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# European Space Agency

## To Planetary Science Archive Interface control document

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### **[Rosetta] - [Earth Based]**

**Document No.**

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LIGIER Nicolas

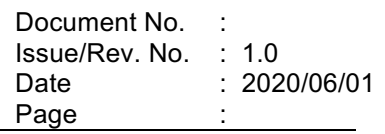
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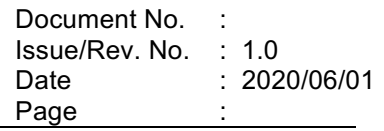
**Prepared by: Instrument Archive Responsible**

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**Approved by: Principal Investigator**



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## TBD ITEMS

[illegible]

## Change Record

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## Table of Contents

<b>1</b>	<b>Introduction</b>	<b>3</b>
1.1	Purpose and Scope	3
1.2	Archiving Authorities	3
1.3	Contents	3
1.4	Intended Readership	3
1.5	Scientific Objectives	4
1.6	Applicable Documents	4
1.7	Relationships to Other Interfaces	4
1.8	Acronyms and Abbreviations	4
1.9	Contact Names and Addresses	6
<b>2</b>	<b>Overview of Instrument Design, Data Handling Process and Product Generation</b>	<b>7</b>
2.1	Scientific Objectives	7
2.2	Data Handling Process	8
2.3	Product Generation	8
2.4	Overview of Data Products	8
2.4.1	Pre-Flight Data Products	8
2.4.2	Sub-System Tests	8
2.4.3	Instrument Calibrations	8
2.4.4	Other Files written during Calibration	8
2.4.5	Data Products	9
2.4.6	Software	9
2.4.7	Documentation	9
2.4.8	Derived and other Data Products	9
2.4.9	Ancillary Data Usage	10
<b>3</b>	<b>Archive Format and Content</b>	<b>11</b>
3.1	Format and Conventions	11
3.1.1	Deliveries and Archive Volume Format	11
3.1.2	Data Set ID Formation	11
3.1.3	Data Directory Naming Convention	11
3.1.4	Filenaming Convention	11
3.2	Standards Used in Data Product Generation	11
3.2.1	PDS Standards	11
3.2.2	Time Standards	11
3.2.3	Reference Systems	11
3.2.4	Other Applicable Standards	11
3.3	Data Validation	11
3.4	Content	12
3.4.1	Volume Set	12
3.4.2	Data Set	12
3.4.3	Directories	12



Document No. :  
Issue/Rev. No. : 1.0  
Date : 2020/06/01  
Page :

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<b>4</b>	<b><i>Detailed Interface Specifications</i></b>	<b>16</b>
<b>4.1</b>	<b>Structure and Organization Overview</b>	<b>16</b>
<b>4.2</b>	<b>Data Sets, Definition and Content</b>	<b>16</b>
<b>4.3</b>	<b>Data Product Design</b>	<b>16</b>
4.3.1	File Characteristics Data Elements	18
4.3.2	Data Object Pointers Identification Data Elements	18
4.3.3	Instrument and Detector Descriptive Data Elements	18
4.3.4	Structure Definition of Instrument Parameter Objects	18
4.3.5	Data Object Definition	18
4.3.6	Description of Instrument	19
4.3.7	Parameters Index File Definition	19
4.3.8	Mission Specific Keywords	19
<b>5</b>	<b><i>Appendix: Available Software to read PDS files</i></b>	<b>19</b>
<b>6</b>	<b><i>Appendix: Example of Directory Listing of Data Set X</i></b>	<b>19</b>

# 1 Introduction

## 1.1 Purpose and Scope

The purpose of this EAICD (Experimenter to (Science) Archive Interface Control Document) is twofold. Firstly, it provides all the instruments involved in the 67P/Churyumov-Gerasimenko's Earth based observation campaign using the imaging (IMG hereafter) technic. A description of the data, including data sources and destinations, is also provided. Then, it is the official interface between the instrument teams and the archiving authority.

## 1.2 Archiving Authorities

The Planetary Data System Standard is used as archiving standard by

- NASA for U.S. planetary missions, implemented by PDS
- ESA for European planetary missions, implemented by the Research and Scientific Support Department (RSSD) of ESA

### 1.1.1 ESA's Planetary Science Archive (PSA)

ESA implements an online science archive, the PSA,

- to support and ease data ingestion
- to offer additional services to the scientific user community and science operations teams as e.g.
  - search queries that allow searches across instruments, missions and scientific disciplines
  - several data delivery options as
    - direct download of data products, linked files and data sets
    - ftp download of data products, linked files and data sets

The PSA aims for online ingestion of logical archive volumes and will offer the creation of physical archive volumes on request.

## 1.3 Contents

This document describes the data flow of the Earth based IMG instruments that performed observation of the comet 67P/Churyumov-Gerasimenko (67P hereafter) during the rendez-vous of the Rosetta spacecraft with the comet from the acquisition until the insertion into the PSA for ESA. It includes information on how data were processed, formatted, labeled and uniquely identified.

The document discusses general naming schemes for data volumes, data sets, data and label files. Standards used to generate products are explained. Software that may be used to access products is explained further on.

The design of the data set structure and data products is given. Examples are given in the appendix.

## 1.4 Intended Readership

The staff of the archiving authority (Planetary Science Archive, ESA, RSSD, design team) and any potential user of the Earth based IMG data. However, people without any experience of the concerned IMG instruments may not be able, based only on this document and the archived data, to work with the archived data. These instruments are complex and one has to familiarize himself with the associated user manuals (including the annexes) and reduction pipeline cookbook before starting to work on these raw uncalibrated data.

## 1.5 Scientific Objectives

A worldwide Earth based observing campaign of the 67P comet was performed in support of in-situ's data acquired during the last stage of the Rosetta mission.

