

A new easily scalable readout system for distributed PMT detector networks

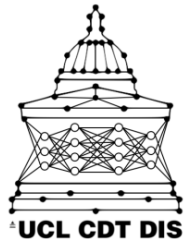
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IOP Institute of Physics

HEPP & APP Annual Conference 2022

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On the menu today

1. Feature overview
2. Components:
 - MicroDAQ
 - DAQ node
3. Envisaged usage
4. First data
5. Conclusion



Feature overview

- Instruments for measuring with **photomultiplier tubes**.
- Time resolution **0.69 ns**, synchronized **< 1 ns** across channels.
- Hit rates up to **26 kHz** per channel.
- Key selling points:

EASY TO INSTALL

JUST ADD:

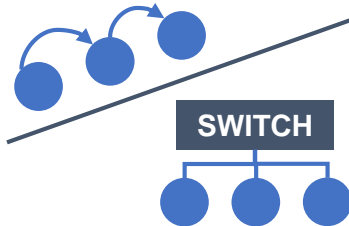


NETWORK



POWER

DISTRIBUTED



AFFORDABLE

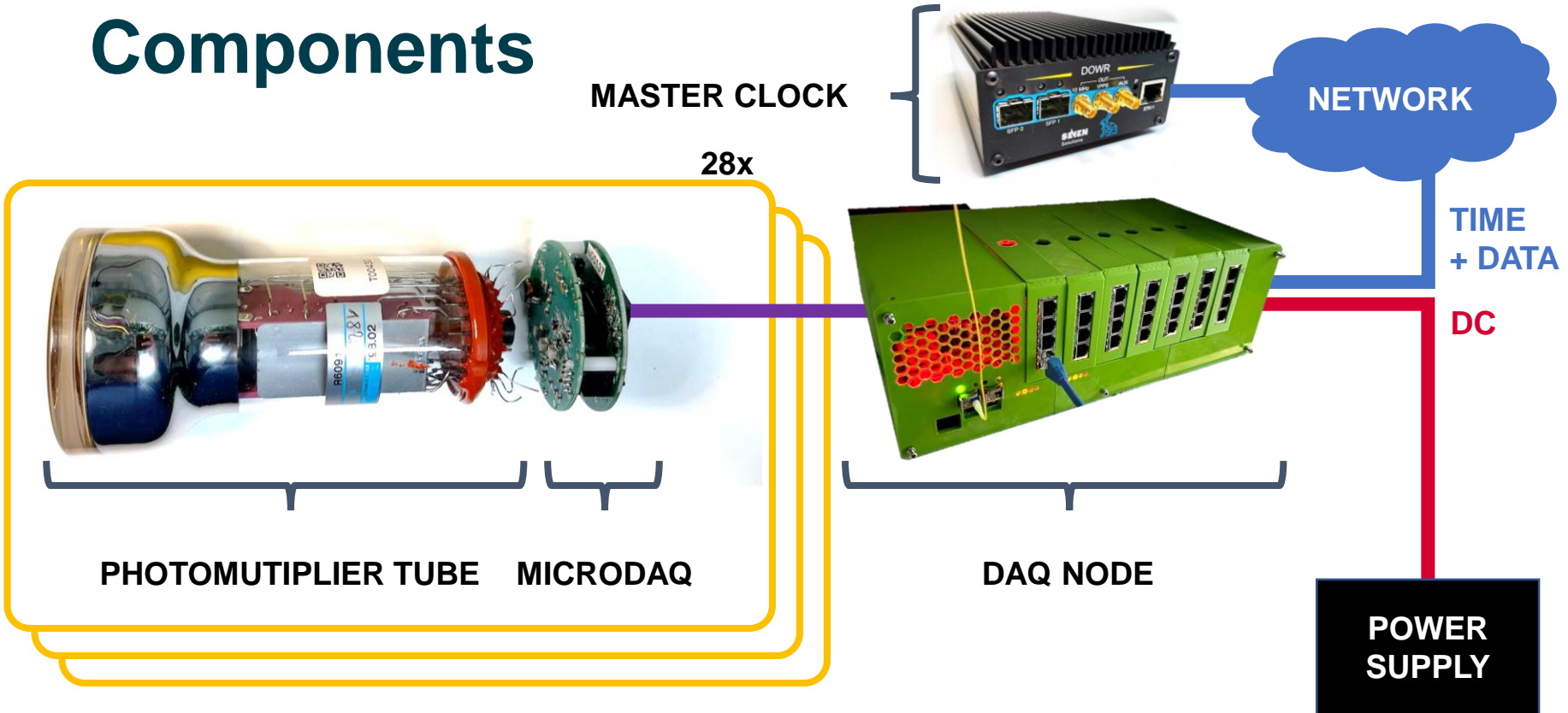
CHIPS $O(\$200K) / \text{kt}$
Super-K $O(\$1M) / \text{kt}$



