Emanuel Pollacco IRFU/SPhN
For the GET collaboration

Systems for Nuclear Physics Today

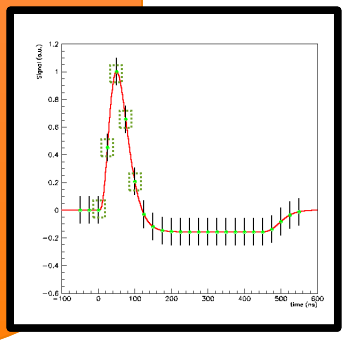
1. Number of Channels Approx. 1,000
2. Short & Reconfigurable Experimental Setups with variety of Detector Types
3. Human & Financial Resources Low

Systems for Nuclear Physics Tomorrow

1. Number of Channels Approx. 20,000
2. Short & Reconfigurable ….
3. Human & …

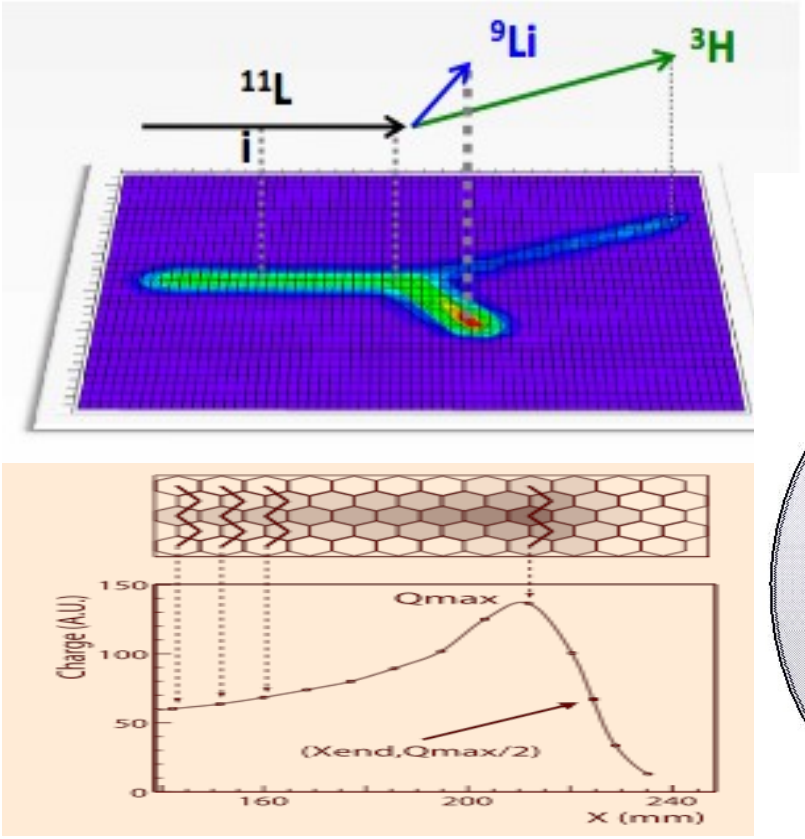
Measure

1. TPC, Si, CsI … (E & T via Charge Sampling),
2. Efficient Trigger
3. 1000 events/sec (TPC like)



Adapting Part. Phys. Techniques

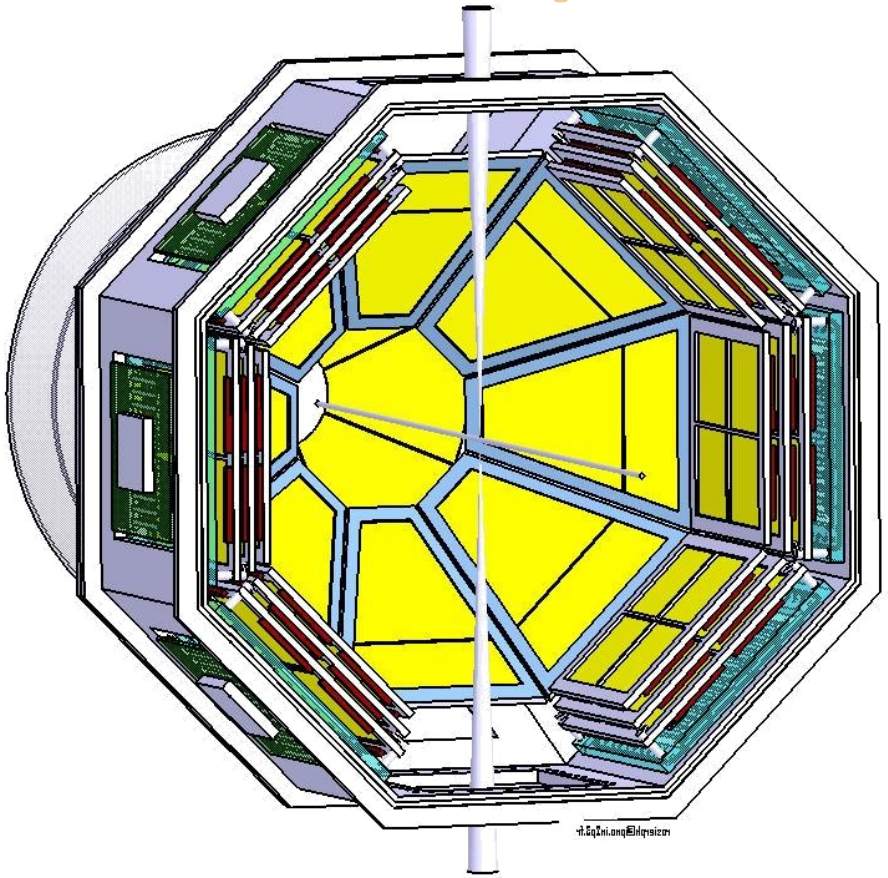
Active Target - 20Kch



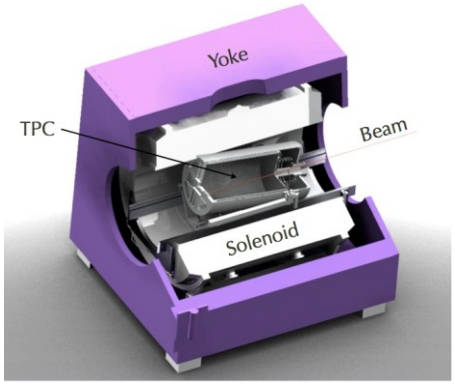
Bragg trace measure