Several techniques were used during this campaign and one of them is the imaging. It is a simple technic based on visible or monochromatic images obtained at wavelength range or by using filters. The purpose of Earth based instruments using this technic was to provide information on the physical and chemical properties of 67P's coma and tail in one go. In the same time, because Earth based observations are by definition large-scale data compared to in-situ ones, the data presented here are complementary to those performed by Rosetta instruments and should permit to contextualize these latter observations.

## 1.6 Applicable Documents

Planetary Data System Preparation Workbook, February 1, 1995, Version 3.1, JPL, D-7669, Part1  
Planetary Data System Standards Reference, June 1, 1999, Version 3.3, JPL, D-7669, Part 2  
Earth based Archive Generation, Validation and Transfer Plan, [September 15, 2017]

## 1.7 Relationships to Other Interfaces

N/A

## 1.8 Acronyms and Abbreviations

<b>ACAM</b>	<b>A</b> uxiliary-port <b>CAM</b> era
<b>ALFOSC</b>	<b>A</b> lhambra <b>F</b> aint <b>O</b> bject <b>S</b> pectrograph and <b>C</b> amera
<b>arcsec</b>	<b>arc-second</b>
<b>BNAO</b>	<b>B</b> ulgarian <b>N</b> ational <b>A</b> stronomical <b>O</b> bservatory
<b>BTA</b>	<b>B</b> ig <b>T</b> elescope <b>A</b> lt-azimuthal
<b>CA</b>	<b>C</b> alar <b>A</b> lto
<b>CAFOS</b>	<b>C</b> alar <b>A</b> lto <b>F</b> aint <b>O</b> bject <b>S</b> pectrograph
<b>CCD</b>	<b>C</b> harge <b>C</b> oupled <b>D</b> evice
<b>DCT</b>	<b>D</b> iscovery <b>C</b> hannel <b>T</b> elescope
<b>Disp.</b>	<b>D</b> ispersion
<b>DOLORES</b>	<b>D</b> evice <b>O</b> ptimized for the <b>L</b> ow <b>R</b> ESolution
<b>EFOSC</b>	<b>E</b> SO <b>F</b> aint <b>O</b> bject <b>S</b> pectrograph and <b>C</b> amera
<b>ESO</b>	<b>E</b> uropean <b>S</b> outhern <b>O</b> bservatory
<b>FIT</b>	<b>F</b> lexible <b>I</b> mage <b>T</b> ransport
<b>FoReRo2</b>	<b>F</b> ocal- <b>R</b> educer- <b>R</b> ozhen- <b>2</b> -channel
<b>FORS2</b>	<b>F</b> Ocal <b>R</b> educer and low dispersion <b>S</b> pectrograph <b>2</b>
<b>GMOS</b>	<b>G</b> emini <b>M</b> ulti- <b>O</b> bject <b>S</b> pectrograph
<b>GTC</b>	<b>G</b> ran <b>T</b> elescopio <b>C</b> anarias
<b>HCT</b>	<b>H</b> imalayan <b>C</b> handra <b>T</b> elescope
<b>HFOSC</b>	<b>H</b> imalayan <b>F</b> aint <b>O</b> bject <b>S</b> pectrograph and <b>C</b> amera



<b>HSC</b>	<b>Hyper Suprime-Cam</b>
<b>IAO</b>	<b>Indian Astronomical Observatory</b>
<b>INT</b>	<b>Isaac Newton Telescope</b>
<b>IO:O</b>	<b>Infrared Optical : Optics</b>
<b>IRAC</b>	<b>InfraRed Array Camera</b>
<b>IRTF</b>	<b>InfraRed Telescope Facility</b>
<b>LCOGT</b>	<b>Las Cumbres Observatory Global Telescope</b>
<b>LIRIS</b>	<b>Long-slit Intermediate Resolution Infrared Spectrograph</b>
<b>LMI</b>	<b>Large Monolithic Imager</b>
<b>LT</b>	<b>Liverpool Telescope</b>
<b>LOT</b>	<b>Lulin One-meter Telescope</b>
<b>MOSCA</b>	<b>Multi Object Spectroscopy Calar Alto</b>
<b>MORIS</b>	<b>MIT Optical Rapid Imaging System</b>
<b>NASACAM</b>	<b>NASA CAMERA</b>
<b>NEOWISE</b>	<b>NEO Wide-field Infrared Survey Explorer</b>
<b>NICS</b>	<b>Near Infrared Camera Spectrometer</b>
<b>NIRI</b>	<b>Near InfraRed Imager</b>
<b>NOT</b>	<b>Nordic Optical Telescope</b>
<b>NTT</b>	<b>New Technology Telescope</b>
<b>OGS</b>	<b>Optical Ground Station</b>
<b>OSIRIS</b>	<b>Optical System for Imaging &amp; low-intermediate Resolution Imaging Spectroscopy</b>
<b>OSN</b>	<b>Observatorio de Sierra Nevada</b>
<b>pix</b>	<b>pixel</b>
<b>PSA</b>	<b>Planetary Science Archive</b>
<b>SAO RAS</b>	<b>Special Astrophysical Observatory of the Russian Academy of Sciences</b>
<b>SCORPIO-2</b>	<b>Spectral Camera with Optical Reducer for Photometric and Interferometric Observations - 2</b>
<b>SDC</b>	<b>Space Debris observation Camera</b>
<b>STELLA</b>	<b>STELLAR Activity robotic observatory</b>
<b>TNG</b>	<b>Telescopio Nazionale Galileo</b>
<b>TRAPPIST</b>	<b>TRANSiting Planets and Planetesimals Small Telescope</b>
<b>UT</b>	<b>Unit Telescope</b>
<b>UTC</b>	<b>Universal Time Coordinated</b>

