



phenoPET

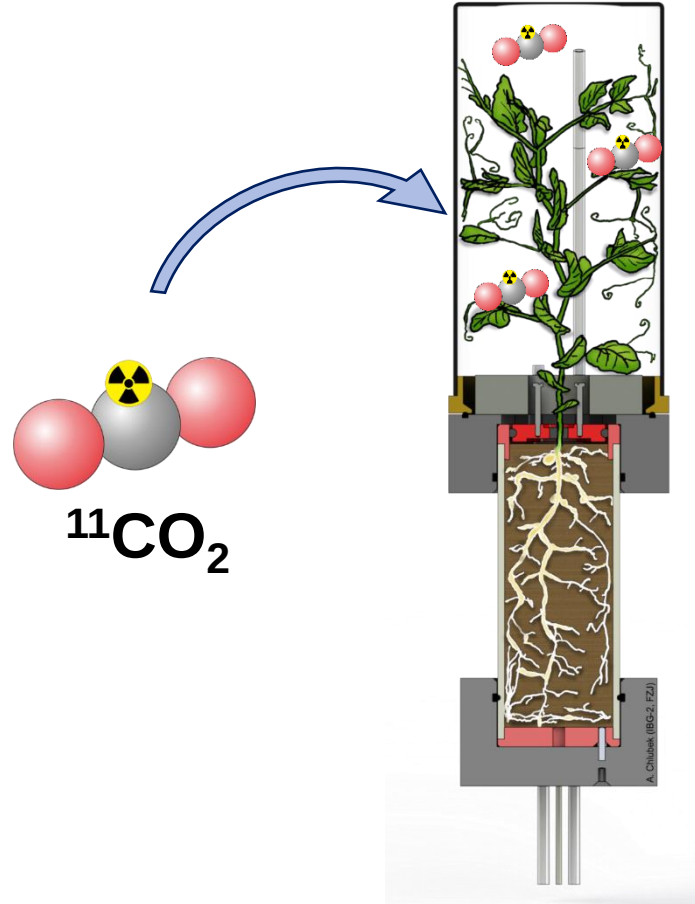
The Readout System of the Plant Scanner

12 September 2023 | Matthias Streun

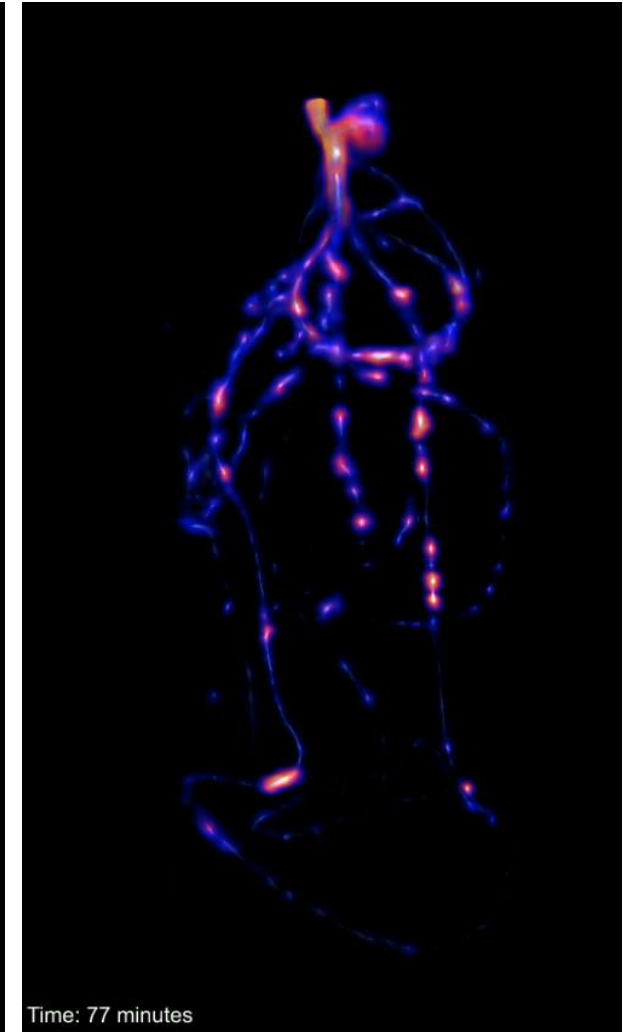
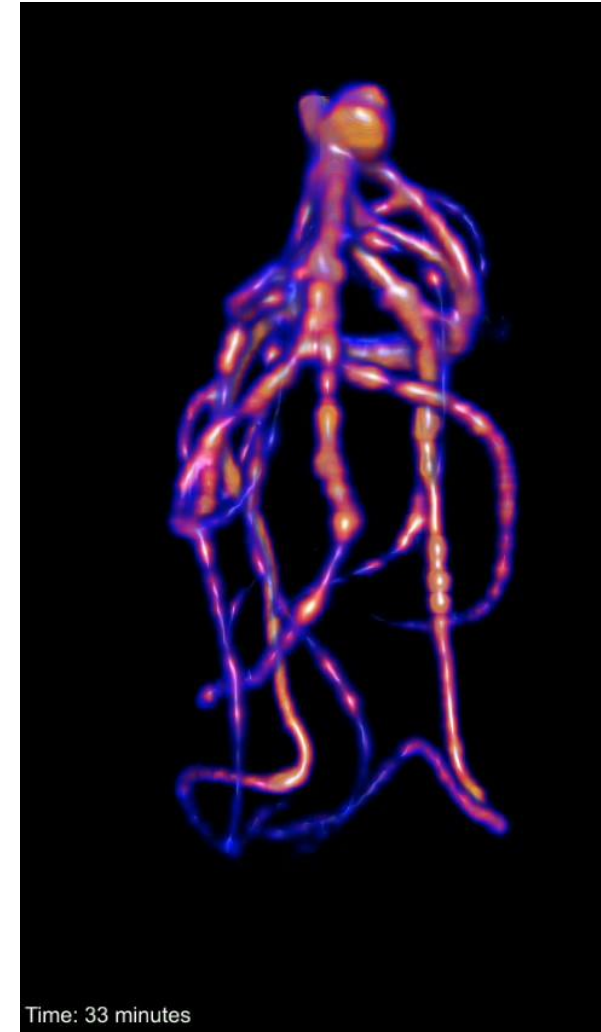
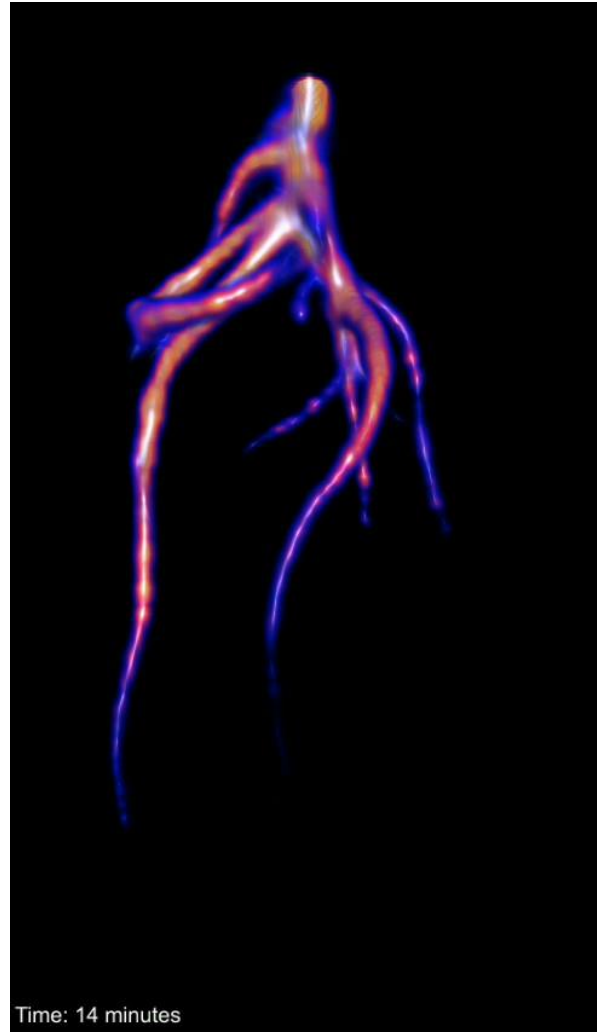
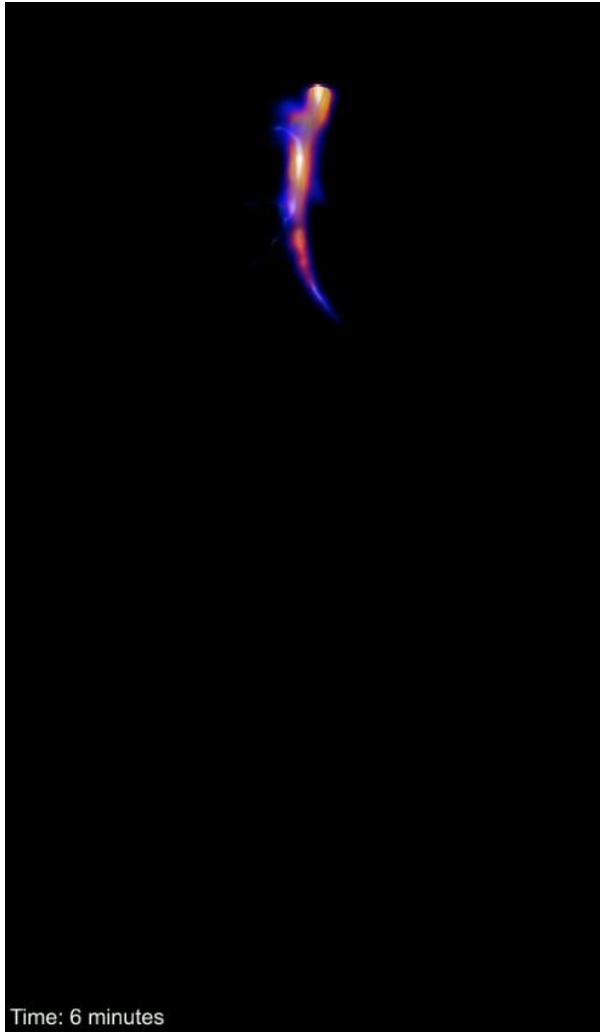
Why PET for Plants?

