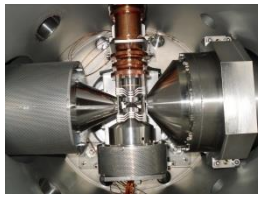
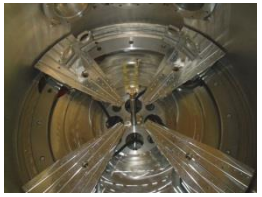



FASTER

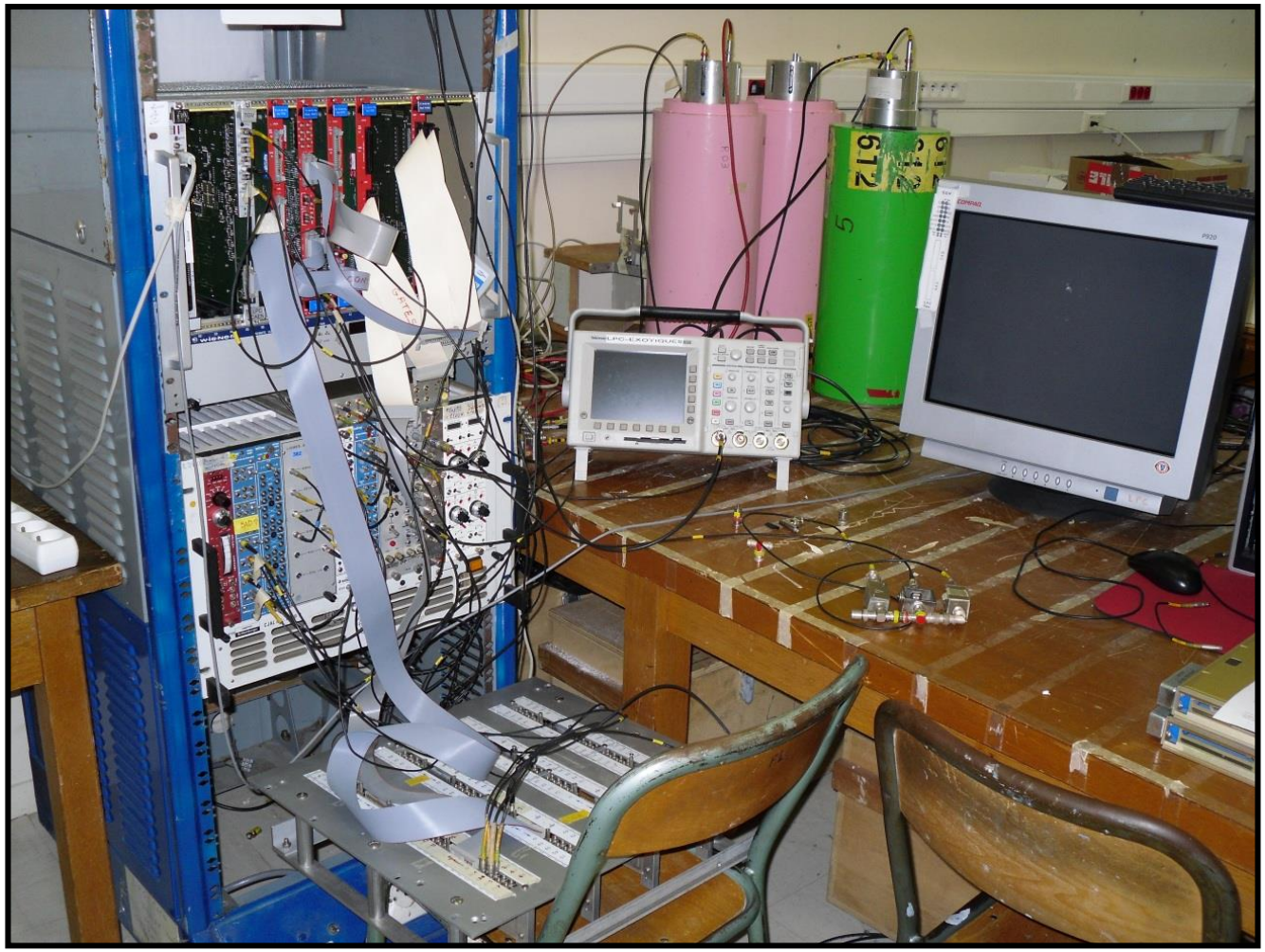
Fast **A**cquisition **S**ys**T**em for nucl**E**ar **R**esearch

A Triggerless ☺ or Multilevel Software Trigger system And much more …

Assemat Julian, **Carniol** Benjamin,
Chaventré Thiérry, **Cussol** Daniel,
Fontbonne Cathy, **Fontbonne** Jean-Marc,
Harang Julien, **Hommet** Jean, **Ingouf** François,
Langlois Jérome, **Poincheval** Jérome,

David Etasse

Abstract



Abstract

FASTER
A1 A2 A3 A4
Faster desktop module
FASTER
A1 A2 B1 B2 B3 B4
Faster desktop module
FASTER
A1 A2 B1 B2
Faster desktop module
FASTER
C1 C2 D1 D2
Faster desktop module

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1. OVERVIEW
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FASTER-V3

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3. DAUGHTER-BOARD
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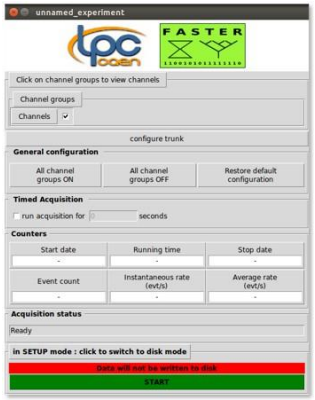
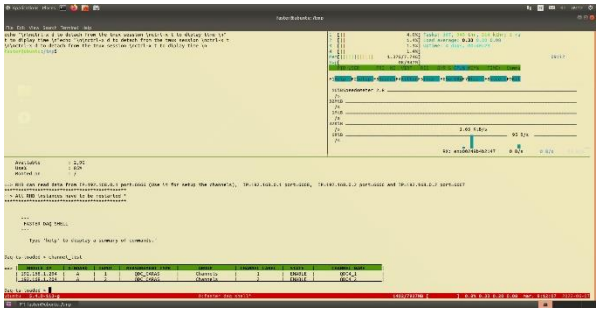
SUMMARY

