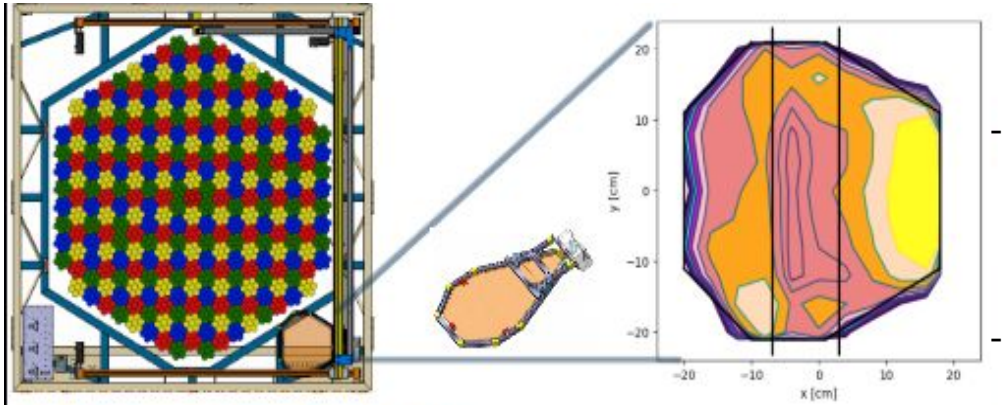
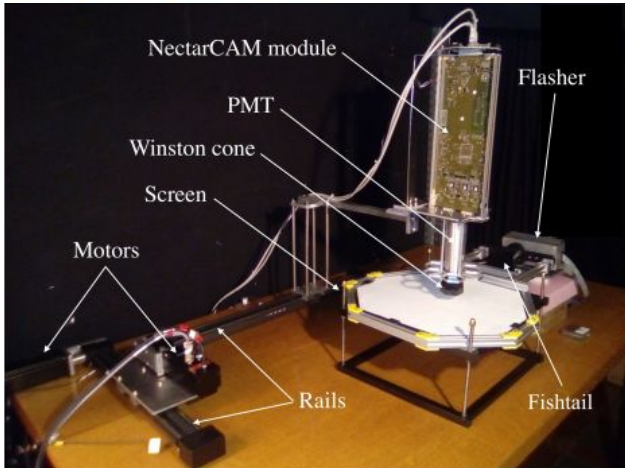
A single photo-electron calibration system for the NectarCAM camera of the Cherenkov Telescope Array Medium-Sized Telescopes

Pooja Sharma[a], Barbara Biasuzzi[a,b], Jonathan Biteau[a], Martin Bourgaux[a], SamiCaroff[c], Giulia Hull[a], Michaël Josselin[a], Kevin Pressard[a], Patrick Sizun[a], Tiina Suomijärvi[a] and Thi Nguyen Trung[a] on behalf of the CTA NectarCAM Collaboration

[a]Laboratoire de Physique des 2 Infinis, Irène Joliot-Curie, Université Paris-Saclay, Université de Paris, IN2P3/CNRS, 91405 Orsay, France
[b]IRFU, CEA, Université Paris-Saclay 91191 Gif-sur-Yvette, France
[c]LAPP, Univ. Grenoble Alpes, Univ. Savoie Mont Blanc, CNRS/IN2P374940 Annecy, France

