

ASTRI Cherenkov Camera Interface Control Document



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ASTRI Mini-Array
Astrofisica con Specchi a Tecnologia Replicante Italiana



Code: ASTRI-INAF-ICD-7132-001

Issue

1.3

Date:

23/10/2020

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DOCUMENT HISTORY

Issue/Revision	Date	Modification
1.0	24/01/2019	First release
1.1	26/05/2020	Changed sections 3.2 and 3.3
1.2	19/10/2020	Changed to comply with the general document scheme for the ASTRI Mini-Array project
1.3	23/10/2020	Added section 3.4



1 Introduction

The ASTRI Mini-Array is an INAF project aimed to construct, deploy and operate a set of 9 Cherenkov telescopes of the 4 meters class at the Observatorio del Teide in Tenerife (IAC, Spain). The ASTRI Mini-Array will observe astronomical sources emitting at very high-energy in the TeV spectral band.

1.1 Purpose

This document is the Interface Control Document regulating the hardware interface between the ASTRI Mini-Array telescope and the ASTRI Cherenkov Camera. The ASTRI Camera will be delivered to the ASTRI telescope contractor by INAF.

1.2 Scope

This document describes the interfaces (mechanical, electrical and communication) of the ASTRI Cherenkov camera to the ASTRI telescope.

1.3 Content

Section 3 deal with the interfaces (mechanical, electrical and communication) of the ASTRI Cherenkov Camera to the ASTRI telescope.

1.4 Definitions and Conventions

1.4.1 Abbreviations and acronyms

ASTRI	Astrofisica con Specchi a Tecnologia Replicante Italiana
BEE	Back End Electronics
CoG	Center of Gravity
FEE	Front End Electronics
IAC	Instituto de Astrofisica de Canarias
INAF	Istituto Nazionale di Astrofisica
SiPM	Silicon Photo Multiplier
VDB	Voltage Distribution Board



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2 Related Documents

APPLICABLE DOCUMENTS

[AD1] ASTRI-INAF-ICD-7132-001 ICD for the Telescope Communication Hardware

REFERENCE DOCUMENTS

[RD1] ASTRI-DES-IASFPA-3200-008 Geometry of the Camera Focal Surface

[RD2] ASTRI-DES-IASFPA-3200-005 Camera Design Document

3 Cherenkov Camera Interface Document.

3.1 Mechanical Interface

This document specifies the mechanical interface between the ASTRI Camera and the ASTRI Telescope.

It is important to note that the mechanical envelope, the weight and the inertia momentum specified in this document refers to the current camera design and may be subject to change, due to the re-design process phase. No change is foreseen in the mechanical interface.

3.1.1 Local reference system, Center of Gravity (CoG) and weight of the camera

The Local Reference System used for the mechanical design of the ASTRI Camera has its origin in the hypothetical opto-mechanical centre of “entrance surface” of the upper surface of the central SiPM tile and the axes oriented as shown in Figure 1.

