AIDA-2020

Advanced European Infrastructures for Detectors at Accelerators

Presentation

Pyrame3, an online framework for Calice SiW Ecal

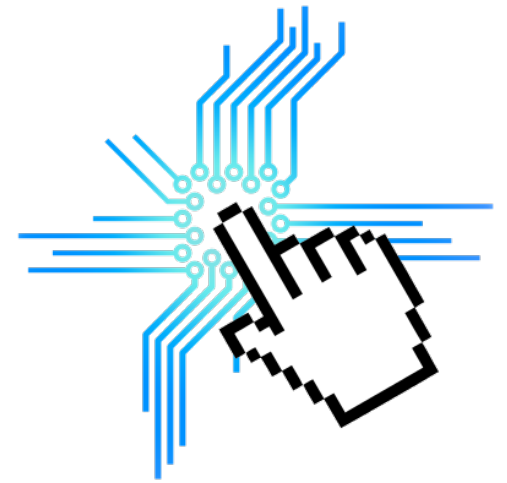Magniette, Frederic (CNRS-LLR)

05 October 2017

This work is part of AIDA-2020 Work Package **14: Infrastructure for advanced calorimeters**.

Pyrame 3

an online framework for Calice SiW-Ecal

Frédéric Magniette on behalf of the Calice collaboration

CHEF Oct. 2017, Lyon
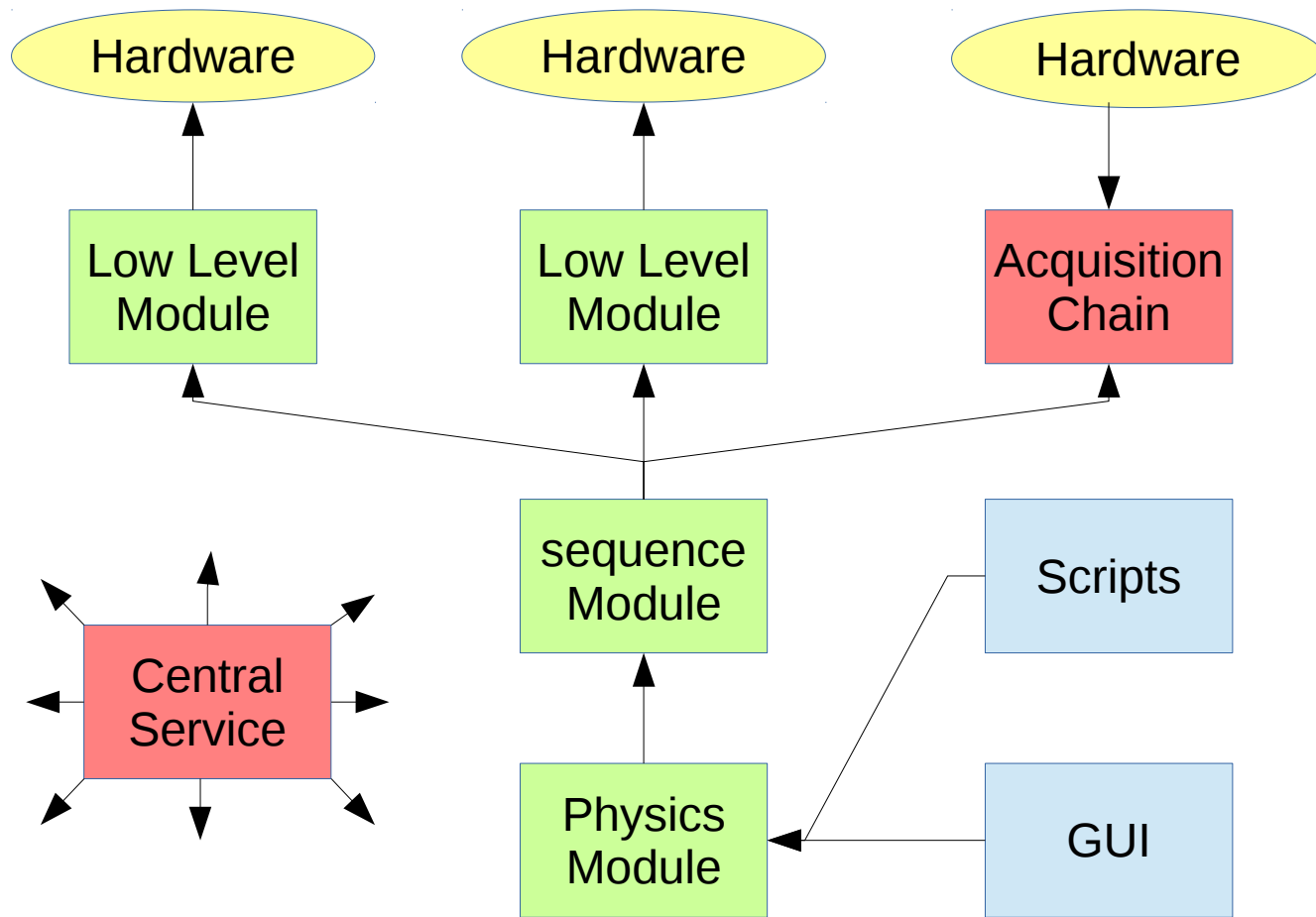
AIDA 2020

cnrs — dépasser les frontières

CALICE — Calorimeter for ILC

l'X ÉCOLE POLYTECHNIQUE — UNIVERSITÉ PARIS-SACLAY
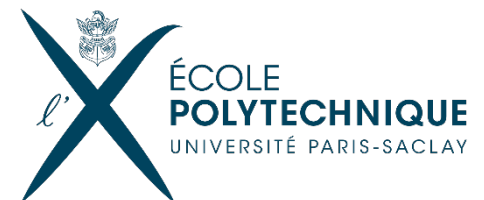
Pyrame in a nutshell

- Online framework
- Collection of command modules
- Peer to peer asynchronous tcp/ip comm.
- One task per module