The plant absorbs C-11 labeled CO₂.

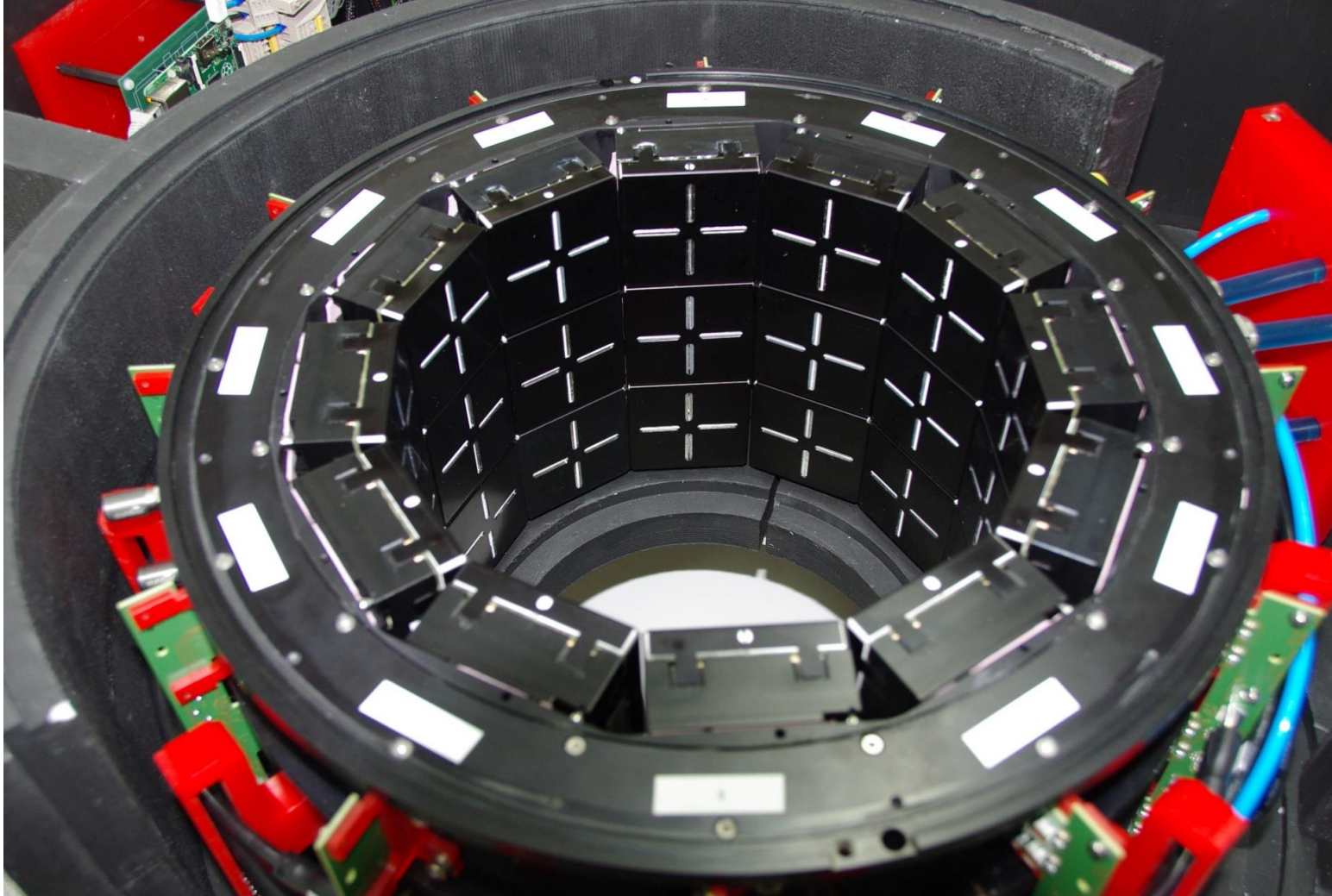
PET can observe the transport of the photo assimilates, particularly in the root system.