Overview

Offline Analysis



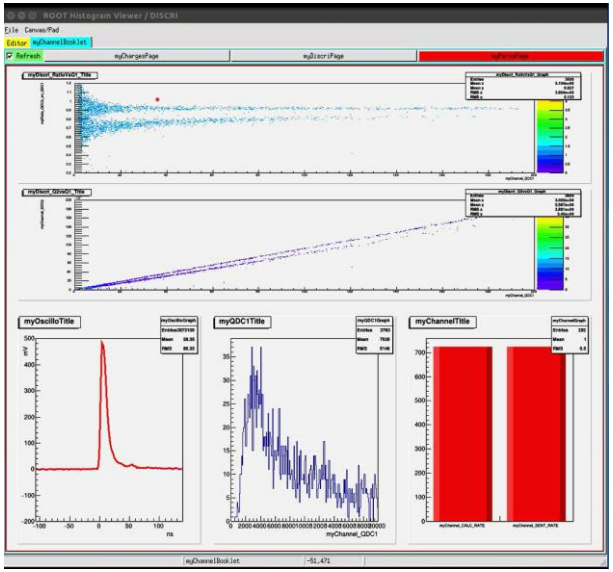


Ubuntu repository

Real Time Algorithms

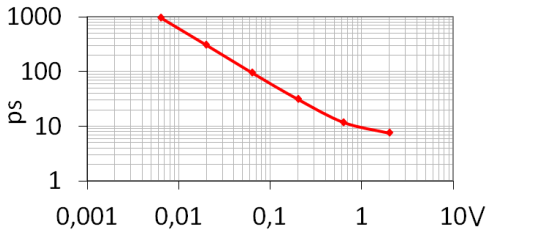
Modular Electronic

RHB



Based on Root

Real Time Algorithms



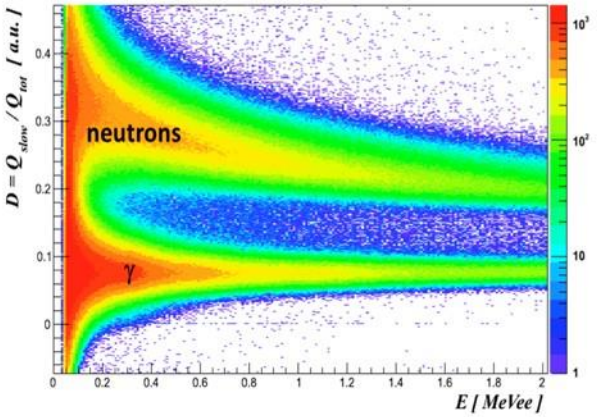
Time resolution VS signal amplitude

FASTER-CRRC4
FASTER-TRAPEZ-TDC

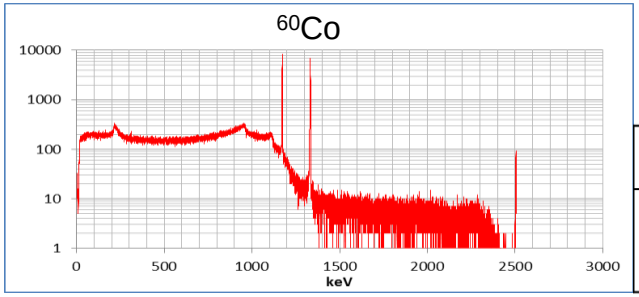
FASTER-QDC-TDC$_{HR}$
FASTER-QT2T
FASTER-RF
FASTER-SCALER
FASTER-SAMPLER

FASTER-ELECTROMETER

FASTER_HV



Demon detector, CARAS board,
FASTER-QDC-TDC$_{HR}$



pic keV	FWHM keV
1173,21	1,71
1332,48	1,90
2505,69	2,41

HPGe detector, MOSAHR board, FASTER_ADC

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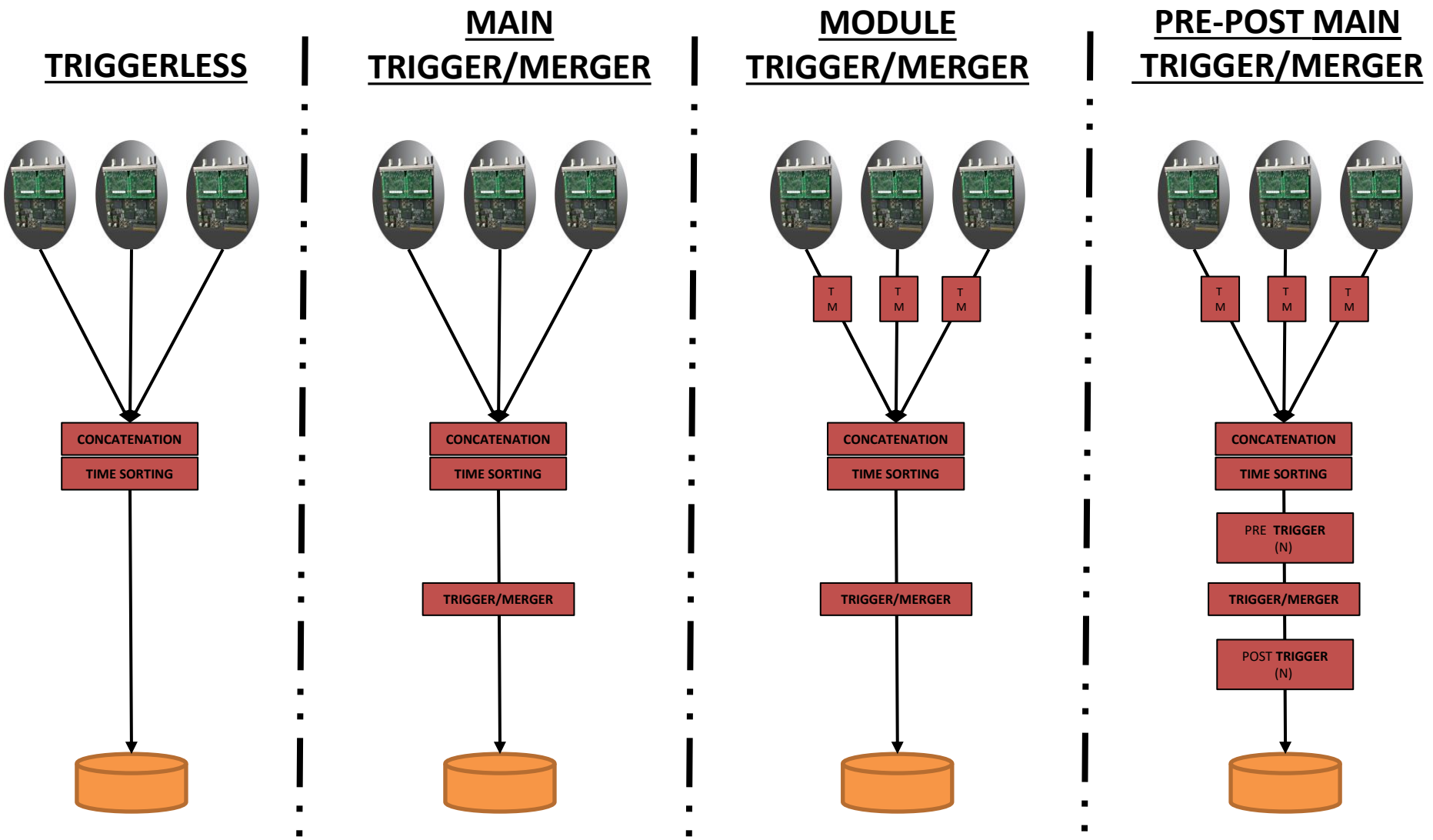
SUMMARY

Multilevel Software Trigger

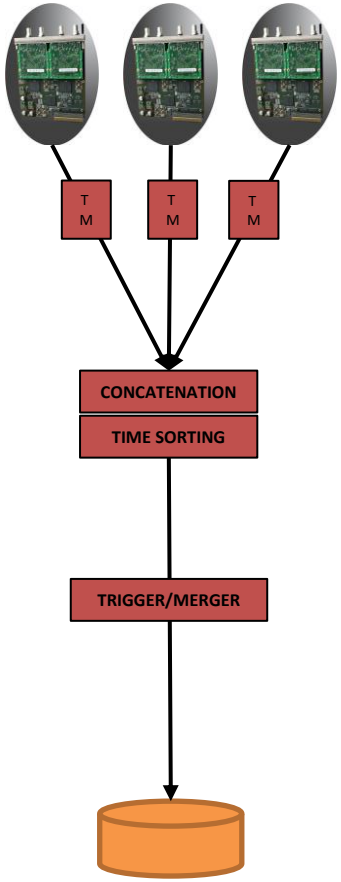


Multilevel Software Trigger

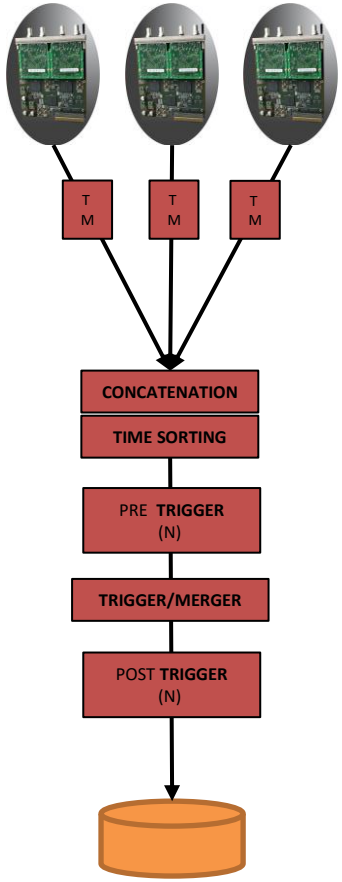
TRIGGERLESS

MAIN TRIGGER/MERGER

MODULE TRIGGER/MERGER

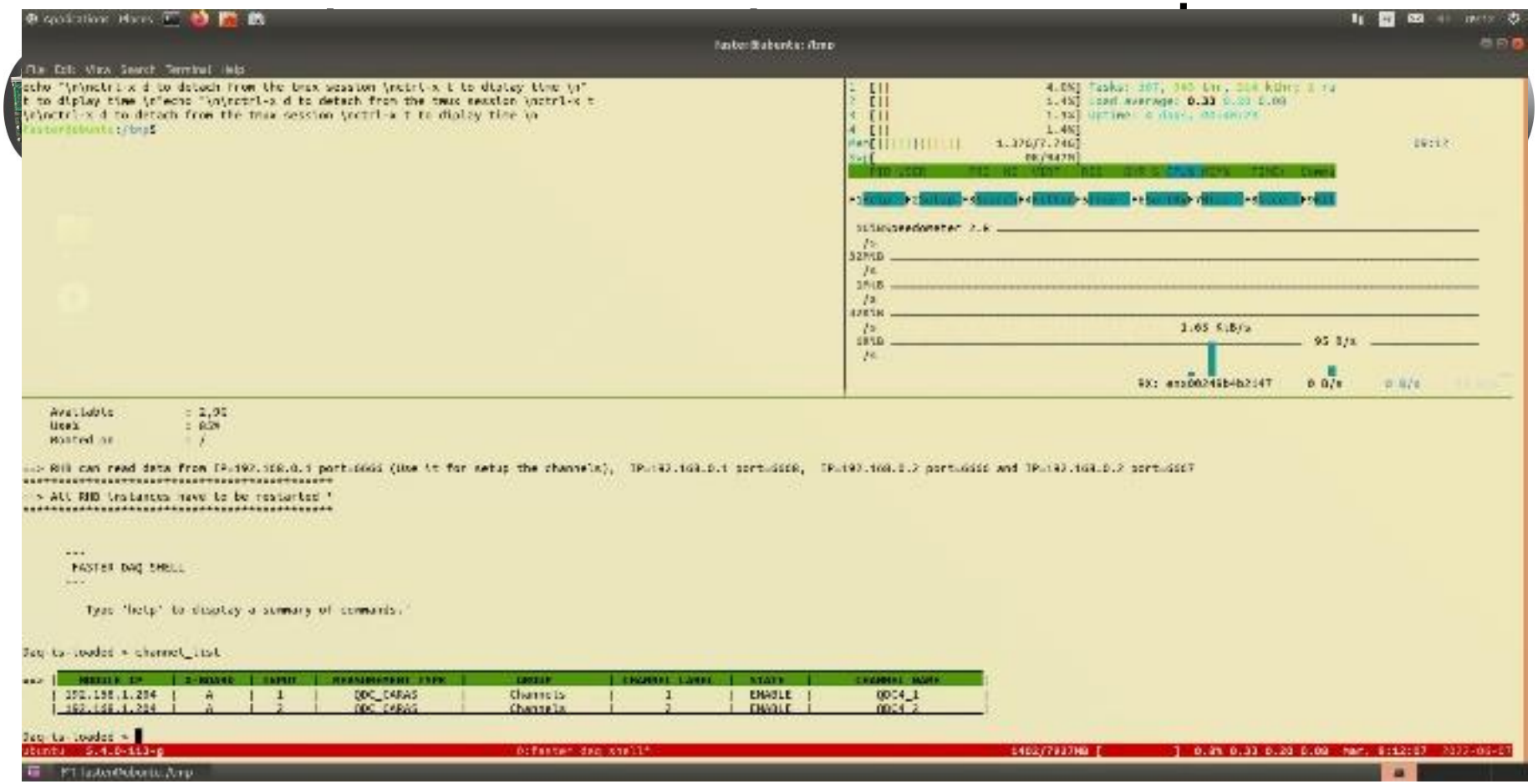


PRE-POST MAIN TRIGGER/MERGER



Multilevel Software Trigger

TRIGGERLESS | **MAIN TRIGGER/MERGER** | **MODULE TRIGGER/MERGER** | **PRE-POST MAIN TRIGGER/MERGER**



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SUMMARY

Commands Overview

QUICK START

General Setup

Install the 20.04 LTS or 22.04 LTS 64 bits Ubuntu distribution. …..
For more details, please visit this page (http://faster.in2p3.fr/index.php/first-steps) Here are the most common commands used to setup your computer :

- **sudo apt-add-repository 'Name of the repository',**
- **sudo apt-get update,**
- **sudo apt-get install Name-of-the-package,**
- **sudo do-release-upgrade –d,**
- **lsb_release -a.**

FASTER Setup

Define a new directory, and use the faster_setup_gui command to define a new FASTER configuration. …..
For more details, please visit this page (http://faster.in2p3.fr/index.php/first-steps-with-faster).
Here are the most common commands for the DAQ :

- **faster_the_mothers,**
- **faster_setup_gui,**
- **faster_gui, faster_daq_shell, faster_hardware_shell**
- **faster_sycoco_reprog,**
- **faster_disfast.**

Analysis Setup

Install the FASTER analysis package.

