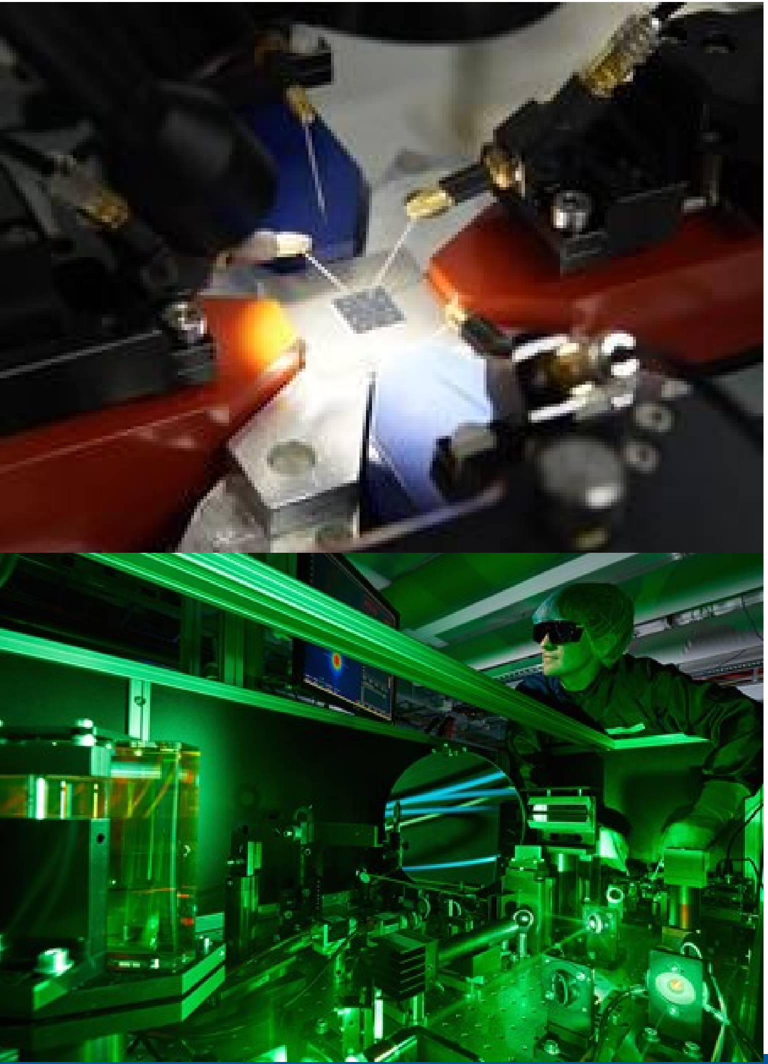
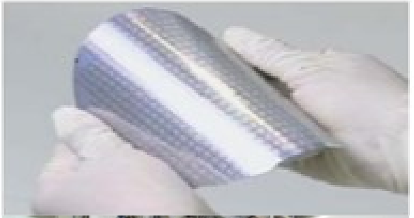


MATTER AND TECHNOLOGIES

Ties Behnke, DESY
Program Speaker

HELMHOLTZ ASSOCIATION

Matter and Technologies:
Our Mission



Bundle competence available in matter
in accelerator and detectors science at Helmholtz:

“Matter and Technologies” will be a platform
for fundamental developments in technologies
to prepare for the future of the field.

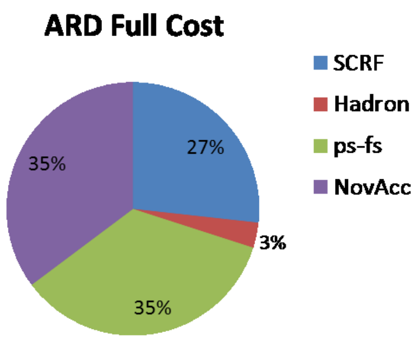
Driven by science
Needed by the science
Important for society
Relevant for industry

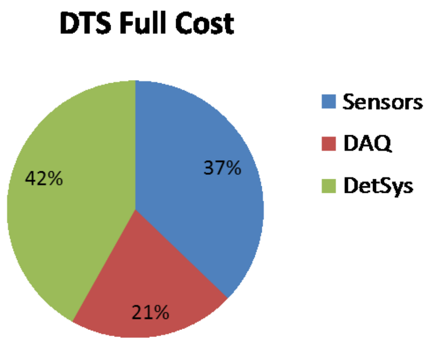
Technology is the motor of innovation and excellence