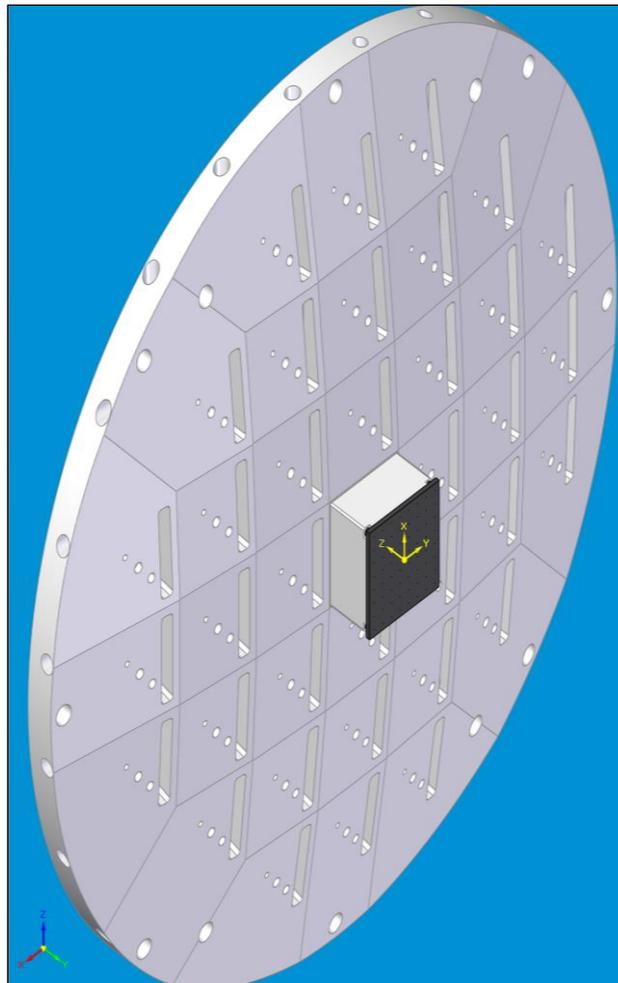


Figure 1. Local Coordinate System of the ASTRI Cherenkov camera

More precisely:



Z axis directed towards the primary mirror of the telescope

X axis parallel to the axis of elevation of the telescope (as defined in [RD1])

Y axis is the vertical axis completing the right-handed orthogonal set (azimuth).

In the current design, the ASTRI Camera CoG, in the Local Reference System, is located as shown in Table 1.

Table 1. Cherenkov Camera CoGs

	Lids Closed	Lids open
X (mm)	-0.11	-0.12
Y (mm)	-0.09	-0.66
Z (mm)	191.01	196.35

The total weight of the camera is 75.6 kg and includes:

- Electronics (BEE, FEE, VDB, ancillaries); mounted on board its dedicated mechanical sub-frame;
- Camera's cooling system;
- Lids, and relative electric set (motors, control boards, sensors);
- Connectors;
- Window and relative support;
- Calibration system.
- Gaskets, fasteners, mechanical ancillaries.

The moments of inertia are given in Table 2:

Table 2. Camera moments of inertia

	Lids Closed	Lids open
I1 (kg m ²)	3.56	3.61
I2 (kg m ²)	3.34	3.28
I3 (kg m ²)	3.03	3.14

For the overall dimensions of the current 3D layout for the ASTRI Camera, refer to Figure 4.

