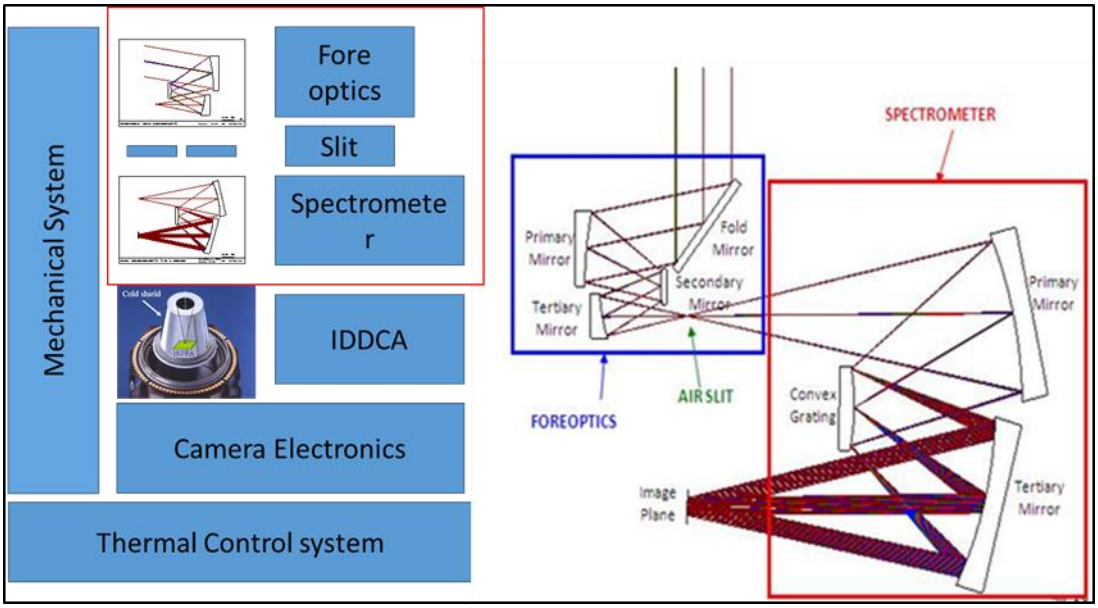

Figure 1. IIRS Payload configuration

HgCdTe based detector array (500 x 256 elements, 30µm) is placed at the focal plane of the spectrometer. The detector array with four band monolithic filter strip (serves dual purposes of order sorting and background flux reduction) integrated in Dewar configuration and cooled to cryogenic temperature (~90K) for operation using rotary stirling cooler. Mechanical system is constructed considering the requirements such as structural, opto-mechanical, thermal and alignment.

The entire EOM is maintained at ~240K to reduce and control instrument background. Aluminum based mirror, grating, and EOM housing is built to maintain structural requirements along with opto-mechanical and thermal stability. Three-tier radiative isolation and multi-stage radiative cooling approach is selected for maintaining the EOM temperature.

EOM along with precision electronics packages are placed on the outer and inner side of Anti-sun side (ASS) deck. Power and Cooler drive electronics packages are placed on bottom side of ASS panel. Cooler drive electronics is developed indigenously at SAC to meet the detector temperature control requirements.

3.2 Optics

The specifications of IIRS optics and grating efficiency are given in **Table 4** and **Figure 2**. IIRS is F/2.5 system with 75 mm effective focal length (EFL). By design IIRS spectral span is from 0.7 µm to 5.0 µm with 16.8 nm spectral sampling and resolution which meets the requirements of 0.8-5.0 µm range with better than 20 nm spectral resolution. Minimum design MTF of IIRS is 50 % at Nyquist (i.e. 17 lp/mm).

Order Sorting Filter (OSF) is required for reducing the higher order contribution. As per design, 250 bands correspond to intended wavelength range of around 0.8–5 µm. Out of 256 bands, **band numbers 1 to 5 and 256 have very low radiometric response, and thus, are not recommended for use**.

Table 4. Optics and grating efficiency specifications

Parameter	Value	Unit
Wavelength Range	0.7 - 5 (0.8 - 5 usable)	µm
Optics MTF @ 17 lp/mm (Nyquist)	≥ 50	%
FOV(±)	5.72	Degrees
Effective Focal Length (EFL)	75	mm
F-number	2.5	-
Spectral Sampling	~16.8	nm/pixel
Desired grating efficiency (%)	≥ 20	@ 0.8 µm
	≥ 50	@ 2.8 µm
	≥ 20	@ 5.0 µm

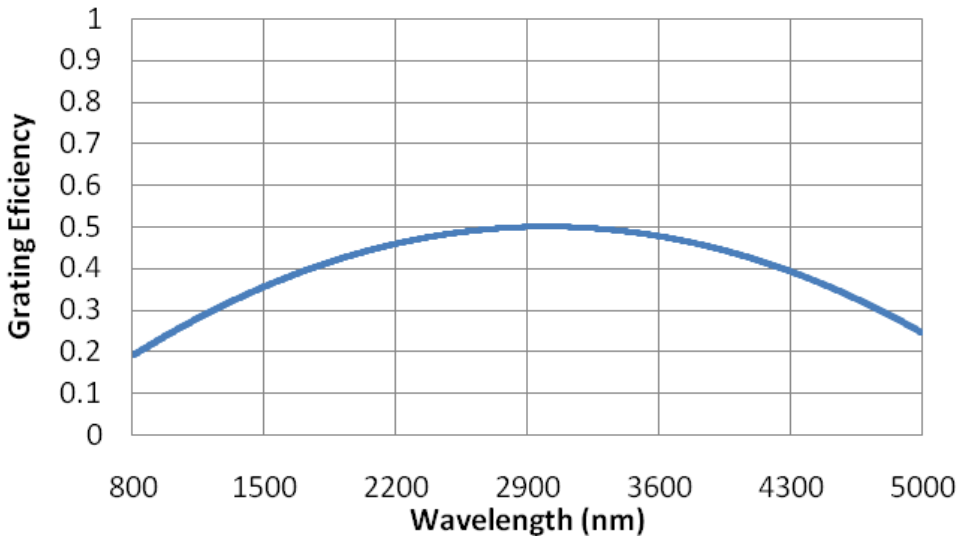

Figure 2. Desired grating efficiency profile

Typical signal condition on Moon in 0.8-5.0 µm range is such that the reflected signal from the lunar surface dominates the spectral range of 0.8-2.5 µm while 2.5-5.0 µm range is dominated by the emitted signal. Spectral range of 2.0-3.5 µm contains very less signal because of less contribution from both, reflected solar light and emission from the surface; and hence may provide less SNR. Detector quantum efficiency and optics throughput (except grating) is almost uniform throughout the 0.8-5.0 µm range.

To have better SNR in 2.0-3.5 μm region also, grating efficiency (**Table 4 and Figure 2**) is maximized in this region at the cost of slight degradation in other regions.

3.3 Exposure Duration

There are four exposure settings (e1, e2, e3 and e4) defined in IIRS. For each exposure setting, there is defined timing duration expressed in milliseconds (ms).

Exposure: Exposure duration

e1: 1 ms

e2: 3 ms

e3: 10 ms

e4: 21 ms

4. Data overview

This section provides a high level description of archive organization under the PDS4 Information Model (IM) as well as the flow of the data from the spacecraft through delivery to PDS. Unless specified elsewhere in this document, the Chandrayaan-2 IIRS archive confirms with version 1.11.0.0 of the PDS4 IM and version 1.11 of the Chandrayaan-2 mission schema. A list of the XML Schema and Schematron documents associated with this archive is provided in **Table 5**.

Table 5. Chandrayaan-2 IIRS archive schema and schematron

XML Document	Steward	Product LID
PDS Master Schema, v.1.0.0.0	ISDA	urn:isro:isda:system_bundle:xml_schema:pds-xml_schema

4.1 Data processing levels

A number of different systems may be used to describe data processing level. This document refers to the data by PDS4 reduction levels. Three different types of data products are envisaged for IIRS payload of Chandrayaan-2. Description of these levels is provided in **Table 6** along with the equivalent designations used in other systems.

Table 6. Chandrayaan-2 IIRS data processing levels

PDS4 level	PDS4 level description	ISRO level	CODMAC level
Raw	Original data from an instrument. If compression, reformatting, packetization, or other translation have been applied to facilitate data transmission or storage, those processes will be reversed so that the archived data are in a PDS approved archive format.	0	2
Calibrated	Data converted to physical units, which makes values independent of the instrument.	1	3
Derived	Results that have been distilled from one or more calibrated data products (for example, maps, gravity or magnetic fields, or ring particle size distributions). Supplementary data, such as calibration tables or tables of viewing geometry, that are used to interpret observational data should also be classified as 'derived' data if not easily matched to one of the other three categories.	2	4+

4.2 Data products

A PDS product consists of one or more digital and/or non-digital objects, and an accompanying PDS label file. The labeled digital objects are classified as data products (i.e. electronically stored files).

Labeled non-digital objects are physical and conceptual entities which have been described by a PDS label. These labels provide identification and description information for labeled objects. The PDS label defines a Logical Identifier (LID) by which any PDS labeled product is referenced throughout the system. More information on the usage of LIDs and the formation of Chandrayaan-2 LIDs is provided in Section 6.1.

PDS4 labels are XML formatted ASCII files. More information on the formatting of PDS labels is provided in Section 6.3.

The PDS4 data products for IIRS are defined based on the data processing levels as Raw (L0) and Calibrated (L1) data products.

The data products definitions for each levels of data processing are given in **Table 7**. The details of the descriptions about the raw and calibrated data product mentioned in **Table 7** are given in the following sub sections.

Table 7. Chandrayaan-2 IIRS data products definitions

Data products levels	**Level-0 (L0)**	**Level-1 (L1)**	**Level-2* (L2)**
Data products definition	Raw qube data with dark data subtracted along with original system level corner coordinates	Radiometrically corrected qube data, original system level/refined level corner coordinates tagged and gridded data	Thermally and photometrically corrected reflectance qube data
PDS4 level	Raw	Calibrated	Derived

Note*: Level-2 data products are under development.

4.2.1 Raw data products

Raw data products contain the raw image qube data (raw count) which is dark data* subtracted without any correction along with the system level corner coordinates. In the imaging season 1 (December 2019 – February 2020) and 2 (May 2020 – July 2020), for each acquisition of image, pre and post-dark sessions were acquired from the non-illuminated side of the Moon. Based on the analysis of both the sessions, pre-imaging dark data was found to have the minimal variations (from average dark count). Hence, data processing chain currently uses pre-imaging dark data for dark estimation.

Note*: If there are changes in dark estimation in due course of time (because of better understanding of payload behavior), it will be notified and DPSIS will be updated in future version of release.

Update*: Currently modelled dark data is being used (instead of pre imaging dark data) to correct for dark bias of the payload.

For each payload observation, PDS4 data products are generated (based on product id and sensor id derived from file name (for details refer Section 6.5 for File Naming Conventions & format), zipped and organized under year-month-day wise collection directory defined under instrument collection structure shown in Section 6.4. For example, if the user has downloaded a zip product as

- ch2_iir_nri_20200701T1351524657_d_img_d18.zip,

unzipped structure of IIRS raw data product at user end will be as shown in **Figure 3**.

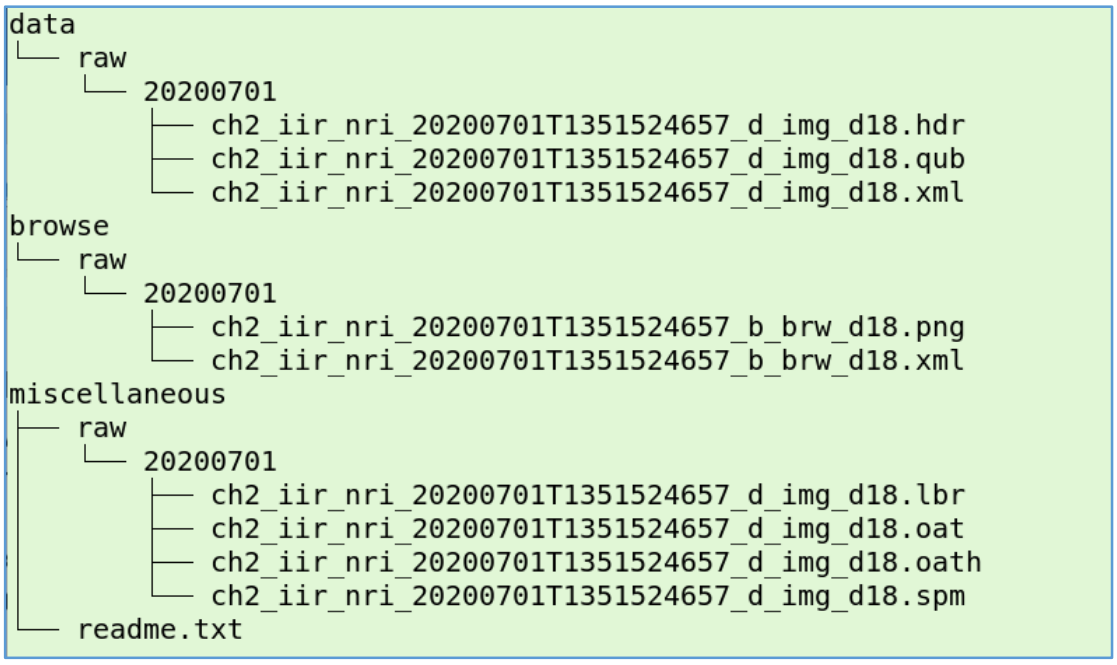

Figure 3. IIRS raw data archive

The details of individual data products along with the data formats present inside the zip product are shown in **Table 8**.

Table 8. IIRS raw data products

PDS4 data product levels	PDS4 data products	Data formats	Description	Visualization tools available
Raw	Data raw image	Binary	The PDS raw data in qube form in generic binary format	Any binary image viewer – imageJ, Envi, Erdas etc. Provide image width, image height, number of bands and data type from label file
	Data raw label	XML	The PDS label product contains description about the raw product.	PDS4 viewer or any web browser
	Browse raw image	PNG	Sub-sampled browse raw image of band no. 40	Any image viewer can be used to load the png file
	Browse raw label	XML	The PDS label product contains description about the browse raw product.	PDS4 viewer or any web browser
	Miscellaneous data (non-PDS data)	Text	Contains four files such as orbit & attitude (oat), orbit & attitude header (oath), liberation angle (lbr), sun parameter file (spm)	Any text viewer software will be able to load the data

4.2.2 Calibrated data products

Calibrated Data Products contain radiometrically corrected data along with the refined corner coordinates. The radiometrically corrected data is generated from raw data by subtracting the dark data as the first step. The detector non-uniformity is corrected by applying Look Up Table (LUT) and then destriping is applied to reduce the residual non-uniformity. The resultant output of the above steps is converted into radiances and then post processing is carried out. This includes keystone correction, radiance adjustment in OSF regions (applied only in OSF regions), radiance corrections at the start and end of the spectral regions. Above mentioned post processing steps improve the accuracy of radiances. This calibrated data is converted to physical units ($mWcm^{-2}sr^{-1}\mu m^{-1}$) and stored as 32-bit floating point numbers in generic binary BSQ format.

The user may find differences in radiances converted using the raw data, look up table and formula provided in Appendix-F with respect to the calibrated data provided as part of PDS4 archive. The differences in radiances values are due to the post processing steps mentioned above. All OSF region bands, bands in the beginning and end are marked as bad bands/low confidence bands as described in Appendix-H.

Apart from radiometrically corrected image qube product, there is another geometrically gridded data product that is generated in DP software which takes Orbit, Attitude and Time (OAT) from level-0 as an input. All these files are generated at level-0 using SPICE kernel as an input. The SPICE Archive (hosted on ISSDC Pradan web application) can be accessed through the following link- https://pradan.issdc.gov.in/pradan/protected/browse.xhtml?id=spice.

For each payload observation, PDS4 data products are generated (based on product id derived from the file name (for details refer Section 6.5 for File Naming Conventions & format), zipped and organized under year-month-day format collection directory defined under instrument collection structure as shown in section 6.4. For example, if the user has downloaded the zip product as

- ch2_iir_nci_20200701T1351524657_d_img_d18.zip

unzipped structure of IIRS raw data product at user end will be as shown in **Figure 4**.

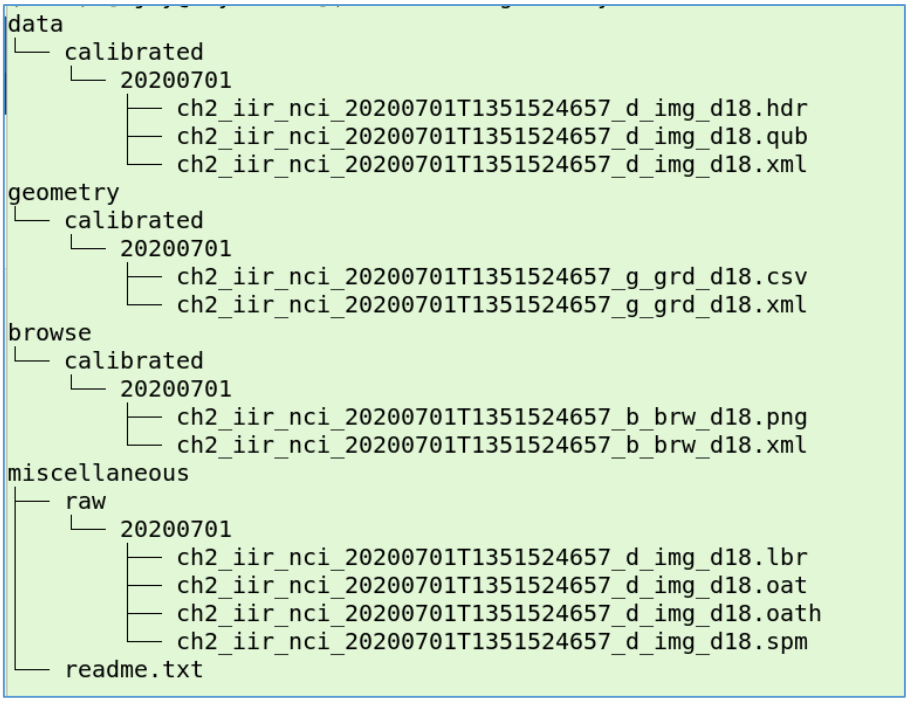

Figure 4. IIRS calibrated data archive

The details of individual data products along with the data formats present inside the zip product are given in **Table 9**.