- On Ubuntu -> sudo apt_get install fasterac
- Other OS -> http://faster.in2p3.fr/index.php/download/category/2-software

For more information, Read the README file in each fasterac example directory.
……
Here are the most common commands :

- **fasterac_example_copy, fasterac_reader_code**

Network Setup

The IPV4 settings must be :

- Connection name : FASTER_eth0
- Address : 192.168.0.1
- Netmask : 255.255.0.0
- Gateway : 0.0.0.0

Here are the most common commands used to scan or check the network :

- **ifconfig,**
- **ping,**
- **faster_ping,**
- **faster_the_mothers,**
- **faster_the_nodes.**

RHB Setup

RHB is our Root Histogram Builder. Do not install a root package by your own, the installation of the rhb package is automatically followed by the installation of a root package. ……..
For more details, please visit this page (http://faster.in2p3.fr/index.php/first-steps-with-rhb)
Here are the most common commands for RHB sofware :

- **faster_rhb_demo_qdc_copy,**
  faster_rhb_demo_crrc4_spectro_copy,
- **faster_rhb_demo_dlmcp_copy,**
  faster_rhb_demo_sampler_copy,
- **faster_rhb_demo_electro_copy,**
  faster_rhb_demo_scaler_copy
- **faster_rhb_demo_dosion_copy**
- **RHB –r,**
- **faster_file_to_rhb.**

Commands Overview

fasterac_reader_code

This program generates a reader example code for a given faster data file.

usage :

> **fasterac_reader_code** my_faster_file.fast my_code

-> generates **my_code.c** and **my_code.make**

> make –f my_code.make

> ./my_code my_faster_file.fast

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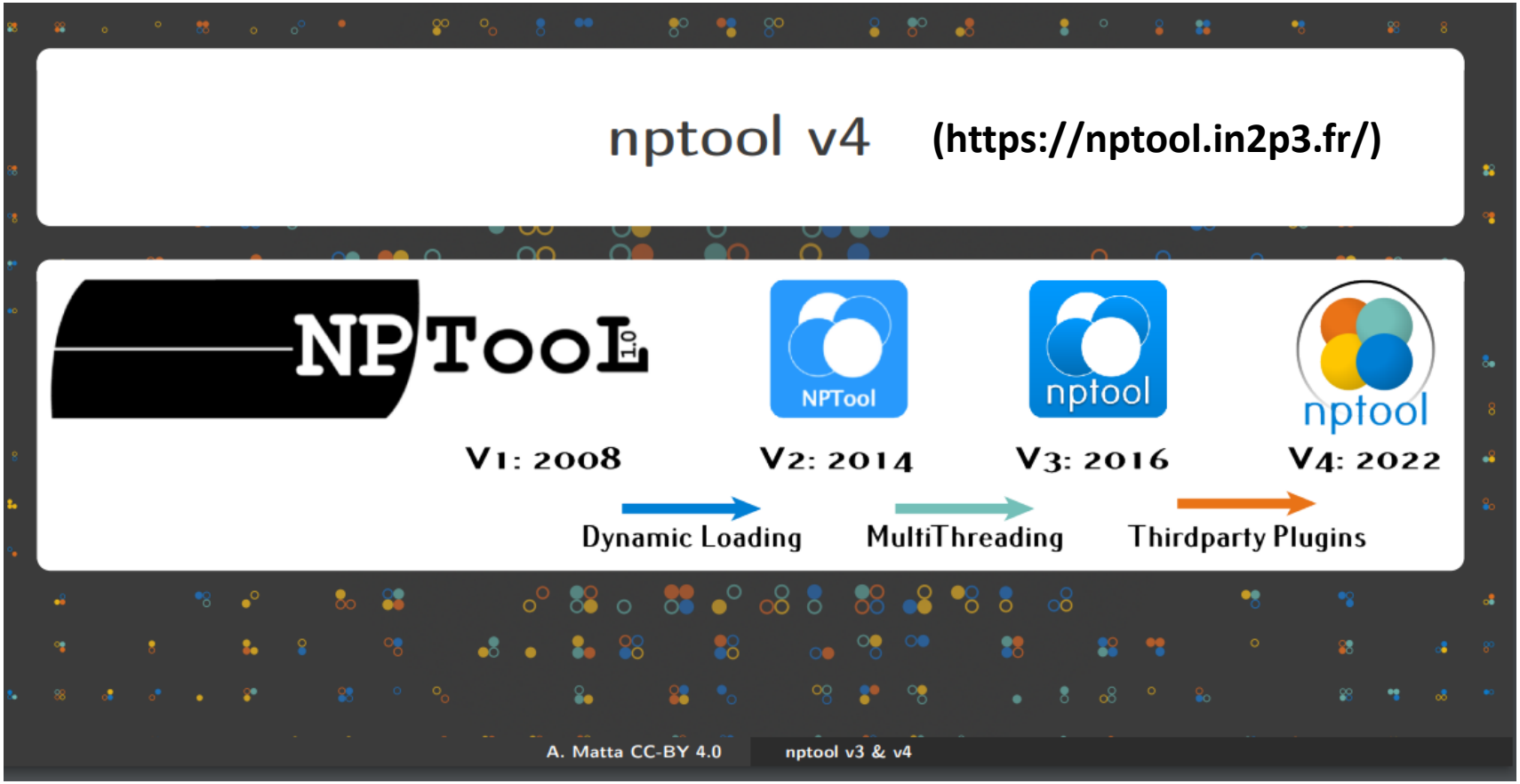
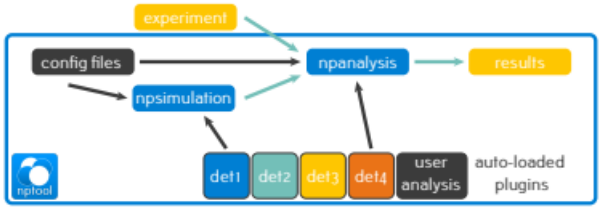
NPTooL Overview



NPTooL Overview

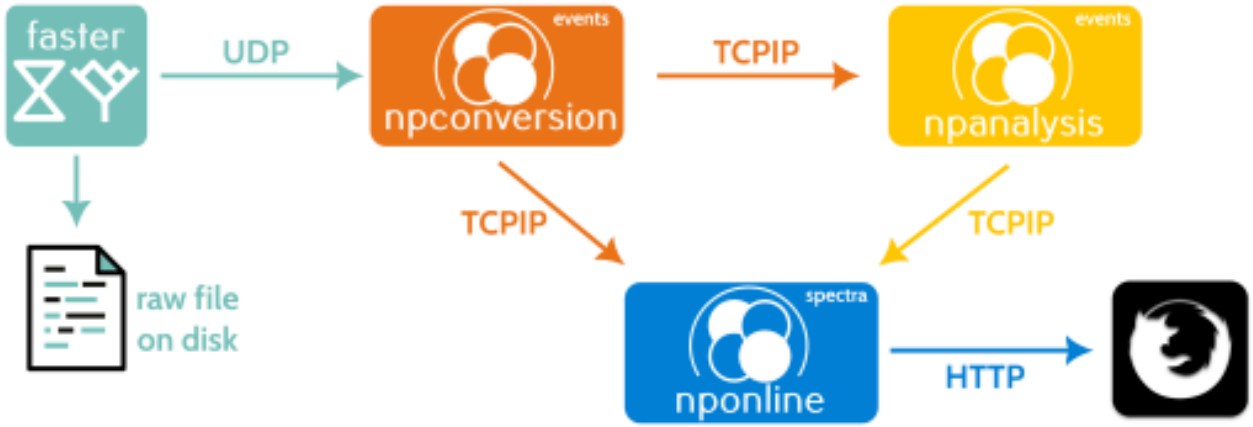
Key Concept: **Analysis & Simulation modular framework** for low energy nuclear physics

- Repository:
  - → gitlab.in2p3.fr/nptool/nptool
- Website:
  - → nptool.in2p3.fr
- Open source, open collaboration
  - → everybody is welcome!
- Support
  - → matta@lpccaen.in2p3.fr
- User base:
  - → V3(2008-now) ∼ 100 users
  - → V4(2022-now) ∼ 20 users



- Readable ASCII config files (YAML)
  - No recompilation needed
  - Input file recorded within output
- Modular design w/ plugins
  - Third party plugins: Control your own repo!
  - Input/Output (faster, root, mfm, ...)
  - Detectors (NebulaPlus, Exogam, ...)
  - Simulation (by end of year)
  - Tool box via plugins: Tracking, Nuclear data, ...
- Projects:
  - One directory, all of your files
  - Custom analysis (online/offline)
  - Custom plugins (duplicates)
  - Custom simulation
- Workflow management example:
  - Snakemake
  - DVC

First transcontinental online analysis with nptool v4



Real time monitoring of the new Nebula-Plus array has been performed remotely between France and Japan for the first time using the new nptool v4 framework in conjonction with the faster, root and nebula-plus plugin.

This validate the version 4 architecture and demonstrate its real world capabilities ahead of several campaign at RIKEN, GANIL and LANL later this year.

This team effort include contribution from various laboratory : LPC Caen, CEA DAM and IJCLab.