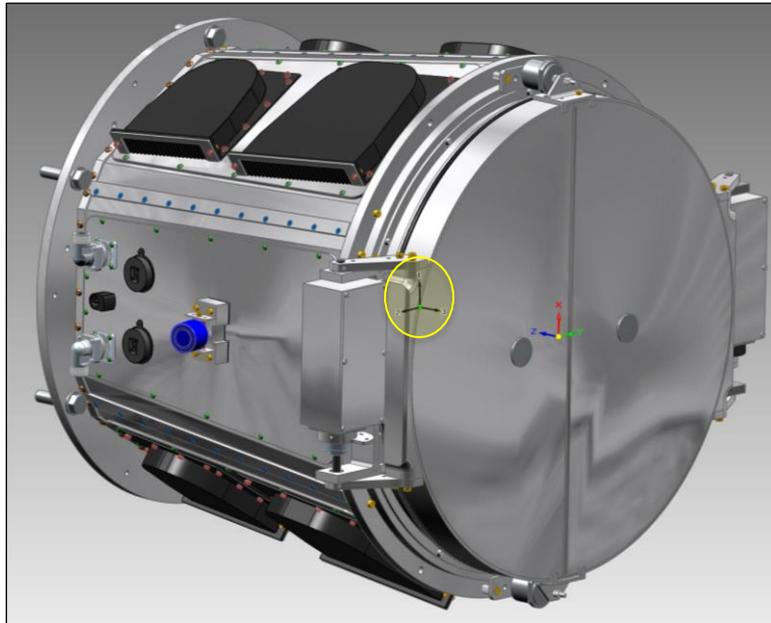


Figure 2. COG with lids closed

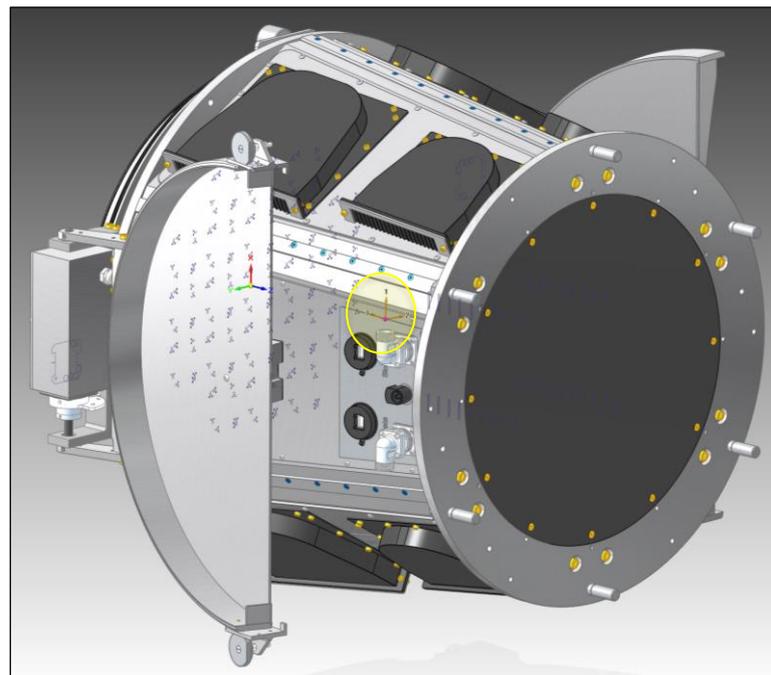


Figure 3. COG with lids opened

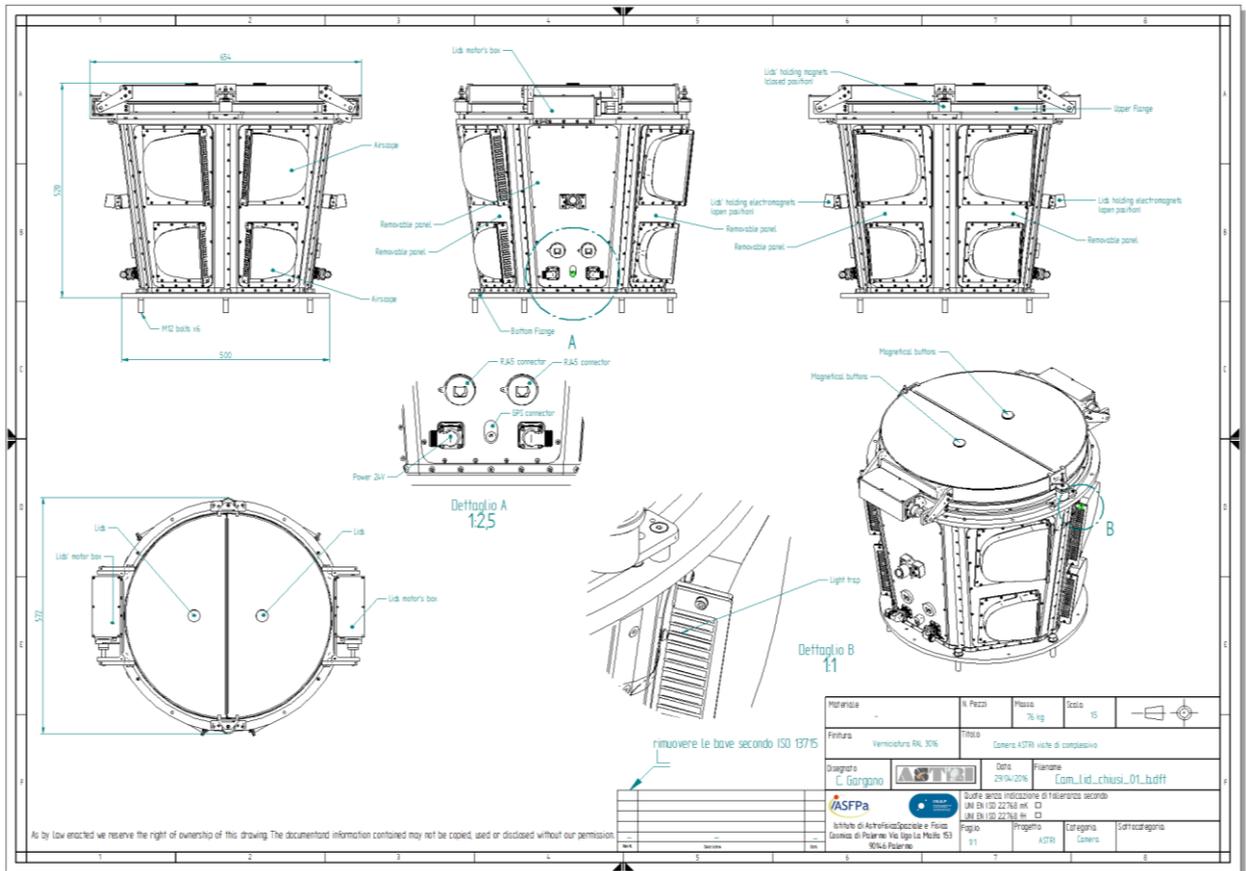


Figure 4. Dimensions and views of the prototype Camera

3.1.2 Mechanical interface

The ASTRI camera will be mounted on the mast structure of the ASTRI telescope (see Figure 5) through six M12 bolts.

The camera is equipped with a suitable interface flange (the *bottom flange*) to the ASTRI telescope. The 2D drawing is shown in Figure 6.