Table 9. IIRS calibrated data products

PDS4 data product levels	PDS4 data products types	Data formats	Description	Visualization tools available
Calibrated	Data calibrated image	Binary	The PDS radiometrically corrected data in qube form in generic binary format	Any binary image viewer – imageJ, envi, erdas, etc. Provide image width, image height, number of bands and data type from label file
	Data calibrated label	XML	The PDS label product contains description about	PDS4 viewer or any web browser

PDS4 data product levels	PDS4 data products types	Data formats	Description	Visualization tools available
			the calibrated product.	
	Browse calibrated image	PNG	Sub-sampled browse calibrated image of band no. 40	Any image viewer can be used to load the png file
	Browse calibrated label	XML	The PDS label product contains description about the browse calibrated product.	PDS4 viewer or any web browser
	Geometric calibrated grid	CSV	A grid file containing longitude, latitude, scan and pixel numbers as four columns alongwith the data	Any text editor, MS Excel can be used to load the csv file.
	Geometric calibrated grid label	XML	The PDS label product contains description about the geometry calibrated product.	PDS4 viewer or any web browser
	Miscellaneous data (non-PDS data)	Text	Contains four files orbit & attitude (oat), orbit & attitude header (oath), liberation angle (lbr), sun parameter file (spm)	Any text viewer software will be able to load the data

4.3 Data products acknowledgment

- The users will make available to the scientific community the salient results of the data analysis through publication in appropriate journals.
- When publishing a paper using the Chandrayaan-2 data, please
    - mention about “Chandrayaan-2” in abstract and
    - include the following statement in acknowledgement - "We acknowledge the use of data from the Chandrayaan-2, second lunar mission of the Indian Space Research Organisation (ISRO), archived at the Indian Space Science Data Centre (ISSDC)".
- If you are using the results of Chandrayaan-2 which are already published and carrying out further interpretation or modeling, please include the following statement in acknowledgement - "The research is based partially / to a significant extent **(whichever is applicable)** on the results obtained from the Chandrayaan-2, second lunar mission of the Indian Space Research Organisation (ISRO), archived at the Indian Space Science Data Centre (ISSDC)".
- ISRO reserves the right to use the published results in its reports and publications with due reference to the publication. If the reports or publications are copyrighted, ISRO will have a royalty-free right under the copyright to reproduce, distribute and use the copyrighted works for their purposes.
- Any print of the data/data products supplied by ISRO should carry the mark "© reserved ISRO" mark in legible letters.

4.4 Data products bundle

The IIRS data archive is organized into three bundles at data level. A description of each bundle is provided in **Table 10**. A more detailed description of the contents and format of each bundle is provided in Section 6.2.

Table 10. IIRS data products bundles

Bundle logical identifier	PDS4 reduction level	Description	Data provider
urn:isro:isda:ch2.iir.raw	Raw	Original data from an instrument. If compression, reformatting, packetization, or other translation has been applied to facilitate data transmission or storage, those processes will be reversed so that the archived data are in a PDS approved archive format	ISSDC
urn:isro:isda:ch2.iir.calibrated	Calibrated	Data converted to physical units, which makes values independent of the instrument.	ISSDC
urn:isro:isda:ch2.iir.derived	Derived	Results that have been distilled from one or more calibrated data products (for example, maps, gravity or magnetic fields, or ring particle size distributions). Supplementary data, such as calibration tables or tables of viewing geometry, used to interpret observational data should also be classified as 'derived' data if not easily matched to one of the other three categories	ISSDC

4.4 Data flow

This section describes only those portions of the Chandrayaan-2 data flow at ISSDC that are directly connected to archiving. The ISSDC will maintain an active archive of all the science data and will provide direct access to the PI through the life of the mission. After the end of the project, ISDA will be the sole long-term archive for all public data.

5. Archive generation

The IIRS archive products are produced by the SAC DP team in cooperation with the ISSDC. The archive volume creation process will be described in this section. Archived data, established at ISSDC from the SAC DP software running at ISSDC, are made available to users electronically as soon as it qualifies as a science product.

5.1 Data Processing and Production Software (DPPS)

After receiving L0 data from the level-0 software at ISSDC, it processes the L0 data into science data products using software provided by the SAC DP. The ISSDC provides the L0 data files with all the ancillary data required for science processing to the SAC DP Software. From this data, the SAC DP Software generates L0 and L1 data products that represent raw and calibrated science data products, respectively. The science data products that the SAC DP software delivers to the ISSDC will be stored by the ISSDC for the duration of the project and will be made available to the PI team or as per the ISRO data distribution policy. The ISSDC will deliver archival-quality science data products to the ISDA for distribution to the public and long-term archiving in accordance with the IIRS Data Products and Archive SIS (this document).

5.2 Data validation

There are two types of data validation. The first is validation of the science data and the second one is validation of the compliance of the archive with PDS archiving and distribution requirements. The first type of validation was carried out by the PI Team, and the second was overseen by the ISDA, in coordination with the PI team. The formal validation of data content, adequacy of documentation and adherence to PDS archiving and distribution requirements is scheduled and coordinated by the ISDA. The peer review of data and documentation was carried out by a team consisting of the members from planetary science community. The review process resulted in the actions (liens) that were recommended by the reviewers or by PDS personnel to correct the archive. After the resolution of liens by the data provider, ISDA completed a final validation before the public release of the data.

5.3 Data transfer methods and delivery schedule

The data products are generated by the Data Processing and Archival Software (DPAS) at ISSDC during the nominal observation phase of IIRS. Initially, the active archive will be established for the data collected over six months. The products will be available for the PI for the initial validation of data. After the completion of lock in period, Long Term Archive (LTA) will be established at ISSDC. The schedule plan of the mission for

IIRS data release is given in **Table 11.**

Table 11. Data release schedule plan

Payload	Release*	Data collection period (from date to date)	Lock-in-period (as per SSPO ISRO HQ)**	Date release to Public***	Products
IIRS	Release 1 (first imaging season)	December 2019 to February 2020	12 months	August 2021	Raw and calibrated datasets
	Release 2 (second imaging season)	May 2020 to June 2020	6 months	February 2022	Raw and calibrated datasets
	Release 3 (third, fourth, fifth and sixth imaging season)	Season 3 Nov 2020 to Feb 2021 Season 4 June 2021 to Feb 2022 Season 5 Feb 2022 to Apr2022 Season 6 May 2022 to Aug 2022	6 months	September 2022	Raw and calibrated datasets
	Release 4 (seventh imaging season)	Season 7 Nov 2022 to Feb 2023	-	March 2023	Raw and calibrated datasets
	Release 5 (eighth imaging season)	Season 8 April 2023 to August 2023	-	September 2023	Raw and calibrated datasets

Payload	Release*	Data collection period (from date to date)	Lock-in-period (as per SSPO ISRO HQ)**	Date release to Public***	Products
IIRS	Release 6 (ninth imaging season)	Season 9 November 2023 to Feb 2024	-	March 2024	Raw and calibrated datasets
	Release 7 (tenth imaging season)	Season 10 March 2024 to June 2024	-	August 2024	Raw and calibrated datasets

***** Archive for the duration of five months (April to August) will be released to the user.
** The lock in period is required for the data verification, validation and peer review process of the PDS data sets before the public release of data.
*** Release dates are the dates on which the ISDA releases archives to the public. The archive is delivered to the ISDA at least two weeks before the date of release to the public.

5.4 Data product and archive volume size estimates

The total archive volume size is estimated on the basis of the data size, number of orbits per day and mission life.

5.5 Backups and duplicates

ISDA is responsible for maintaining at least three copies of its science archives and for delivering one copy of the data to the ISSDC for archiving. As the archives are released, ISSDC generates at least three copies on appropriate physical media for long-term storage.

6. Archive organization and file naming conventions

6.1 Namespace registration

PDS4 archive standard is adopted for the archiving of Chandrayaa-2 mission data. PDS4 is an international archive standard that is being adopted by various space agencies across globe. PDS4 is adopted by all the members of International Planetary Data Alliance (IPDA) including ISRO. First step towards starting archive activities for any space agency is to register namespace via IPDA. The namespace registered by ISRO at IPDA will be used as root to the archive of ISRO's upcoming and future planetary missions. For Chandrayaan-2 mission also, the namespace shown in the **Table 12** will be used as root.

Table 12. ISDA Namespace for PDS4

Namespace ID	Logical Identifier prefix	Authority	Steward	Steward_ ID	Provider/contact Point
isda	urn:isro:isda	ISRO Science Data Archive	ISRO	isda	Ajay K Prashar T P Srinivasan B.N. Ramakrishna

6.2 Logical identifiers

Logical Identifier (LID) is unique to the product. Version Identifier (VID) indicates the version improvements with respect to the products. All LIDs consist of a series of colon-separated segments.
Namespace:{BundleID}_{SubBundleID}:[{CollectionID}_PDS4DataProductLevel:[{ProductID}]]. **Table 13** shows values for LID construction.

Table 13. LID for Chandrayaan-2 mission

Namespace	Bundle Id	Sub Bundle Id	Collection Id	PDS4 data product level	Product Id
urn:isro:isda	ch2	cho	iir	raw calibrated derived	Address data Product SIS document or EAICD

The following **Table 14** shows the construction of LID to be used for all the scientific payloads of the mission.

Table 14. LID for Chandrayaan-2 mission instruments

Instrument id	Logical identifier
iir	urn:isro:isda:ch2_cho:iir_raw:productId urn:isro:isda:ch2_cho:iir_calibrated:productId urn:isro:isda:ch2_cho:iir_derived:productId

The products, collections and bundles may evolve over time as calibration or other processing changes lead to improved versions. PDS appends a VID of the form M.n to LID to indicate different versions. The suffix is separated from LID by double colon. Archive structure is designed both at mission phase level and instrument level.

6.3 Mission archive structure at bundle level

At mission level, data is organized as mission id wise bundle. At the next level, it is further organized based on the instrument host id wise bundle. The instrument host id bundle at next level is organized based on the mission phase id. Each mission phase id is having instrument id wise collection. All these mission attributes - mission id, instrument host id, mission phase id and instrument id are defined under archive conventions. For IIRS instrument, **Table 15** shows values defined for mission attributes in archive conventions.

Table 15. Mission attributes defined at structure level

Mission Attributes	Values	Defined at structure level
mission id	ch2	ch2_bundle
instrument host id	cho	cho_bundle
mission phase id	nop	nop (normal operation phase)
instrument id	iir	iir_collection

All these attributes mentioned in the **Table 15** are used in designing the archive structure at mission level. The archive organization of mission level data products is shown in **Figure 5**.

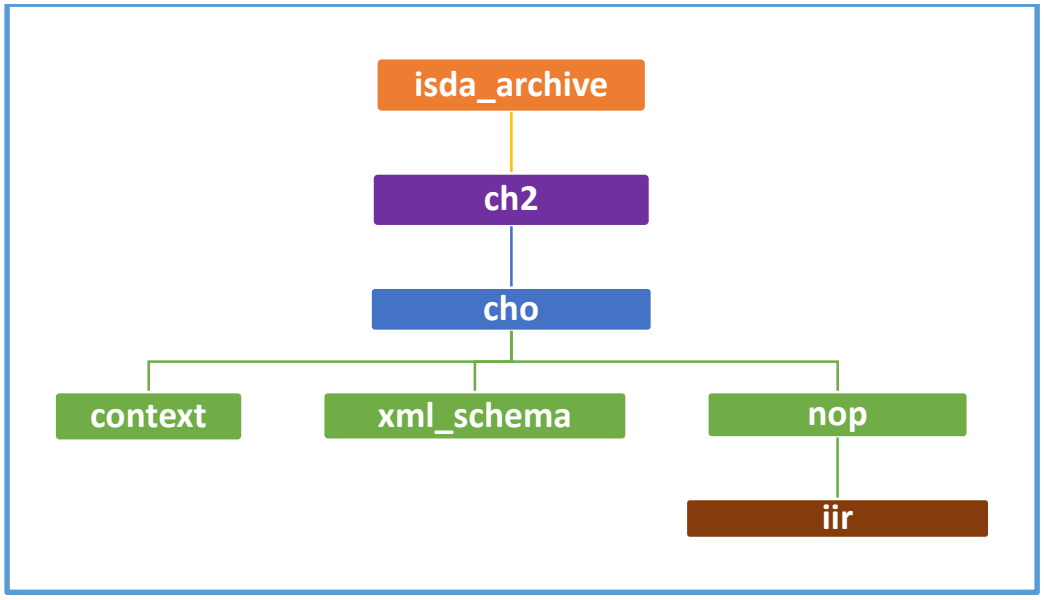

Figure 5. Chandrayaan-2 mission level archive organization

6.4 Instruments collection

Under each instrument wise data collection, data is organized under each directory defined by PDS4. Data is organized based on the levels of data processing and data products definitions. To handle requirement of archiving the data products for 12 orbits in a day, data products are organized into year-month-day format as yyyymmdd. The year-month-day wise directory contains PDS4 data products including PDS4 label products. The details of collection structure for IIRS are shown in **Figure 6**.

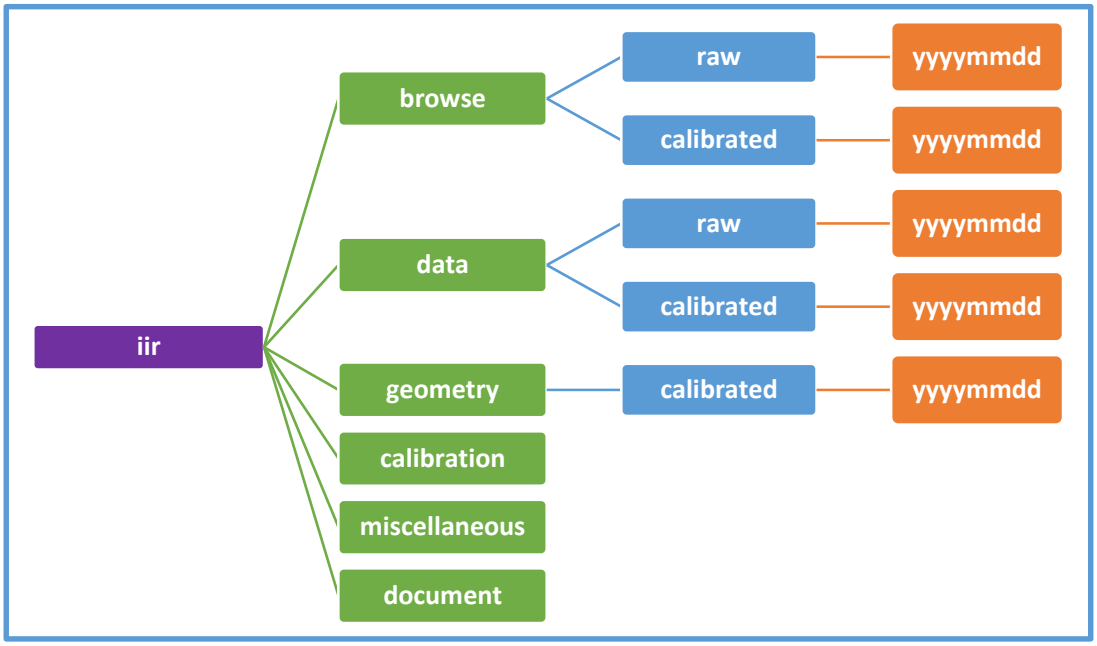

Figure 6. Collection structure for Chandrayaan-2 IIRS Instrument

At instrument level, collection of different product types is defined as per standard PDS4 conventions. The collection types are defined in detail in **Table 16**.

Table 16. Collection product types

File or Directory name	Description
root	Root directory describing full iirs collection datasets.
browse	Contains 'quick-look' products designed to facilitate use of the archive.
calibration	Contains data and files necessary for the calibration of basic products.
context	Contains list of products comprising various objects, identified with in the PDS4 registry, that are specific to the science bundle. These include physical objects such as instruments, spacecraft and planets and conceptual objects such as missions.
document	Contains all components (figure, tables, text, etc.) of one or more related documents. The document includes software interface specifications (SISs), calibration reports.
data	Contains observational products, often separated according to processing level, target, instrument mode, etc.
xml_schema	Contains XML schemas and related products which may be used for generating and validating PDS4 labels.
geometry	Contains non-SPICE geometry products – Grid data file contains derived geometry information – latitude and longitude for given image scan line and pixel direction.
miscellaneous	Contains supplementary information provided by data provider to be useful in the interpretation and use of other collections in the bundle but which does not fit within the scope of the other collections. For example, meta data catalogs, database dumps, and records of modification history could be included.

6.4.1 Root directory content

Files in the root directory include an overview of the archive and a description of the collection for the PDS4 data set. The root directory contains the files shown in **Table 17.**

Table 17. Root directory content products

File name	File contents	File provided by
bundle.xml	Collection content and format information	Archive Team
readme.txt	Collection content and format information	Archive Team

6.4.2 Browse directory content

Under the Browse directory there is a separate sub-directory which is year-month-day format for each type of product. This contains browse image for each image data, which is a down-sampled version of the full resolution image, with the size of m pixels x n lines and 8 bits per pixel. This browse image is defined as an object and contained in the data file. PNG images, derived from the browse image, are stored in this directory as well as the label files pointing to these images. All the browse PNG images are named as per file naming convention.

6.4.3 Calibration directory content

The calibration directory contains calibration files used to process the data products, or calibration data needed to use the data products. Raw data is the dark data subtracted. The calibration files are look-up-table (LUT) files and saturation radiances generated during the ground calibration exercise.

The naming convention of these LUT files is based on the parameters – mission (ch2), instrument id (iir), cal, exposure (e1, e2, e3, e4), gain (g2) and calibration file type (lut_coeff or saturations_radiance). The files are contained in the calibration directory and are shown in **Table 18**.

Table 18. Calibration directory content products

File name	File contents	File provided by
collection_calibration_inventory.csv	Contains about the list of calibration data products in the collection inventory	Archive team
collection_calibration_inventory.xml	XML Label defining the inventory csv file	Archive team

6.4.4 Context directory content

The context directory contains the list of products comprising various objects, identified within the PDS4 registry, that are specific to the science bundle. These include physical objects such as instruments, spacecraft and planets; and conceptual objects such as missions. The files contained in the context directory are shown in **Table 19**.

Table 19. Context directory content products

File name	File contents	File provided by
collection_context_inventory.csv	Contains information about the list of context data products in the collection inventory	Archive team
collection_ context_inventory.xml	XML Label defining the inventory csv file	Archive team

6.4.5 Document directory content

The document directory contains documentation to help the user understand and use the archive data. The files contained in the document directory are shown in the

Table 20.

Table 20. Document directory content products

File name	File contents	File provided by
collection_document_inventory.xml	Label to define the inventory	Archive team
collection_document_inventory.csv	A description of the contents of this directory	Archive team
ch2_iir_pds_dp_archive_sis.pdf	Description of instrument and PDS data products and Archive Structure	Archive team
ch2_iir_pds_dp_archive_sis.xml	XML label defining iirs pds sis pdf	Archive team

6.4.6 Data directory content

Under the data directory there are three separate directories based on the defined PDS4 data products levels – raw, calibrated and derived. Under each sub-directory, there are again sub-directories based on year-month-day format. These contain PDS4 data products mainly single image qube data containing all the bands arranged in band sequential manner and associated label files in XML format. All the browse binary images are named as per file naming conventions mentioned under section 6.5.

6.4.7 Xml_schema directory content

This directory contains XML schemas and related products which may be used for generating and validating PDS4 labels. The files contained in the xml_schema directory areshown in **Table 21**.

