European Space Agency

To Planetary Science Archive
Interface control document

[Rosetta] - [Earth Based]

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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

ACAM	**A**uxiliary-port **CAM**era
ALFOSC	**Al**hambra **F**aint **O**bject **S**pectrograph and **C**amera
arcsec	**arc-sec**ond
BNAO	**B**ulgarian **N**ational **A**stronomical **O**bservatory
BTA	**B**ig **T**elescope **A**lt-azimuthal
CA	**C**alar **A**lto
CAFOS	**C**alar **A**lto **F**aint **O**bject **S**pectrograph
CCD	**C**harge **C**oupled **D**evice
DCT	**D**iscovery **C**hannel **T**elescope
Disp.	**Disp**ersion
DOLORES	**D**evice **O**ptimized for the **LO**w **RES**olution
EFOSC	**ESO** **F**aint **O**bject **S**pectrograph and **C**amera
ESO	**E**uropean **S**outhern **O**bservatory
FIT	**F**lexible **I**mage **T**ransport
FoReRo2	**Fo**cal-**Re**ducer-**Ro**zhen-**2**-channel
FORS2	**FO**cal **R**educer and low dispersion **S**pectrograph **2**
GMOS	**G**emini **M**ulti-**O**bject **S**pectrograph
GTC	**G**ran **T**elescopio **C**anarias
HCT	**H**imalayan **C**handra **T**elescope
HFOSC	**H**imalayan **F**aint **O**bject **S**pectrograph and **C**amera

HSC	**H**yper **S**uprime-**C**am
IAO	**I**ndian **A**stronomical **O**bservatory
INT	**I**saac **N**ewton **T**elescope
IO:O	**I**nfrared **O**ptical : **O**ptics
IRAC	**I**nfra**R**ed **A**rray **C**amera
IRTF	**I**nfra**R**ed **T**elescope **F**acility
LCOGT	**L**as **C**umbres **O**bservatory **G**lobal **T**elescope
LIRIS	**L**ong-slit **I**ntermediate **R**esolution **I**nfrared **S**pectrograph
LMI	**L**arge **M**onolithic **I**mager
LT	**L**iverpool **T**elescope
LOT	**L**ulin **O**ne-meter **T**elescope
MOSCA	**M**ulti **O**bject **S**pectroscopy **C**alar **A**lto
MORIS	**M**IT **O**ptical **R**apid **I**maging **S**ystem
NASACAM	**NASA CAM**ERA
NEOWISE	**NEO W**ide-field **I**nfrared **S**urvey **E**xplorer
NICS	**N**ear **I**nfrared **C**amera **S**pectrometer
NIRI	**N**ear **I**nfra**R**ed **I**mager
NOT	**N**ordic **O**ptical **T**elescope
NTT	**N**ew **T**echnology **T**elescope
OGS	**O**ptical **G**round **S**tation
OSIRIS	**O**ptical **S**ystem for **I**maging & low-intermediate **R**esolution **I**maging **S**pectroscopy
OSN	**O**bservatorio de **S**ierra **N**evada
pix	**pix**el
PSA	**P**lanetary **S**cience **A**rchive
SAO RAS	**S**pecial **A**strophysical **O**bservatory of the **R**ussian **A**cademy of **S**ciences
SCORPIO-2	**S**pectral **C**amera with **O**ptical **R**educer for **P**hotometric and **I**nterferometric **O**bservations **- 2**
SDC	**S**pace **D**ebris observation **C**amera
SPRAT	**SP**ectrograph for the **R**apid **A**cquisition of **T**ransients
STELLA	**STELL**AR **A**ctivity robotic observatory
TNG	**T**elescopio **N**azionale **G**alileo
TRAPPIST	**TRA**nsiting **P**lanets and **P**lanetes**I**mals **S**mall **T**elescope
UT	**U**nit **T**elescope