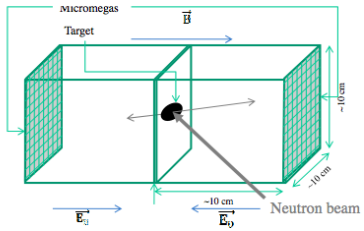
&

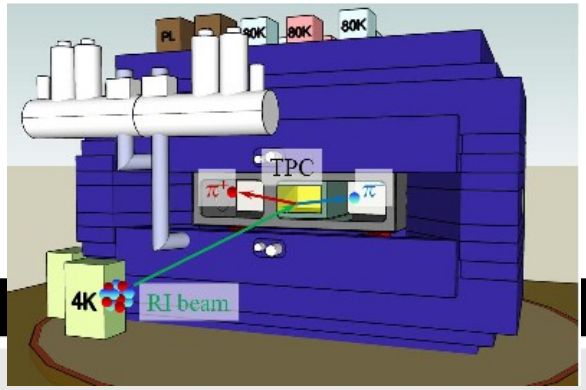
Si 4pi – 12K ch

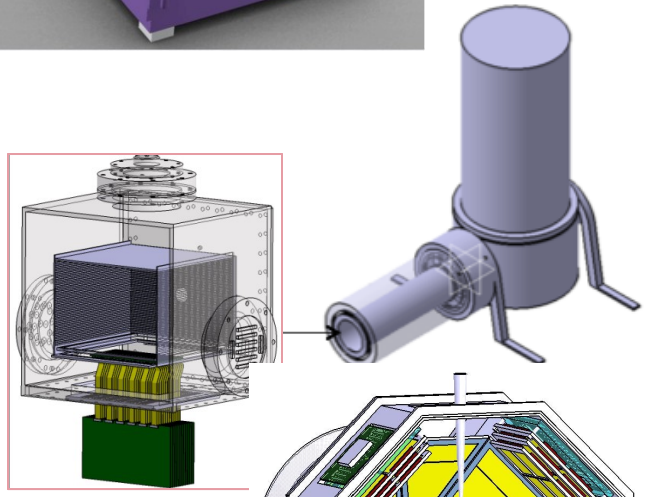


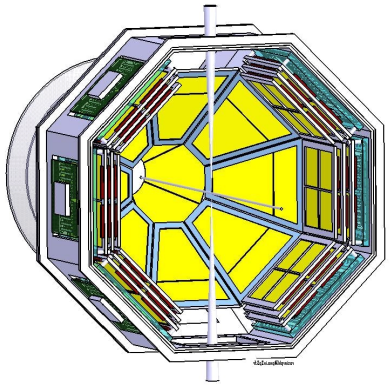
Systems to be covered by GET











- Projects employing **GET**
  - ACTAR (GANIL, IRFU, IPNO, SFTC, …) – Micromegas + Si – 20k channels
  - 2p-TPC (CENBG) – GEM/Micromegas – 20k channels
  - AT-TPC (MSU, LBL …) – Micromegas – 12k channels
  - GASPARD (GANIL, IRFU, IPNO, …) – Si & CsI – 15k channels
  - BTD (IRFU & GANIL) – 100 channels
  - SAMÜRAI-TPC (RIKEN) – Micromegas -15k channels
  - FORFIRE – IRFU – Industry
  - Test system - IRFU
- Under Study use of GET/ GET modules
  - S3 – (SPIRAL2+IRFI+…) – Si/gas tracker - 500 chan