Dynamic Measurement of the C11 Uptake in a Pea Root

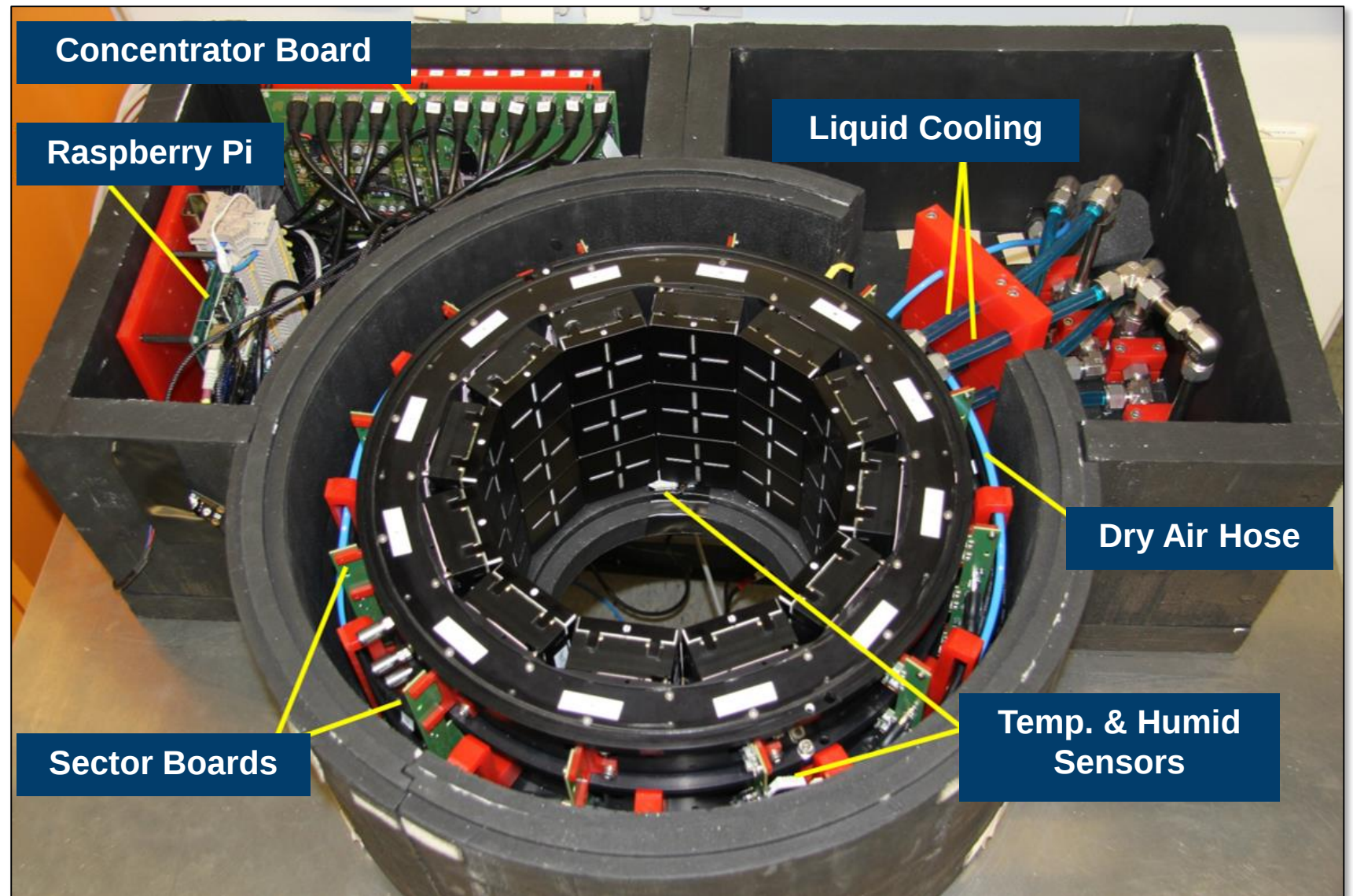


Plant Scanner *phenoPET*

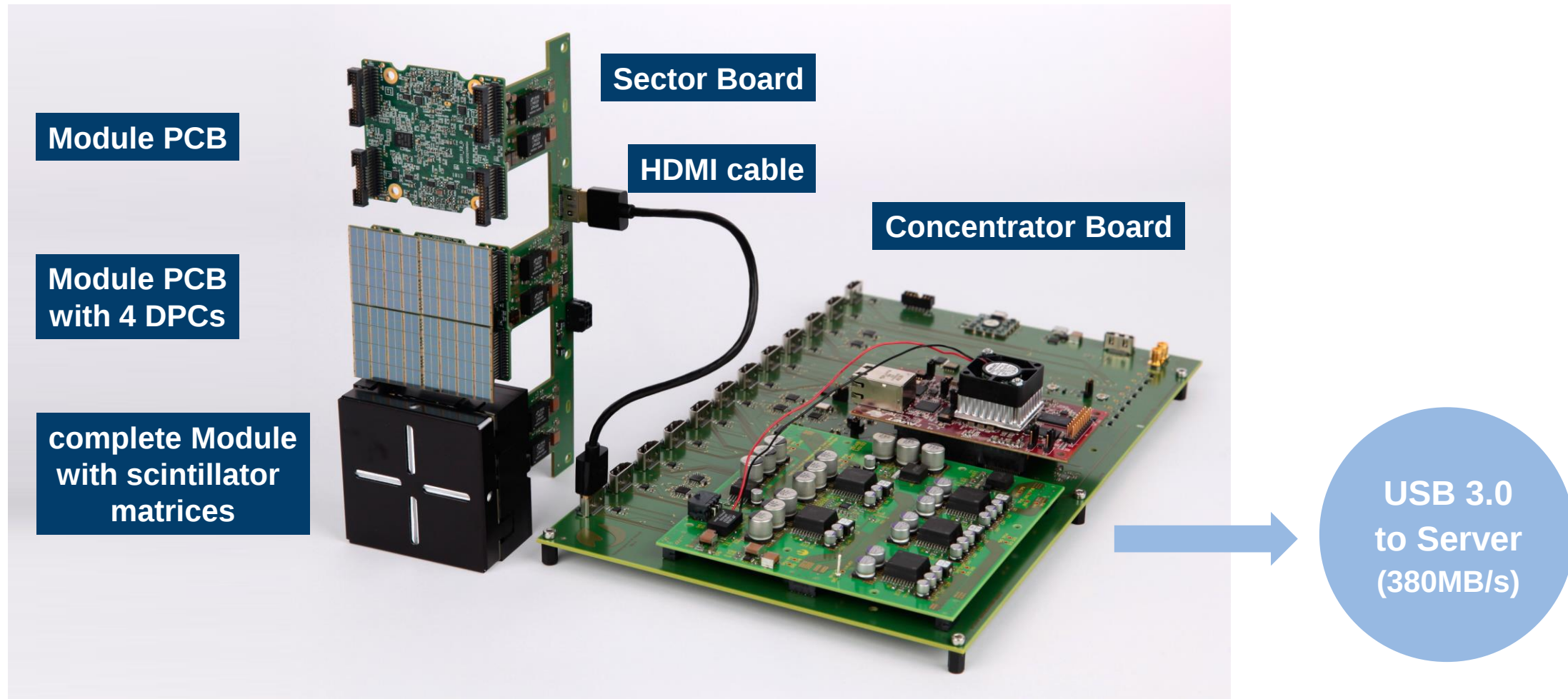


- **Field of View:**
 $\varnothing$ 180 mm $\times$ 200 mm
- **Scintillation Detectors with:**
 - LYSO crystals and