Fundamental research is one of the most efficient driving forces
for new technologies

MT current structure

Accelerator Research and Development				Detector Technologies and Systems		
MT ARD				MT DTS		
SCRF	Hadron	ps -fs	NovAcc	Sensors	DAQ	DetSys





MT in POFIV

Fundamental structure has been working ok

Adjustments within ARD and DTS are anticipated

- Dynamics (on the sub-topic level)
- More focus on innovation and transfer
- Reap in the results from building up MT

- Challenges
  - XFEL ready/ HL-LHC construction phase
  - FAIR construction phase
  - Refocus in POFIV on center based approach: relation to programme
  - Alignment with national and international strategies and roadmaps

Ties Behnke (DESY)/ Peter Michel (HZDR)

DTS:
Marc Weber (KIT)

ARD:
Andreas Jankowiak (HZB)

DESY/ FZJ/ GSI/ HZB/ HZDR/ KIT

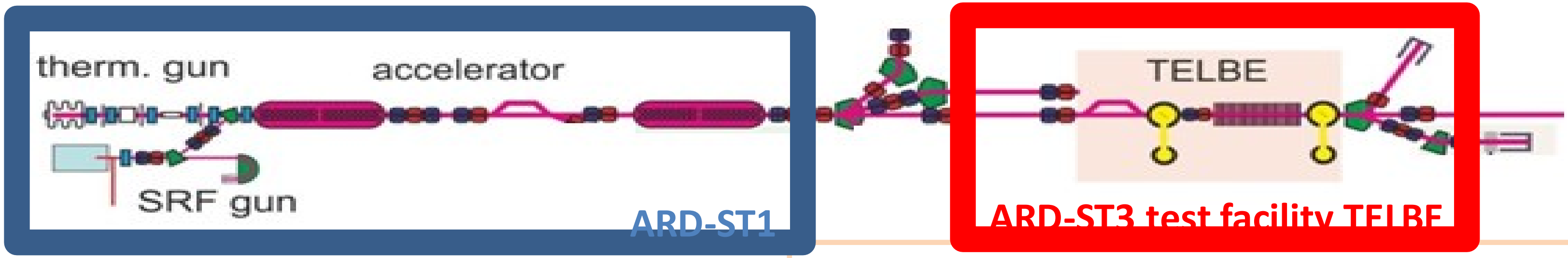
ARD in POFIV

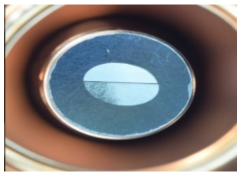
We start to see first results from the installation of the new program.

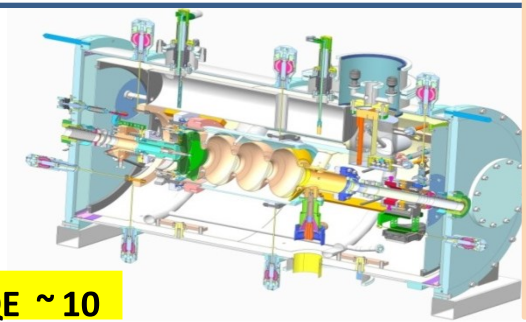
ST1: CW SRF Science and Technology → **XFEL**
ST2: Concept and prototypes for the advancement of conventional accelerators → **FAIR/ EDM**
ST3: Beam diagnostics and dynamics of ultra short pulses → **All**
ST4: Novel Accelerators and their applications → **Future**

Towards a 4th generation lightsource

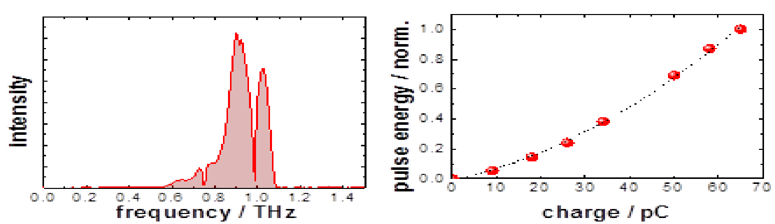
- SRF gun: 80 – 100 pC, E_{kin} = 4 MeV, 100 kHz CW
- ARD-ST3 testfacility TELBE: full pulse/bunch-resolved characterization