  - MINOS ➔ (p;2p, γ) - (IRFU)– Micromegas - 8K channels
  - FIDIAS (IRFU) – Micromegas 5K Channels (IRFU)

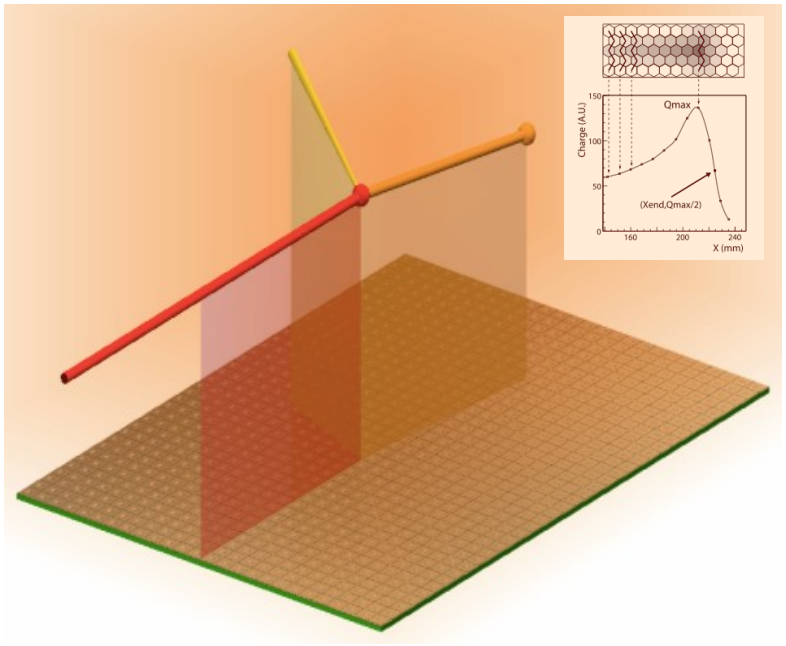
100 K Channels Gas, Si & CsI

➔ **GENERIC**

GET Project Objectives

- Develop for Nucl. Physics :- Full Data Acquisition system for
  - Active Targets(Target = Gas). ➔ Nucl. Spec & Astrophys. with Radio active Beams
  - TPC ➔ Exotique Decay & EoS with RABs

  Require
  - Low detection thresholds (A,Z, E, The, Phi) for slow ions (below 300KeV),
  - Dynamic range (~Z^2),
  - High Luminosity & Solid Angle,
  - Effective Internal TPC Trigger,
  - Gas & pressure (H_2, D_2, ^3He, He …)
  - Different detector Systems,
  - Pad density (25-100 pads/cm^2)