<b>VIMOS</b>	<b>V</b> isible <b>M</b> ulti- <b>O</b> bject <b>S</b> pectrograph
<b>VLT</b>	<b>V</b> ery <b>L</b> arge <b>T</b> elescope
<b>WHT</b>	<b>W</b> illiam <b>H</b> erschel <b>T</b> elescope
<b>WFC</b>	<b>W</b> ide <b>F</b> ield <b>C</b> amera
<b>WFSIP1</b>	<b>W</b> ide <b>F</b> ield <b>S</b> TELLA <b>I</b> maging <b>P</b> hotometer <b>1</b>
<b>Xshooter</b>	<b>X</b> -shooter
<b>YAO</b>	<b>Y</b> unnan <b>A</b> stronomical <b>O</b> bservatory
<b>YFOSC</b>	<b>Y</b> AO <b>F</b> aint <b>O</b> bject <b>S</b> pectrograph and <b>C</b> amera

## 1.9 Contact Names and Addresses

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PSA Permanent point of contact: [psahelp@cosmos.esa.int](mailto:psahelp@cosmos.esa.int)

## 2 Overview of Instrument Design, Data Handling Process and Product Generation

The main particularity, complexity, of this Earth based observation campaign relies on the numerous different telescopes and instruments involved in it: 62 instruments installed on 38 different telescopes were used in this campaign (see Snodgrass et al. 2017, table 1), thus allowing to get a large amount of varied data that will bring new insights on the cometary science but also to contextualize the Rosetta mission.

One of the technique used during the campaign is IMG. Forty instruments (installed on 29 different telescopes) were involved. Detailed description, main characteristics of the instruments and others additional information are given in documents provided in the "DOCUMENT" directory. Some of these documents are available on these websites:

BNAO-ROZHEN – FoReRo2 (in bulgarian): <http://www.astro.bas.bg/forero/papers/jock2.pdf>  
CA – CAFOS: <https://www.caha.es/alises/cafos/cafos.html>  
CA – MOSCA: <https://www.caha.es/CAHA/Instruments/MOSCA/mosca.html>  
ESO – TRAPPIST: <https://www.eso.org/public/teles-instr/lasilla/trappist/>  
ESO-NTT – EFOSC: <https://www.eso.org/sci/facilities/lasilla/instruments/efosc.html>  
ESO-VLT – FORS2: <https://www.eso.org/sci/facilities/paranal/instruments/fors/overview.html>  
ESO-VLT – VIMOS: [www.eso.org/public/france/teles-instr/paranal-observatory/vlt/vlt-instr/vimos/](http://www.eso.org/public/france/teles-instr/paranal-observatory/vlt/vlt-instr/vimos/)  
ESO-VLT – XSHOOTER: <https://www.eso.org/sci/facilities/paranal/instruments/xshooter.html>  
GEMINI-NORTH – GMOS: <https://www.gemini.edu/sciops/instruments/gmos/>  
GEMINI-NORTH – NIRI: <https://www.gemini.edu/sciops/instruments/niri/>  
GEMINI-SOUTH – FLAMINGOS2: <https://www.gemini.edu/sciops/instruments/flamingos2/>  
GEMINI-SOUTH – GMOS: <https://www.gemini.edu/sciops/instruments/gmos-0>  
GTC – OSIRIS: <http://www.gtc.iac.es/instruments/osiris/osiris.php>  
IAO-HCT – HFOSC: <https://www.iap.res.in/iao/hfosc.html>  
INT – WFC: <http://www.ing.iac.es/astronomy/instruments/wfc/>  
IRTF – MORIS: <http://irtfweb.ifa.hawaii.edu/~moris/>  
IRTF – SpeX: <http://irtfweb.ifa.hawaii.edu/~spex/>  
KEPLER: [https://www.nasa.gov/mission\\_pages/kepler/spacecraft/index.html](https://www.nasa.gov/mission_pages/kepler/spacecraft/index.html)  
LCOGT (multiple sites): <https://lco.global/observatory/instruments/>  
LOWELL 31-inch – NASACAM: <https://lowell.edu/research/research-facilities/31-inch/>  
LOWELL-DCT – LMI: <http://ftp.lowell.edu/dct/technical.php?req=lmi>  
LT – IOO: <http://telescope.livjm.ac.uk/TelInst/Inst/IOO/>  
LULIN – LOT (Chinese) : <http://www.lulin.ncu.edu.tw/>  
NEOWISE: [https://www.nasa.gov/mission\\_pages/neowise/mission/index.html](https://www.nasa.gov/mission_pages/neowise/mission/index.html)  
NOT – ALFOSC: <http://www.not.iac.es/instruments/alfosc/>  
NOT – STAN CAM: <http://www.not.iac.es/instruments/stancam/>  
OGS – SDC: <http://vivaldi.iiac.es/OOCC/iac-managed-telescopes/ogs/>  
OSN – CCD-0.90M (Spanish): <https://www.iaa.csic.es/~pja/osn/Tel90m/strom.html>  
OSN – CCD-1.50M: <https://www.iaa.csic.es/~pja/osn/Tel150m/guiaobservac150CCDWright.html>  
SCORPIO-2 – SAO RAS: [https://www.sao.ru/hq/lsvfo/devices/scorpio-2/descript\\_eng.html](https://www.sao.ru/hq/lsvfo/devices/scorpio-2/descript_eng.html)  
SPITZER – IRAC: <https://irsa.ipac.caltech.edu/data/SPITZER/docs/irac/>  
STELLA – WIFSI1: <https://www.aip.de/en/research/facilities/stella/instruments/>  
SUBARU – HSC: <https://hsc.mtk.nao.ac.jp/ssp/instrument/#hyper>  
TNG – DOLORES: <http://www.tng.iac.es/instruments/lrs/>  
TNG – NICS: <http://www.tng.iac.es/instruments/nics/>  
WENDELSTEIN – T-0.43M: [www.wendelstein-observatorium.de/wst\\_en.html#43cm](http://www.wendelstein-observatorium.de/wst_en.html#43cm)  
WENDELSTEIN – T-2.0M: [http://www.wendelstein-observatorium.de/wst\\_en.html#2m](http://www.wendelstein-observatorium.de/wst_en.html#2m)  
WHT – ACAM: <http://www.ing.iac.es/Astronomy/instruments/acam/>  
WHT – LIRIS: <http://www.ing.iac.es/Astronomy/instruments/liris/index.html>  
YAO-LIJIANG – YFOSC: <https://grandma.lal.in2p3.fr/observatories/gmq-2-4/>