 - Digital SiPMs (Philips DPCs)
- **Performance:**
 - Spatial Resolution: $\sim$ 1.6 mm
 - Energy Resolution: $\sim$ 16.6%
 - Time Resolution: 300-800 ps

The System

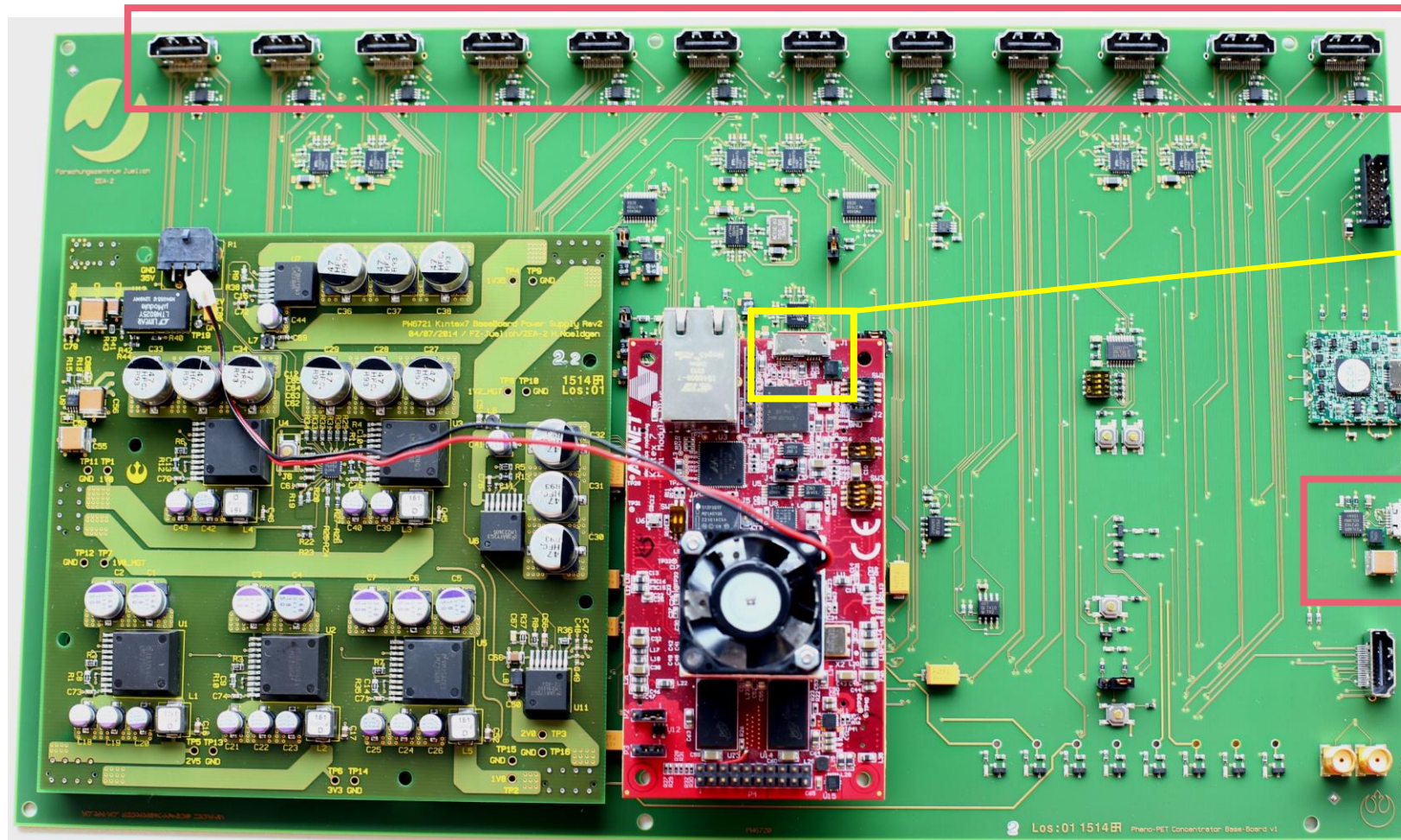


Sector Board & Concentrator Board



The Concentrator Board

12x HDMI Module Connectors (*data in*)



