17 Mechanical Workshop

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Thanks to our state-of-the-art and versatile machinery we could manufacture numerous demanding and complicated parts, for in-house projects, for other departments of the University and the ETH and even for outside contractors. To manage these projects efficiently an Access database software package was purchased. In the reporting period we focused on the maintenance of existing tools: the large VDF lathe, the Kern 480 computer controlled lathe and the Picomax 54 drilling and milling center were examined and refurbished.

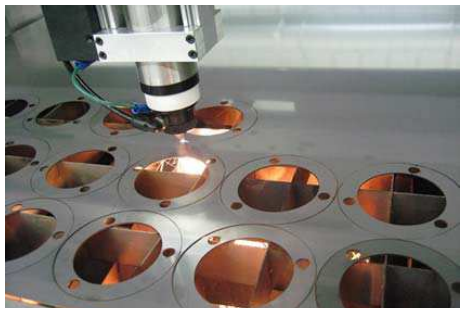
Our metal and technical material store supplied more than 30 institutes of the university, universities of applied science and local high schools with materials. Increasingly, we also help to solve technical problems, for example in the selection of materials. This service is actively used and appreciated. The information event organized by the workshop staff in November 2014 proved to be a good platform for the exchange of ideas and demands.

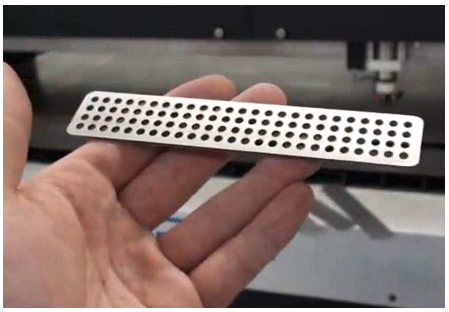
At the beginning of 2015 Reto Maier took over the position of Kurt Bösiger, who has been leading the workshop since 2002 and will retire later this year.

The evaluation of a new high speed laser cutting and engraving system started in June 2014 and the procurement was approved in January 2015 by the administration.

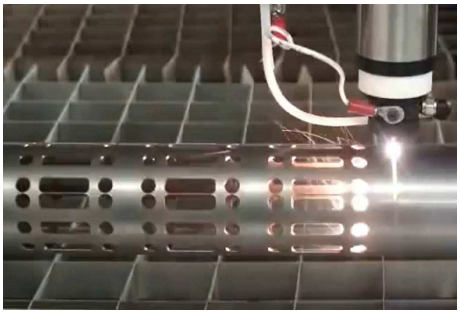
- The new high speed laser cutting and engraving system

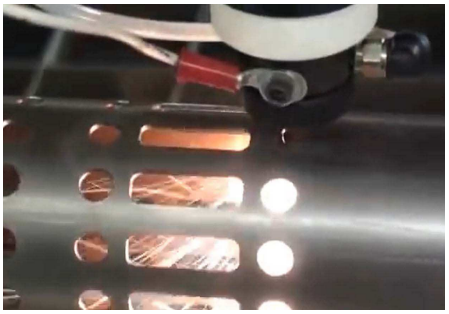
The device will be commissioned in June 2015. The CO2 laser power is 400 watts which allows to cut also metals (steel up to 4.5 mm, stainless steel 3 mm, aluminum 1.5 mm, brass and tungsten 1 mm) including molybdenum and plastics. The working area of 1320 mm x 1270 mm expands our present possibilities. In addition engravings can be made on working pieces up to this size.





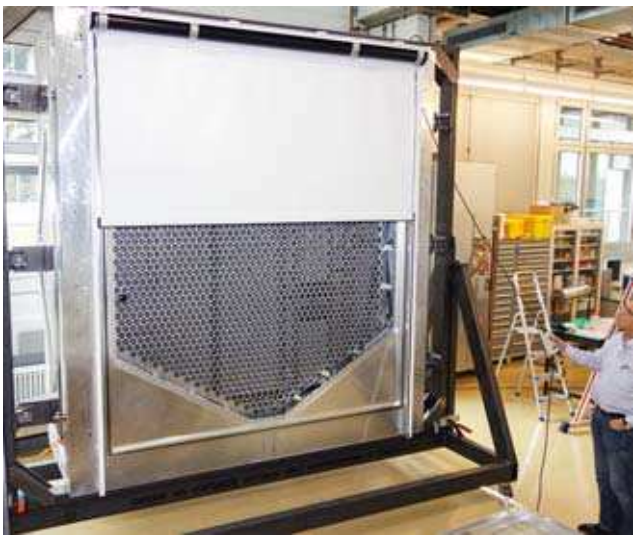
- Engraving process and a fabricated stainless steel workpiece