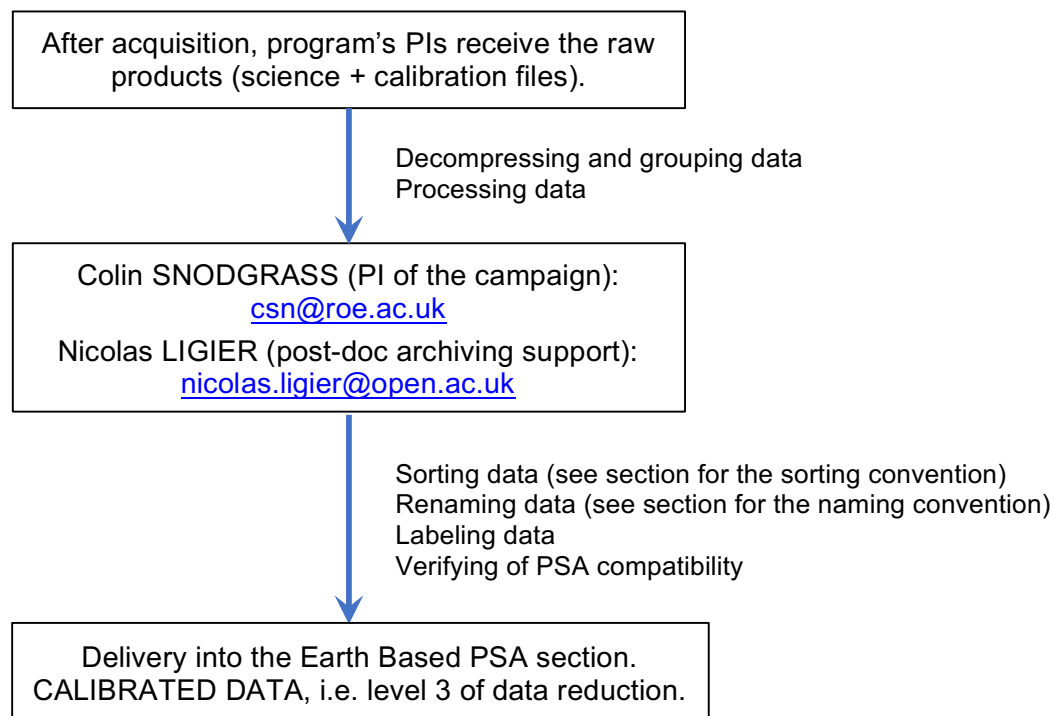
### 2.1 Scientific Objectives

Comets are commonly considered as the most pristine objects in the Solar System. From Mars 2014

until September 2016, the Rosetta spacecraft and its impressive payload (21 instruments in total, 11 on the orbiter and 10 on the lander *Philae*) was fully dedicated to the *in-situ* study of 67P's nucleus and its close environment, providing unprecedented results. Parallel to the Rosetta mission, a ground-based observation campaign including numerous instruments using some different scientific techniques was performed. The main scientific objectives of this very large coordinated campaign were to provide (1) essential data for mission planning, (2) large-scale context information for the coma far beyond, and (3) also a way to directly compare 67P with other comets.

This dataset is about instruments using imaging data that provides critical information about the shape and size of 67P's dust coma and tail, but also about the physical properties of the cometary grains. Such information allows to better constrain models for the cometary activity, especially by comparing the results with in-situ data from the Rosetta spacecraft.

## 2.2 Data Handling Process



## 2.3 Product Generation

See section 2.2. Contact Nicolas LIGIER (see section 1.9) for further information.

## 2.4 Overview of Data Products

### 2.4.1 Pre-Flight Data Products

N/A

### 2.4.2 Sub-System Tests

N/A

### 2.4.3 Instrument Calibrations

ESA's archiving policy is to ideally make available all the files that observers got during acquisitions. However, due to the huge amount that calibration files represent in this Earth based campaign, in agreement with ESA's archiving scientists, it has been decided to only archive calibration files that

are not already available on an existing archiving website. It is the case for most instruments in this dataset. In this case, a text file is provided in each sub-directory of the CALIB directory explaining how to request these calibration files. For some of these websites, an account need to be created before making a request for the files; if it is, the procedure is given in the text file mentioned previously. If existing, reduction pipelines available online are provided in the DOCUMENT subdirectory. These pipelines may be particularly complex and generally require the installation of specific packages. If existing, information is once again provided in the DOCUMENT subdirectory.

#### 2.4.4 Other Files written during Calibration

N/A

#### 2.4.5 Data Products

Science files and calibration files are the two types of data products in this dataset. Science products consist in cometary files (67P), sky references (SKY) and standard stars (STD), while calibration products generally correspond to flat files (FLAT), bias files (BIAS) and dark files (DARK). Some other additional subdivisions may exist, for example corresponding to the wavelength domain in which data were acquired (ex: "B" for blue, "R" for red, etc...). For every single file, the format used is always FIT.