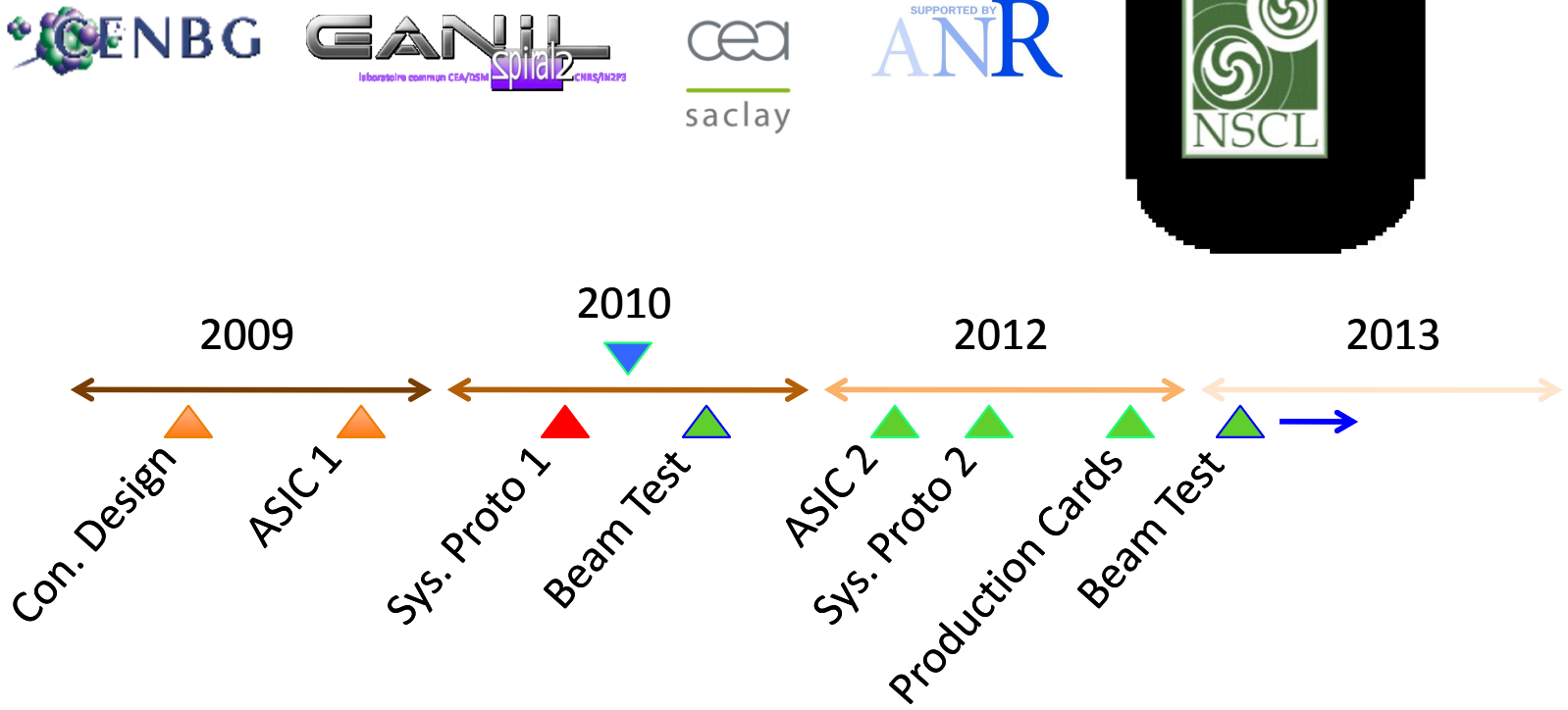


- Opportunity to develop a generic /reconfigurable system approach for Nucl. Phys. to cover medium size systems (256 – 32K channels).

➔ This is an experimental system

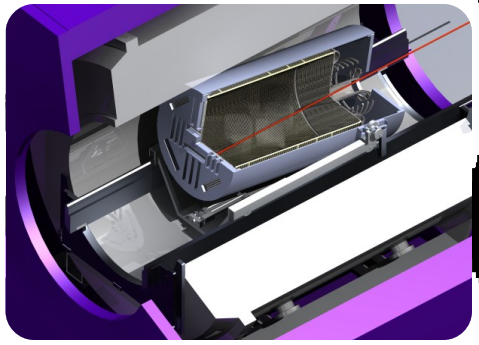
GET Project

R&D Financed 75% (France)
25% (US)



SYSTEM GET

Conceptuel Design



AT -TPC

Very FE
Pre-amp/
Protection

Embedded
Systems:
T. Stamp/ 0-
suppress/For
matting/reduc
tion/
Calibration
Slow Control