- Cutting tool in action with the pipe rotary cutting option

- Manufacturing of large parts for the FlashCam camera housing on a special table installed in the lock-smithery of the workshop



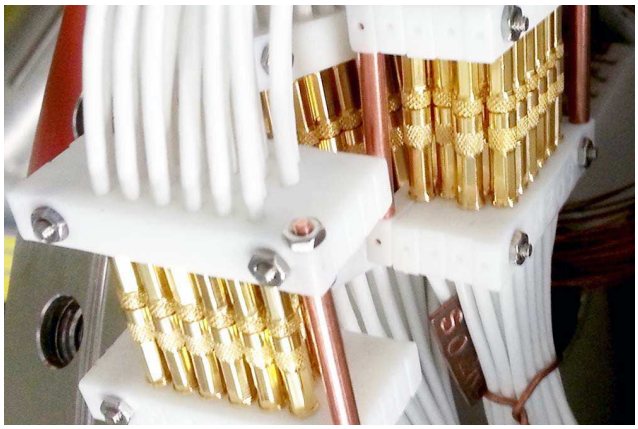
- The FlashCam camera housing during a shutter test in the assembly hall

Below we mention a selection of our activities:

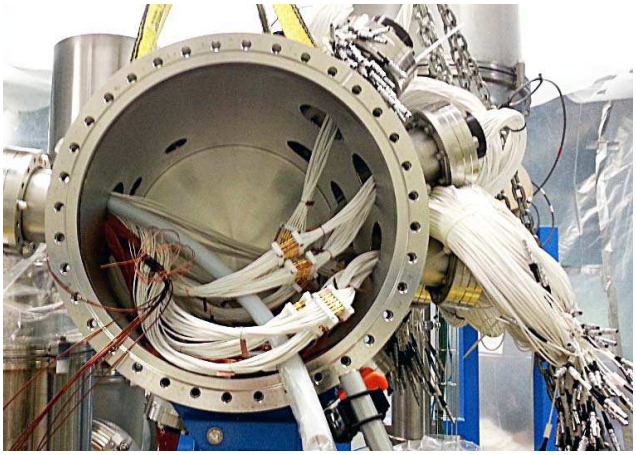
- CTA Cherenkov Telescope Array (Sec. 6)
  The prototype FlashCam camera was put together in the large assembly hall. Different frames, bushings, mounting brackets used for the installation in the thermal insulated housing were manufactured.
  Custom designed racks with integrated cooling units for the detector readout electronics as well as a retractable target holder were made. We could only install the components thanks to the installation space with a total height of eight meters available at the institute workshop.

- Astroparticle Physics (Sec. 4)
  For the Xenon experiment various test structures were prepared. In particular we produced special parts for connectors made of Teflon, insulators for voltage dividers and various brackets. Thanks to the new milling machine the large XENON1T porcupine chamber could be made. At the beginning of 2015 we started with the preparation of the 85 copper ring electrodes used in the TPC field forming structure. These rings are made of high purity copper purchased specifically for this experiment.