EXTENDABLE



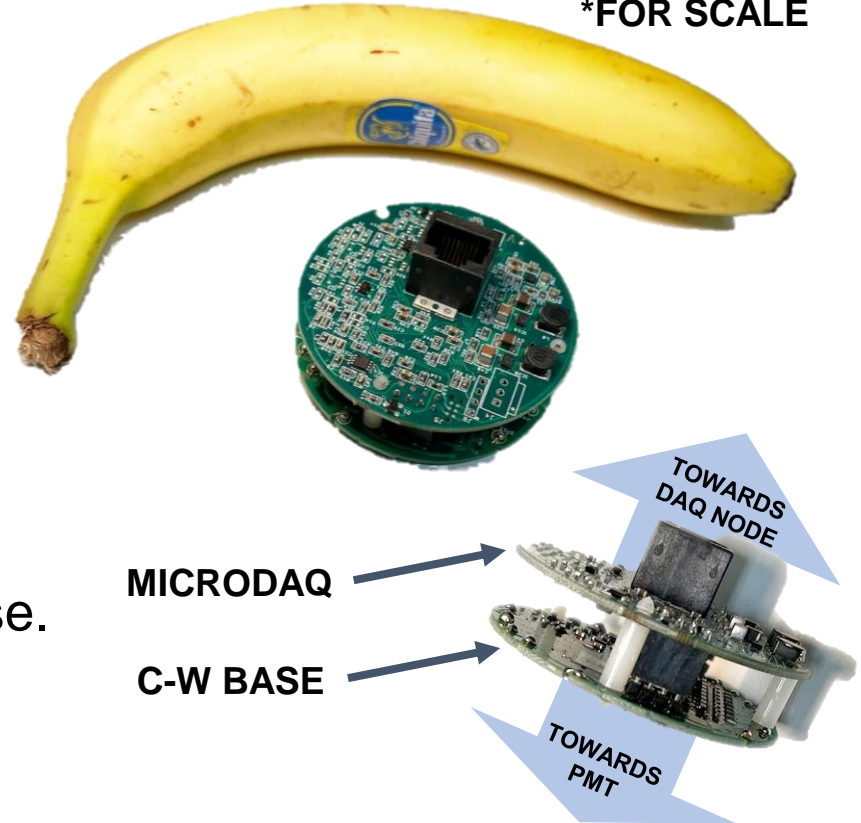
Components



MicroDAQ

- Proprietary board with STM32 microcontroller.
- Small PMT-shaped form factor.
- Generates high voltage **in situ** using a Cockroft-Walton base.
- Receives precise clock signals.
- Digitizes, timestamps analog pulse.

*FOR SCALE



DAQ node

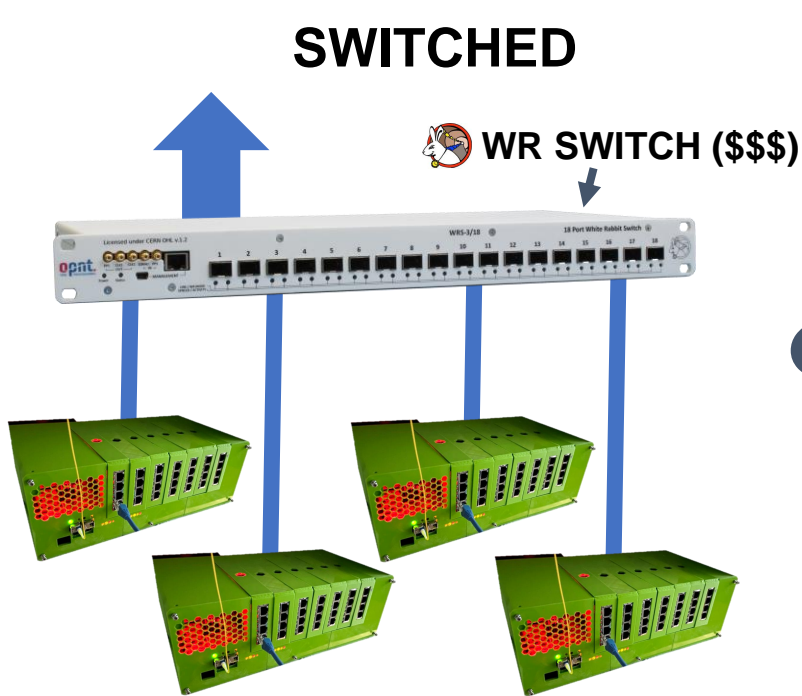
- Autonomously reads out up to **28 MicroDAQ channels**.
- White Rabbit compatible: **single fiber** for precise time & data.
- Network-booted: easy to manage.
- Data directed towards **a backend**.
- Supports up to **26 kHz per channel**.
- Affordable 3D-printed enclosure.