- Functional code in Python, C/C++/Root, R, Lua, Shell
- Open-source
- Used on different HEP experiments :
  - T2K wagasci
  - Calice SiW-Ecal
 - Harpo (TPC)

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Dozens of hardware modules (drivers)

- Buses : RS232, GPIB, Ethernet, TCP, UDP, USB

- Power Supplies (Agilent, CAEN, Hameg…)

- Pattern Generators (Agilent)

- Motion controllers and probe station (Newport,Thorlabs,Signatone)

- Digital storage oscilloscopes (Lecroy)

- Particle detector chip (Omega)

- GaussMeter (LakeShore)

- Multimeter (Keithley)

It is very easy to write (adapt) a new module for your hardware

Acquisition Chain

- Multi-media
- Multi-format
- Fast : 4Gb/s
- Collect all data from all sources
- Aggregate by stream
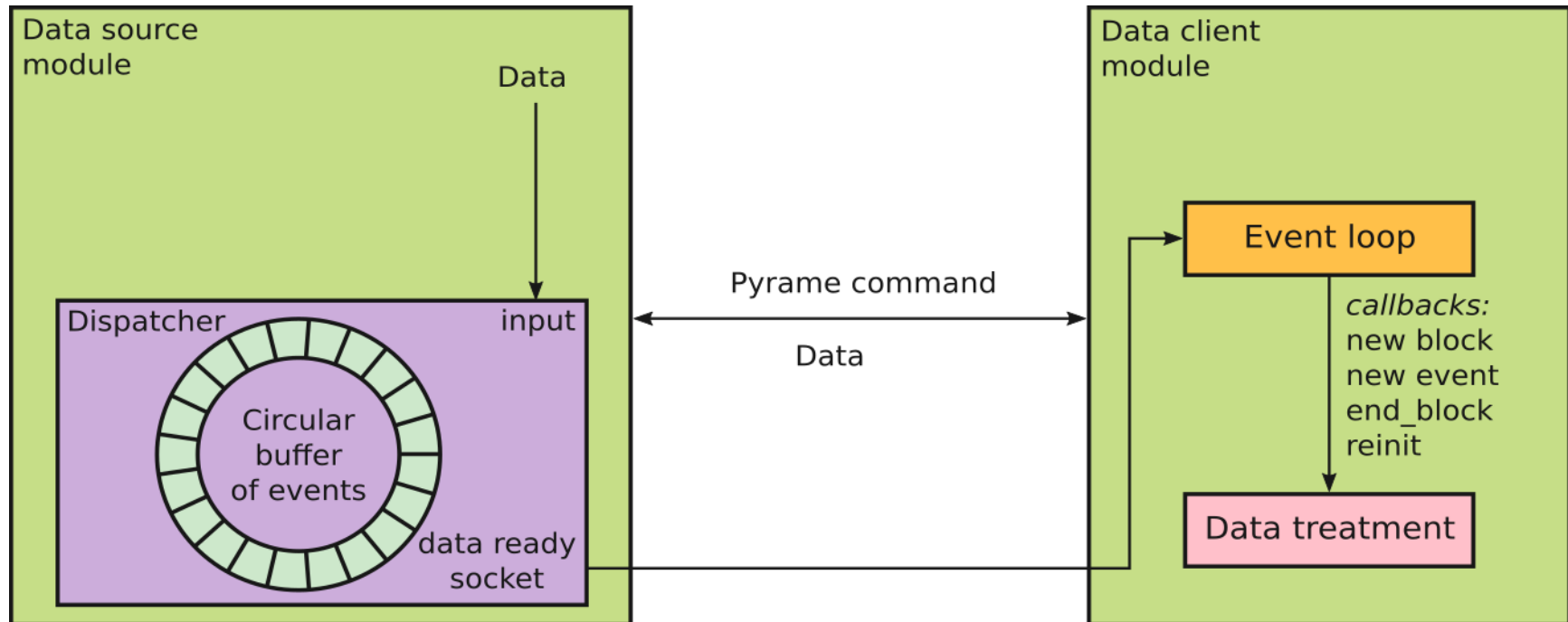- Extract command packets

