19 Mechanical Workshop

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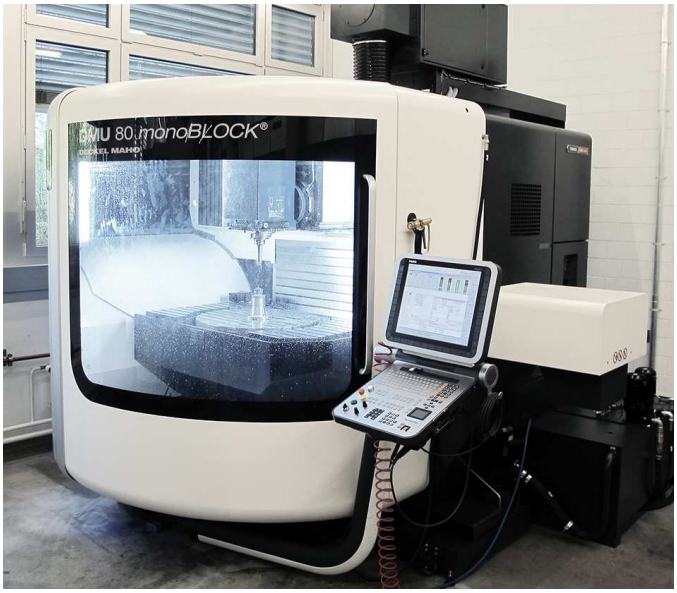
Last year the Cherenkov Telescope Array (CTA) and the CMS barrel pixel upgrade projects were in the main focus of the mechanical workshop. Apart from the usual repairs and maintenance work we produced parts for other departments of the university, the ETH and contractors. Over 30 institutes and local high schools were supplied with materials and technical support by the central metal and technical material store maintained by our staff. [1]

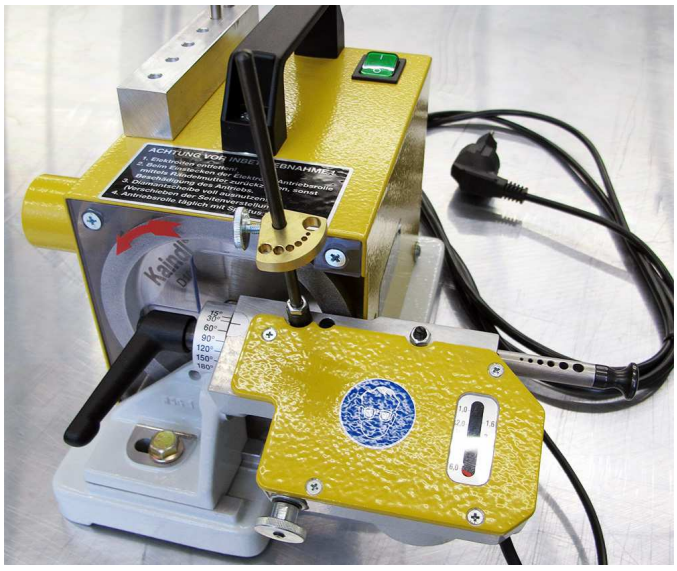


- The new milling machine

- The 1250 mm x 700 mm work area with 70 cm rotary table

The workshop staff conducted the basic mechanical workshop courses for the bachelor students in physics during 8 weeks. During this time, 11 courses were carried out at 35 hours each. In October 2013 we organized again the welding courses for the physics laboratory assistant apprentices from the ETH. For people interested in a grade as a poly-technician we provided two one-week trial apprenticeships.

There is an increasing demand for optimized and more precise production of complicated parts, both for single work pieces and small series, so we replaced a 23-year old milling machine by a state-of-the-art device. The modular design ensures the necessary sturdiness and provides optimal ergonomics and easy handling through a door that gives wide access to the large work area. The table moves vertically with speeds of up to 1 m/s and can rotate with up to 1 revolution per second around the rotary axes. Work pieces up to 850 mm x 600 mm x 600 mm can be processed with spindle speeds up to 300 revolutions per second. This is actually the largest milling machine available at the University. Extensive standard equipment, a large range of expansion options, advanced CNC controls and numerous software features make the machine perfectly equipped for complete 5-axes simultaneous machining.



- The new electrode grinding machine

[1] For a catalogue see http://www.physik.uzh.ch/groups/werkstatt/

A new electrode grinding machine now helps to improve the welding quality. The diamond grinding wheel is ideal for grinding of Tungsten carbide welding electrodes with diameter 1.0 - 4.0 mm with a top angle from 15 - 180 deg. Accurate centering in longitudinal direction grants a stable arc and a longer lifetime of the electrodes.

To make the welding process more efficient we purchased a universal beveling machine used for processing of bevels and radii on plates, containers, inner and outer edges, contour profiles, drilling and pipe ends. The device combines a patented system for fast exchange of the milling head with a patented spring technology for vibration-free operation resulting in longer tool life. In addition to milling heads for 0-80 deg bevels and 2-4 mm radii there exist diamond crowns and abrasive belt heads for efficient edge processing.