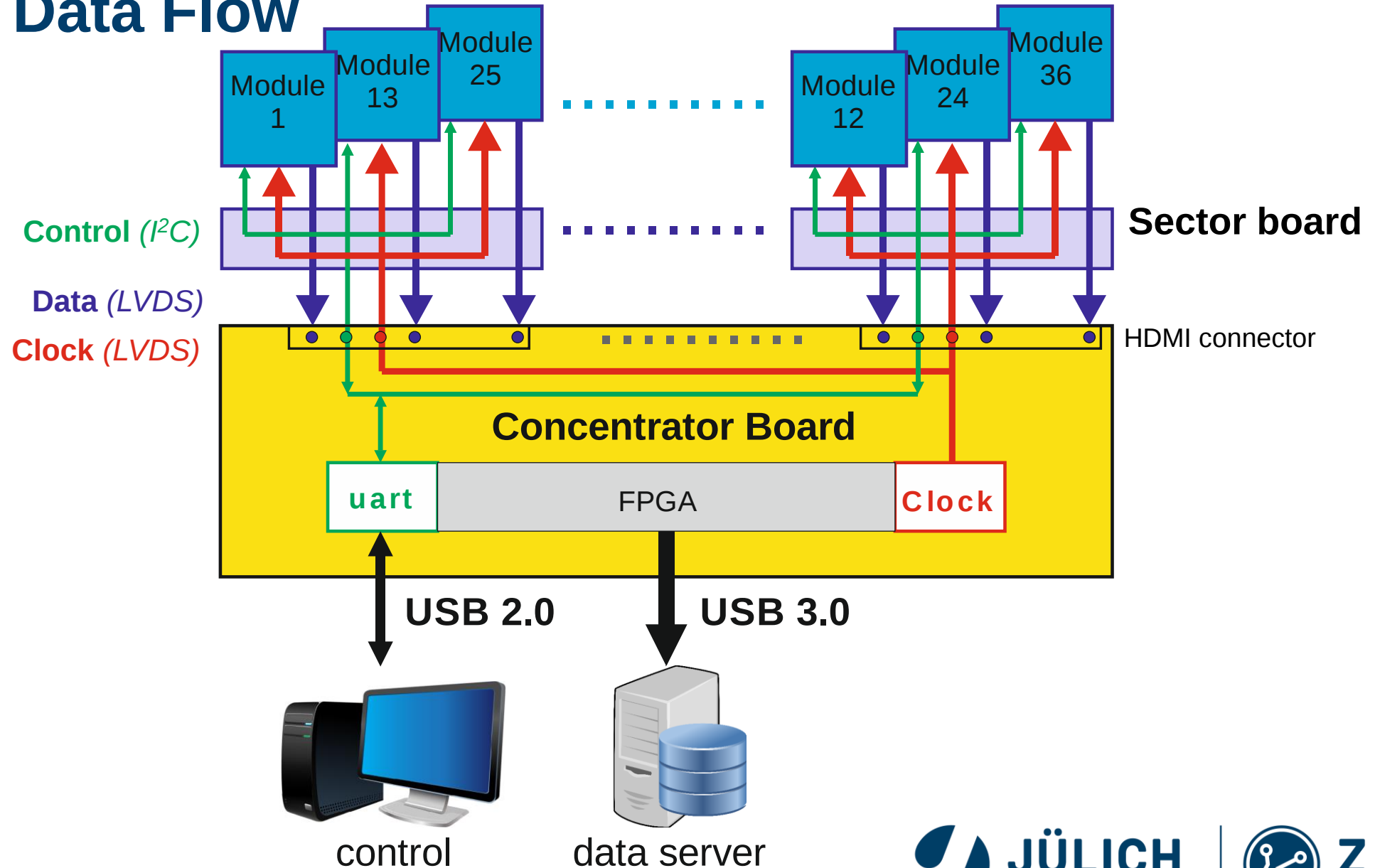
USB3.0
data output

USB2.0 UART

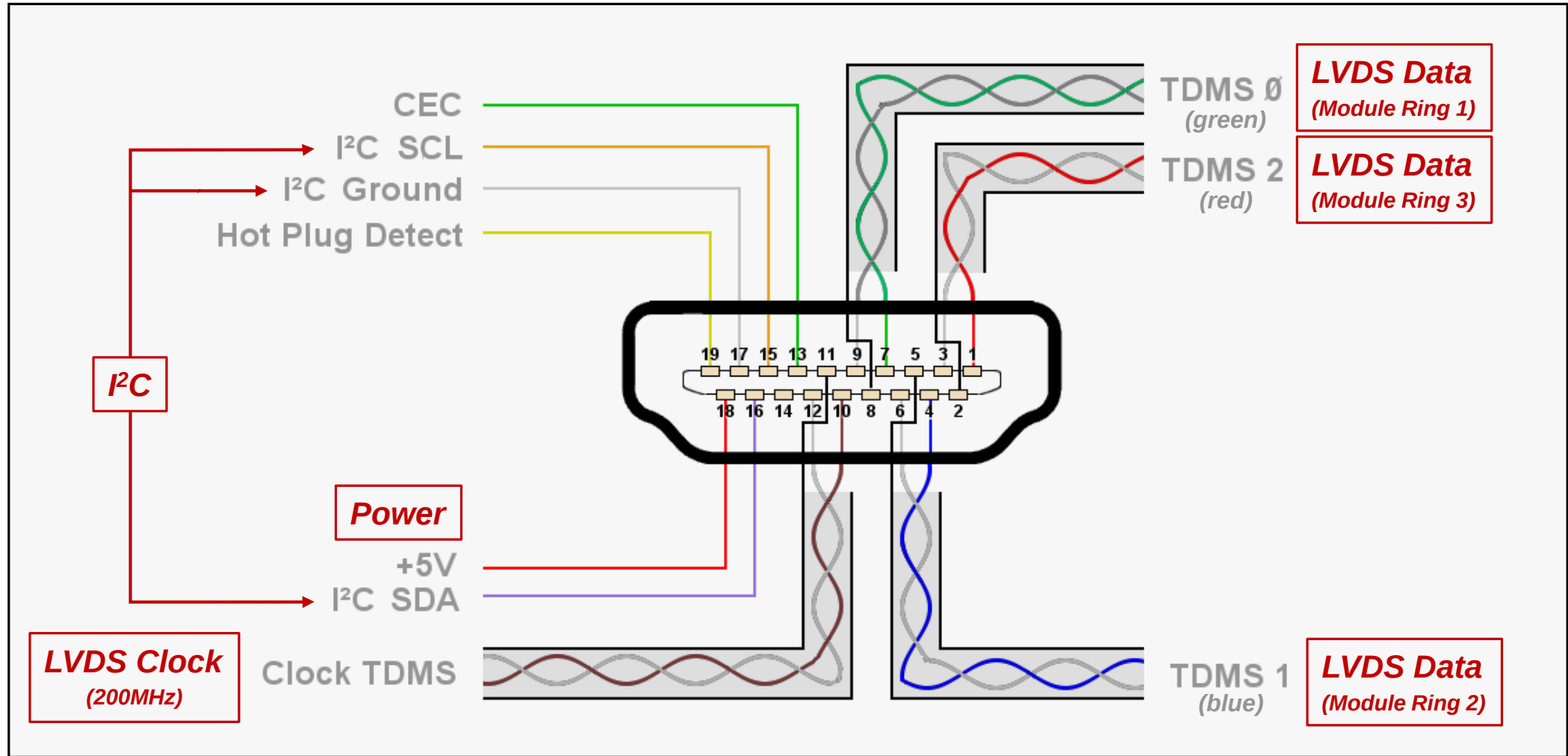
Power Supply

KINTEX-7 MiniModule

System Data Flow



(Ab)using Standard HDMI Connectors

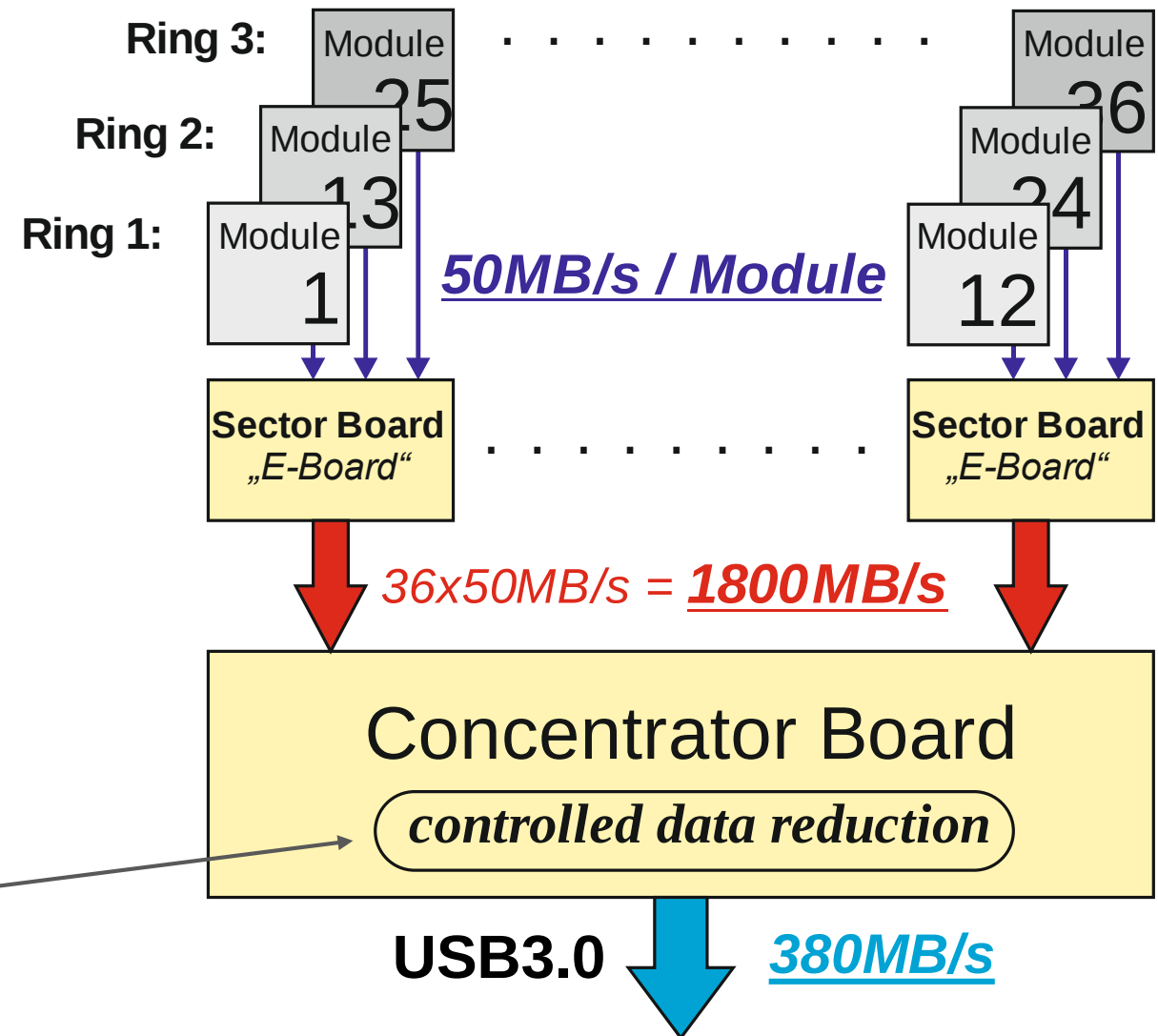


Data Flow and Rates

Rate per Module: up to 50MB/s

