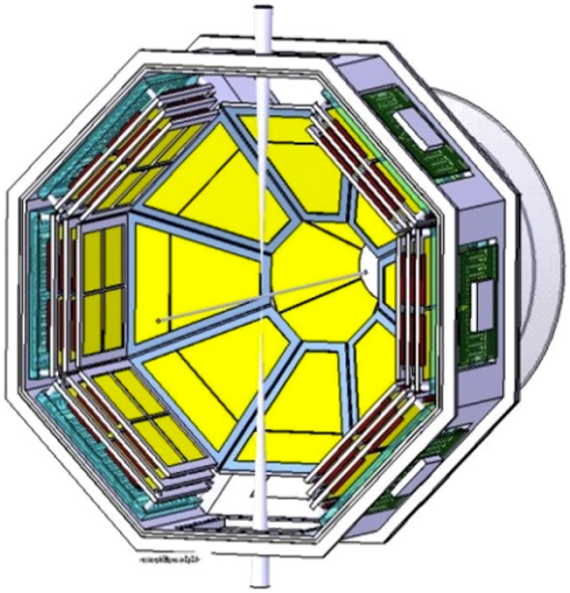
GASPARD-TRACE: Introduction and Present working scheme for the electronics

Andres Gadea (IFIC-CSIC, Spain)

- **Introduction to Sampling FEE and the GASPARD-TRACE FEE design**
- **Working scheme for the GASPARD-TRACE FEE.**
- **Outlook**



GASPARD-HYDE-TRACE Workshop 2017 23-24 January 2017

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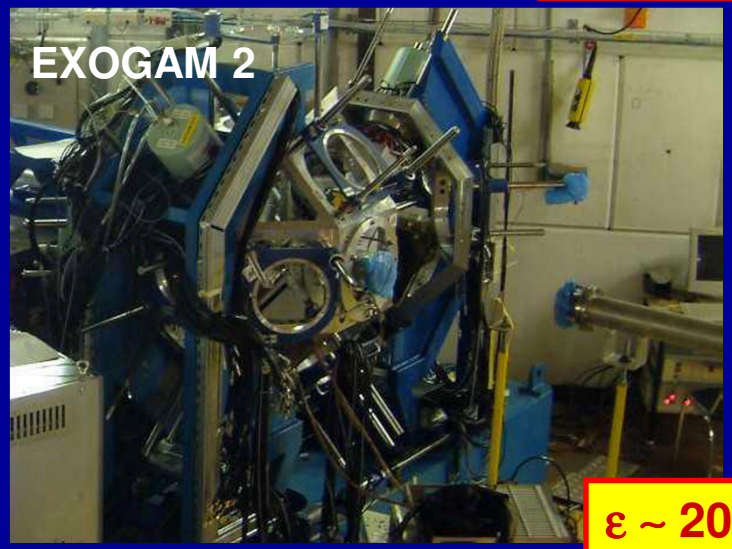
Expected to use GASPARD-TRACE with:

Large γ–Arrays based on Compton Suppressed Detectors

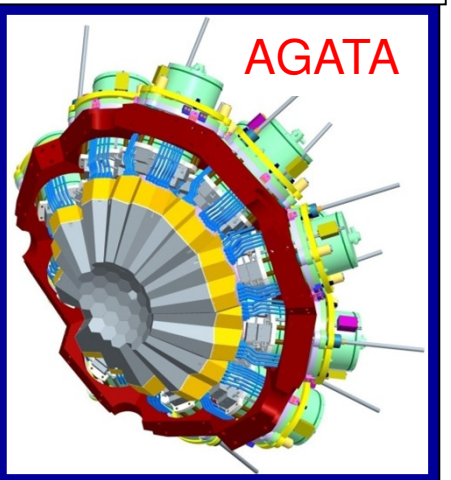
ε ~ 8 %



ε ~ 20 %

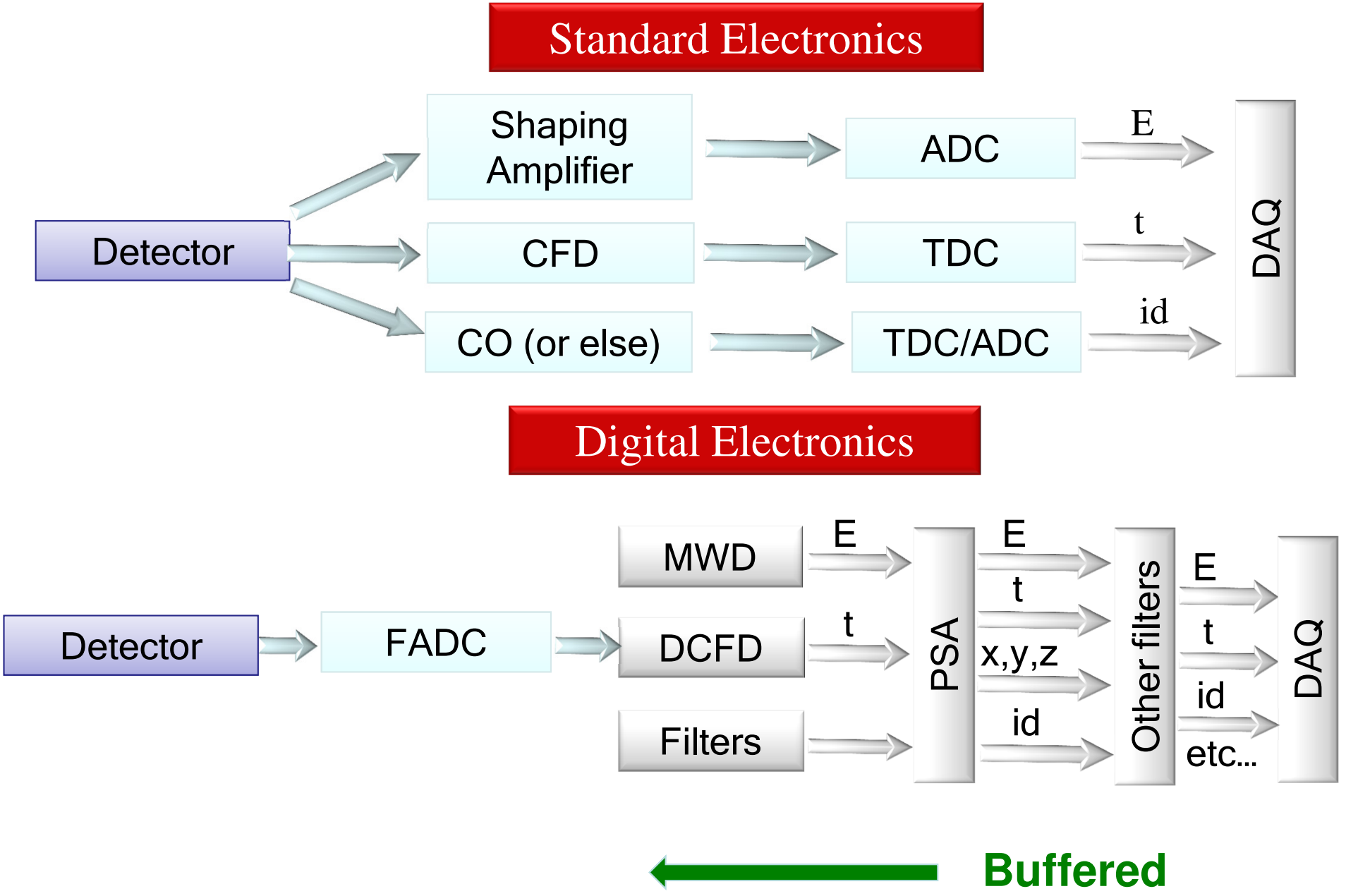
Tracking Arrays based on Position Sensitive Ge Detectors