UTC	**U**niversal **T**ime **C**oordinated
VIMOS	**VI**sible **M**ulti-**O**bject **S**pectrograph
VLT	**V**ery **L**arge **T**elescope
WHT	**W**illiam **H**erschel **T**elescope
WFC	**W**ide **F**ield **C**amera
WIFSIP1	**Wi**de **F**ield **S**TELLA **I**maging **P**hotometer **1**
Xshooter	**X-shooter**
YAO	**Y**unnan **A**stronomical **O**bservatory
YFOSC	**Y**AO **F**aint **O**bject **S**pectrograph and **C**amera

1.9 Contact Names and Addresses

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PSA Permanent point of contact: psahelp@cosmos.esa.int

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

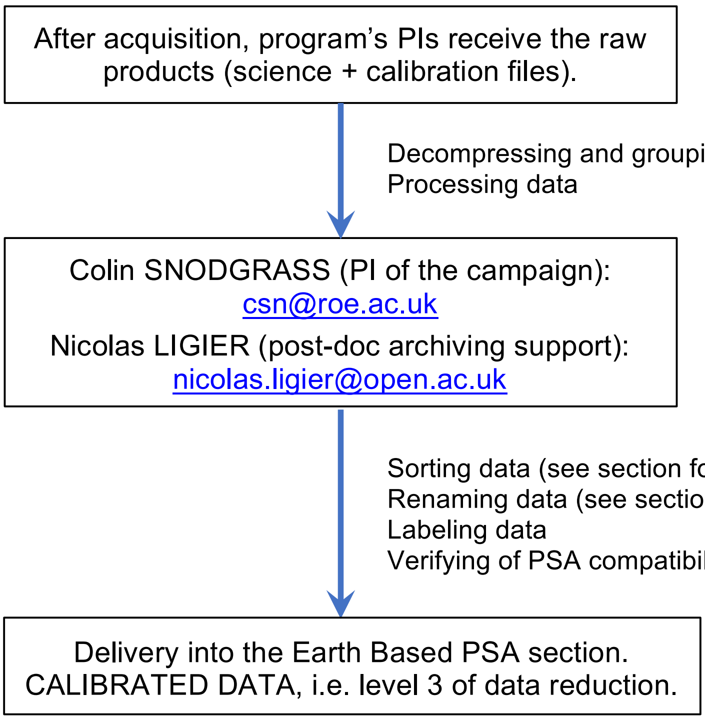
The main particularity, complexity, of this Earth based observation campaign relies on the numerous different telescopes and instruments involved in it: 62 instruments installed on 38 different telescopes were used in this campaign (see Snodgrass et al. 2017, table 1), thus allowing to get a large amount 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. More than 40 instruments (installed on almost 30 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/
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.iiap.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
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 – IO:O: http://telescope.livjm.ac.uk/TelInst/Inst/IOO/
LT – SPRAT: http://telescope.livjm.ac.uk/TelInst/Inst/SPRAT/
LULIN – LOT (Chinese) : http://www.lulin.ncu.edu.tw/
NEOWISE: https://neowise.ipac.caltech.edu/
NOT – ALFOSC: http://www.not.iac.es/instruments/alfosc/
NOT – STANCAM: http://www.not.iac.es/instruments/stancam/
OGS – SDC: http://vivaldi.ll.iac.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/lsfvo/devices/scorpio-2/descript_eng.html
SPITZER – IRAC: https://irsa.ipac.caltech.edu/data/SPITZER/docs/irac/
STELLA – WiFSIP1: 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
WENDELSTEIN – T-2.0M: 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/gmg-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 and 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). 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_FORS2_PIPELINE_MANU
- ESO_VLT_FORS2_REF_PAPER
- ESO_VLT_FORS2_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_LOGBOOK
- 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
- LCOGT_REFERENCE_PAPER
- LOWELL_DCT_LMI_USER_MANUAL
- LOWELL_DCT_REFERENCE_PAPER
- LT_IOO_REFERENCE_PAPER
- LT_SPRAT_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_WIFSIP1_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**dited **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-2-67P-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,
→ "2" is about the data reduction level, in this RDR which means raw 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 3.1.3 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. In the precise case of this data set, there is no calibration file in the subdirectories as all the calibration files are provided in the level 3 dataset, here: EAR-C-MULTI-3-67P-IMG-V1.0. The CALINFO.TXT file provides supplementary information about how to get the primary calibration files.