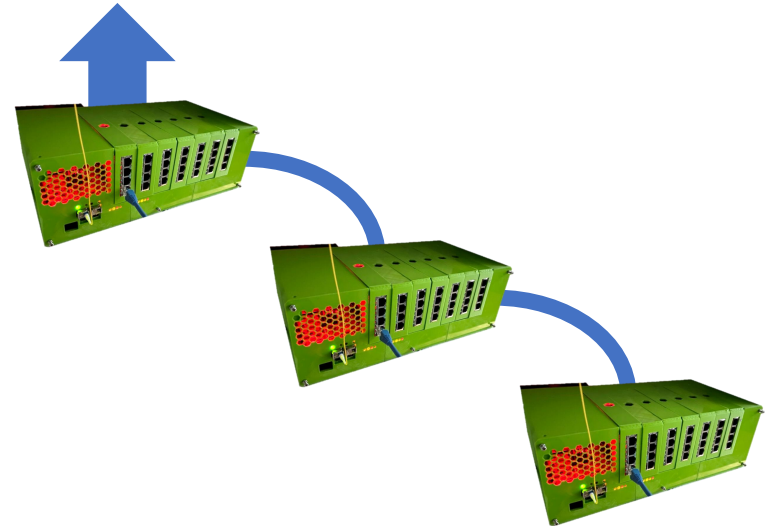
IEEE 1588
Precision Time Protocol

Supported topologies

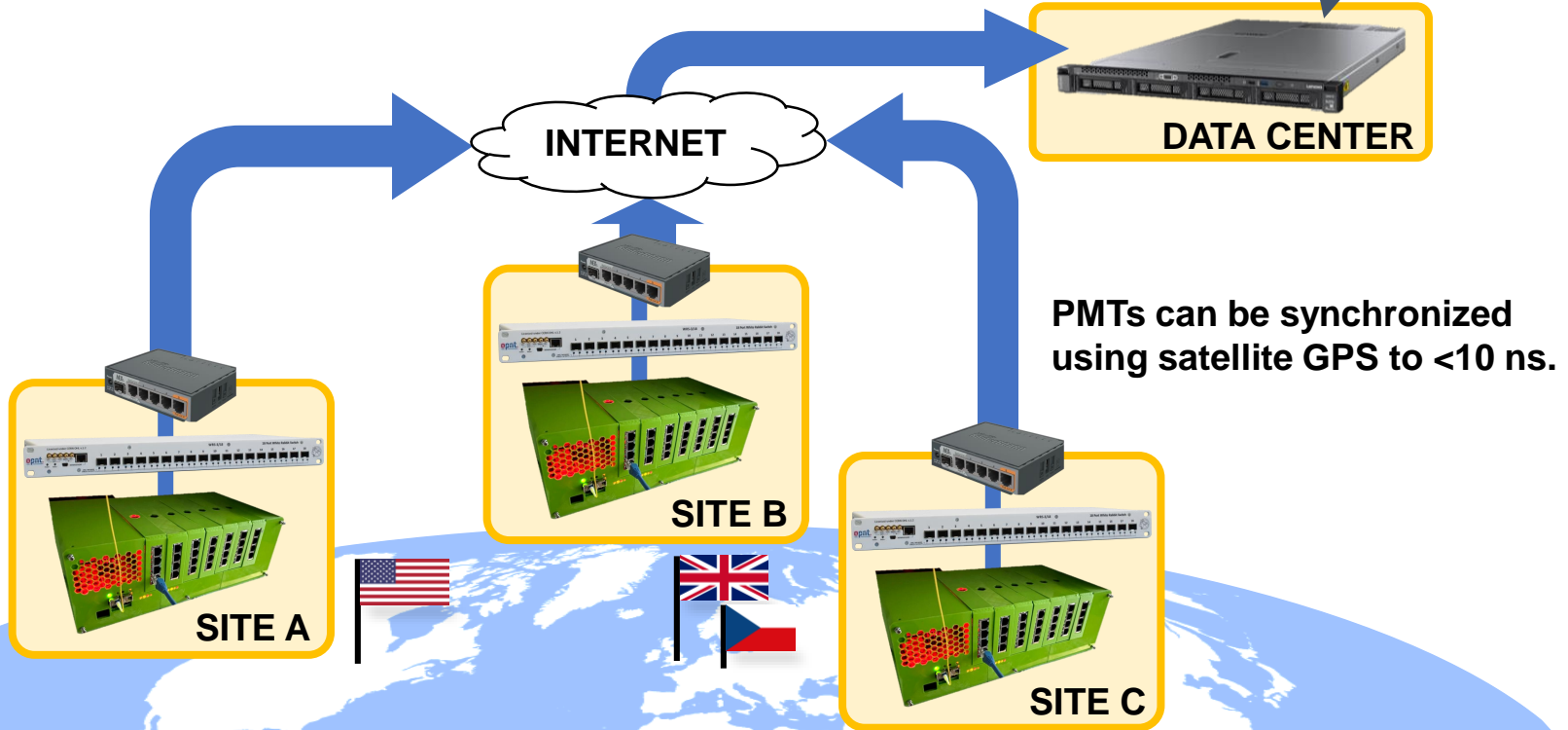
SWITCHED



DAISY-CHAINED



Supported topologies (continued) DAQ BACKEND

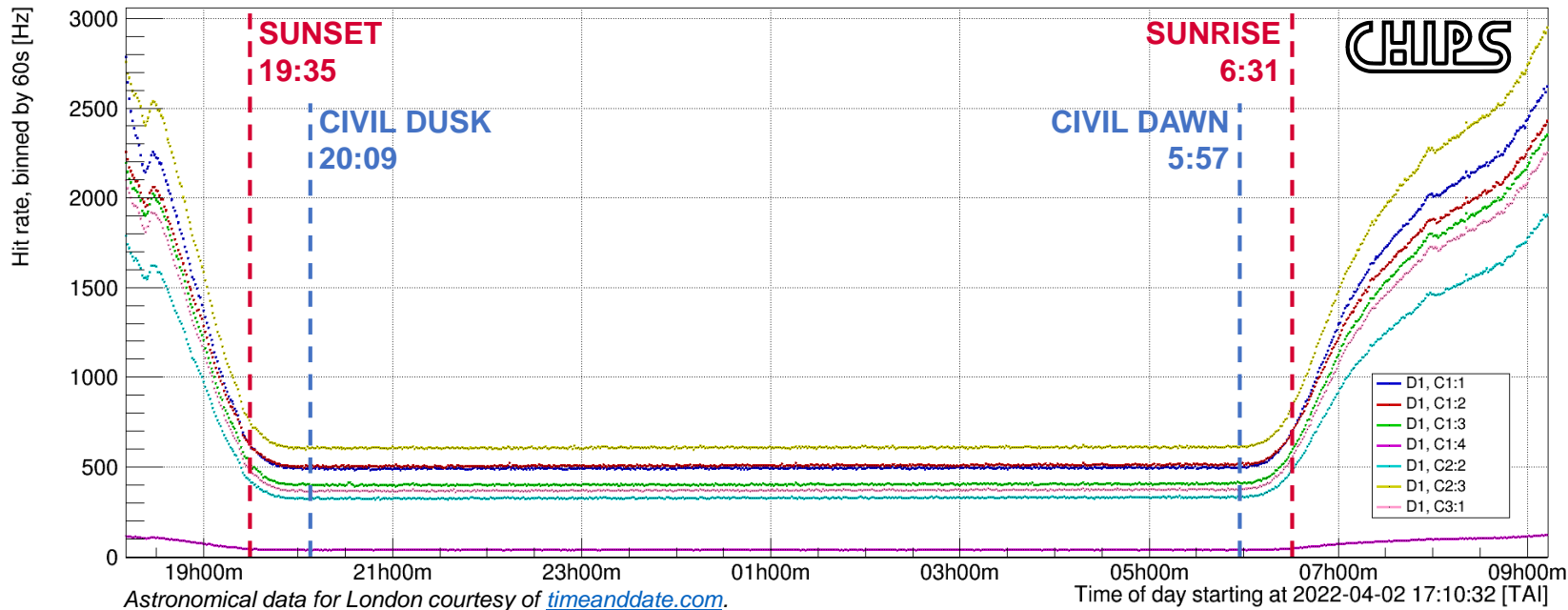


First data!

Hamamatsu
R6091



- 7 PMTs, London, taken 6.3×10^8 hits overnight.



Conclusions

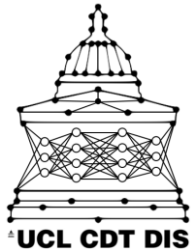
