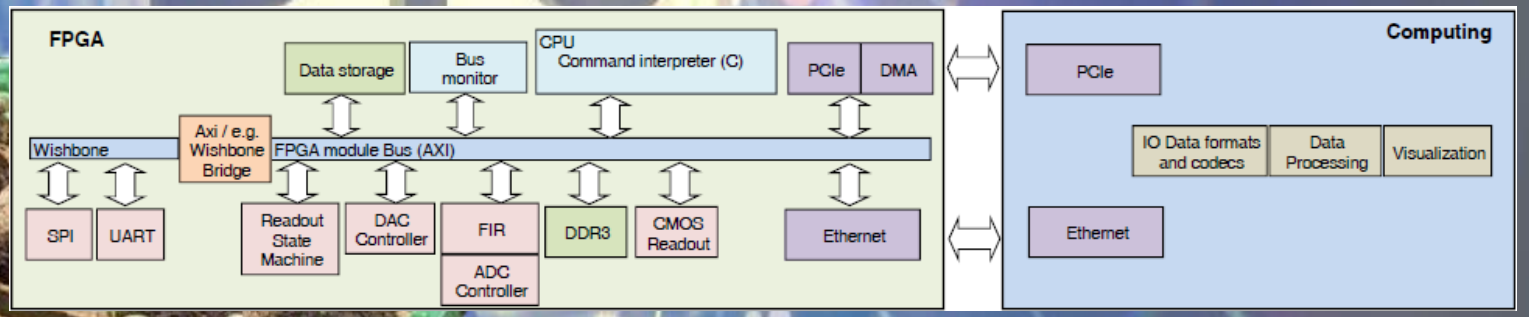
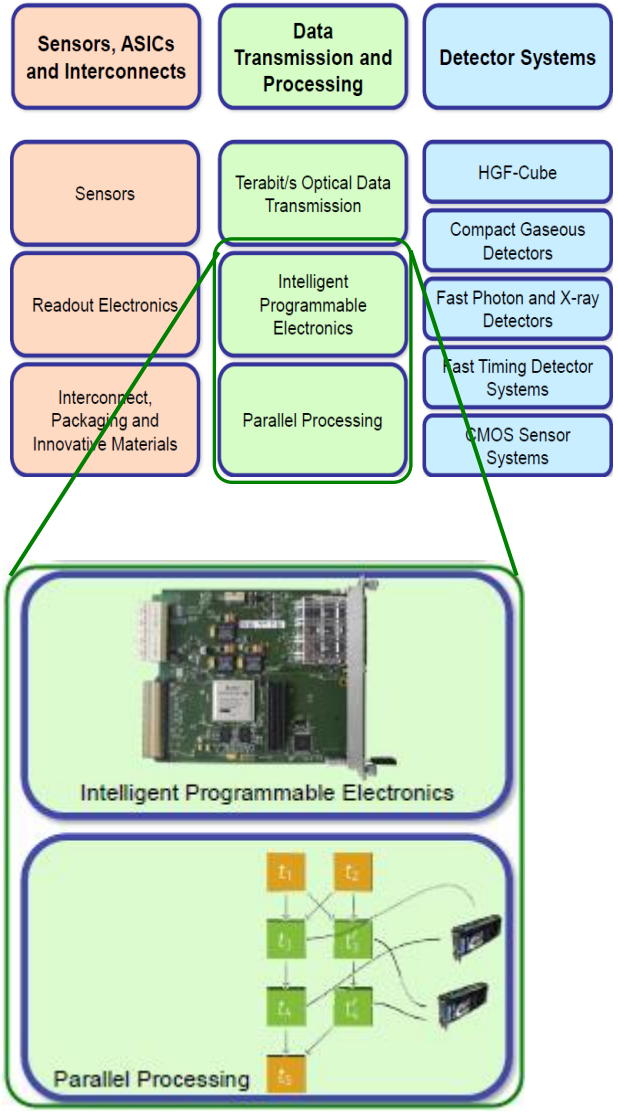
The DTS platform

a generic seedling tray



Peter Kaever, (HZDR)

DTS Topics



DTS requirements:

⇒ Higher data rates (#channels++, resolution+, readout rate++)

⇒ Requirement for preprocessing

⇒ larger, multi-level-systems

Large variety of application and sensors

- USCT (KIT)
- High power X-ray tomography (HZDR)
- Dark matter (KIT)
- X-ray camera (KIT, HZG)
- Medical imaging, beamline equipment, …..

