

Hendrik Krause

Contribution to
11. Annual MT Meeting

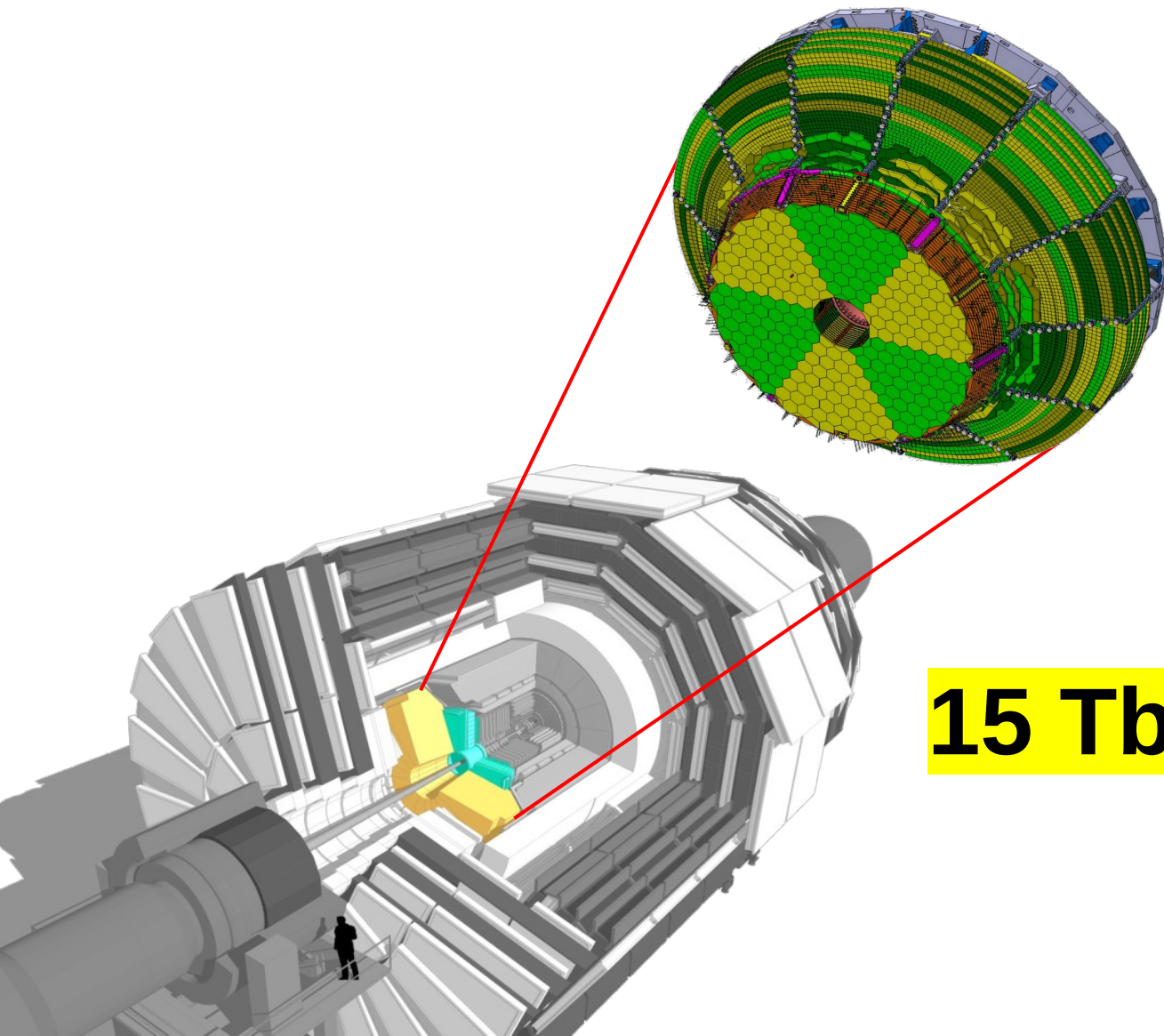
Nov 03, 2025

15 Tb/s

Frankfurt DE-CIX 13.84 Tb/s*



*average traffic speed in the last month