- Next-gen distributed, highly autonomous instruments.
- Decent resolution but affordable & extendable.
- Currently tested in 3 locations around the World.
- More results to come!

Thanks for listening!

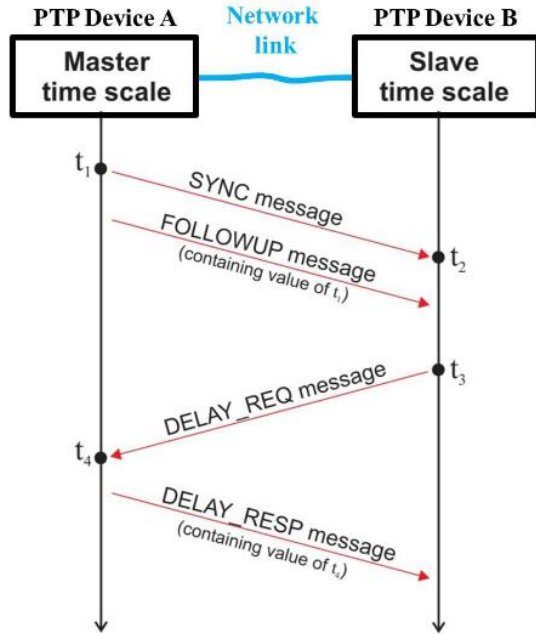
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- petr.manek.19@ucl.ac.uk
- <https://petrmanek.cz/research>