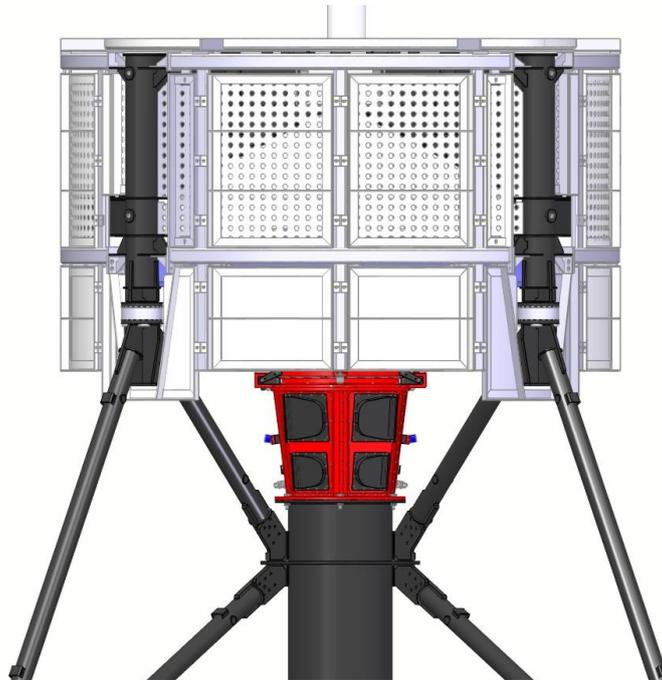


Figure 5. ASTRI camera prototype on the telescope's mast

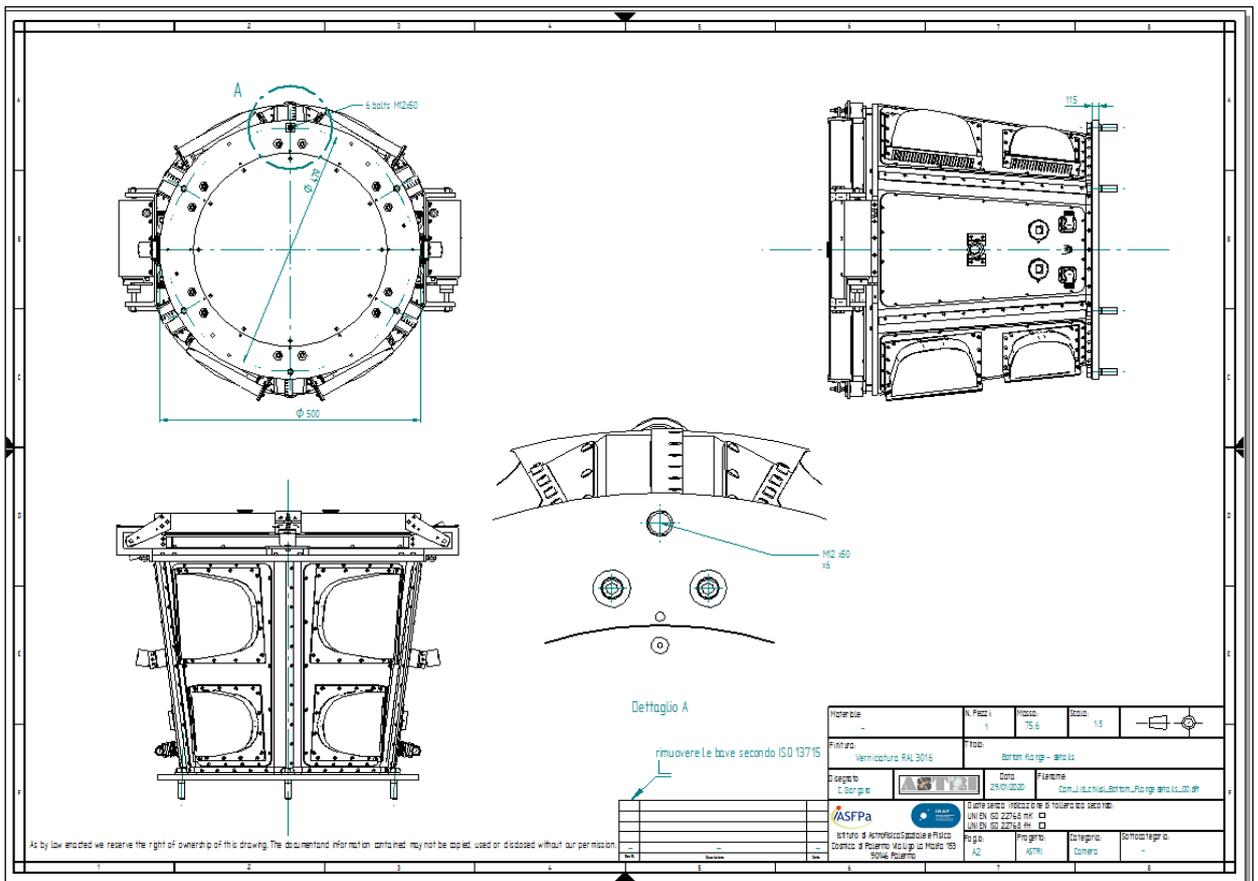


Figure 6. Bottom flange: details

3.1.3 Lids

The camera is equipped with a light-tight cover structure (lid). This structure is composed by two petals mounted, via suitable support, on the backbone structure of the camera. The two petals are able to perform a rotation of 0-270 degrees through two motorized functions. The space requirement of a single lid it is show in Figure 7.

