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ASTRI SST-2M Data Challenge: TC-03 at SLN
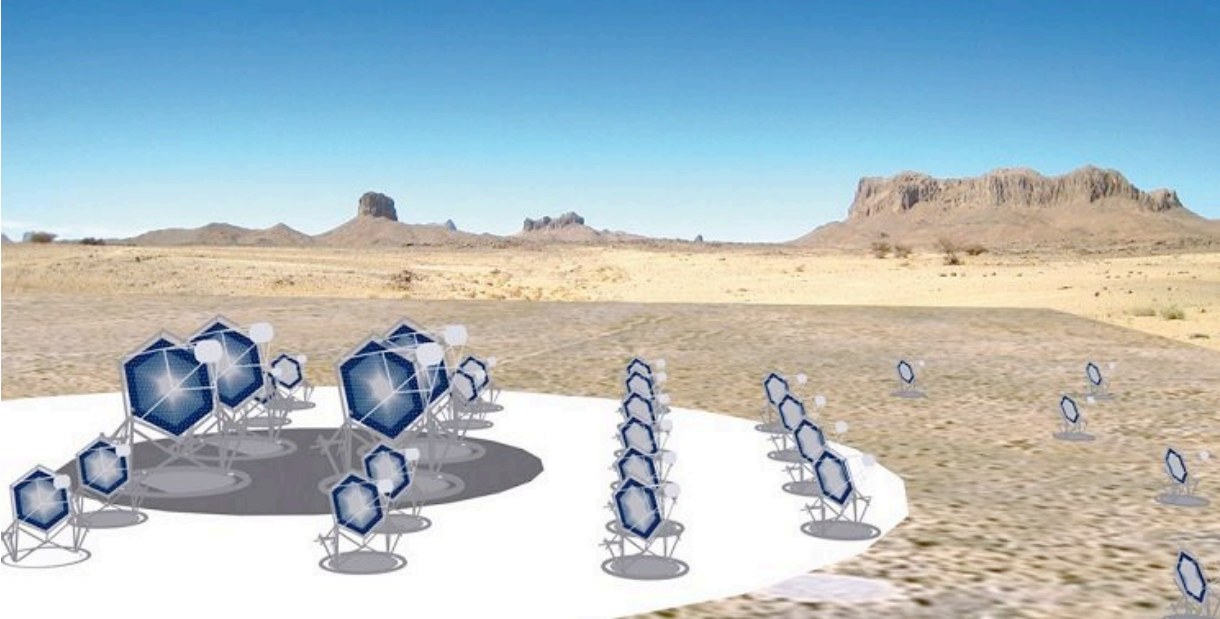
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DOCUMENT HYSTORY

Version	Date	Modifications
1.0	08/03/2016	First DRAFT Version
2.0	18/03/2016	Update on SCI-TECH0 architecture. Update on SCI-TECH0 content. Update on origin_id. Listed the TC-03 @ SLN data-set.
3.0	23/03/2016	Final version.

LIST OF ACRONYMS

2M	Dual-Mirror
ASTRI	Astrofisica con Specchi a Tecnologia Replicante Italiana
BEE	Back-End Electronics
CALDB	Calibration Data-Base
CTA	Cherenkov Telescope Array
DL	Data Level
FITS	Flexible Image Transport System
FoV	Field of View
HK	Housekeeping
I/F	Inter-face
MASS	Mini-Array Software System
OM	Operation Mode
OP	Operation Procedure
PEQ	Photon-electron Equivalent
SiPM	Silicon Photo Multiplier
SLN	Serra La Nave
SST	Small Size Telescope
SW	Software
TBC	To Be Confirmed
TBD	To Be Defined
TBW	To Be Written
TC	Test Case
TR	Test Report
TCP/IP	Transmission Control Protocol / Internet Protocol
VAR	Variance Packet

APPLICABLE DOCUMENTS

[AD1]   ASTRI-PRO-IASFPA-3300-001 – Issue 3.4 *"The ASTRI SST-2M Prototype: Reference Guide to the Operational Procedures"* – Lombardi et al., - 04/06/2015

[AD2]   ASTRI-SPEC-IASFPA-006 – Issue 10.0 *"ASTRI Operation Modes and High-Level User Requirements"* – Vercellone – 26/05/2014

[AD3]   ASTRI-IR-IASFBO-3700-026 – Issue 2.4 *"ASTRI Camera Server/ASTRI Camera Interface Control Document"* – Trifoglio et al., - 04/06/2015

[AD4]   ASTRI-DES-IASFPA-3200-008 – Issue 1.1 "*The ASTRI SST-2M Prototype: Geometry of the Focal Plane Camera*" – Capalbi & Maccarone – 02/07/2013