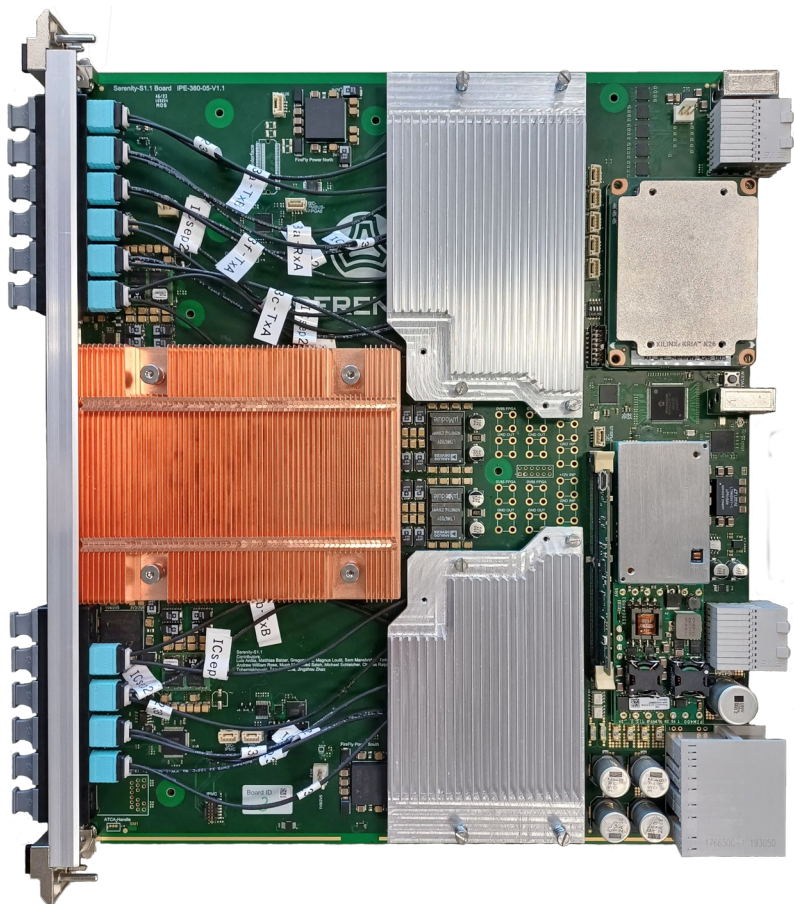


CMS upgrade HGCAL

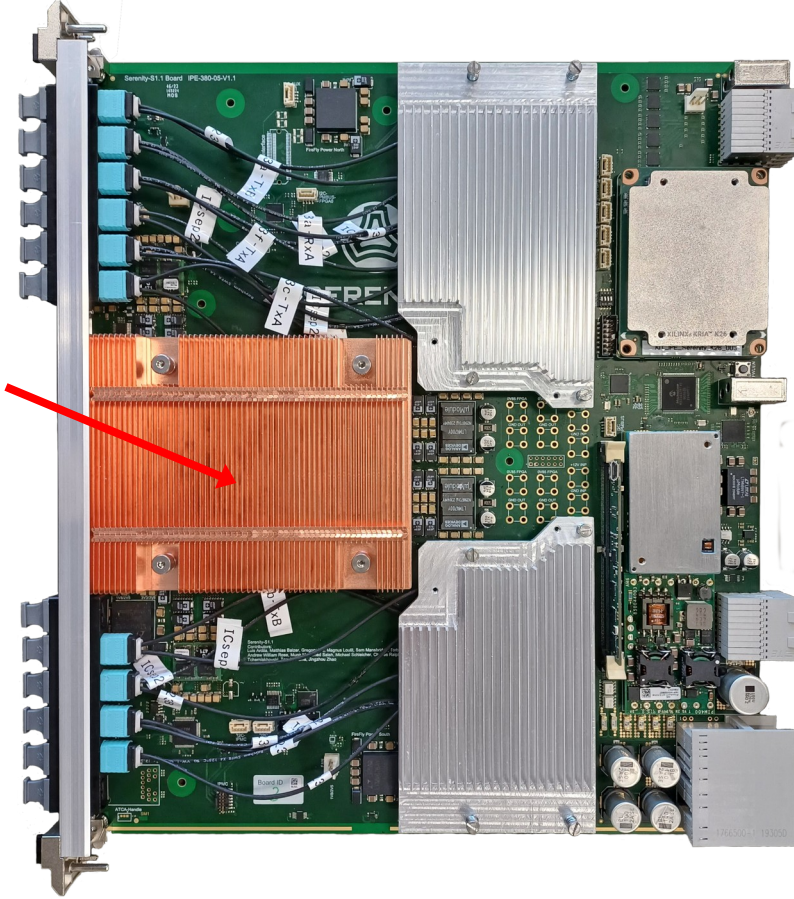
15 Tb/s event data



SERENITY



AMD VU13P FPGA



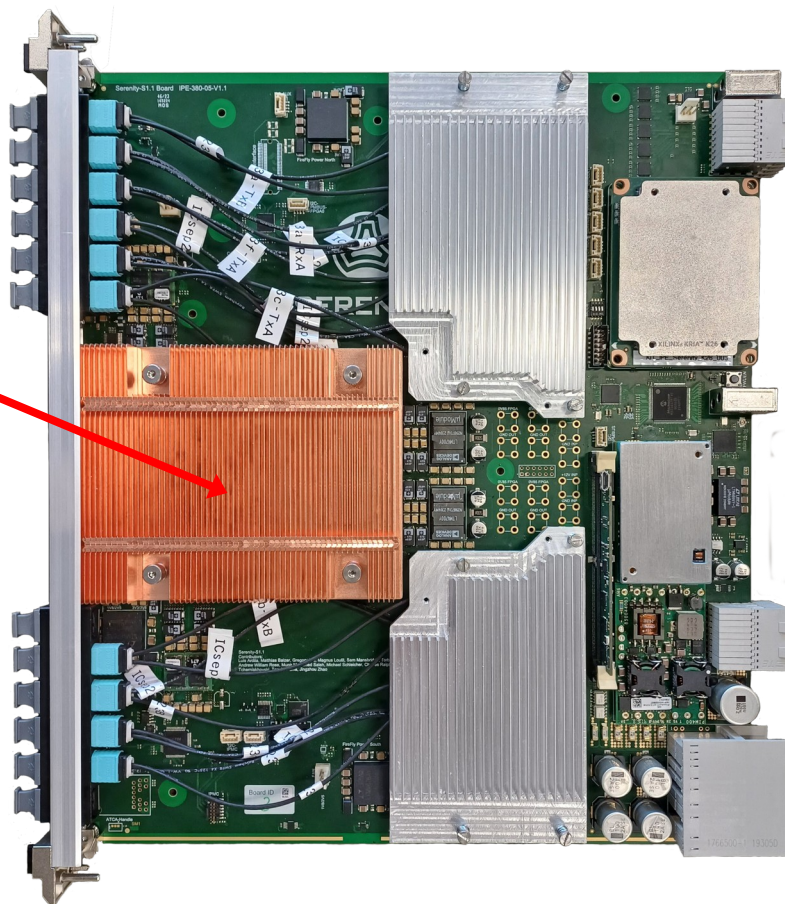