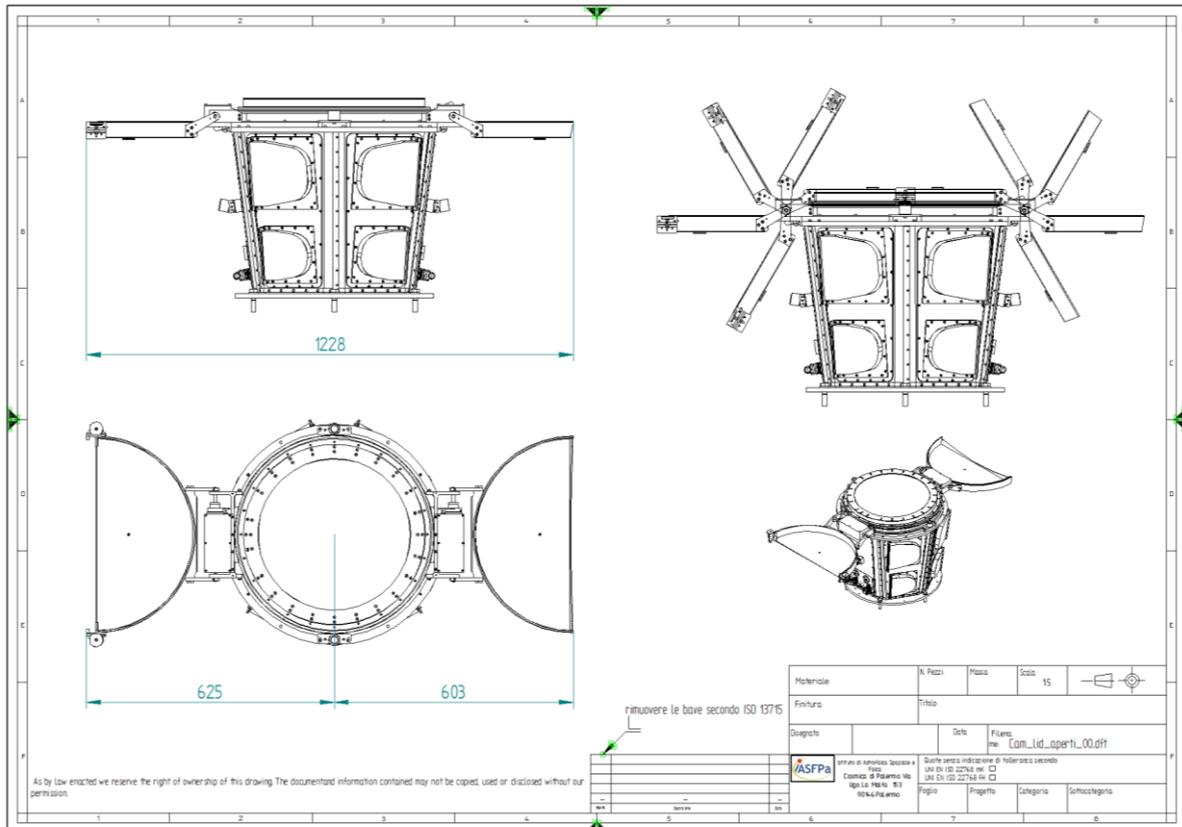


Figure 7. lids open: size

3.1.4 Update of the mechanical interface

A poke yoke system on the mast's flange shall be present to allow the mounting of the camera without ambiguity.

3.2 Electrical Interface

The Cherenkov Camera is powered by a 24V for a Max power consumption of 1600W. Suggested connector type is JAE Electronics JL04V-2E18-10PE-B-R Digi-Key 670-2113-ND.

On a different line, the camera thermal control system shall be powered. The system has a max power consumption of 900W@24V and the suggested connector is JAE Electronics JL04V-2E18-10PE-B-R Digi-Key 670-2113-ND.

The camera shall also have two Ethernet IP67 connections. The selected type of connector is a RJ45 receptacle as shown in Figure 8 (see [AD1]) .

