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FITS Template for: Solar Orbiter [INST] Low Latency Data Product Description Document

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APPROVAL

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DISTRIBUTION

Name/Organisational Unit
Solar Orbiter instrument teams
Solar Orbiter SOC



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1 INTRODUCTION

1.1 Purpose and Scope

This Low Latency Data Product Description Document (LLDPDD) describes the format and content of the [Instrument Name] ([INST]) Low Latency (LL) data. It includes descriptions of the data products and associated metadata, including the data format, content, and generation pipeline, in accordance with the Low Latency FITS ICD [LLFITSICD]. These products will be stored and distributed from the Solar Orbiter Science Archive (SOAR) of the SOC.

The specifications described in this LLDPDD apply to all [INST] Low Latency products generated by the instrument-provided pipeline running at the Solar Orbiter SOC, specified as LLo1 data. A similar document will be provided by the SOC, describing the [INST] LLo2 data that were generated at SOC after processing the LLo1 data.

This document only includes descriptions of Low Latency products generated at SOC. It does not address the Science data delivered by the Science pipelines run at the [Instrument Name] Team premises, as these data products shall be described in [DPDD].

1.2 Applicable Documents

[LLFITSICD] SOL-SGS-OTH-0003, Solar Orbiter Interface Control Document for Low Latency Data FITS Files

1.3 Reference Documents

[DPDD] Solar Orbiter [INST] Data Product Description Document, template available from SOL-SGS-OTH-0004-DPDDtemplate

[FITSDOC] Definition of the Flexible Image Transport System,
http://fits.gsfc.nasa.gov/standard30/fits_standard30aa.pdf

[METADATA] SOL-SGS-TN-0009, Metadata Definition for Solar Orbiter Science Data

[SEGU] SOL-SGS-TN-0006, SOC Engineering Guidelines for External Users

[SOAR] SOL-SGS-PL-0009, Solar Orbiter Archive Plan

1.4 Acronyms and Abbreviations

FITS	Flexible Image Transport System
LLo1	Low Latency Level 1
LLo2	Low Latency Level 2
SOAR	Solar Orbiter Archive



2 [INST] INSTRUMENT DESCRIPTION

High-level description of the instrument and instrument science objectives, with a reference to an external, publicly available instrument document (such as the instrument paper). The proposed structure for this section is indicated below (see sub-sections).

2.1 Science Objectives

Describe the instrument science objectives.

2.2 Operational Modes producing LL data

Description of the instrument modes, with references to the type of LL data products generated (defined in the following sections).

3 DATA GENERATION PROCESS

The [INST] LLo1 products are produced by the pipeline delivered by the [INST] Instrument Team and running at SOC. The data generation is described in this section.

The procedure for delivery of the LL data pipelines from the [INST] Instrument Team to the SOC must be fully compliant with the SOC Engineering Guidelines for External Users [SEGU].

SOC will host the instrument pipelines and retrieve the low latency data from MOC after downlink, passing it as input to the instrument pipelines. SOC will also post process the output of the pipelines, applying operations that will include, but not necessarily be limited to, time conversion from on-board time (OBT) to UTC and transformation of FOV parameters from instrument coordinates to an appropriate scientific coordinate system. SOC will not apply calibrations to the output of the instrument pipelines. SOC will also provide a simple web-based visualisation tool for the low latency. SOC will also distribute the low latency data files via the Solar Orbiter Archive, hosted at ESAC, following the policies described in the Archive Plan [SOAR].

3.1 Scientific Measurements

Top-level description of the data acquired by the instrument.

3.2 Data Flow Overview

This section will include a top-level description of the data processing workflow in the LL pipeline.

[Include Block Diagram showing the data sources and the processing steps]



4 DATA PRODUCT DESCRIPTIONS

[INST] LLO1 data products are formatted in accordance with the rules outlined in **[LLFITSICD]**. This section provides details on the filenames, formats and metadata for each of the products included in the **[INST]** LLO1 data.

4.1 General Data Format

The **[INST]** LLO1 data are formatted in FITS files with the following general structure:

[Describe the FITS structure that applies to all of the instrument's LLO1 data, e.g. common fields in the filename, common data structures in the FITS file (# of extensions, primary header, etc.)]

The following sections provide for each LLO1 data product a detailed description of the content and format, including for each product:

- Product filename
- Brief description of the data product. In the LLO2 Description Document, this text will be copied from the relevant LLO1 section.
- FITS structure
- FITS keywords in each header, with their values or valid ranges. Add links to any software that can extract these data from a FITS file.
- Expected cadence and dataset volume.