Project situation

- rising complexity, less manpower
- ambitious planning
- whatever resource, you need more…

Technical Situation:

- Specific detectors & frontend electronics
- [generic] Intelligent Programmable Electronics + computing: extract information from raw data

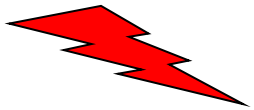
Technology in FPGA‘s & processing:

- FPGA as DAQ-Interface (ADC / Asics) + preprocessing unit
- Ethernet, PCIe
- Crate system: Nim, VME, Micro TCA, …
- GPU, CPU, DSP, uC
- Linux
- Software Development in VHDL; C/C++, Python; Open GL, CUDA,…

⇒ Commodity equipment and common tools

⇒ Subsystems with high performance (and complexity) on various levels

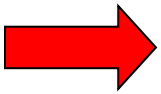
Easy start



Rugged & convenient use: Large gap

Experiment instrumentation (in many cases) requires the full set :

- Control and data streaming
- Start- & configuration scripts
- Security & Safety
- History and Logging
- Diagnosis
- HMI / GUI
- Parameter Handling
- Version handling
- configuration handling

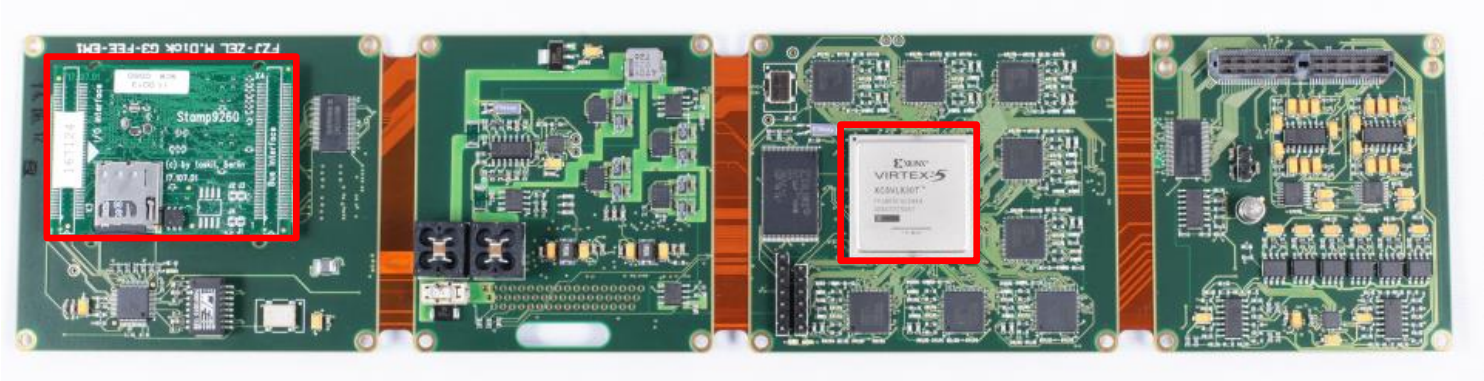


Modularity inside & across layers => platform

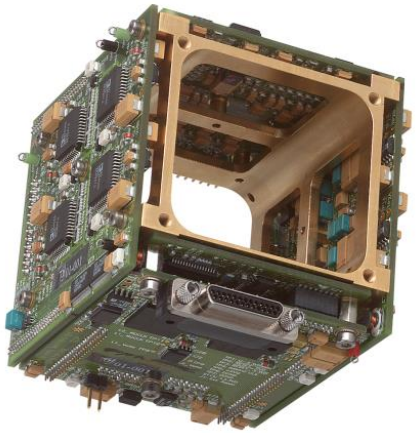
DTS-platform: component-based & cooperative

