DTS at DESY

With contributions from many members of particle physics, photon science, astroparticle physics, accelerator science

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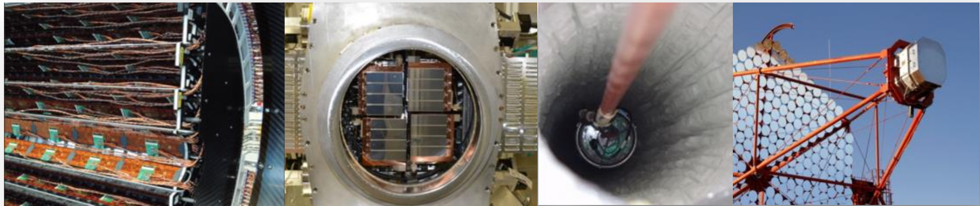


Detector development

Results from the center review spring 2018

Observations:

Particular strengths of the RU

- Skilled and competent people
- High Quality of the infrastructure
- Strong connection between developers and end-users.

A few specific aspects would however need to be further developed:

- Serious need for data acquisition, management, and analysis resources
- Lack of a few really concrete development goals for particle physics beyond LHC.

Specific recommendations

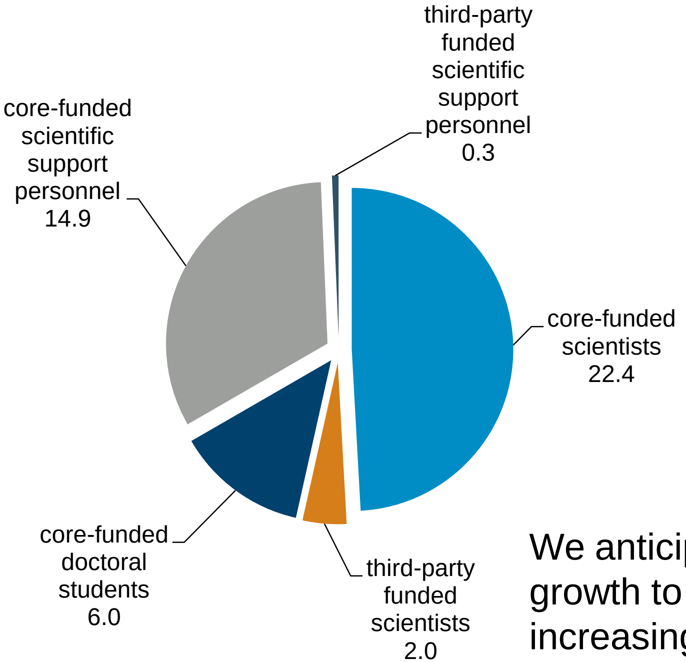
- Take full advantage of opportunities offered by DMA creation.
- Consider building a test-beam facility for photon detector R&D and characterization.
- Consider getting involved in R&D for particle physics detectors beyond 2025.Consider getting involved in developments for medium-term experiments to fill the gap between LHC and future colliders.
- Continue to keep a well-balanced programme of developments w.r.t. MU and MML programs and to foster cross-fertilization and interaction between their communities.

Develop a concrete plan for a “Distributed Detector Laboratory” (DDL) for the entire program topic DTS to be realized with highest priority.

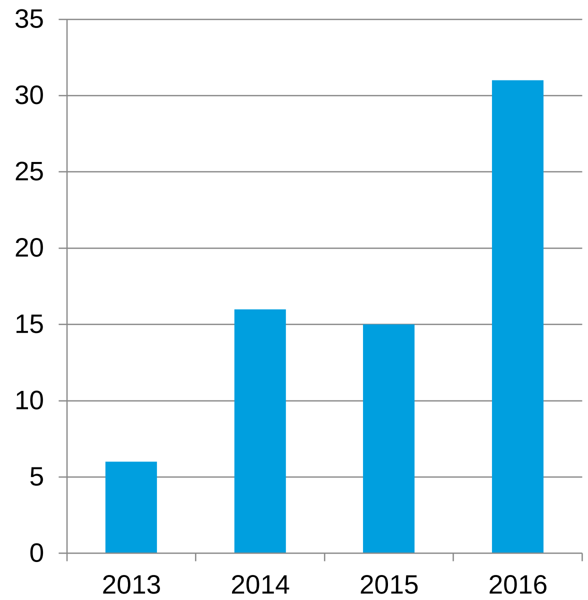
Detector status:

Numbers

Distribution of personnel



Number of “detector” publications



We anticipate a modest growth to support the increasing demands from experiments on- and offsite DESY

Part I: Milestones

Overall goals: Detectors at DESY

Detector Development:

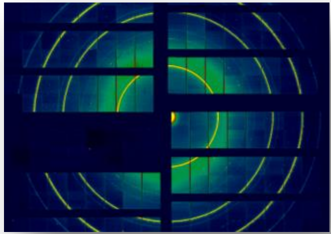
- Enable scientific excellence by developing detector systems for science applications for DESY

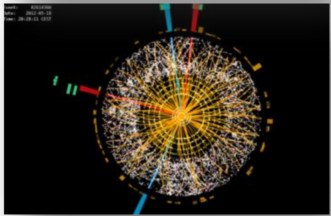
Short/ medium-term perspective:

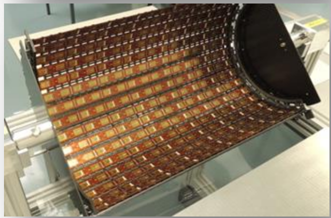
- Focus on detectors for XFEL.EU, PETRA, FLASH, HL-LHC and CTA, foresight program
- Build common infrastructure
- 4D detectors: spatial, energy and time

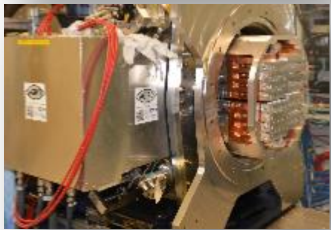
Longer-term vision

- In all areas, make detector development at DESY an activity which is recognised around the globe for its leadership and quality
- Strengthen fundamental detector development at DESY









Short-term perspective: Milestones

Short-term milestones
Detectors for XFEL.EU, PETRA, FLASH, HL-LHC and CTA, foresight program

XFEL detectors

AGIPD, DSSC: (2019/2020)

- Commissioning, new systems, larger systems

PERCIVAL @ PETRA and FLASH (spring 2019)

- Demonstrate system with beam

LHC (around 2025)

Deliver the LHC detector upgrades (with MU), strong R&D into large scale silicon systems, calorimetry

DDL (2021)

Establish the distributed detector laboratory with strong contributions from DESY in

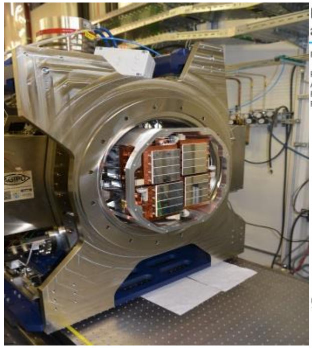
- Postprocessing
- Novel detector materials
- Cryogenics platform
- Test infrastructure (e.g, electron, photon)

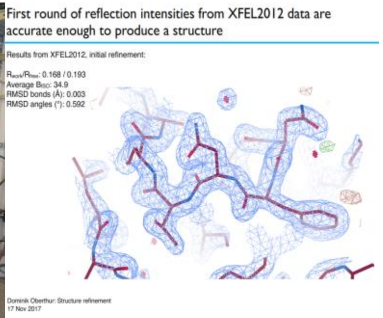
Significantly increase the access to a broad range of cutting edge technologies at DESY and for DESY