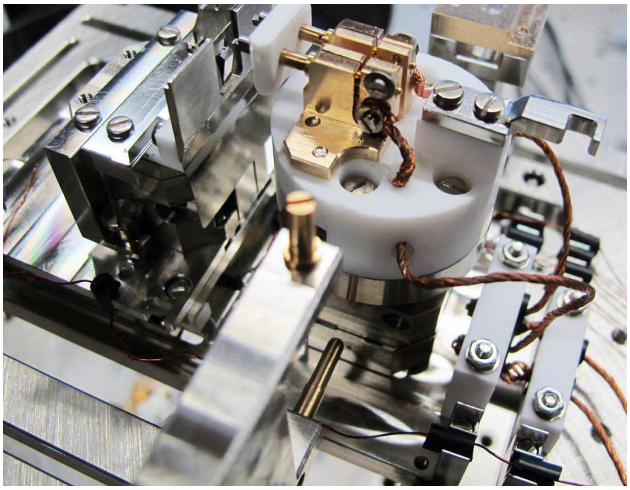
- Physics on the nanometer scale (Sec. 15)
  Modifications and maintenance at the six station vapor deposition apparatus were made. We fabricated a load-lock system which enables the rapid transfer of samples into an ultra high vacuum chamber without affecting the chamber pressure. We manufactured and tested parts for the low energy electron point source (LEEPS) microscope. All material used must be suitable for ultra high vacuum and large temperature variations. Thus, the insulators are made of ceramic and the other parts of stainless steel and titanium.



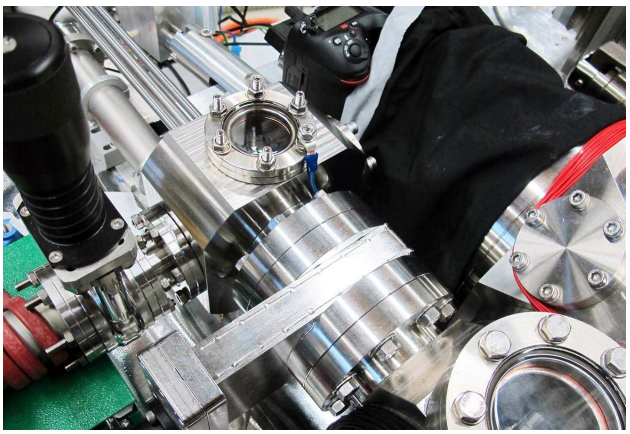
- Closer view of the custom made Teflon connector parts



- The XENON1T porcupine chamber during the cable installation at the underground lab at the Laboratori Nazionali del Gran Sasso (LNGS)



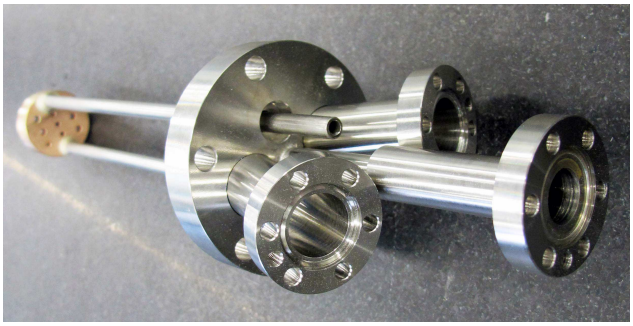
- Detailed view of the LEEPS microscope with field emission tip and sample holder in the center



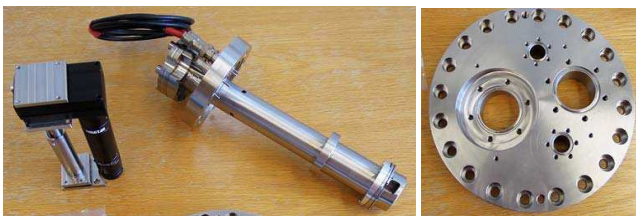
- Load-lock system enabling the rapid transfer of samples into the UHV chamber. An additional port permits the electro-spray deposition of biomolecules onto ultra-clean freestanding graphene.

- Surface Physics (Sec. 14)
  A new series of borazon cooler and Fasel sources were manufactured and assembled. Throughout the year molybdenum sample holders were adapted and maintained. These sample holders are covered on the inside with an insulating ceramic layer and can withstand temperatures up to 1000 ^{0}C. A small series of standard molybdenum sample holders was made as well.
  We produced a detector flange and parts for an electron diffraction experiment, which is installed at the Paul Scherrer Institute. Parts for the Sinergia project were produced. We performed maintenance work and made different modifications.