[AD5]   ASTRI-IR-OARM-3700-051 – Issue 5.2 "*Naming convention for the ASTRI Prototype data files*" – Lombardi & Lucarelli – 15/05/2014

[AD6]   ASTRI-IR-OARM-3700-037 – Issue 2.8 "*FITS data format for the ASTRI DL0 DATA*" – Lombardi et al., - 18/07/2014

[AD7]   ASTRI-TN-IASFPA-3000-025 – Issue 2.0 – *"ASTRI SST-2M Data Challenge: TC-03 – MC0, EVT0, CAL0, TECH0 & CALDB I/F with Analysis Pipelines"* – Vercellone – 25/03/2015

REFERENCE DOCUMENTS

[RD1]   "Archive Status" – Gallozzi – ASTRI MASS Meeting – Bologna, 18/06/2014

[RD2]   "ASTRI Data Management" – ASTRI MASS Meeting – Bologna, 02/02/2015

1.   INTRODUCTION

The ASTRI SST-2M Prototype will be a scientific and technological demonstrator for several innovative technologies, such as the two-mirror optical configuration and the SiPMs camera installed at the telescope focal plane.

We have installed the ASTRI SST-2M Prototype at the Serra la Nave Observing Station on Mt. Etna (Catania) in Fall 2014.

Although the ASTRI SST-2M prototype is mainly a technological demonstrator, it will perform scientific observations on the Crab Nebula, MRK 421 and MRK 501. Preliminary calculations show that in the maximum sensitivity range (E>1 TeV) we can detect a flux level of 1 Crab at 5-sigma in a few hours, while in the energy range E>10 TeV the same flux at 5-sigma can be reached in a few tens of hours.

A remarkable improvement in terms of performance could come from the operation, in 2017, of a SST-2M array of precursors, composed by 9 SST-2M Prototype replicas (whose design could be subject to an assessment phase) and proposed to be placed at final CTA Southern Site. The ASTRI SST-2M array of precursors will be able to study in great detail relatively bright sources (a few x 10^{-12} erg cm^{-2} s^{-1} at 10 TeV) with an angular resolution of a few arcmin and an energy resolution of about 10-15%, extending the current sensitivity up to 100 TeV.

Moreover, thanks to the array approach, it will be possible to verify the wide FoV performance to detect very high energy showers with the core located at a distance up to 500m, to compare the mini-array performance with the Monte Carlo expectations (by means of well chosen target objects and long observations), and to perform the first CTA science (thanks to, e.g., about five solid detections during the first year of operation).

2. SCOPE

In order to validate the software functionality and interfaces, a verification procedure has been planned, which is organized in a set of Test Cases.

This test case is a (partial) answer to the request of setting-up an ASTRI Data Challenge (see Minutes of the MASS SW VCONF, 2013-05-28).

This simplified scheme will allow us to perform a preliminary test case involving the first steps of the ASTRI SST-2M SW components that are related to the Data Handling.

The goal of this document is to provide a simplified scheme for the Test Case 03 at SLN.

This simplified scheme is based on the following basic assumptions.

1. The DL0-RAW data shall be compliant with respect to:
   - the **operation procedures,** as defined in [AD1];
   - the **operation modes,** as defined in [AD2] for each operation procedure;
   - the **format** and the **content** of the different data packets for each operation mode, as defined in [AD3], and mapping the ASTRI SST-2M camera geometry as defined in [AD4];
   - the **naming convention** as defined in [AD5].

2. The DL0-FITS data shall be compliant with respect to:
   - the **naming convention** as defined in [AD5];
   - the **format** as defined in [AD6].