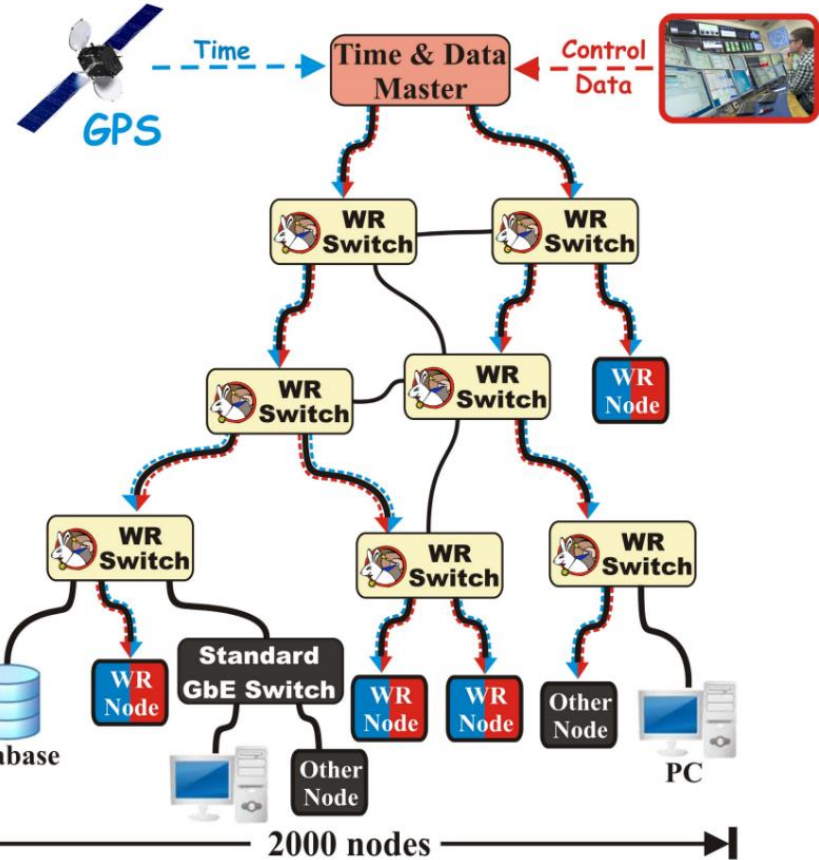
Find slides online:



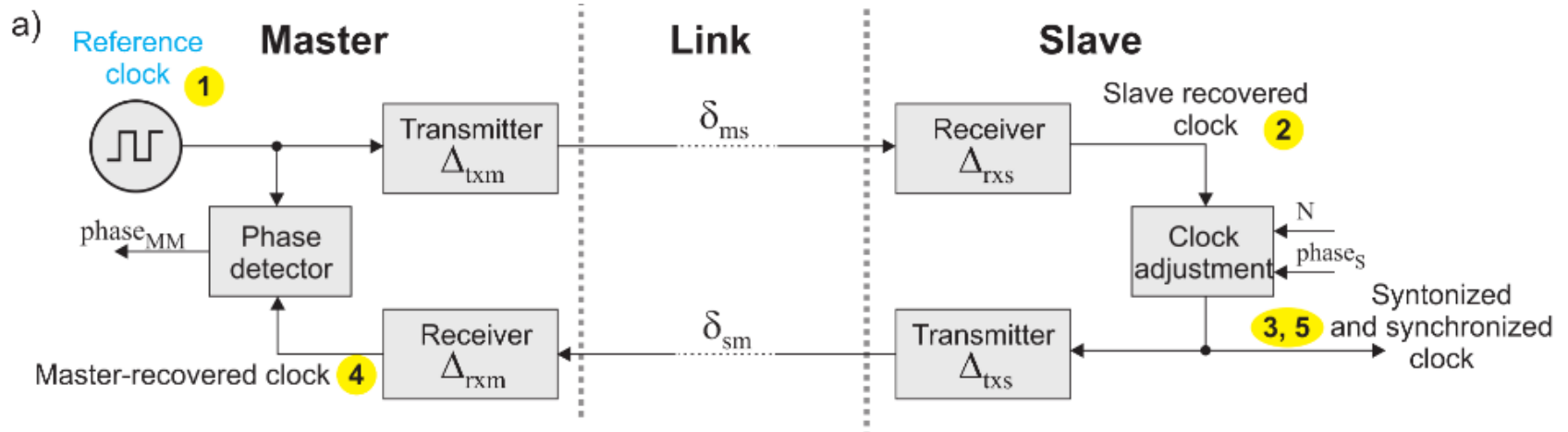
Backup: White Rabbit



Courtesy of Maciej Lipiński.

