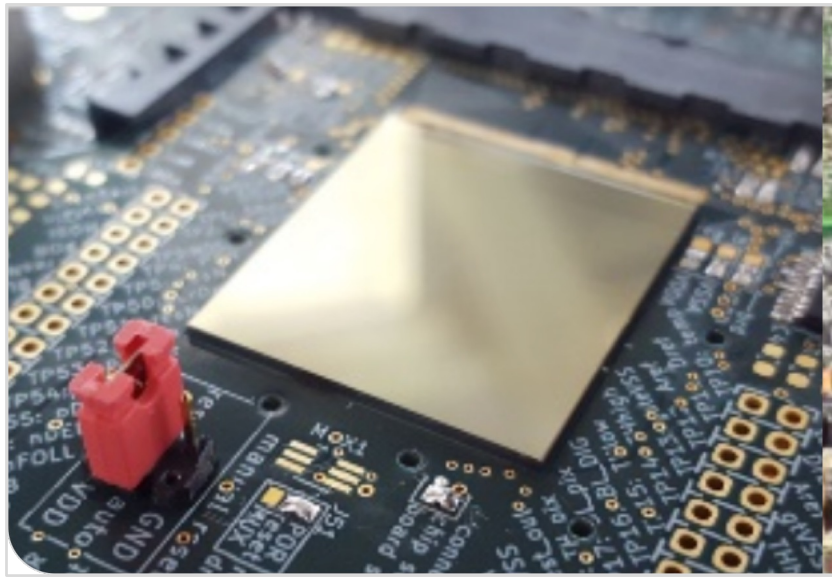
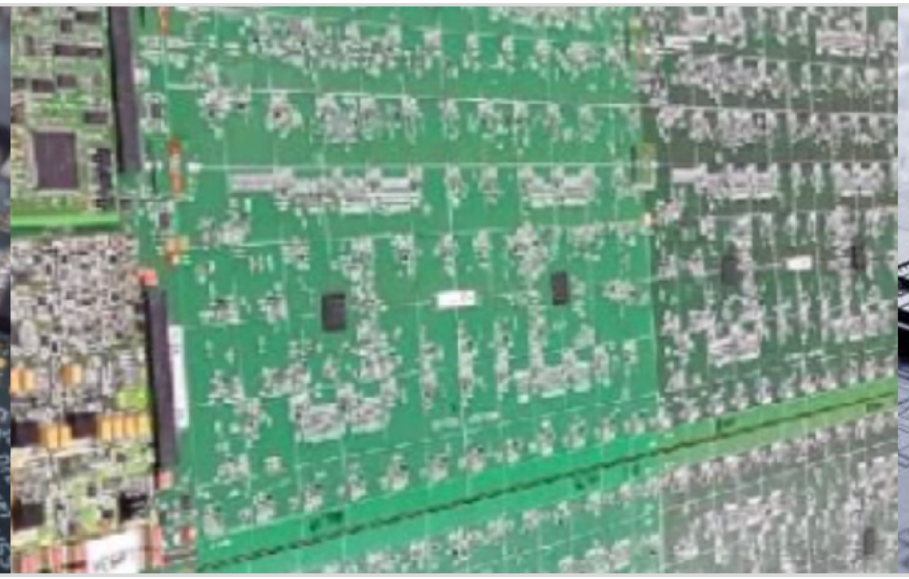
Karlsruhe Institute of Technology

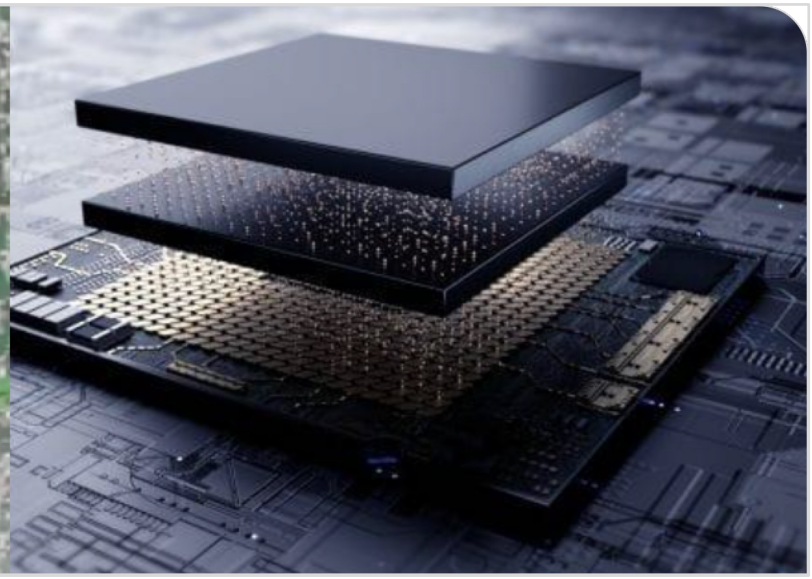
Institute for Data Processing and Electronics