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Summary

FASTERv2 is currently used in

- **FRANCE** : Paris-Sud University, Caen University, CIMAP, IPHC, CEA Saclay, CEA Bruyères, IJCLAB, SUBATECH, GANIL, LP2i, LPC-Caen,
- **ROMANIA** : INFN-HH
- **SPAIN** : Granada University,
- **SWITZERLAND** : PSI, CERN (Isolde),
- **USA** : CENPA , GONZANA University, MSU, LOS ALAMOS
- **RUSSIA** : JNIR
- **JAPAN** : RICKEN
- **UZBEKISTAN**
- **CHINA**

FASTERv2 in few numbers

- 120 Systems used (~500 AMC Modules, ~80 MCHs, ~40 Standalone modules),
- 2 ,5 M€,
- 3.5 FTE,
- 21 Laboratories , 3 Universities

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FASTERv3 Overview

FASTER-V3

A New real time, multi-protocol concentrator and/or digital acquisition platform

Same real time FPGA algorithms as FASTER-V2

+

User algorithms

+

News digitizers (16bits@125 Msps-> 10bits@5 Gsps)

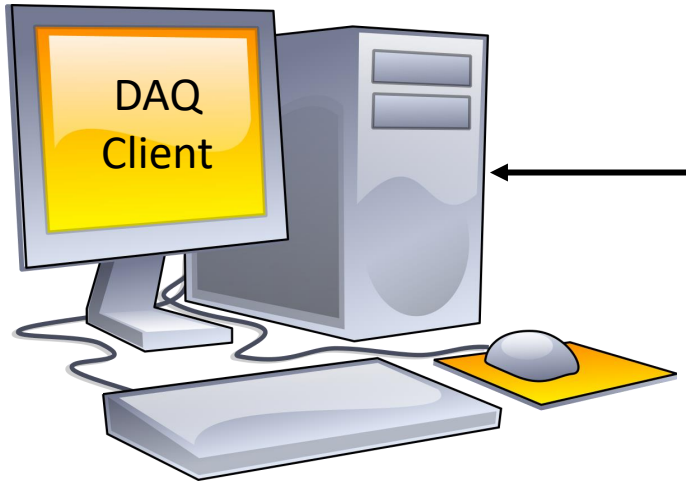
+

1588 V2.1 and SyncE (WhiteRabbit)

+

Epics compatible

FASTERv3 Overview



FASTERv2

1 Gbe

DAQ
Server
(FPGAs)

FASTERv3

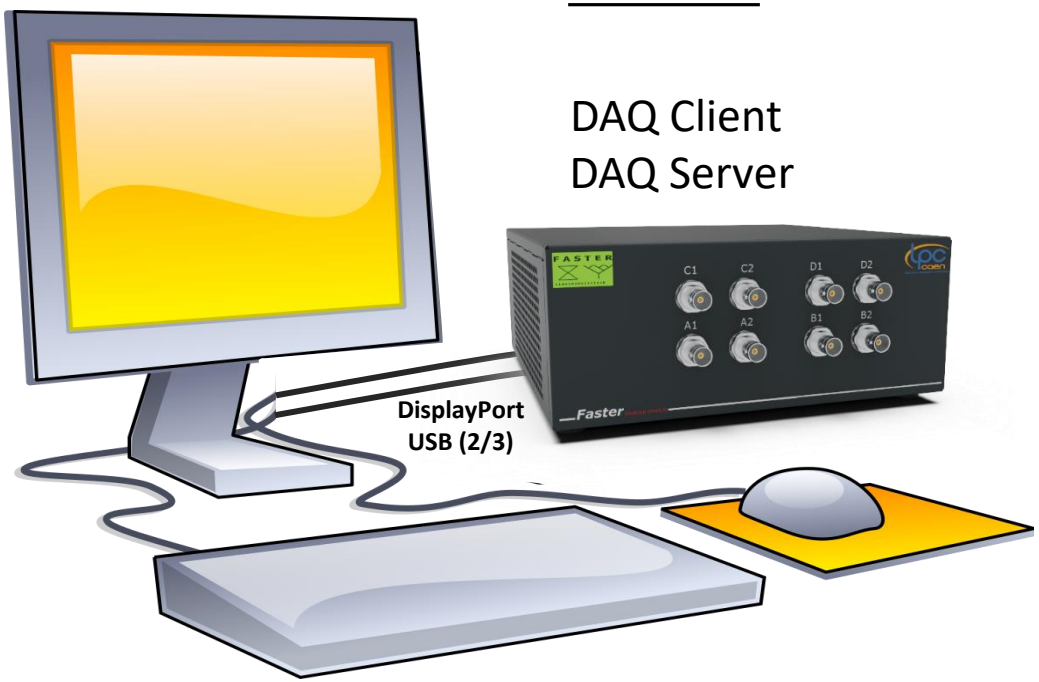
10 Gbe

DAQ
Server
(CPU and FPGA)

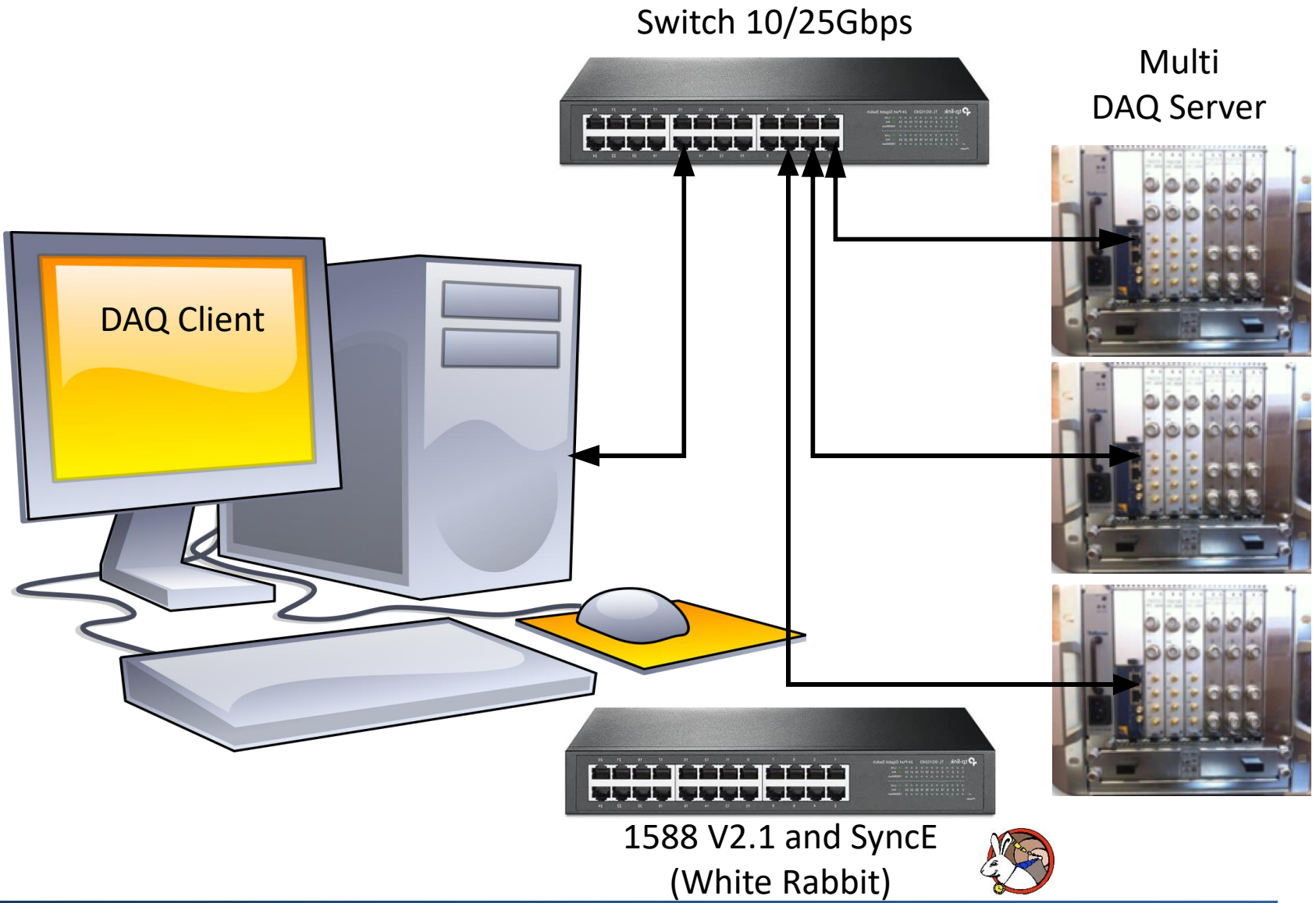
FASTERv3 Overview

FASTERv3

DAQ Client
DAQ Server



FASTERv3 Overview



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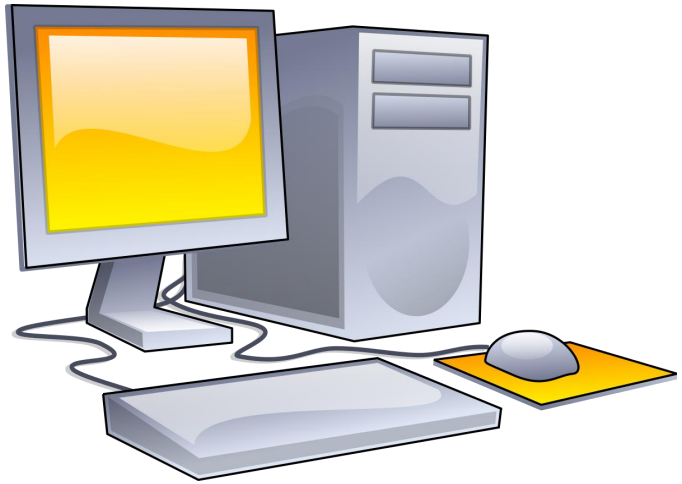
FASTERv3 Mother-Board



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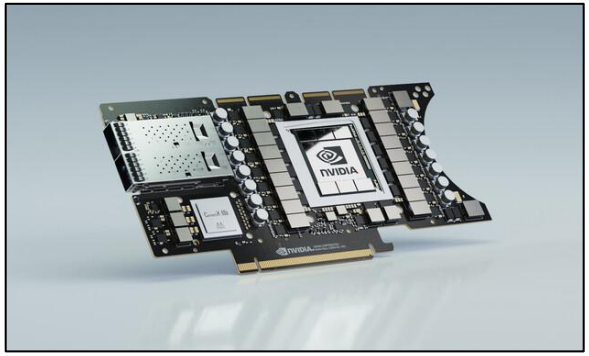
Software Environnement
- Ubuntu 22.04
- Cuda 10
- PyTorch
- TensorFlow
- TensorRT
- C/C++

+



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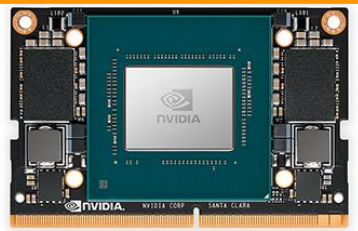
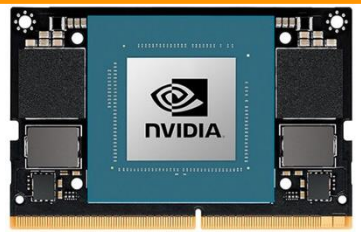
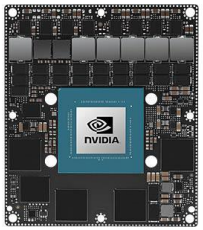
FASTERv3 Mother-Board