Table 21. Xml_schema directory content products

File name	File contents	File provided by
collection _xml_schema_inventory.csv	Contains information about the list of xml schema in the collection inventory	Archive team

collection _xml_schema_inventory.xml	XML Label defining the xml schema csv file	Archive team

6.4.8 Geometry directory content

Under the geometry directory, there is a calibrated sub-directory which is based on the defined PDS4 data products levels. Under each sub directory, there are again sub-directories based on year-month-day format. This contains PDS4 data products mainly grid file in csv format for the middle band defined for IIRS and associated label files in XML format. All the grid files are named as per file naming conventions mentioned in section 6.5.

6.4.9 Miscellaneous directory content

Under the miscellaneous directory, there are two separate sub-directories based on the defined PDS4 data products levels – raw and calibrated. Under each sub directory, there are again sub directories based on year-month-day format. This contains data products mainly orbit and attitude file (oat), orbit and attitude header file (oath), liberation angle file (lbr) and sun parameter file (spm) in ASCII text format. All the files with extension oat, oath, lbr and spm are named as per file naming conventions in section 6.5. It also contains the supplementary information provided by data provider, which can be useful in the interpretation of data or for understanding other collections in the bundle, but does not fit within the scope of other collections. The files contained in the Miscellaneous Directory are shown in **Table 22**.

Table 22. Miscellaneous directory content

File Name	File Contents	File Provided By
collection_miscellaneous_inventory.csv	Contains information about the list of miscellaneous files in the collection inventory	Archive team
collection_miscellaneous_inventory.xml	XML Label defining the xml schema csv file	Archive team

6.5 File naming conventions and formats

This section describes the naming convention used for science data files for the mission. **Table 23** shows the detail description about the following file naming conventions designed for the data products.

ch2_<inst>_<mtc>_<YYYYMMDDTHHMMSSssss>_<p>_<prd>_<stn>.fff

Table 23. File naming conventions

Code	Description
ch2	It denotes the mission name whose value is fixed as ch2.
inst	It denotes the Instrument ID, it can have following value: = iir (refers to the IIRS)
m	It denotes the mission phase name. It can have following values: = e (refers to the Earth Bound Phase - ebp) = n (refers to the Normal Operations Phase - nop)
t	It denotes the data type. It can have following values: = r (referes to raw data) = c (referes to clibrated data) = d (referes to derived data)
c	It denotes the imaging mode/camera id/band. It can have the following value: = i (referes to Imaging InfraRed Spectrometer (IIRS))
YYYYMMDDTHHMMSSssss	It denotes the observation/imaging start time and has the following format: YYYY stands for year MM stands for month DD stands for day T stands for time. HH stands for hour MM stands for minute SS stands for seconds ssss stands for 1/10 millisecond or 100 microsecond

Code	Description
p	It denotes the PDS data products categories. Its value can be any of the following: = d (referes to data products under data directory) = b (referes to browse data products under browse directory) = g (referes to gridded data products under geometry directory)
prd	It denotes the PDS data product name. Its value can be any of the following: = img (referes to the image data product) = brw (referes to the browse data product) = grd (referes to the gridded data product)
stn	It denotes the station id from which data was acquired. Its value can be any of the following: = d32 (ISSDC, Bangalore) = d18 (ISSDC, Bangalore) = gds (Gold Stone, USA) = cnb (Canberra, Australia)
fff	It denotes the standard file type extension. It can have any one of the following values: = img (PDS image data file) = qub (PDS image qube data file) = hdr (Envi header file) = xml (PDS detached label file) = jpg (PDS browse data file) = csv (PDS geometry data file) = tif (PDS geotiff data for derived products)

All underscore characters '_' are mandatory and separate the different fields.

7. Archive product formats

IIRS archive data are formatted in accordance with PDS specifications. This section provides details on the formats used for each of the products included in the archive. The detailed file formats for the defined data products based on PDS4 data types are shown in next sub-section.

7.1 Data file formats

For a single scene, both primary as well as secondary datasets are defined that contain data product levels, types and formats as given in **Table 24**.

Table 24. IIRS PDS4 data products format

Sensors	PDS4 data product levels	PDS4 data products types	Data formats	Data type*
Hyperspectral	Raw	Image	Binary Spectral Qube	UnsignedLSB2
	Raw	Browse	PNG	UnsignedByte
	Calibrated	Image	Binary Spectral Qube	IEEE754LSBSingle
	Calibrated	Browse	PNG	UnsignedByte
	Calibrated	Geometry	CSV	ASCII Text
	Derived	Image	Binary Spectral Qube	IEEE754LSBSingle

Note*:

UnsignedLSB2 is UInt16 (Unsigned Integer of 16-bit length)

SignedLSB2 is Int16 (Signed Integer of 16-bit length)

Unsigned Byte is 8-bit unsigned integer

IEEE754LSBSingle is floating point of 32-bit length

7.2 Document product file formats

All the files under document collection are written in text format, csv, png, xml and pdf.

7.3 PDS labels

PDS labels are ASCII text files written in the eXtensible Markup Language (XML). All product labels are detached from the digital files (if any) containing the data objects they describe (except Product_Bundle). There is one label for every product. Each product, however, may contain one or more data objects. The data objects of a given product may all reside in a single file, or they may be stored in multiple separate files. PDS4 label files must end with the file extension ".xml".

7.3.1 XML documents

For the Chandrayaan-2 mission, PDS labels will conform to the PDS master schema based upon the 1.11.0.0 version of the PDS Information Model for structure, and the 1.11.0.0 version of the PDS schematron for content. By using an XML editor, these documents may be used to validate the structure and content of the product labels.

The PDS master schema and schematron documents are produced, managed and supplied by the ISDA Archive Working Group (AWG). In addition to these documents, the AWG has produced archive conventions containing the additional XML attribute and parameter definitions specific to mission.

Examples of PDS labels required for the IIRS archive are shown in **Appendix B** (bundle products), **Appendix C** (collection products), and **Appendix D** (basic products).

7.4 Delivery package

Data transfers from ISDA to the data users are accomplished using delivery packages. Delivery packages include the following elements:

- The package which consists of a compressed bundle of the products being transferred.
- A transfer manifest which maps each product's LID/VID to the physical location of the product label in the package after uncompressing.
- A checksum manifest which lists the MD5 checksum of each file included in the package after uncompressing.

Appendix-A: Support staff and cognizant persons

Table 25. Chandrayaan-2 team staff

Teams	Person Name	Contact	Email Id
Operations Team @ ISSDC IDSN Bylalu, Bengaluru	Sri. Sreenath	+91-80-2809-4416/17/18 (SCC), 2809-4419 (MOX), 2202-9173/74 (ISSDC-IDSN)	sreenath@istrac.gov.in
Principal Investigator (PI) Team @ SAC Ahmedabad	Satadru Bhattacharya	+91-79-26914361	satadru@sac.isro.gov.in

Appendix-B: Sample Bundle Product Label

```
<Product_Bundle xmlns="http://pds.nasa.gov/pds4/pds/v1"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://pds.nasa.gov/pds4/pds/v1
https://pds.nasa.gov/pds4/pds/v1/PDS4_PDS_1700.xsd">
 <Identification_Area>
  <logical_identifier>urn:isro:isda:ch2_cho</logical_identifier>
  <version_id>1.0</version_id>
  <title>Chandrayaan-2 IIRS Data Archive Products Bundle</title>
  <information_model_version>1.11.0.0</information_model_version>
  <product_class>Product_Bundle</product_class>
  <Citation_Information>
   <author_list>isro,issdc,sac</author_list>
   <publication_year>2021</publication_year>
   <description>Chandrayaan-2 Orbiter IIRS Payload Data Products</description>
  </Citation_Information>
  <Modification_History>
   <Modification_Detail>
    <modification_date>2021-08-12</modification_date>
    <version_id>1.0</version_id>
    <description>Peer reviewed version of the Chandrayaan-2 orbiter IIRS payload
data products bundle</description>
   </Modification_Detail>
  </Modification_History>
 </Identification_Area>
 <Context_Area>
  <Time_Coordinates>
   <start_date_time>2019-12-02Z</start_date_time>
   <stop_date_time>2020-02-12Z</stop_date_time>
  </Time_Coordinates>
  <Investigation_Area>
   <name>Chandrayaan-2</name>
   <type>Mission</type>
   <Internal_Reference>
    <lid_reference>urn:isro:isda:ch2_cho.iir:context:mission</lid_reference>
    <reference_type>bundle_to_investigation</reference_type>
   </Internal_Reference>
  </Investigation_Area>
  <Observing_System>
   <name>Chandrayaan-2</name>
   <Observing_System_Component>
    <name>Chandrayaan-2 Orbiter</name>
    <type>Spacecraft</type>
    <Internal_Reference>

<lid_reference>urn:isro:isda:ch2_cho.iir:context:inst_host_spacecraft</lid_reference
>
```

```
      <reference_type>is_instrument_host</reference_type>
     </Internal_Reference>
    </Observing_System_Component>
    <Observing_System_Component>
     <name>imaging infrared spectrometer</name>
     <type>Instrument</type>
     <Internal_Reference>
      <lid_reference>urn:isro:isda:ch2_cho.iir:context:inst_iir</lid_reference>
      <reference_type>is_instrument</reference_type>
     </Internal_Reference>
    </Observing_System_Component>
   </Observing_System>
   <Target_Identification>
    <name>Moon</name>
    <type>Satellite</type>
    <Internal_Reference>
     <lid_reference>urn:isro:isda:context:target:satellite.moon</lid_reference>
     <reference_type>data_to_target</reference_type>
    </Internal_Reference>
   </Target_Identification>
  </Context_Area>
  <Bundle>
   <bundle_type>Archive</bundle_type>
  </Bundle>
  <Bundle_Member_Entry>
   <lid_reference>urn:isro:isda:ch2_cho.iir:calibration</lid_reference>
   <member_status>Primary</member_status>
   <reference_type>bundle_has_calibration_collection</reference_type>
  </Bundle_Member_Entry>
  <Bundle_Member_Entry>
   <lid_reference>urn:isro:isda:ch2_cho.iir:data</lid_reference>
   <member_status>Primary</member_status>
   <reference_type>bundle_has_data_collection</reference_type>
  </Bundle_Member_Entry>
  <Bundle_Member_Entry>
   <lid_reference>urn:isro:isda:ch2_cho.iir:document</lid_reference>
   <member_status>Primary</member_status>
   <reference_type>bundle_has_document_collection</reference_type>
  </Bundle_Member_Entry>
  <Bundle_Member_Entry>
   <lid_reference>urn:isro:isda:ch2_cho.iir:context</lid_reference>
   <member_status>Primary</member_status>
   <reference_type>bundle_has_context_collection</reference_type>
  </Bundle_Member_Entry>
  <Bundle_Member_Entry>
   <lid_reference>urn:isro:isda:ch2_cho.iir:browse</lid_reference>
   <member_status>Primary</member_status>
```

```
  <reference_type>bundle_has_browse_collection</reference_type>
 </Bundle_Member_Entry>
 <Bundle_Member_Entry>
  <lid_reference>urn:isro:isda:ch2_cho.iir:geometry</lid_reference>
  <member_status>Primary</member_status>
  <reference_type>bundle_has_geometry_collection</reference_type>
 </Bundle_Member_Entry>
 <Bundle_Member_Entry>
  <lid_reference>urn:isro:isda:ch2_cho.iir:miscellaneous</lid_reference>
  <member_status>Primary</member_status>
  <reference_type>bundle_has_member_collection</reference_type>
 </Bundle_Member_Entry>
 <Bundle_Member_Entry>
  <lid_reference>urn:isro:isda:ch2_cho.iir:schema</lid_reference>
  <member_status>Primary</member_status>
  <reference_type>bundle_has_schema_collection</reference_type>
 </Bundle_Member_Entry>
</Product_Bundle>
```

Note: All the filled values in the above xml fields are only indicative values.

Appendix-C: Sample Collection Product Label

```
<Product_Collection xmlns="http://pds.nasa.gov/pds4/pds/v1"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://pds.nasa.gov/pds4/pds/v1
http://pds.nasa.gov/pds4/pds/v1/PDS4_PDS_1400.xsd
http://pds.nasa.gov/pds4/disp/v1
http://pds.nasa.gov/pds4/disp/v1/PDS4_DISP_1301.xsd
http://pds.nasa.gov/pds4/sp/v1
http://pds.nasa.gov/pds4/sp/v1/PDS4_SP_1100.xsd">

 <Identification_Area>
  <logical_identifier>urn:isro:isda:ch2_cho.iir:document</logical_identifier>
  <version_id>1.0</version_id>
  <title>Chandrayaan-2 Orbiter IIRS document file collection</title>
  <information_model_version>1.11.0.0</information_model_version>
  <product_class>Product_Collection</product_class>
  <Citation_Information>
   <author_list>Chandrayaan-2 DP Team</author_list>
   <editor_list> Chandrayaan-2 DP Team</editor_list>
   <publication_year>2021</publication_year>
   <description>collection of document products.</description>
  </Citation_Information>
  <Modification_History>
   <Modification_Detail>
    <modification_date>2021-08-12</modification_date>
    <version_id>1.0</version_id>
    <description>Initial version</description>
   </Modification_Detail>
  </Modification_History>
 </Identification_Area>
 <Context_Area>
  <Investigation_Area>
   <name>chandrayaan-2</name>
   <type>Mission</type>
   <Internal_Reference>

<lidvid_reference>urn:isro:isda:context:investigation:mission.chandrayaan2::1.0</lid
vid_reference>
     <reference_type>collection_to_investigation</reference_type>
   </Internal_Reference>
  </Investigation_Area>
  <Observing_System>
   <Observing_System_Component>
    <name>Chandrayaan 2 Orbiter</name>
    <type>Spacecraft</type>
    <description>
```

```
Chandrayaan-2 Orbiter is an Orbiter craft under the Chandrayaan-2 Spacecraft
 consists of various scientific instruments.
      </description>
    </Observing_System_Component>
    <Observing_System_Component>
     <name>imaging infrared spectrometer</name>
     <type>Instrument</type>
     <description>
      IIRS (Imaging InfraRed Spectrometer) is one of the scientific instrument hosted
      on the Chandrayaan-2 Orbiter. The instrument is a grating based spectrometer
      covering the spectral region between 0.8 µm to 5.0 µm.
     </description>
    </Observing_System_Component>
  </Observing_System>
  <Target_Identification>
   <name>Moon</name>
   <type>Satellite</type>
   <description>Moon is a natural satellite of Earth</description>
  </Target_Identification>
 </Context_Area>
 <Collection>
  <collection_type>Document</collection_type>
 </Collection>
 <File_Area_Inventory>
  <File>
   <file_name>collection_document_inventory.csv</file_name>
   <local_identifier>collection_document_inventory.csv</local_identifier>
   <creation_date_time>2020-07-26</creation_date_time>
   <file_size unit="byte">73</file_size>
   <records>1</records>
   <md5_checksum>f0002af440a312f1a12f783ed4d7e3e5</md5_checksum>
  </File>
  <Inventory>
   <offset unit="byte">0</offset>
   <parsing_standard_id>PDS DSV 1</parsing_standard_id>
   <records>1</records>
   <record_delimiter>Carriage-Return Line-Feed</record_delimiter>
   <field_delimiter>Comma</field_delimiter>
   <Record_Delimited>
    <fields>2</fields>
    <groups>0</groups>
    <maximum_record_length unit="byte">259</maximum_record_length>
    <Field_Delimited>
```

```
        <name>Member Status</name>
        <field_number>1</field_number>
        <data_type>ASCII_String</data_type>
        <maximum_field_length unit="byte">1</maximum_field_length>
        <description>This column specifies the member status</description>
       </Field_Delimited>
       <Field_Delimited>
        <name>LIDVID_LID</name>
        <field_number>2</field_number>
        <data_type>ASCII_LIDVID_LID</data_type>
        <maximum_field_length unit="byte">255</maximum_field_length>
        <description>This column specifies the LIDVID of the files that comprise the
collection.</description>
       </Field_Delimited>
     </Record_Delimited>
     <reference_type>inventory_has_member_product</reference_type>
   </Inventory>
  </File_Area_Inventory>

</Product_Collection>
```

Note: All the filled values in the above xml fields are only indicative values.

Appendix-D: Sample Data Product Labels

<?xml version="1.0" encoding="UTF-8" standalone="no"?><?xml-model
href="https://isda.issdc.gov.in/pds4/isda/v1/ch2_ldd_ISDA_1000.sch"
schematypens="http://purl.oclc.org/dsdl/schematron" ?><Product_Observational
xmlns="http://pds.nasa.gov/pds4/pds/v1"
xmlns:disp="http://pds.nasa.gov/pds4/disp/v1"
xmlns:isda="https://isda.issdc.gov.in/pds4/isda/v1"
xmlns:pds="http://pds.nasa.gov/pds4/pds/v1"
xmlns:sp="http://pds.nasa.gov/pds4/sp/v1"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://pds.nasa.gov/pds4/pds/v1
http://pds.nasa.gov/pds4/pds/v1/PDS4_PDS_1B00.xsd
http://pds.nasa.gov/pds4/disp/v1
http://pds.nasa.gov/pds4/disp/v1/PDS4_DISP_1301.xsd
http://pds.nasa.gov/pds4/sp/v1 http://pds.nasa.gov/pds4/sp/v1/PDS4_SP_1100.xsd
https://isda.issdc.gov.in/pds4/isda/v1
https://isda.issdc.gov.in/pds4/isda/v1/ch2_ldd_ISDA_1000.xsd">

<Identification_Area>

<logical_identifier>urn:isro:isda:ch2_cho.iir:data_calibrated:ch2_iir_nci_20191210t1
903478507_d_img_d18</logical_identifier>
<version_id>1.0</version_id>
<title>Chandrayaan-2 Orbiter IIRS Experiment</title>
<information_model_version>1.11.0.0</information_model_version>
<product_class>Product_Observational</product_class>
<Modification_History>
<Modification_Detail>
<modification_date>2019-12-02</modification_date>
<version_id>1.0</version_id>
<description>PDS4 product label created by SAC Optical DP
Team</description>
</Modification_Detail>
</Modification_History>
</Identification_Area>
<Observation_Area>
<Time_Coordinates>
<start_date_time>2019-12-10T19:03:47.8507Z</start_date_time>
<stop_date_time>2019-12-10T19:13:15.5452Z</stop_date_time>
</Time_Coordinates>
<Primary_Result_Summary>
<purpose>Science</purpose>