MT DTS Plans - KIT

Frank Simon







Outline

All still very much work in progress

- Scientific topics
- Evolution wrt POF IV
- Personnel

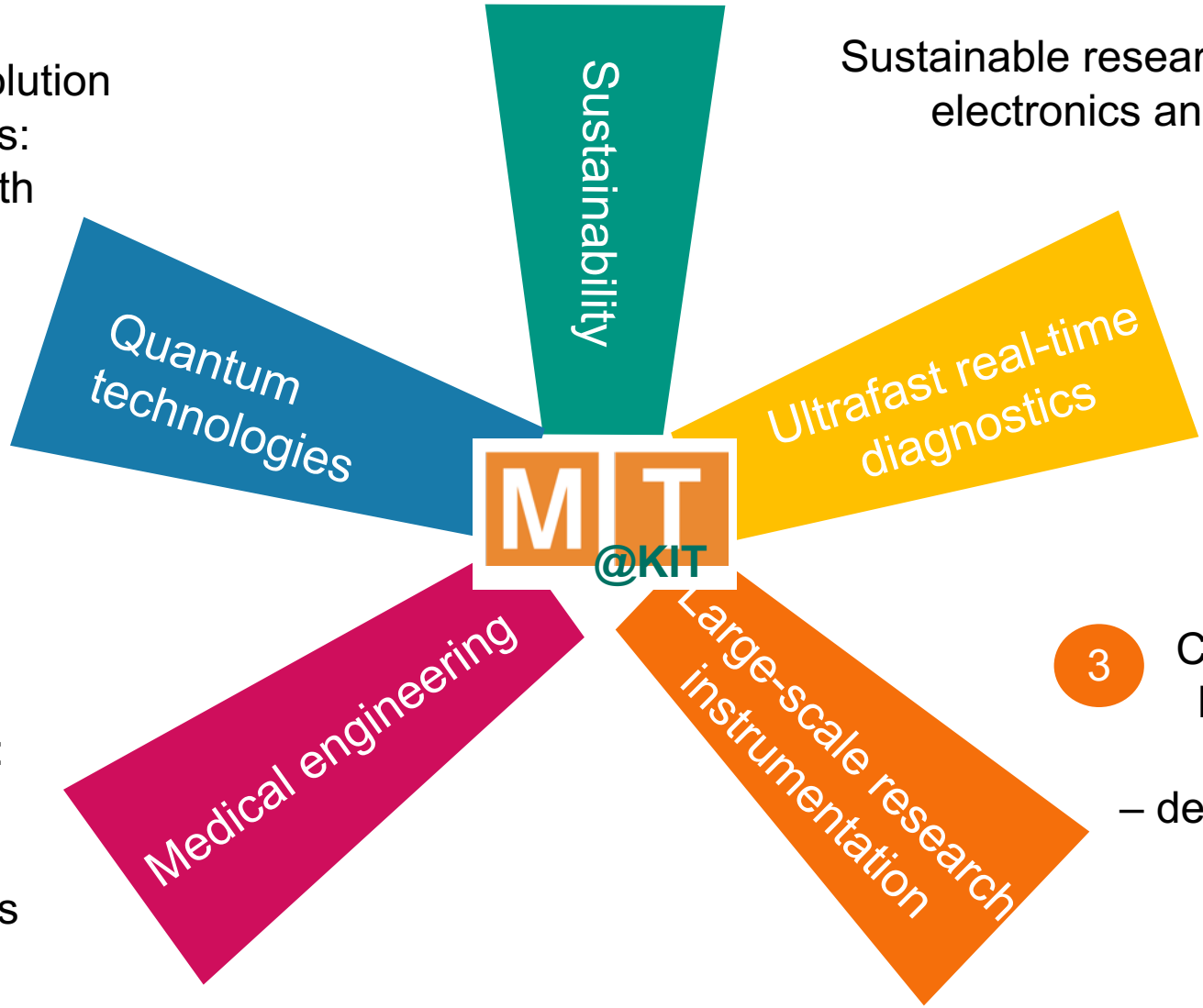
Frank Simon (frank.simon@kit.edu)