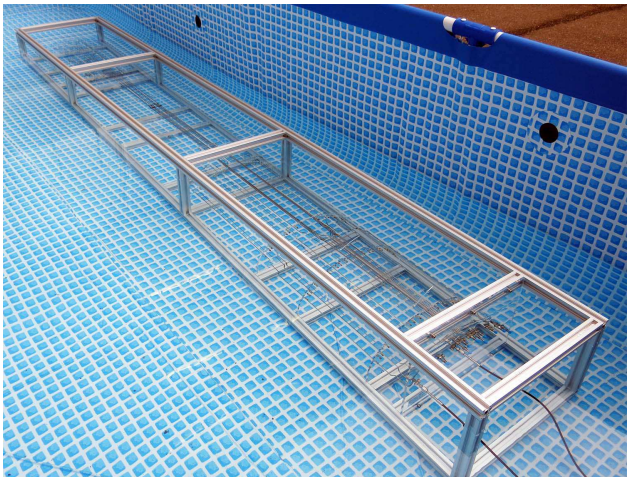
- CMS Barrel Pixel detector upgrade (Sec. 11)
  A new pixel detector has been designed for the CMS experiment at CERN (Phase I Pixel Upgrade) with lightweight mechanics and a CO2 cooling system. The demanded performances aim for 15 kW of cooling power at -20 ^{0}C evaporation temperature. The cooling structures are made of stainless steel tubes with a wall thickness down to 0.05 mm. Tests with the full-size cooling test-system prototypes produced in the workshop showed leakage at the soldering joints. To solve these problems we needed more time than planned. We tried to improve the soldering technology and made tests with different brazing alloys and flux. For the leakage and pressure tests instead of using water we changed to nitrogen gas with a test pressure of 200 bar. To find the leaks efficiently, we submersed the complete 3,2 meter long cooling test-system during the tests in a pool, which was set up outside of the workshop.
  At the end of February 2015 we finally had a working test-system at hand. The setup was then transported to CERN and is meanwhile connected to a CO2 cooling plant to perform the needed cooling tests. Currently, we continue with various soldering test runs to get a better understanding of the leakage long term effects which occurred. In early February 2015, we



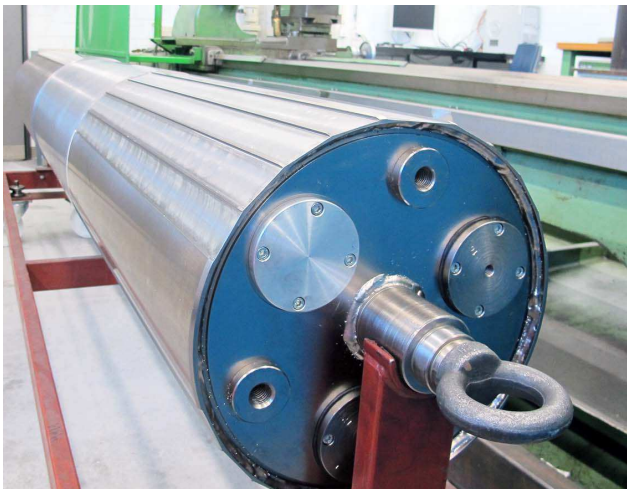
- Base flange of a home-built Knudsen-cell evaporator used for depositing thin films. The material to be evaporated, is contained in a crucible (not shown), which can be heated resistively or by electron-beam bombardment. The setup is water cooled.



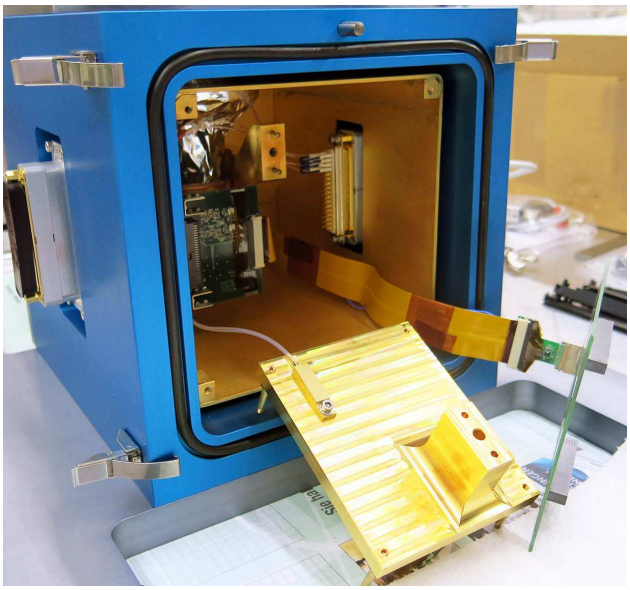
- Parts of an electron diffraction experiment. Electrons back-reflected by a sample produce light on a phosphorous screen after amplification by a micro channel plate. These parts are mounted inside a tube, seen in the middle. The screen is imaged through a vacuum viewport onto an external CCD, seen on the left. The picture on the right shows the detector flange.