ε ~ 10 % (1π) - 40 %(4π)



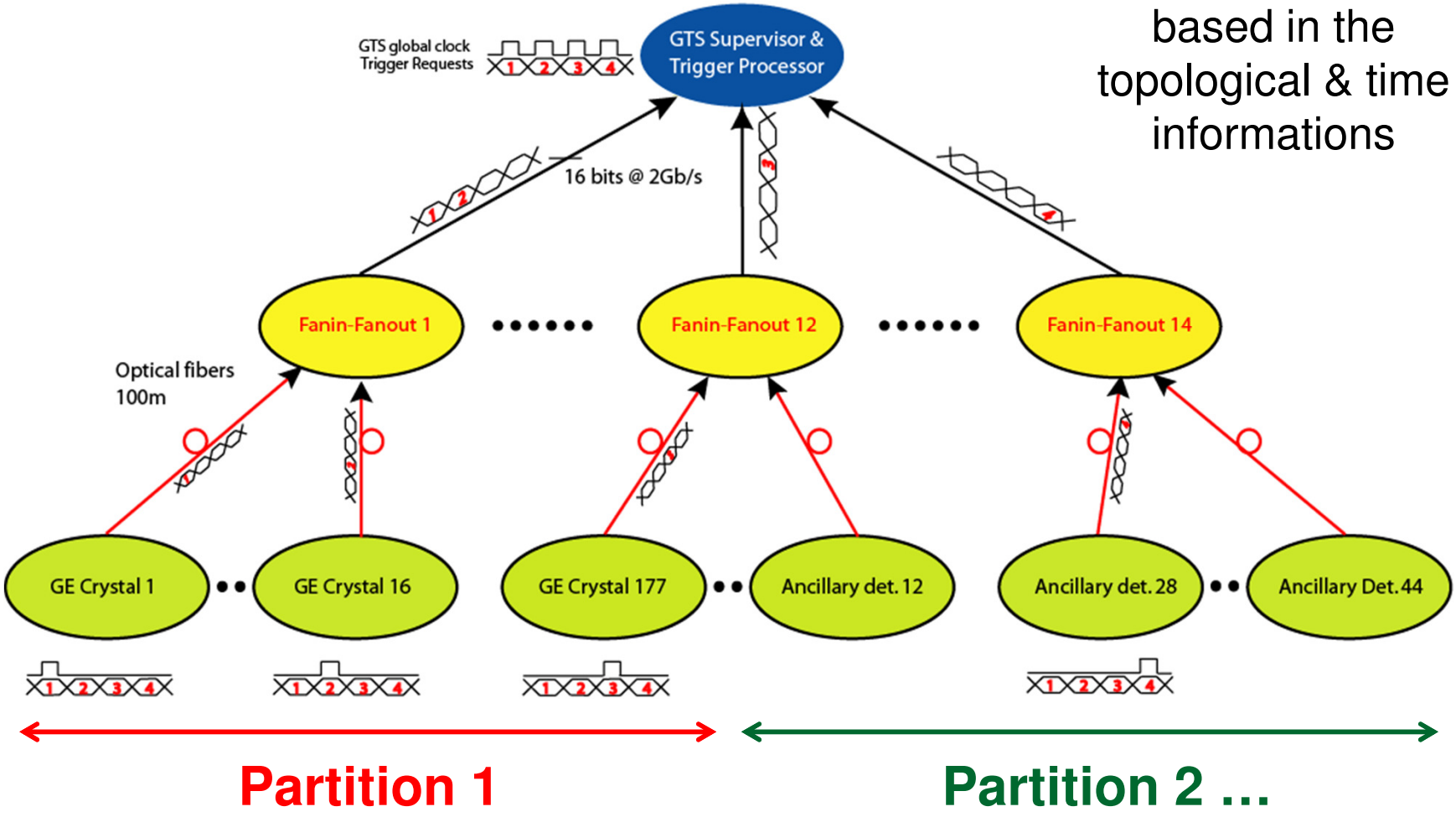
- **Presently all three arrays are using digital sampling electronics.**
- **All three arrays are using electronics synchronized and triggered with GTS**