Below we mention a selection of our activities:

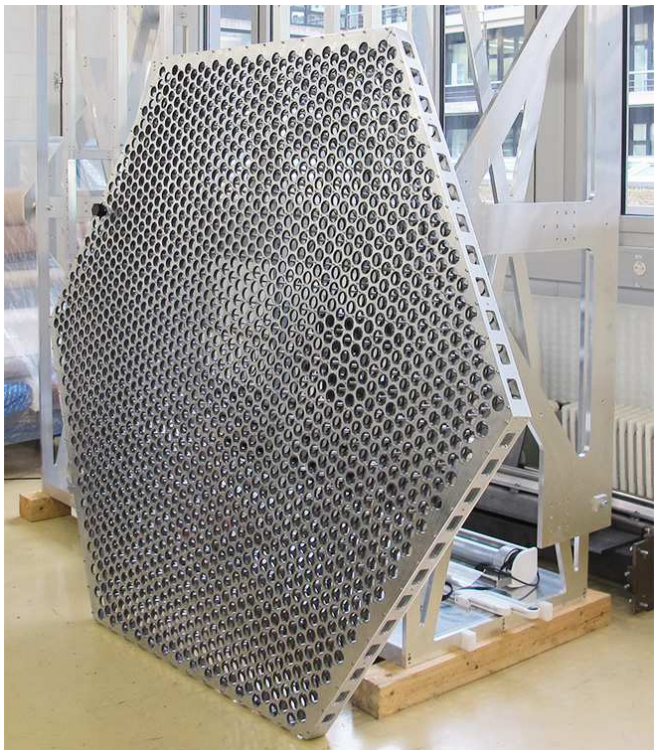
- Demonstration and laboratory experiments and Science Lab of the University
  We repaired and improved different experiments used for the demonstrations in the basic physics lectures and in the laboratory courses. The Science Lab of the University is a research and learning laboratory for students, pupils and teachers. The program will encompass the subjects of physics, mathematics, chemistry and geography as well as interdisciplinary topics. We produced a set of parts for experiments in connection with magnetism.

- CTA Cherenkov Telescope Array (Sec. 7)
  Test setups for the FlashCam camera, mounting tools for the camera housing assembly and a support frame were produced. In the welding shop a special large size welding table was installed necessary to complete the parts. Distribution boxes, rails and detectors mounts were manufactured. We supported the research group also in the assembly of the individual components.

- The FlashCam camera support frame

- The new beveling machine

- Parts for a Science Lab experiment.

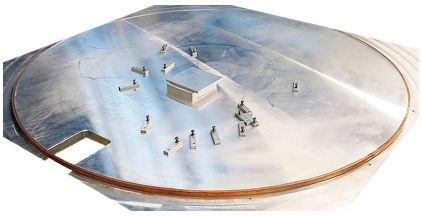


- The FlashCam camera structure built up in the workshop assembly hall

- Surface Physics (Sec. 16)
  For the extensions of the Sinergia apparatus we manufactured different parts. The flange shown in the figure on the right is used to support an additional electron source. We made parts for bachelor thesis projects carried out in the surface physics group and did maintenance and repair work. Again a small series of dedicated molybdenum sample holders was fabricated.

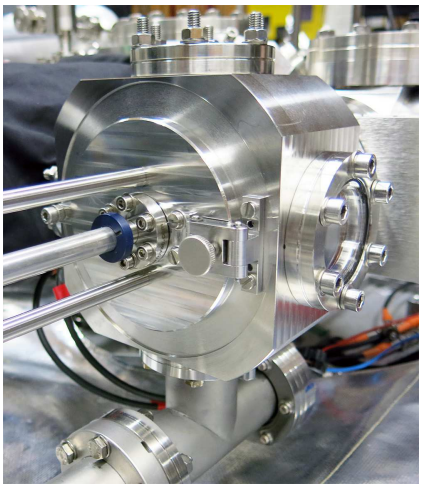
- Stainless steel flange for the Sinergia apparatus

- Astroparticle Physics (Sec. 3, 4)
  New steel bands for the calibration system of the GERDA experiment, test setups and different Teflon reflectors were fabricated. For a new larger time projection chamber (TPC) of the XENON experiment we made first prototypes of ring electrodes used in the electric field forming structure. The ring electrode consists of oxygen-free copper and has a diameter of 985 mm and a cross-section of 5 mm x 10 mm.



- Voltage divider ring after the welding process

- Physics on the nanometer scale (Sec. 17)
  The vapor deposition device with six coating stations was modified and maintained. We produced new evaporation masks and a door with hinge-joints for a homemade load-lock chamber for fast insertion of samples in an ultra high vacuum (UHV) coherent low-energy electron microscope. The aperture in the middle of the door permits the mounting of a wobble stick for samples manipulation. We built support structures for electrical contacts used to heat samples in a UHV chamber.