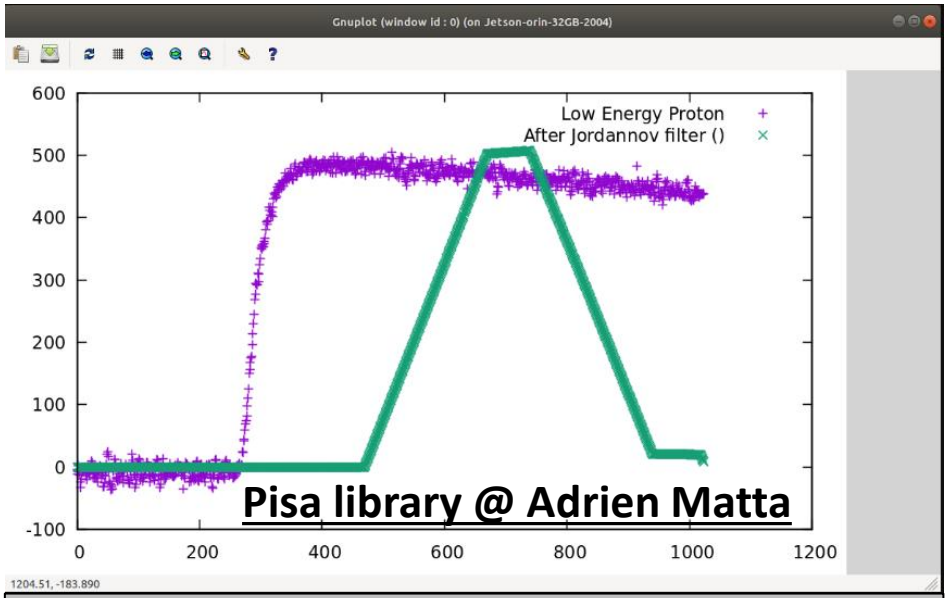



	Jetson TX2 NX 4GB 2017	Jetson Xavier NX 16GB 2020	Jetson Orin NX 16GB 2023
AI Performance	5 TOPS	21 TOPS	100 TOPS
GPU	256-core NVIDIA Pascal Architecture	384-core NVIDIA Volta Architecture	1024-core NVIDIA Ampere Architecture
GPU		48 Tensor Cores	32 Tensor Cores
CPU	2-core NVIDIA Denver 4-core Arm® Cortex®-A57	6-core NVIDIA Carmel ARM	8-core Arm® Cortex®-A78AE
Memory	4 GB 128-bits LPDDR4, 1600 MHz - 51.2 GBs	16 GB 128-bits LPDDR4x 59.7GB/s	16 GB 128-bits LPDDR5 102.4GB/s
PCIe	PCIe 1 x2 + 1 x1 (Gen2), Root Port Only	1 x1 (PCIe Gen3) + 1 x4 (PCIe Gen4), (Root Port, & Endpoint)	1 x4 + 3 x1 (PCIe Gen4, Root Port, & Endpoint)
Power	7.5 W - 15 W	10 W | 15 W | 20 W	10 W – 25 W
Cost (HT)	188 €	549 €	651 €

FASTERv3 Hardware



	Jetson Orin AGX 32GB
AI Performance	200 TOPS
GPU	2048-core@1.3GHz NVIDIA Ampere Architecture 16 MP, 128 CUDA Cores/MP Max number of threads per MP: 1536 1536 * 16 = 24 576
GPU	56 Tensor Cores
CPU	12-core Arm® Cortex®-A78AE 2.2GHz
Memory	32GB 256-bit LPDDR5 204.8GB/s
PCIe	2 x8 + 1 x4 + 2 x1 (PCIe Gen4, Root Port, & Endpoint)
Power	10W – 40W
Cost (HT)	1238 €

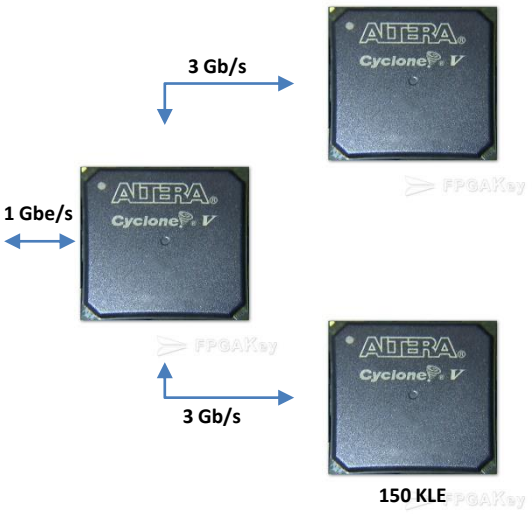


100 000 Frames of 1024 samples
In double precision → 819 MB
Processing a BLR, Moving Average
And Jordanov filter
On jetson Orin AGX 32 GB

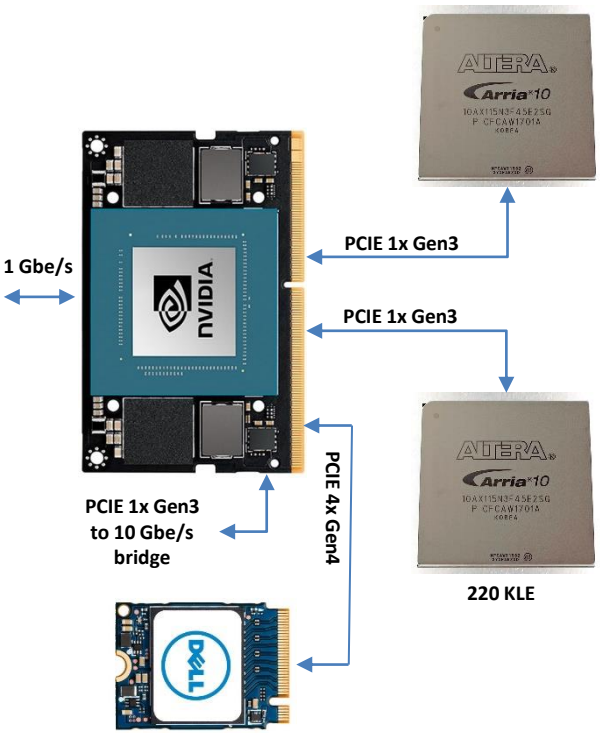
	12 CPUs	GPU (Shared memory)	GPU (Dedicated memory)
CPP	1330 ms		
C	400 ms (50us)	330 ms	300 us (75 us)