Analogue vs Digital Electronics



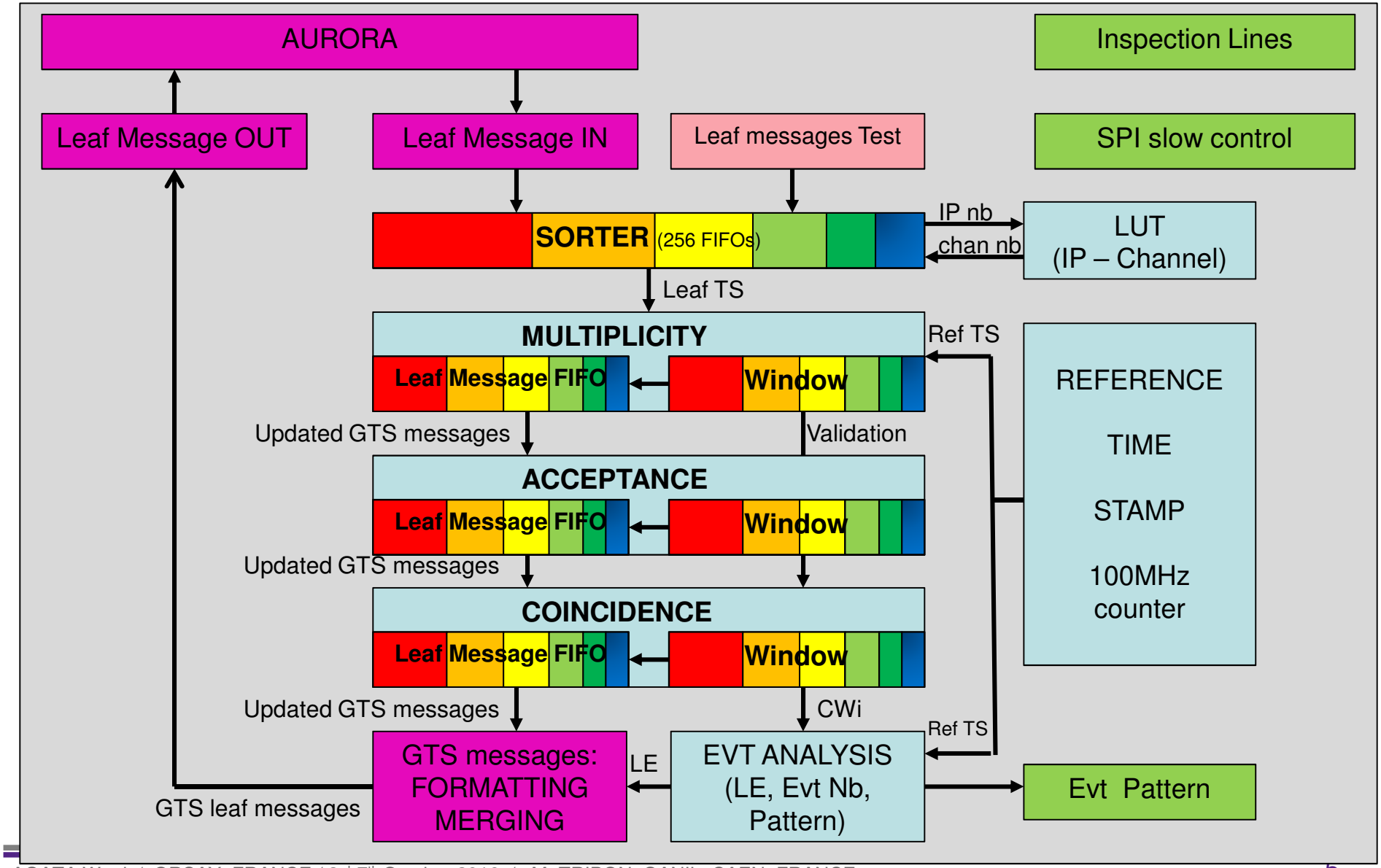
GTS Trigger & Synchronization Structure

GTS Trigger decisions are based in the topological & time informations



The GANIL GTS Trigger Processor

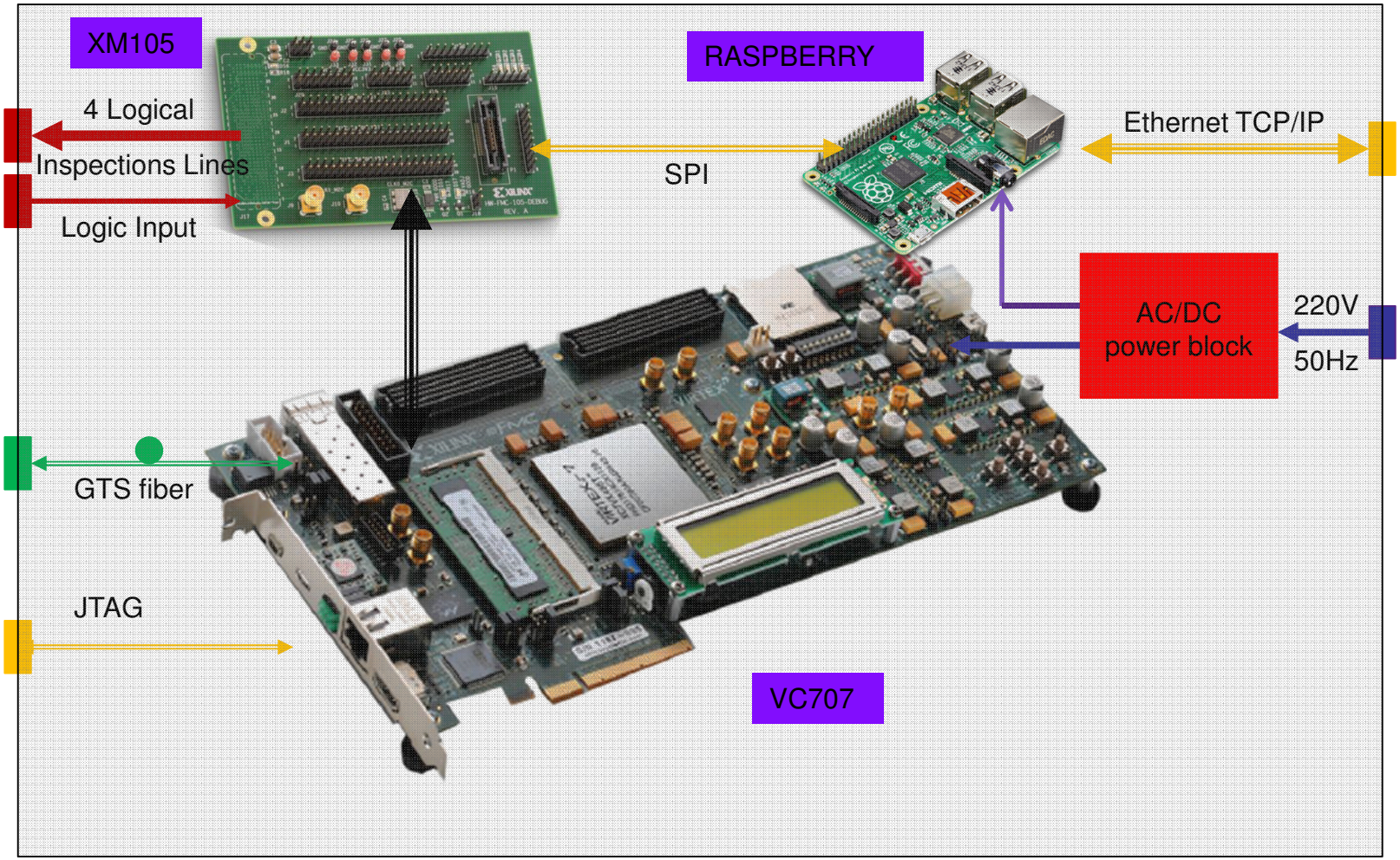