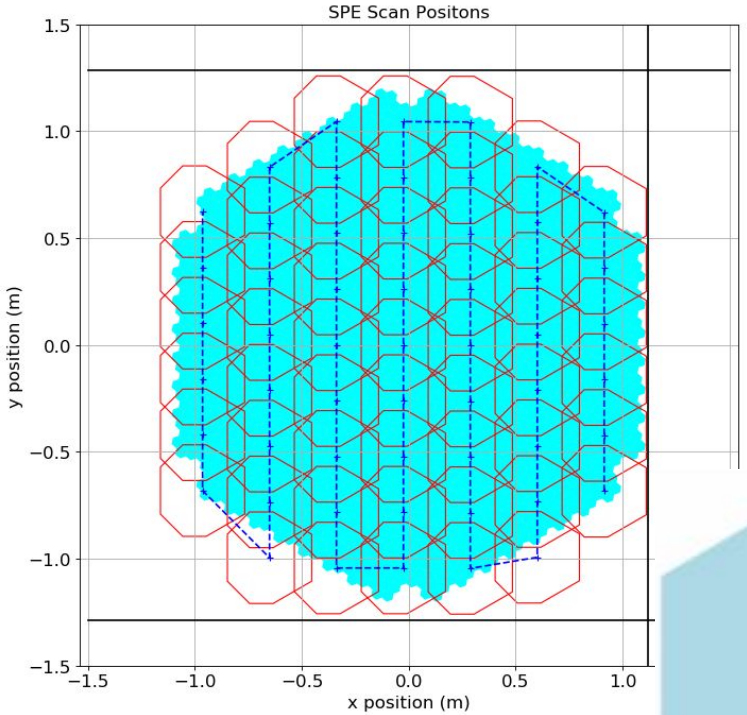
SPE Calibration System





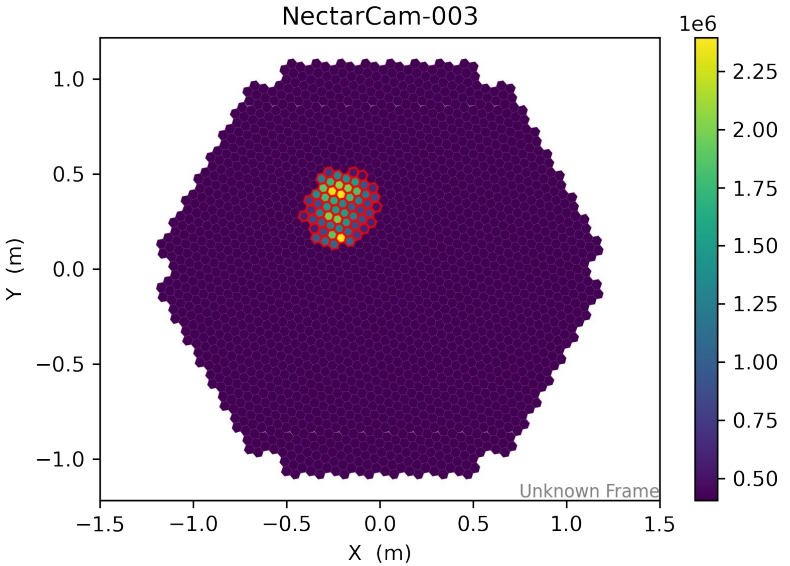
- A single photo-electron system has been designed to calibrate the NectarCAM camera of the Medium-Sized Telescopes of CTA. It measures accurately the gain of the camera's PMTs.
- A calibration screen scans the entire camera consisting of 1855 PMTs using motors.
- The homogeneity map was obtained using the test bench designed for SPE calibration.
- We can see that light is satisfactorily spread across the screen within 10 contours ranging from half down to a tenth of the maximum screen emissivity.

Scan Positions



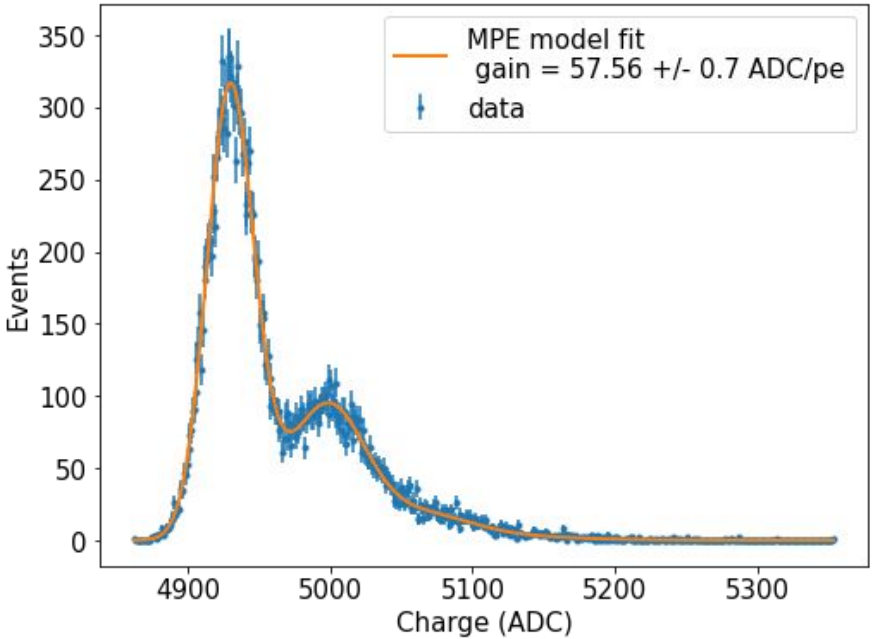
- To minimise the time taken to calibrate, different scan patterns were studied.
- Sufficient overlap between two successive screen position is considered to account for edge effects.
- Limits of the movement are set by the edges of the camera internal frame.
- Range of possible velocity and acceleration values of motor, to and fro motion of screen to the parking position and transition between each row results in 55 scan positions with scanning time ranging from 17 to 28 mins.

Test run of mini NectarCAM



- First data acquired with the SPE calibration system of the mini NectarCAM camera in Adlershof (2019) has been analysed.
- Using Ctapipe data processing, the associated time stamps of each event have been used to identify pixels in front of the screen.
- Finally charge of each event reconstructed after pedestal subtraction for every pixel around the peak is shown.
- For each illuminated pixel, a histogram of the charge distribution is stored.

Gain determination



- The charge distribution of each pixel is modelled by a multi p.e. spectrum accounting for a two-gaussian SPE response and the pedestal level.
- The first peak in figure corresponds to the pedestal (zero photon). Subsequent peaks correspond to photo-electrons.
- We obtain a mean gain of 56 ADC/p.e. and associated standard deviation of 2.1 ADC/p.e over the mini camera.
- A histogram of the gain distribution of~21k events in all the illuminated pixels was also studied. This allowed us to obtain the pixel variation in gain which was ~4%.