FASTERv3 Mother-Board

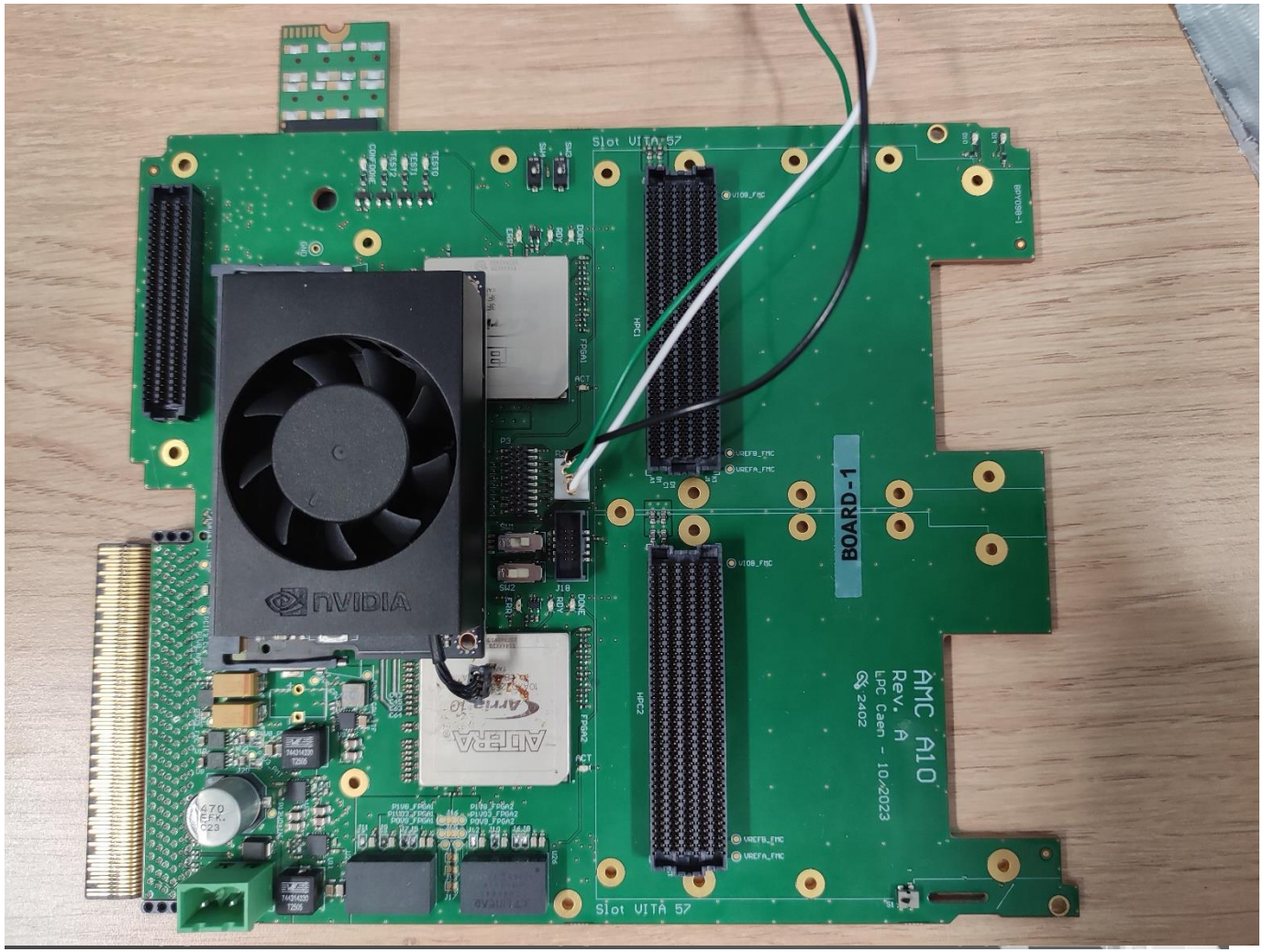
FASTERV2



FASTERV3-0

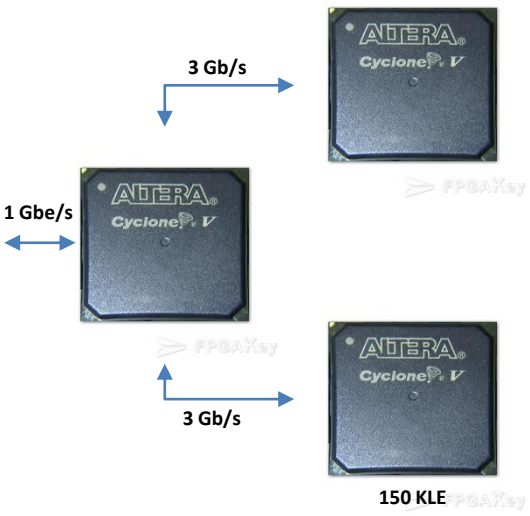


FASTERv3 Mother-Board

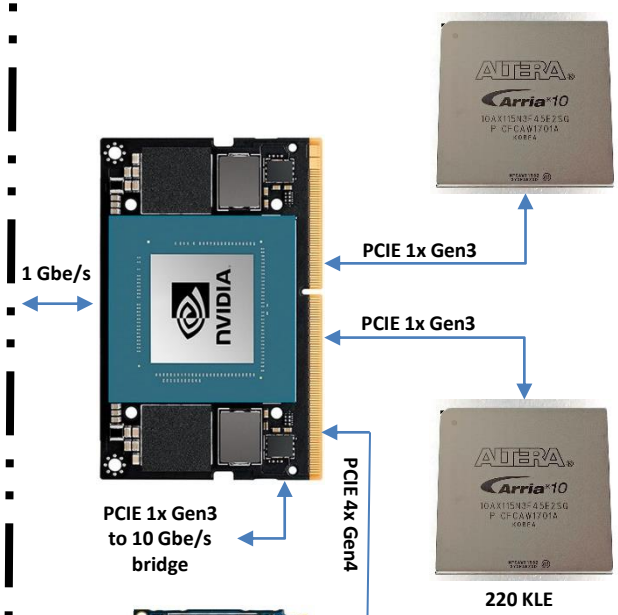


FASTERv3 Mother-Board

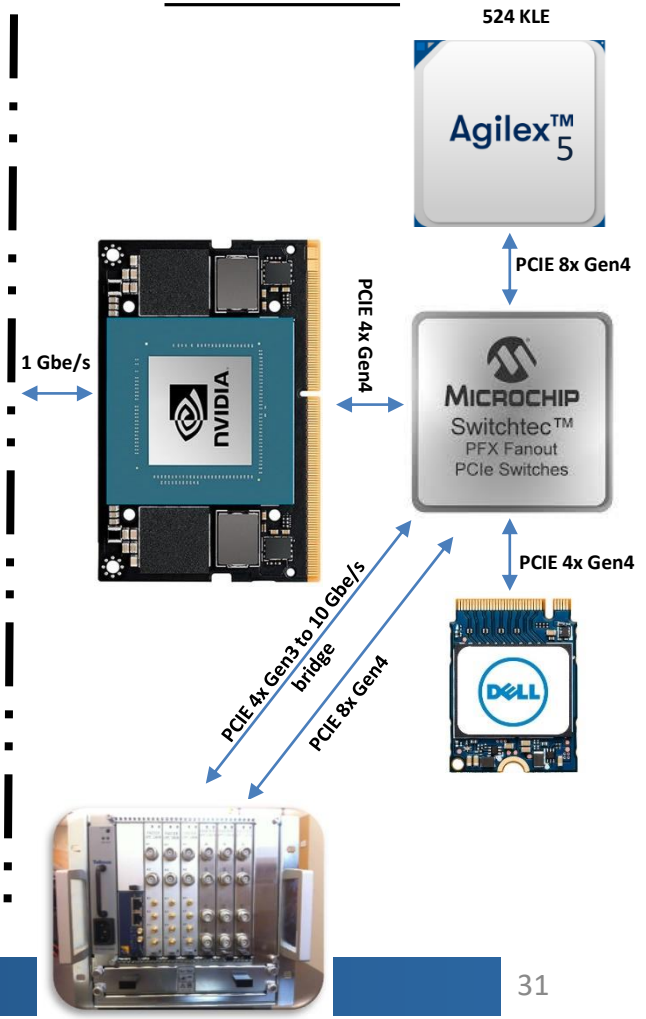
FASTERV2



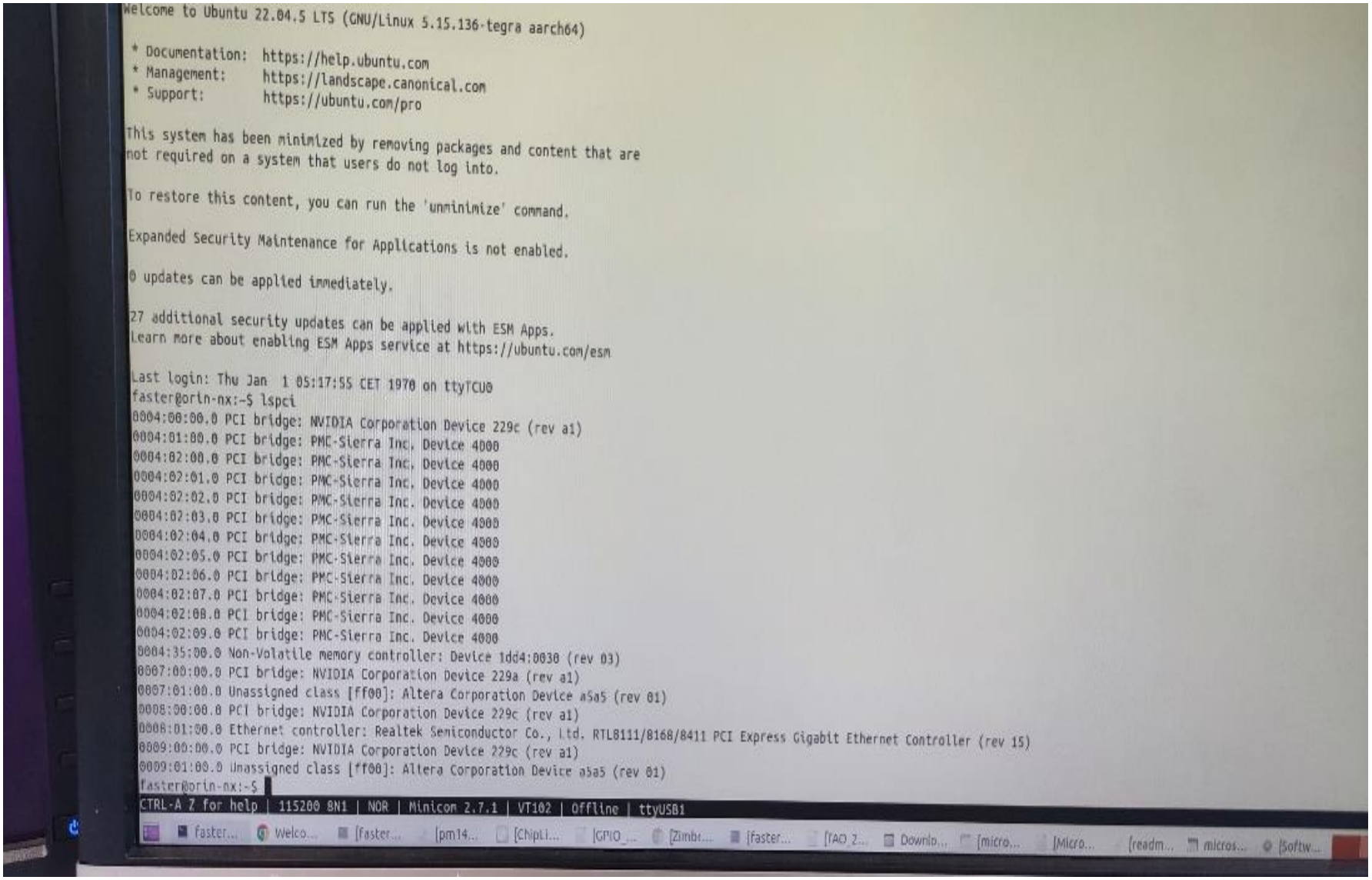
FASTERV3-0



FASTERV3-1



FASTERv3 Mother-Board



Agenda

FASTER-V2

1. OVERVIEW
2. REAL TIME ALGORITHMS
3. MULTILEVEL SOFTWARE TRIGGER
4. COMMANDS OVERVIEW
5. NPTooL OVERVIEW
6. SUMMARY

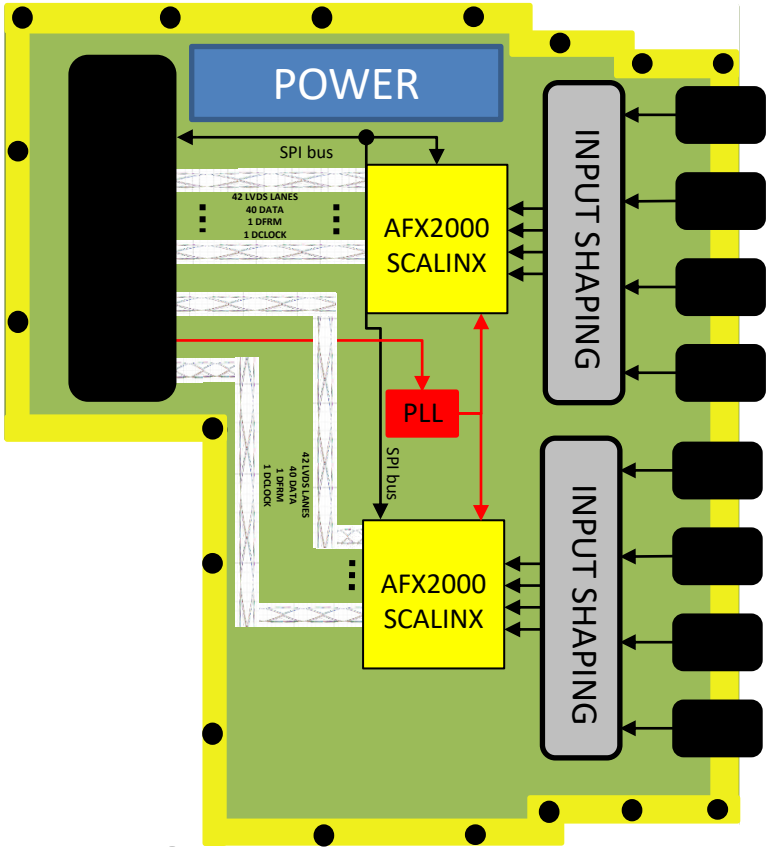
FASTER-V3

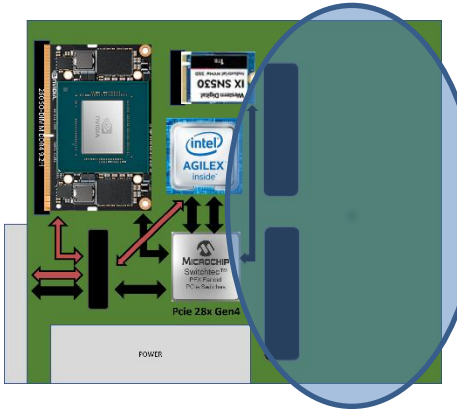
1. OVERVIEW
2. MOTHER-BOARD
3. DAUGHTER-BOARD
4. EPICS FRAMEWORK

SUMMARY

FASTERv3 Daughter-Board

AFX2000
Quad Analog Front-End with 5GSPS ADC
Resolution up to 16-bit and BW up to 300MHz