<processing_level>Calibrated</processing_level>

</Primary_Result_Summary>

```
    <Investigation_Area>
      <name>Chandrayaan-2</name>
      <type>Mission</type>
      <Internal_Reference>

<lidvid_reference>urn:isro:isda:context:investigation:mission.chandrayaan2::1.0</lid
vid_reference>
        <reference_type>data_to_investigation</reference_type>
      </Internal_Reference>
    </Investigation_Area>
    <Observing_System>
      <Observing_System_Component>
        <name>Chandrayaan 2 Orbiter</name>
        <type>Spacecraft</type>
        <description>
          Chandrayaan-2 Orbiter is an Orbiter craft under the Chandrayaan-2
Spacecraft
          consists of various scientific instruments.
        </description>
      </Observing_System_Component>
      <Observing_System_Component>
        <name>imaging infrared spectrometer</name>
        <type>Instrument</type>
        <description>
          IIRS (Imaging InfraRed Spectrometer) is one of the scientific instrument
hosted
          on the Chandrayaan-2 Orbiter. The instrument is a grating based
spectrometer
          covering the spectral region between 0.8 um to 5.0 um.
        </description>
      </Observing_System_Component>
    </Observing_System>
    <Target_Identification>
      <name>Moon</name>
      <type>Satellite</type>
      <description>Moon is a natural satellite of Earth</description>
    </Target_Identification>

    <Mission_Area>
      <isda:Product_Parameters>

<isda:job_id>IIRXXD18CHO0131502NNNN19344203223192_V5_1</isda:job_id>

<isda:level0_dir_name>IIRXXD18CHO0131502NNNN19344203223192_V5_1</isda:le
vel0_dir_name>
        <isda:imaging_orbit_number>1315</isda:imaging_orbit_number>
        <isda:dumping_orbit_number>1315</isda:dumping_orbit_number>
```

```
            <isda:line_exposure_duration
unit="ms">53.060</isda:line_exposure_duration>
            <isda:gain>g2</isda:gain>
            <isda:exposure>e1</isda:exposure>
            <isda:exposure_duration unit="ms">1</isda:exposure_duration>
            <isda:detector_temperature unit="K">88.970</isda:detector_temperature>
            <isda:tertiary_mirror_temperature unit="degC">-
36.584</isda:tertiary_mirror_temperature>
            <isda:spectrometer_casing_temperature unit="degC">-
39.677</isda:spectrometer_casing_temperature>
            <isda:dewar_vw_temperature unit="degC">-
47.352</isda:dewar_vw_temperature>
            <isda:detector_pixel_width
unit="micrometer">30</isda:detector_pixel_width>
            <isda:focal_length unit="mm">74.999</isda:focal_length>
            <isda:reference_data_used>SELENE</isda:reference_data_used>
            <isda:orbit_limb_direction>Ascending</isda:orbit_limb_direction>
            <isda:spacecraft_yaw_direction>False</isda:spacecraft_yaw_direction>
            <isda:spacecraft_altitude unit="km">87.59</isda:spacecraft_altitude>
            <isda:pixel_resolution unit="m/pixel">70.07</isda:pixel_resolution>
         </isda:Product_Parameters>
         <isda:Geometry_Parameters>
            <isda:System_Level_Coordinates>
               <isda:upper_left_latitude
unit="deg">0.249290</isda:upper_left_latitude>
               <isda:upper_left_longitude
unit="deg">29.728266</isda:upper_left_longitude>
               <isda:upper_right_latitude
unit="deg">0.247194</isda:upper_right_latitude>
               <isda:upper_right_longitude
unit="deg">30.276273</isda:upper_right_longitude>
               <isda:lower_left_latitude
unit="deg">29.617787</isda:lower_left_latitude>
               <isda:lower_left_longitude
unit="deg">29.748629</isda:lower_left_longitude>
               <isda:lower_right_latitude
unit="deg">29.615265</isda:lower_right_latitude>
               <isda:lower_right_longitude
unit="deg">30.412481</isda:lower_right_longitude>
            </isda:System_Level_Coordinates>
            <isda:Refined_Corner_Coordinates>
               <isda:upper_left_latitude
unit="deg">0.440846</isda:upper_left_latitude>
               <isda:upper_left_longitude
unit="deg">29.741986</isda:upper_left_longitude>
               <isda:upper_right_latitude
unit="deg">0.452856</isda:upper_right_latitude>
```

```
            <isda:upper_right_longitude
unit="deg">30.301078</isda:upper_right_longitude>
            <isda:lower_left_latitude
unit="deg">29.820688</isda:lower_left_latitude>
            <isda:lower_left_longitude
unit="deg">29.753239</isda:lower_left_longitude>
            <isda:lower_right_latitude
unit="deg">29.806452</isda:lower_right_latitude>
            <isda:lower_right_longitude
unit="deg">30.431041</isda:lower_right_longitude>
          </isda:Refined_Corner_Coordinates>
        </isda:Geometry_Parameters>
      </Mission_Area>
    </Observation_Area>
    <File_Area_Observational>
      <File>

<file_name>ch2_iir_nci_20191210T1903478507_d_img_d18.qub</file_name>
        <creation_date_time>2021-07-26T14:29:38</creation_date_time>
        <file_size unit="byte">2739200000</file_size>
        <md5_checksum>acc7c979dfde71caead3dad4bf292729</md5_checksum>
        <comment>
          This File contains the radiance spectral image
          md5_checksum is provided for ensuring data integrity when users are
downloading the data.
        </comment>
      </File>
      <Array_3D_Spectrum>


        <name>IIRS Image Cube</name>
        <local_identifier>SPECTRAL_QUBE_OBJECT</local_identifier>
        <offset unit="byte">0</offset>
        <axes>3</axes>
        <axis_index_order>Last Index Fastest</axis_index_order>

 <description>


The core of the image cube has 256 spectral bands.
          Bands are stored sequentially in the cube.

 </description>

 <Element_Array>
          <data_type>IEEE754LSBSingle</data_type>
          <unit>mW/cm**2/sr/µm</unit>
```

```
</Element_Array>
<Axis_Array>
 <axis_name>BAND</axis_name>
 <elements>256</elements>
 <sequence_number>1</sequence_number>
 <Band_Bin_Set>


   <Band_Bin>
     <band_number>1</band_number>
     <band_width unit="nm">19.8</band_width>
     <center_wavelength unit="nm">712.3</center_wavelength>
   </Band_Bin>

   <Band_Bin>
     <band_number>2</band_number>
     <band_width unit="nm">19.9</band_width>
     <center_wavelength unit="nm">729.2</center_wavelength>
   </Band_Bin>

   <Band_Bin>
     <band_number>3</band_number>
     <band_width unit="nm">20.0</band_width>
     <center_wavelength unit="nm">746.0</center_wavelength>
   </Band_Bin>

   <Band_Bin>
     <band_number>4</band_number>
     <band_width unit="nm">20.1</band_width>
     <center_wavelength unit="nm">762.9</center_wavelength>
   </Band_Bin>

   <Band_Bin>
     <band_number>5</band_number>
     <band_width unit="nm">20.2</band_width>
     <center_wavelength unit="nm">779.7</center_wavelength>
   </Band_Bin>

   <Band_Bin>
     <band_number>6</band_number>
     <band_width unit="nm">20.3</band_width>
     <center_wavelength unit="nm">796.6</center_wavelength>
   </Band_Bin>

   <Band_Bin>
     <band_number>7</band_number>
     <band_width unit="nm">20.4</band_width>
```

```
    <center_wavelength unit="nm">813.4</center_wavelength>
  </Band_Bin>

  <Band_Bin>
    <band_number>8</band_number>
    <band_width unit="nm">20.4</band_width>
    <center_wavelength unit="nm">830.3</center_wavelength>
  </Band_Bin>

  <Band_Bin>
    <band_number>9</band_number>
    <band_width unit="nm">20.5</band_width>
    <center_wavelength unit="nm">847.2</center_wavelength>
  </Band_Bin>

  <Band_Bin>
    <band_number>10</band_number>
    <band_width unit="nm">20.5</band_width>
    <center_wavelength unit="nm">864.0</center_wavelength>
  </Band_Bin>

  <Band_Bin>
    <band_number>11</band_number>
    <band_width unit="nm">20.6</band_width>
    <center_wavelength unit="nm">880.9</center_wavelength>
  </Band_Bin>

  <Band_Bin>
    <band_number>12</band_number>
    <band_width unit="nm">20.6</band_width>
    <center_wavelength unit="nm">897.7</center_wavelength>
  </Band_Bin>

  <Band_Bin>
    <band_number>13</band_number>
    <band_width unit="nm">20.6</band_width>
    <center_wavelength unit="nm">914.6</center_wavelength>
  </Band_Bin>

  <Band_Bin>
    <band_number>14</band_number>
    <band_width unit="nm">20.7</band_width>
    <center_wavelength unit="nm">931.4</center_wavelength>
  </Band_Bin>

  <Band_Bin>
    <band_number>15</band_number>
```

```
    <band_width unit="nm">20.7</band_width>
    <center_wavelength unit="nm">948.3</center_wavelength>
  </Band_Bin>

  <Band_Bin>
    <band_number>16</band_number>
    <band_width unit="nm">20.8</band_width>
    <center_wavelength unit="nm">965.1</center_wavelength>
  </Band_Bin>

  <Band_Bin>
    <band_number>17</band_number>
    <band_width unit="nm">20.8</band_width>
    <center_wavelength unit="nm">982.0</center_wavelength>
  </Band_Bin>

  <Band_Bin>
    <band_number>18</band_number>
    <band_width unit="nm">20.9</band_width>
    <center_wavelength unit="nm">998.8</center_wavelength>
  </Band_Bin>

  <Band_Bin>
    <band_number>19</band_number>
    <band_width unit="nm">20.9</band_width>
    <center_wavelength unit="nm">1015.7</center_wavelength>
  </Band_Bin>

  <Band_Bin>
    <band_number>20</band_number>
    <band_width unit="nm">20.9</band_width>
    <center_wavelength unit="nm">1032.5</center_wavelength>
  </Band_Bin>

  <Band_Bin>
    <band_number>21</band_number>
    <band_width unit="nm">21.0</band_width>
    <center_wavelength unit="nm">1049.4</center_wavelength>
  </Band_Bin>

  <Band_Bin>
    <band_number>22</band_number>
    <band_width unit="nm">21.0</band_width>
    <center_wavelength unit="nm">1066.2</center_wavelength>
  </Band_Bin>

  <Band_Bin>
```

```
  <band_number>23</band_number>
  <band_width unit="nm">21.1</band_width>
  <center_wavelength unit="nm">1083.1</center_wavelength>
</Band_Bin>

<Band_Bin>
  <band_number>24</band_number>
  <band_width unit="nm">21.1</band_width>
  <center_wavelength unit="nm">1099.9</center_wavelength>
</Band_Bin>

<Band_Bin>
  <band_number>25</band_number>
  <band_width unit="nm">21.1</band_width>
  <center_wavelength unit="nm">1116.8</center_wavelength>
</Band_Bin>

<Band_Bin>
  <band_number>26</band_number>
  <band_width unit="nm">21.2</band_width>
  <center_wavelength unit="nm">1133.6</center_wavelength>
</Band_Bin>

<Band_Bin>
  <band_number>27</band_number>
  <band_width unit="nm">21.2</band_width>
  <center_wavelength unit="nm">1150.5</center_wavelength>
</Band_Bin>

<Band_Bin>
  <band_number>28</band_number>
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  <center_wavelength unit="nm">1167.3</center_wavelength>
</Band_Bin>

<Band_Bin>
  <band_number>29</band_number>
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  <center_wavelength unit="nm">1184.2</center_wavelength>
</Band_Bin>

<Band_Bin>
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  <center_wavelength unit="nm">1201.1</center_wavelength>
</Band_Bin>
```

```
<Band_Bin>
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</Band_Bin>

<Band_Bin>
  <band_number>32</band_number>
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  <center_wavelength unit="nm">1234.8</center_wavelength>
</Band_Bin>

<Band_Bin>
  <band_number>33</band_number>
  <band_width unit="nm">21.4</band_width>
  <center_wavelength unit="nm">1251.6</center_wavelength>
</Band_Bin>

<Band_Bin>
  <band_number>34</band_number>
  <band_width unit="nm">21.4</band_width>
  <center_wavelength unit="nm">1268.5</center_wavelength>
</Band_Bin>

<Band_Bin>
  <band_number>35</band_number>
  <band_width unit="nm">21.4</band_width>
  <center_wavelength unit="nm">1285.3</center_wavelength>
</Band_Bin>

<Band_Bin>
  <band_number>36</band_number>
  <band_width unit="nm">21.5</band_width>
  <center_wavelength unit="nm">1302.2</center_wavelength>
</Band_Bin>

<Band_Bin>
  <band_number>37</band_number>
  <band_width unit="nm">21.5</band_width>
  <center_wavelength unit="nm">1319.0</center_wavelength>
</Band_Bin>

<Band_Bin>
  <band_number>38</band_number>
  <band_width unit="nm">21.5</band_width>
  <center_wavelength unit="nm">1335.9</center_wavelength>
</Band_Bin>
```

```
<Band_Bin>
  <band_number>39</band_number>
  <band_width unit="nm">21.5</band_width>
  <center_wavelength unit="nm">1352.7</center_wavelength>
</Band_Bin>

<Band_Bin>
  <band_number>40</band_number>
  <band_width unit="nm">21.6</band_width>
  <center_wavelength unit="nm">1369.6</center_wavelength>
</Band_Bin>

<Band_Bin>
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</Band_Bin>

<Band_Bin>
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</Band_Bin>

<Band_Bin>
  <band_number>43</band_number>
  <band_width unit="nm">21.6</band_width>