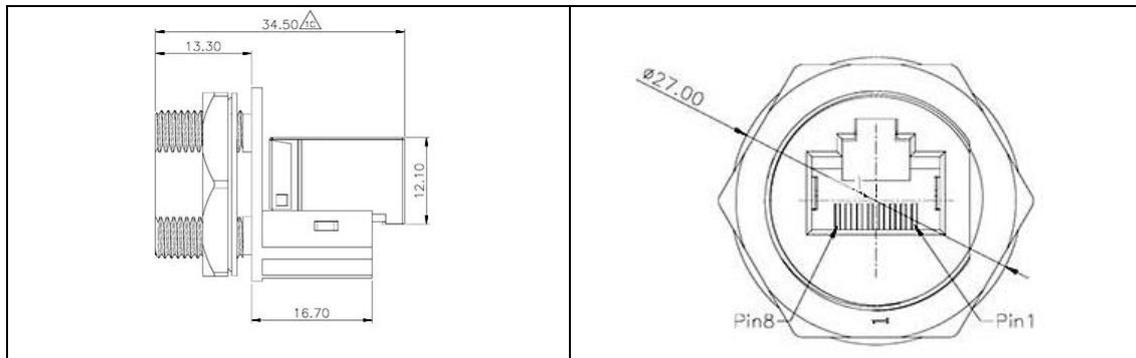


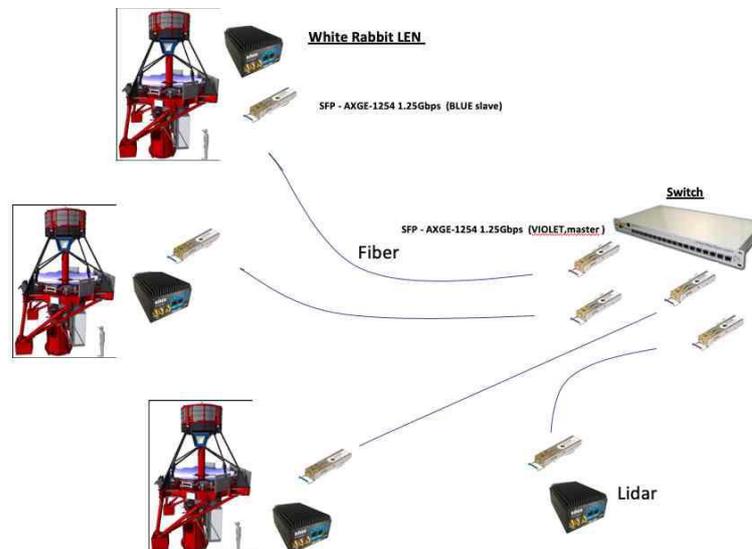
Figure 8. Receptacle Connector on Camera Assembly for Ethernet connection

3.3 Data Interface

There is no direct SW interface between the Cherenkov camera Local Control software running on the Camera BEE and the Telescope Structure Local control software running on the Telescope Control Unit (TCU).

3.4 Time Synchronization System Interface

The camera electronics is equipped with a time synchronization system (White Rabbit), to give the whole Mini-Array the same clock. The overall scheme is shortly described hereafter:



The main elements are:

- 1 switch, serving the whole miniarray of nine telescopes
- 9 bidirectional SFP transceivers for fiber datalink (master), by the switch side (1 per telescope);
- 9 bidirectional SFP transceivers for fiber datalink (slave), by the camera side (1 per telescope);
- 9 synchronization boards (1 per camera).

At present, the SFP transceivers' and the switch's model has been chosen; not so for the synchronization board that, however, shall be one of the following:

White Rabbit LEM		
Power Supply	5V DC, 1.5A, max. 7.5 Watts	
Dimensions	54 x 105 x 135 mm	

SPEC+FMC DIO		
Power Supply	12V DC, 2.0 A, 5-12 Watts	
Dimensions	171.4 x 111.2 mm	

ZEN CTA		
Power Supply	12 Watts	
Dimensions	172 x 60 x 24 mm	

TiCks CTA		 <p style="font-size: small; text-align: center;">Figure 2.1 – Top view of the ZEN-CTA board.</p>  <p style="font-size: small; text-align: center;">Figure 2.2 – Bottom view of the ZEN-CTA board.</p>
Power Supply	4 Watts	
Dimensions	164×60×27 mm	

Due to the signal runs on fiber, the Camera shall also have 1/2 fiber connectors.