#### 2.4.6 Software

As this delivery concerns calibrated data, additional software could be required (see section 2.4.3). Information about such software should be available on concerned websites. If not, and if required by reviewers, such software could be described in a new version of this EAICD.

#### 2.4.7 Documentation

The DOCUMENT folder provides every existing user manuals and data reduction pipeline manuals for the different instrument. When existing, published reference scientific paper will be also provided. Except this file (using the DOC format), the format of all the documentation is PDF.

Following is the list of the available PDF documents:

- EAICD\_C67PEARTH\_IMG\_V1\_0
- BNAO\_ROZHEN\_FORERO2\_REF\_N1
- BNAO\_ROZHEN\_FORERO2\_REF\_N2
- CA\_CAFOS\_USER\_GUIDE
- ESO\_NTT\_EFOSC\_USER\_MANUAL
- ESO\_TRAPPIST\_REF\_PAPER\_N1
- ESO\_TRAPPIST\_REF\_PAPER\_N2
- ESO\_VLT\_FOR2\_PIPELINES\_MANU
- ESO\_VLT\_FOR2\_REF\_PAPER
- ESO\_VLT\_FOR2\_USER\_MANU\_P99
- ESO\_VLT\_VIMOS\_REDUC\_MANU\_V7
- ESO\_VLT\_VIMOS\_USER\_MANU\_P98
- ESO\_VLT\_XSHOOTER\_REF\_PAPER
- ESO\_VLT\_XSHOOTER\_USER\_MANU
- GEMINI\_IRAF\_IMG\_REDUC\_TUTO
- GEMINI\_LOWELL\_DATA\_PAPER
- GEMINI\_N\_GMOS\_REF\_PAPER\_N1
- GEMINI\_N\_GMOS\_REF\_PAPER\_N2
- GEMINI\_N\_NIRI\_REDUC\_GUIDE
- GEMINI\_N\_NIRI\_REF\_PAPER
- GEMINI\_S\_FLAMING2\_RED\_BOOK
- GEMINI\_S\_FLAMING2\_REF\_PAPER
- GTC\_OSIRIS\_USER\_MANUAL\_V3
- IAO\_HCT\_HFOSC\_USER\_MANUAL
- IAO\_HCT\_HFOSC\_USER\_MANUAL
- INT\_POSTER\_PRESENTATION

- IRTF\_MORIS\_REFERENCE\_PAPER
- IRTF\_MORIS\_USER\_MANUAL
- IRTF\_SPEX\_REDUC\_TOOL\_MANUAL
- IRTF\_SPEX\_REF\_PAPER\_N1
- IRTF\_SPEX\_REF\_PAPER\_N2
- IRTF\_SPEX\_REF\_PAPER\_N3
- IRTF\_SPEX\_USER\_MANU
- KEPLER\_ARCHIVE\_MANUAL
- KEPLER\_DATA\_PROC\_HANDBOOK
- KEPLER\_INSTRUMENT\_HANDBOOK
- KEPLER\_OBSERVATION\_PROPOSAL
- LCOGT\_REFERENCE\_PAPER
- LOWELL\_DCT\_LMI\_USER\_MANUAL
- LOWELL\_DCT\_REFERENCE\_PAPER
- LT\_IOO\_REFERENCE\_PAPER
- LULIN\_LOT\_REFERENCE\_PAPER
- NEOWISE\_REFERENCE\_PAPER\_N1
- NEOWISE\_REFERENCE\_PAPER\_N2
- NOT\_OVERVIEW\_PRESENTATION
- OGS\_ESA\_BULLETIN
- OSN\_REFERENCE\_PAPER
- SAO\_RAS\_SCORPIO2\_REDUC\_N1
- SAO\_RAS\_SCORPIO2\_REDUC\_N2
- SAO\_RAS\_SCORPIO2\_REF\_PAPER
- SPITZER\_IRAC\_INST\_HANDBOOK
- SPITZER\_IRAC\_REF\_PAPER
- STELLA\_WFSIP1\_REF\_PAPER
- SUBARU\_HSC\_PIPELINE\_POSTER
- SUBARU\_HSC\_USER\_MANUAL
- TNG\_DOLORES\_INTERF\_MANUAL
- TNG\_DOLORES\_USER\_MANUAL
- TNG\_NICS\_USER\_GUIDE
- WENDELSTEIN\_REF\_PAPER1
- WENDELSTEIN\_REF\_PAPER2
- WENDELSTEIN\_REF\_PAPER3
- WENDELSTEIN\_REF\_PAPER4
- WENDELSTEIN\_SCIENCE\_PAPER
- WHT\_ACAM\_OVERVIEW
- WHT\_ACAM\_REFERENCE\_PAPER
- WHT\_LIRIS\_COOKBOOK
- YAO\_LIJIANG\_INTRO\_PAPER
- YAO\_LIJIANG\_PRESENTATION

#### 2.4.8 *Derived and other Data Products*

The ephemeris information of 67P/Churyumov-Gerasimenko during the campaign are given in the SPICE dataset in the PSA/PDS, with the following DATA\_SET\_ID: RO-RL-E-M-A-C-SPICE-6-[V1.0]. Most relevant information is located in the meta-kernel in the EXTRAS/MK/ directory of that dataset. Further details and information can be found in the SPICE dataset's DATA subdirectory.

#### 2.4.9 *Ancillary Data Usage*

N/A

## 3 Archive Format and Content

### 3.1 Format and Conventions

#### 3.1.1 Deliveries and Archive Volume Format

The volumes are organized the standard way, one data set on one volume. In consultation with archive scientists, we will produce separate volumes for EDR (**E**dit**D** **D**ata **R**ecord, raw data, level 2), RDR (**R**educed **D**ata **R**ecord, calibrated data, level 3) and DDR (**D**erived **D**ata **R**ecord, processed and evaluated data, level 4) data. Volumes will be delivered by FTP.