  <center_wavelength unit="nm">1420.1</center_wavelength>
</Band_Bin>

<Band_Bin>
  <band_number>44</band_number>
  <band_width unit="nm">21.7</band_width>
  <center_wavelength unit="nm">1437.0</center_wavelength>
</Band_Bin>

<Band_Bin>
  <band_number>45</band_number>
  <band_width unit="nm">21.7</band_width>
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</Band_Bin>

<Band_Bin>
  <band_number>46</band_number>
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  <center_wavelength unit="nm">1470.7</center_wavelength>
```

```
</Band_Bin>

<Band_Bin>
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</Band_Bin>

<Band_Bin>
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  <band_width unit="nm">21.7</band_width>
  <center_wavelength unit="nm">1504.4</center_wavelength>
</Band_Bin>

<Band_Bin>
  <band_number>49</band_number>
  <band_width unit="nm">21.8</band_width>
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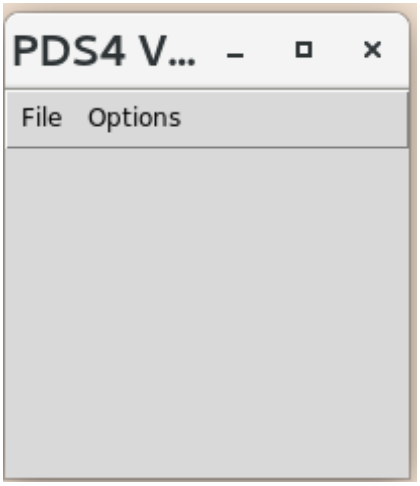
Note: All the filled values in the above xml fields are only indicative values.

Appendix-E: Visualize PDS4 Data Products using PDS4 Viewer

There are many PDS tools are available for opening the Raw/Calibrated Data products such as PDS4Viewer. PDS4Viewer is a simple display tool for visualizing data contained in the PDS4 data standard. PDS4Viewer tool can be downloaded from internet using link “http://sbndev.astro.umd.edu/wiki/PDS4_Viewer”. This Software is available for both Linux as well as window platform. The given data sets can be opened using PDS4Viewer.

The instructions to open the data using PDS4Viewer are as follows:

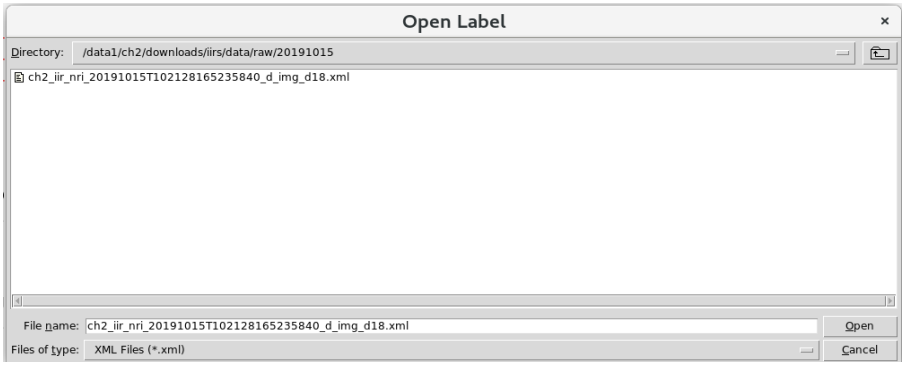
1. Download the PDS4Viewer tool from internet location “http://sbndev.astro.umd.edu/wiki/PDS4_Viewer”. There will be zip files (for both Linux/Windows) which contain the PDS4Viewer.
2. Extract the Zip file into any location.
3. Go to the extracted directory and run the pds4_viewer executable file. The PDS4Viewer GUI will come up on the screen, as shown below.



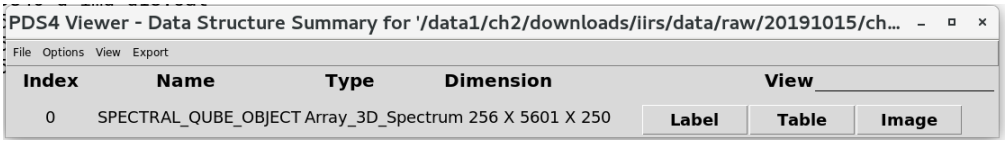
Opening PDS4 Raw/Calibrated Image Product

==========

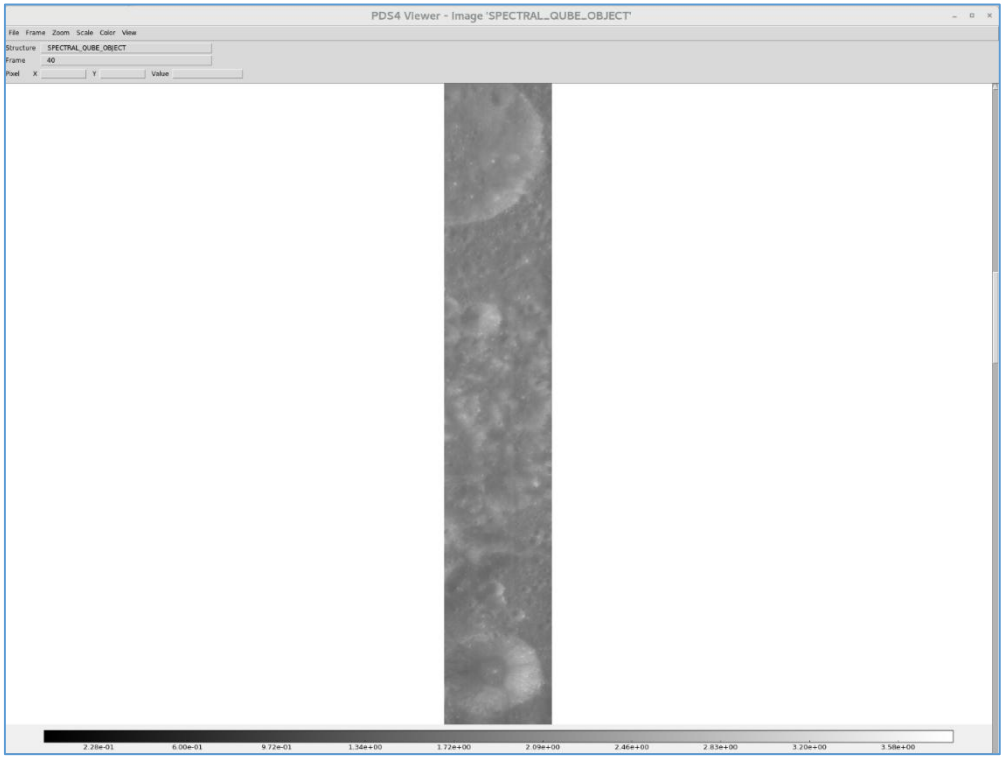
1. After opening the PDS4Viewer display tool. Click on the <File> menu and select <Open> object.
2. From the dialog box (shown below) and select a label file (xml file) and click <Open> button.



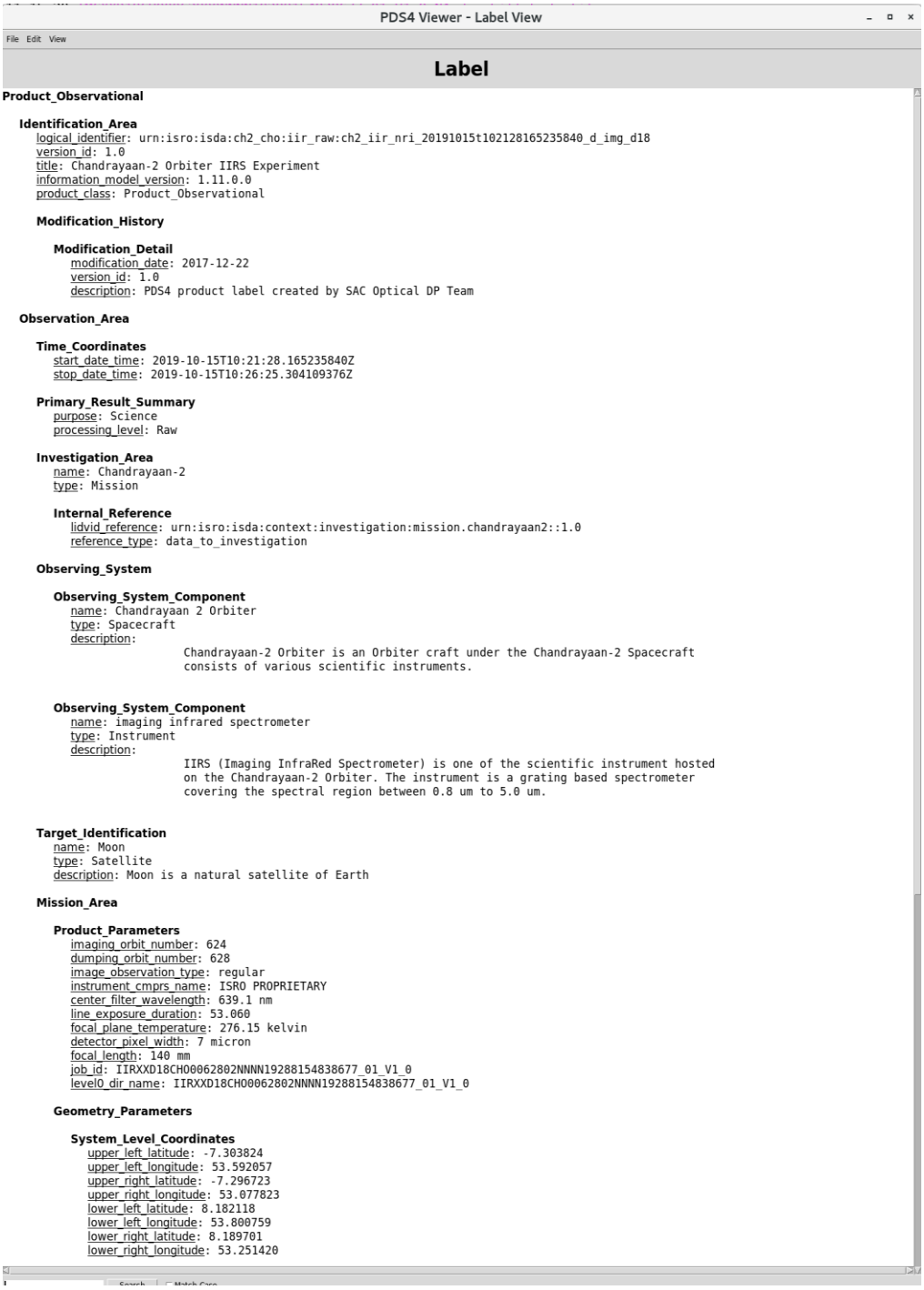
3. After clicking <Open> button, the data will be loaded in the PDS4Viewer as shown below:



4. For opening an image, click on the <Image> button as shown on the figure in step 3. The following figure shows the image from the IIRS payload data that will open.



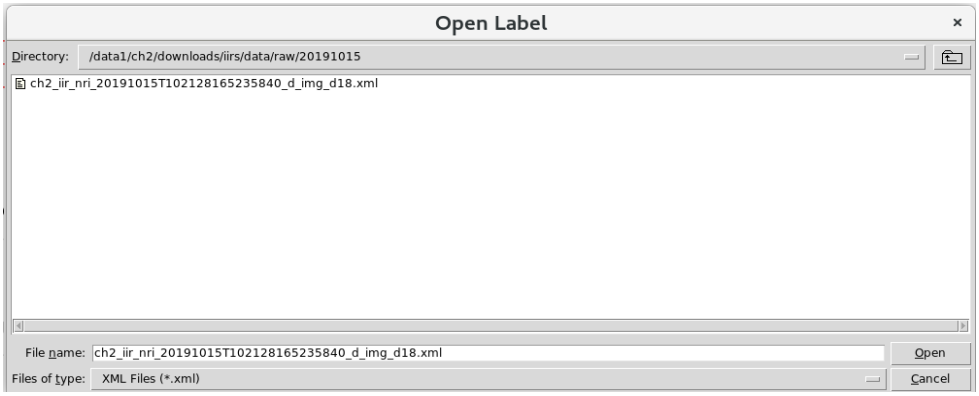
5. For opening a label, click on the <Label> button shown in step 3. The figures below show the label file as label view.



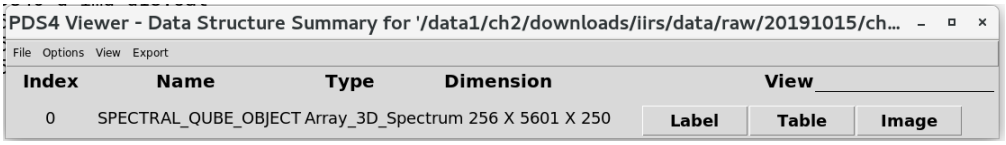
Opening PDS4 Geometry Grid Data Product

==========

1. After opening the PDS4Viewer display tool. Click on the <File> menu and select <Open> object.
2. From the dialog box (shown below) and select a label file (xml file) and click <Open> button.



3. After clicking <Open> button, the data will be loaded in the PDS4Viewer as shown below:



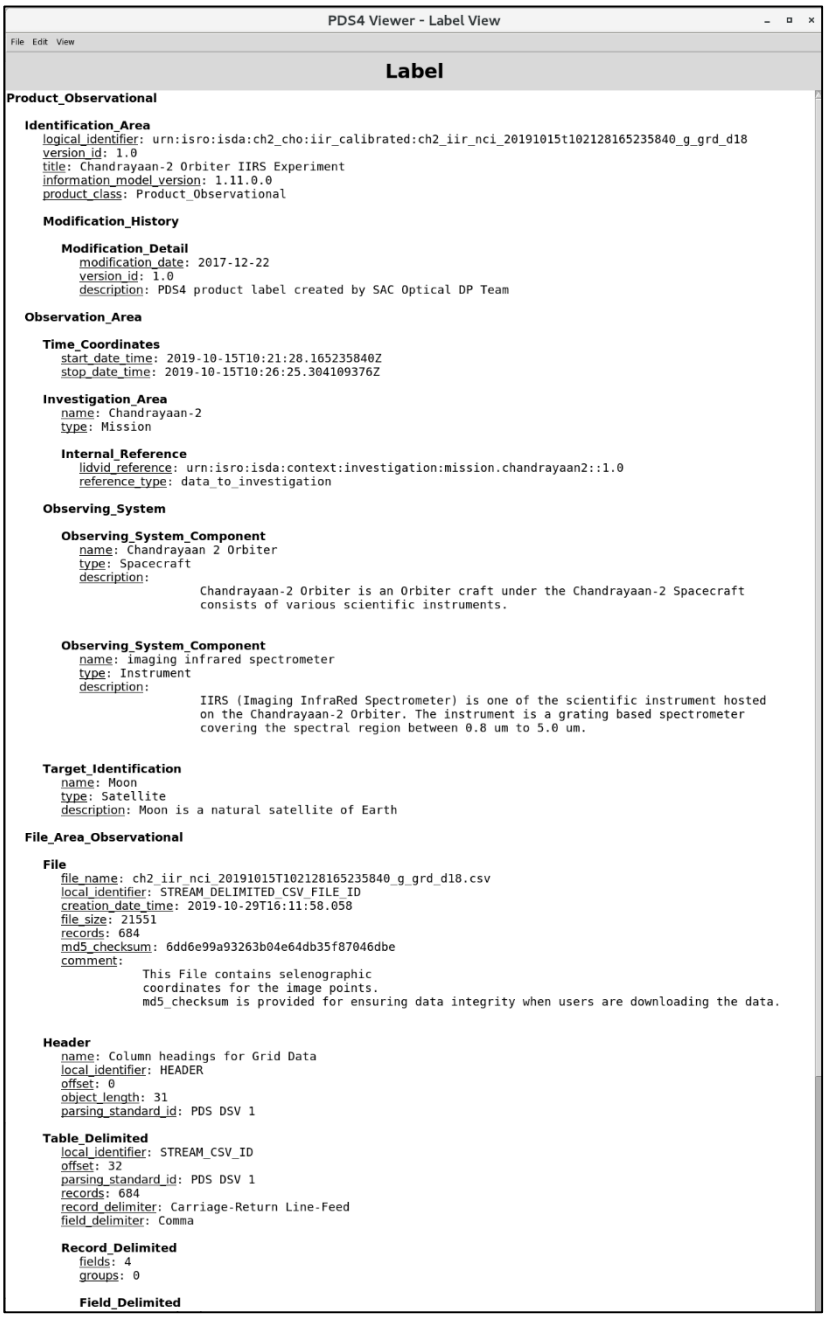
4. For opening grid file, click on the <Table> button shown on the figure in step 3. The figure below shows the grid file from the IIRS payload data.

PDS4 Viewer - Table 'STREAM_CSV_ID'

File Options View

Row #	Longitude	Latitude	Pixel	Scan
0	3.6217574	-7.5675971	0	0
1	53.5163493	-7.55992139	50	0
2	53.411094	-7.55223422	100	0
3	53.3059679	-7.54453395	150	0
4	53.2009473	-7.53681898	200	0
5	53.0981069	-7.52924245	249	0
6	53.6235564	-7.42892095	0	50
7	53.5181254	-7.42130806	50	50
8	53.4128471	-7.41368406	100	50
9	53.3076977	-7.40604733	150	50
10	53.2026537	-7.39839627	200	50
11	53.0997903	-7.39088274	249	50
12	53.6253525	-7.29025591	0	100
13	53.5198978	-7.28270594	50	100
14	53.4145957	-7.2751452	100	100
15	53.3094224	-7.26757209	150	100
16	53.2043543	-7.25998503	200	100
17	53.1014671	-7.25253461	249	100
18	53.6271487	-7.15159136	0	150
19	53.5216697	-7.14410444	50	150
20	53.4163431	-7.13660711	100	150
21	53.3111451	-7.12909778	150	150
22	53.2060522	-7.12157486	200	150
23	53.1031404	-7.11418767	249	150
24	53.6289464	-7.01292924	0	200
25	53.5234422	-7.00550537	50	200
26	53.4180904	-6.99807143	100	200
27	53.312867	-6.99062587	150	200
28	53.2077485	-6.98316709	200	200
29	53.1048114	-6.97584313	249	200
30	53.6307463	-6.87427746	0	250
31	53.5252163	-6.86691654	50	250
32	53.4198384	-6.8595459	100	250
33	53.3145889	-6.852164	150	250
34	53.2094441	-6.84476926	200	250
35	53.1064811	-6.83750844	249	250
36	53.6325472	-6.73563071	0	300
37	53.5269906	-6.72833283	50	300
38	53.421586	-6.7210256	100	300
39	53.3163096	-6.71370746	150	300
40	53.2111378	-6.70637687	200	300
41	53.1081481	-6.69917929	249	300
42	53.634347	-6.59698776	0	350
43	53.528763	-6.5897532	50	350
44	53.4233309	-6.58250964	100	350
45	53.3180269	-6.57525555	150	350
46	53.2128273	-6.56798937	200	350
47	53.1098103	-6.5608553	249	350
48	53.6361464	-6.45835938	0	400
49	53.5305343	-6.45118813	50	400
50	53.4250741	-6.44400825	100	400
51	53.3197417	-6.43681819	150	400
52	53.2145136	-6.42961643	200	400
53	53.1114684	-6.42254586	249	400
54	53.6379506	-6.31972941	0	450

5. For opening a label, click on the <Label> button shown in step 3. The figure below shows the label file as label view.



Appendix-F: Count to Radiance Conversion

The step wise procedure for converting image raw count to radiance is as follows:

(1) Dark Subtraction - Dark data (modelled dark) is subtracted from the raw image using following formula

Raw count = DN - Dark count

where,

DN is digital number which is raw image pixel value of raw image data,

Dark count is the modelled dark data,

Raw count is the value obtained when the dark data is subtracted from input raw data.

(2) LUT Correction - Look up table is applied to the Raw Count data using following formula

Radiance value = Raw count * multiplicative factor (gain) + offset

where,

Raw Count is the output obtained from step (1),

multiplicative factor (gain) is obtained from the Look up table,

offset is obtained from the Look up table,

Radiance Value is the output from above mentioned formula in physical units ($mWcm^{-2}sr^{-1}\mu m^{-1}$)

(3) Statistically derived destriping coefiicients are applied on the output data from step 2.

(4) Post processing

   a. Keystone correction
   b. Radiance adjustment in OSF regions (applied only in OSF)
   c. Radiance correction at start and end of the spectral regions

Note:

- Raw Count indicates the brightness of a pixel. The minimum Raw Count is 0 and maximum value depends upon number of bits defined for IIRS image i.e. 14-bit, which translates to the maximum value of 16383. Hence, Raw Count image pixel can take value between 0 and 16383 and there is no unit defined for Raw Count.
- LUT (Look up table) provides the multiplicative factor (gain) and offset to convert Raw Count to Radiance Count. The LUT file is kept in the calibration directory.
- **Table 26** containing information about saturation radiance and dynamic range. These values are also available in the calibration directory.

- SR stands for Saturation Radiance. Min_SR and Max_SR are the minimum and maximum saturation radiances, respectively.
    - For a given Exposure and Gain combination where payload cannot be operated in its nominal condition, then the value for the Max_SR is set as no value and it is indicated as -9999.
- Minimum saturation radiance value is always set to 0.
- IIRS has two gains (G1, G2) and four exposures (E1, E2, E3, E4) settings. G2 is the preffered gain setting. For any particular combination of exposure & gain value, the maximum saturation radiance and dynamic range values can be obtained from the **Table 26**, for all the bands.

Table 26. IIRS saturation radiance information

	E1G2		E2G2		E3G2		E4G2	
Band	**Max_SR**	**Dynamic Range**	**Max_SR**	**Dynamic Range**	**Max_SR**	**Dynamic Range**	**Max_SR**	**Dynamic Range**
1	4722.73	15136.48	1598.28	14202.43	350.77	10951.32	83.59	5783.26
2	4530.20	15120.57	1529.92	14159.74	332.58	10842.34	74.40	5560.48
3	4403.88	15105.90	1490.02	14145.96	323.80	10828.35	74.07	5544.90
4	3077.71	15119.70	1026.34	14141.00	222.31	10758.26	48.31	5365.94
5	1147.56	15064.18	358.95	14073.71	79.26	10689.59	16.99	5326.91
6	803.86	15110.79	248.94	14119.18	55.07	10691.84	11.56	5236.09
7	644.71	15064.89	198.63	14077.32	44.14	10663.92	9.75	5228.68
8	472.66	15100.79	145.97	14080.60	32.46	10616.85	6.48	5111.06
9	360.11	15089.17	110.71	14089.56	24.56	10633.01	4.92	5130.12
10	306.61	15104.29	94.33	14094.85	20.94	10606.81	4.21	5054.63
11	252.82	15088.78	77.70	14085.26	17.32	10617.76	3.49	5106.38
12	218.10	15101.10	66.99	14084.05	14.91	10576.01	3.06	5022.56
13	201.43	15103.78	62.73	14093.84	14.01	10640.00	2.94	5140.67
14	184.76	15106.46	56.67	14096.92	12.62	10607.39	2.68	5059.44
15	172.14	15094.20	52.83	14091.04	11.86	10640.20	2.64	5170.74
16	157.64	15109.13	48.44	14105.12	10.81	10634.31	2.24	5114.98
17	157.15	15097.70	48.32	14104.81	10.79	10673.10	2.23	5209.70
18	158.13	15075.30	48.46	14067.28	10.85	10614.74	2.23	5146.36
19	150.21	15102.64	46.01	14117.67	10.32	10712.97	2.23	5290.26
20	133.81	15110.71	41.11	14110.72	9.44	10671.91	1.98	5228.43
21	128.00	15108.46	39.33	14132.26	9.07	10758.21	1.93	5384.26
22	120.24	15124.09	36.98	14143.07	8.49	10753.68	1.85	5356.58
23	118.35	15110.00	36.41	14140.05	8.36	10788.28	1.83	5448.40
24	118.63	15127.35	36.36	14153.15	8.39	10786.97	1.84	5422.54
25	114.89	15054.39	35.36	14095.22	8.13	10781.85	1.81	5502.79
26	113.69	15127.62	34.86	14153.67	8.09	10792.02	1.78	5471.22
27	110.68	15115.71	33.93	14153.92	7.83	10832.11	1.75	5539.37

	E1G2		E2G2		E3G2		E4G2	
28	123.56	15094.80	37.84	14118.54	8.70	10747.27	1.86	5376.70
29	225.82	15059.54	70.07	14077.19	16.30	10719.38	3.62	5368.40
30	821.75	15110.88	258.49	14108.24	58.75	10645.97	9.64	5130.19
31	720.44	15090.30	223.75	14079.68	48.96	10589.37	9.89	5041.10
32	494.43	15097.72	152.54	14064.34	33.14	10496.27	6.60	4810.12
33	342.48	15077.61	105.17	14040.48	22.81	10458.32	4.27	4749.14
34	224.78	15088.03	69.20	14029.89	14.89	10375.27	2.72	4552.49
35	155.94	15036.62	47.75	13975.29	10.31	10307.82	1.86	4463.45
36	115.91	15038.89	35.35	13950.08	7.73	10189.10	1.36	4226.49
37	92.03	15048.13	28.02	13955.30	6.02	10178.52	-9999	16384.00
38	69.57	15058.13	21.22	13940.36	4.52	10078.37	-9999	16384.00
39	58.65	15007.08	17.86	13886.23	3.83	10012.42	-9999	16384.00
40	52.06	15041.32	15.81	13893.60	3.35	9926.88	-9999	16384.00
41	46.75	15020.36	14.25	13864.73	2.99	9870.74	-9999	16384.00
42	42.94	14994.46	13.01	13812.64	2.70	9729.94	-9999	16384.00
43	40.75	15006.30	12.32	13815.70	2.55	9702.31	-9999	16384.00
44	37.86	15010.62	11.42	13794.42	2.35	9591.47	-9999	16384.00
45	35.33	14968.80	10.68	13740.03	2.19	9519.66	-9999	16384.00
46	34.55	14994.90	10.37	13743.87	2.10	9420.21	-9999	16384.00
47	35.47	14974.40	10.66	13718.11	2.16	9373.96	-9999	16384.00
48	34.53	14975.60	10.35	13688.59	2.06	9240.18	-9999	16384.00
49	34.27	14926.80	10.28	13634.01	2.05	9166.32	-9999	16384.00
50	33.85	14960.07	10.14	13638.00	2.00	9068.30	-9999	16384.00
51	32.68	14938.36	9.75	13610.32	1.91	9021.87	-9999	16384.00
52	31.82	14946.32	9.49	13590.79	1.84	8907.83	-9999	16384.00
53	31.38	14922.24	9.34	13558.52	1.81	8846.54	-9999	16384.00
54	30.74	14928.94	9.14	13538.40	1.75	8732.80	-9999	16384.00
55	30.90	14904.42	9.18	13506.98	1.75	8676.89	-9999	16384.00
56	30.62	14911.25	9.08	13487.10	1.70	8566.63	-9999	16384.00
57	30.96	14859.79	9.18	13436.28	1.72	8514.53	-9999	16384.00
58	30.68	14863.76	9.07	13409.68	1.68	8383.42	-9999	16384.00
59	30.15	14816.89	8.92	13364.18	1.64	8341.78	-9999	16384.00
60	30.82	14882.28	9.12	13396.44	1.66	8261.18	-9999	16384.00
61	31.06	14861.63	9.17	13373.89	1.66	8230.32	-9999	16384.00
62	30.24	14867.73	8.93	13354.08	1.59	8122.94	-9999	16384.00
63	31.26	14849.88	9.20	13337.47	1.64	8109.28	-9999	16384.00
64	32.14	14858.62	9.46	13326.17	1.67	8029.35	-9999	16384.00
65	33.26	14814.24	9.80	13293.04	1.73	8033.44	-9999	16384.00
66	35.29	14855.56	10.40	13315.78	1.81	7992.64	-9999	16384.00
67	38.34	14842.31	11.31	13313.39	1.97	8025.75	-9999	16384.00

	E1G2		E2G2		E3G2		E4G2	
68	46.25	14851.65	13.64	13307.33	2.45	7968.11	-9999	16384.00
69	50.47	14838.12	14.90	13300.98	2.61	7985.60	-9999	16384.00
70	67.18	14788.83	19.95	13241.10	3.46	7891.09	-9999	16384.00
71	104.58	14804.88	31.28	13261.78	5.37	7928.14	-9999	16384.00
72	120.34	14786.63	36.01	13238.52	6.15	7886.12	-9999	16384.00