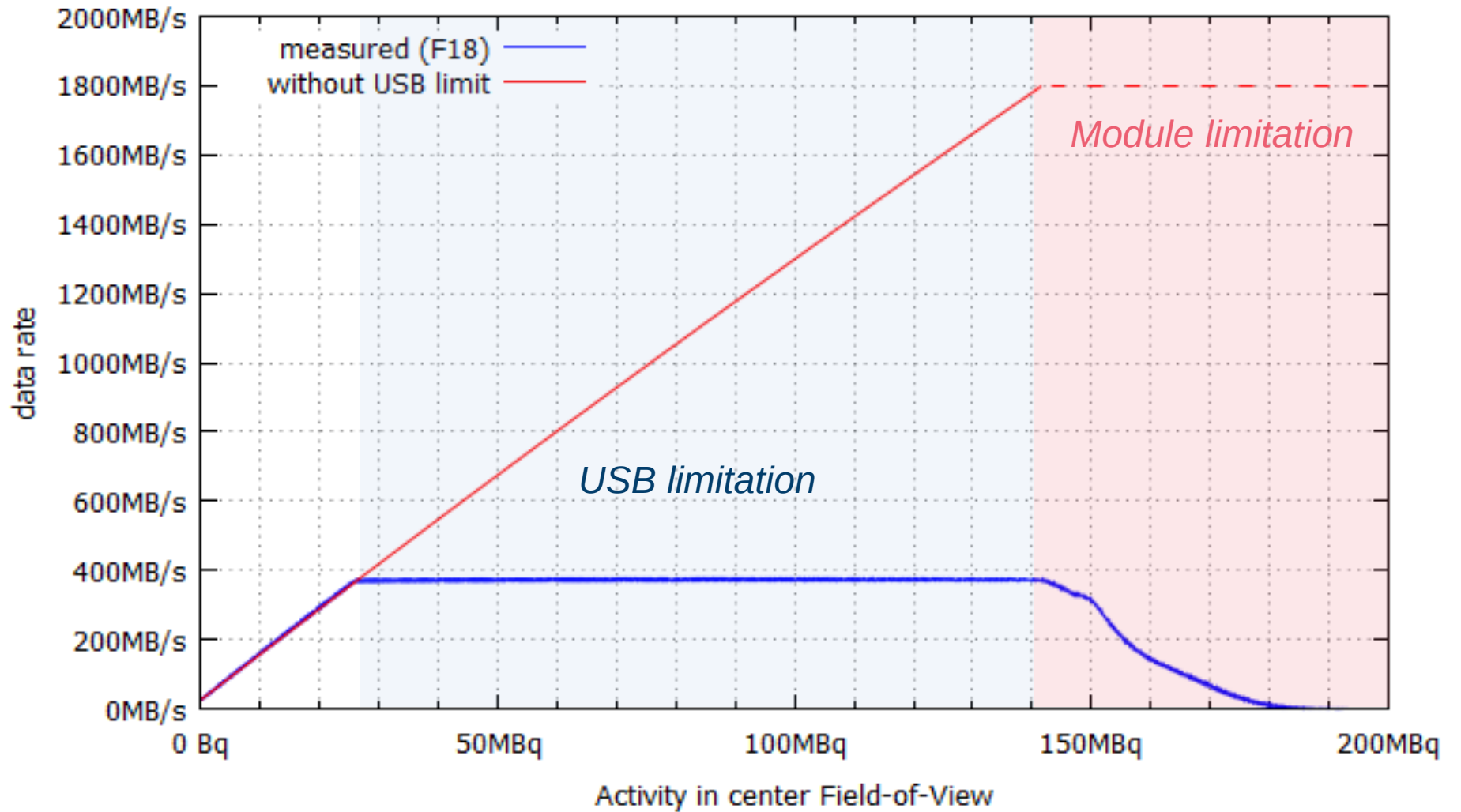
USB3.0 max Data Rate: 380MB/s

→ *Data reduction required*



USB Limitation

Data rate vs. Source Activity

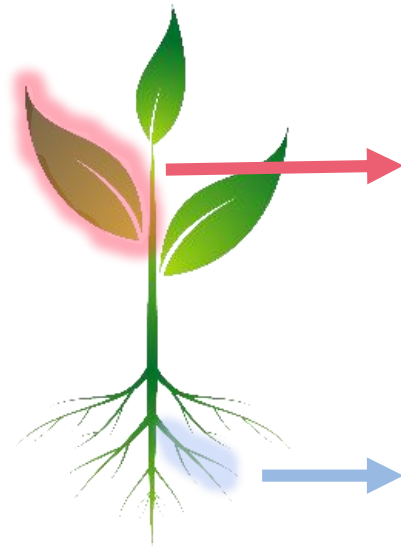


USB Limitation

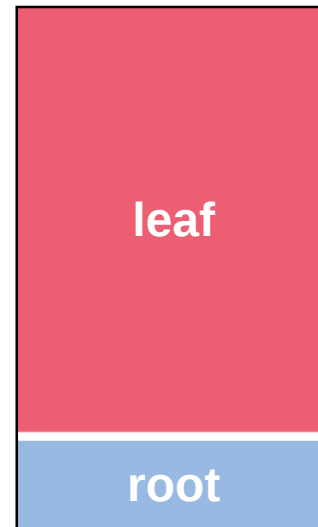
Drawback of Limitation and Benefit of Higher Bandwidth

With rate limitation:

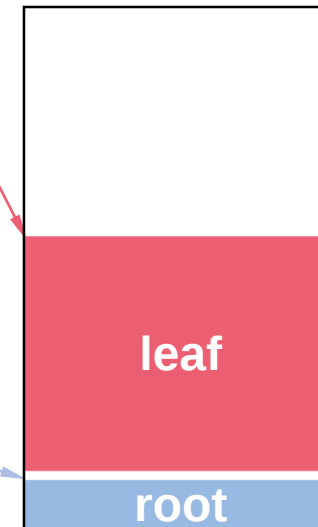
events from important „cold“ regions will be displaced by events from „hot“ regions.



no. of counts



after limitation



Without limitation:

more counts from weak regions in spite of high activity in other regions.

