Report of the Electronics Division

Project Review 2015

Max-Planck-Institut für Physik
(Werner-Heisenberg-Institut)

Outline

- Projects in 2015
- Manpower
  - Distribution in 2015
  - Requests for 2016/17
- Status of some selected projects
- Infrastructure

Projects in 2015

- Main Projects
  - ATLAS HEC low voltage (EA, EE)
  - ATLAS MDT BMG prototype (EA, EE, EP)
  - ATLAS MDT trigger prototype (EE, EP)
  - Belle-II CO_2 cooling (EA)
  - Belle-II Kapton (EE, EP)
  - MAGIC SiPM cluster (EE, EP)
- Minor Projects
  - ATLAS SCT (EA, EP)
  - CTA (EA, EP)
  - CRESST (EA, EP)
  - GERDA (EA)
  - MAGIC maintenance (EA, EP)

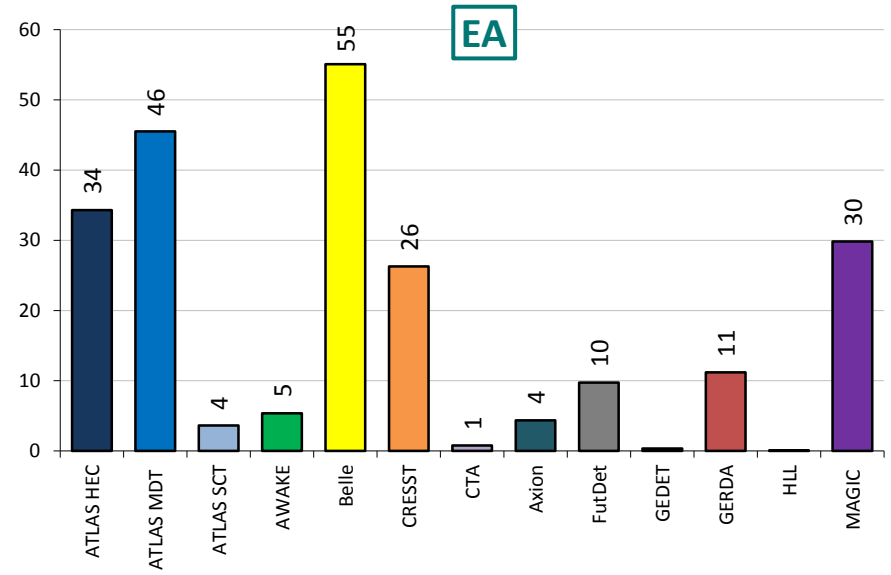
Groups

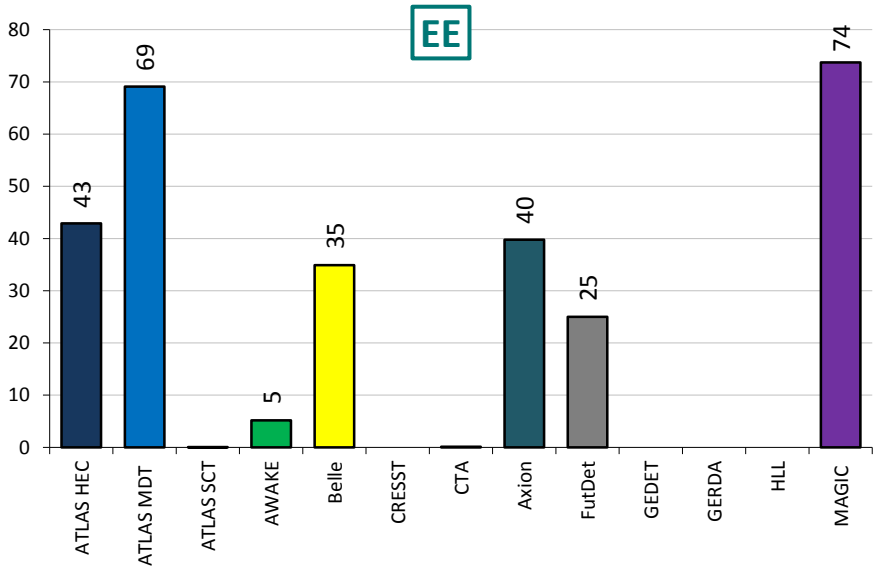
EA: Elektronikanlagen
Electronics Installation

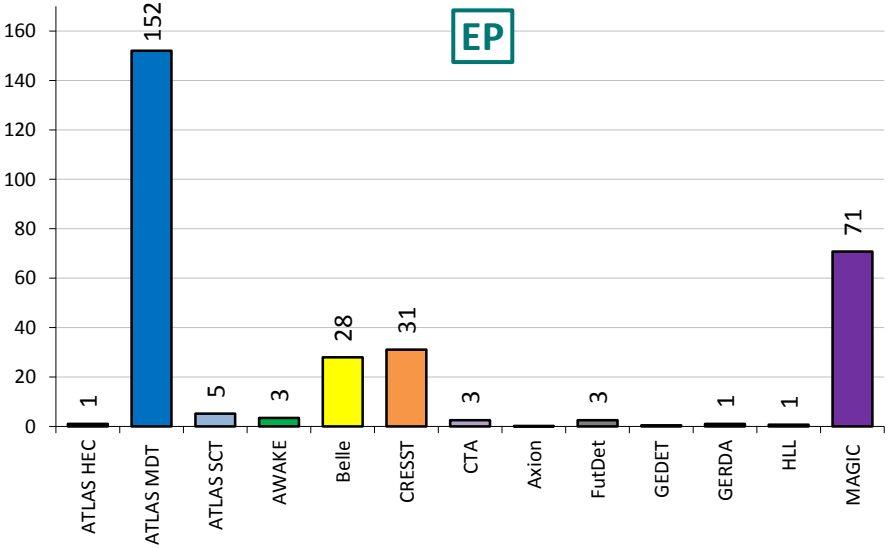
EE: Elektronikentwicklung
Electronics Design

EP: Elektronikproduktion
Electronics Production

Work of Individual Groups in 2015





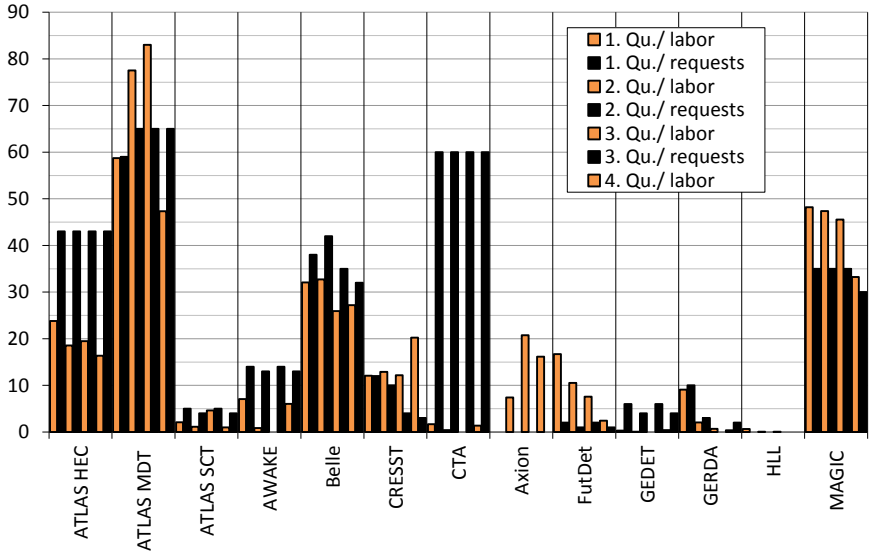


- January – November in MW (man-week)
- Assumption: 10 MW per quarter and person. This accommodates for vacation and illness.
- Caution: The scales differ!