4.2 [Data Product Name]

Brief description of the content of the file type, its intended use and any general caveats.

Filename: solo_LL01_**[descriptor]**_**[timefield]**_V**[version]**_freefield.fits

Expected data volume and cadence: *volume per data product in MegaBytes + expected cadence*

FITS structure: *description of number of HDUs. The content and/or structure of all headers and data units shall be described in more detail below.*

Primary Header

[Use the template below to describe the metadata, based on the minimum set of mandatory keywords for LLO1 FITS files. Values in blue are fixed; other values can be replaced as appropriate.]

```
SIMPLE =                               T / file does conform to FITS standard
BITPIX =                               16 / number of bits per data pixel
NAXIS  =                               2 / number of data axes
NAXIS1 =                               1024 / length of data axis 1
NAXIS2 =                               1024 / length of data axis 2
```



```

EXTEND = F / whether the FITS file contains extensions
COMMENT -----
FILENAME= 'solo_LL01_eui-fsi174_0000086399_V201810121423C.fits' / FITS filename
DATE = '2018-10-12T14:23:57.167' / FITS file creation date in UTC
OBT-BEG = 0000086399.1234 / Start of acquisition time in OBT
TIMESYS = 'OBT' / System used for time keywords
COMMENT -----
LEVEL = 'LL01' / Processing level of the data
CREATOR = 'createfits' / FITS creation software
ORIGIN = 'Solar Orbiter SOC, ESAC' / Location where file has been generated
VERS_SW = '2.4' / Software version
VERSION = '201810121423' / Version of data product
COMPLETE= 'C' / 'C' if data complete, 'I' if incomplete
COMMENT -----
OBSRVTRY= 'Solar Orbiter' / Satellite name
TELESCOP= 'SOLO/EUI/FSI174' / Telescope/Sensor name
INSTRUME= 'EUI' / Instrument name
DETECTOR= 'FSI174' / Instrument subunit or sensor
OBS_MODE= 'SYNOPTIC' / Observation mode
WAVELNTH= 174 / [Angstrom] Peak wavelength
XPOSURE = 10. / [s] Total effective exposure time.
BUNIT = 'DN' / Units of physical value
DATAMIN = 10. / Minimum valid physical value
DATAMAX = 3599. / Maximum valid physical value
BLANK = -2147483648 / Value marking undefined pixels
PXBEG1 = 1 / First read-out pixel in 1st dimension
PXEND1 = 2048 / Last read-out pixel in 1st dimension
PXBEG2 = 1 / First read-out pixel in 2nd dimension
PXEND2 = 2048 / Last read-out pixel in 2nd dimension
NBIN1 = 2 / Binning factor in 1st dimension
NBIN2 = 2 / Binning factor in 2nd dimension
NBIN = 4 / Total binning factor
COMPRESS= 'WICOM' / Data compression used onboard
COMMENT -----
WCSNAME = 'InstrumentLOS' / Instrument line-of-sight reference frame
CTYPE1 = 'YLOS-TAN' / Description of first spatial axis.
CTYPE2 = 'ZLOS-TAN' / Description of second spatial axis.
CRPIX1 = 512.5 / Ref pixel at centre of image.
CRPIX2 = 512.5 / Ref pixel at centre of image.
CUNIT1 = 'arcsec' / Units along axis 1.
CUNIT2 = 'arcsec' / Units along axis 2.
CDELTA1 = 2.01165 / Pixel scale along axis 1 in unit CUNIT1.
CDELTA2 = 2.03521 / Pixel scale along axis 2 in unit CUNIT2.
CRVAL1 = 0. / First coordinate of ref pixel in unit CUNIT1.
CRVAL2 = 0. / Second coordinate of ref pixel in unit CUNIT2.
COMMENT -----
HISTORY createfits 238 / example of SWname and runID that created file
END

```

Primary Data array (if applicable)

Integer array 1024x1024



Extension 1, Secondary Header (if applicable)

Description of the metadata in the first secondary header, in similar format as for the primary header, conform [LLFITSICD] and extra keywords for FITS secondary headers described in [METADATA].

...

Extension n, Secondary Header (if applicable)

5 APPENDIX – [INST] LLo1 DATA PRODUCTS MATRIX

A table with a summary of the data products names and description.

Data Product	Description	Descriptor	Avg cadence	Expected Daily Vol