FARM
L-3
Event-
Building
Data
Control
S. Control
Web
Services
Security

PAC

AsA
ASIC
ADC
FPGA
PULSER
T/V/I

+
Memo

gger

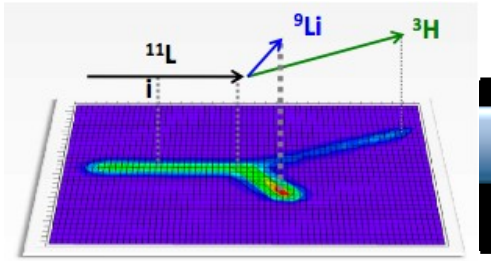
Front-End
Stab./Security
Coding

3 Levels
Trigger
Clock

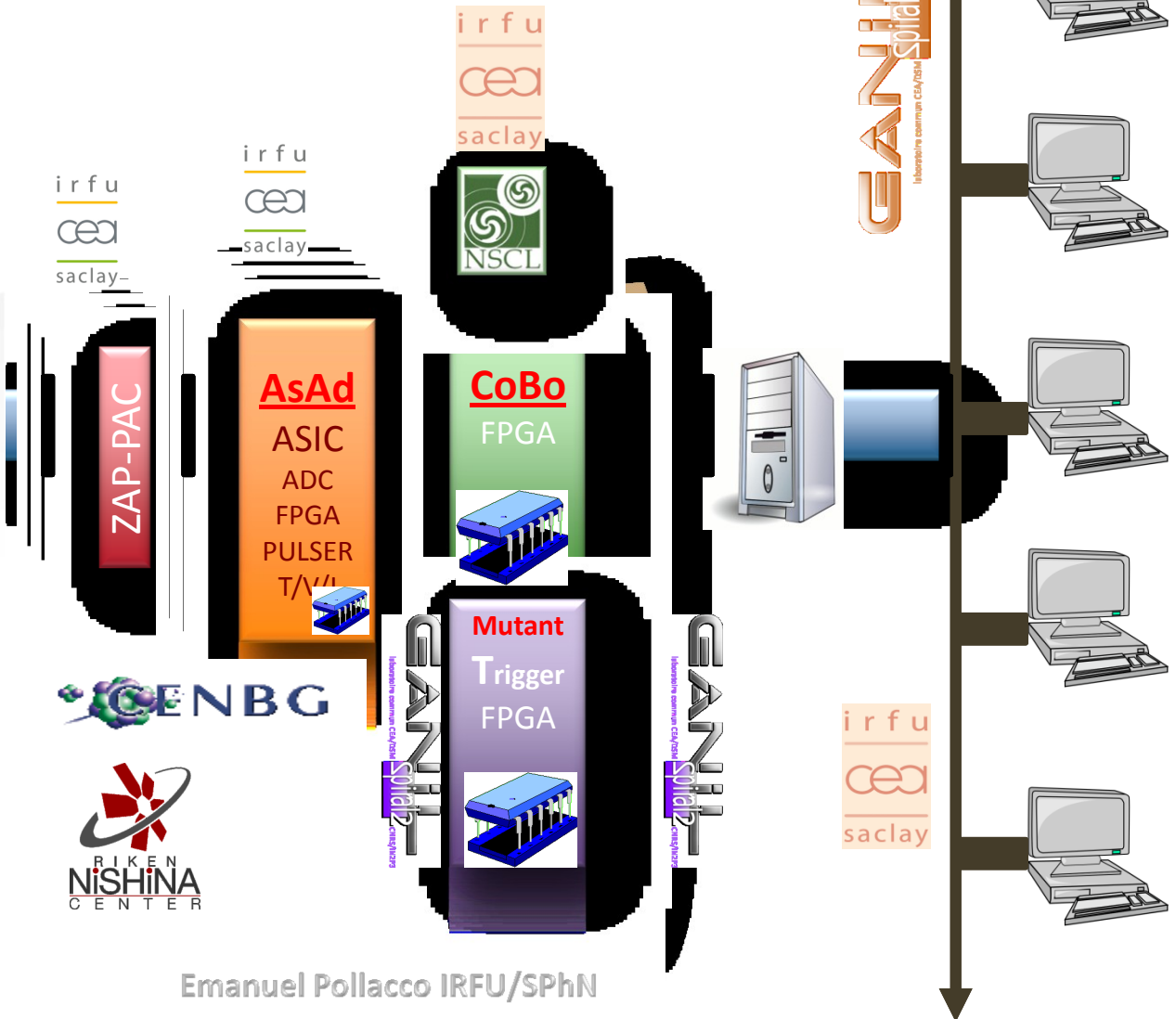
Emanuel Pollacco IRFU/SPhN

SYSTEM GET

Conceptuel Design

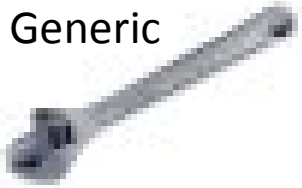


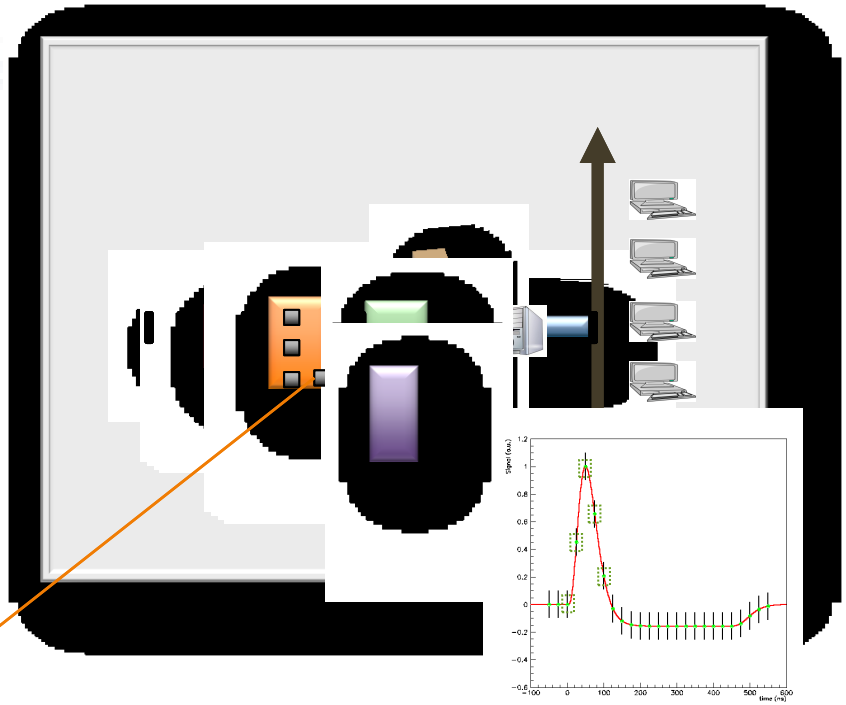