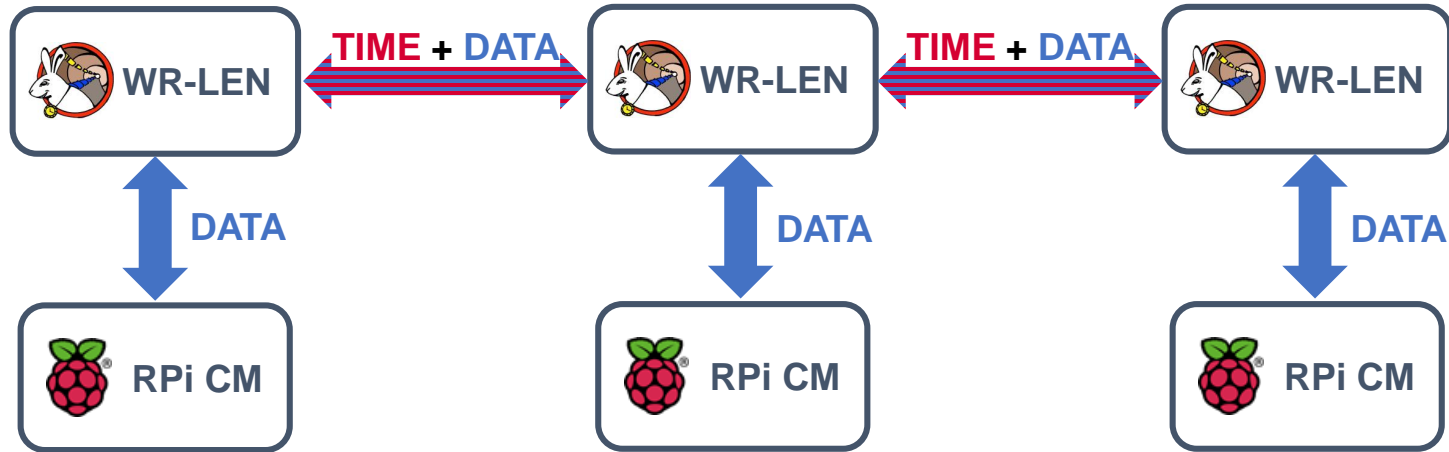


Backup: White Rabbit



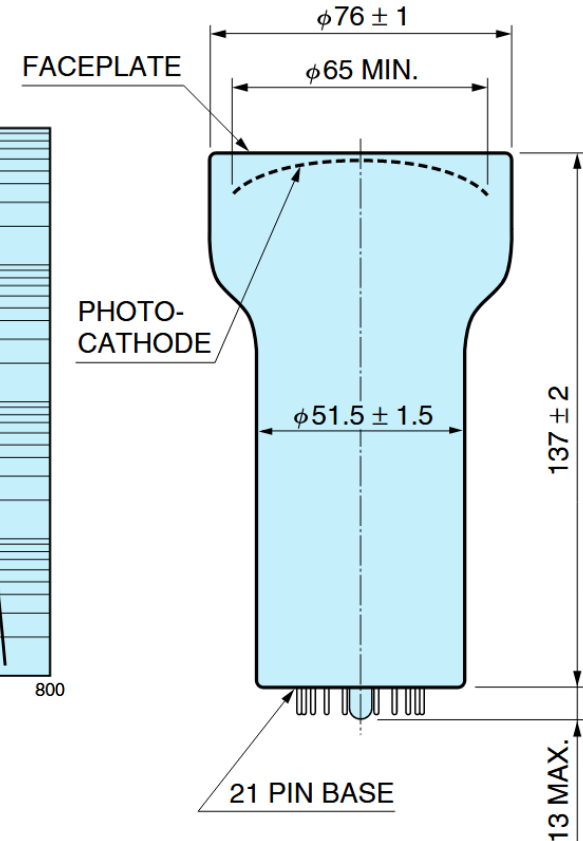
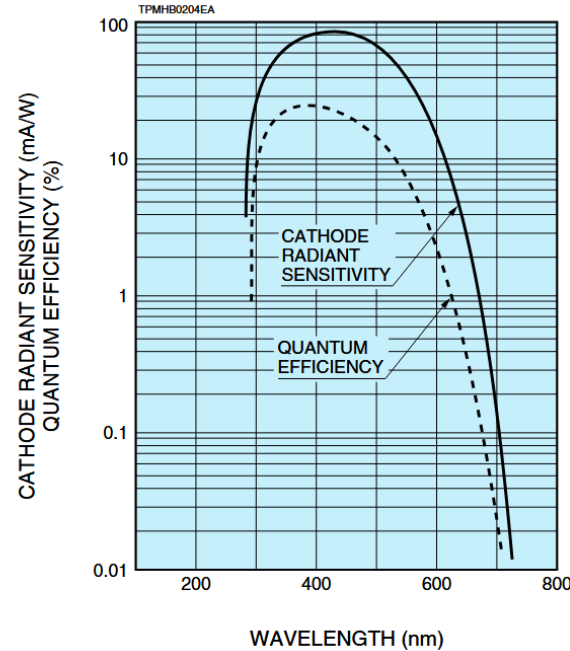
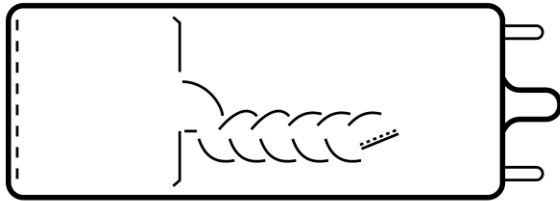
Courtesy of Maciej Lipiński.