GTS TP simplified block diagram Courtesy of M.Tripon



The GANIL GTS Trigger Processor

TP hardware Courtesy of M.Tripon

TP hardware components housed in a custom box (19" case, rack mount, 1 U)



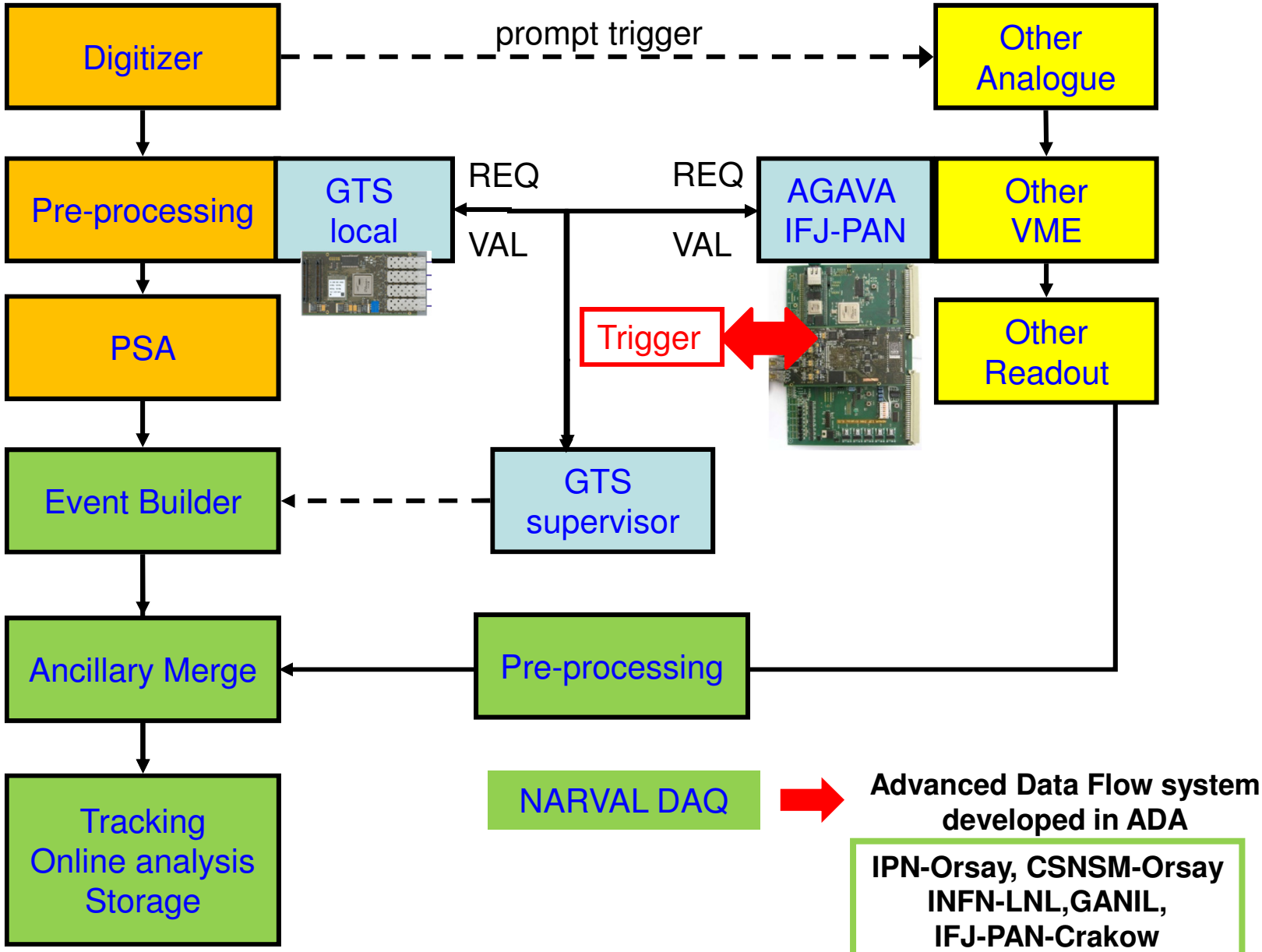
GANIL Trigger Processor Partition and features