ACTAR

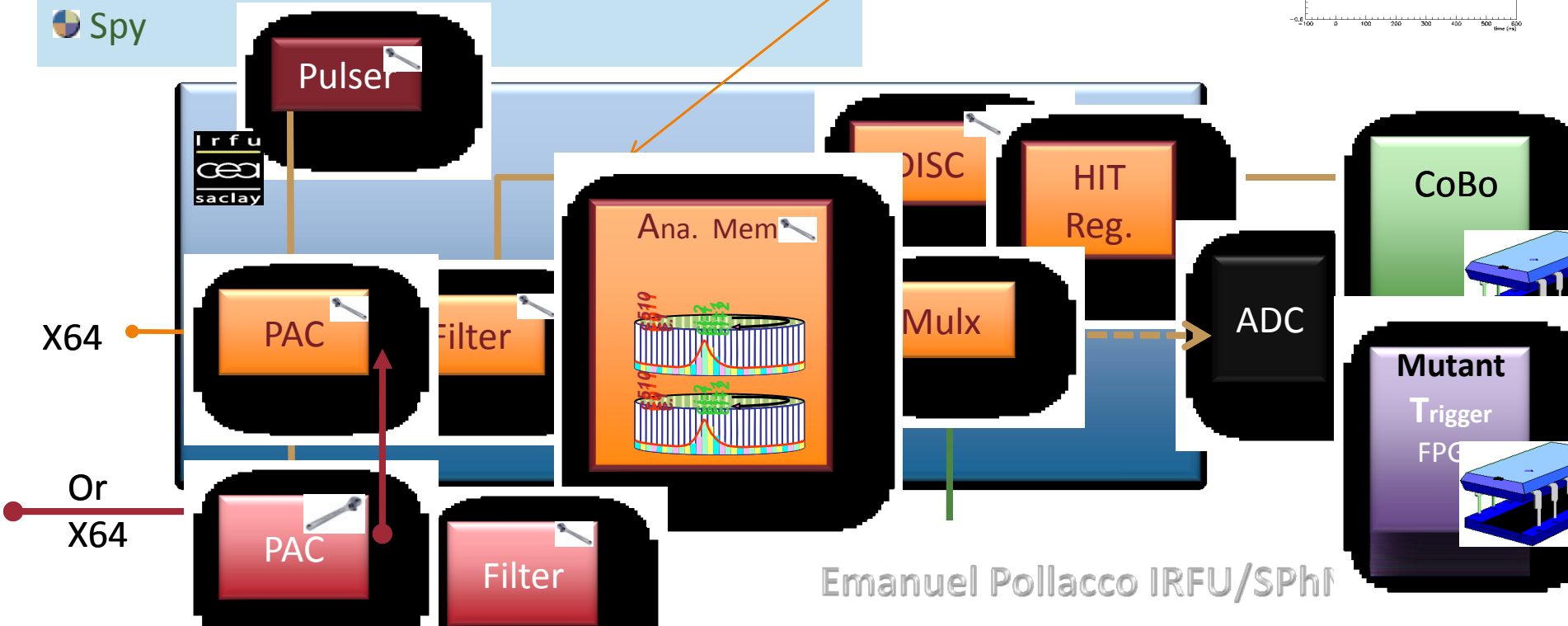


Asic AGET

- CMOS 0.35µm
- Int./Ext. PAC &/or Filter
- Gain & Disc/channel ➔ 120, 240 fC, 1, 10 pC.
- Shaping 50-1000 nsec
- Sampling rate 1-100Mhz ➔ 25MHz ADC 12/14bits
- Selective Readout – Hit Reg.
- Windowed SCA readout ➔ 128/256/512 or variable
- **2 fast time- consequative SCA windows**
- Pulser facilities
- Spy

