16 Electronics Workshop

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During the past year the electronics workshop supported the scientists during all phases of conception, design, purchasing and commissioning of various experimental setups. In the following sections the contributions to selected projects are highlighted.

For the CTA group of Prof. Canelli and Prof. Straumann (Sec. 6), staff of the workshop assisted in final construction and outfitting of two camera bodies of the CTA Flashcam project. This included electric and electronic wiring and testing as well as assembly and commissioning of the liquid cooling system of the camera bodies. Particular emphasis was put on the development, commissioning and verification of the fully redundant electric power system and its control hardware together with the required documentation. Another task has been the reduction of electronic noise in the Flashcam frontend boards in the photon detection plane to improve the signal-to-noise ratio of the photomultiplier signals. In parallel, 220 mirror actuator sets produced for the CTA Large Scale Telescope prototype were shipped to La Palma (Canary Islands, Spain). As the actuator system of the Physik-Institut has been selected as the common mirror actuator system for the complete CTA project, additional upgrades are integrated into a next D-series design, of which 60 sets will be prototyped in 2018. The upgrade includes improved electronics package as well as improved mechanical reliability. Figure 16.1 shows the two CTA FlashCam camera bodies in the assembly hall.

Based on a design from the University of Santa Cruz, we produced four test-boards for silicon photomultiplier detectors for the group of Prof. Serra (Sec. 8). Featuring a high speed, low-noise preamplifier directly next to the detector position allows for easy adaption to multiple sensor types and future applications. For the LHCb-UT project, we developed an interface board to connect a needle card for SALT128 readout chip wafers to an FPGA board (see Fig. 16.2). This interface board provides level translators for programming signals and general input/output-lines in addition to regulated voltages for operation of the SALT128 chip.

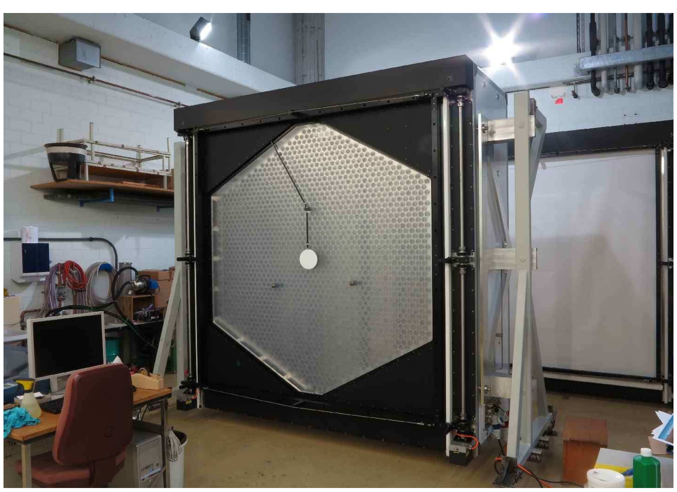

Fig. 16.1 – The two CTA FlashCam camera bodies in the assembly hall. The front camera has its lid opened and the optical calibration target extended.

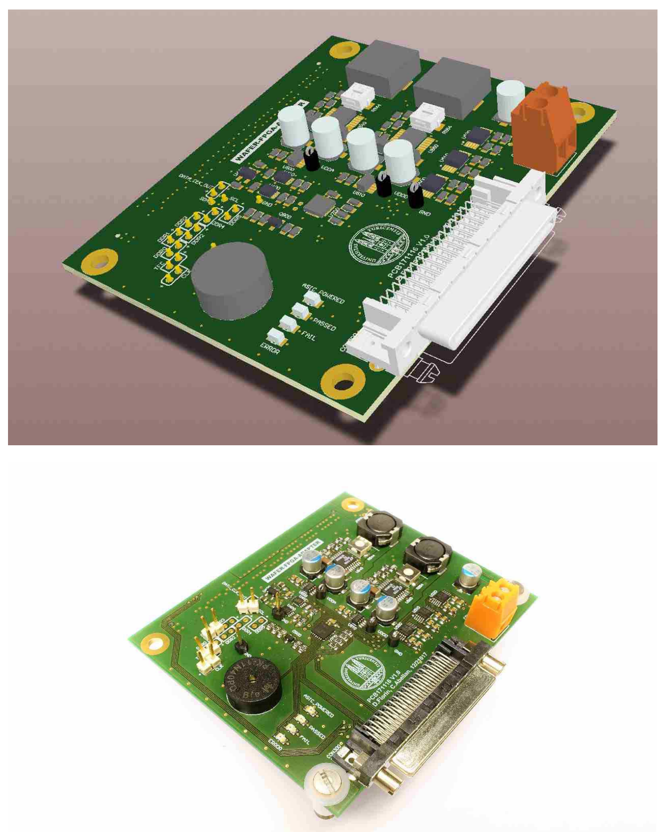

Fig. 16.2 – SALT128 wafer-FPGA adapter board: simulated CAD view and real hardware.

FIG. 16.3 – New remote control for the WALKUERE manipulator next to its old and larger version.