- Nowadays GTS limited to 255 leaves (definition of the protocol)
- GANIL Trigger Processor partitions: 13 partitions
  - P128 : 128 channels from 0 to 127
  - P64 : 64 channels from 128 to 191
  - P32 : 32 channels from 192 to 223
  - P16 : 16 channels from 224 to 239
  - P8 : 8 channels from 240 to 247
  - P1_1 à P1_8 : 8 partitions of 1 channel de 248 à 255
- For each partition, Multiplicity window, Acceptance window , Multiplicity validation and Coincidence Window are implemented.
- Slave mode included (Window for validation for a detector not participating in the trigger)

Note: GASPARD-TRACE can profit from the trigger partitions, using different Merging Boards or a Merging Board able to encode the trigger request.

Information by M.Trippon

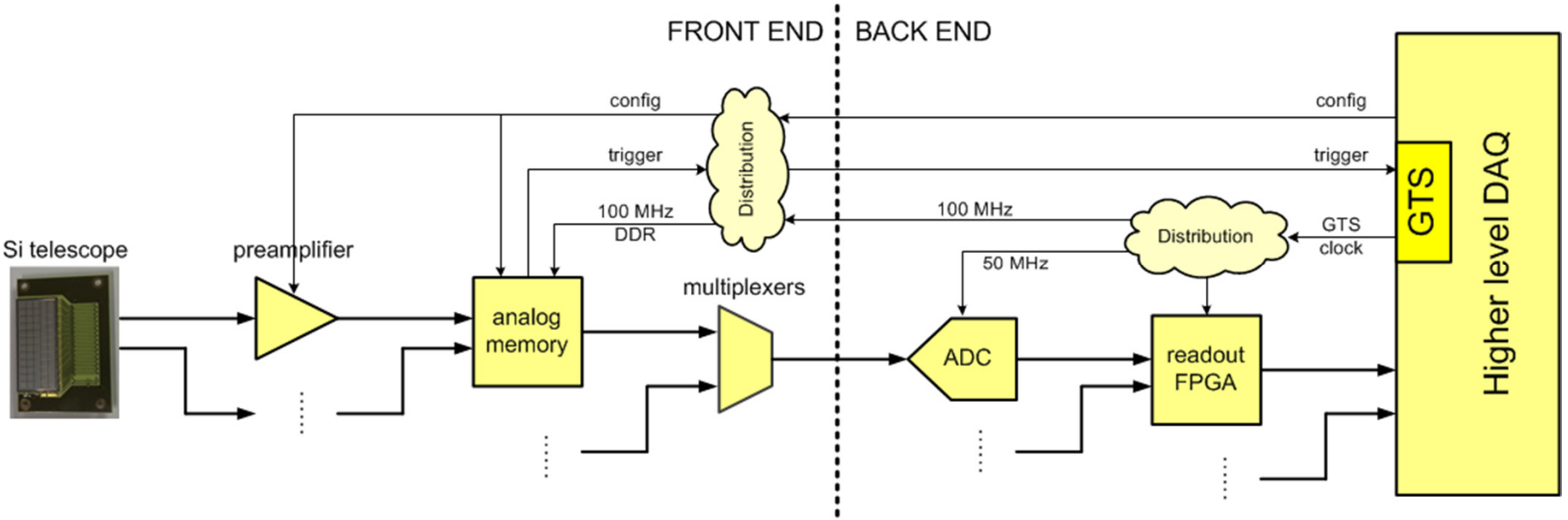
Present GTS / NARVAL solution for Other Detectors



GASPARD-TRACE
Front-end Electronics requirements.

- High integration to limit cost and reduce complexity in a large number of channels (>10000). Readout by few lines.
- Digital FEE with a sampling frequency ≥ 200 MHz (required for Pulse Shape Discrimination and timing)
- Large dynamical range (Possibly fast reset PA)
- Capability to contribute to the GTS trigger
- Capability to synchronize with AGATA, EXOGAM2 and GALILEO.
- Samples read-out to perform off-line advanced PSA

GASPARD-TRACE
readout chain concept (I)



- Multiple detectors analogically sampled and buffered
- All detectors synchronized and participating to the trigger
- Readout, through a single line, including all identification of the channel and all ingredients for calibration