Key Topics for POF V

The Scientific Focus

Karlsruhe Institute of Technology

1 Ultimate energy resolution for precision experiments:
– KATRIN++ detector with < 1eV resolution



Sustainable research facilities by intelligent electronics and online data processing

2 Realize ultrafast diagnostics and analyze large-data streams:
– electron beam diagnostics

Innovate medical diagnostics and therapy:
– beam monitoring for radiation therapy
– non-radiating diagnosis

3 Cutting-edge technologies for large-scale experiments and facilities:
– detector modules and DAQ for LHC (CMS, LHCb)
– Higgs factory
– photon science

Frank Simon (frank.simon@kit.edu)

Institute for Data Processing and Electronics

Ultimate Energy Resolution for Precision Experiments

Quantum Technologies

1

- Goals:
  - Quantum sensors with sub-eV resolution
  - large-scale detector arrays; readout and control systems

- First steps, incl multiplexed readout, for ECHo
- Setup of fabrication at KIT: HSS

POF IV

- Long-term infrastructure
  - Advancing quantum sensors towards Megapixel
  - (Foundry-like service for superconducting sensors?)

- Many possible applications
  - A focus: KATRIN++: The ultimate neutrino mass measuremenr
  - Applications of quantum sensor arrays in fundamental physics experiments

Ultrafast Diagnostics

Electron Beam Diagnostics

2

- Goals: Beam diagnostics for a wide range of beam applications
  - Compact accelerators, accelerator R&D in MT-ARD
  - Radiation therapy
  - Particle colliders: SuperKEKB, future Higgs factories
  - Photon science

- Development of ultrafast instruments
  low-latency control with AI
  - Detection of different regions of the EM spectrum
  - Single-shot measurement at high repetition rate
  - High SNR, sub-ps time resolution, high spatial resolution
  - High-rate DAQ

Cutting-edge Technology for large Experiments

Detectors and DAQ

- Detectors, DAQ and Trigger for collider experiments and photon science

- CMS @ LHC – DAQ & Trigger: Development of 5D reconstruction and trigger algorithms on data; commissioning and operation of DAQ systems
- CMOS sensors – LHCb Phase IIb upgrade: MightyTracker as key application
- Beyond LHC: Shape next generation experiments at a future Higgs Factory
  Goal: towards the end of POF V provide a concrete technical proposal
  Embedded in DRD collaborations
  - DRD 3: Silicon sensor development
  - DRD 6: 5D calorimetry, including system aspects (electronics integration, ...)
  - DRD 7: Electronics and on-detector processing – focus on DAQ, data transmission (SiPh) and interconnections and packaging

- Photon science and medical applications – such as High-Z sensors

- System competences essential: Integration, packaging, ...

Frank Simon (frank.simon@kit.edu)

Evolution of the Activities

Changing Emphasis

- Overall a continuation and evolution of current activities, with some changes.
  - Stronger emphasis on HEP instrumentation: Future LHC upgrades, next-generation collider (Higgs Factory): Technologically most challenging in terms of operational environment, data rates, integration. Integration of activities in DRD collaborations.
  - Technologies for quantum sensors (also relevant for quantum compution) growing in importance. An area with unique expertise.
  - Maintaining program in ultrafast diagnostics, beam diagnostics – with the possibility to expand to additional applications.
- Continue to evolve competence in packaging and integration technologies.

Frank Simon (frank.simon@kit.edu)

Personnel

KIT MT DTS People

- The current team will large stay in place

- Anticipated addition:
  A professorship on “Intelligent data acquistion and control” with significant involvement in MT-DTS at IPE.
  - Search progress.