18 Electronics Workshop

D. Florin, P. Soland, and A. Vollhardt

In addition to the routine service and support work for the research groups of the institute the electronics workshop also performed some maintenance tasks for the LHCb experiment at CERN during the extended period of beam interrupt. Various setups and devices for the laboratories and demonstration experiments for the undergraduate lectures were improved. For example a battery supported power supply was developed for a sensitive weight comparator used in a measurement of the gravitational constant.

Below we list some of our more interesting projects and activities.

- **Phase Transitions, Materials and Applications (Sec. 13)**
  For the probing of samples inside the helium cryostat, a small printed circuit board based on a low-loss ceramic substrate has been designed and assembled (see Fig. 18.1).

  We developed and manufactured a device used to build a thermo-electric oscillator (see Fig. 18.2). The unit allows the measurement of the specific heat of samples with a novel method. The instrument consists essentially of an inductance (gyrator) and an amplifier. To allow high flexibility many of the settings can be adjusted with switches and potentiometers.

- **Superconductivity and Magnetism (Sec. 12)**
  For a rotating sample holder inside the cryostat, the electronic boards (base plate and sample board, see Fig. 18.4) were designed and mounted in collaboration with the mechanical workshop.

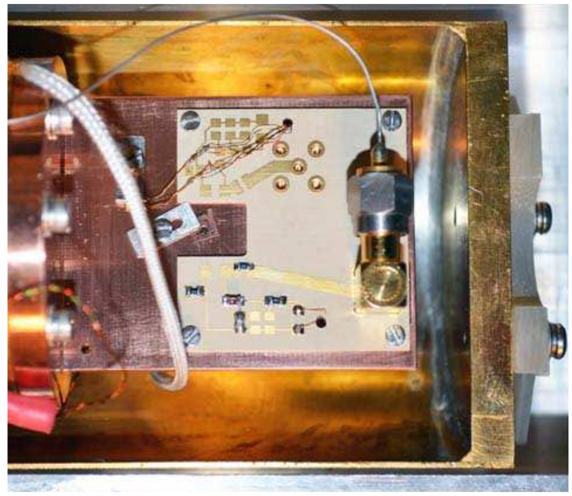

FIG. 18.1 – *Sample holder with low-loss ceramic substrate printed circuit board.*