72x Optical Tranceivers



AMD VU13P FPGA



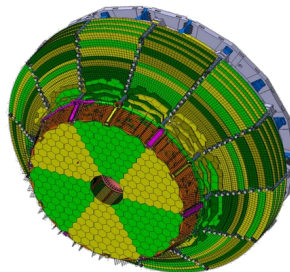
52x Optical Tranceivers



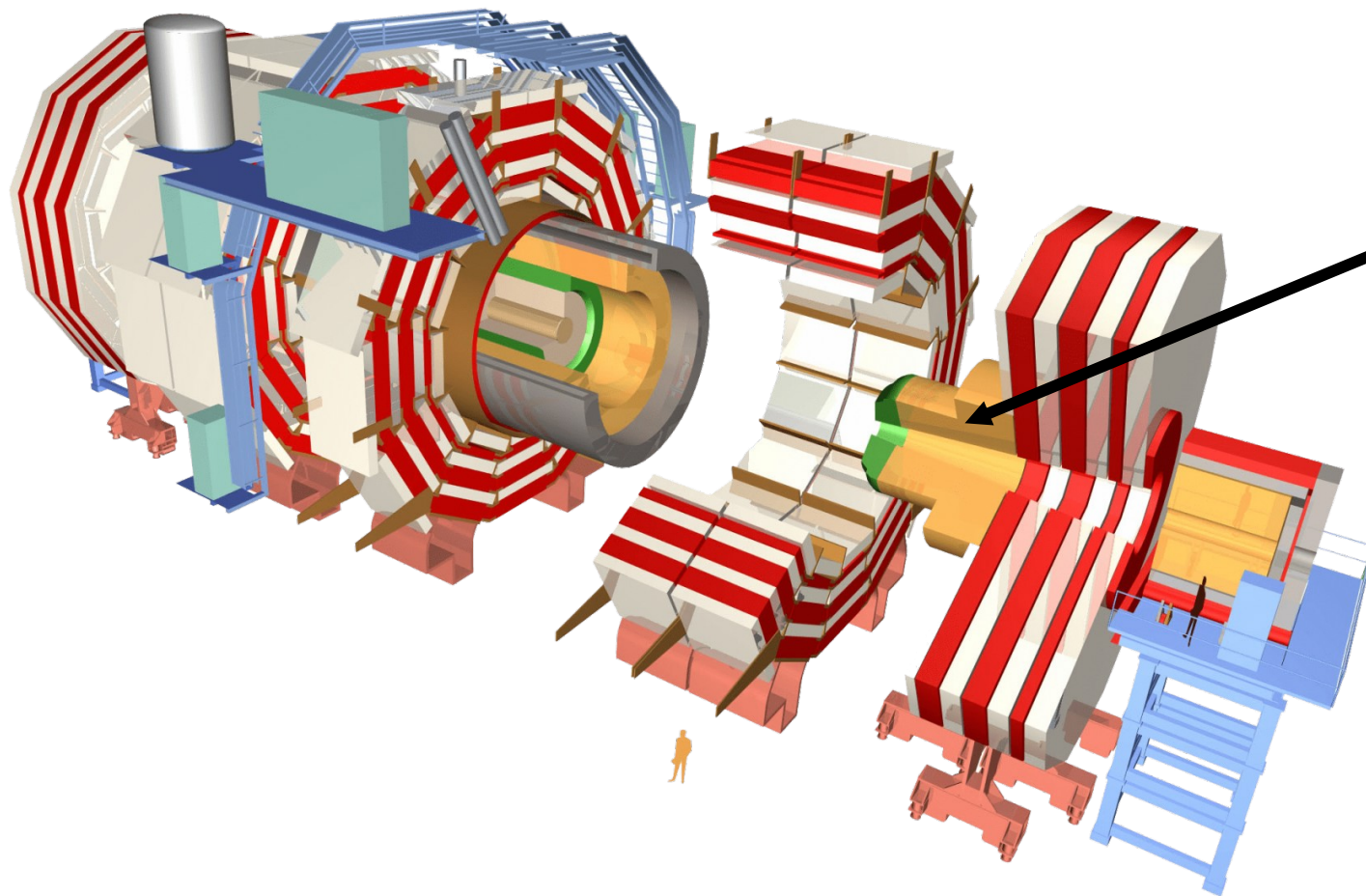
How many



for



?