- Door installed on the load-lock chamber with the wobble stick for the sample manipulation

- CMS Barrel Pixel detector upgrade (Sec. 13)
  A new pixel detector has been designed for the CMS experiment at CERN (Phase I Pixel Upgrade), in order to preserve the high tracking quality at luminosity and pile-up beyond the original specifications. It features four layers in the barrel, one more than the present detector. The new CO_2 cooling system combined with a modified cabling scheme and new lightweight mechanics will contribute greatly to the material budget reduction in the tracking acceptance. The demanded performances aim for 15 kW of cooling power at -20 C evaporation temperature. The system has a so far unmatched size for an evaporative CO_2 cooling system used in a high energy physics detector. For the necessary functional tests of the complete cooling system we manufactured two full-size cooling test-system prototypes. The cooling structures are made out of stainless steel tubes with over 500 solder joints and is pressure tested at 160 bar.

- Cooling test system for the CMS Barrel Pixel upgrade; in the foreground the part which cools the four detector layers.

- DAMIC Dark Matter in CCDs (Sec. 6)
  Thanks to the low electronic noise DAMIC reaches a detection threshold below 0.5 keV nuclear recoil energy, making the search for dark matter particles with masses below 10 GeV possible. We manufactured the parts for a test setup (the AlpineCube) for studies of different CCD types.

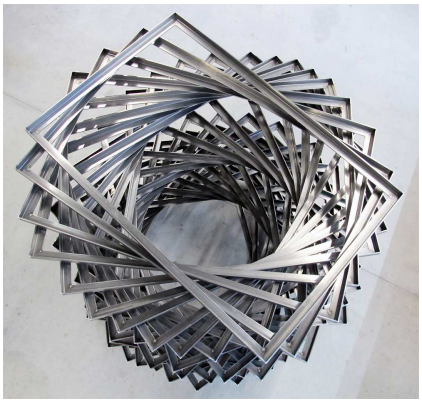
- Education of the workshop staff and apprentices
  Courses in computer aided design (CAD) and manufacturing (CAM) were attended. We attended welding training courses and went to the regular meetings devoted to the education of the apprentices. We visited machinery and tool manufacturers, and exhibitions. In May and June the apprentices passed their examinations with great success. In the final work the candidate made a special gimbal suspension for a photo camera. The device is used at the Remote Sensing Laboratories RSL at the department of geography. In August two apprentices started their education at the workshop. In addition to the compulsory Swissmechanic courses our apprentices attended advanced training courses in turning and milling, CNC programming, pneumatics and electronics.

- Activities for other departments and outside companies
  For several institutes and departments of the University work was performed.
  We designed, manufactured and assembled new portable specimen holder containers for the department of pathology. The computer controlled movable cross table allows an automatic deposition of the various samples in the specimen holder.
  For the Zoological Museum we made picture frames and small test-series of adjustable LED lamps used for a special exhibition.
  New transfer cars for 240 liter nitrogen tanks were designed and fabricated. The built-in lifting mechanism allows a comfortable and safe transportation of the 300 kg vessels at the department of virology.

- Portable computer controlled cross table with specimen holder

- Parts for the AlpineCube test setup

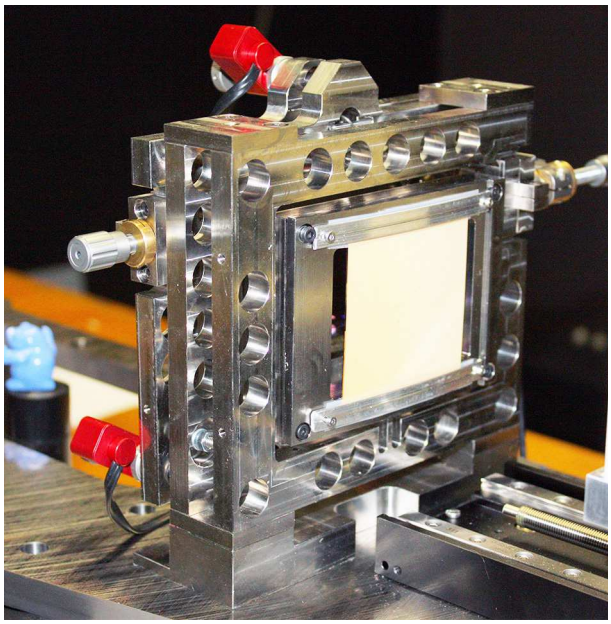
- The gimbal camera suspension



- Metal picture frames for a special exhibition at the Zoological Museum

- Liquid nitrogen vessel transfer car

In collaboration with researchers of the Centre Suisse d'Electronique et de Microtechnique (CSEM) we manufactured an electro-mechanical frame made out of Invar used for X-ray grating-based phase contrast imaging for bio-medical applications. The light weight design ensures mechanical and thermal stability of the grating interferometer during operation on a rotating gantry. The project is a collaboration between CSEM and PSI and is supported by the CCMX Analytical Platform.
New LED lamps with a power of 60 W and a more efficient heat sink design for the outdoor and indoor use were produced for a lighting company.



- Electro-mechanical frame made out of Invar

- Led lamp