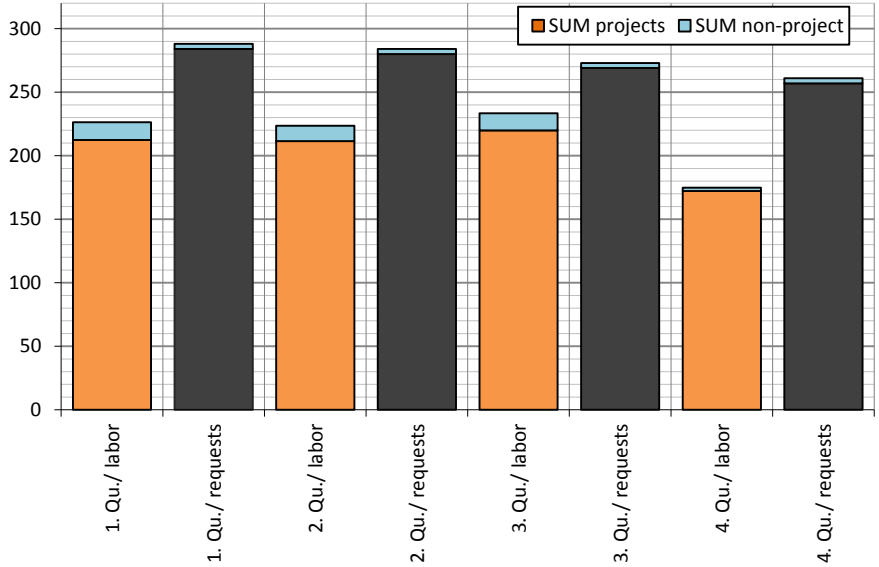
Comparison of Work & Request 2015

- January – November in MW (man-week)
- December missing
- Largest projects: ATLAS MDT, Belle and MAGIC
- Noticeable shift of manpower mainly from ATLAS HEC and CTA to other projects

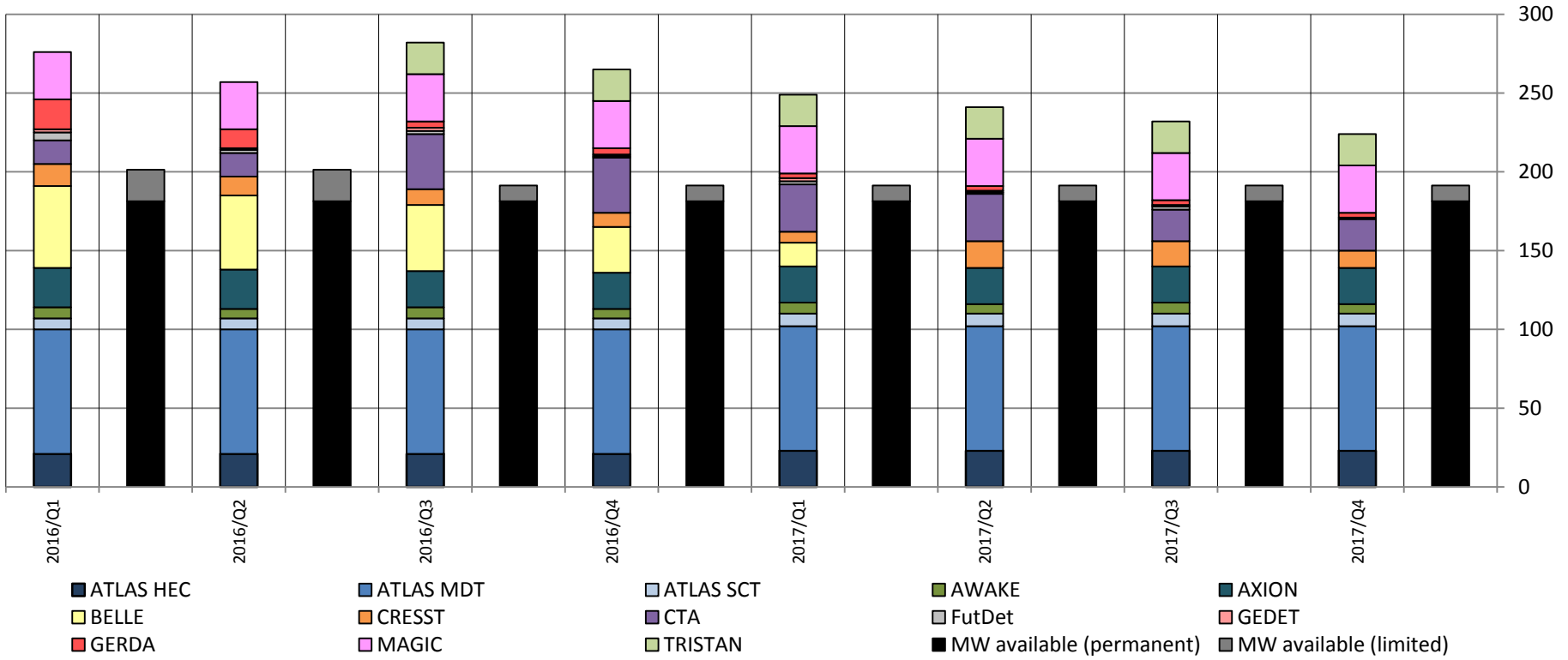
Electronics division work & requests 2015



Work vs. requests in total, 2015



Requests for 2016/17



Biggest projects 2016/17:

Demands higher than resources!