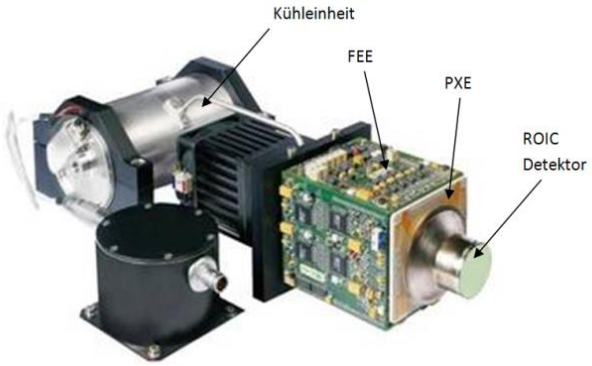
IR-Detector Front-End-Electronics

Heinz Rongen, Mario Schlösser



- Stamp-9260 CPU-Module (taskit): ARM-9
- 32 bit Bus connection to Virtex-4 FPGA
- Embedded Linux
- 4 PCB-„wings“, connected via Flex-PCB





iNODE – intelligentNetworkOperatingDEvice

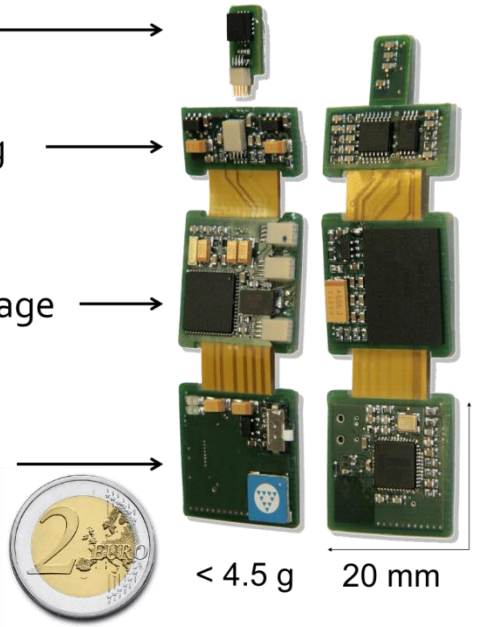
Heinz Rongen, Mario Schlösser

Sensors → EKG, EEG, Neuro
ACC, Compass, Gyro, 10 DoF,
Barometer, Temperature…

Signal conditioning → adaptive filters & amplifiers
up to 32 channels
up to 5 MS/s total

Processing & Storage → power efficient µC
real-time OS
SELFX capabilities
signal processing
64 GB eMMC flash

Communication → wireless
bi-directional
networking on demand



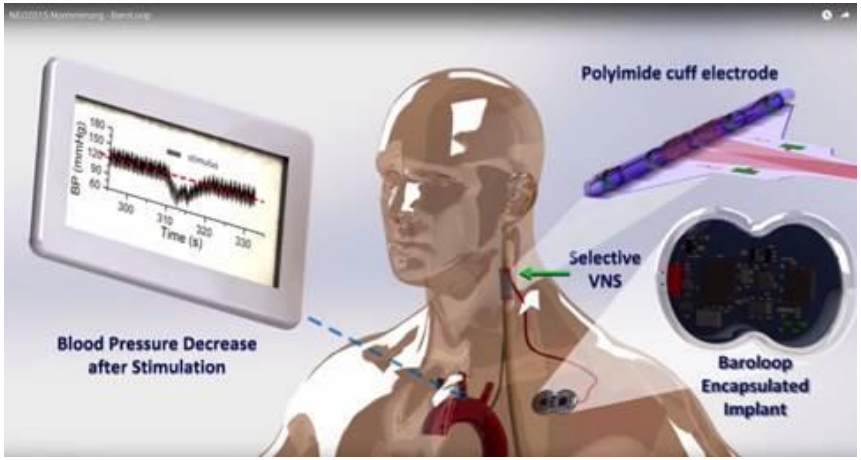
Neuronal Mechanisms of the Passive Auditory Spatial Localization