302x

High-granularity
Calorimeter



49x

Level-1 Trigger



24x

MIP Timing Detector



302x

High-granularity
Calorimeter



1x

Beam Radiation,
Instrumentation,
and Luminosity



20x

Resistive Plate
Chambers



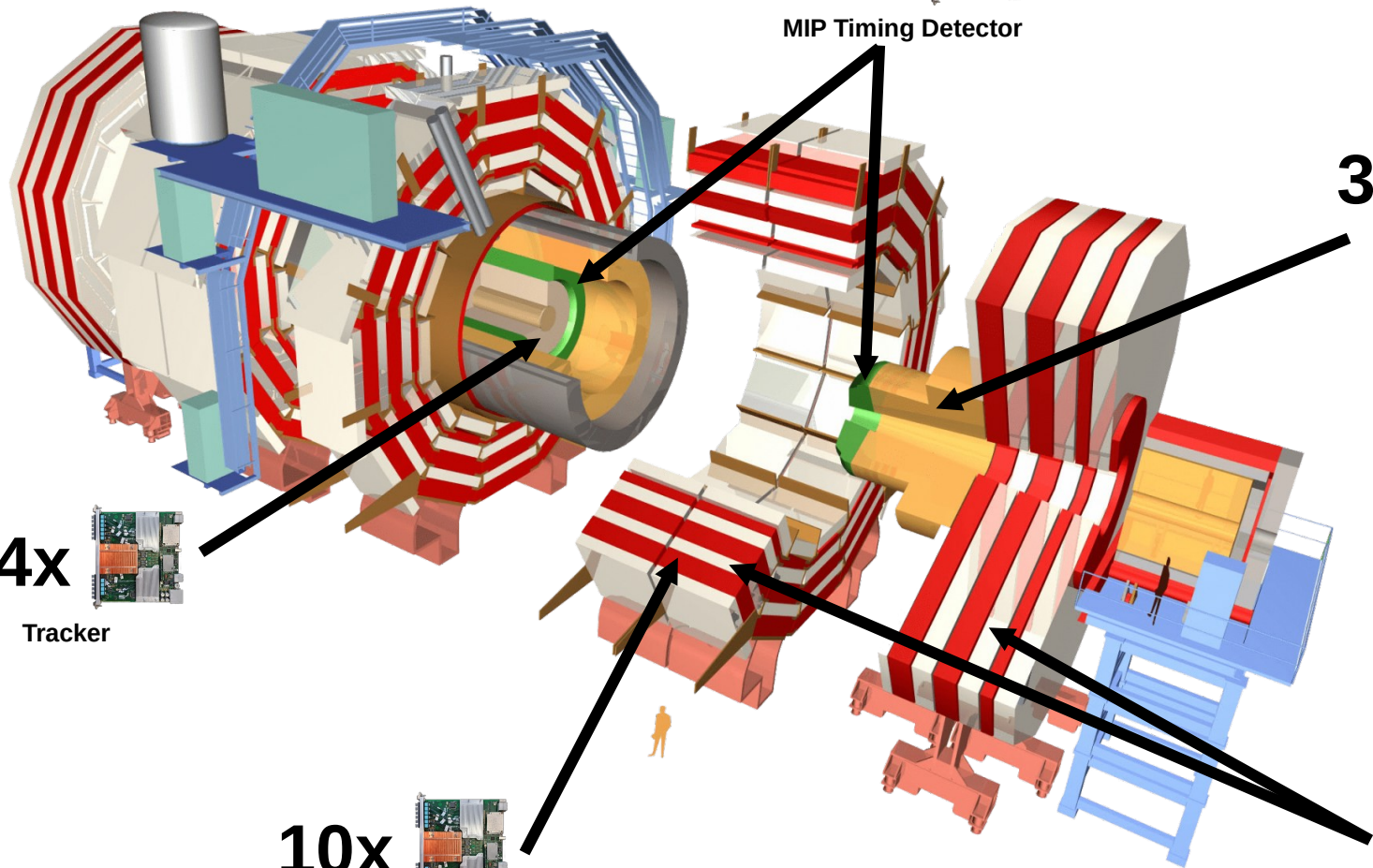
214x

Tracker



10x

Drift Tubes



Serenity

Serenity Everywhere

**How do we ensure every
Serenity works?**

How do we ensure every Serenity works?

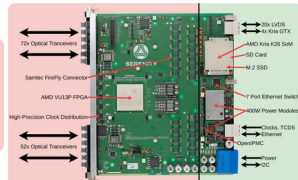
Visit my poster!

KIT
Karlsruhe Institute of Technology

M T DTS
MATTER AND TECHNOLOGIES
Detector Technologies and Systems

Serenity-S1: A Versatile Data Processing Card for CMS Phase-2

H. Krause, L. Ardila-Perez, M. Balzer, M. Fuchs and T. Mehner on behalf of the Serenity consortium
(heide.krause@kit.edu)



Payload Area

- Performance optimized
- Two FPGA options
 - AMD VU13P or VU13P
- Multiple FireFly options
 - 10x T12 / R12, 1x B04
- Copper / optical
- Up to 25 Gb/s each
- Sync or async clock paths
- Central power control

Service Area

- Space optimized
- Board management
 - AMD Kria K26 SoM
- Monitoring and control per ATCA standard
 - OpenPAC
- Cascade power modules
- Ethernet access via backplane

Versatile Applications

- The High-Granularity-Calorimeter (HGCL) will replace the endcap calorimeters in CMS
- Due to high data rates, 302 Serenity-S1 cards will be used for DAQ and trigger
- CMS Tracker will be upgraded for HL-LHC
- 214 Serenity-S1 cards will be used as DAQ and timing cards (DTC)