ATLAS MDT

- Chamber construction
- Trigger development

Belle-II

- CO_2 cooling
- Kapton cable
- Assembly

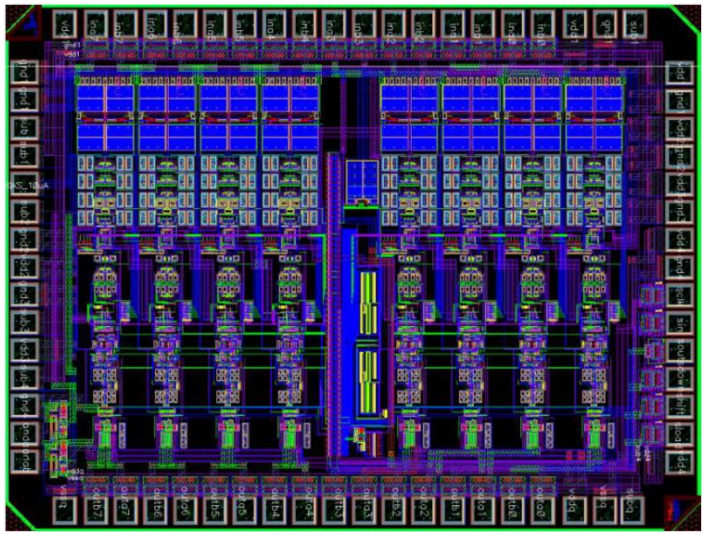
MAGIC / CTA

- Maintenance
- Sum trigger update
- Start of CTA construction

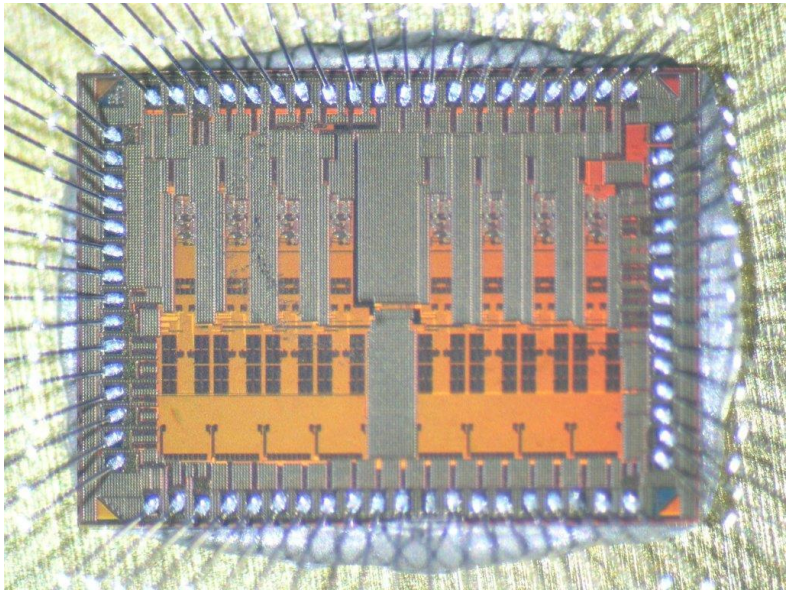
ATLAS HEC – Low Voltage

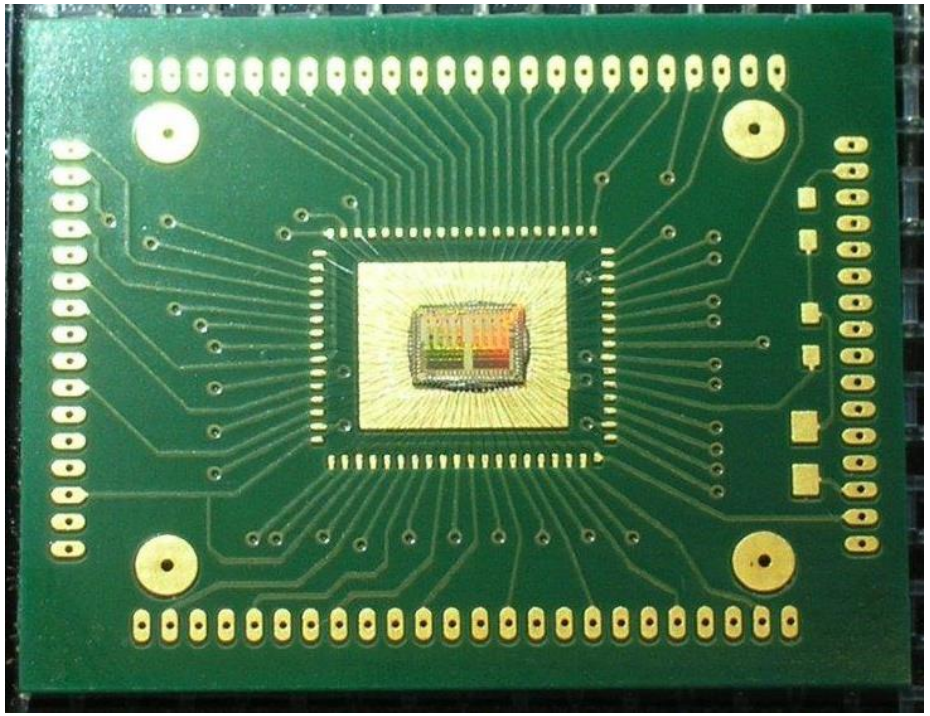
- Software development for new slow control infrastructure: New PC, change of OS (Windows -> Linux), new hardware and an update programming environment.
- Preparations for radiation tests with neutrons:
  - Microsemi (Actel) ProASIC3 FPGA
  - Power diodes
  - Low voltage regulators
  - DC/DC converters
- Next test planned for spring 2016
- Needs a lot of infrastructure:
  - ~ 50 power supplies
  - Cables + wiring (40 m)
  - Automatic monitoring
  - Temperature sensors
  - Mechanical supports

ATLAS MDT – ASD2 ASIC



- Layout had been submitted to foundry in November 2014.
- 40 dies were delivered in March 2015.
- Several have been mounted on adapter boards with ASD-compatible pin-out.
- Thorough testing has been done is still ongoing.



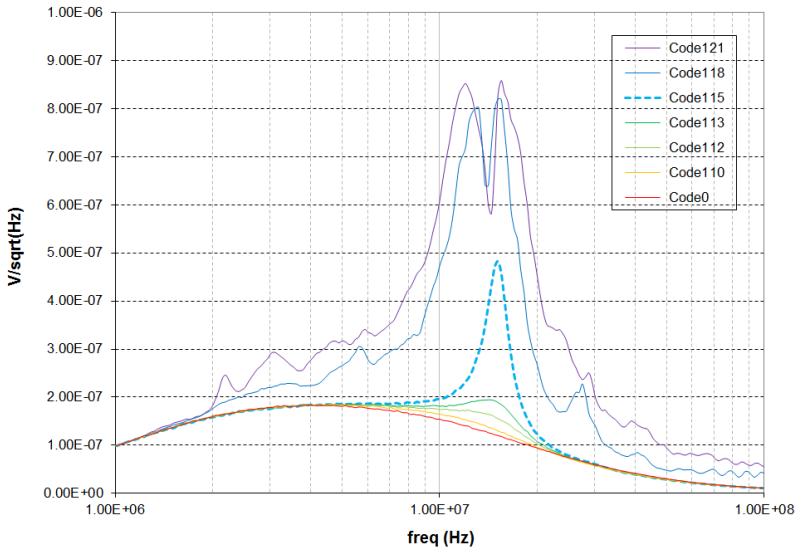


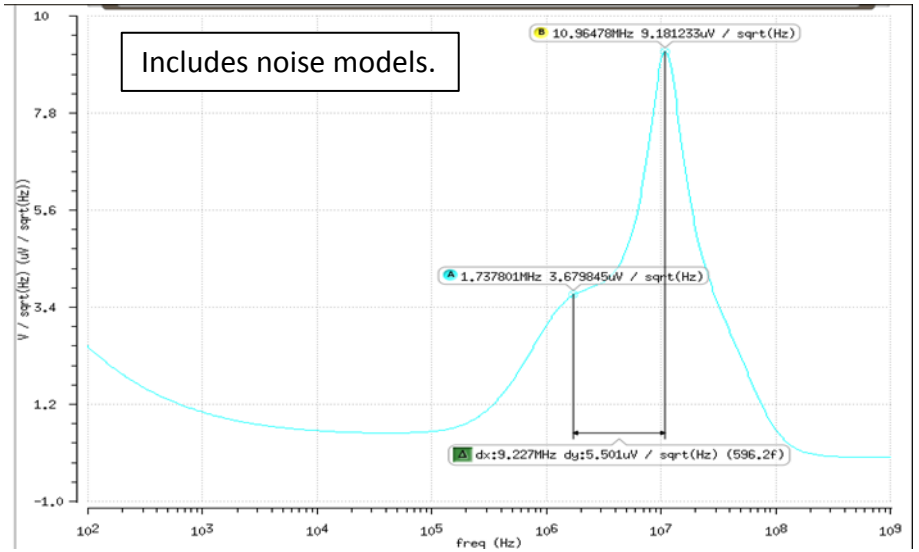
ATLAS MDT – ASD2 Oscillation Issue

Measurement

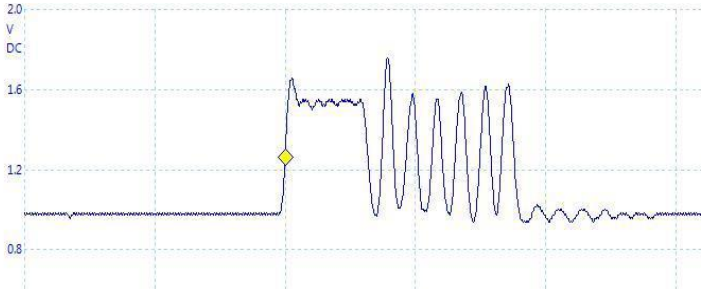
Simulation (incl. parasitics)

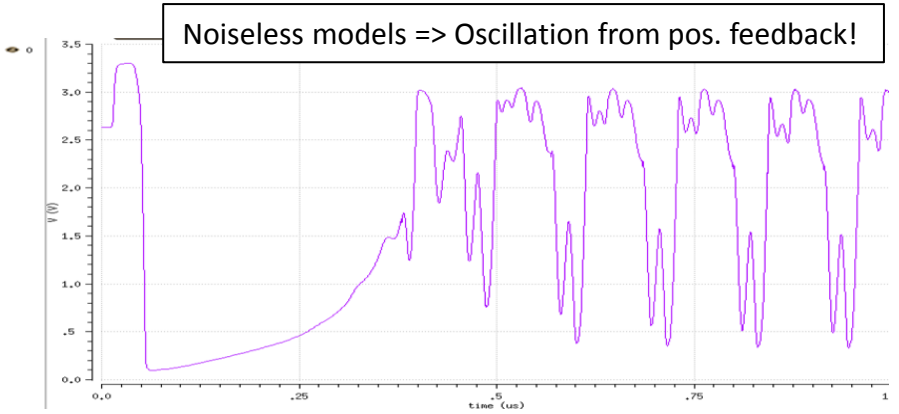
Frequency domain





Time domain





ATLAS MDT – ASD2 Findings

Achievements:

- The rise time of the shaped pulse meets the requirements.
- ADC for measurement of pulse height working.
- All loadable settings have an expected affect on the output.
- Improved LVDS output signals.

Issues discovered:

- Oscillation, especially at lower thresholds.
- Large property discrepancies among the 8 channels.
- Amplification of channel 7 smaller than the others.
- Gain depending in discriminator threshold.
- Mistakes in some digital configuration bits.