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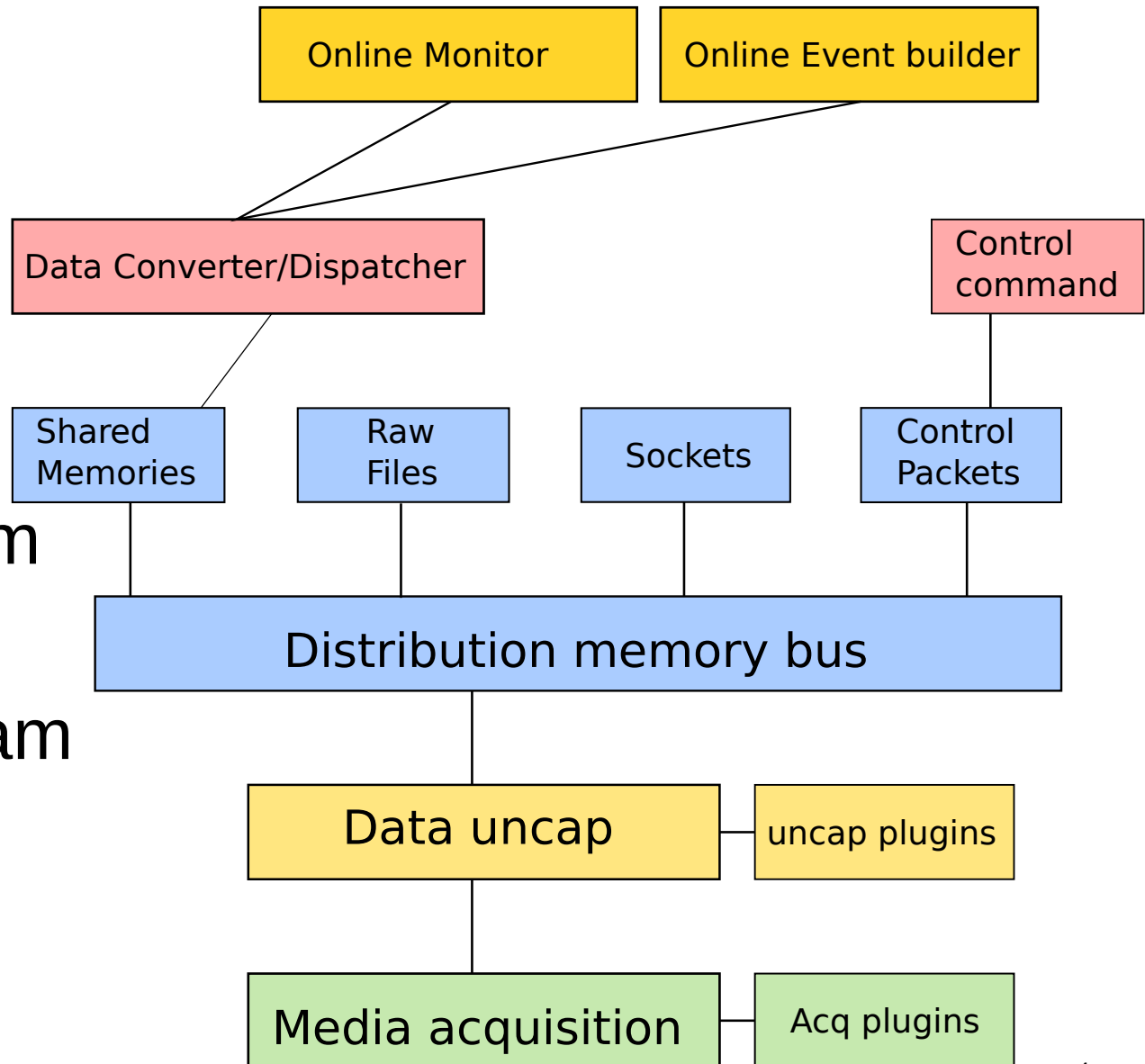
What's new in Pyrame 3