Mg cathode QE ~ 10^{-3}



THz spectrum and charge dependence

MuT /ARD Subtopics ST1 „SRF“ & ST3 „ps-fs“

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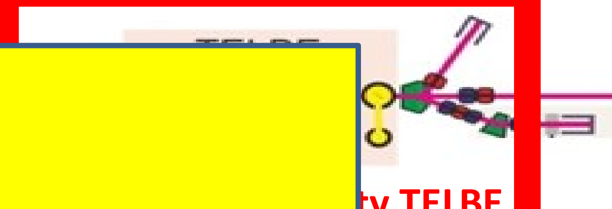
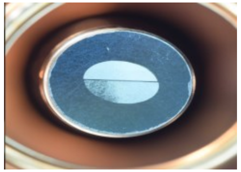
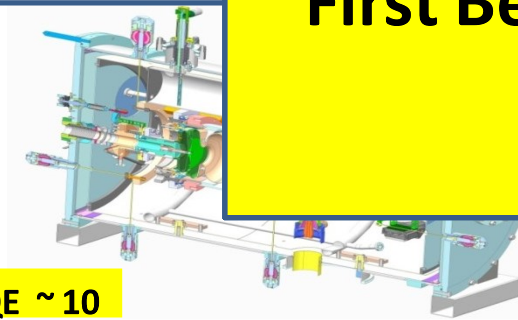


First Beam: 3.12.2016





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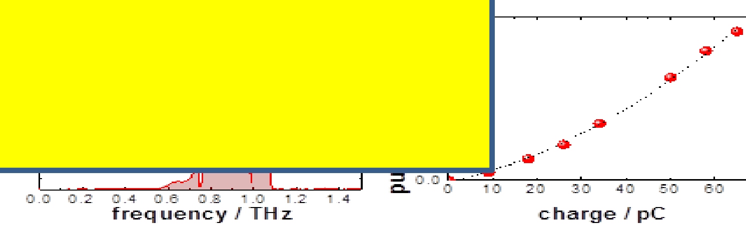
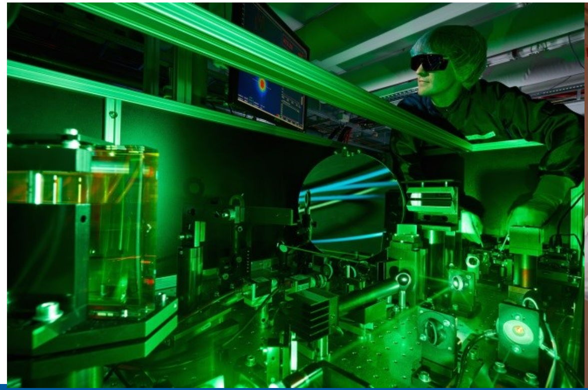


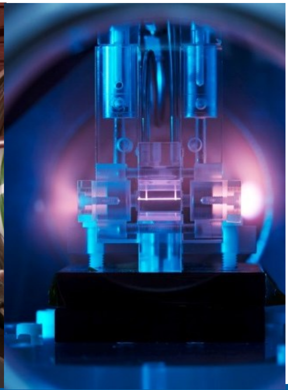
THz spectrum and charge dependence

MuT /ARD Subtopics ST1 „SRF“ & ST3 „ps-fs“

Plasma-acceleration

- Plasma-based electron and hadron accelerators:
  - Driven by lasers (for both e- and hadron), by e-beams (for e-: SPARC_LAB & FLASHForward in EU), by p-beams (AWAKE)
  - e-: Multi-GeV beams have been achieved → beam energy sufficient for applications → applications around the corner?!
  - Hadrons: ion beams have been produced and transported
  - Activities at many centers in Europe (as well as US and Asia)
  - Athena proposal to Helmholtz





