

IPE – Institute for Data Processing and Electronics at KIT **Marc Weber** • Who are we? What do we do ? What could we do for you? 232

KIT – University of the State of Baden-Wuerttemberg and National Laboratory of the Helmholtz Association

www.kit.edu

Location



South East of Germany

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London	Kijmegen (Saale) Łódź
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Woking	Brussel Dusseldorf University Device Leipzig Dresden
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	Mulhouse O Budanest
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Location





What is KIT ?



Karlsruhe University (TH) +

FZK = KIT



Massachusettch? Massasusettschs? Massachusetts? Sagen Sie einfach Karlsruhe.

Am 1. Oktober eröffnet das Karlsruher Institut für Technologie.

Willkommen im Bundesland der unbegrenzten Möglichkeiten. Denn nitgendwo in Deutschland wird so viel in Forschung und Entwicklung investiert wie in Baden-Württemberg, Unsere neueste wissenschaftspolitische Innovatioe: das Karlstuher Institut für Technologie, kurz KIT. Das ist so etwas Ähnliches wie diese Hochschule in Amerika, das Massachusetts Institute

of Technology (MIT). Nur nicht ganz so weit weg und nicht ganz so kompliziert auszusprechen. Dafür aber genauso gut. Denn mit dem KIT haben die Exzellenz-Universität Karlsruhe und eine der erfolgreichsten Großforschungseinrichtungen Europas, das Forschungszentrum Karlsruhe, ihre Stärken gebündelt. Das Ergebnis ist eine Einrichtung, die Forschung und Lehre auf innovative Weise miteinander vernetzt. Ziel ist es, schon bald zu den weltweit führenden Wissenschaftseinrichtungen zu gehören. Nicht unmöglich – bei einem Jahreibudget von 700 Millionen Euro und 8000 Mitarbeitern. Aber unmöglich ist bei uns ja sowieso fast nichts. Also, forschen Sie mit unter www.kit.edu oder www.baden-wuerttenberg.de







What do we do at IPE ?



- Development of electronics, detectors, slow-control, data acquisition systems and Grid tools
- Emphasis is on systems, from concept, design, commissioning to operation
- About ~80 staff and students, ~50% permanent
- Facilities: electronics and mechanical workshop, clean room
- Large variety of projects
 - duration from month(s) to decade
 - from commercial, applied to basic science
 - collaborative (most) to individual
 - fields: structure of matter, climate, energy, nano and micro technology, medical

Selected projects



Currently we run ~25 projects, will only show a few pictures

- Pierre Auger cosmic ray observatory
- Radio detection of cosmic rays
- KATRIN neutrino experiment
- Data processing for pixel detectors in synchrotron radiation
- High-power UV LED
- Atomic force microsope (AFM)
- MinCE
- Battery research
- Quench detection
- Balloon, satellite and weather station instrumentation
- 3D Ultrasonic computer tomography (USCT) for mammography
 Grid

Pierre Auger cosmic ray observatory





24 fluorescence telescopes



1600 water tanks on 3000 km²





IPE contributions: FD electronics; digitization and digital signal processing; first and second level trigger; and much more

Radio detection of cosmic rays





Challenges: antenna selection; low noise, low-power preamps and filters; digital signal processing; self-trigger; wire-less data transmission; environmental influences



KATRIN – neutrino mass measurement



KATRIN







Challenges: extremely complex environment; 18.6 KV/ 6 T field, cryogenics, vacuum, etc. need high-precision and systematics control



GPUs for X-ray tomography









2000 frames with ~ 3Mpixels each ⇔ 24 GB data in a few seconds

Computing platform: 2x Quad Core CPU 4 PCIe slots for GPUs



Challenges: size of data sets, GPU

programming, fast camera data links, 'real time' data processing, data storage

High intensity UV LED arrays





Challenges: packaging, interconnects, thermal management, cooling system, light extraction, current source

stove: \approx 7 W/cm²

AFM – optimized cantilever position detection



Substantial improvement through clean-up:

- new layout with reduced EMI
- selection of better op-amps
- removal of trimmers
- less power, etc.





old design





Lab on chip: miniaturized capillary electrophoresis (MinCE)



From laboratory setup to portable device...

Allows investigation of ionic fluids. TT project





IPE contributions:

electronics and

software



Quench detection for fusion



Complete system for more than 700 coils at W7-X

W7-X Stellerator coil











MIPAS – GLORIA



IPE provided monitoring, control, DAQ and power systems for IR spectroscopy of atmospheric gases; participation in numerous campagnes



Challenges: high reliability, vibrations, low temperature and pressure, power during long duration flights



3D ultrasonic computer tomography (USCT)



Mammography with excellent resolution without X rays

electronics and hardware developed and constructed in house; world-leading and advanced R&D

Challenges: high data rates and volume; large number of sensors; reproducable and affordable sensor production; image reconstruction









Insti

Microassembly facilities



- 400 m² clean room
- Pick and place machine
- Wire bonding and (so far limited) flip chip capabilities
- Die saw
- Automatic probe station
- Thick film ceramic MCM production
- Environmental chambers
- Electronics and mechanical workshop













Moore's Law: GPU – CPU



Source: Nvidia CUDA Programming Guide



