6 Very High Energy Gamma Ray Astronomy with CTA

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(CTA)

The next generation of Imaging Atmospheric Cherenkov Telescopes (IACT) for the detection of very high energy (VHE) gamma rays is on its way with the Cherenkov Telescope Array (CTA) project (www.cta-observatory.org). CTA aims to broaden the detectable energy range of VHE gamma rays and to improve on the precision of locating their origin compared to existing IACTs. This will be realized with two arrays, one on the southern hemisphere with about 100 and one on the northern hemisphere with about 20 IACTs. Three sizes of telescopes are foreseen to cover the full energy range of tens of GeV up to hundreds of TeV.

In the past year several major steps brought the CTA project closer to its realization. The first step was the foundation of the CTA Observatory (CTAO), a limited liability company (gGmbH), as an interim entity. Another step was the final site selection for the two telescope arrays. La Palma (Canary Islands) has been chosen to host the northern array at the same location as the already existing MAGIC [2] Cherenkov telescopes. The southern array will be located on the European Southern Observatory (ESO) area in Chile and should be operated by ESO. While the final agreement has already been signed for La Palma, CTAO is expected to finalize the contract with ESO in early 2017. In early March 2016 UZH group leader Prof. Ulrich Straumann was elected as Managing Director (MD) of the CTAO for one year (see e.g. [1]). Prof. Straumann has already been confirmed by the CTA council for a second period as MD beginning of 2017.

Since the UZH CTA group is involved in several major projects of CTA, i.e. camera mechanical body with safety and power for FlashCam, mirror actuators, interface control documents as well as the master clock for the whole telescope array, time management among the sub-projects is essential. A large part of the time is also invested into paperwork for different reviews, project planning and documentation.

6.1 FlashCam camera body

The FlashCam camera [3] is the first fully digital Cherenkov telescope camera and will suit the mid-size telescope of CTA. One major contribution of our group towards the camera has been the development and production of prototype series of photon-detector units. However, for a future mass-production of the units the responsibility was handed over to the University of Erlangen. The second large contribution is the design and production of the whole camera body mechanics including the camera safety control, the power control and distribution, as well as the cooling. After the first prototype body was tested on its mechanical compatibility with the mid-size telescope structure prototype in Adlershof, Berlin, the majority of the time was devoted to the integration of the lessons learned into the mechanical and electrical designs and the ordering of material for two additional prototype cameras. The redesign of the camera body is now finished, material ordered and already in-house and assembly of the body mechanics has started beginning of this year. Figure 6.1 shows the current state of one of the two camera bodies in our assembly hall. The two bodies should be ready

Fig. 6.1 – Assembly work of two prototype camera bodies has started with the aim of shipping the bodies to the integration lab in Heidelberg for the installation of the electronics in summer 2017. Shown is the rear view of one of the prototypes with open doors, installed racks, safety and power cabinet in the left lower corner, as well as the heat exchangers and fan trays.

Fig. 6.2 – Two safety and power cabinets under 24/7 testing before installation into the camera.

for shipment to the integration lab in Heidelberg in the course of this summer.

The safety and power cabinet of the camera has also been redesigned slightly to accommodate a more up-to-date control unit with a dedicated safety matrix and to make the cabinet even easier to maintain. Two prototypes have been assembled in-house and completed last year and have since been put to several functionality tests and long-term operation (over 4′000 hours of continuous operation accomplished). Figure 6.2 shows the two cabinets before being installed in the camera bodies.

6.2 Mirror actuator

The 220 actuator sets (figure 6.3), each consisting of two actuators and a fix point, produced in 2015 have meanwhile been tested by our Japanese collaborators and it was found that the mechanical tolerance was too large for some devices. This triggered an internal process of localizing the problematic production step and improving on the reliability of the production of the pieces. After fixing the few outliers and increasing the mechanical tolerance specifications from 20 up to 30 μm such to avoid an increased price due to hand-selection of good parts, all devices were accepted. It is expected that the actuators can be sent to the site for final installation on the first large-size telescope prototype on La Palma by the end of the year.

Fig. 6.3 – Latest version of the Zurich actuator as produced for the large-size prototype telescope.

The consolidation of devices which could be used across the different telescope types and hence reduce costs and improve maintainability has already started a long time ago in CTA. In this process the Zurich actuators have been chosen as standard actuators for the whole CTA. This means that a production batch of roughly 12′000 single actuators over the period of the next few years needs to be planned and organized. This step needs to be evaluated very carefully and will make an extension of the existing team a necessity.

[1] SBFI Newsletter, April 2016

[2] J. A. Coarasa *et al.*, (MAGIC collaboration), J. Phys. Soc. Jap. Suppl. 77B (2008) 49.

[3] G. Pühlhofer *et al.*, (FlashCam Collaboration), arXiv 1211.3684 [astro-ph.IM] (2012).