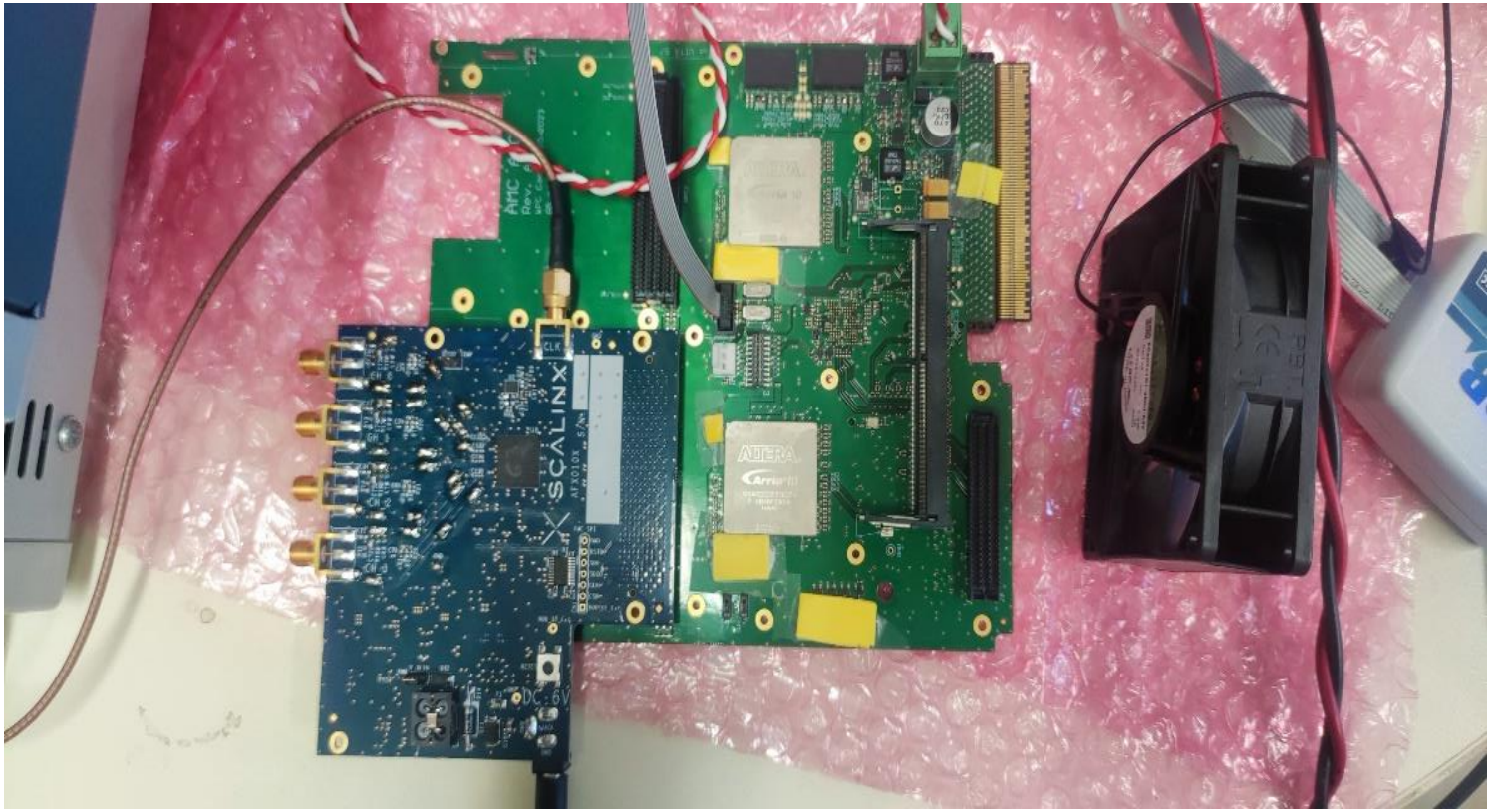




- 2 FADC (500Msps@12bits)
- ±1V input range
- ±1V input adjustable Offset
- 100 MHz Bandwidth

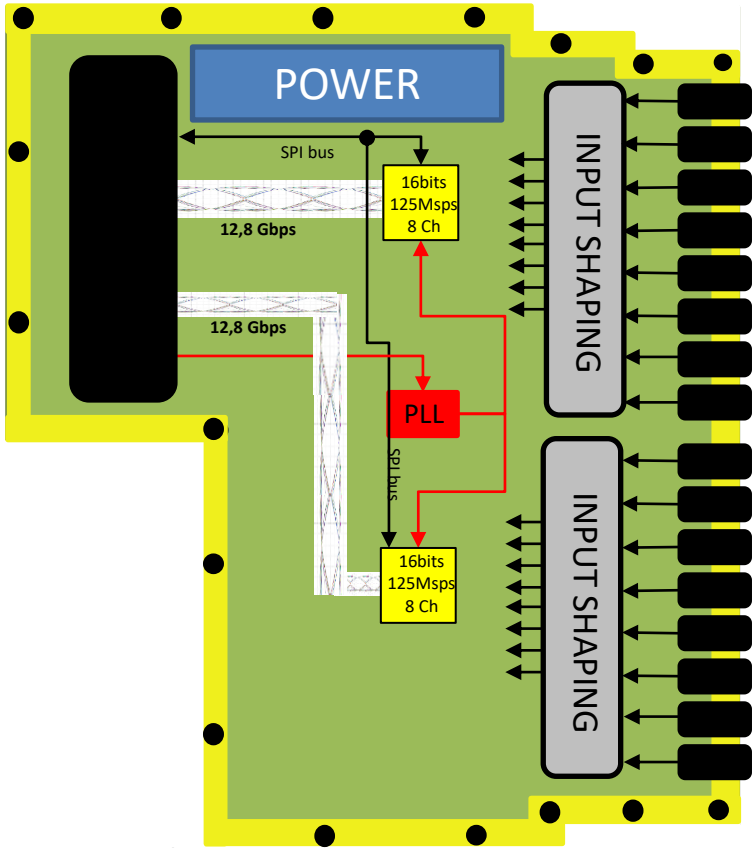
- 8 FADC@16bits
- 625 Msps → 5 Gsps
- 2V input range
- 300 MHz Bandwidth

FASTERv3 Daughter-Board



FASTERv3 Daughter-Board

- 4 FADC (125Msps@14bits)
- ±1V, ±2V, ±5V, ±10V input range
- 25 MHz Bandwidth



- 16 FADC (125Msps@16bits)
- ±1V, ±2V, ±5V, ±10V input range
- 25 MHz Bandwidth

Agenda

FASTER-V2

1. OVERVIEW
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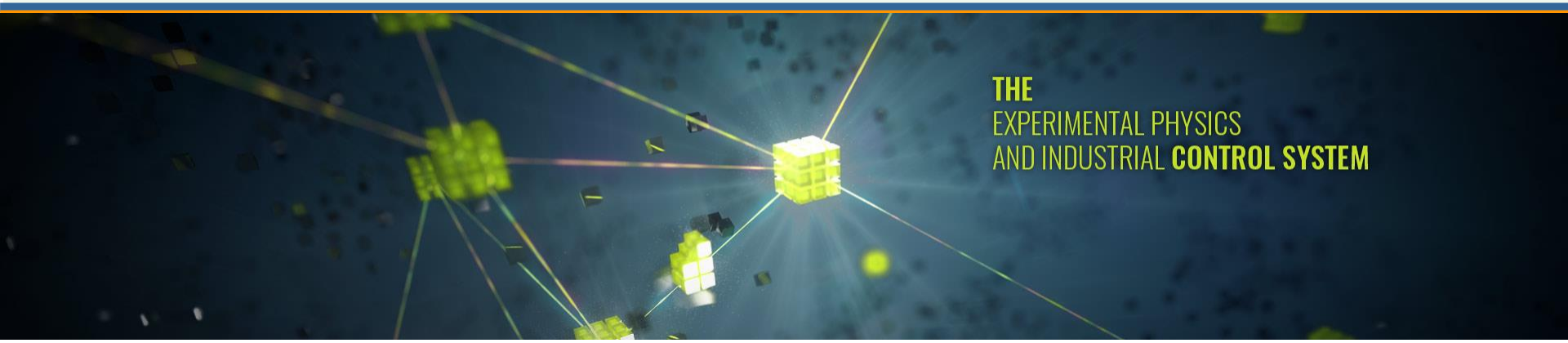
6. SUMMARY

FASTER-V3

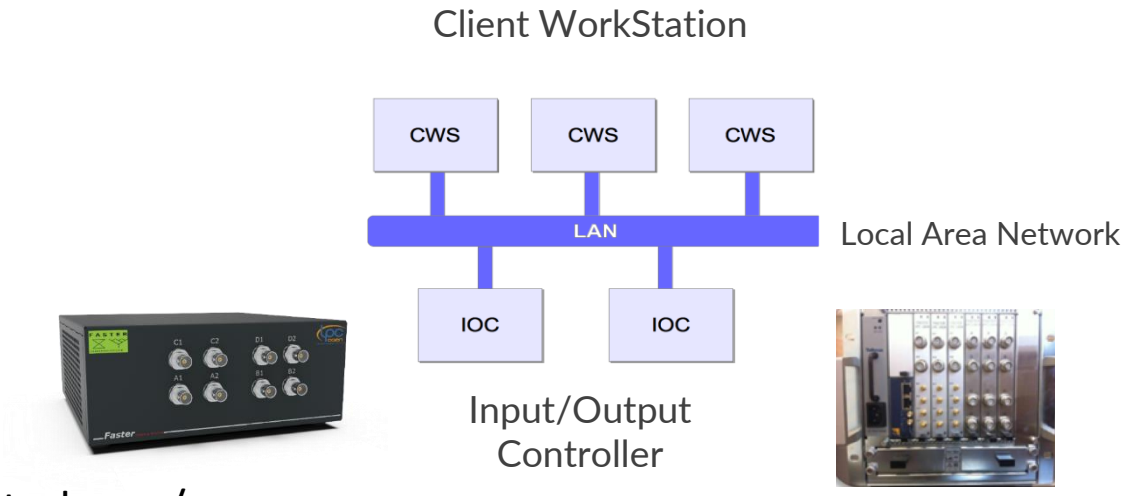
1. OVERVIEW
2. MOTHER-BOARD
3. DAUGHTER-BOARD
4. EPICS FRAMEWORK

SUMMARY

Epics Framework



A simple EPICS control system can be composed of one or more IOCs and Client WorkStations that communicate over a LAN