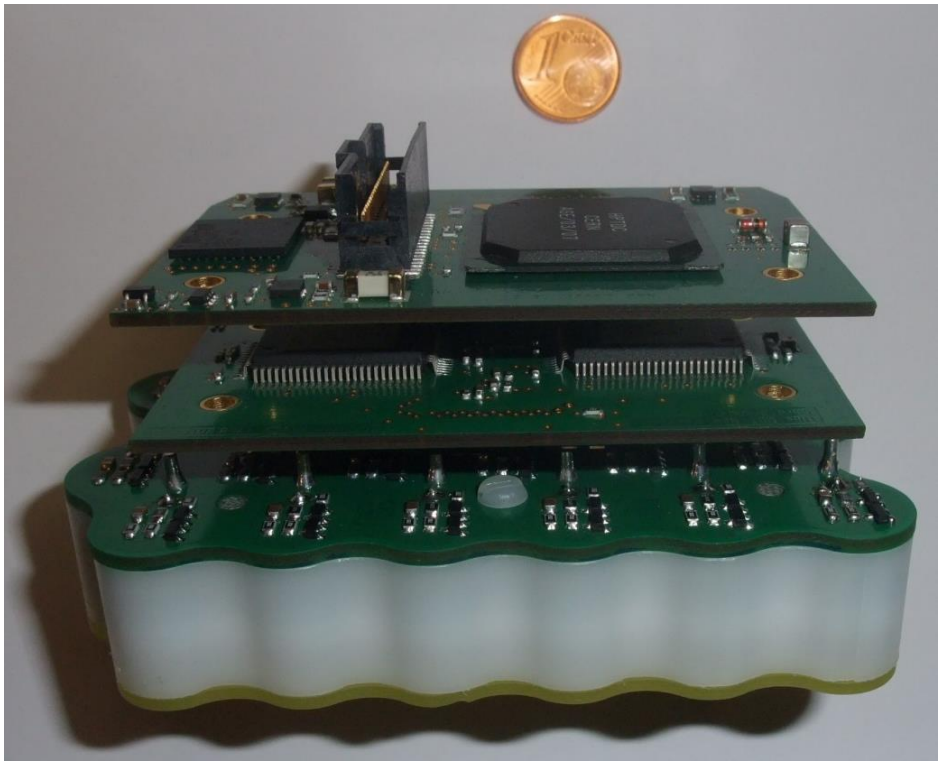
Future steps:

$\Rightarrow$ Thorough simulation to understand the sources of issues.

$\Rightarrow$ Re-design of critical function blocks.

$\Rightarrow$ Add test structures in the next submission.

ATLAS MDT – Small Mezzanine Boards

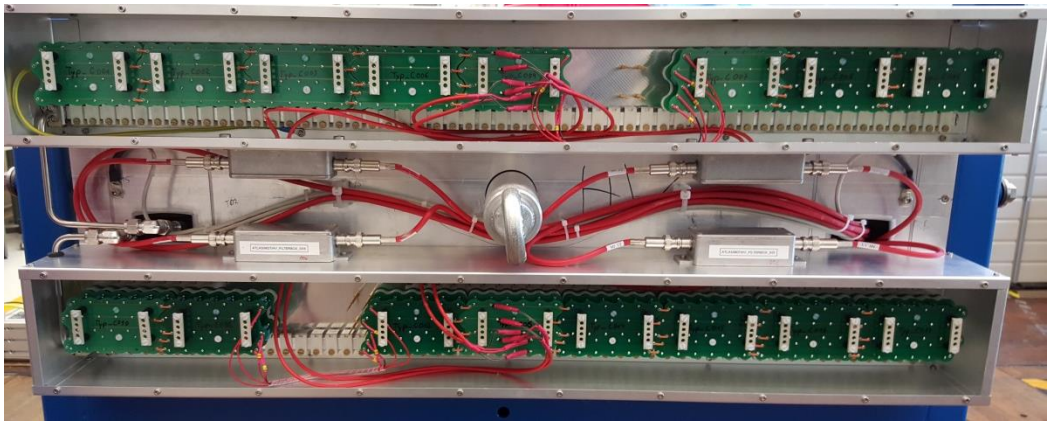


- Issues with noise solved by a metal plate between two layers wired to Faraday cage.
- Redesign to fix some digital problems.
- FPGA firmware development to support ASD configuration and some slow control functions.

- Software for FW download and automated quality control routines finished. Test stand set up at the electronics production.
- Mass production of 250 stacks started, ongoing in 2016.

ATLAS MDT – BMG Chamber Production

Read-out side with 16 stacked mezzanine cards.



High voltage side with 4 filter boxes.

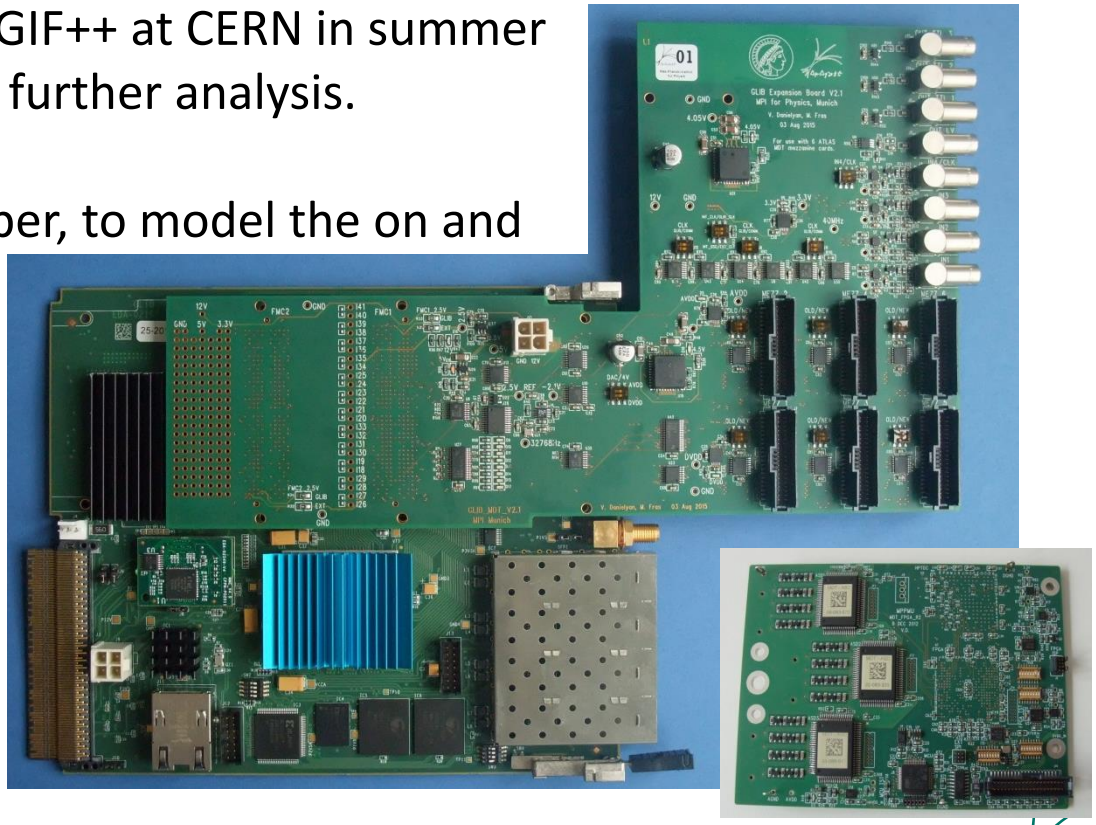
- Design and development of HV supply, cable management and grounding.
- First prototype built and tested.
- 12 individual chambers with different gaps to be produced in 2016.
- Pipelined production: One chamber per month.

ATLAS MDT – Trigger Demonstrator

- Purpose: Studies of fast hardware-based high p_T trigger with ~6 µs latency.
- Based on GLIB + expansion board + trigger mezzanine card.
- Universal setup for all current and future mezzanine cards.
- Firmware development for GLIB FPGA (Xilinx Virtex-6) and mezzanine card FPGA (Actel ProASIC3) done to implement a fast TDC with trigger matching.
- Successful data taking at the GIF++ at CERN in summer this year. Raw data stored for further analysis.

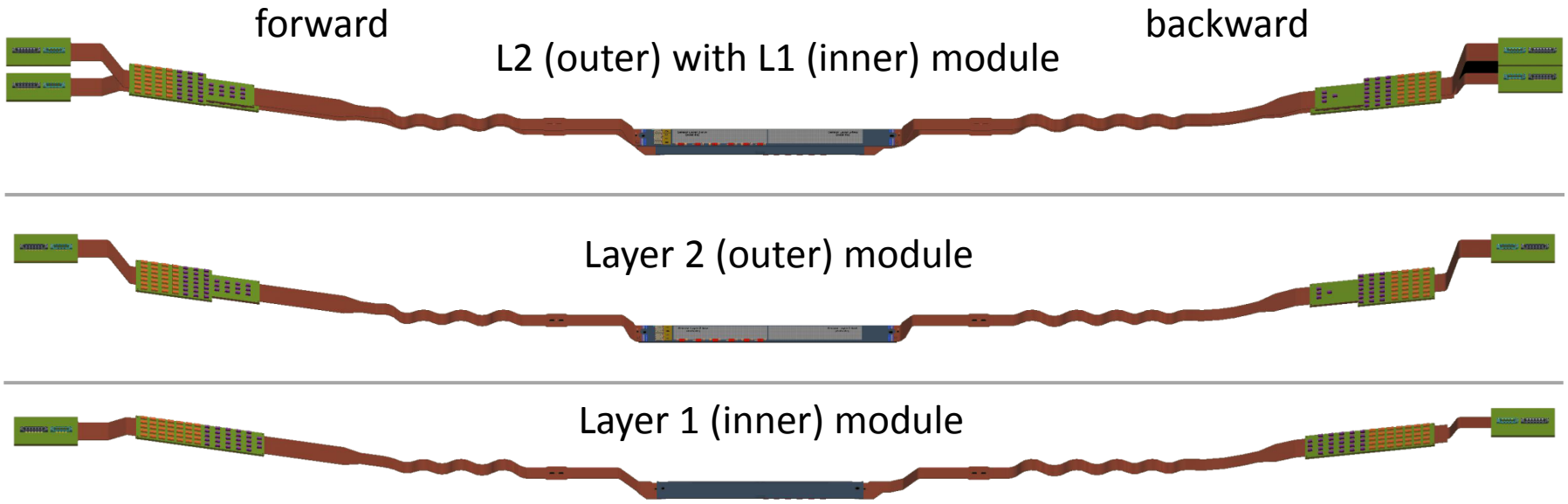
Future activities:

- Data transfer via an optical fiber, to model the on and off detector part at ATALS.
- Implement buffers for feeding arbitrary data and read intermediate values.
- Implement region of interest (ROI) matching and track reconstruction on Xilinx Zynq SoC.

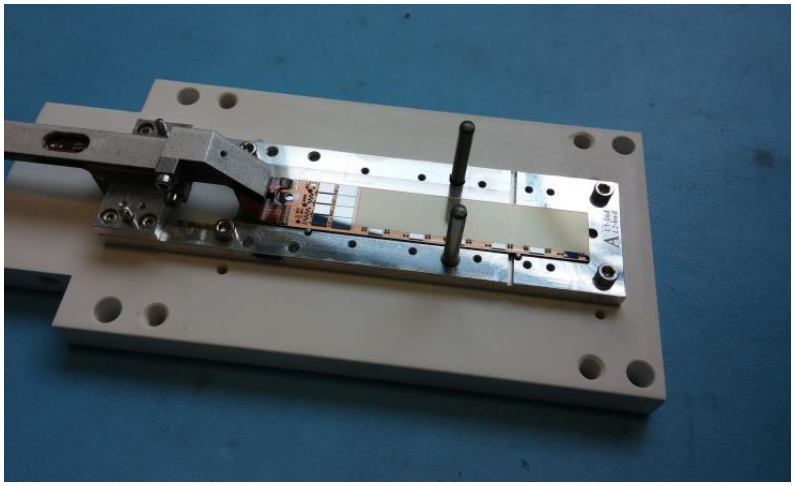


Belle-II – Kapton Cable

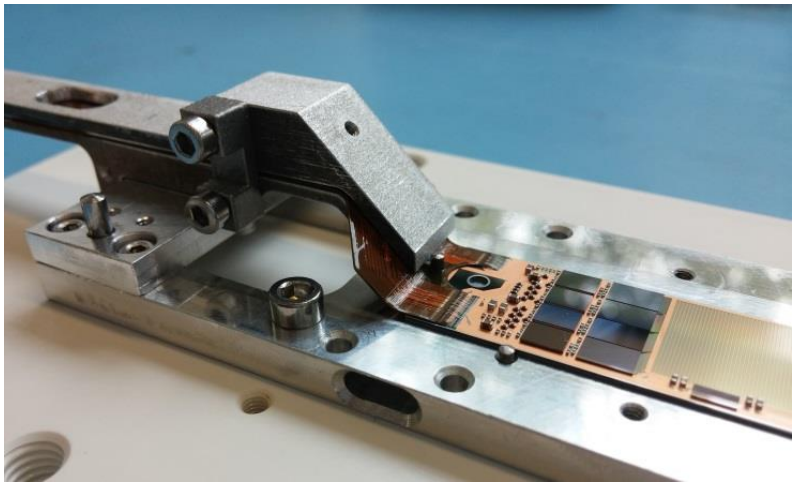
- First prototype of L2bwd incl. capacitors delivered and tested.
- Layout of all 4 individual variants (L1fwd, L1bwd, L2fwd, L2bwd) finished recently, just in time for the DESY test in April 2016.
- Production of all 4 type will start soon. It is done by a company.
- Electrical performance is OK, but electromechanical issues (alignment of connectors) may lead to a re-design.



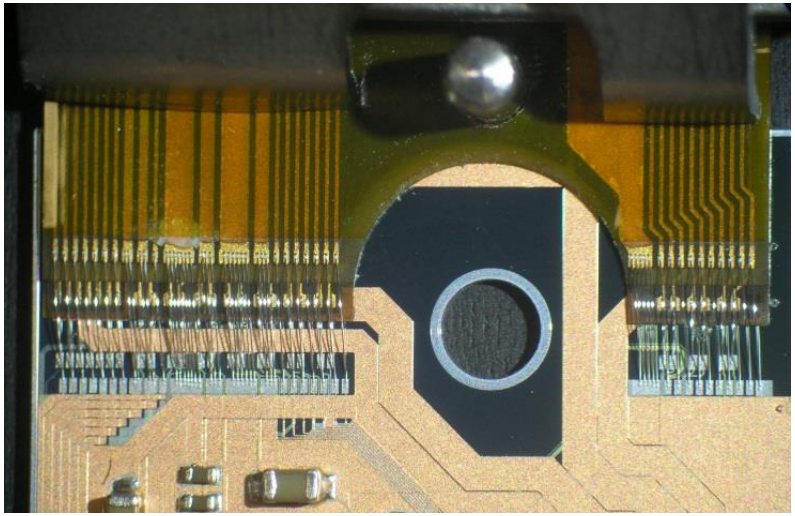
Belle-II – PXD9 Assembly



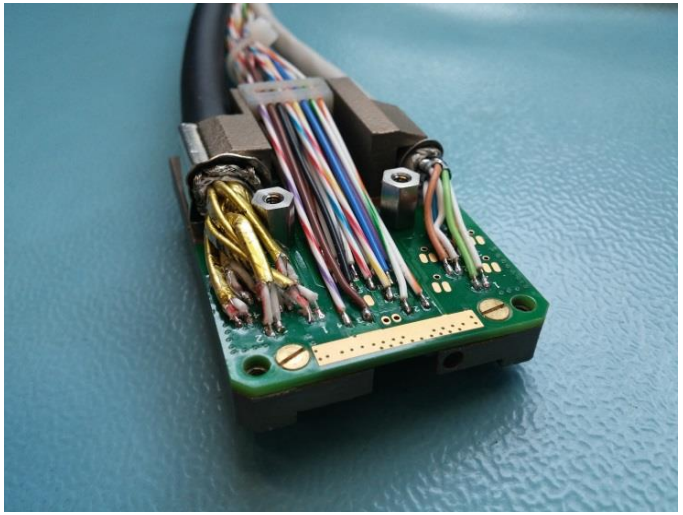
PXD9 module with Kapton and support



Detailed view of connection



Bond wires PXD9 -Kapton



Patch panel with cables

Belle-II – Kapton Cable Testing

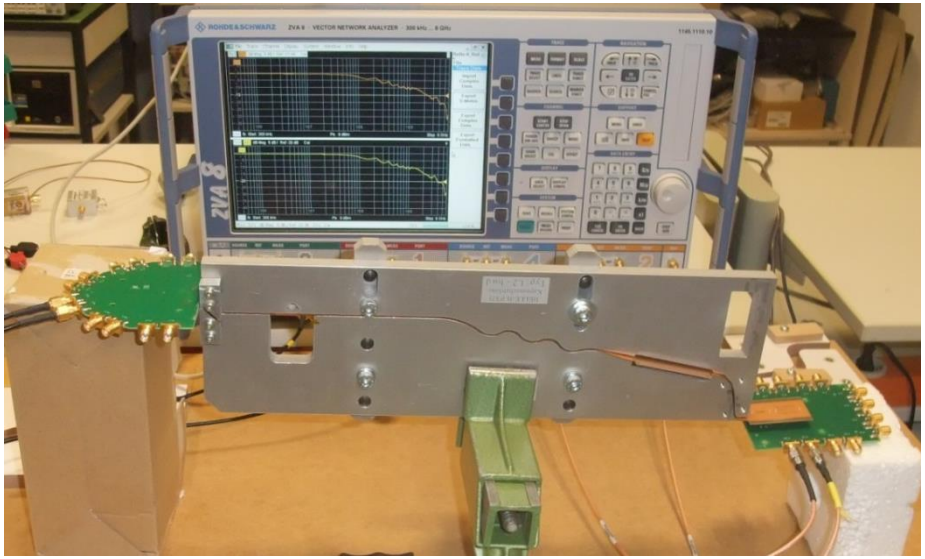
- Measurement of the PXD9 L2bdw Kapton cable with the network analyzer.
- Adapter boards designed for connection to measurement device.