Institut für Biologie II
RWTH Aachen

Flow Control in Nature and Technology

Marine Science Center
Universität Rostock

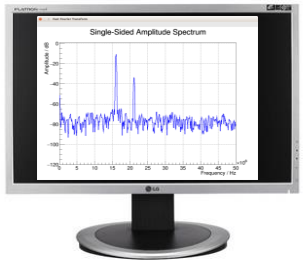
functional prototype for Baroloop projekt implant



Evaluation: 1 week for: ADC => FFT => DAC

characterize ADC‘s

Bert Lange, Philipp Födisch



CPU

Root GUI

Root FFT

UDP Capture

ROOT
Data Analysis Framework

mean(y(t))

PID Control

max(A(f))

DAC Out

UDP Socket

ETH2

Prozessor-AMC-Modul
4-Kern 2.1 GHz Intel
Core i7
Ubuntu Linux

N.A.T.
MCH
Switch

Backplane
1000BASE-KX

FMC

ADC

DAC

DESY HGF-AMC

FPGA

HZDR
1GbE
UDP
Core

GTX

U ~ f

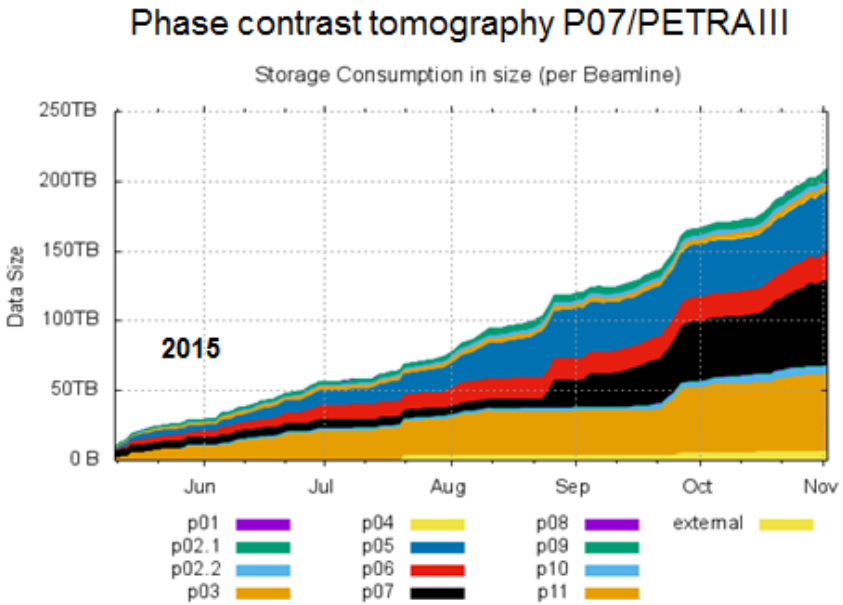
HZDR: 3 x 100 MSPS ADC + DAC

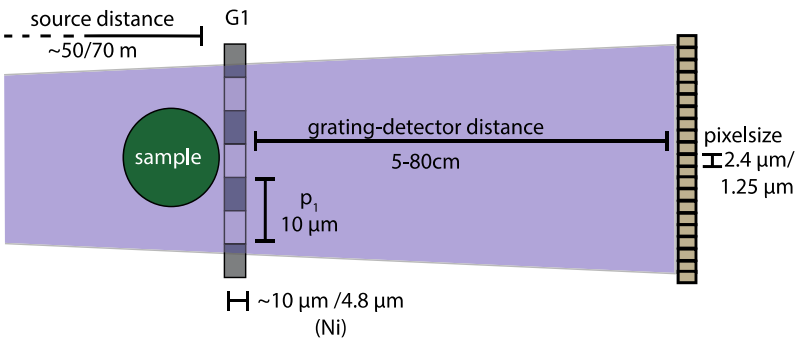
UFO DAQ Framework: Andreas Kopmann

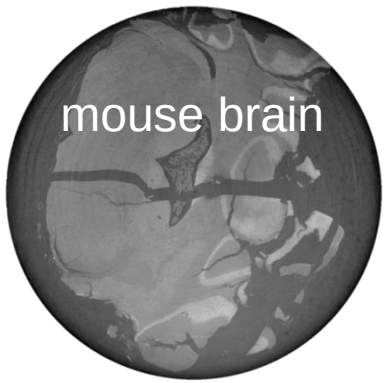
- Integration of a 20MPixel Camera (36×24 mm²) up to 5000fps within 6 months
- improving phase-contrast-tomographie @ HZG & PETRA3
- Install base: KIT/ANKA, HZG, PETRA P05+P07

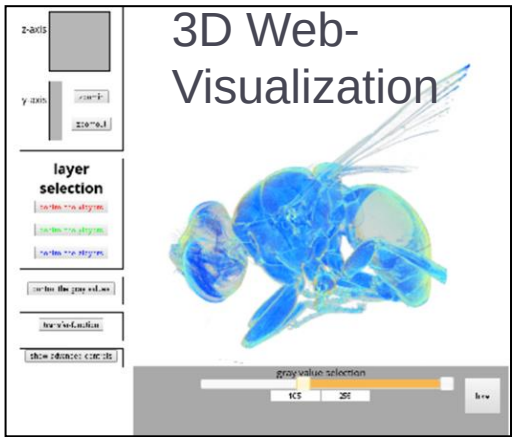
- UFO DAQ Framework is a modular approach, combining FPGA and GPU computing;
  - particular focus on reconstruction
  - continuous improvement & extension

- New: Web-based visualization
- first prototype for x-ray & ultrasonic tomography