- New online data handling mechanism

- Online decoders

- Online reconstruction

- Online Monitoring

- Unified configuration system

- Advanced scripting facilities

PYRAME
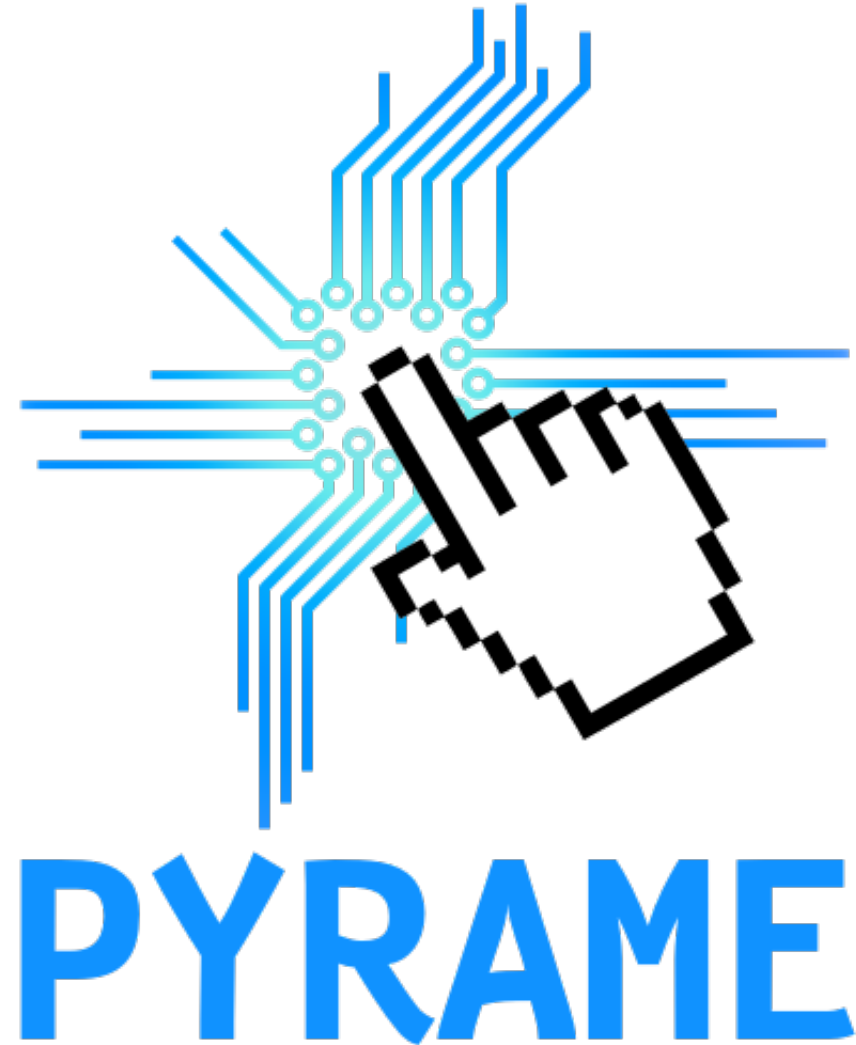
Dispatcher and Event Loop

- Break real-time constrainst
- Fair subsampling
- Data structure publication
- Serve data to any client (multiple access)
- New run reinit mechanism
- central index of data sources

- Ease online analysis development
- Allow chaining
- Possibility to use multiple event-loops at the same time
- field value extraction by name function
- Only for C/C++ (ok for root)