Sucessful projects

Recent Highlights

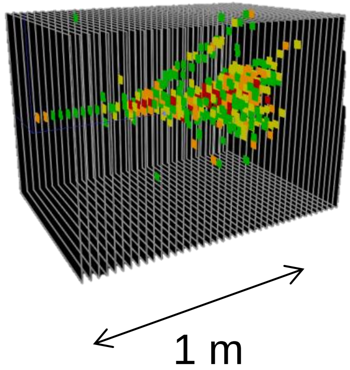
AGIPD detector: sucessful commisioning and operation at the European XFEL



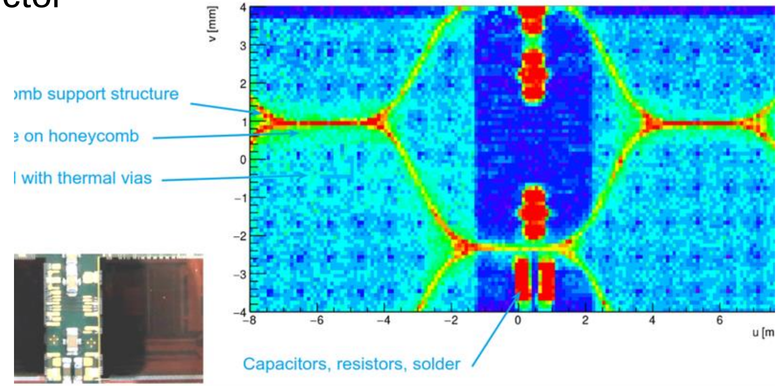


Granular calorimeters

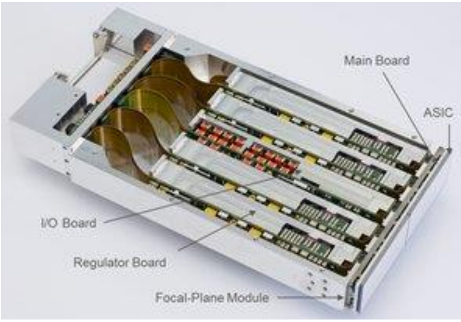
- Game changing technology
- DESY driving force
- Developed for ILC, now used e.g. at CMS



"Material tomography" using the DESY testbeam of a detector element



DSSC prototype



Longer-term perspective: Strategy

Longer-term perspective:
in all areas, make detector development at DESY an activity which is recognised around the globe for it‘s leadership and quality.

Expand our know-how and capabilities in sensor design a

1 new leading scientists
in detector development
(Excellence initiative)

Expand o
photonics an

Ensure that our syst tence is
maintained
structure

Fully commision the
DAF, integrate it fully
into the det dev
infrastructure

Strategically position ourselves for leading
contri ience, particle and

XFEL detectors, LHC
detectors, Astrophysics
Future facilities

Fo pact
contributions.

St asis.

Professorship DetDev:
Photon Science: Heinz
LHC: Ingrid
DetDev: new

Longer-term perspective: Milestones

Longer-term perspective
Detectors with ultimate spacial resolution (um), time resolution (ns) and excellent energy resolution in one system

Detector Roadmap:

- **Detectors for CW-XFEL+DLSR (2026)**
  - Push the limits towards faster readout and larger data rates
- **4D tracking detector (2025)**
  - Pico-second timing in silicon sensors
- **New detector concepts (continuous)- foresight program**
  - Highly granular calorimeters,
  - CTA upgrade, new colliders, non-collider, neutrino, others

Technology roadmap:

- **CMOS sensors (2026)**
  - Next generation sensors, design, post-processing
- **Fast Readout/ Data Transfer**
- **Develop new sensor technologies (continuous)**
  - sensors, materials, concepts
- **Find new applications (2023):**
  - Digital SiPM for tracking and more.
- **Push existing technologies (2022)**
  - Highly-granular gaseous detectors, others

