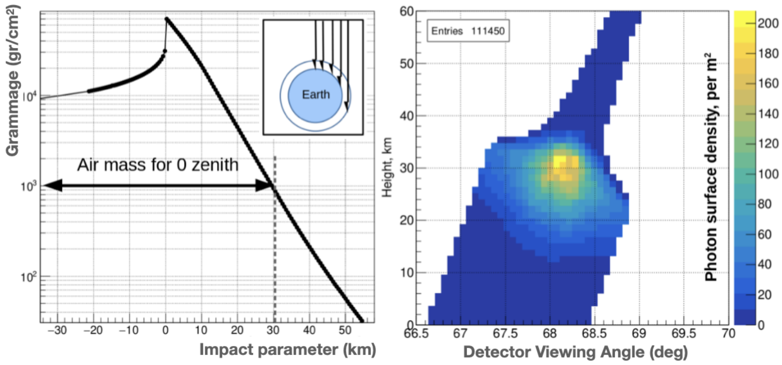

Figure 2: **Left:** Grammage of a cosmic particle as a function of its impact parameter. The insert at the top-right schematically shows incoming particles with different impact parameters. In case the impact parameter is larger than the radius of the Earth, the maximum air mass seen by the particle doubles. **Right :** Photon surface density (z-axis) as a function of the viewing angle and height of a UHECR (primary particle: 100 PeV proton) estimated with EASCherSim [11] (see Sec. 3). The total number of simulated protons is about 1.1×10^5.

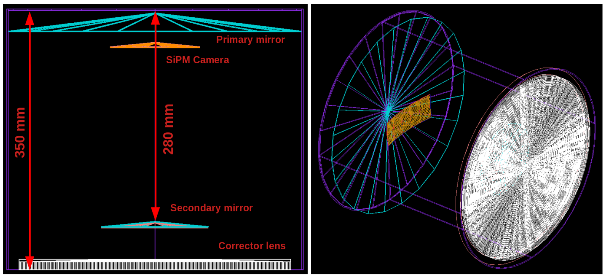

Figure 3: **Left :** View from the top of the payload of Terzina. **Right :** Side view and SiPM camera.

	RoC*	Distance to primary mirror	Diameter
units	m	mm	mm
Big mirror	0.80	0	394
Small mirror	0.36	280	144
Camera plane	0.30	40	121
Corrector	-	350	362
Equivalent focal length : 925 mm			

*RoC - Radius of Curvature

Table 1: Parameters of the optical system

namely the FPA. The dual mirror configuration is chosen to maximize the focal length in the available space which is a envelope in the shape of a cut-cone with a 394 mm diameter and a 350 mm length. The resulting focal length is about 925 mm. The telescope is inclined by 67.5° with respect to nadir, having an optical axis pointing towards the Earth's limb (see Figures 1 and 3).

The FPA is conceived to detect photons from below and above the limb. It has a rectangular shape with a 2 : 5 aspect ratio. It is composed of 10 SiPM arrays of 8×8 pixels each and the point spread function (PSF) of the optical system and the dimension of the limb from the orbit of Terzina are compatible with a 3×3 mm^2 pixel size forming 2 rows of 5 arrays each. The sensors are provided by the Fondazione Bruno Kessler (FBK) and described below. The telescope has a field-of-view of 7.2° horizontally and 2.5°, as each pixel sees 0.18°. It can observe a vast volume of the atmosphere with a cross-section of 140×360 km^2.

The camera frontend electronics is composed of 10 Application Specific Integrated Circuits (ASICs), each reading out one SiPM module with 64 channels. The ASIC has an input amplification stage and only digitizes signals upon validation of trigger conditions described in Sec. 5.1. The currently foreseen amplifier has a bandwidth of 35 MHz forming the amplified signal with $\sim$ 10 ns rising time. In Fig. 4 different scenarios are reported. The red line is the raw signal as provided to the input of the preamplifier. The blue line is the output of the preamplifier with 2 pF output load. After some optimizations to the bias parameters the preamplifier response was improved in terms of speed. The power consumption of the stage was maintained constant, while its noise performance was reduced by a factor 2. Nonetheless the noise increase is tolerable, due to the amplitude of signals to be detected. The orange and green lines represent the preamplifier output with capacitive loads of respectively 200 fF and 2 pF at its output. The 200 fF value is more realistic while the 2 pF is a worst case scenario. The ASIC samples the analog signals at a frequency of 200 MHz. It will digitize at least 3 points on the rising edge of the signal. The digitized signals from the ASICs will be brought out of the telescope system through a hole in the primary mirror partly obscured by the secondary, to a box where the electronic harness is located. The box will include an FPGA collecting the data from all 10 ASICs to form the trigger described in Sec. 5.1. The full Terzina SiPM camera plane with the ASIC system should not consume more than 5 W.

Due to the large NGB and dark current rate (DCR), the sensor technology has to be chosen taking into account many factors. Among the others described in the paragraph below, it is important to take into consideration the power consumption and the radiation tolerance.