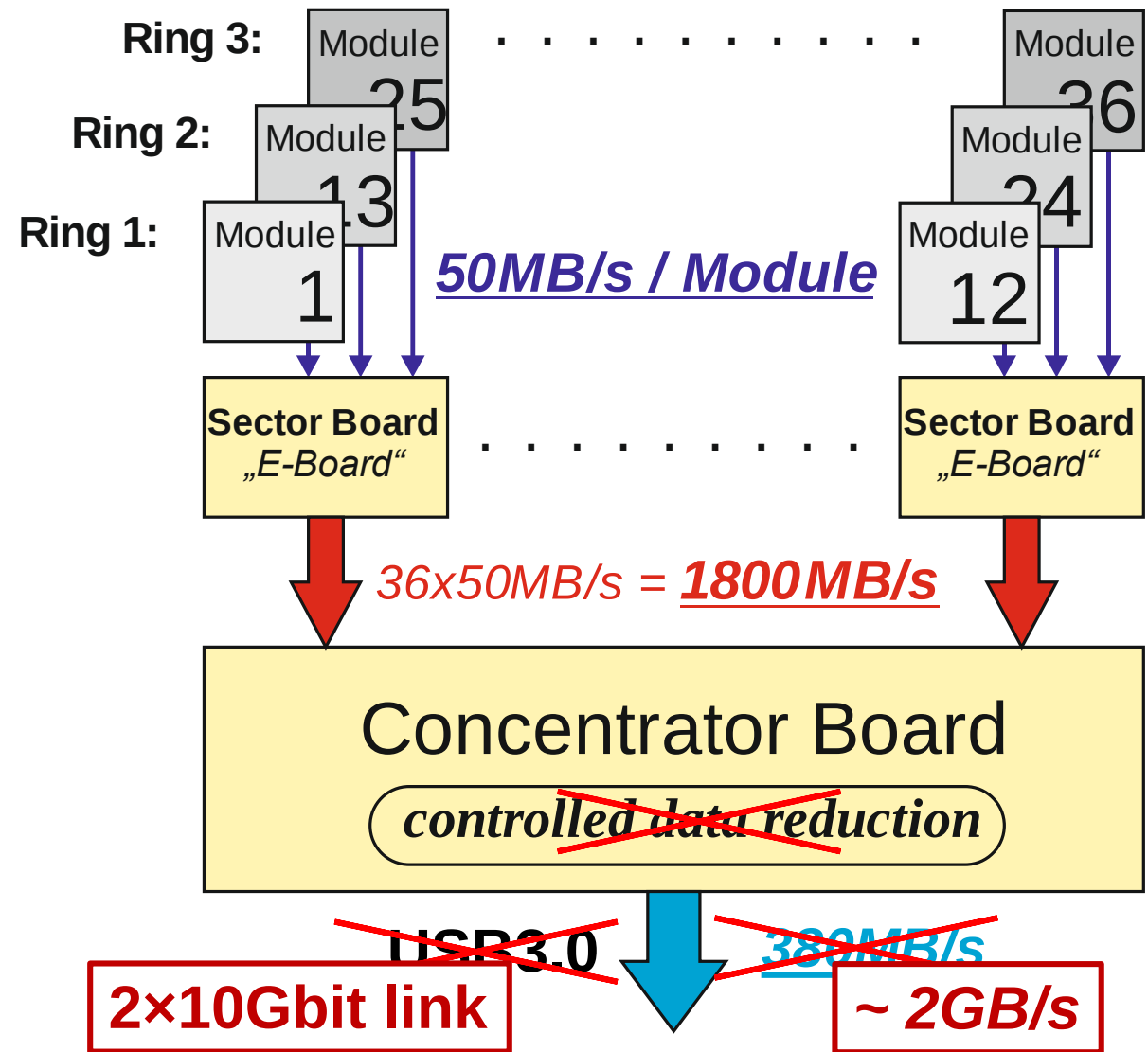
Upgrade: Overcoming the USB Limitation

Replacement of USB 3.0 connection by two 10Gbit lines.

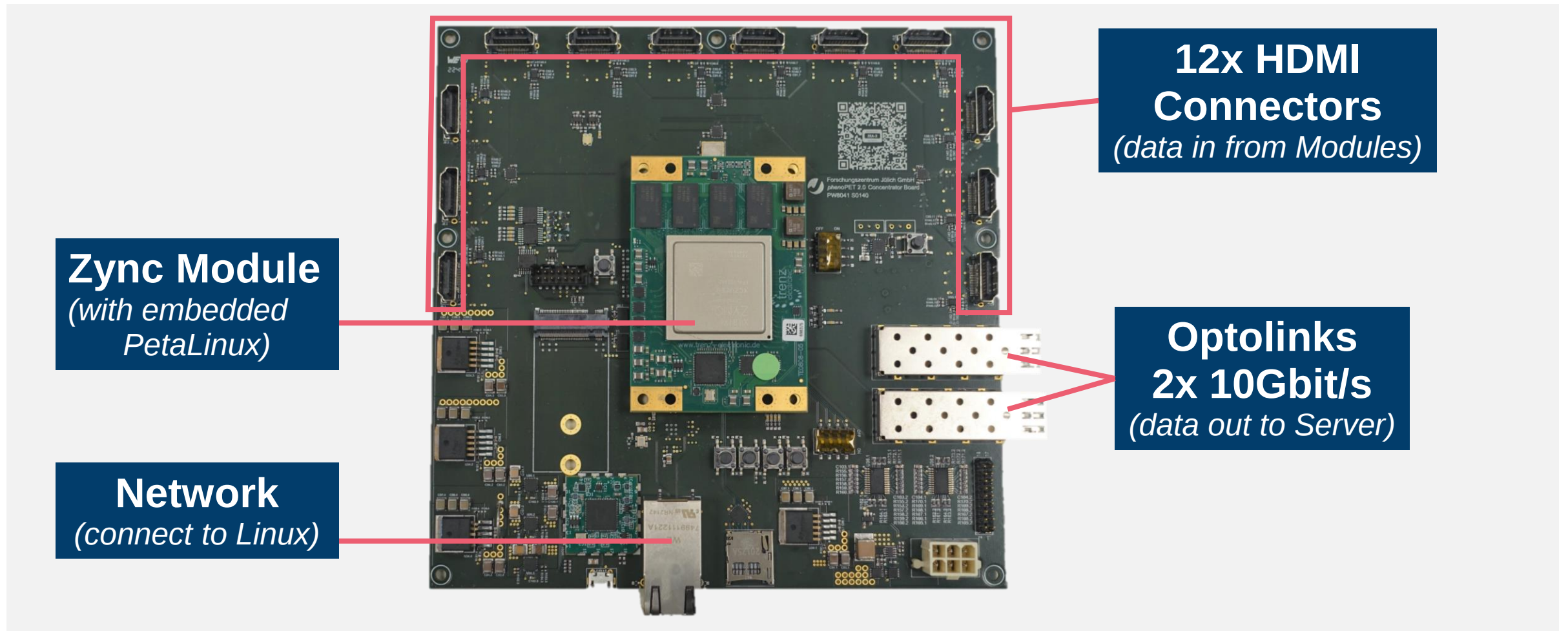
Rate per Module: up to 50MB/s

~~USB3.0 max Data Rate: 380MB/s~~

Full rate by 2 × 10Gbit opto links



Upgrade: The New Concentrator Board



Summary

- ***pheno*PET is a medium sized PET scanner based on digital SiPMs**
(18 x 20 cm Field of View)
- **High Quality Dynamic Measurements with ≤ 1 min frames**
- **Data Transfer Rate limited to 380 MB/s (USB3.0)**
Upgrade in progress:
Replacement of USB3.0 by 20 GBit optolink

Thanks

Coworkers @ Jülich

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