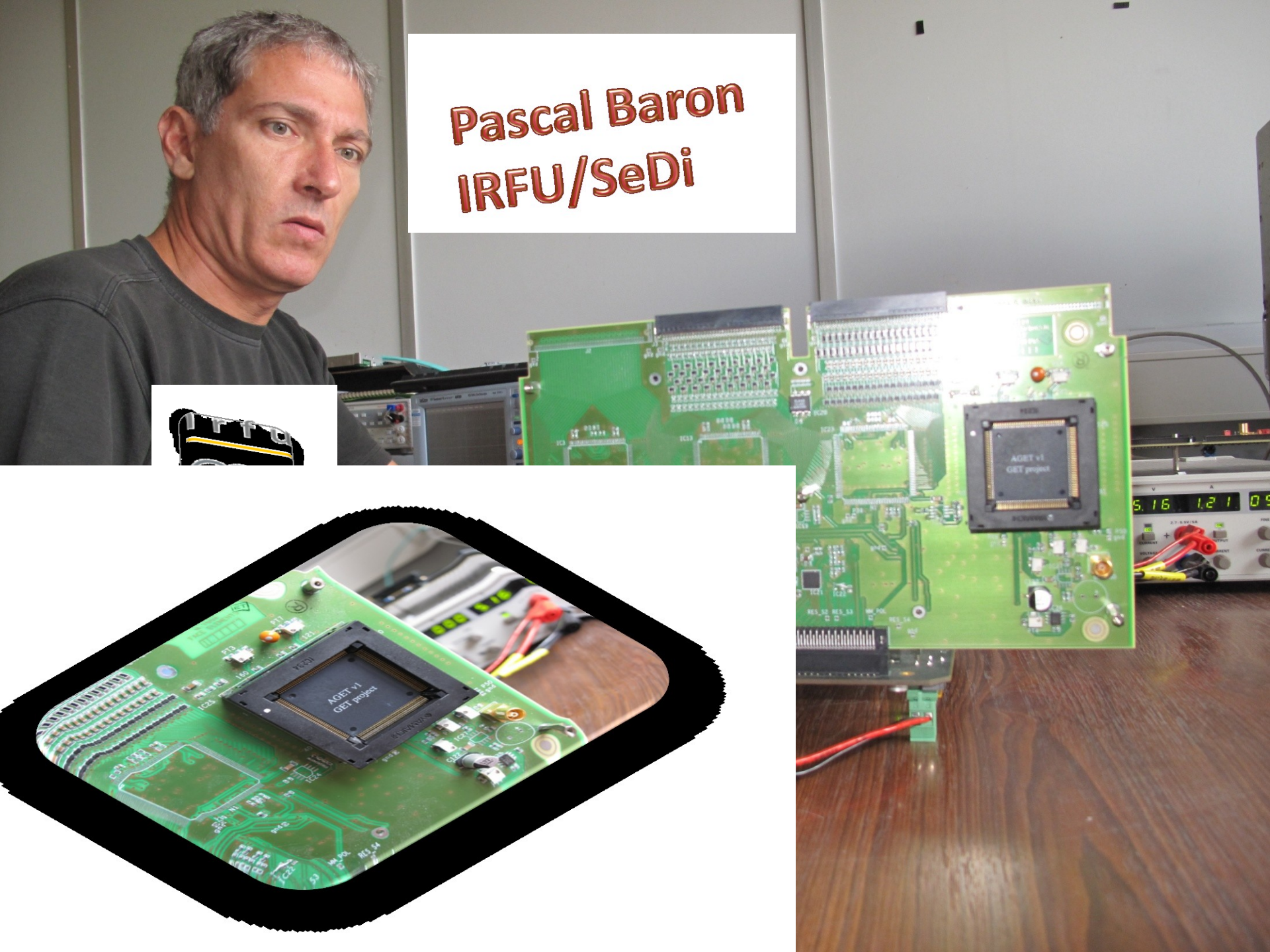






Emanuel Pollacco IRFU/SPhI