Backup: WR-LEN & Compute Module



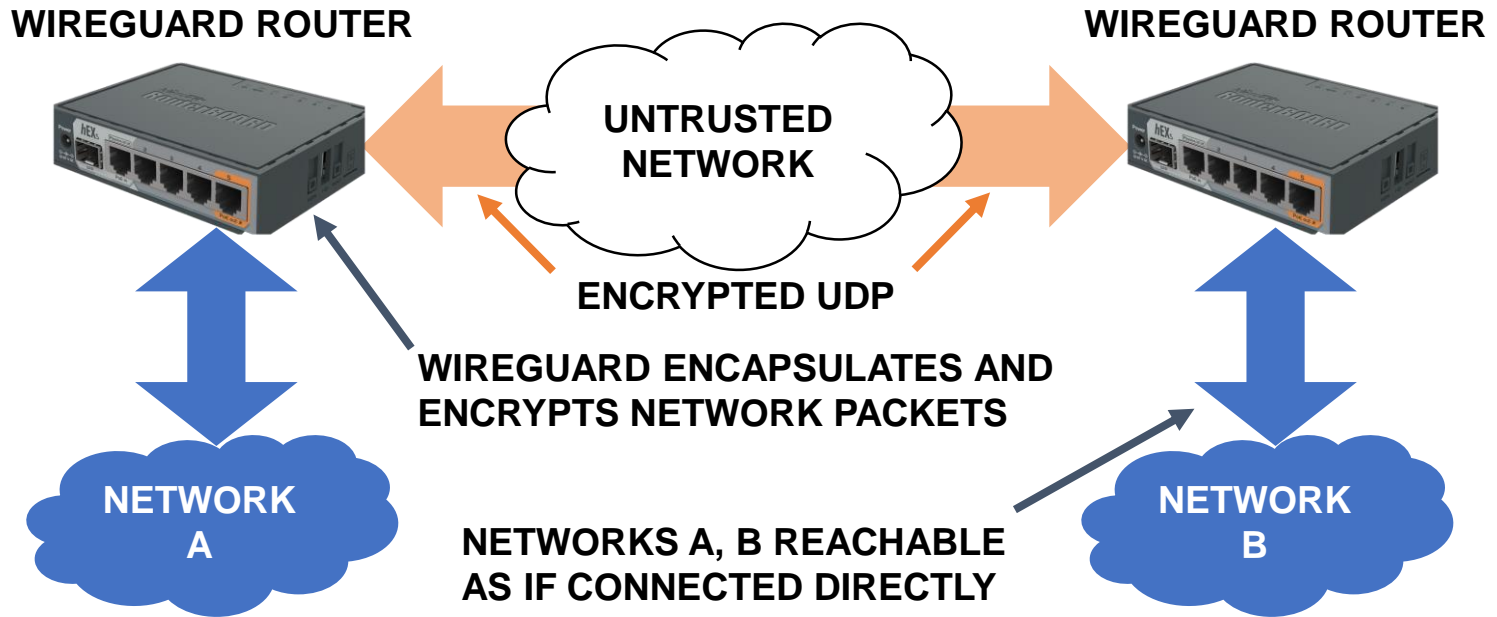
Backup: Hamamatsu PMTs

- Model: R6091
- Response: 300-650 nm
- Pulse rise: 2.6 ns
- Dynode: lin. focused



All units are mm. Courtesy of Hamamatsu photonics K.K.