#### 3.1.2 Data Set ID Formation

At this moment: EAR-C-MULTI-3-67P-IMG-V1.0

- “EAR” is about the fact that the data come from Earth-based instruments,
- “C” is about the object’s type, in this case a Comet,
- “MULTI” is about the fact that the data come from multiple instruments,
- “3” is about the data reduction level, in this RDR which means reduced data,
- “67P” is about the target of the data, i.e. the comet 67P/Churyumov-Gerasimenko,
- “IMG” is about the scientific method employed to acquire the data, in this case imaging,
- and “V1.0” is about the version of this data set, in this case the version 1.0

#### 3.1.3 Data Directory Naming Convention

The directory tree of the “DATA” directory is divided into several subdirectories. In the case of this data set, there are three layers. From the most global to the most specific, these layers are:

- 1) The telescope name (ex: CA),
- 2) The instrument name (ex: CAFOS),
- 3) The date of acquisition, following the convention <year>\_<month>\_<day> (ex: 2015\_08\_14).

#### 3.1.4 Filenaming Convention

One of the main highlight of this Earth based observation campaign is certainly the huge diversity of telescopes (38) and instruments (62) involved. However, in terms of archiving, it represents the main difficulty as there is no worldwide file-naming convention. Consequently, no file-naming convention has been set up for this dataset, except that the data are all using the FIT format.

### 3.2 Standards Used in Data Product Generation

#### 3.2.1 PDS Standards

The PDS3 standards are used.

#### 3.2.2 Time Standards

The time standard used is UTC.

#### 3.2.3 Reference Systems

N/A

#### 3.2.4 Other Applicable Standards

N/A

### 3.3 Data Validation

Work in progress with ESA’s archive scientists.

## 3.4 Content

### 3.4.1 Volume Set

N/A

### 3.4.2 Data Set

See section 0 for further information on the data set naming convention.

### 3.4.3 Directories

#### 3.4.3.1 Root Directory

The root directory of the data set is equal to the DATA\_SET\_ID keyword value. It contains the files AAREADME.TXT and VOLDESC.CAT.

#### 3.4.3.2 Calibration Directory

According to the PDS standards, this directory has to be named "CALIB". It contains subdirectories for each instrument used and a file named CALINFO.TXT. Whatever the data set of the Earth based campaign of 67P, the CALIB directory is always organized with the following structure:

```
<CALIB >
||   <telescope name>
||       ||   <instrument name>
||       ||       ||   <acquisition date>
||       ||       ||   <acquisition date>
||   <telescope name>
||       ||   <instrument name>
||       ||       ||   <acquisition date>
||       ||       ||   ...
```

Some sub-subdirectories may exist depending on the type of files (BIAS, FLAT and DARK mostly) and other divisions based on parameters, such as the wavelength domain or the filter used, may also exist. However, no calibration files are available for the majority of the instruments. Instead, TXT files named INFO\_CALIB\_\*\*\* are provided to explain how to get the calibration files on existing archiving websites, if any.

#### 3.4.3.3 Catalog Directory

This directory contains standard PDS catalog files:

- CATALOG.TXT
- DATASET.CAT
- INST\_ACAM.CAT
- INST\_ALFOSC.CAT
- INST\_CAFOS.CAT
- INST\_CCDT90.CAT
- INST\_CCDT150.CAT
- INST\_EFOSC2.CAT
- INST\_FLAMINGOS2.CAT
- INST\_FORERO2.CAT
- INST\_FOR2.CAT
- INST\_GMOSN.CAT
- INST\_GMOSS.CAT
- INST\_HFOSC.CAT
- INST\_HSC.CAT
- INST\_I0046.CAT
- INST\_I1092.CAT



- INST\_I1093.CAT
- INST\_IOO.CAT
- INST\_IRAC.CAT
- INST\_KEPLERPHOT.CAT
- INST\_LCOGT\_CTIO\_SBIG78.CAT
- INST\_LCOGT\_CTIO\_SINIS03.CAT
- INST\_LCOGT\_CTIO\_SINIS04.CAT
- INST\_LCOGT\_HO\_MEROPE.CAT
- INST\_LCOGT\_MCD\_SBIG74.CAT
- INST\_LCOGT\_MCD\_SINIS05.CAT
- INST\_LCOGT\_SAAO\_SBIG70.CAT
- INST\_LCOGT\_SAAO\_SBIG76.CAT
- INST\_LCOGT\_SSO\_SBIG71.CAT
- INST\_LIRIS.CAT
- INST\_LMI.CAT
- INST\_LOTCCD.CAT
- INST\_MORIS.CAT
- INST\_MOSCA.CAT
- INST\_NASACAM.CAT
- INST\_NEOWISEDET.CAT
- INST\_NIRI.CAT
- INST\_OSIRIS.CAT
- INST\_SCORPIO2.CAT
- INST\_SDC.CAT
- INST\_STANCAM.CAT
- INST\_TRAPPCCDS.CAT
- INST\_UNIDDET.CAT
- INST\_VIMOS.CAT
- INST\_WFC.CAT
- INST\_WIFSIP.CAT
- INST\_WWFI.CAT
- INST\_XSHOOTER.CAT
- INSTHOST\_BNAO2M.CAT
- INSTHOST\_CAO22M.CAT
- INSTHOST\_CAO35M.CAT
- INSTHOST\_DCT.CAT
- INSTHOST\_GEMININ.CAT
- INSTHOST\_GEMINIS.CAT
- INSTHOST\_GTC.CAT
- INSTHOST\_IAOHCT.CAT
- INSTHOST\_KEPLER.CAT
- INSTHOST\_LCOGT\_CTI1004.CAT
- INSTHOST\_LCOGT\_CTI1005.CAT
- INSTHOST\_LCOGT\_CTI1009.CAT
- INSTHOST\_LCOGT\_HO10.CAT
- INSTHOST\_LCOGT\_MCD10.CAT
- INSTHOST\_LCOGT\_SAAO1010.CAT
- INSTHOST\_LCOGT\_SAAO1013.CAT
- INSTHOST\_LCOGT\_SSO.CAT
- INSTHOST\_LIJIANG24M.CAT
- INSTHOST\_LOWELL31IN.CAT
- INSTHOST\_LULIN1M.CAT
- INSTHOST\_NAOJSUBARU.CAT
- INSTHOST\_NEOWISE.CAT
- INSTHOST\_OBS056T9.CAT
- INSTHOST\_OBS060T1.CAT