- 104 additional Serenity-S1 cards will be used by various other CMS subsystems for phase-2 (BRIL, MTD, LIT, ...)
- TRISTAN is the next experiment generation at KATRIN
- New detector requires new readout system with online cluster-evaluation
- 3 Serenity-S1 cards will be used

➡ Suitable for large-, medium- and small-scale setups!

Road to Production and Testing

- Pre-series Production started in August 2025
- Main-series Production started in October 2025

➡ Hardware development done and production started!

Factory Acceptance Test

- Test / Configure every board in 10 Minutes
- Highly automated
- Used directly at the production site

User Acceptance Test

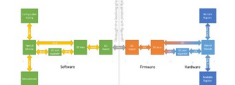
- Sub-detector specific tests at CERN

➡ My work ensures every board is properly tested!

Advanced Board Management

Serenity Management Shell (SMASH)

- Framework that runs on the Kria K26 SoM
- Controls the board communication infrastructure
 - I2C and PMBus based
- Works by mirroring the physical bus topology into software
- Flexible against hardware changes through independent modules connected by bind commands



Extensible Modular (data) Processor (EMP)-Framework

- Framework that runs on the FPGA
- Centered around a payload area
- Infrastructure easily configurable via single config file
 - Link Type/Protocol, Clock Speed, Buffer, ...
- Register access from the Kria SoM via AXI chip2chip
- IPBus via AXI chip2chip

➡ You can focus on your awesome physics algorithm!

Interested and want to know more? Visit our webpage and read our paper ➡