Not feasible to link GTS to each detector Strip/PAD

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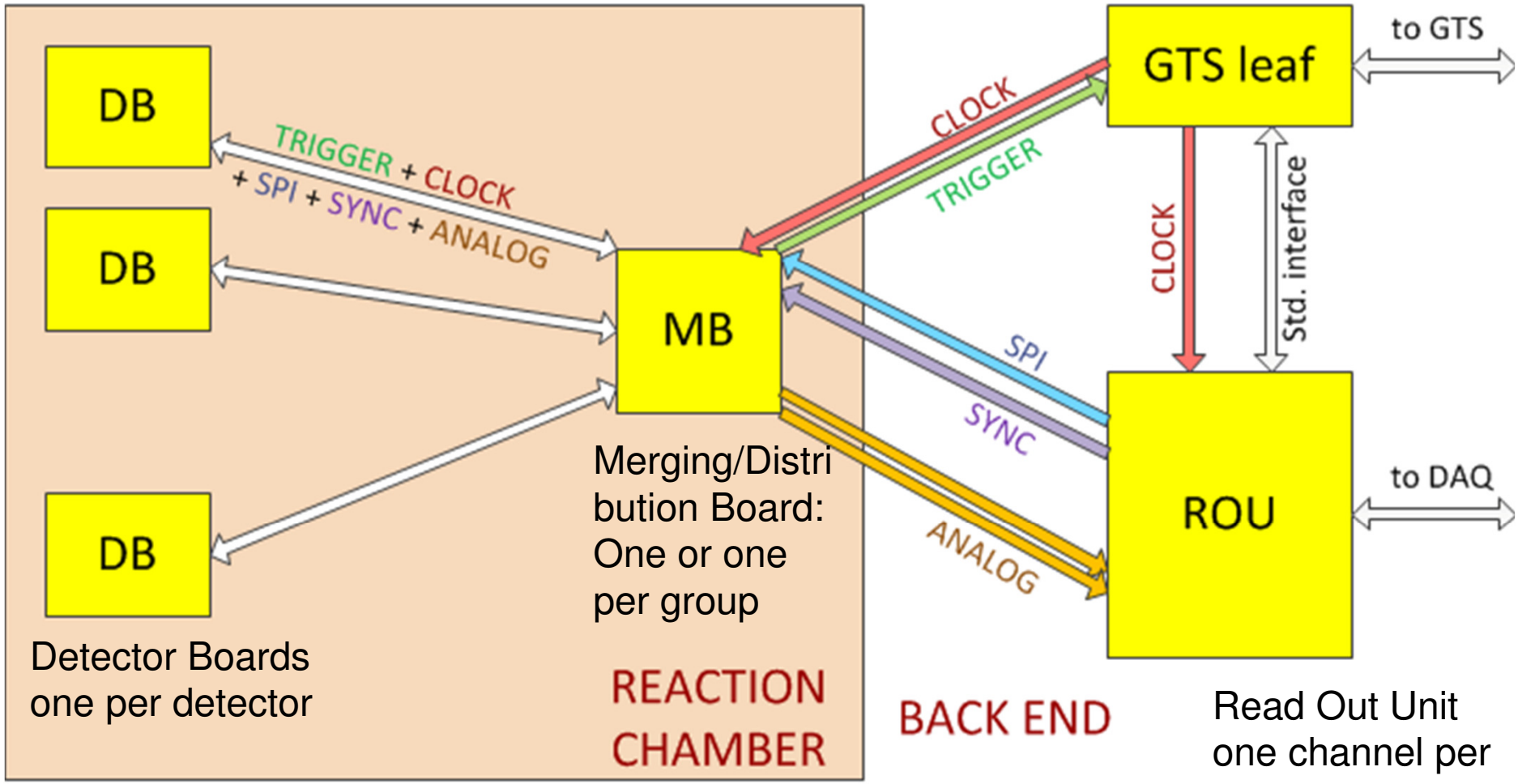
GASPARD-TRACE
readout chain concept (II)



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GASPARD-TRACE
Electronics Ingredients:

- Highly integrated pre-amplifier on ASIC
  - ToT ASIC (IPNO Orsay): with Fast Reset and ToT capability
    (See S.Capra contribution)
  - iPACI ASIC (INFN-Milano): with Current and Charge signals
    (See J.-J. Dormand contribution)
- Shaper to take into account the baseline (to be understood where to place it)
- Analogue buffer PLAS (sampling at 200 MHz, clock, synchronization, trigger detector Pad/Strip identification etc…
- Merging/Distribution board:
  - Clock Distribution
  - Trigger Merger
  - Control Distribution
  - Synchronization Distribution
- READOUT system Sampling at 50 MHz, One channel per Detector/PLAS, GTS leaf capability. After read-out Narval or GALILEO DAQ is to be used.
- To be discussed how to include ToF measurements

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GASPARD-TRACE
Electronics Ingredients:

The READOUT system should be able to:

- •Receive an external trigger request from the PLAS ASIC
- •Capability to link to GTS and provide a time stamp at the time of the trigger request.
- •Should be able to produce a synchronize order for the PLAS ASIC and assign the PLAS counters for all detectors the corresponding GTS timestamp offset.
- •To input the data sequence to be sample at least at 50 MHz.
- •On receiving real data, to decode the synchronization counter from the data sequence and reconstruct the corresponding GTS time stamp.
- •Decode detector identifier and Digitize the analogue samples amplitude from the waveform, as well as the sample information stored in the data flow.
- •Receiving the Validation or rejection answer from the GTS TP, with transfer the data or clean/flush them respectively.

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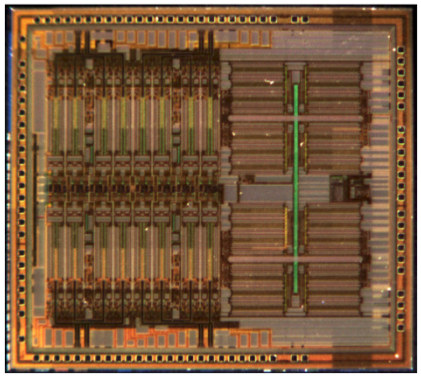
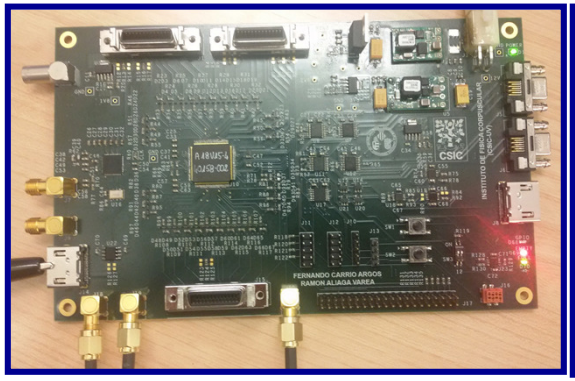
The AGATA Group at IFIC: Contribution

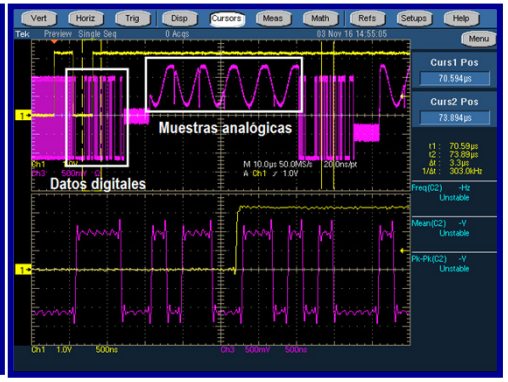
Grant PROMETEO II/2014/019 2014-17

•Microelectronics R&D for the readout of the GHT light charged particle DSSSD/Si-PAD telescope detector array as tagging detector for AGATA. Development of an ASIC with synchronized analogue buffers: signal sampling for particle identification: IFIC (R.Aliaga et al.) Electronics serv., UPV-I3M, UVEG-ETSE.