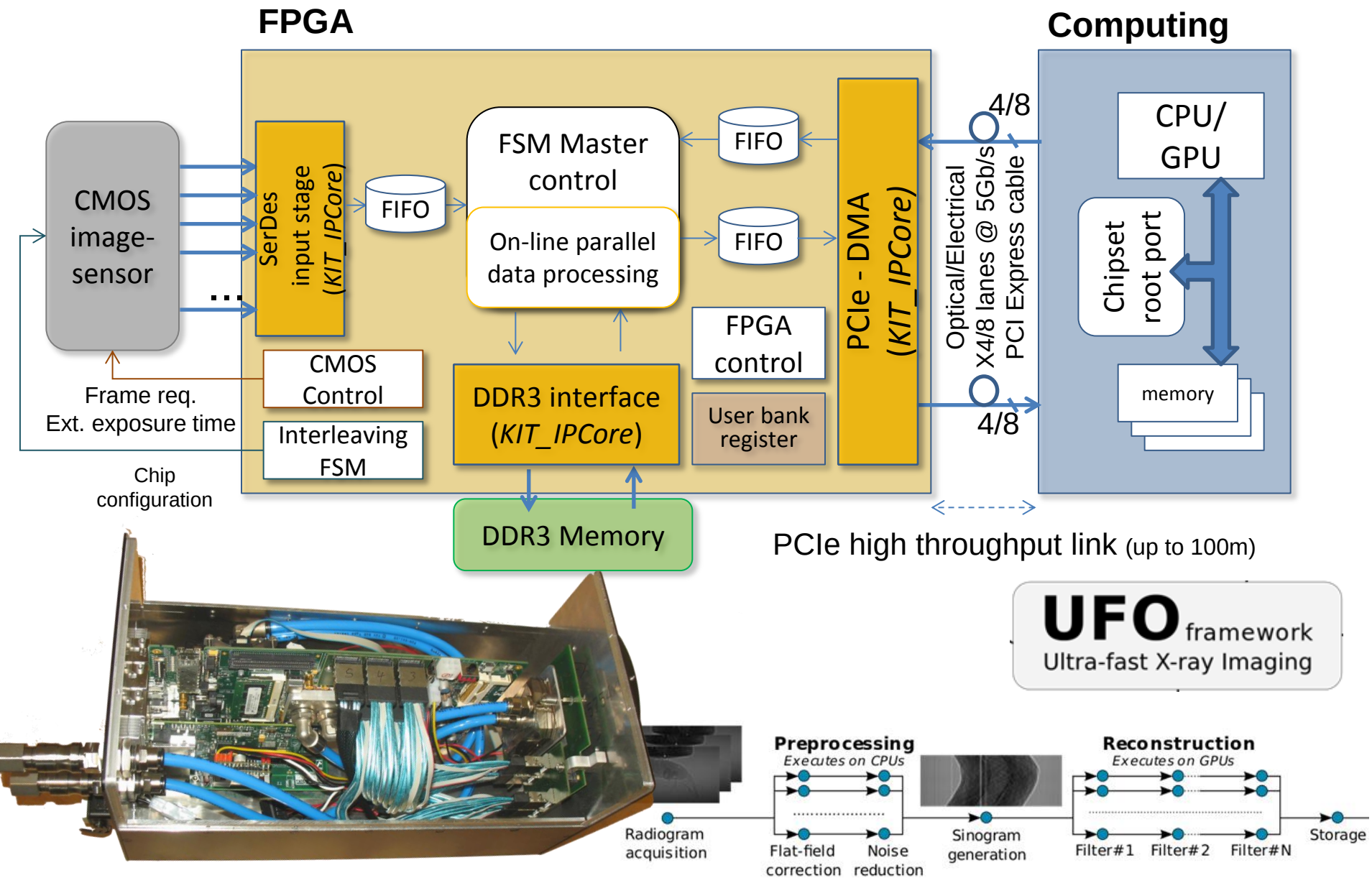






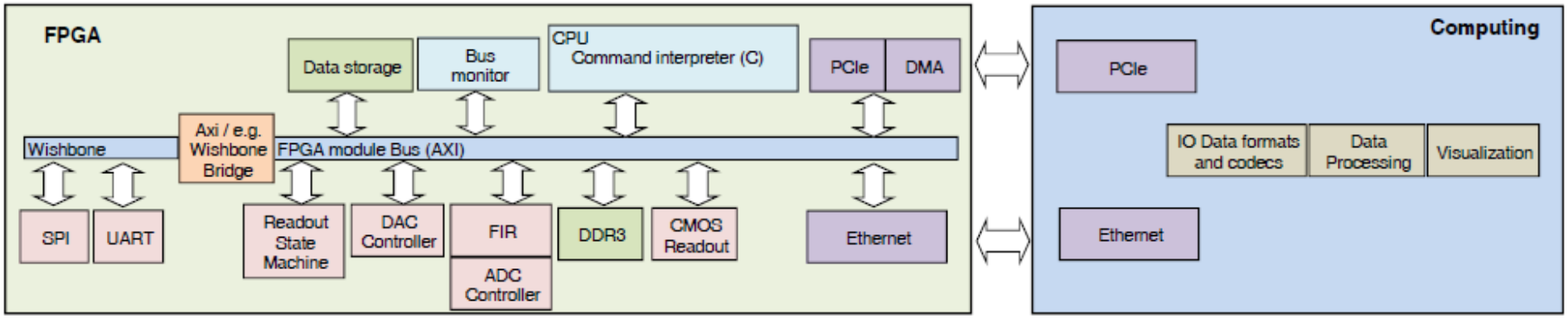
Camera Architecture

Helmholtz-Zentrum Geesthacht
Centre for Materials and Coastal Research
Karlsruher Institut für Technologie
Andreas Kopmann