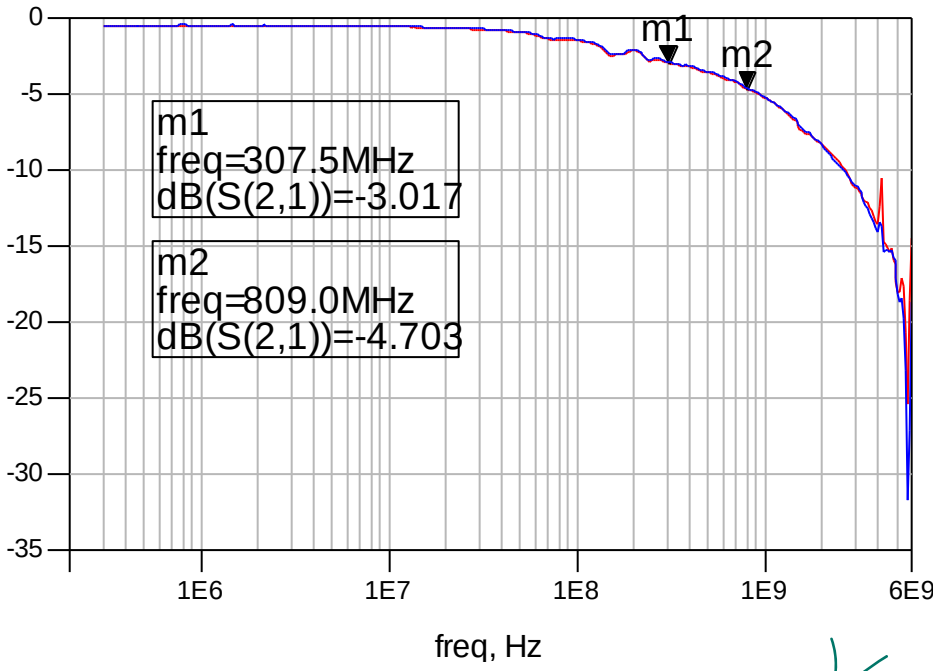
Results:

- All 4 high-speed lines behave very similar.
- Bandwidth ≈ 300 MHz.
- Attenuation at 800 MHz ≈ 5 dB.
- Differential impedance ≈ 90 Ohms.
- No influence of bending observed.

⇒ No problem for the serial signal transmission.

⇒ Signal integrity measures may be necessary.





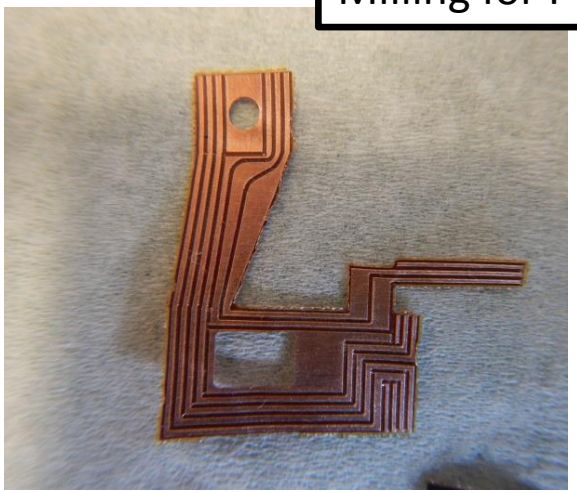
Belle-II – CO_2 Cooling

- Cooperation with CERN.
- Ordering of a all components done.
- Installation of the electrical cabinets.
- Large set of components mounted.
- Most wiring will to be done in 2016.

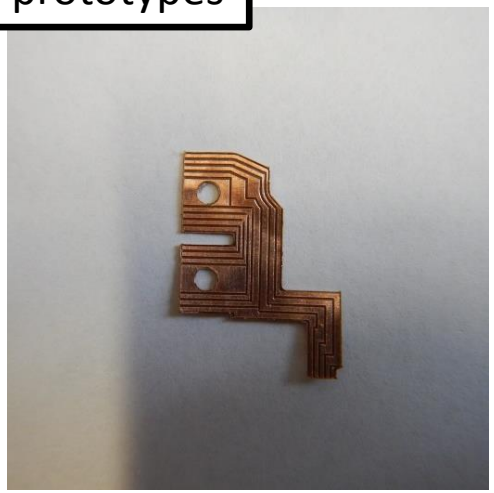
- Power and grounding concept ready and implemented.
- Tests at MPI in 2016.
- Shipping to Japan planned after successful operation.
- Tight schedule!