Backup: WireGuard tunneling

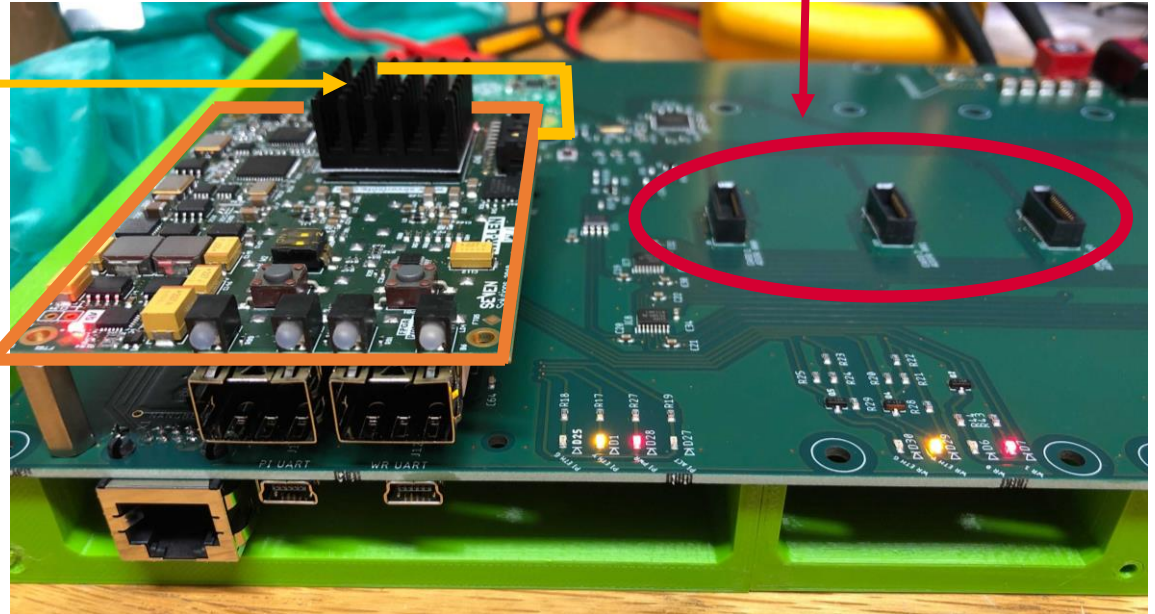


Backup: DAQ node, on-board devices

BANK PORTS (7x)

RASPBERRY PI CM 4

WHITE RABBIT LEN

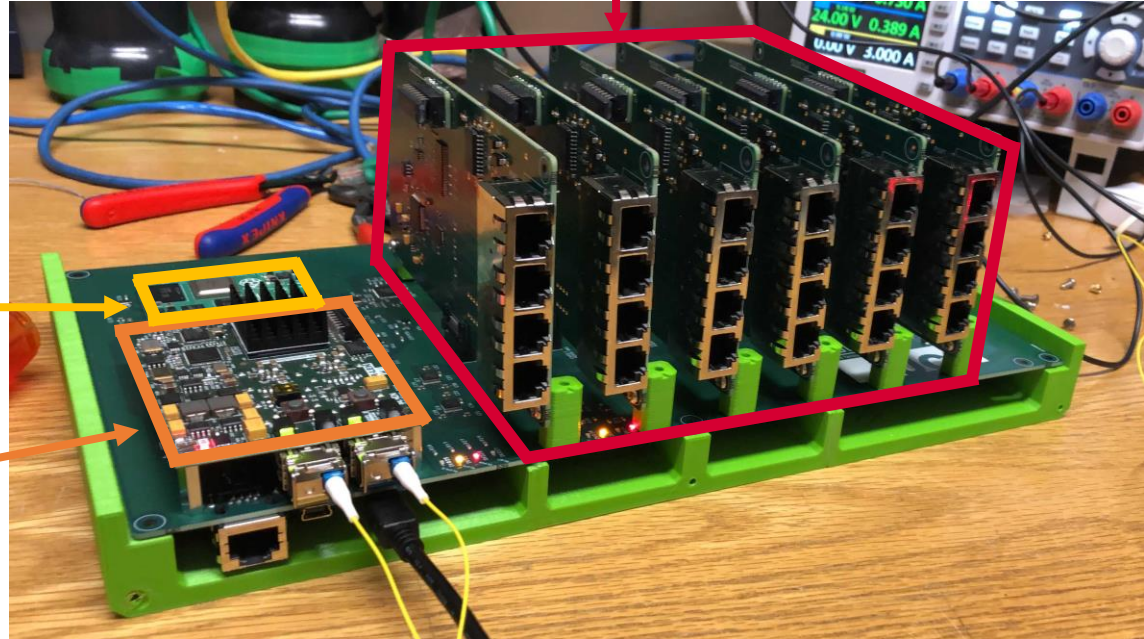


Backup: DAQ node without case

7 BANKS (4 PORTS EACH)

RASPBERRY PI CM 4

WHITE RABBIT LEN



Backup: DAQ node, a single bank