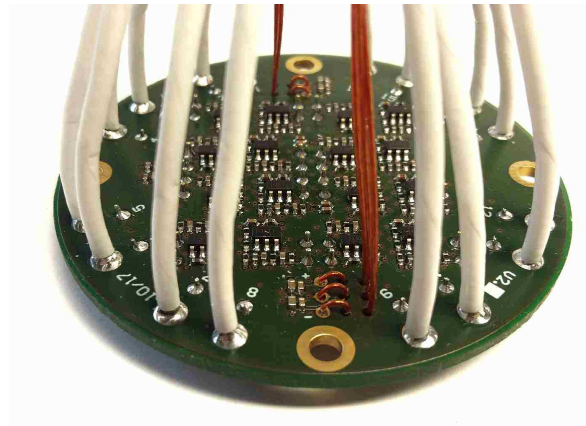

FIG. 16.5 – 16-channel preamplifier for the XENOSCOPE experiment.

For the group of Prof. Osterwalder (Sec. 13), the current joystick controller for the WALKUERE manipulator has proven to be not precise enough and too bulky. An improved version featuring a better control of positioning motor speeds and much reduced overall size was developed. The new remote control for the WALKUERE manipulator is shown in Fig. 16.3 together with the old version. Another setup required a new set of two PID temperature controllers (Fig 16.4), which were assembled and wired into a lab-compatible box with the correct external connectors.

For the Xenoscope project of the group of Prof. Baudis (Sec. 5), a compact 16-channel Silicon Photomultiplier amplifier was developed, which directly interfaces to the detector (see Fig. 16.5). In addition to amplifying the detector signals, the circuit also connects the required bias voltage to each individual channel.

A 100 MHz phase detector was built for the group of Prof. Aegerter (Sec. 14). Based on an IQ-mixer with appropriate filtering, the input signal is mixed with a reference signal and the phase information can be measured via DC-levels at the I- and Q-channel outputs (Fig. 16.6). Compared to the previous scope-based solution, this approach has the potential to significantly speed up the data taking process without compromising on signal quality.

FIG. 16.4 – Dual PID controller for the Group Osterwalder.

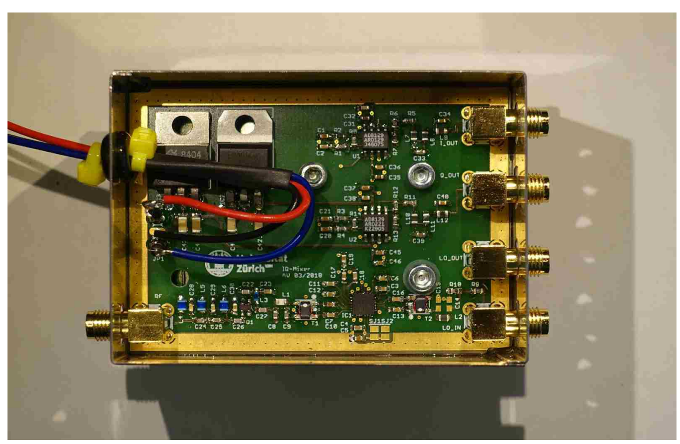

FIG. 16.6 – 100 MHz phase detector for the Group Aegerter.

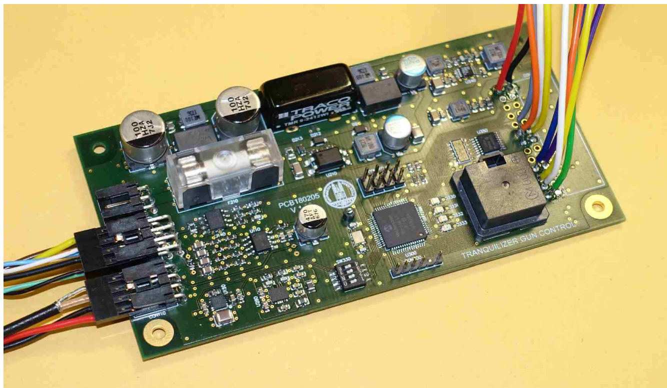

FIG. 16.7 – Control board for the tranquilizer gun remote control unit.

FIG. 16.8 – Microcontroller board for the electronics apprentice training program.

For an external project from the mechanical workshop, we assisted in the design and construction of control boards for a tranquilizer gun for wildlife animals. This control board handles the steering of the 2-axis gun turret together with a video channel for precise aiming and motion sensor to alert the operator if a potential target approaches the bait. The remote control unit for the operator is separated with a 100 m long network cable to allow the animals to approach the bait undisturbed.

A dedicated microcontroller board has been developed for the education of our electronics apprentice, together with the required training documentation and programming environment. This allows for an efficient introduction into microcontroller system development based on the C programming language. Starting on August 1st, 2018 the workshop will welcome a second electronics apprentice starting her 4-year higher education with the Physik-Institut.

The electronics workshop also organized and coordinated emergency power outlets in various laboratories. This work over the last years has been proven effective during an unplanned power cut in January 2018 which had little to no effect on the Physik-Institut.