3. The Archive shall be compliant with respect to:
   - the **architecture** as defined in [RD1].

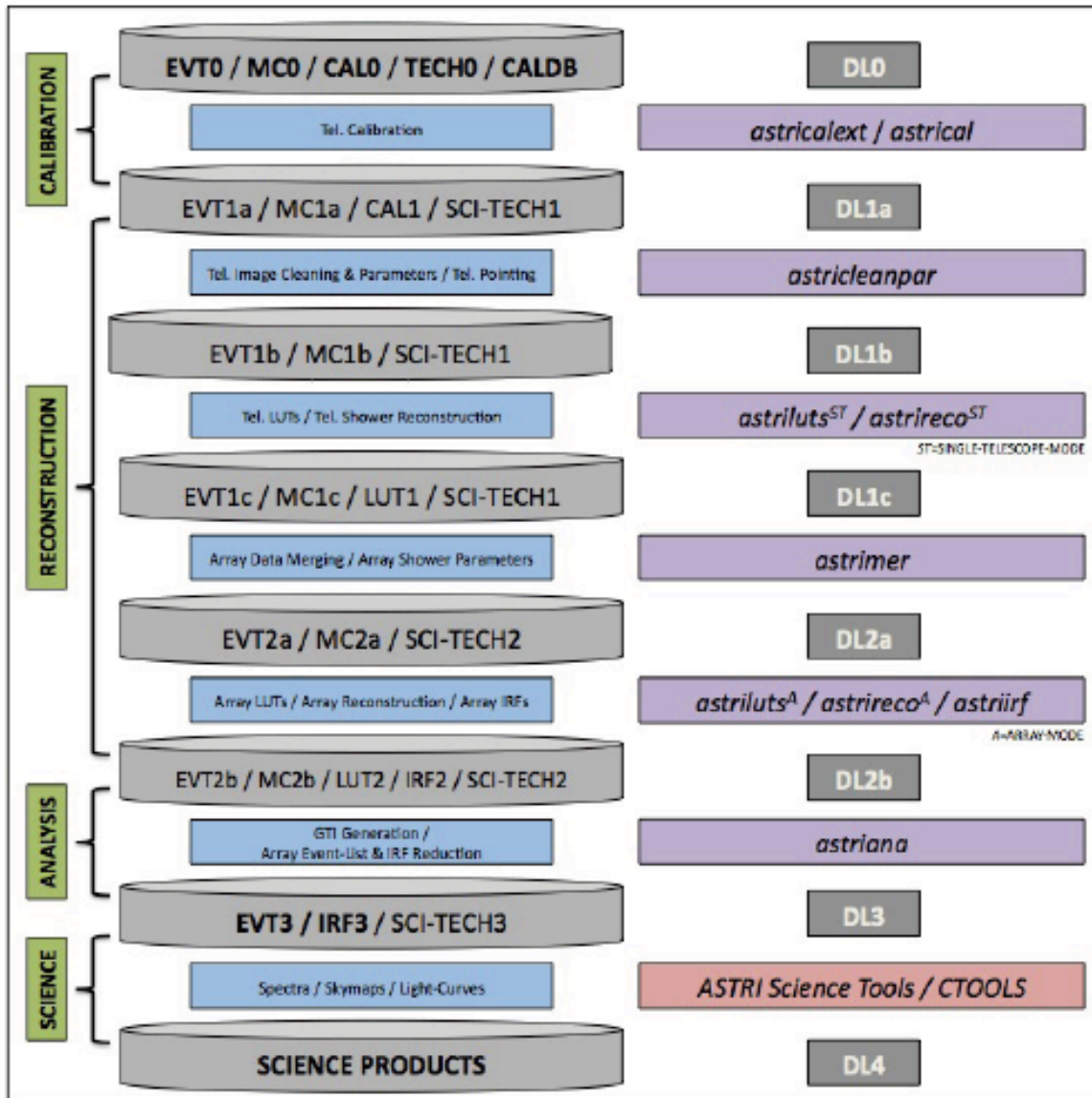Figure 1 shows the different ASTRI SST-2M and Mini-array Data Levels (DL) as discussed in [RD2].

Figure 1: Schematic flow of the ASTRI SST-2M data flow. From [RD2]

3. TEST CASE 03 at SLN (TC-03/SLN)

We describe here a simplified test case that can be run in order to verify several components of the ASTRI MASS SW.

TC-03/SLN is a non-blind test case. This means that the content of the RAW files will be known, in order to allow a preliminary test of the SW chain.

TC-03/SLN will, on a first approximation, test all the SW I/F with DL0 data, i.e. it will deal with EVT0, CAL0, and SCI-TECH0.

3.1 **TC-03/SLN Main Steps**

By means of TC-03/SLN we plan to simulate the data-flow during a routine scientific observation with its main steps down to the generation, handling, and archiving of the all the DL0 files:

1. Generation on N data packet files from the Camera BEE in L0-RAW format, in order to simulate the data contained in a baseline "data-taking procedure" (OP_006) as defined in [AD1]; the L0-RAW data-set is composed of the following files:
   1.1. C11v2.bin
        C12v2.bin
        C13.bin
        C14.bin
        S21.bin
        S22.bin
        VAR.bin
        HK.bin
2. Handling and archiving of the DL0-RAW data files and their conversion in DL0-FITS files format. All files shall be compliant w.r.t. their naming convention as defined in [AD5];
   2.1. Execution of a series of K1 test to validate the format, the content, and the archiving procedures applied at this stage, and the generation of their Reports.
3. Handling and archiving of the SCI-TECH0 data files. A memo on the SCI-TECH0 generation will be provided by OAR and archived in the TC-03 at SLN Redmine webpage.
   3.1. Generation of a series on K2 test reports to validate the format, the content, and the archiving procedures applied at this stage.