CRESST – Kaptons and Supports

Milling for PCB prototypes

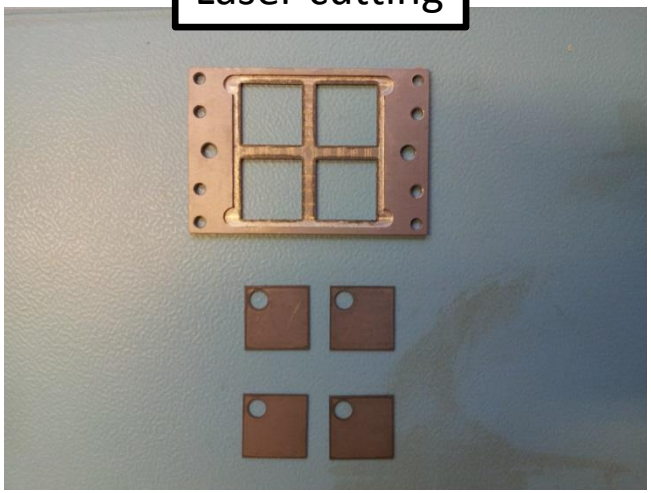


Bottom plate iStick

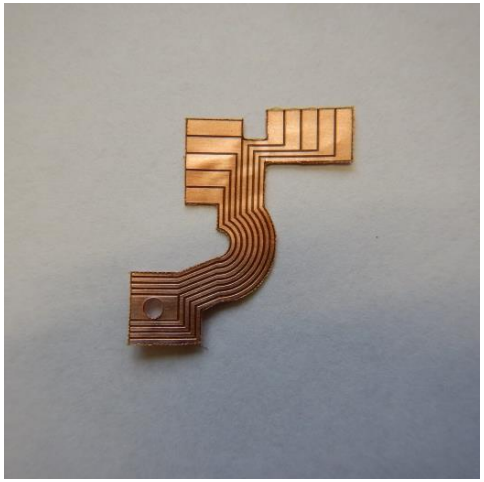


Top plate iStick

Laser cutting

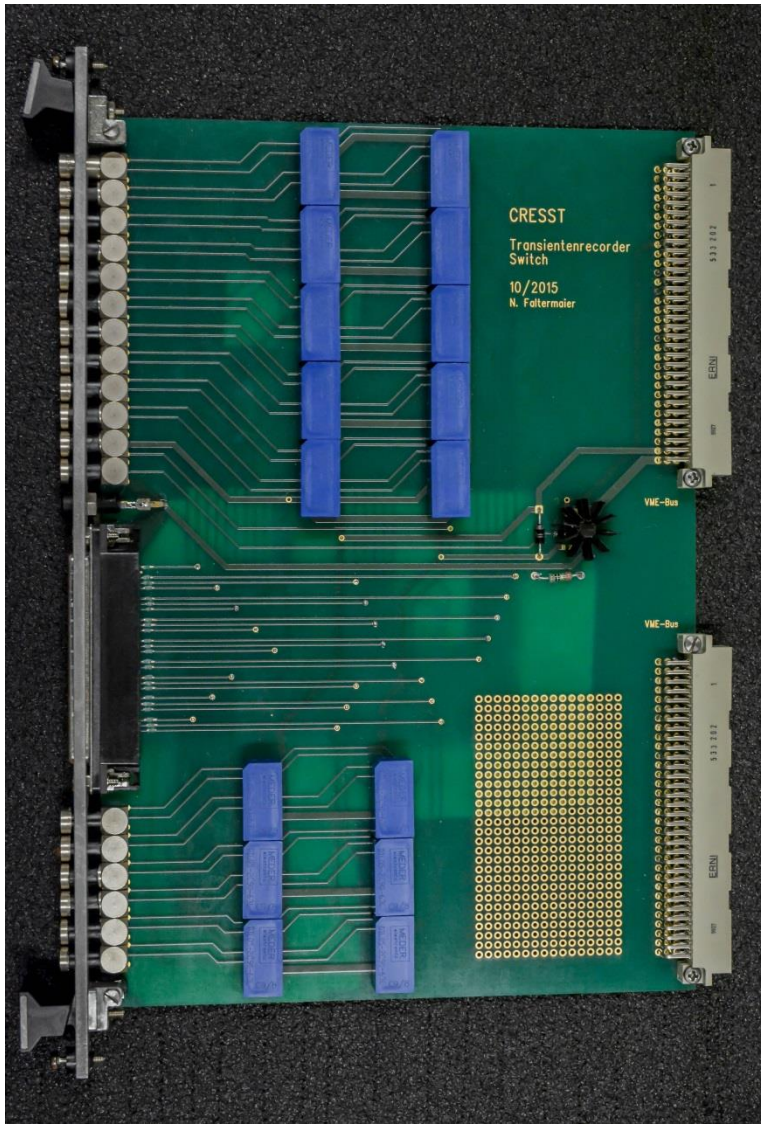


Side band

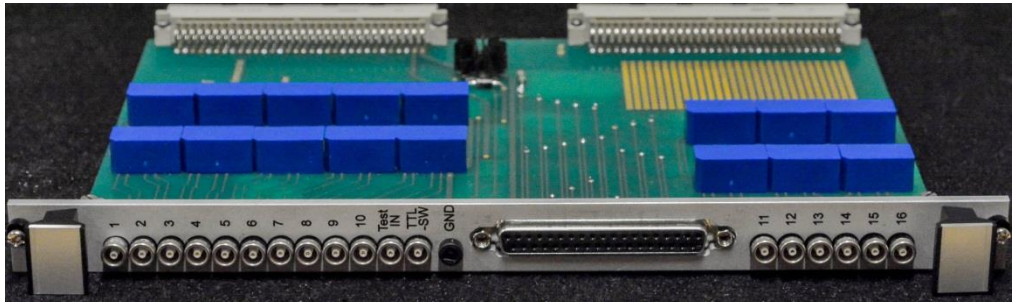


Top plate PD LD

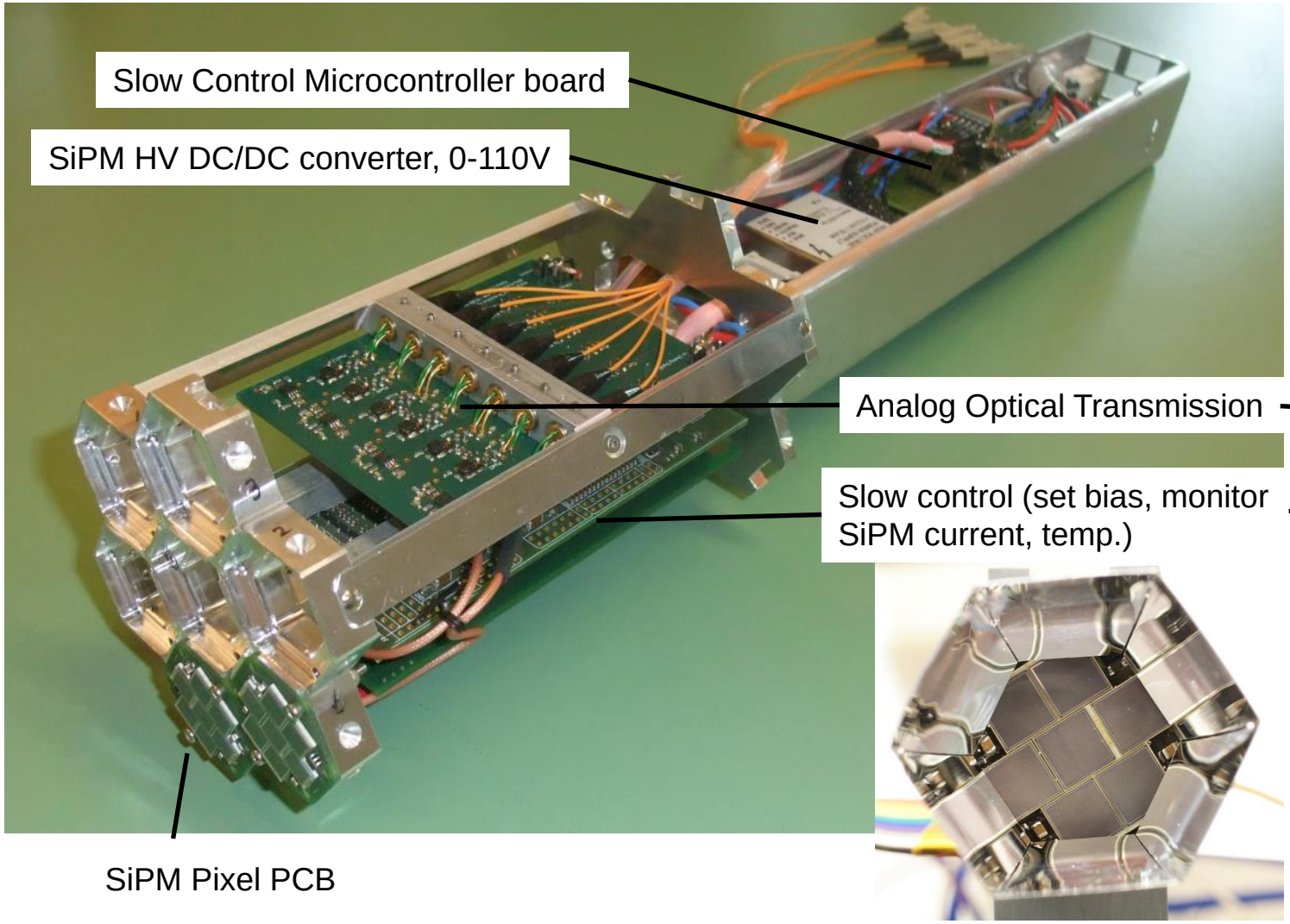
CRESST – Transient Recorder Switch

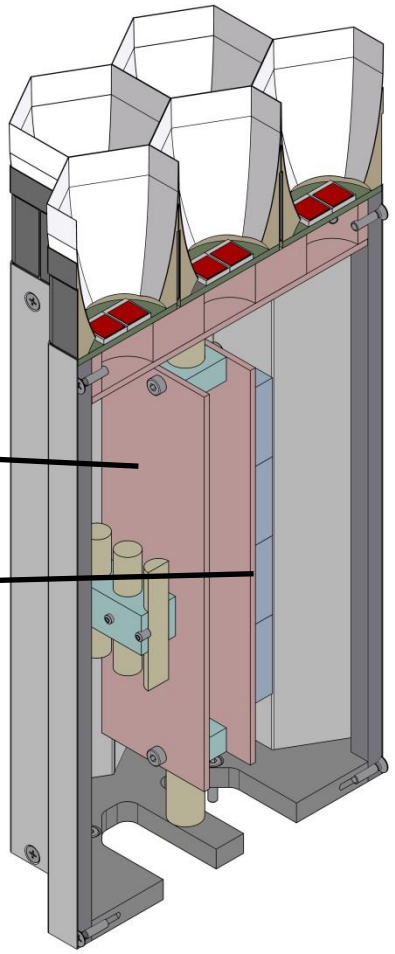


- Switch between measurement and calibration signal.
- Calibration of the offset and gain of two 16 channel transient recorders.
- Separated grounds per channel due to differential signals.
- Development, design and layout and assembly done by a former apprentice.