73	89.76	14809.49	26.79	13275.28	4.63	7970.31	-9999	16384.00
74	72.27	14854.38	21.51	13312.47	3.75	7981.58	-9999	16384.00
75	62.04	14801.05	18.47	13274.01	3.24	8024.30	-9999	16384.00
76	56.54	14852.20	16.75	13307.82	2.94	8038.59	-9999	16384.00
77	50.58	14853.71	14.97	13349.06	2.65	8146.72	-9999	16384.00
78	45.04	14842.52	13.34	13336.82	2.37	8133.23	-9999	16384.00
79	40.59	14860.34	12.04	13374.45	2.17	8238.09	-9999	16384.00
80	36.50	14877.86	10.81	13387.92	1.94	8237.32	-9999	16384.00
81	33.86	14872.75	10.03	13405.58	1.83	8332.09	-9999	16384.00
82	31.73	14875.12	9.42	13383.58	1.71	8294.89	-9999	16384.00
83	31.17	14856.05	9.28	13379.68	1.70	8385.31	-9999	16384.00
84	31.20	14856.19	9.27	13390.09	1.72	8393.59	-9999	16384.00
85	31.69	14860.58	9.42	13435.09	1.75	8504.31	-9999	16384.00
86	31.26	14880.72	9.31	13452.88	1.74	8516.53	-9999	16384.00
87	30.57	14901.75	9.11	13493.76	1.71	8624.48	-9999	16384.00
88	29.45	14886.72	8.77	13479.17	1.65	8613.22	-9999	16384.00
89	28.80	14909.12	8.60	13520.02	1.63	8714.67	-9999	16384.00
90	28.70	14866.77	8.56	13480.39	1.63	8688.22	-9999	16384.00
91	29.02	14884.24	8.67	13514.41	1.67	8788.01	-9999	16384.00
92	28.83	14909.07	8.61	13544.91	1.66	8827.40	-9999	16384.00
93	28.95	14930.64	8.69	13585.06	1.69	8929.72	-9999	16384.00
94	28.21	14922.61	8.50	13590.28	1.66	8983.50	-9999	16384.00
95	28.61	14912.15	8.61	13597.94	1.71	9080.90	-9999	16384.00
96	28.93	14934.79	8.73	13624.97	1.72	9094.75	-9999	16384.00
97	28.32	14949.32	8.54	13645.93	1.69	9136.65	-9999	16384.00
98	27.07	14930.84	8.16	13611.48	1.60	9048.55	-9999	16384.00
99	26.36	14912.50	7.95	13595.74	1.56	9041.08	-9999	16384.00
100	27.02	14903.87	8.15	13554.44	1.58	8931.45	-9999	16384.00
101	26.28	14931.70	7.92	13588.83	1.54	8944.14	-9999	16384.00
102	26.76	14937.17	8.06	13568.73	1.55	8834.70	-9999	16384.00
103	26.48	14918.53	7.98	13551.08	1.53	8821.54	-9999	16384.00
104	27.34	14926.01	8.25	13534.00	1.57	8720.79	-9999	16384.00
105	26.78	14906.28	8.08	13512.90	1.54	8692.89	-9999	16384.00
106	26.57	14913.12	8.54	13492.56	1.59	8581.84	-9999	16384.00
107	26.35	14919.97	8.60	13446.54	1.61	8548.36	-9999	16384.00

	E1G2		E2G2		E3G2		E4G2	
108	26.13	14926.81	8.62	13416.70	1.60	8439.32	-9999	16384.00
109	25.92	14933.65	8.95	13439.24	1.66	8444.56	-9999	16384.00
110	25.70	14940.50	9.37	13393.23	1.73	8322.71	-9999	16384.00
111	25.49	14947.34	10.18	13396.70	1.89	8309.50	-9999	16384.00
112	25.27	14954.19	10.37	13379.86	1.89	8209.71	-9999	16384.00
113	25.05	14961.03	10.30	13415.54	1.87	8332.79	-9999	16384.00
114	24.84	14967.88	10.22	13451.22	1.85	8455.87	-9999	16384.00
115	24.62	14974.72	10.15	13486.90	1.83	8578.95	-9999	16384.00
116	24.40	14981.56	10.08	13522.59	1.81	8702.02	-9999	16384.00
117	24.19	14988.41	10.01	13558.27	1.78	8825.10	-9999	16384.00
118	23.97	14995.25	9.93	13593.95	1.76	8948.18	-9999	16384.00
119	23.75	15002.10	9.86	13629.63	1.74	9071.26	-9999	16384.00
120	23.54	15008.94	9.79	13665.31	1.72	9194.34	-9999	16384.00
121	23.32	15015.79	9.71	13700.99	1.70	9317.41	0.10	6927.45
122	23.11	15022.63	9.64	13736.67	1.67	9440.49	0.10	6953.22
123	22.89	15029.47	9.57	13772.36	1.65	9563.57	0.11	7037.16
124	22.67	15036.32	9.50	13808.04	1.63	9686.65	0.12	7047.27
125	22.46	15043.16	9.42	13843.72	1.61	9809.73	0.13	7174.38
126	22.24	15050.01	9.35	13879.40	1.59	9932.80	0.13	7229.71
127	22.02	15056.85	9.28	13915.08	1.57	10055.88	0.14	7320.82
128	21.81	15063.70	9.20	13950.76	1.54	10178.96	0.15	7369.10
129	21.59	15070.54	9.13	13986.44	1.52	10302.04	0.16	7453.47
130	21.38	15077.38	9.06	14022.13	1.50	10425.12	0.17	7492.57
131	21.16	15084.23	8.99	14057.81	1.48	10548.20	0.18	7590.24
132	20.94	15091.07	8.91	14093.49	1.46	10671.27	0.19	7626.20
133	20.73	15097.92	8.84	14129.17	1.43	10794.35	0.20	7738.53
134	20.51	15104.76	8.77	14164.85	1.41	10917.43	0.21	7741.76
135	20.29	15111.61	8.69	14200.53	1.39	11040.51	0.23	7865.60
136	20.08	15118.45	8.62	14236.21	1.37	11163.59	0.23	7893.86
137	19.86	15125.29	8.55	14271.89	1.35	11286.66	0.25	7987.95
138	19.64	15132.14	8.48	14307.58	1.32	11409.74	0.26	8004.80
139	19.43	15138.98	8.40	14343.26	1.30	11532.82	0.27	8016.56
140	19.21	15145.83	8.33	14378.94	1.28	11655.90	0.28	7973.50
141	19.00	15152.67	8.26	14414.62	1.26	11778.98	0.28	7864.86
142	19.07	15180.20	8.40	14403.14	1.26	11628.00	0.27	7500.23
143	19.60	15132.26	8.27	14296.34	1.22	11311.77	0.24	6857.66
144	18.62	15101.67	8.37	14165.76	1.15	10828.75	0.20	5847.56
145	19.56	15019.33	8.42	14007.88	1.10	10406.40	0.18	4996.78
146	19.46	15017.53	8.30	13908.56	1.05	9976.39	-9999	16384.00
147	19.64	14960.22	8.16	13769.42	1.00	9537.36	-9999	16384.00

	E1G2		E2G2		E3G2		E4G2	
148	18.92	14927.13	8.15	13629.52	0.93	9024.10	-9999	16384.00
149	19.01	14851.40	8.01	13424.16	0.87	8509.80	-9999	16384.00
150	19.06	14821.84	7.75	13311.28	0.80	7952.72	-9999	16384.00
151	18.80	14753.51	7.81	13137.54	-9999	16384.00	-9999	16384.00
152	18.54	14675.17	7.62	12927.28	-9999	16384.00	-9999	16384.00
153	18.29	14590.76	7.49	12713.90	-9999	16384.00	-9999	16384.00
154	18.60	14546.68	7.35	12539.84	-9999	16384.00	-9999	16384.00
155	19.00	14468.17	7.42	12332.00	-9999	16384.00	-9999	16384.00
156	19.17	14434.40	7.69	12131.74	-9999	16384.00	-9999	16384.00
157	19.80	14321.75	8.03	11885.61	-9999	16384.00	-9999	16384.00
158	20.30	14248.83	8.12	11626.48	-9999	16384.00	-9999	16384.00
159	20.67	14153.27	8.38	11374.91	-9999	16384.00	-9999	16384.00
160	20.94	14077.62	8.52	11105.99	-9999	16384.00	-9999	16384.00
161	20.92	13967.56	8.65	10815.89	-9999	16384.00	-9999	16384.00
162	20.93	13901.95	8.56	10574.40	-9999	16384.00	-9999	16384.00
163	21.12	13835.84	8.36	10344.04	-9999	16384.00	-9999	16384.00
164	21.26	13752.48	7.98	10054.40	-9999	16384.00	-9999	16384.00
165	21.11	13664.97	7.56	9823.96	-9999	16384.00	-9999	16384.00
166	21.04	13573.37	6.91	9537.78	-9999	16384.00	-9999	16384.00
167	20.88	13488.54	7.24	9348.44	-9999	16384.00	-9999	16384.00
168	20.03	13412.09	7.00	9097.49	-9999	16384.00	-9999	16384.00
169	19.98	13361.90	6.66	8958.01	-9999	16384.00	-9999	16384.00
170	19.42	13329.13	6.25	8765.75	-9999	16384.00	-9999	16384.00
171	19.19	13278.45	6.07	8645.80	-9999	16384.00	-9999	16384.00
172	18.85	13159.26	5.72	8376.16	-9999	16384.00	-9999	16384.00
173	18.69	13154.03	5.49	8262.05	-9999	16384.00	-9999	16384.00
174	18.31	13068.24	5.25	8033.84	-9999	16384.00	-9999	16384.00
175	18.07	13031.52	5.06	7891.12	-9999	16384.00	-9999	16384.00
176	17.74	12971.42	4.77	7677.20	-9999	16384.00	-9999	16384.00
177	17.32	12910.30	4.61	7523.26	-9999	16384.00	-9999	16384.00
178	17.04	12817.58	4.33	7267.08	-9999	16384.00	-9999	16384.00
179	17.17	12780.37	4.18	7130.48	-9999	16384.00	-9999	16384.00
180	16.78	12720.22	3.95	6912.59	-9999	16384.00	-9999	16384.00
181	16.74	12668.01	3.88	6779.81	-9999	16384.00	-9999	16384.00
182	16.40	12613.56	3.70	6584.42	-9999	16384.00	-9999	16384.00
183	16.60	12533.97	3.67	6457.51	-9999	16384.00	-9999	16384.00
184	16.71	12509.86	3.51	6273.94	-9999	16384.00	-9999	16384.00
185	16.70	12442.67	3.48	6164.96	-9999	16384.00	-9999	16384.00
186	16.63	12412.82	3.33	5975.98	-9999	16384.00	-9999	16384.00
187	17.12	12315.59	3.31	5843.21	-9999	16384.00	-9999	16384.00

	E1G2		E2G2		E3G2		E4G2	
188	16.93	12308.98	3.14	5664.42	-9999	16384.00	-9999	16384.00
189	17.20	12251.24	3.13	5585.38	-9999	16384.00	-9999	16384.00
190	17.22	12231.96	3.02	5434.46	-9999	16384.00	-9999	16384.00
191	17.44	12198.09	3.02	5362.88	-9999	16384.00	-9999	16384.00
192	17.26	12155.29	2.91	5199.94	-9999	16384.00	-9999	16384.00
193	17.70	12126.80	2.93	5146.34	-9999	16384.00	-9999	16384.00
194	17.70	12088.23	2.81	4996.35	-9999	16384.00	-9999	16384.00
195	17.77	12072.48	2.81	4978.14	-9999	16384.00	-9999	16384.00
196	17.55	12025.26	2.67	4808.40	-9999	16384.00	-9999	16384.00
197	17.90	12009.06	2.69	4788.51	-9999	16384.00	-9999	16384.00
198	17.77	11928.70	2.58	4638.59	-9999	16384.00	-9999	16384.00
199	18.15	11845.99	2.62	4582.97	-9999	16384.00	-9999	16384.00
200	18.17	11920.51	2.53	4496.71	-9999	16384.00	-9999	16384.00
201	18.52	11911.53	2.54	4493.96	-9999	16384.00	-9999	16384.00
202	18.57	11879.59	2.45	4368.70	-9999	16384.00	-9999	16384.00
203	18.83	11870.62	2.49	4371.49	-9999	16384.00	-9999	16384.00
204	18.83	11841.52	2.39	4247.82	-9999	16384.00	-9999	16384.00
205	19.18	11812.84	2.44	4254.83	-9999	16384.00	-9999	16384.00
206	19.16	11806.44	2.33	4142.50	-9999	16384.00	-9999	16384.00
207	19.50	11801.26	2.40	4160.76	-9999	16384.00	-9999	16384.00
208	19.53	11744.04	2.33	4041.97	-9999	16384.00	-9999	16384.00
209	19.72	11767.50	2.38	4066.97	-9999	16384.00	-9999	16384.00
210	19.71	11713.38	2.28	3944.81	-9999	16384.00	-9999	16384.00
211	20.06	11745.00	2.32	3992.69	-9999	16384.00	-9999	16384.00
212	20.11	11684.30	2.20	3842.89	-9999	16384.00	-9999	16384.00
213	20.41	11706.40	2.27	3873.54	-9999	16384.00	-9999	16384.00
214	20.31	11680.10	2.15	3765.96	-9999	16384.00	-9999	16384.00
215	20.71	11682.02	2.23	3802.39	-9999	16384.00	-9999	16384.00
216	20.58	11651.65	2.13	3685.08	-9999	16384.00	-9999	16384.00
217	20.97	11654.33	2.21	3724.62	-9999	16384.00	-9999	16384.00
218	21.03	11625.12	2.12	3609.24	-9999	16384.00	-9999	16384.00
219	21.48	11623.86	2.21	3657.72	-9999	16384.00	-9999	16384.00
220	21.53	11612.07	2.12	3565.77	-9999	16384.00	-9999	16384.00
221	21.98	11616.66	2.20	3610.09	-9999	16384.00	-9999	16384.00
222	22.03	11599.49	2.12	3526.94	-9999	16384.00	-9999	16384.00
223	22.23	11604.59	2.19	3574.12	-9999	16384.00	-9999	16384.00
224	22.26	11568.53	2.09	3498.22	-9999	16384.00	-9999	16384.00
225	22.66	11551.78	2.20	3538.58	-9999	16384.00	-9999	16384.00
226	22.59	11556.16	2.12	3461.64	-9999	16384.00	-9999	16384.00
227	22.97	11582.71	2.21	3517.74	-9999	16384.00	-9999	16384.00

	E1G2		E2G2		E3G2		E4G2	
228	23.18	11580.67	2.18	3470.28	-9999	16384.00	-9999	16384.00
229	23.73	11586.04	2.30	3519.63	-9999	16384.00	-9999	16384.00
230	23.79	11544.81	2.25	3432.95	-9999	16384.00	-9999	16384.00
231	24.43	11586.38	2.38	3523.66	-9999	16384.00	-9999	16384.00
232	24.45	11572.72	2.32	3451.33	-9999	16384.00	-9999	16384.00
233	25.14	11564.38	2.46	3518.94	-9999	16384.00	-9999	16384.00
234	25.26	11579.47	2.41	3471.23	-9999	16384.00	-9999	16384.00
235	25.86	11592.04	2.56	3545.81	-9999	16384.00	-9999	16384.00
236	26.02	11564.75	2.52	3487.20	-9999	16384.00	-9999	16384.00
237	26.63	11582.70	2.65	3574.67	-9999	16384.00	-9999	16384.00
238	26.50	11604.76	2.59	3547.24	-9999	16384.00	-9999	16384.00
239	26.61	11598.13	2.72	3631.03	-9999	16384.00	-9999	16384.00
240	26.48	11629.76	2.63	3626.98	-9999	16384.00	-9999	16384.00
241	27.08	11647.12	2.79	3711.20	-9999	16384.00	-9999	16384.00
242	27.14	11649.91	2.75	3690.39	-9999	16384.00	-9999	16384.00
243	27.54	11669.86	2.91	3789.41	-9999	16384.00	-9999	16384.00
244	27.49	11675.70	2.89	3770.93	-9999	16384.00	-9999	16384.00
245	28.05	11697.04	3.09	3864.29	-9999	16384.00	-9999	16384.00
246	28.64	11708.54	3.09	3839.74	-9999	16384.00	-9999	16384.00
247	29.31	11681.96	3.30	3930.16	-9999	16384.00	-9999	16384.00
248	29.89	11726.86	3.40	3942.37	-9999	16384.00	-9999	16384.00
249	31.18	11746.32	3.77	4083.76	-9999	16384.00	-9999	16384.00
250	32.30	11753.39	3.92	4064.63	-9999	16384.00	-9999	16384.00
251	33.70	11775.67	4.34	4167.34	-9999	16384.00	-9999	16384.00
252	34.75	11780.06	4.42	4151.44	-9999	16384.00	-9999	16384.00
253	36.65	11779.59	4.91	4242.14	-9999	16384.00	-9999	16384.00
254	43.83	11780.20	6.48	4212.65	-9999	16384.00	-9999	16384.00
255	51.68	11831.02	8.31	4334.84	-9999	16384.00	-9999	16384.00
256	52.33	11810.95	5.28	4305.32	-9999	16384.00	-9999	16384.00

Appendix-G: Central Wavelengths for IIRS bands

Table 27 shows central wavelength and band width for all the bands of IIRS.

Table 27. IIRS central wavelength and band width

Band number	Center wavelength (nm)	Band width (nm)
1	712.3	19.8
2	729.2	19.9
3	746	20
4	762.9	20.1
5	779.7	20.2
6	796.6	20.3
7	813.4	20.4
8	830.3	20.4
9	847.2	20.5
10	864	20.5
11	880.9	20.6
12	897.7	20.6
13	914.6	20.6
14	931.4	20.7
15	948.3	20.7
16	965.1	20.8
17	982	20.8
18	998.8	20.9
19	1015.7	20.9
20	1032.5	20.9
21	1049.4	21
22	1066.2	21
23	1083.1	21.1
24	1099.9	21.1
25	1116.8	21.1
26	1133.6	21.2
27	1150.5	21.2
28	1167.3	21.2
29	1184.2	21.3
30	1201.1	21.3
31	1217.9	21.3
32	1234.8	21.4
33	1251.6	21.4
34	1268.5	21.4
35	1285.3	21.4
36	1302.2	21.5
37	1319	21.5
38	1335.9	21.5
39	1352.7	21.5

Band number	Center wavelength (nm)	Band width (nm)
40	1369.6	21.6
41	1386.4	21.6
42	1403.3	21.6
43	1420.1	21.6
44	1437	21.7
45	1453.8	21.7
46	1470.7	21.7
47	1487.5	21.7
48	1504.4	21.7
49	1521.2	21.8
50	1538.1	21.8
51	1555	21.8
52	1571.8	21.8
53	1588.7	21.8
54	1605.5	21.8
55	1622.4	21.9
56	1639.2	21.9
57	1656.1	21.9
58	1672.9	21.9
59	1689.8	21.9
60	1706.6	21.9
61	1723.5	21.9
62	1740.3	21.9
63	1757.2	22