3.2 **TC-03/SLN: Data-Taking Procedure (OP_006)**

The data-taking Procedure OP_006 is detailed in [AD1], Section 2.3.

OP_006 is, on his turn, composed of three Sub-Procedures, OP_006.1 (Pre-Calibration), OP_006.2 (Data-Taking), and OP_006.3 (Post-Calibration), respectively.

3.3 **TC-03/SLN: Operation Modes relevant for OP_006**

The Data-Taking Procedure will be composed of several Operation Modes.

A detailed description of the ASTRI Operation Modes is given in [AD2].

3.4 **TC-03/SLN: The Test Case Data-set**

We plan to make use of the following L0-RAW data:

1. Camera BEE-like DL0-RAW (same data as delivered for TC-03 and described in [AD7]) archived at the INAF/IASFBO FTP server dedicated to ASTRI with path: /TEST_DATA/RAWDATA_TC03
2. SCI-TECH0 (Weather station and Mount).

For each Operation Sub-Procedure, different Operation Modes are envisaged. Moreover, for each Operation Mode, different Data Packets will be generated (both Science and Periodic Packets). For a detailed description, see [AD7].

We assume:

1. Origin_id = 01
2. Program_id = 003
3. Observation_id = 00001

A detailed description of Science and Periodic Packets is provided in AD[3].

3.5 **TC-03/SLN: Camera Server Data Handling and L0-RAW to L0-FITS Conversion**

We expect the following minimal steps to be performed:

1. Acquisition of the L0-RAW data stream (by means of a simplified and ad-hoc transfer medium).
2. Conversion of the L0-RAW data stream into L0-FITS files.
3. Temporary archiving of the L0-RAW and L0-FITS files (by means of a simplified and ad hoc medium) in the Camera Server Unit.
4. FTP transfer of the L0-RAW and L0-FITS files to the On-site FTP server (by means of a simplified and ad-hoc handshake mechanism).

3.5.1 **TC-03/SLN: Camera Server Data Handling and L0-RAW to L0-FITS Conversion Test Reports**

We expect the following Test Reports to be generated:

1. TR-03.01: Verification of the L0-RAW data stream.
2. TR-03.02: Verification of the successful L0-RAW to L0-FITS conversion both in terms of data content and data format.

3. TR-03.03: Verification of the correct temporary archiving of the L0-RAW and L0-FITS data files at Camera Server level.
4. TR-03.04: Verification of the correct FTP file transfer of L0-RAW and L0-FITS files to the FTP On-site server.

3.6 **TC-03/SLN: L0-RAW and L0-FITS Data Handling and Archiving Procedures**

We expect the following minimal steps to be performed:

1. Acquisition of the L0-RAW and L0-FITS files (by means of a simplified and ad-hoc transfer medium).
2. Archiving of the L0-RAW and L0-FITS files (according to the proper naming convention rules) at the On-Site Archive level.

3.6.1 **TC-03/SLN: L0-RAW and L0-FITS Data Handling and Archiving Procedures Test Reports**

We expect the following Test Reports to be generated:

1. TR-03.05: Verification of the correct acquisition of the L0-RAW and L0-FITS files.
2. TR-03.06: Verification of the correct archiving of the L0-RAW and L0-FITS data files (according to the proper naming convention rules) at the On-Site Archive level.

3.7 **TC-03/SLN: SCI-TECH0 Production and Archiving Procedures**

We expect the following minimal steps to be performed:

1. Generation of SCI-TECH0 files according to an ad-hoc procedure as detailed in MIN-TCON-1000-199.
2. Handling and archiving of SCI-TECH0 files (according to the proper naming convention rules) at the On-Site Archive Level.

3.7.1 **TC-03/SLN: SCI-TECH0 Production and Archiving Procedures Test Reports**

We expect the following Test Reports to be generated:

1. TR-03.07: Verification of the correct production of SCI-TECH0 files.
2. TR-03.08: Verification of the correct archiving of SCI-TECH0 files (according to the proper naming convention rules) at the On-Site Archive Level.

3.8 **TC-03/SLN: Delivered data files**

We plan to deliver L0-RAW data files for each packet type as described in [AD7] (see also Section 3.1).

3.9 **TC-03/SLN: Reference matrices/tables**

In order to verify the correctness of the TC-03/SLN data format and content a simple check ("diff" or other similar tools) will be applied w.r.t. the TC-03 files. If any discrepancy should occur, a more detailed set of tests will be performed, as described in [AD7].

4.   CONCLUSIONS

The completion of TC-03 at SLN will allow us to verify that all the I/F relevant for the data analysis pipelines are correct.

We will plan a series of Test Cases in order to complete -within the ASTRI SW Schedule- the design, the coding and the implementation of all the ASTRI SST-2M SW components.