Data format

- Basic data bricks are "events" which contains fields splitted in 3 domains
  - Space coordinates
  - Time coordinates
  - Any other data: hit, energy, quality tag…
- Events are grouped in "blocks"
  - A block can have some global properties including a unique id for the run
- Event grouping is up to the online developper
  - Beware : subsampling quality relies heavily on statistical representativity. There should be no bias in event representativity in blocks
- Pyrame can be easily adapted to any format that can embed such a structure (for example LCIO)
- SAF : a simple ascii format

```
prop1,prop2!time1,time2...|space1,space2,...|data1,data2…!time1,time2...
```
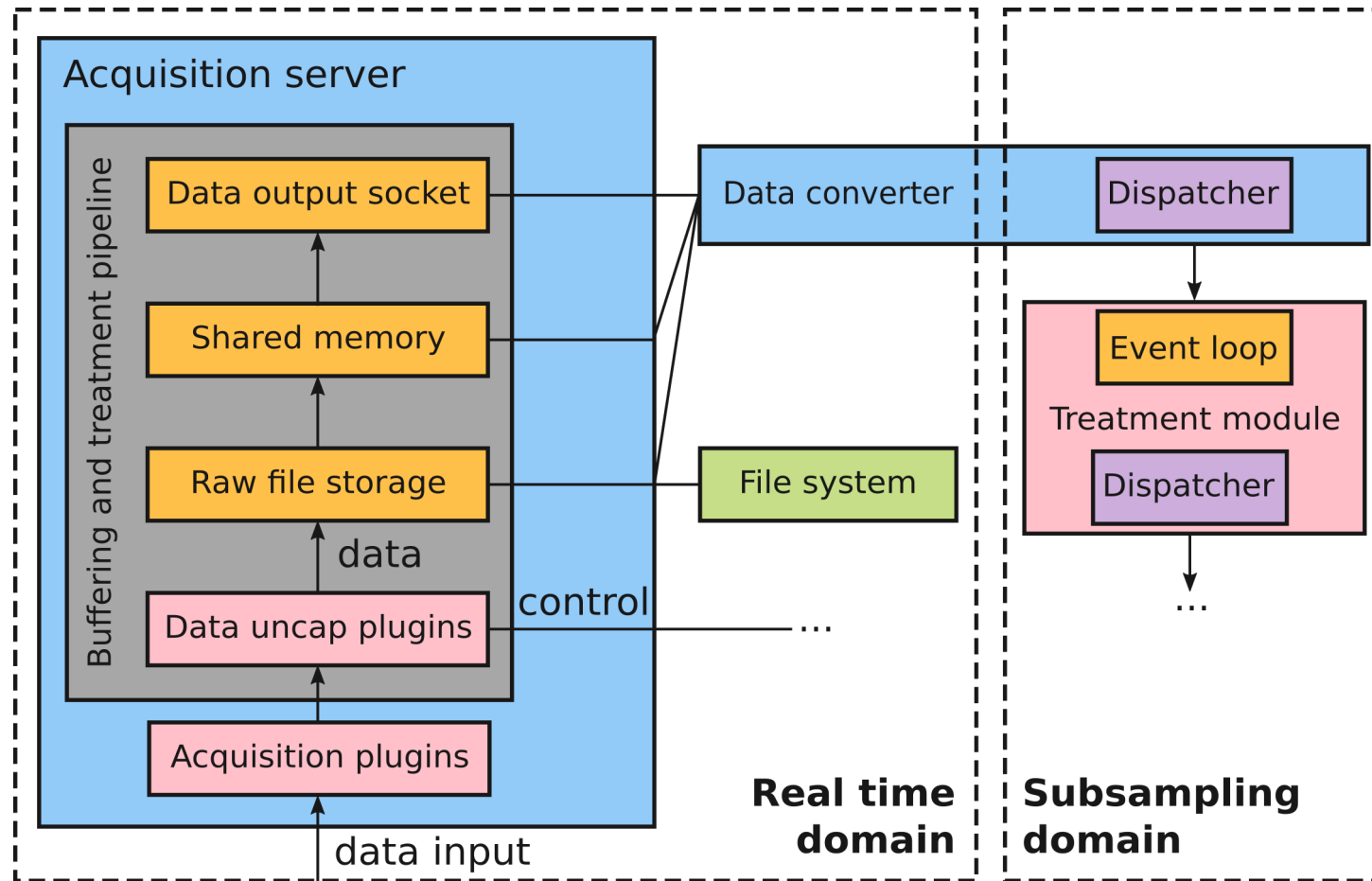
Performance
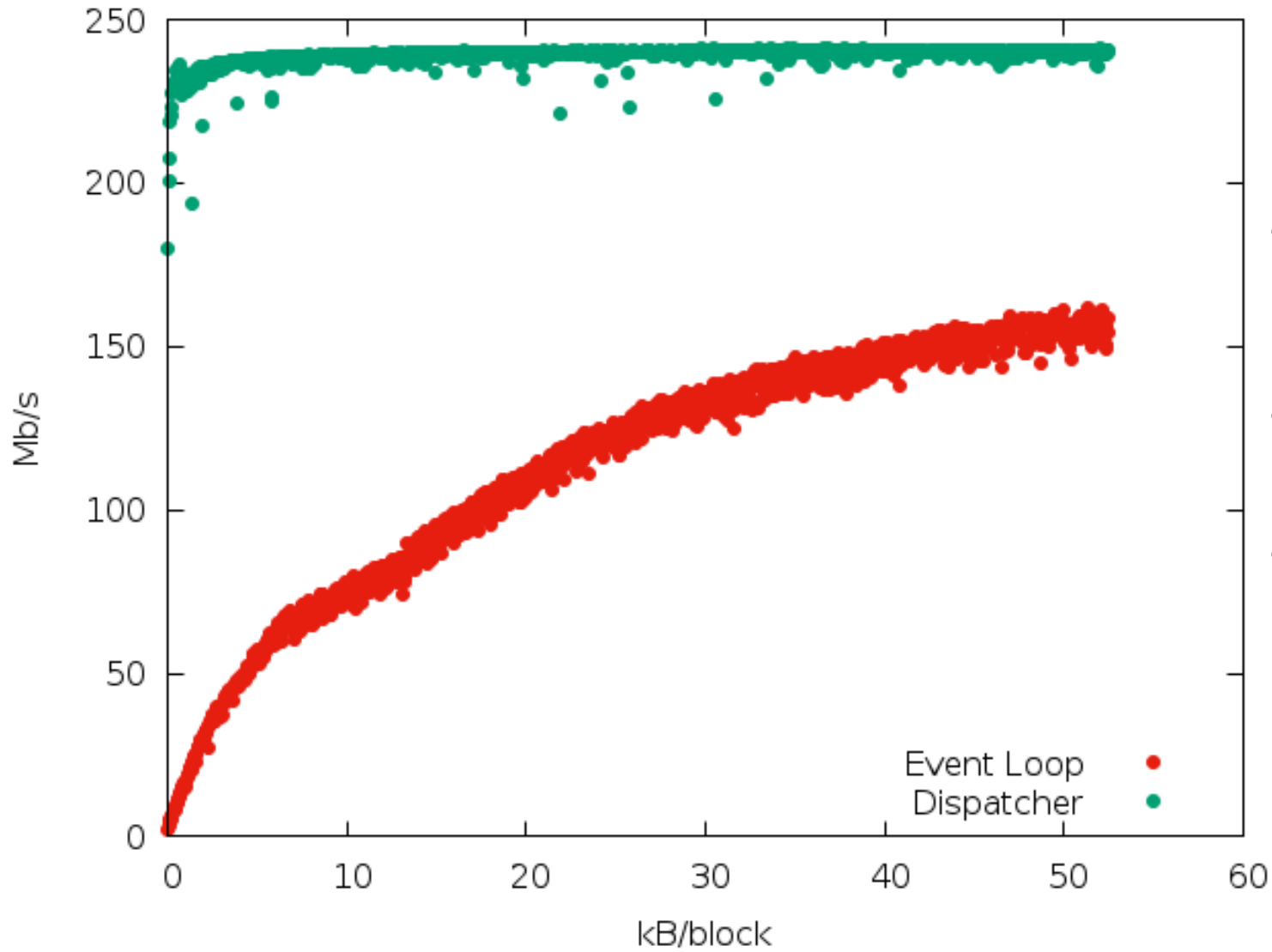
- Event-loop decoding is better if packets are big : network overhead
- encoding and decoding are linear in data size
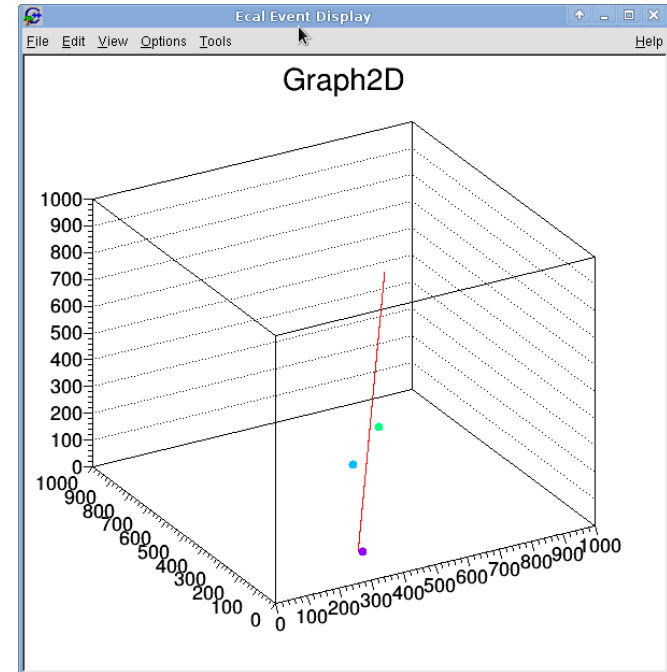- Can be improved by a binary format