UFO framework
Ultra-fast X-ray Imaging

DTS Platform : technical features



Approach:

- ⇒ Focus on FPGA‘s, aim at computing
- ⇒ component based, modular, scaleable
- ⇒ allow cherry picking to avoid specificity
- ⇒ Join competence & efforts across HGF-centers
- ⇒ Merge and optimize existing technology
- ⇒ Build an ecosystem (platform & contributors & users)
- ⇒ Continuous & early deployment
- ⇒ common methods, shared know-how

First focus topics

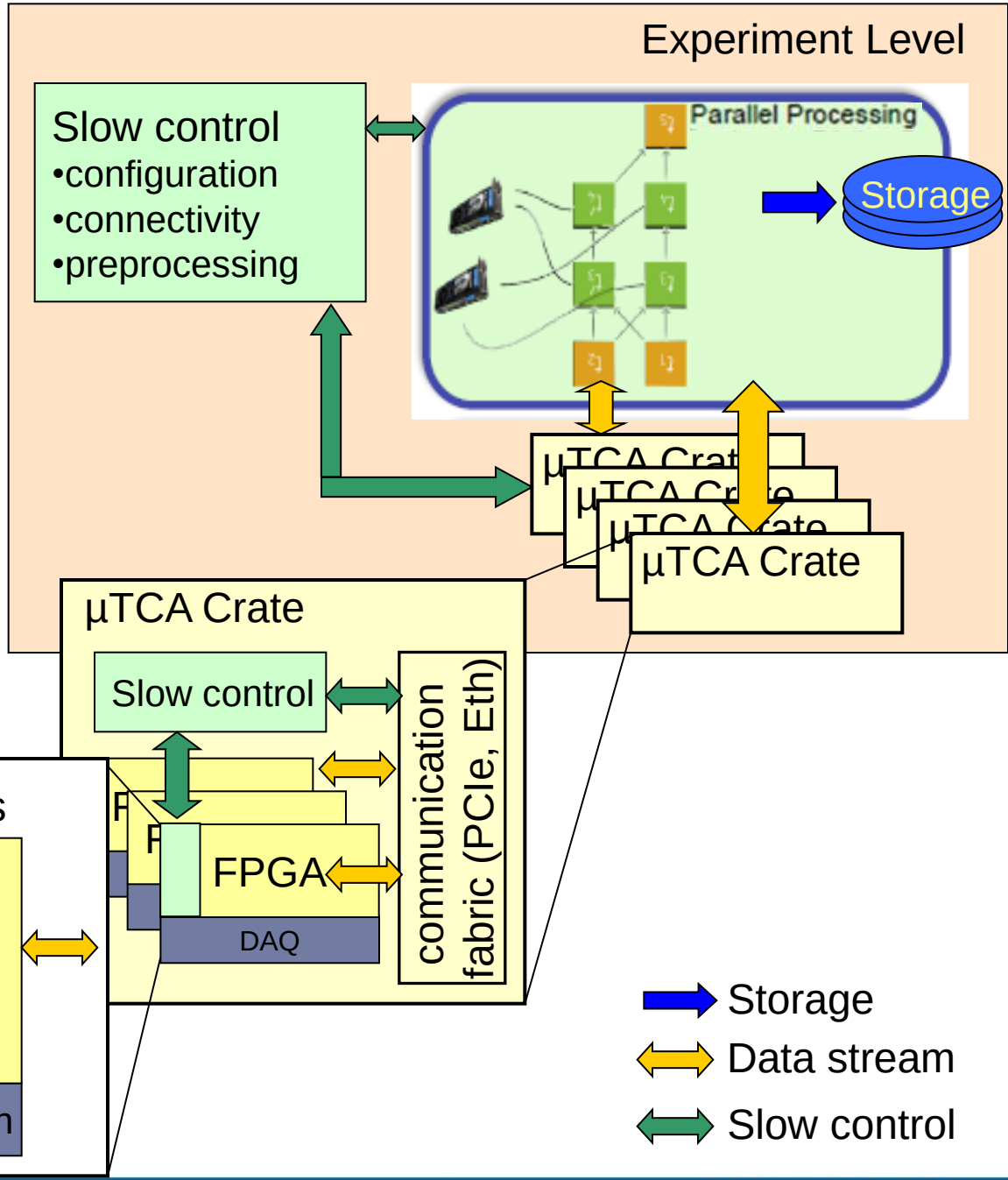
- ⇒ 10 Gb/s Ethernet
- ⇒ PCIe + DMA
- ⇒ „small footprint“ Microcontrollers
- ⇒ system modeling
- ⇒ linux driver development
- ⇒ HGF-AMC board support package