- Prototype cooling system during a leakage test in a water pool



- The cylinder prepared for the fabrication of the Barrel Pixel Supply Tube structures



- The Alpine Cube test setup during the installation of the CCD base plate

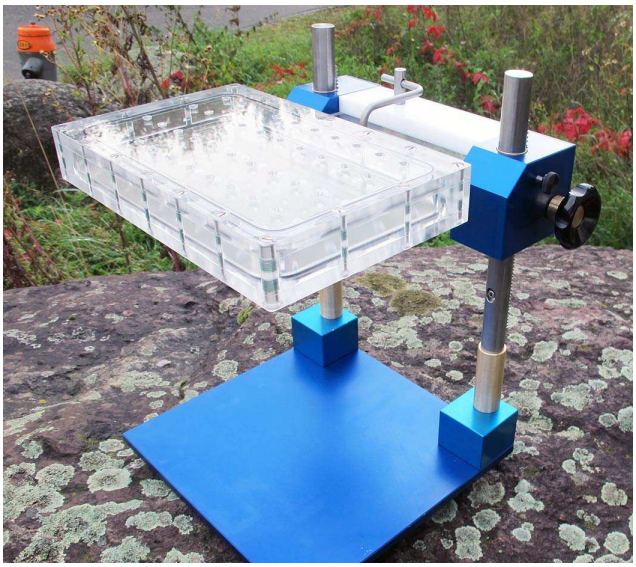
started with the preparation of the production cylinder needed for the fabrication of the Supply Tube structures for the new detector system. The VDF lathe was re-measured and adjusted to an accuracy of +/- 0.02 mm based on the diameter over the length of 3 m.

- DAMIC Dark Matter in CCDs (Sec. 5)
  We produced additional parts for the AlpineCube test setup used for studies of different CCD types. Various parts were refined (gold-plated) and the system was assembled and tested for vacuum leaks.

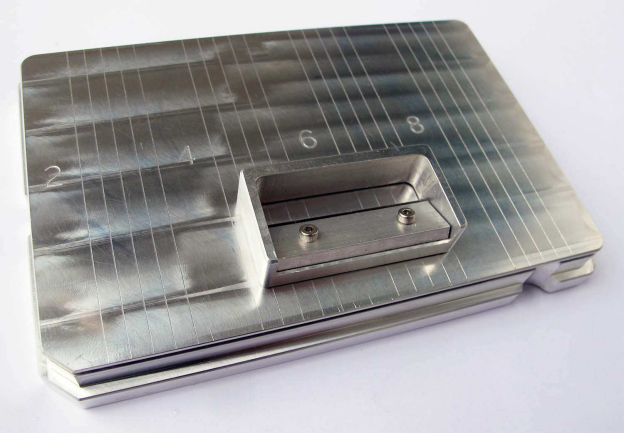
- Demonstration and laboratory experiments
  We repaired and improved different experiments used for the demonstrations in the basic physics lectures and in the laboratory courses for students of natural sciences and medicine.

- Basic mechanical workshop and welding courses
  In August and September 2014 and January and February 2015 the basic mechanical workshop courses for the bachelor students were provided. In total eleven courses were carried out at 35 hours each. In October 2014 the physics laboratory assistant apprentices from the ETH attended the welding courses. For institute staff members we organized an internal basic workshop course in November 2014.