See R.Aliaga talk







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Summary and Outlook

- The GASPARD-TRACE detector is a fundamental tool for Nuclear Structure research at the next generation of RIB Facilities.

- Coupling GASPARD-TRACE at the state-of-the-art Ge arrays will provide an ideal setup for spectroscopy of exotic product with direct reaction in inverse kinematics.

- The foreseen arrays are instrumented with sample electronics with buffering capability, Trigger and Synchronization GTS based and thus with large trigger latencies.

- GASPARD-TRACE will benefit from a sampling electronics as well, in particular for PSA providing particle id at low energies and for better timing.

- The prototype of different parts of the electronics chain PA and exists and testing is ongoing.

Thank You!

EXCELENCIA SEVERO OCHOA
MINECO, Grant n. FPA2014-57196-C5
GVA Grant PROMETEO II/2014/019

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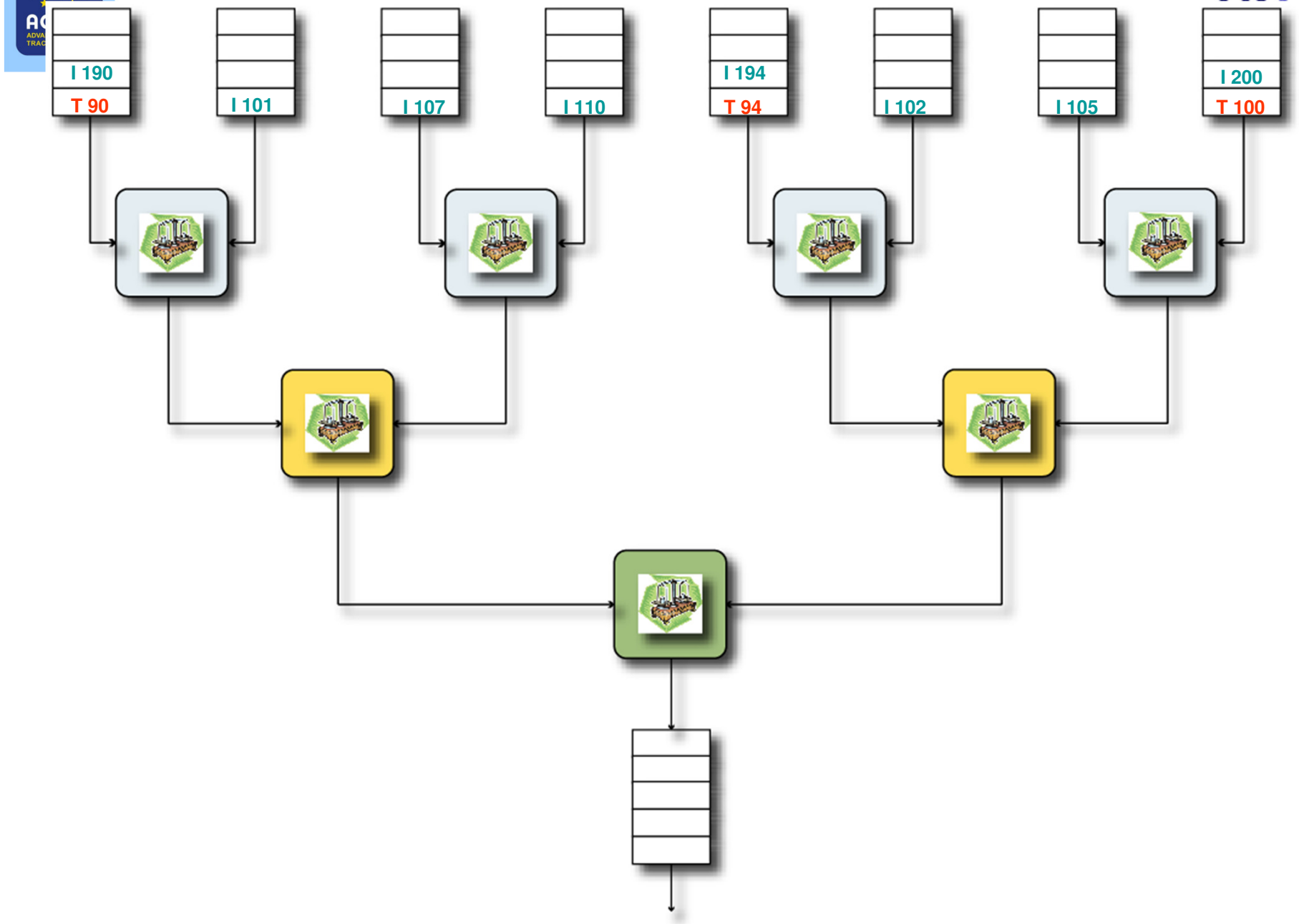
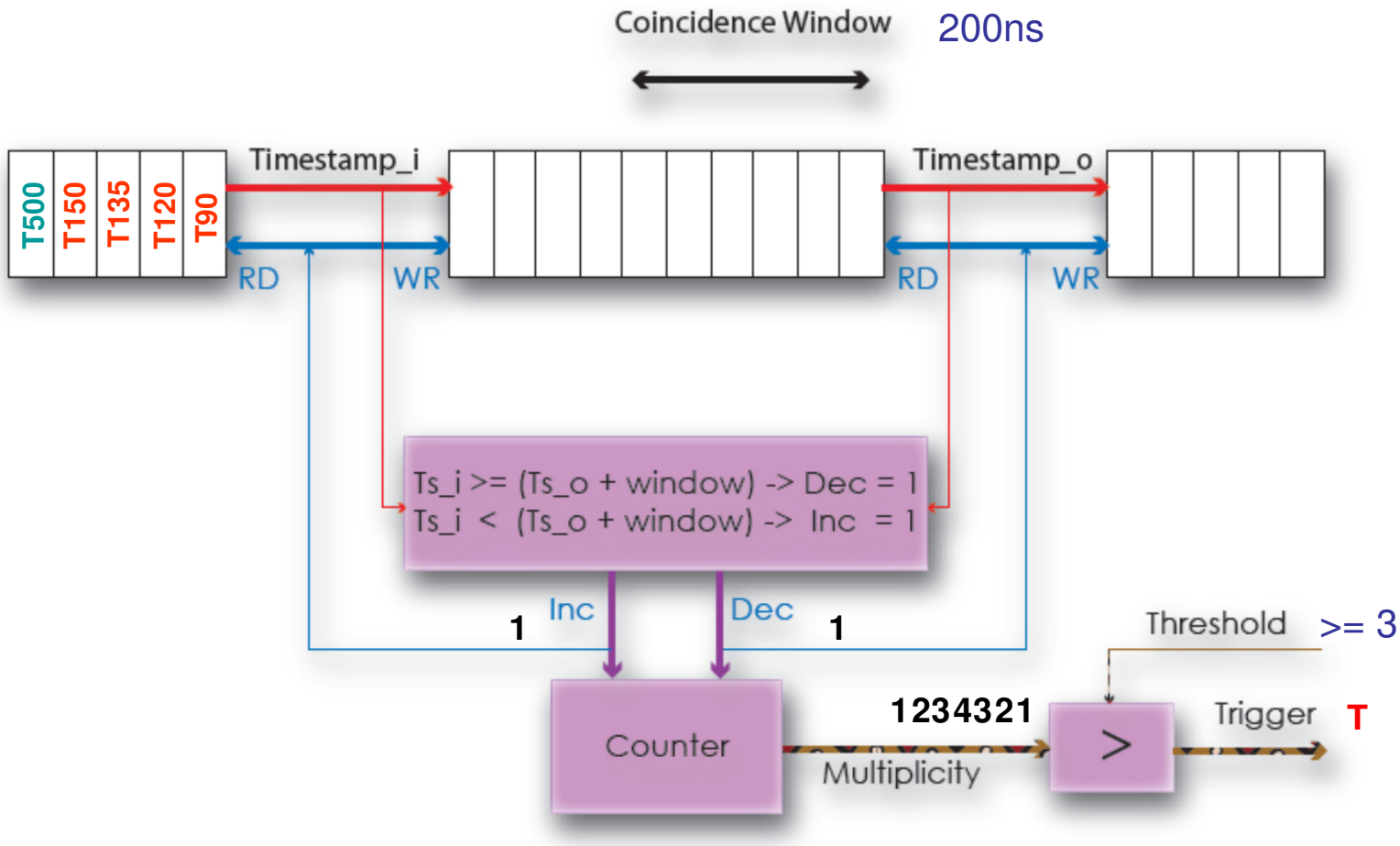
Online Sequential Batcher Sort