- INSTHOST\_OBS060T3.CAT
- INSTHOST\_OBS270T7.CAT
- INSTHOST\_OBS376T3.CAT
- INSTHOST\_OGS.CAT
- INSTHOST\_OSN15M.CAT
- INSTHOST\_OSN90CM.CAT
- INSTHOST\_RDLMINT.CAT
- INSTHOST\_RDLMLT.CAT
- INSTHOST\_SAOBTA.CAT
- INSTHOST\_SPITZER.CAT
- INSTHOST\_STELLA.CAT
- INSTHOST\_TRAPPIST.CAT
- INSTHOST\_WHT.CAT
- INSTHOST\_WO2M.CAT
- MISSION.CAT
- REF.CAT
- SOFTWARE.CAT

#### 3.4.3.4 Index Directory

This directory contains standard PDS index files:

- INDXINFO.TXT
- INDEX.LBL
- INDEX.TAB

#### 3.4.3.5 Browse Directory and Browse Files

No browse files so no browse directory.

#### 3.4.3.6 Geometry Directory

N/A

#### 3.4.3.7 Software Directory

N/A

#### 3.4.3.8 Gazetteer Directory

N/A

#### 3.4.3.9 Label Directory

N/A

#### 3.4.3.10 Document Directory

Along with the DOCINFO.TXT, we provide documents using the PDF or DOC formats. Inside the latter document(s), images are referenced and stored in extra files using the PNG format. All the documents exclusively relative to the instruments are stored in a subdirectory named "INSTDOC".

#### 3.4.3.11 Extras Directory

N/A

#### 3.4.3.12 Data Directory

Whatever the data set of the Earth based campaign of 67P, the DATA directory is always organized with the following structure:

<DATA>

```
|| <telescope name>
|| || <instrument name>
|| || || <acquisition date>
|| || || <acquisition date>
|| <telescope name>
|| || <instrument name>
|| || || <acquisition date>
|| || || ...
```

Some sub-subdirectories may exist depending on the type of files (67P, STD) and other divisions based on parameters, such as the wavelength domain (H, K, J, etc..), channels (CH1, CH2) or filters (G, I, R, Z, etc...), may exist. Finally, the OBSERVING\_NOTES.TXT file is given in the DATA directory. This document provides a fixed table containing general information about the data archived.

## 4 Detailed Interface Specifications

### 4.1 Structure and Organization Overview

The structure and the organization are already defined in earlier sections (0 and 3.4.3.12).

### 4.2 Data Sets, Definition and Content

Most of the content of the data set corresponds to the data. Each data file uses the FIT format and is associated to a LBL file containing information useful to understand the data file and contextualize its acquisition. Following is a table summing the different observations per telescope and per instrument.

Telescope	Instrument	Number of filter(s) used	Program ID	Principal investigator's name(s)
BNAO-ROZHEN	FORERO2	1	-	G. BORISOV and P. NIKOLOV
CA	CAFOS	1	-	F. MORENO
CA	MOSCA	1	-	F. MORENO
ESO	TRAPPIST	-	-	E. JEHIN
ESO-NTT	EFOSC	1	194.C-0207	P. LACERDA
ESO-VLT	FORS2	-	093.C-0593 094.C-0054 096.C-0821 097.C-0201 592.C-0924 595.C-0066	S. BAGNULO, C. SNODGRASS and M. TAYLOR
ESO-VLT	VIMOS	4 (reds): vm-R-1.5, vm-R-2.5, vm-R-3.5 and vm-R-4.5	097.C-0472	A. FITZSIMMONS
ESO-VLT	XSHOOTER	1	094.C-0054	C. SNODGRASS
GEMINI-NORTH	GMOS	4: G, I, R and Z	GN-2016A-Q-53	M.M. KNIGHT
GEMINI-NORTH	NIRI	3: J, H and K	GN-2015B-Q-53 GN-2016A-Q-53	M.M. KNIGHT
GEMINI-SOUTH	FLAMINGOS2	3: J, H and K	GS-2014B-Q-15 GS-2015A-Q-54	M.M. KNIGHT
GEMINI-SOUTH	GMOS	4: G, I, R and Z	GS-2014B-Q-76	M.M. KNIGHT
GTC	OSIRIS	-	-	C. SNODGRASS
IAO-HCT	HFOSC	2: I and R	HCT-Cyc-P08	A.K. SEN
INT	WFC	-	-	A. FITZSIMMONS, S.C. LOWRY and C. SNODGRASS
IRTF	MORIS	-	-	Y. RAMANJOOLOO
IRTF	SPEX	-	-	S. PROTOPAPA and Y. RAMANJOOLOO