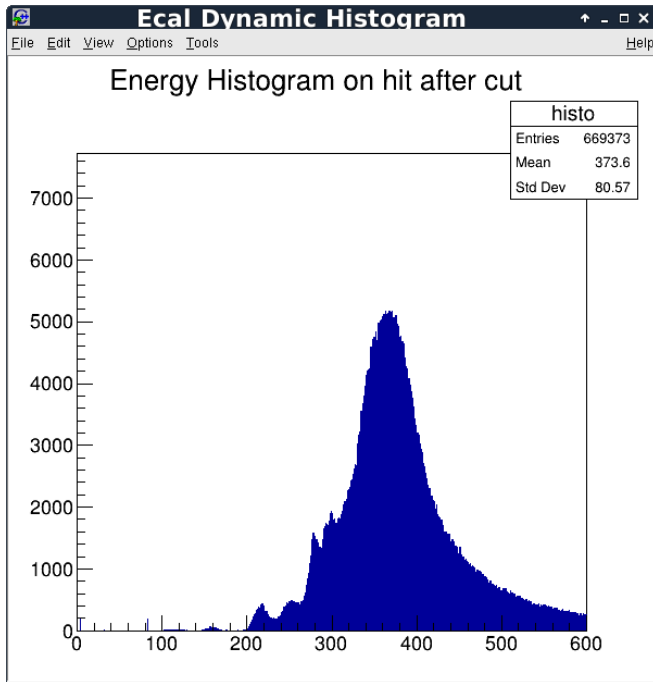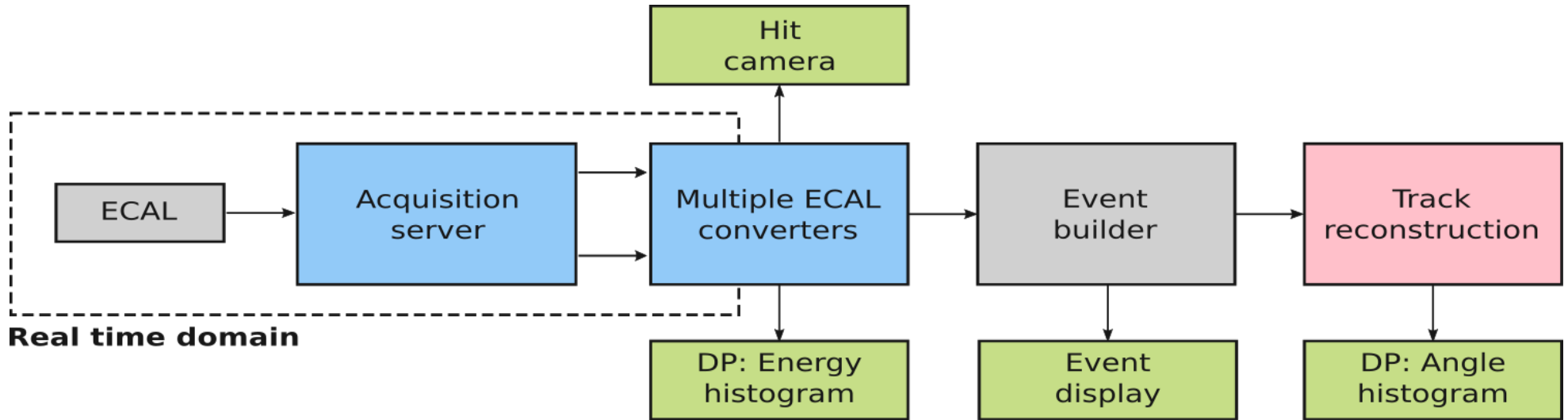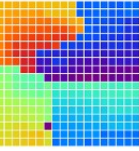On HP Zbook with I5 8 threads processor