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_FORS2.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 (3.1.3 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 (3.368µm) and W2 (4.618µm)	-	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 (3.6µm) and CH2 (4.5µm)	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 yellow show data that are not existing at raw level (only reduced level and beyond).

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          =  5244
FILE_NAME             = "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:

```
^EXT1_PRIMARY_HEADER = ("N20160216S0249.FIT",1)
^EXT1_IMAGE          = ("N20160216S0249.FIT",9)
^EXT2_IMAGE_HEADER   = ("N20160216S0249.FIT",880)
^EXT2_IMAGE          = ("N20160216S0249.FIT",882)
^EXT3_IMAGE_HEADER   = ("N20160216S0249.FIT",1753)
^EXT3_IMAGE          = ("N20160216S0249.FIT",1755)
^EXT4_IMAGE_HEADER   = ("N20160216S0249.FIT",2626)
^EXT4_IMAGE          = ("N20160216S0249.FIT",2628)
^EXT5_IMAGE_HEADER   = ("N20160216S0249.FIT",3499)
^EXT5_IMAGE          = ("N20160216S0249.FIT",3501)
^EXT6_IMAGE_HEADER   = ("N20160216S0249.FIT",4372)
^EXT6_IMAGE          = ("N20160216S0249.FIT",4374)
```

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                =  EXT1_PRIMARY_HEADER
  BYTES                     =  23040
  HEADER_TYPE               =  FITS
  INTERCHANGE_FORMAT        =  BINARY
  RECORDS                   =  8
  DESCRIPTION               = "Primary header of the file and of the image #1"
END_OBJECT            =  EXT1_PRIMARY_HEADER
OBJECT                =  EXT1_IMAGE
```

```
    OFFSET                   =  32768                          /* BZERO header */
    SCALING_FACTOR           =  1                             /* BSCALE header */
    LINE_SAMPLES             =  544                           /* NAXIS1 header */
    LINES                    =  2304                          /* NAXIS2 header */
    UNIT                     = "DATA NUMBER"
    SAMPLE_BITS              =  16                            /* BITPIX header */
    SAMPLE_TYPE              =  MSB_UNSIGNED_INTEGER
    LINE_DISPLAY_DIRECTION   =  UP
    SAMPLE_DISPLAY_DIRECTION =  RIGHT
    DESCRIPTION              = "GEMINI-NORTH GMOS raw science file: ext.#1/6"
  END_OBJECT           =  EXT1_IMAGE
  OBJECT               =  EXT2_IMAGE_HEADER
    BYTES                    =  5760
    HEADER_TYPE              =  FITS
    INTERCHANGE_FORMAT       =  BINARY
    RECORDS                  =  2
    DESCRIPTION              = "Header of the image #2 of the file"
  END_OBJECT           =  EXT2_IMAGE_HEADER
  OBJECT               =  EXT2_IMAGE
    OFFSET                   =  32768                          /* BZERO header */
    SCALING_FACTOR           =  1                             /* BSCALE header */
    LINE_SAMPLES             =  544                           /* NAXIS1 header */
    LINES                    =  2304                          /* NAXIS2 header */
    UNIT                     = "DATA NUMBER"
    SAMPLE_BITS              =  16                            /* BITPIX header */
    SAMPLE_TYPE              =  MSB_UNSIGNED_INTEGER
    LINE_DISPLAY_DIRECTION   =  UP
    SAMPLE_DISPLAY_DIRECTION =  RIGHT
    DESCRIPTION              = "GEMINI-NORTH GMOS raw science file: ext.#2/6"
  END_OBJECT           =  EXT2_IMAGE
  OBJECT               =  EXT3_IMAGE_HEADER
    BYTES                    =  5760
    HEADER_TYPE              =  FITS
    INTERCHANGE_FORMAT       =  BINARY
    RECORDS                  =  2
    DESCRIPTION              = "Header of the image #3 of the file"
  END_OBJECT           =  EXT3_IMAGE_HEADER
  OBJECT               =  EXT3_IMAGE
    OFFSET                   =  32768                          /* BZERO header */
    SCALING_FACTOR           =  1                             /* BSCALE header */
    LINE_SAMPLES             =  544                           /* NAXIS1 header */
    LINES                    =  2304                          /* NAXIS2 header */
    UNIT                     = "DATA NUMBER"
    SAMPLE_BITS              =  16                            /* BITPIX header */
    SAMPLE_TYPE              =  MSB_UNSIGNED_INTEGER
    LINE_DISPLAY_DIRECTION   =  UP
    SAMPLE_DISPLAY_DIRECTION =  RIGHT
    DESCRIPTION              = "GEMINI-NORTH GMOS raw science file: ext.#3/6"
  END_OBJECT           =  EXT3_IMAGE
  OBJECT               =  EXT4_IMAGE_HEADER
    BYTES                    =  5760
    HEADER_TYPE              =  FITS
    INTERCHANGE_FORMAT       =  BINARY
    RECORDS                  =  2
    DESCRIPTION              = "Header of the image #4 of the file"
  END_OBJECT           =  EXT4_IMAGE_HEADER
  OBJECT               =  EXT4_IMAGE
    OFFSET                   =  32768                          /* BZERO header */
    SCALING_FACTOR           =  1                             /* BSCALE header */
    LINE_SAMPLES             =  544                           /* NAXIS1 header */
    LINES                    =  2304                          /* NAXIS2 header */
    UNIT                     = "DATA NUMBER"
    SAMPLE_BITS              =  16                            /* BITPIX header */
```