https://epics-controls.org/

FASTERv3 Overview

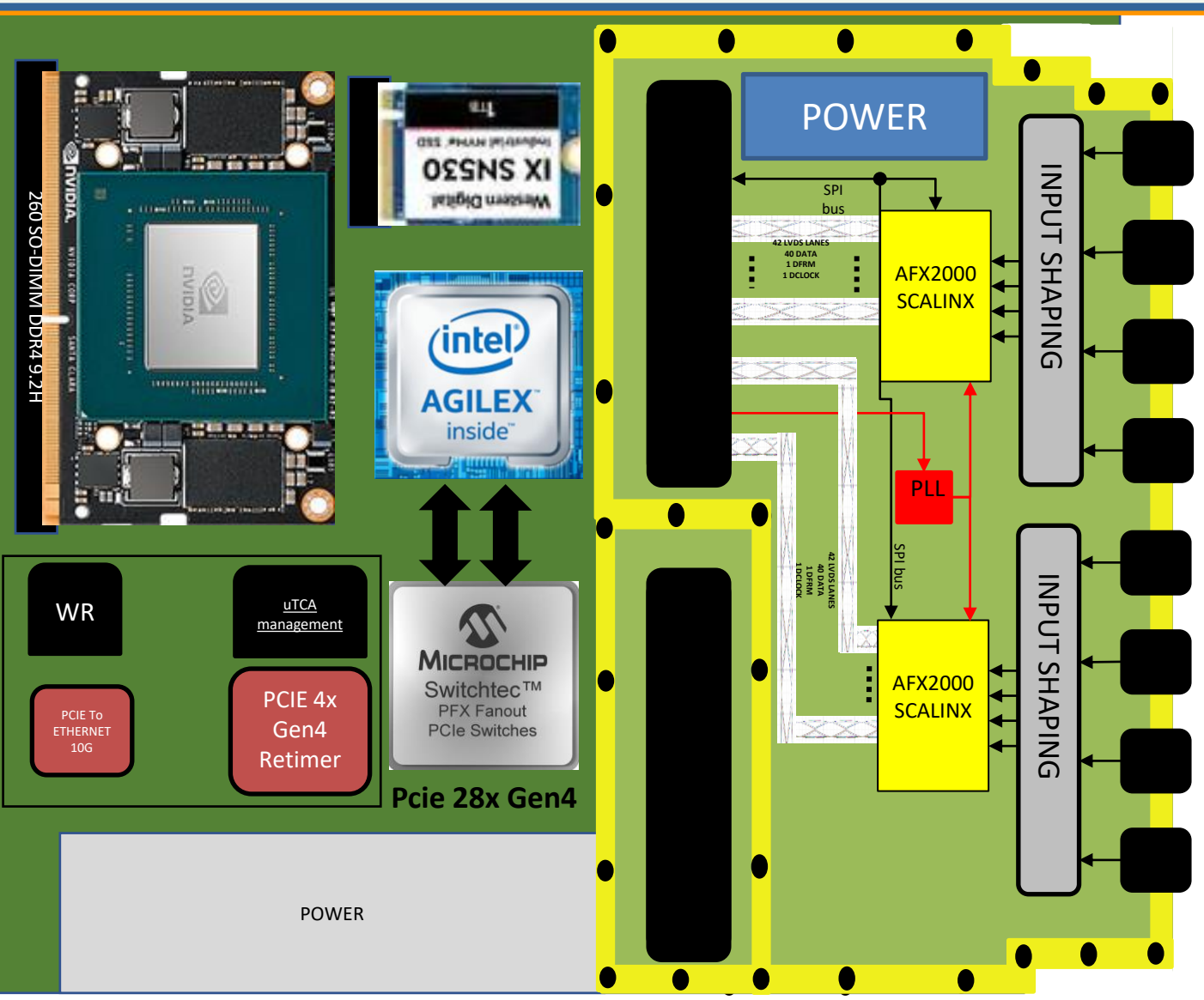
- Increase number of channels per board,
- Decrease Cost per channel,
- Use as a data concentrator
- Increase flexibility,
- Computer with Ubuntu LTS 64 bits or Docker Container ,
- C, C++, Python and Cuda
- NPTooL and EPICS
- First release in 2025-2026.

Agenda

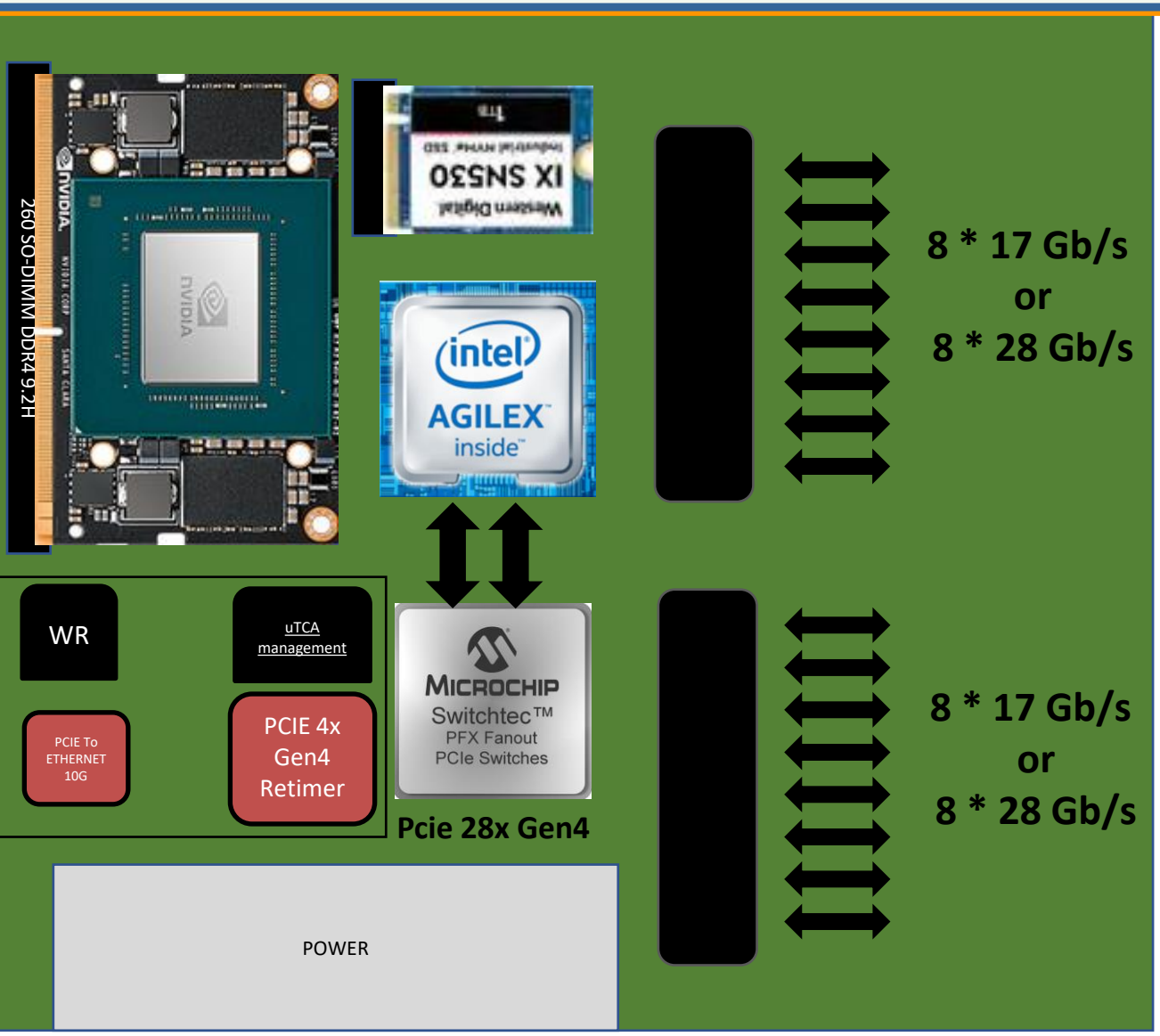
Thank you for Your Attention

FASTERv3 Module

- 8 CPU 2,2Ghz
- 1024 Cores GPU 918 MHz
- 16 GB RAM
- 2 TB SSD PCIE 4x Gen4
- ~600 KLe Agilex 5
- 16 Channels 625 Msps/16bits
  or
- 16 Channels 1.25 Gsps/10bits
  or
- 8 Channels 2,5Gsps/10bits
  or
- 4 Channels 5 Gsps/10 bits
  or
- 8 at 1Gsps, 4 at 2,5Gsps, 1 at 5Gsps
- Internal connection PCIe Gen4
- External connection
  - 10 Gb/s Ethernet
  - PCIe 8x Gen4
    or
  - 40Gb/s Ethernet
- WhiteRabbit compatible
- Epics compatible
- Ubuntu 22.04 LTS



FASTERv3 Module

- 4 CPU 2,2Ghz
- 512 Cores GPU 625 MHz
- 4 GB RAM
- 2 TB Nvme 4x Gen4
- ~600 KLe Agilex 5
- 2 * 8 * 17 Gb/s (default)
  or
- 2 * 8 * 28 Gb/s

- Internal connection
  PCIe Gen4
- External connection
  - 10 Gb/s Ethernet
  - PCIe 8x Gen4 128Gb/s
    or
  - 40Gb/s Ethernet
- WhiteRabbit compatible
- Epics compatible
- Ubuntu 22.04 LTS