FIG. 18.2 – *Thermo electronic oscillator device.*

FIG. 18.3 – *Electronics of the thermo electronic oscillator.*

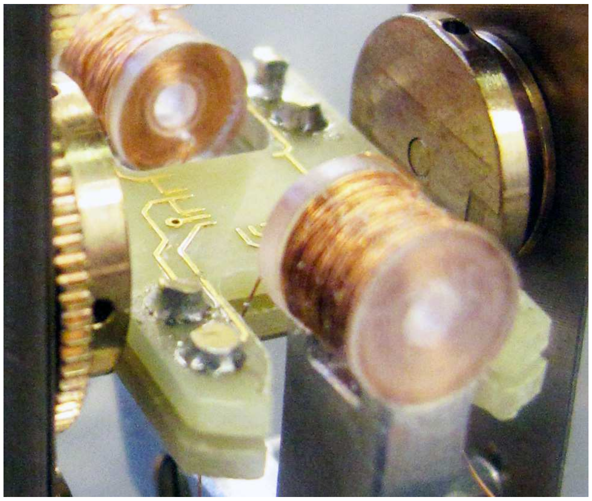

FIG. 18.4 – *Sample board installed on the sample holder.*

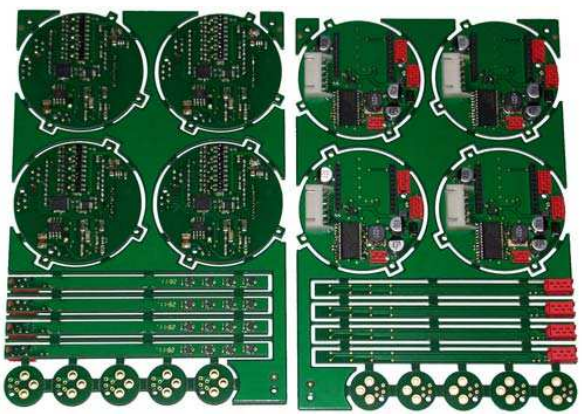

FIG. 18.5 – *Active mirror control printed circuit boards.*

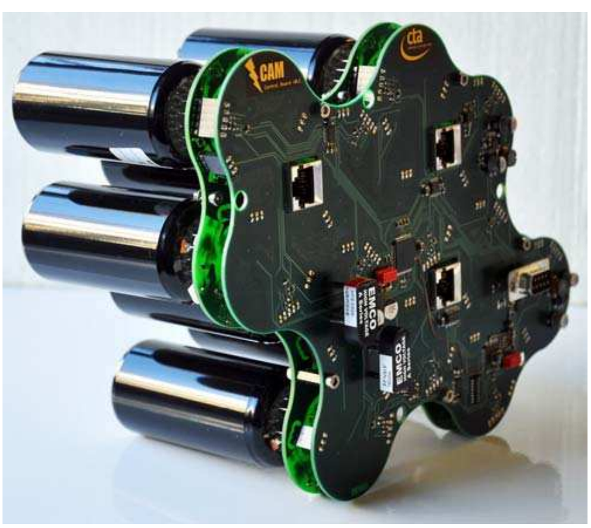

FIG. 18.6 – *Complete FlashCam module.*

- **Electronics for the Cherenkov Telescope Array (CTA) experiment (Sec. 6)**
  The controllers for the Active Mirror Control (AMC) actuators (see Fig. 18.5) have been exchanged and a bootloader software was implemented allowing the complete firmware to be uploaded remotely via the wireless interface.

  For the FlashCam project a 12-channel photomultiplier readout board has been designed (see Fig. 18.6). Special features are the low-power design which includes the PMT bias supply and the on-board preamplifier which prepares the PMT signals for transmission over three differential CAT-6 cables. Individual control of the bias voltage of all 12 channels as well as voltage and current monitoring is done via a commercial fault-tolerant CAN-bus.

  For the FlashCam photomultipliers a compact DC/DC power supply with +5 V input voltage and adjustable (-500 V / -1500 V) high voltage outputs was developed. To minimize the influence of higher order parasitic signals the transformation is based on Royer converters.

- **Neutrinoless double beta decay (Sec. 3)**
  For the precise positioning of the calibration sources in the GERDA experiment we produced a motor control system (hard- and software, see Figs. 18.7 through 18.10). The unit houses three identical blocks allowing the independent vertical positioning of three different radioactive sources. A DC-motor coupled to a planetary gear set moves the source container fixed to a perforated stainless steel band with a velocity of 10 mm/s and a precision of about 1 mm over the full range of 7 m.

  For the position determination of the source two independent sensors are used to make the system redundant. Optical incremental encoders measure the position using the perforation of the steel band. The upper end position is determined by a micro end switch which also defines the absolute reference position. The second system consists of a multi-turn magnetic absolute encoder which is fixed to the axis of the planetary gear. The motor controller logic evaluates the signals of the end switches and the position encoders and performs different consistency tests.

The controller can be connected to a computer through an RS-232/422 interface allowing computer controlled operation. Alternatively the front panel of the control unit can be used for local operation. LCD displays indicate the actual source positions as well as status and error messages.

In connection with other astroparticle physics experiments we also designed a printed circuit board using surface mounted devices which serves as a universal photomultiplier base.

Fig. 18.7 – *Motor control unit (front view).*

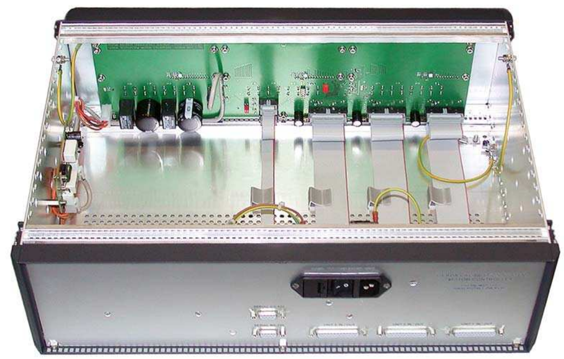

Fig. 18.8 – *Motor control unit (inside view).*

Fig. 18.9 – *Main printed circuit board of the motor control system.*

Fig. 18.10 – *Deviation roller with incremental encoder, end switch and control electronics.*