```
    SAMPLE_TYPE               =  MSB_UNSIGNED_INTEGER
    LINE_DISPLAY_DIRECTION    =  UP
    SAMPLE_DISPLAY_DIRECTION =  RIGHT
    DESCRIPTION               = "GEMINI-NORTH GMOS raw science file: ext.#4/6"
  END_OBJECT           =  EXT4_IMAGE
  OBJECT               =  EXT5_IMAGE_HEADER
    BYTES                     =  5760
    HEADER_TYPE               =  FITS
    INTERCHANGE_FORMAT        =  BINARY
    DESCRIPTION               = "Header of the image #5 of the file"
  END_OBJECT           =  EXT5_IMAGE_HEADER
  OBJECT               =  EXT5_IMAGE
    OFFSET                    =  32768                    /* BZERO header */
    SCALING_FACTOR            =  1                       /* BSCALE header */
    LINE_SAMPLES              =  544                     /* NAXIS1 header */
    LINES                     =  2304                    /* NAXIS2 header */
    UNIT                      = "DATA NUMBER"
    SAMPLE_BITS               =  16                      /* BITPIX header */
    SAMPLE_TYPE               =  MSB_UNSIGNED_INTEGER
    LINE_DISPLAY_DIRECTION    =  UP
    SAMPLE_DISPLAY_DIRECTION =  RIGHT
    DESCRIPTION               = "GEMINI-NORTH GMOS raw science file: ext.#5/6"
  END_OBJECT           =  EXT5_IMAGE
  OBJECT               =  EXT6_IMAGE_HEADER
    BYTES                     =  5760
    HEADER_TYPE               =  FITS
    INTERCHANGE_FORMAT        =  BINARY
    RECORDS                   =  2
    DESCRIPTION               = "Header of the image #6 of the file"
  END_OBJECT           =  EXT6_IMAGE_HEADER
  OBJECT               =  EXT6_IMAGE
    OFFSET                    =  32768                    /* BZERO header */
    SCALING_FACTOR            =  1                       /* BSCALE header */
    LINE_SAMPLES              =  544                     /* NAXIS1 header */
    LINES                     =  2304                    /* NAXIS2 header */
    UNIT                      = "DATA NUMBER"
    SAMPLE_BITS               =  16                      /* BITPIX header */
    SAMPLE_TYPE               =  MSB_UNSIGNED_INTEGER
    LINE_DISPLAY_DIRECTION    =  UP
    SAMPLE_DISPLAY_DIRECTION =  RIGHT
    DESCRIPTION               = "GEMINI-NORTH GMOS raw science file: ext.#6/6"
  END_OBJECT           =  EXT6_IMAGE
```

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