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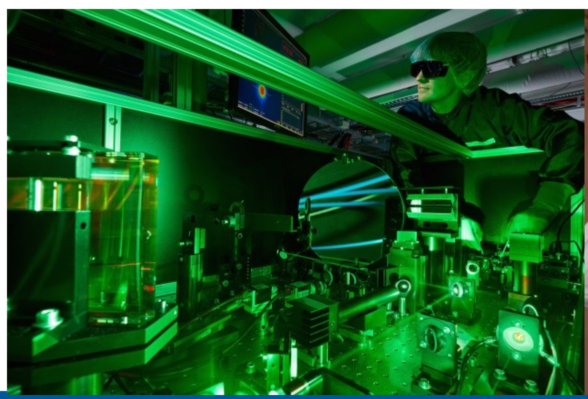
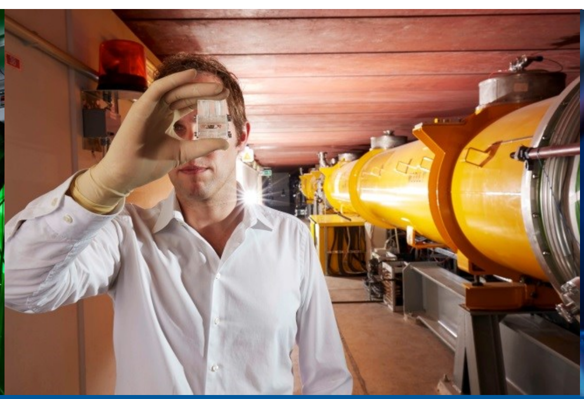
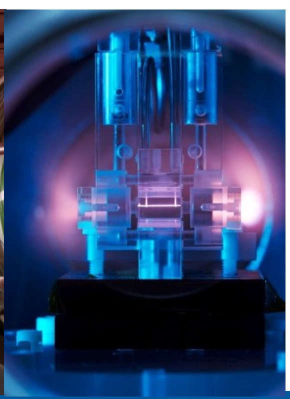
  - e-: Multi-GeV beams have been ac… s → applications around the corner?!
  - Hadrons: ion beams have been pr…
  - Activities at many centers in Europ…

First applications: compact light sources
Particle/ nuclear physics applications are still further away
EU Study: EUPRAXIA

DTS in POFIV

Discussion is less advanced than ARD discussion

- Semi-conductor sensors
- Microelectronics
- DAQ and processing
- Novel detection systems

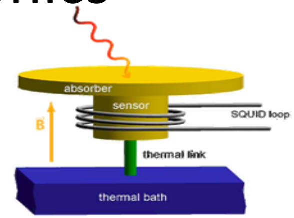
Areas where we can improve:

- Collaboration between centers
- More technologies
- Stronger links to astroparticle

Recent application on innovative detectors was not successful,
Will have to find ways to integrate this (partially) into current structure
Discuss intensely possible application for distributed detector laboratory

DTS- Innovative Detector Systems

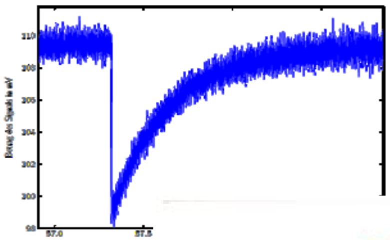
SQUIDs- Software Defined Radio Electronics for MMC and Qubits

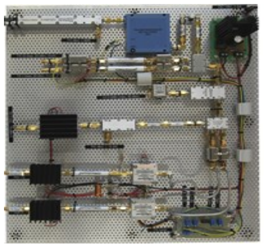


- Metallic Magnetic Calorimeter Detectors

  Development towards extreme low noise detectors: cryogenic detectors

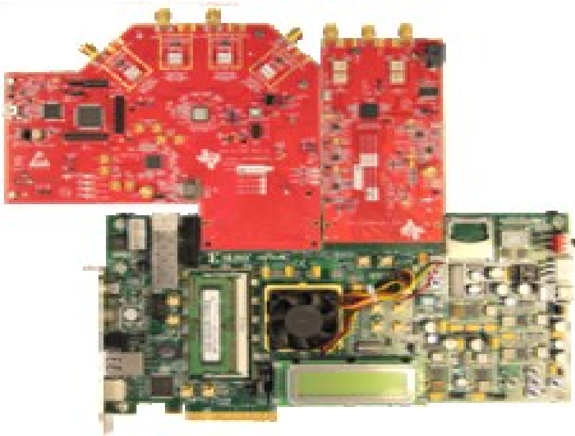
  Goal: Electronics for multichannel readout