64	1774	22
65	1790.9	22
66	1807.7	22
67	1824.6	22
68	1841.4	22
69	1858.3	22
70	1875.1	22
71	1892	22
72	1908.9	22
73	1925.7	22
74	1942.6	22
75	1959.4	22
76	1976.3	22
77	1993.1	22
78	2010	22
79	2026.8	22
80	2043.7	22
81	2060.5	22.1
82	2077.4	22.1
83	2094.2	22.1

Band number	Center wavelength (nm)	Band width (nm)
84	2111.1	22.1
85	2127.9	22.1
86	2144.8	22.1
87	2161.6	22.1
88	2178.5	22.1
89	2195.3	22.1
90	2212.2	22.1
91	2229	22.1
92	2245.9	22
93	2262.8	22
94	2279.6	22
95	2296.5	22
96	2313.3	22
97	2330.2	22
98	2347	22
99	2363.9	22
100	2380.7	22
101	2397.6	22
102	2414.4	22
103	2431.3	22
104	2448.1	22
105	2465	22
106	2481.8	22
107	2498.7	22
108	2515.5	22
109	2532.4	22
110	2549.2	22
111	2566.1	22
112	2582.9	22
113	2599.8	22
114	2616.7	22
115	2633.5	21.9
116	2650.4	21.9
117	2667.2	21.9
118	2684.1	21.9
119	2700.9	21.9
120	2717.8	21.9
121	2734.6	21.9
122	2751.5	21.9
123	2768.3	21.9
124	2785.2	21.9
125	2802	21.9
126	2818.9	21.9
127	2835.7	21.9

Band number	Center wavelength (nm)	Band width (nm)
128	2852.6	21.9
129	2869.4	21.8
130	2886.3	21.8
131	2903.1	21.8
132	2920	21.8
133	2936.8	21.8
134	2953.7	21.8
135	2970.6	21.8
136	2987.4	21.8
137	3004.3	21.8
138	3021.1	21.8
139	3038	21.8
140	3054.8	21.8
141	3071.7	21.8
142	3088.5	21.8
143	3105.4	21.8
144	3122.2	21.7
145	3139.1	21.7
146	3155.9	21.7
147	3172.8	21.7
148	3189.6	21.7
149	3206.5	21.7
150	3223.3	21.7
151	3240.2	21.7
152	3257	21.7
153	3273.9	21.7
154	3290.7	21.7
155	3307.6	21.7
156	3324.5	21.7
157	3341.3	21.7
158	3358.2	21.7
159	3375	21.7
160	3391.9	21.7
161	3408.7	21.7
162	3425.6	21.7
163	3442.4	21.7
164	3459.3	21.7
165	3476.1	21.7
166	3493	21.7
167	3509.8	21.7
168	3526.7	21.7
169	3543.5	21.7
170	3560.4	21.7
171	3577.2	21.7

Band number	Center wavelength (nm)	Band width (nm)
172	3594.1	21.7
173	3610.9	21.7
174	3627.8	21.7
175	3644.6	21.7
176	3661.5	21.7
177	3678.3	21.7
178	3695.2	21.7
179	3712.1	21.7
180	3728.9	21.7
181	3745.8	21.7
182	3762.6	21.7
183	3779.5	21.7
184	3796.3	21.7
185	3813.2	21.7
186	3830	21.7
187	3846.9	21.7
188	3863.7	21.7
189	3880.6	21.7
190	3897.4	21.7
191	3914.3	21.7
192	3931.1	21.7
193	3948	21.8
194	3964.8	21.8
195	3981.7	21.8
196	3998.5	21.8
197	4015.4	21.8
198	4032.2	21.8
199	4049.1	21.8
200	4066	21.8
201	4082.8	21.9
202	4099.7	21.9
203	4116.5	21.9
204	4133.4	21.9
205	4150.2	21.9
206	4167.1	21.9
207	4183.9	22
208	4200.8	22
209	4217.6	22
210	4234.5	22
211	4251.3	22
212	4268.2	22
213	4285	22.1
214	4301.9	22.1
215	4318.7	22.1

Band number	Center wavelength (nm)	Band width (nm)
216	4335.6	22.1
217	4352.4	22.2
218	4369.3	22.2
219	4386.1	22.2
220	4403	22.2
221	4419.9	22.3
222	4436.7	22.3
223	4453.6	22.3
224	4470.4	22.4
225	4487.3	22.4
226	4504.1	22.4
227	4521	22.4
228	4537.8	22.5
229	4554.7	22.5
230	4571.5	22.5
231	4588.4	22.6
232	4605.2	22.6
233	4622.1	22.7
234	4638.9	22.7
235	4655.8	22.7
236	4672.6	22.8
237	4689.5	22.8
238	4706.3	22.8
239	4723.2	22.9
240	4740	22.9
241	4756.9	23
242	4773.8	23
243	4790.6	23.1
244	4807.5	23.1
245	4824.3	23.2
246	4841.2	23.2
247	4858	23.3
248	4874.9	23.3
249	4891.7	23.4
250	4908.6	23.4
251	4925.4	23.5
252	4942.3	23.5
253	4959.1	23.6
254	4976	23.6
255	4992.8	23.7
256	5009.7	23.8

* Out of the 256 bands, band numbers 1 to 5 and 256 have very low radiometric response, thus, their use is not recommended. As per design 250 bands corresponds to intended wavelength range of around 0.8 – 5 µm.

Appendix-H: Bands Validity List

There are two tables in this appendix. **Table 28** contains validity of bands with respect to Modes and Band Number. 0 indicates invalid/less confidence and 1 indicates valid band. Reason for assigning the invalid/less confidence tag with to a band is given in **Table 29**. All bands with VALID tag are valid bands and other tags (SATURATION, OSF, INVALID) are to be treated as invalid bands.

INVALID: Extremely low or no response from the instrument. This region of spectrum is updated with the help of neighboring bands except for first five bands (Band Number 1 to 5)

OSF: Order Sorting Filter Location: Less confidence in radiance

SATURATION: Invalid band as spectrometer has saturated

VALID: Good Band (where user can expect image content)

Table 28. Bands validity

Band number	E1G2	E2G2	E3G2	E4G2
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	0	0	0	0
5	0	0	0	0
6	0	0	0	0
7	1	1	1	1
8	1	1	1	1
9	1	1	1	1
10	1	1	1	1
11	1	1	1	1
12	1	1	1	1
13	1	1	1	1
14	1	1	1	1
15	1	1	1	1
16	1	1	1	1
17	1	1	1	1
18	1	1	1	1
19	1	1	1	1
20	1	1	1	1
21	1	1	1	1
22	1	1	1	1
23	1	1	1	1
24	1	1	1	1
25	1	1	1	1
26	1	1	1	1
27	1	1	1	1
28	1	1	1	1

Band number	E1G2	E2G2	E3G2	E4G2
29	0	0	0	0
30	0	0	0	0
31	0	0	0	0
32	0	0	0	0
33	0	0	0	0
34	0	0	0	0
35	1	1	1	1
36	1	1	1	1
37	1	1	1	1
38	1	1	1	0
39	1	1	1	0
40	1	1	1	0
41	1	1	1	0
42	1	1	1	0
43	1	1	1	0
44	1	1	1	0
45	1	1	1	0
46	1	1	1	0
47	1	1	1	0
48	1	1	1	0
49	1	1	1	0
50	1	1	1	0
51	1	1	1	0
52	1	1	1	0
53	1	1	1	0
54	1	1	1	0
55	1	1	1	0
56	1	1	1	0
57	1	1	1	0
58	1	1	1	0
59	1	1	1	0
60	1	1	1	0
61	1	1	1	0
62	1	1	1	0
63	1	1	1	0
64	1	1	1	0
65	1	1	1	0
66	1	1	1	0
67	1	1	1	0
68	1	1	1	0
69	0	0	0	0
70	0	0	0	0
71	0	0	0	0
72	0	0	0	0
73	0	0	0	0
74	0	0	0	0
75	0	0	0	0
76	1	1	1	0
77	1	1	1	0
78	1	1	1	0
79	1	1	1	0

Band number	E1G2	E2G2	E3G2	E4G2
80	1	1	1	0
81	1	1	1	0
82	1	1	1	0
83	1	1	1	0
84	1	1	1	0
85	1	1	1	0
86	1	1	1	0
87	1	1	1	0
88	1	1	1	0
89	1	1	1	0
90	1	1	1	0
91	1	1	1	0
92	1	1	1	0
93	1	1	1	0
94	1	1	1	0
95	1	1	1	0
96	1	1	1	0
97	1	1	1	0
98	1	1	1	0
99	1	1	1	0
100	1	1	1	0
101	1	1	1	0
102	1	1	1	0
103	1	1	1	0
104	1	1	1	0
105	1	1	1	0
106	1	1	1	0
107	1	1	1	0
108	1	1	1	0
109	1	1	1	0
110	1	1	1	0
111	1	1	1	0
112	1	1	1	0
113	1	1	1	0
114	1	1	1	0
115	1	1	1	0
116	1	1	1	0
117	1	1	1	0
118	1	1	1	0
119	1	1	1	0
120	1	1	1	0
121	1	1	1	0
122	1	1	1	0
123	1	1	1	0
124	1	1	1	0
125	1	1	1	0
126	1	1	1	0
127	1	1	1	0
128	1	1	1	0
129	1	1	1	0
130	1	1	1	0

Band number	E1G2	E2G2	E3G2	E4G2
131	1	1	1	0
132	1	1	1	0
133	1	1	1	0
134	1	1	1	0
135	1	1	1	0
136	1	1	1	0
137	1	1	1	0
138	1	1	1	0
139	1	1	1	0
140	1	1	1	0
141	1	1	1	0
142	1	1	1	0
143	1	1	1	0
144	1	1	1	0
145	1	1	1	0
146	1	1	1	0
147	1	1	0	0
148	1	1	0	0
149	1	1	0	0
150	1	1	0	0
151	1	1	0	0
152	1	1	0	0
153	1	1	0	0
154	1	1	0	0
155	1	1	0	0
156	1	1	0	0
157	1	1	0	0
158	1	1	0	0
159	1	1	0	0
160	1	1	0	0
161	1	1	0	0
162	0	0	0	0
163	0	0	0	0
164	0	0	0	0
165	0	0	0	0
166	0	0	0	0
167	0	0	0	0
168	0	0	0	0
169	0	0	0	0
170	0	0	0	0
171	0	0	0	0
172	1	0	0	0
173	1	0	0	0
174	1	0	0	0
175	1	0	0	0
176	1	0	0	0
177	1	0	0	0
178	1	0	0	0
179	1	0	0	0
180	1	0	0	0
181	1	0	0	0

Band number	E1G2	E2G2	E3G2	E4G2
182	1	0	0	0
183	1	0	0	0
184	1	0	0	0
185	1	0	0	0
186	1	0	0	0
187	1	0	0	0
188	1	0	0	0
189	1	0	0	0
190	1	0	0	0
191	1	0	0	0
192	1	0	0	0
193	1	0	0	0
194	1	0	0	0
195	1	0	0	0
196	1	0	0	0
197	1	0	0	0
198	1	0	0	0
199	1	0	0	0
200	1	0	0	0
201	1	0	0	0
202	1	0	0	0
203	1	0	0	0
204	1	0	0	0
205	1	0	0	0
206	1	0	0	0
207	1	0	0	0
208	1	0	0	0
209	1	0	0	0
210	1	0	0	0
211	1	0	0	0
212	1	0	0	0
213	1	0	0	0
214	1	0	0	0
215	1	0	0	0
216	1	0	0	0
217	1	0	0	0
218	1	0	0	0
219	1	0	0	0
220	1	0	0	0
221	1	0	0	0
222	1	0	0	0
223	1	0	0	0
224	1	0	0	0
225	1	0	0	0
226	1	0	0	0
227	1	0	0	0
228	1	0	0	0
229	1	0	0	0
230	1	0	0	0
231	1	0	0	0
232	1	0	0	0

Band number	E1G2	E2G2	E3G2	E4G2
233	1	0	0	0
234	1	0	0	0
235	1	0	0	0
236	1	0	0	0
237	1	0	0	0
238	1	0	0	0
239	1	0	0	0
240	1	0	0	0
241	1	0	0	0
242	1	0	0	0
243	1	0	0	0
244	1	0	0	0
245	1	0	0	0
246	1	0	0	0
247	1	0	0	0
248	1	0	0	0
249	1	0	0	0
250	1	0	0	0
251	1	0	0	0
252	0	0	0	0
253	0	0	0	0
254	0	0	0	0
255	0	0	0	0
256	0	0	0	0

All bands with VALID tag are valid bands and other tags (SATURATION, OSF, INVALID) are to be treated as invalid bands.

Table 29. Bands validity Reason

Band Number	Band Center Wavelength (nm)	E1G2	E2G2	E3G2	E4G2
1	712.3	INVALID	INVALID	INVALID	INVALID
2	729.2	INVALID	INVALID	INVALID	INVALID
3	746	INVALID	INVALID	INVALID	INVALID
4	762.9	INVALID	INVALID	INVALID	INVALID
5	779.7	INVALID	INVALID	INVALID	INVALID
6	796.6	INVALID	INVALID	INVALID	INVALID
7	813.4	VALID	VALID	VALID	VALID
8	830.3	VALID	VALID	VALID	VALID
9	847.2	VALID	VALID	VALID	VALID
10	864	VALID	VALID	VALID	VALID
11	880.9	VALID	VALID	VALID	VALID
12	897.7	VALID	VALID	VALID	VALID
13	914.6	VALID	VALID	VALID	VALID
14	931.4	VALID	VALID	VALID	VALID
15	948.3	VALID	VALID	VALID	VALID
16	965.1	VALID	VALID	VALID	VALID

Band Number	Band Center Wavelength (nm)	E1G2	E2G2	E3G2	E4G2
17	982	VALID	VALID	VALID	VALID
18	998.8	VALID	VALID	VALID	VALID
19	1015.7	VALID	VALID	VALID	VALID
20	1032.5	VALID	VALID	VALID	VALID
21	1049.4	VALID	VALID	VALID	VALID
22	1066.2	VALID	VALID	VALID	VALID
23	1083.1	VALID	VALID	VALID	VALID
24	1099.9	VALID	VALID	VALID	VALID
25	1116.8	VALID	VALID	VALID	VALID
26	1133.6	VALID	VALID	VALID	VALID
27	1150.5	VALID	VALID	VALID	VALID
28	1167.3	VALID	VALID	VALID	VALID
29	1184.2	OSF	OSF	OSF	OSF
30	1201.1	OSF	OSF	OSF	OSF
31	1217.9	OSF	OSF	OSF	OSF
32	1234.8	OSF	OSF	OSF	OSF
33	1251.6	OSF	OSF	OSF	OSF
34	1268.5	OSF	OSF	OSF	OSF
35	1285.3	VALID	VALID	VALID	VALID
36	1302.2	VALID	VALID	VALID	VALID
37	1319	VALID	VALID	VALID	VALID
38	1335.9	VALID	VALID	VALID	SATURATION
39	1352.7	VALID	VALID	VALID	SATURATION
40	1369.6	VALID	VALID	VALID	SATURATION
41	1386.4	VALID	VALID	VALID	SATURATION
42	1403.3	VALID	VALID	VALID	SATURATION
43	1420.1	VALID	VALID	VALID	SATURATION
44	1437	VALID	VALID	VALID	SATURATION
45	1453.8	VALID	VALID	VALID	SATURATION
46	1470.7	VALID	VALID	VALID	SATURATION
47	1487.5	VALID	VALID	VALID	SATURATION
48	1504.4	VALID	VALID	VALID	SATURATION
49	1521.2	VALID	VALID	VALID	SATURATION
50	1538.1	VALID	VALID	VALID	SATURATION
51	1555	VALID	VALID	VALID	SATURATION
52	1571.8	VALID	VALID	VALID	SATURATION
53	1588.7	VALID	VALID	VALID	SATURATION
54	1605.5	VALID	VALID	VALID	SATURATION
55	1622.4	VALID	VALID	VALID	SATURATION
56	1639.2	VALID	VALID	VALID	SATURATION
57	1656.1	VALID	VALID	VALID	SATURATION
58	1672.9	VALID	VALID	VALID	SATURATION
59	1689.8	VALID	VALID	VALID	SATURATION
60	1706.6	VALID	VALID	VALID	SATURATION
61	1723.5	VALID	VALID	VALID	SATURATION
62	1740.3	VALID	VALID	VALID	SATURATION

Band Number	Band Center Wavelength (nm)	E1G2	E2G2	E3G2	E4G2
63	1757.2	VALID	VALID	VALID	SATURATION
64	1774	VALID	VALID	VALID	SATURATION
65	1790.9	VALID	VALID	VALID	SATURATION
66	1807.7	VALID	VALID	VALID	SATURATION
67	1824.6	VALID	VALID	VALID	SATURATION
68	1841.4	VALID	VALID	VALID	SATURATION
69	1858.3	OSF	OSF	OSF	SATURATION
70	1875.1	OSF	OSF	OSF	SATURATION
71	1892	OSF	OSF	OSF	SATURATION
72	1908.9	OSF	OSF	OSF	SATURATION
73	1925.7	OSF	OSF	OSF	SATURATION
74	1942.6	OSF	OSF	OSF	SATURATION
75	1959.4	OSF	OSF	OSF	SATURATION
76	1976.3	VALID	VALID	VALID	SATURATION
77	1993.1	VALID	VALID	VALID	SATURATION
78	2010	VALID	VALID	VALID	SATURATION
79	2026.8	VALID	VALID	VALID	SATURATION
80	2043.7	VALID	VALID	VALID	SATURATION
81	2060.5	VALID	VALID	VALID	SATURATION
82	2077.4	VALID	VALID	VALID	SATURATION
83	2094.2	VALID	VALID	VALID	SATURATION
84	2111.1	VALID	VALID	VALID	SATURATION
85	2127.9	VALID	VALID	VALID	SATURATION
86	2144.8	VALID	VALID	VALID	SATURATION
87	2161.6	VALID	VALID	VALID	SATURATION
88	2178.5	VALID	VALID	VALID	SATURATION
89	2195.3	VALID	VALID	VALID	SATURATION
90	2212.2	VALID	VALID	VALID	SATURATION
91	2229	VALID	VALID	VALID	SATURATION
92	2245.9	VALID	VALID	VALID	SATURATION
93	2262.8	VALID	VALID	VALID	SATURATION
94	2279.6	VALID	VALID	VALID	SATURATION
95	2296.5	VALID	VALID	VALID	SATURATION
96	2313.3	VALID	VALID	VALID	SATURATION
97	2330.2	VALID	VALID	VALID	SATURATION
98	2347	VALID	VALID	VALID	SATURATION
99	2363.9	VALID	VALID	VALID	SATURATION
100	2380.7	VALID	VALID	VALID	SATURATION
101	2397.6	VALID	VALID	VALID	SATURATION
102	2414.4	VALID	VALID	VALID	SATURATION
103	2431.3	VALID	VALID	VALID	SATURATION
104	2448.1	VALID	VALID	VALID	SATURATION
105	2465	VALID	VALID	VALID	SATURATION
106	2481.8	VALID	VALID	VALID	SATURATION
107	2498.7	VALID	VALID	VALID	SATURATION
108	2515.5	VALID	VALID	VALID	SATURATION

Band Number	Band Center Wavelength (nm)	E1G2	E2G2	E3G2	E4G2
109	2532.4	VALID	VALID	VALID	SATURATION
110	2549.2	VALID	VALID	VALID	SATURATION
111	2566.1	VALID	VALID	VALID	SATURATION
112	2582.9	VALID	VALID	VALID	SATURATION
113	2599.8	VALID	VALID	VALID	SATURATION
114	2616.7	VALID	VALID	VALID	SATURATION
115	2633.5	VALID	VALID	VALID	SATURATION
116	2650.4	VALID	VALID	VALID	SATURATION
117	2667.2	VALID	VALID	VALID	SATURATION
118	2684.1	VALID	VALID	VALID	SATURATION
119	2700.9	VALID	VALID	VALID	SATURATION
120	2717.8	VALID	VALID	VALID	SATURATION
121	2734.6	VALID	VALID	VALID	SATURATION
122	2751.5	VALID	VALID	VALID	SATURATION
123	2768.3	VALID	VALID	VALID	SATURATION
124	2785.2	VALID	VALID	VALID	SATURATION
125	2802	VALID	VALID	VALID	SATURATION
126	2818.9	VALID	VALID	VALID	SATURATION
127	2835.7	VALID	VALID	VALID	SATURATION
128	2852.6	VALID	VALID	VALID	SATURATION
129	2869.4	VALID	VALID	VALID	SATURATION
130	2886.3	VALID	VALID	VALID	SATURATION