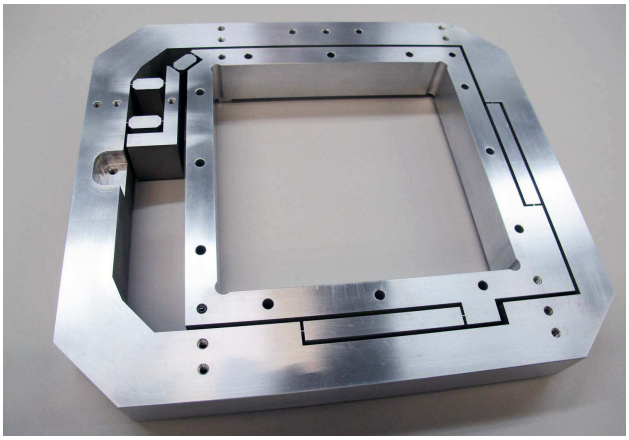
- Education of the apprentices and the workshop staff
  Courses in computer aided design (CAD) and manufacturing (CAM) were attended. We took part in welding seminars and went to the regular meetings devoted to the education of the apprentices. We visited machinery and tool manufacturers, and exhibitions. For people interested in a grade as a poly-technician we provided one-week trial apprenticeships in May and August 2014 and several trial days in March 2015.



- Vaporization unit for the Institute of Forensic Medicine.



- Sample holder with an integrated hair cleaving tool. With this unit, hair samples can be forensically examined faster.



- Special grid holder for X-ray grating-based phase contrast imaging made for the Centre Suisse d'Electronique et de Microtechnique (CSEM)

For other departments and outside companies:

- Institute of Forensic Medicine
  Five sample vaporization devices and a special hair-sample holder

- Institute of Physiology
  Sample holders with membranes

- Zoological Museum
  Earphone spiral cables

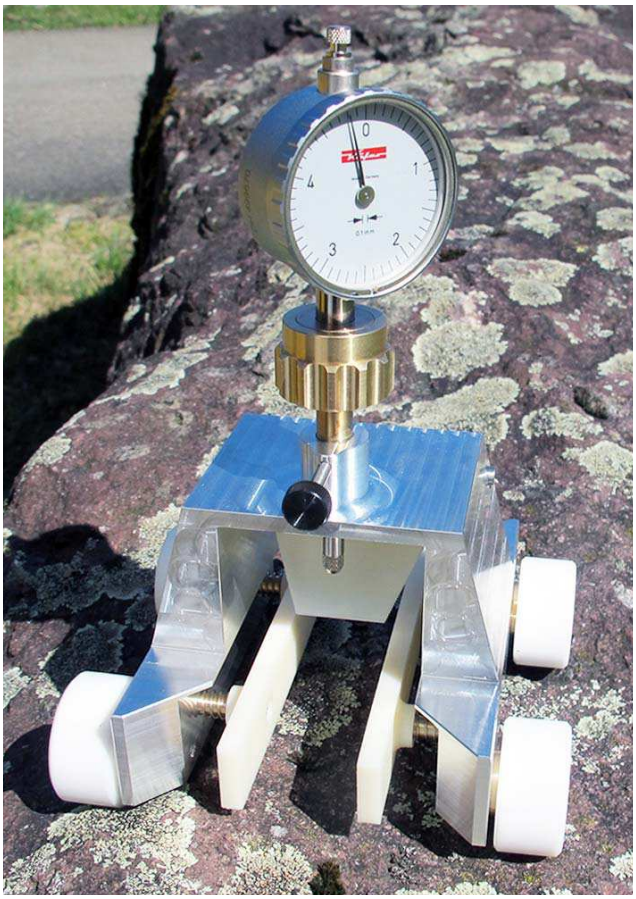
- University of Applied Sciences Rapperswil (HSR)
  A high-pressure cell and a special flywheel

- Centre Suisse d'Electronique et de Microtechnique (CSEM)
  special grid holders used for the EVITA project
  CSEM leads the consortium which aims at new non-destructive inspection methods for the novel fibrous composite airplane materials give a weight (and thus fuel) reduction of >20%.

- A lighting company
  Small series of holders for energy-saving LED lights

- Department of Geography
  a mobile Augmented Reality 3D sandbox with dimensions 850 mm x 1150 mm x 1950 mm

- An outside company
  A series of special measuring carriages, allowing to check the turbine blade positions in gas turbine compressor wheels after their assembly



- Measuring tool to survey the gas turbine compressor wheels after the assembly of the single blades on the rotor spindle