DTS Platform example

- µTCA as crate system
  - ruggedness
  - diagnosis
  - connectivity fabric

- AMC boards
  - configuration
  - FPGA-performance
    - interfacing
    - preprocessing
    - communication

- Experiment level
  - slow control integrated
  - scaleability
  - dynamic configuration
    > connectivity
    > preprocessing

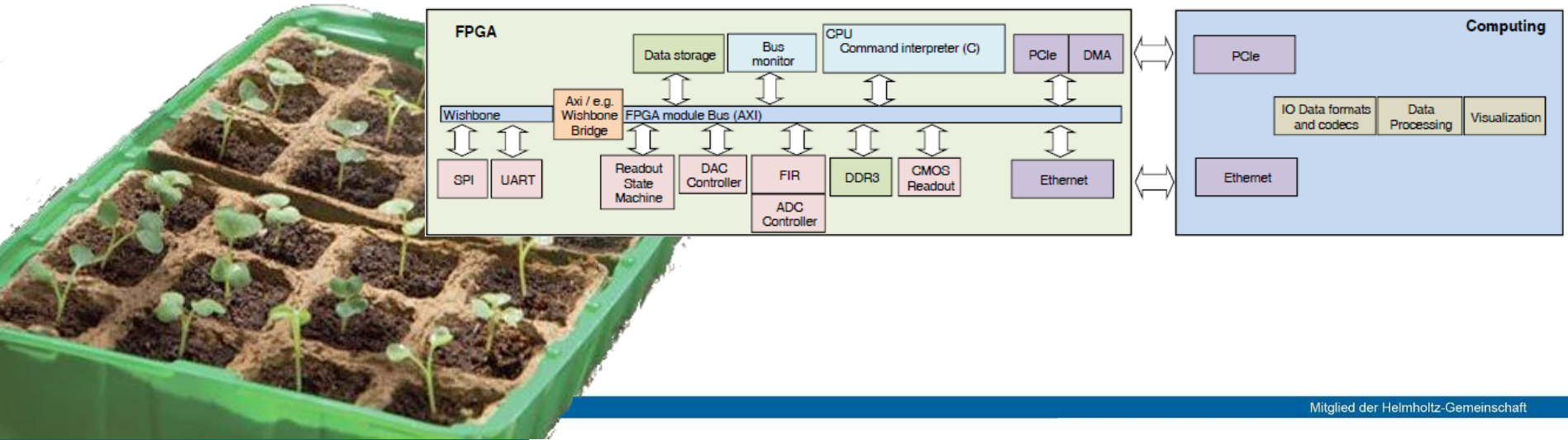


Conclusion

- High-speed DAQ systems are a key component for future experiments
- These systems are highly complex and challenging
- DTS-Platform (technology, contributors, users) can be very helpful

- Goal: exchange of know-how, common methods and projects
- The initial nucleus is still fragile and has to be fostered

- There is a unique chance to join efforts
- **Support the DAQ-platform !**



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THANK YOU !

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