KEPLER	-	-	-	C. SNODGRASS
LCOGT	-	-	-	T. LISTER
LOWELL-31inch	NASA cam	2: R and CN	-	M.M. KNIGHT
LOWELL-DCT	LMI	2: R and CN	-	M.M. KNIGHT
LT	IO:O	4: G, I, R and Z	PL15A23 IL15B01a	G. JONES and C. SNODGRASS
LT	SPRAT	2: Blue, Red	PL15A23 IL15B01a	C. SNODGRASS and G. JONES
LULIN	LOT	Many different filters (see file's header).	-	Z.Y. LIN
NEOWISE	-	2: W1 (3.368 $\mu$ m) and W2 (4.618 $\mu$ m)	-	A. MAINZER and J. BAUER
NOT	ALFOSC	Many different filters (see file's header).	-	H. LEHTO and B. ZAPRUDIN
NOT	STANCAM	2: R and V	-	H. LEHTO and B. ZAPRUDIN
OGS	SDC	1	-	D. KOSCHNY
OSN	CCD-0.90M	-	-	F. MORENO
OSN	CCD-1.50M	-	-	F. MORENO
SAO-RAS-BTA	SCORIO2	2: G and R	-	N. KISELEV, V. ROSENBUSH and A. IVANOVA
SPITZER	IRAC	2: CH1 (3.6 $\mu$ m) and CH2 (4.5 $\mu$ m)	11106	M.S.P. KELLEY
STELLA	WIFSIP1	-	-	C. SNODGRASS
SUBARU	HSC	1	o16612	M. YAGI
TNG	DOLORES	Many different filters (see file's header).	A31TAC_16 ITP15_6	G.P. TOZZI and C. SNODGRASS
TNG	NICS	-	-	G.P. TOZZI and C. SNODGRASS
WENDELSTEIN	T-0.43M	-	-	H. BOEHNHARDT
WENDELSTEIN	T-2.0M	-	-	H. BOEHNHARDT
WHT	ACAM	-	-	A. FITZSIMMONS and C. SNODGRASS
WHT	LIRIS	-	-	C. SNODGRASS
YAO-LIJIANG	YFOSC	Many different filters (see file's header).	-	Z.Y. LIN

Table 1 - List of instruments, with main information, involved in this dataset. Rows highlighted in red show data that are not ready for delivery yet, while rows in yellow highlights partial delivery.

## 4.3 Data Product Design

### 4.3.1 File Characteristics Data Elements

Following is an example of the file characteristics data elements section existing in a LBL file:

```
RECORD_TYPE      = FIXED_LENGTH
RECORD_BYTES     = 2880
FILE_RECORDS     = 9953
FILE_NAME        = "MRG_N20160216S0249.FIT"
DATA_FORMAT      = FITS
```

Every LBL file in the "DATA" directory contains the keywords `RECORD_TYPE`, `RECORD_BYTES`, `FILE_RECORDS`, `FILE_NAME` and `DATA_FORMAT`. In the case of this data set, the fixed length record type and the fits data format are always used and the record bytes is constantly equal to 2880. Thus, only the `FILE_RECORDS` and the `FILE_NAME` keywords differ between the LBL file.

### 4.3.2 Data Object Pointers Identification Data Elements

Following is an example of the data object pointers identification data elements existing in a LBL file:

```
^HEADER          = ("MRG_N20160216S0249.FIT",1)
^IMAGE           = ("MRG_N20160216S0249.FIT",8)
```

Since attached LBL file are used, pointers refer to a position in the corresponding FIT file.

### 4.3.3 Instrument and Detector Descriptive Data Elements

Following is an example of the keywords contained in a LBL file describing the main characteristics of the instrument and the telescope used to acquire the data:

```
INSTRUMENT_HOST_ID = "GEMINI-N"
INSTRUMENT_HOST_NAME = "GEMINI NORTH OBSERVATORY 8.1-M GEMINI
                        RITCHEY-CHRETIEN ALTAZIMUTH REFLECTOR"
INSTRUMENT_ID      = "GMOS-N"
INSTRUMENT_NAME     = "GEMINI MULTI-OBJECT SPECTROGRAPH - NORTH (GMOS-N)"
TELESCOPE_DIAMETER = 8.1 <m>
TELESCOPE_LATITUDE  = +19.8238 <deg>
TELESCOPE_LONGITUDE = -155.4691 <deg>
```

### 4.3.4 Structure Definition of Instrument Parameter Objects

N/A

### 4.3.5 Data Object Definition

Following is an example of the data object definition section existing in a LBL file:

```
OBJECT          = HEADER
  BYTES          = 20160
  HEADER_TYPE    = FITS
  INTERCHANGE_FORMAT = BINARY
  RECORDS        = 7
  DESCRIPTION    = "Header of the file"
END_OBJECT
OBJECT          = IMAGE
  OFFSET         = 0          /* expected value as no info in header */
  SCALING_FACTOR = 1          /* expected value as no info in header */
  LINE_SAMPLES   = 3108      /* NAXIS1 header */
  LINES          = 2304      /* NAXIS2 header */
  UNIT           = "DATA NUMBER"
  SAMPLE_BITS    = 32        /* BITPIX header */
  SAMPLE_TYPE    = IEEE_REAL
  LINE_DISPLAY_DIRECTION = UP
  SAMPLE_DISPLAY_DIRECTION = RIGHT
  DESCRIPTION    = "GEMINI-NORTH GMOS calibrated file"
END_OBJECT
```

#### *4.3.6 Description of Instrument*

N/A

#### *4.3.7 Parameters Index File Definition*

The index files are automatically generated by the PVV program

#### *4.3.8 Mission Specific Keywords*

Following are an example of specific, additional keywords that may be useful to scientists working on such Earth based cometary observation program:

```
TARGET_HELIOCENTRIC_DISTANCE = 2.4 <AU>  
GEOCENTRIC_DISTANCE = 1.5 <AU>
```

These keywords may be primordial to contextualize and interpret the data.

## **5 Appendix: Available Software to read PDS files**

N/A

## **6 Appendix: Example of Directory Listing of Data Set X**

N/A