Online converters

- A data converter can be launched by data source
- Decode data in real time + do some very basic reconstruction
- Group data by blocks corresponding to time slots
- Feed a dispatcher

Applications for SiW-Ecal : Calicoes

Online Monitoring

- Instanciate event loops connected to all decoders
- make plots from data
- Simple version just make some beam spotting
- Expert version make plots of all errors and malfunction
- Monitor beam in real time
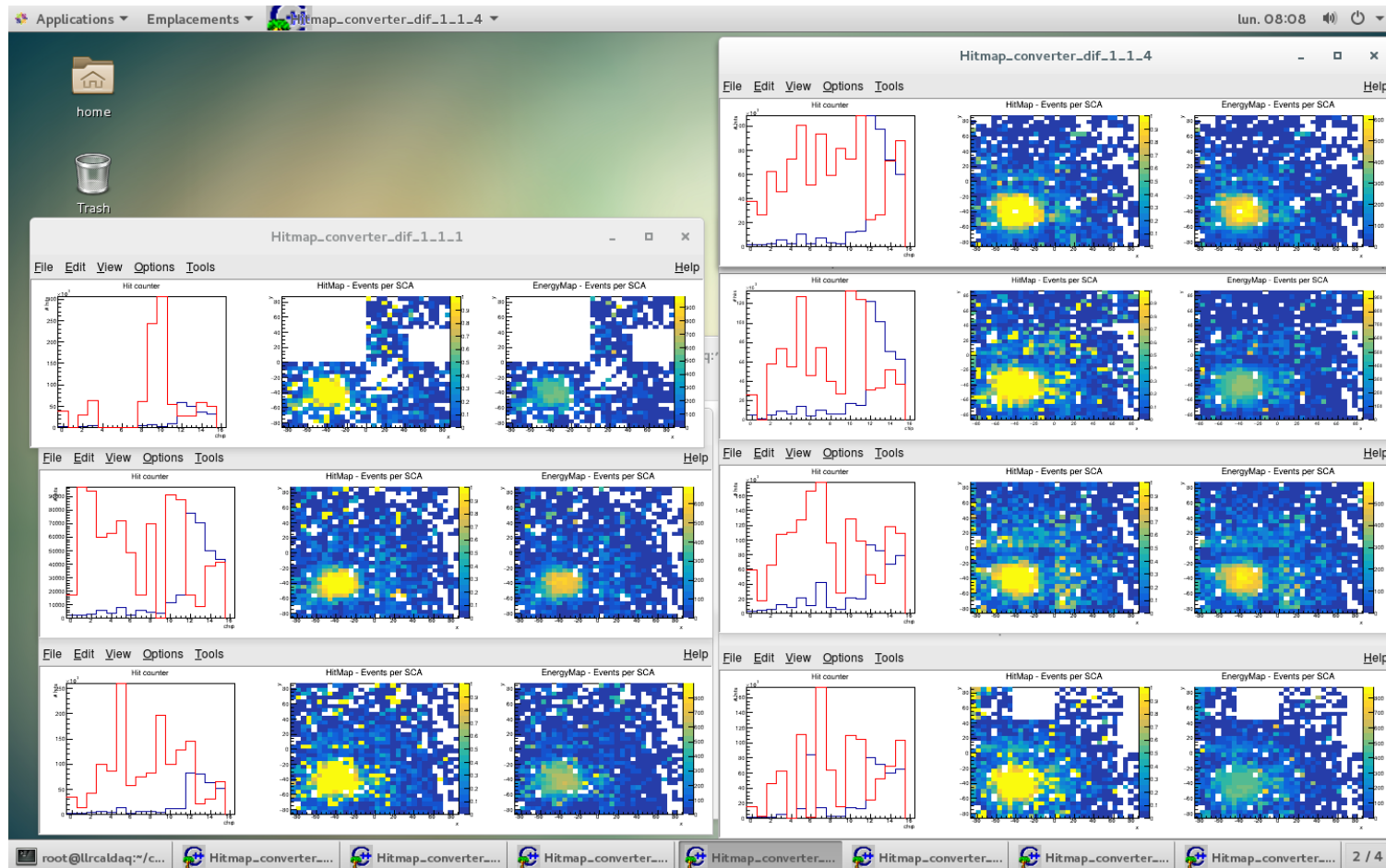
Beam monitoring during beam-test @ DESY

New scripting facilities

- Allow any complex behavior (calibration, data driven reconfiguration...)

- All hardware accessible from script

- Central configuration file (all HW)

- All electronics from detector is reconfigurable on the fly

- Integrate offline analysis, inducing reconfiguration

- Export variables from online treatments, usable in script

- Scripts are written in

```
Move table to position 32
Set high-voltage to 100v
Wait 120s
Do
    Acquire data for 300s
    Analyse data
    Output noisy channels
    Mask noisy channels
Until #noisy-channels=0
Start event builder
Acquire data
Do
    Eb export variable #full-events
    Wait 60s
Until #full-events>=1000
Stop acquisition
```
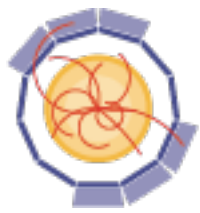
Eudaq integration

- Eudaq and Calicoes now have the same state machine

- Easy command integration for "normal run"

- Calicoes includes already a Eudaq1 producer (migration planned to Eudaq2)

- Data feeding for Eudaq will be done through a multiple event-loops client (not implemented yet)

- Question : how to format data to avoid second specific decoding inside Eudaq ?

- What about some "standard format" with a generic decoder provided natively in Eudaq ? extended LCIO ? compressed JSON ? Podio ? Specific new binary format ?

Summary and perspectives

- Pyrame 3 is an online framework, flexible, stable and performant

- Provides new functionalities in online monitoring and advanced scripting

- Provides advanced support to SiW-Ecal testbeams for years : see A. Irles talk tuesday

- Open-source, available at

  www.llr.in2p3.fr/sites/pyrame

- Foreseen developments

  – High level data analysis

  – Optimize data transfert by adopting adapted new format

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