131	2903.1	VALID	VALID	VALID	SATURATION
132	2920	VALID	VALID	VALID	SATURATION
133	2936.8	VALID	VALID	VALID	SATURATION
134	2953.7	VALID	VALID	VALID	SATURATION
135	2970.6	VALID	VALID	VALID	SATURATION
136	2987.4	VALID	VALID	VALID	SATURATION
137	3004.3	VALID	VALID	VALID	SATURATION
138	3021.1	VALID	VALID	VALID	SATURATION
139	3038	VALID	VALID	VALID	SATURATION
140	3054.8	VALID	VALID	VALID	SATURATION
141	3071.7	VALID	VALID	VALID	SATURATION
142	3088.5	VALID	VALID	VALID	SATURATION
143	3105.4	VALID	VALID	VALID	SATURATION
144	3122.2	VALID	VALID	VALID	SATURATION
145	3139.1	VALID	VALID	VALID	SATURATION
146	3155.9	VALID	VALID	VALID	SATURATION
147	3172.8	VALID	VALID	SATURATION	SATURATION
148	3189.6	VALID	VALID	SATURATION	SATURATION
149	3206.5	VALID	VALID	SATURATION	SATURATION
150	3223.3	VALID	VALID	SATURATION	SATURATION
151	3240.2	VALID	VALID	SATURATION	SATURATION
152	3257	VALID	VALID	SATURATION	SATURATION
153	3273.9	VALID	VALID	SATURATION	SATURATION
154	3290.7	VALID	VALID	SATURATION	SATURATION

Band Number	Band Center Wavelength (nm)	E1G2	E2G2	E3G2	E4G2
155	3307.6	VALID	VALID	SATURATION	SATURATION
156	3324.5	VALID	VALID	SATURATION	SATURATION
157	3341.3	VALID	VALID	SATURATION	SATURATION
158	3358.2	VALID	VALID	SATURATION	SATURATION
159	3375	VALID	VALID	SATURATION	SATURATION
160	3391.9	VALID	VALID	SATURATION	SATURATION
161	3408.7	VALID	VALID	SATURATION	SATURATION
162	3425.6	OSF	OSF	SATURATION	SATURATION
163	3442.4	OSF	OSF	SATURATION	SATURATION
164	3459.3	OSF	OSF	SATURATION	SATURATION
165	3476.1	OSF	OSF	SATURATION	SATURATION
166	3493	OSF	OSF	SATURATION	SATURATION
167	3509.8	OSF	OSF	SATURATION	SATURATION
168	3526.7	OSF	OSF	SATURATION	SATURATION
169	3543.5	OSF	OSF	SATURATION	SATURATION
170	3560.4	OSF	OSF	SATURATION	SATURATION
171	3577.2	OSF	OSF	SATURATION	SATURATION
172	3594.1	VALID	SATURATION	SATURATION	SATURATION
173	3610.9	VALID	SATURATION	SATURATION	SATURATION
174	3627.8	VALID	SATURATION	SATURATION	SATURATION
175	3644.6	VALID	SATURATION	SATURATION	SATURATION
176	3661.5	VALID	SATURATION	SATURATION	SATURATION
177	3678.3	VALID	SATURATION	SATURATION	SATURATION
178	3695.2	VALID	SATURATION	SATURATION	SATURATION
179	3712.1	VALID	SATURATION	SATURATION	SATURATION
180	3728.9	VALID	SATURATION	SATURATION	SATURATION
181	3745.8	VALID	SATURATION	SATURATION	SATURATION
182	3762.6	VALID	SATURATION	SATURATION	SATURATION
183	3779.5	VALID	SATURATION	SATURATION	SATURATION
184	3796.3	VALID	SATURATION	SATURATION	SATURATION
185	3813.2	VALID	SATURATION	SATURATION	SATURATION
186	3830	VALID	SATURATION	SATURATION	SATURATION
187	3846.9	VALID	SATURATION	SATURATION	SATURATION
188	3863.7	VALID	SATURATION	SATURATION	SATURATION
189	3880.6	VALID	SATURATION	SATURATION	SATURATION
190	3897.4	VALID	SATURATION	SATURATION	SATURATION
191	3914.3	VALID	SATURATION	SATURATION	SATURATION
192	3931.1	VALID	SATURATION	SATURATION	SATURATION
193	3948	VALID	SATURATION	SATURATION	SATURATION
194	3964.8	VALID	SATURATION	SATURATION	SATURATION
195	3981.7	VALID	SATURATION	SATURATION	SATURATION
196	3998.5	VALID	SATURATION	SATURATION	SATURATION
197	4015.4	VALID	SATURATION	SATURATION	SATURATION
198	4032.2	VALID	SATURATION	SATURATION	SATURATION
199	4049.1	VALID	SATURATION	SATURATION	SATURATION
200	4066	VALID	SATURATION	SATURATION	SATURATION

Band Number	Band Center Wavelength (nm)	E1G2	E2G2	E3G2	E4G2
201	4082.8	VALID	SATURATION	SATURATION	SATURATION
202	4099.7	VALID	SATURATION	SATURATION	SATURATION
203	4116.5	VALID	SATURATION	SATURATION	SATURATION
204	4133.4	VALID	SATURATION	SATURATION	SATURATION
205	4150.2	VALID	SATURATION	SATURATION	SATURATION
206	4167.1	VALID	SATURATION	SATURATION	SATURATION
207	4183.9	VALID	SATURATION	SATURATION	SATURATION
208	4200.8	VALID	SATURATION	SATURATION	SATURATION
209	4217.6	VALID	SATURATION	SATURATION	SATURATION
210	4234.5	VALID	SATURATION	SATURATION	SATURATION
211	4251.3	VALID	SATURATION	SATURATION	SATURATION
212	4268.2	VALID	SATURATION	SATURATION	SATURATION
213	4285	VALID	SATURATION	SATURATION	SATURATION
214	4301.9	VALID	SATURATION	SATURATION	SATURATION
215	4318.7	VALID	SATURATION	SATURATION	SATURATION
216	4335.6	VALID	SATURATION	SATURATION	SATURATION
217	4352.4	VALID	SATURATION	SATURATION	SATURATION
218	4369.3	VALID	SATURATION	SATURATION	SATURATION
219	4386.1	VALID	SATURATION	SATURATION	SATURATION
220	4403	VALID	SATURATION	SATURATION	SATURATION
221	4419.9	VALID	SATURATION	SATURATION	SATURATION
222	4436.7	VALID	SATURATION	SATURATION	SATURATION
223	4453.6	VALID	SATURATION	SATURATION	SATURATION
224	4470.4	VALID	SATURATION	SATURATION	SATURATION
225	4487.3	VALID	SATURATION	SATURATION	SATURATION
226	4504.1	VALID	SATURATION	SATURATION	SATURATION
227	4521	VALID	SATURATION	SATURATION	SATURATION
228	4537.8	VALID	SATURATION	SATURATION	SATURATION
229	4554.7	VALID	SATURATION	SATURATION	SATURATION
230	4571.5	VALID	SATURATION	SATURATION	SATURATION
231	4588.4	VALID	SATURATION	SATURATION	SATURATION
232	4605.2	VALID	SATURATION	SATURATION	SATURATION
233	4622.1	VALID	SATURATION	SATURATION	SATURATION
234	4638.9	VALID	SATURATION	SATURATION	SATURATION
235	4655.8	VALID	SATURATION	SATURATION	SATURATION
236	4672.6	VALID	SATURATION	SATURATION	SATURATION
237	4689.5	VALID	SATURATION	SATURATION	SATURATION
238	4706.3	VALID	SATURATION	SATURATION	SATURATION
239	4723.2	VALID	SATURATION	SATURATION	SATURATION
240	4740	VALID	SATURATION	SATURATION	SATURATION
241	4756.9	VALID	SATURATION	SATURATION	SATURATION
242	4773.8	VALID	SATURATION	SATURATION	SATURATION
243	4790.6	VALID	SATURATION	SATURATION	SATURATION
244	4807.5	VALID	SATURATION	SATURATION	SATURATION
245	4824.3	VALID	SATURATION	SATURATION	SATURATION
246	4841.2	VALID	SATURATION	SATURATION	SATURATION

Band Number	Band Center Wavelength (nm)	E1G2	E2G2	E3G2	E4G2
247	4858	VALID	SATURATION	SATURATION	SATURATION
248	4874.9	VALID	SATURATION	SATURATION	SATURATION
249	4891.7	VALID	SATURATION	SATURATION	SATURATION
250	4908.6	VALID	SATURATION	SATURATION	SATURATION
251	4925.4	VALID	SATURATION	SATURATION	SATURATION
252	4942.3	INVALID	SATURATION	SATURATION	SATURATION
253	4959.1	INVALID	SATURATION	SATURATION	SATURATION
254	4976	INVALID	SATURATION	SATURATION	SATURATION
255	4992.8	INVALID	SATURATION	SATURATION	SATURATION
256	5009.7	INVALID	SATURATION	SATURATION	SATURATION

Appendix-I: Local Data Dictionary

ISRO Science Data Archive (ISDA) was established during Chandrayaan-1 mission in 2008. All the products hosted for users under ISDA are PDS compliant. Currently, PDS4 is the standard adopted for present and future generation archive by all the space agencies for their missions. For Chandrayaan-2 mission also, PDS4 Archive standard was adopted.

To handle the ISRO planetary mission's specific parameters, there is a concept in PDS4 called Local Data Dictionary (LDD). In LDD, one can define all the parameters which can be used as a reference for future planetary missions. LDD takes basic data dictionary of PDS4 and builds local dictionary on top of it. For Chandrayaan-2 mission and future planetary missions of ISRO, list of parameters is identified as shown in **Table 30**.

Table 30. ISDA local data dictionary class and attributes list

Class/Sub Class Hierarchy	Attribute Name	Description/Value
Mission_Area • Product_Parameters	job_id	Unique id assign by DP Scheduler when the product is ingested
	level0_dir_name	DP Input Level-0 directory name
	imaging_orbit_number	Imaging Orbit Number assigned on board
	dumping_orbit_number	Dumping Orbit Number is assigned based on the data collected on ground station
	line_exposure_duration	Image integration time
	gain	Gain is one of the operating modes. It is value is set as g2
	exposure	exposure is one of the operating modes. It is value is set as e1, e2, e3 and e4
	exposure_duration	Exposure duration defined for each exposure settings – e1,e2,e3 and e4
	detector_temperature	Detector temperature
	tertiary_mirror_temperature	Tertiary mirror temperature
	spectrometer_casing_temperature	Spectrometer casing temperature
	dewar_vw_temperature	dewar_vw_temperature
	detector_pixel_width	Pixel width of detector
	focal_length	Instrument focal length
	spacecraft_altitude	Spacecraft height
	orbit_limb_direction	Orbit limb direction it can

Class/Sub Class Hierarchy	Attribute Name	Description/Value
	spacecraft_yaw_direction	have two values - Ascending or Descending Spacecraft yaw mode it can have two values – True/False a) True means Reverse, in flight yaw mode Reverse describes 180 degree rotated from nominal. b) False means Forward, in flight yaw mode Forward describes 0 degree rotated from nominal) There are four possible orbit_limb_direction and spacecraft_yaw_direction combinations: 1. Descending and False, no changes in lines or samples are performed 2. Descending and True, samples are reversed 3. Ascending and False, both lines and samples are reversed 4. Ascending and True. Lines are reversed
	reference_data_used	Reference data set used in refining the system level corners List of Possible Values 1. SELENE (10 meter ortho reference) 2. LRO (100 meter ortho reference) 3. CLEMENTINE (100 meter ortho reference) 4. System (available reference but no match found gone with system level) 5. n/a means not available
	pixel_resolution	Image pixel resolution expressed in unit m/pixel
	roll	Spacecraft spinning on X-axis value expressed in degree
	pitch	Spacecraft spinning on Y-axis value expressed in

Class/Sub Class Hierarchy	Attribute Name	Description/Value
		degree
	yaw	Spacecraft spinning on Z-axis value expressed in degree
	sun_azimuth	Angle between the projection of sun rays and a line due south or north and value is expressed in degree
	sun_elevation	Angle between the horizon and the Sun's disc centre and value is expressed in degree
	solar_incidence	Angle between the sun's rays and the normal on a surface and value is expressed in degree
	projection	projection is map projection which is set of transformations employed to represent the curved two-dimensional surface of a globe on plane. List of possible values 1. Selenographic 2. Polar stereographic
	area	Area on which imaging is done. List of Possible Values 1. Equatorial 2. North Pole 3. South Pole
Mission_Area • Geometry_Parameters ○ System_Level_Coordinates ○ Refined_Level_Coordinates	upper_left_latitude	Upper left latitude reticle point with number 1
	upper_left_longitude	Upper left longitude reticle point with number 1
	upper_right_latitude	Upper right latitude reticle point with number 3
	upper_right_longitude	Upper right longitude reticle point with number 3
	lower_left_latitude	Lower left latitude reticle point with number 7
	lower_left_longitude	Lower left longitude reticle point with number 7
	lower_right_latitude	Lower right latitude reticle point with number 9
	lower_right_longitude	Lower right longitude reticle point with number 9

Appendix-J: Data Disclaimer

Imaging Infrared Spectrometer (IIRS) is an imaging hyperspectral instrument on-board Chandrayaan-2. This instrument is primarily designed for mineralogical and volatile studies of the lunar surface. The useful spectral range of IIRS is 0.8-5 µm having 250 contiguous bands. It has 80 m ground sampling distance and 20 km swath at nadir from 100 km orbit altitude.
The public release of IIRS data has two levels - Level-0 and -1.

Level-0 data is the uncalibrated data (instrument raw data) in count numbers as 14-bit unsigned integer stored as 16-bit unsigned integer in generic binary Band sequential (BSQ) format. It can be converted to spectral radiance data (level-1) by using maximum and minimum saturation radiances, and the dynamic ranges of spectral bands provided in Appendix F.

Level-1 is the data that has been converted to physical units (mW/cm2/sr/µm) with a scaling factor of 1000 and stored as 32-bit floating point numbers in generic binary BSQ format. Ancillary information is provided as text files.

This data is provided on an experimental as is basis, because the in-orbit calibration-validation exercises are still pending as image acquisition over calibration sites are yet to happen. These datasets will be updated as and when the newer/better processing steps are added. The user is requested to ascertain the utility of the datasets of interest before any publication of results derived from this dataset.

It is to bring to the notice of the user that the instrument principal investigator (PI) or Department of Space/Indian Space Research Organization (DOS/ISRO) is not responsible for any dispute/disrepute that may arise due to the use of this dataset. The user should neither redistribute the data to third party nor it be used for any commercial purpose without the knowledge of Department of Space/Indian Space Research Organization (DOS/ISRO).