New Detector Technologies

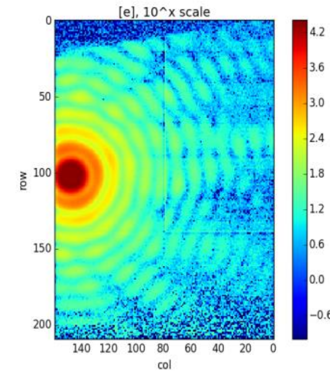
Pushing the limits

Cryogenic detectors have arrived at DESY:
ALPSII use of TES detectors

Cryostats just arrived at DESY

Percival:

low energy detector
for FLASH and PETRA,
Postprocessing for low energy operation done at JBL

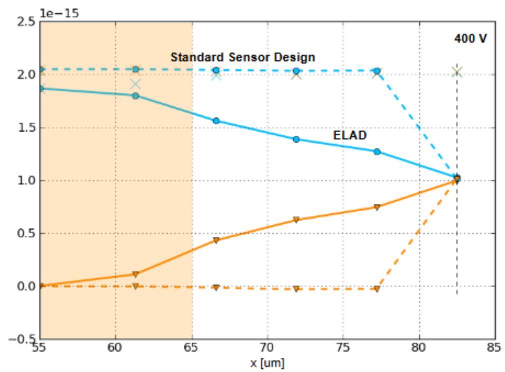


Picture of a pin-hole diffraction pattern at 91ev at FLASH

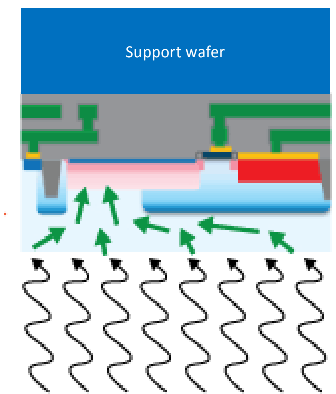
ELAD Sensor

Innovative Sensors:

Push for speed, resolution, etc.



Note: this relies on post-processing which only very few places around the world can do:
One central issue for DDL.



Part II: DESY perspective

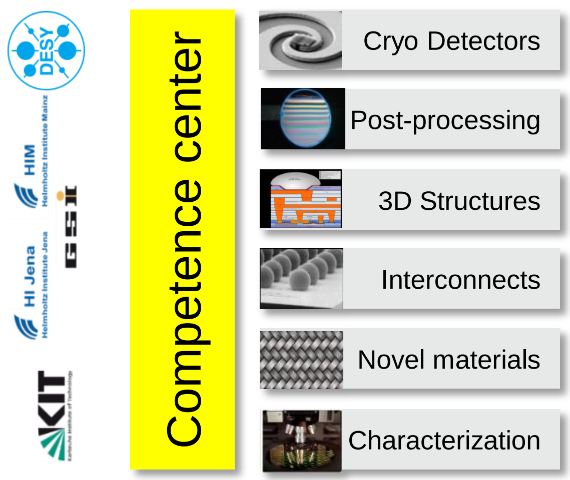
Facilities

DESY facilities and platforms	Cooperation at DESY
We strongly rely on and use the DESY facilities. We intend to significantly expand our local capabilities through the DDL We anticipate a very close and fruitful collaboration with DMA on site. - Goal is a close integration of DMA into the detector design process, and vice versa	Our science groups in photon science, particle physics, astro-particle are among the best in the world. Very dynamic development of the campus and the science done here in all fields Very close integration of detector development into the overall science program

Questions/ Issues

Distributed Detector Laboratory

- Currently develop concrete plan for DESY
  - Post processing, including 3D
  - Center for detector materials
  - Cryogenic platform at DESY
  - Test beams at DESY (electron, photon)



General concerns:

- Long term technical “service” support
- Maintain the support in case the DDL flies beyond the lifetime of the DDL extra funding
- Need to further develop the cooperation with DMA

Timeline:
Proposal ready spring 2019