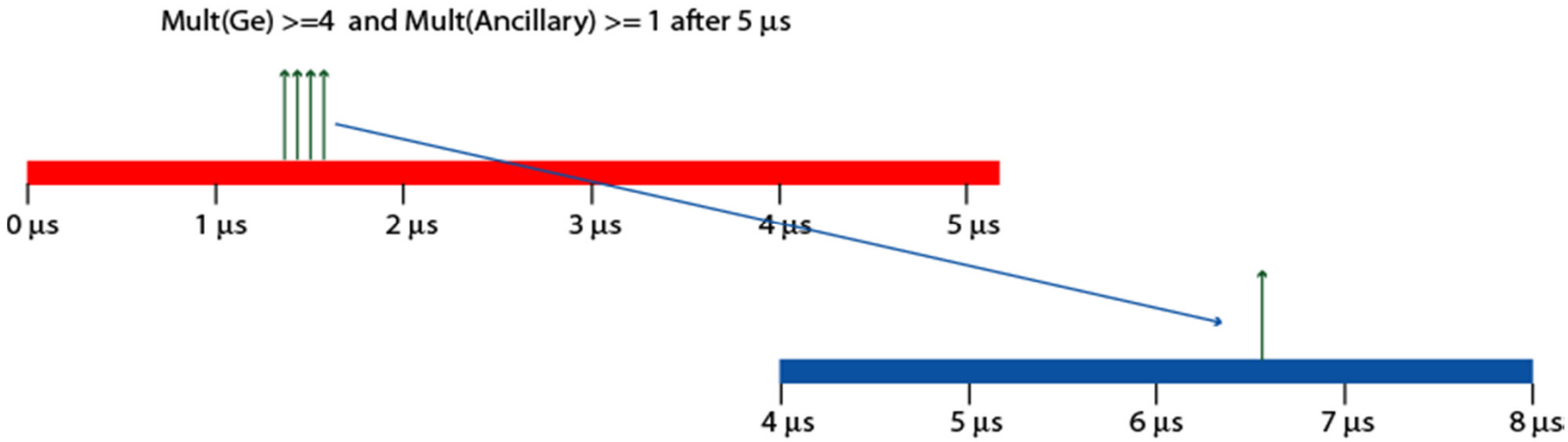


Multiplicity Processor



Partitions Coincidence

- Prompt and delayed
- Case study:
  - M(Ge) >= N and M(Other Detector) >= K before/after deltaT



M. Bellato, L. Berti, J. Chavas, INFN-Pd and LNL