- Quantum Bits Readout with great challenges

  Goal: Electronics for Control and Readout of multiple Qubits

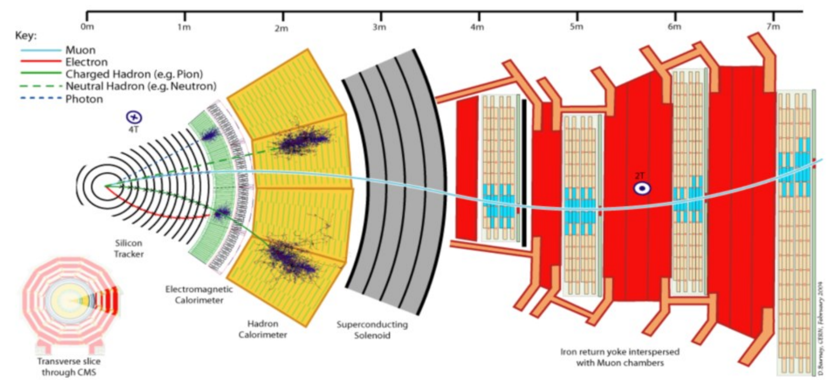


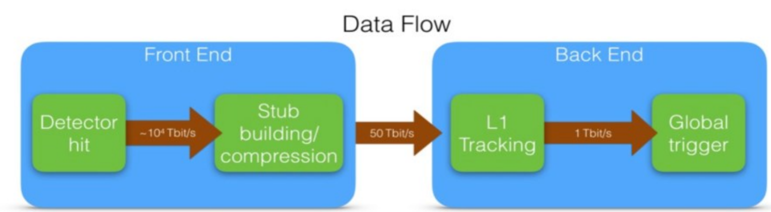
First multichannel demonstrator has successfully taken data.

Study: GPUs for the CMS Track Trigger

- Goal: adopt FPGA algorithm for GPU with Hough transform
  to identify track candidates within 6 us and with high throughput

GPU	FPGA
Rapid development cycles and high flexibility	Huge I/O bandwidth
Large bandwidth to external memory	Deterministic timings/runtime
High floating-point performance	High bit-level performance





Gaseous Detectors

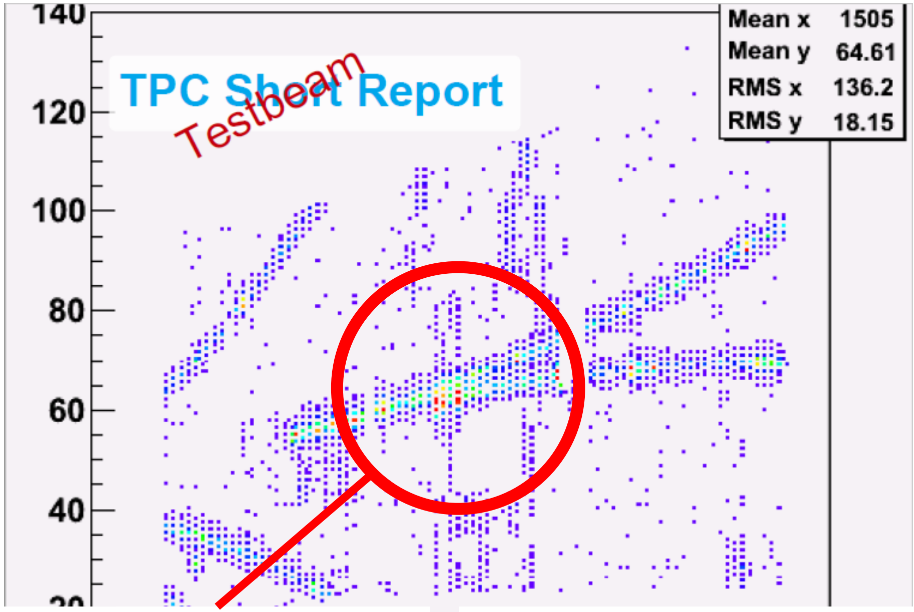
None-semiconductor detectors:

- Gaseous detectors (TPC, RPC)
- Cryogenic detectors
- Calorimetric detectors

Application:

ALICE upgrade
ILC detector
Neutrino experiments
Others?

Map of raw data before hit-finding



Area of overlapping hits

Recent test beam of GEM based TPC at DESY

Summary

We are converging towards the outline of MT in POFIV

Expect no major changes compared to POFIV, but careful development

Very nice results already in both ARD and DTS (results shown are a small selection of recent highlights, and by no means a complete list of topics)

Annual meeting of MT: January 31 – Feb 2, 2017, at the GSI
https://indico.desy.de/conferenceDisplay.py?confId=15981
Please register and learn more about detectors and accelerators