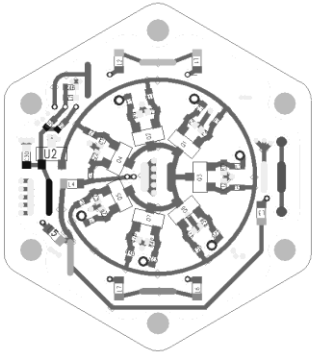


MAGIC – SiliconPM Cluster





MAGIC – SiPM Cluster

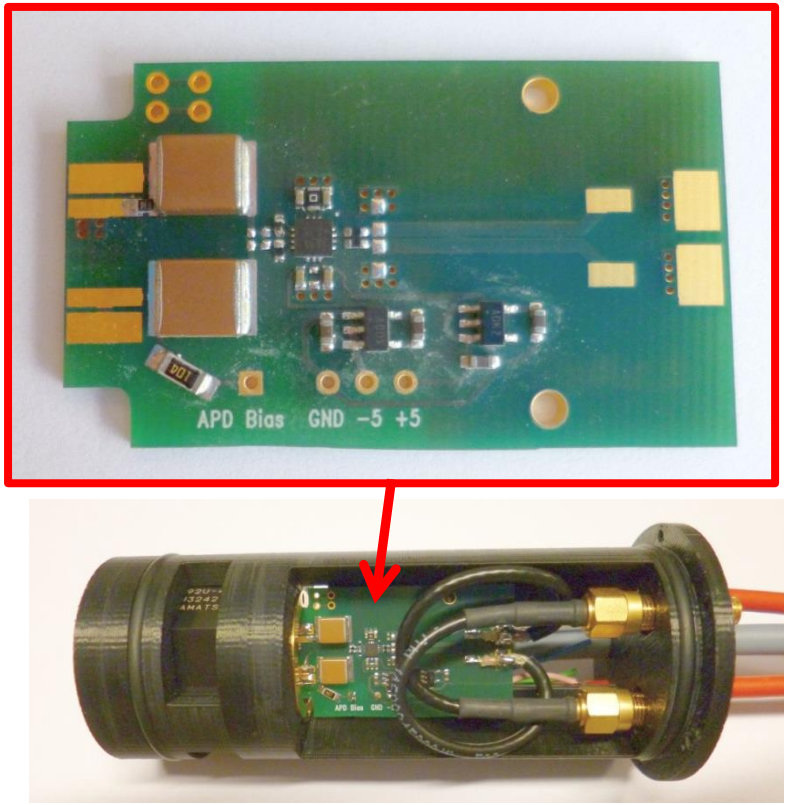


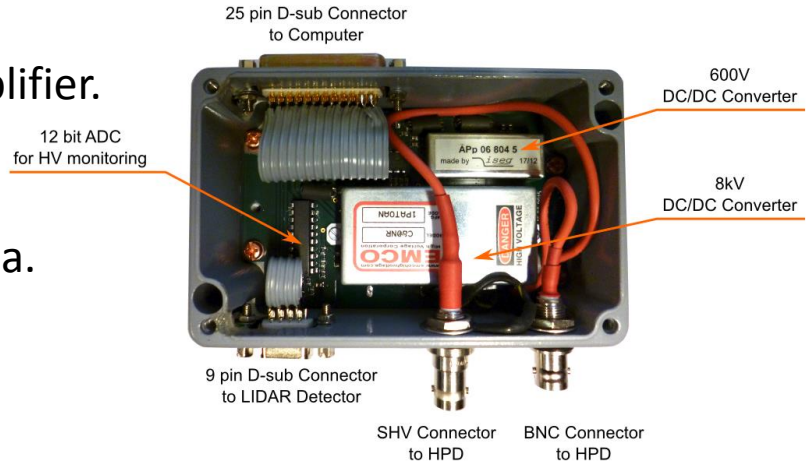
- Components:
  - Pixel-board with 7 pixel á 7 SiPMs (silicon photo multipliers).
  - VCSEL-board with aluminum cooling block.
  - Analog board with OP-AMPS for bias voltage and temperature sensors.
  - SiPM interface board with 40 DAC and 48 ADC channels.
  - SCCP - Interface between MAGIC camera electronics and the SiPM cluster.
  - Power board with high voltage DC/DC converter.
- Installation in the MAGIC I camera in May 2015.
- Operational and collecting data for comparison with PMT clusters.
- A second “bare bone” cluster was produced and provided to the INFN (Padua/Italy) to get started SiPM sensor prototyping.

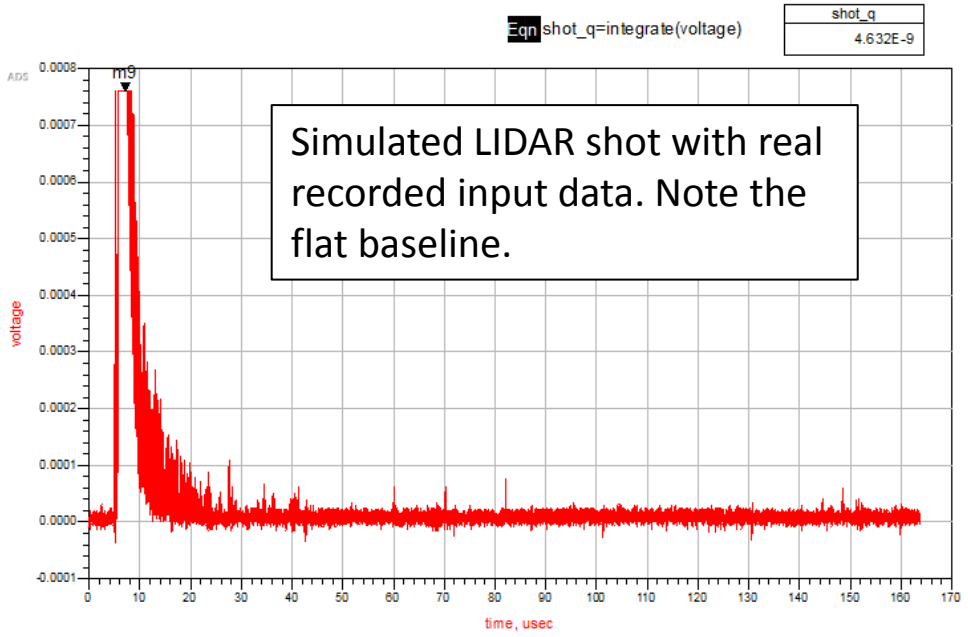
MAGIC – LIDAR Upgrade

Upgrade of existing system:

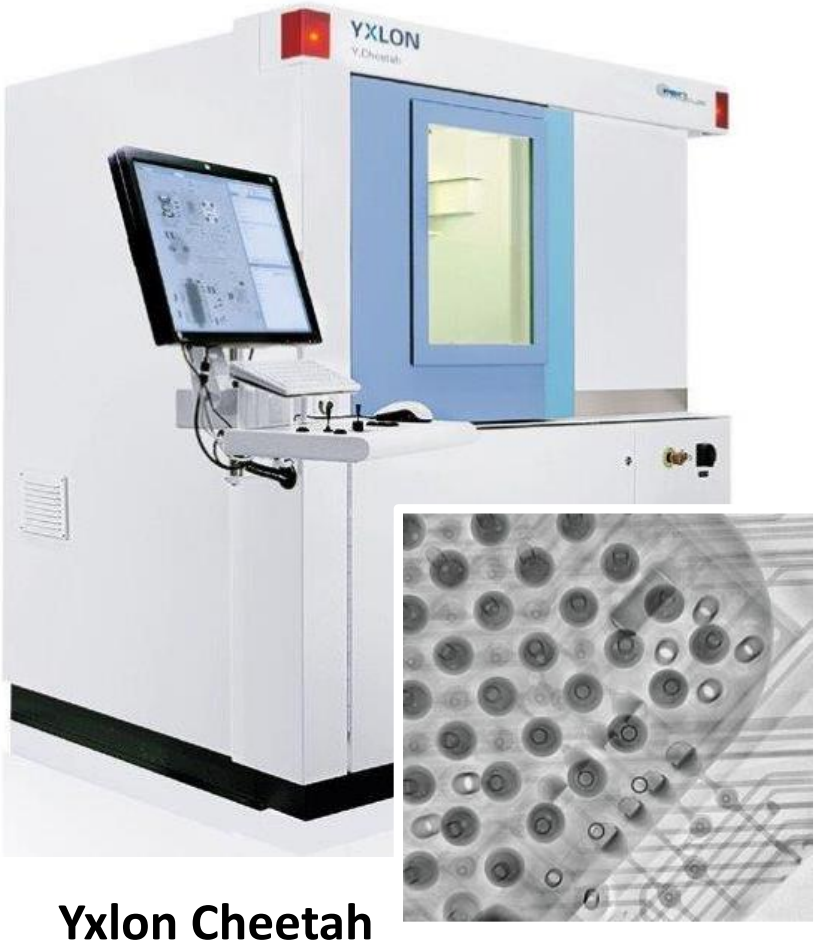
- Differential, high BW (~500 MHz), low noise amplifier.
- Improved computer controlled power supply in separate metal shielded enclosure.
- First successful tests end of Nov. 2015 in La Palma.







New Tools – X-Ray and Digital Microscope



Yxlon Cheetah

- High resolution X-ray
- CT-mode (3D)
- 25 - 160 kV

Keyence VHX-5000

- 3D pictures with depth of focus
- Magnification 20 – 5000
- Versatile measurements
- HDR mode, glare reduction

Conclusion

- Huge diversity of knowledge, abilities, tools and technologies necessary.
  => Specialization mandatory!
- Much work done in 2015.
- A lot more will come in the next years.

Thank you for your attention!