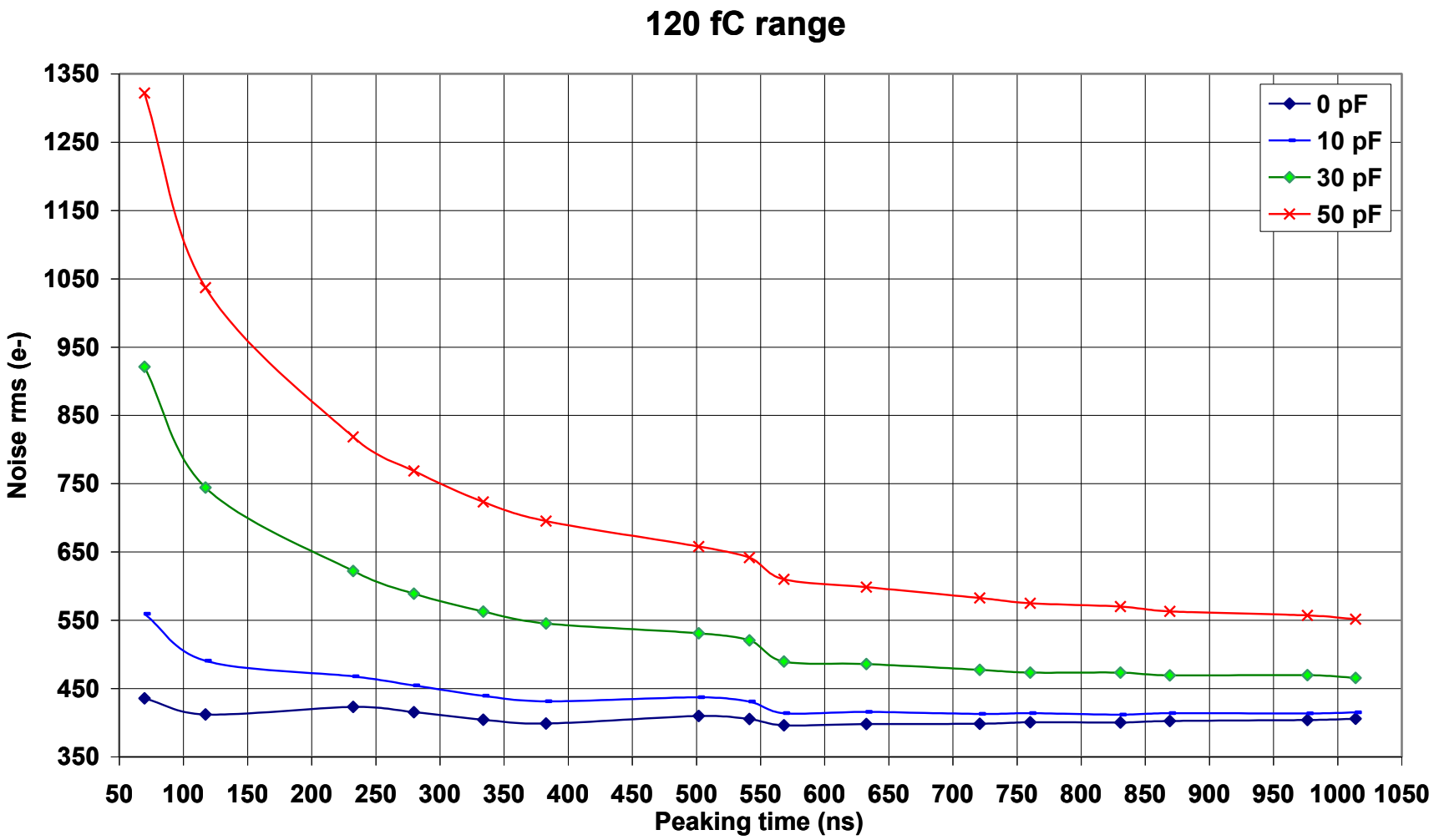
Pascal Baron
IRFU/SeDi

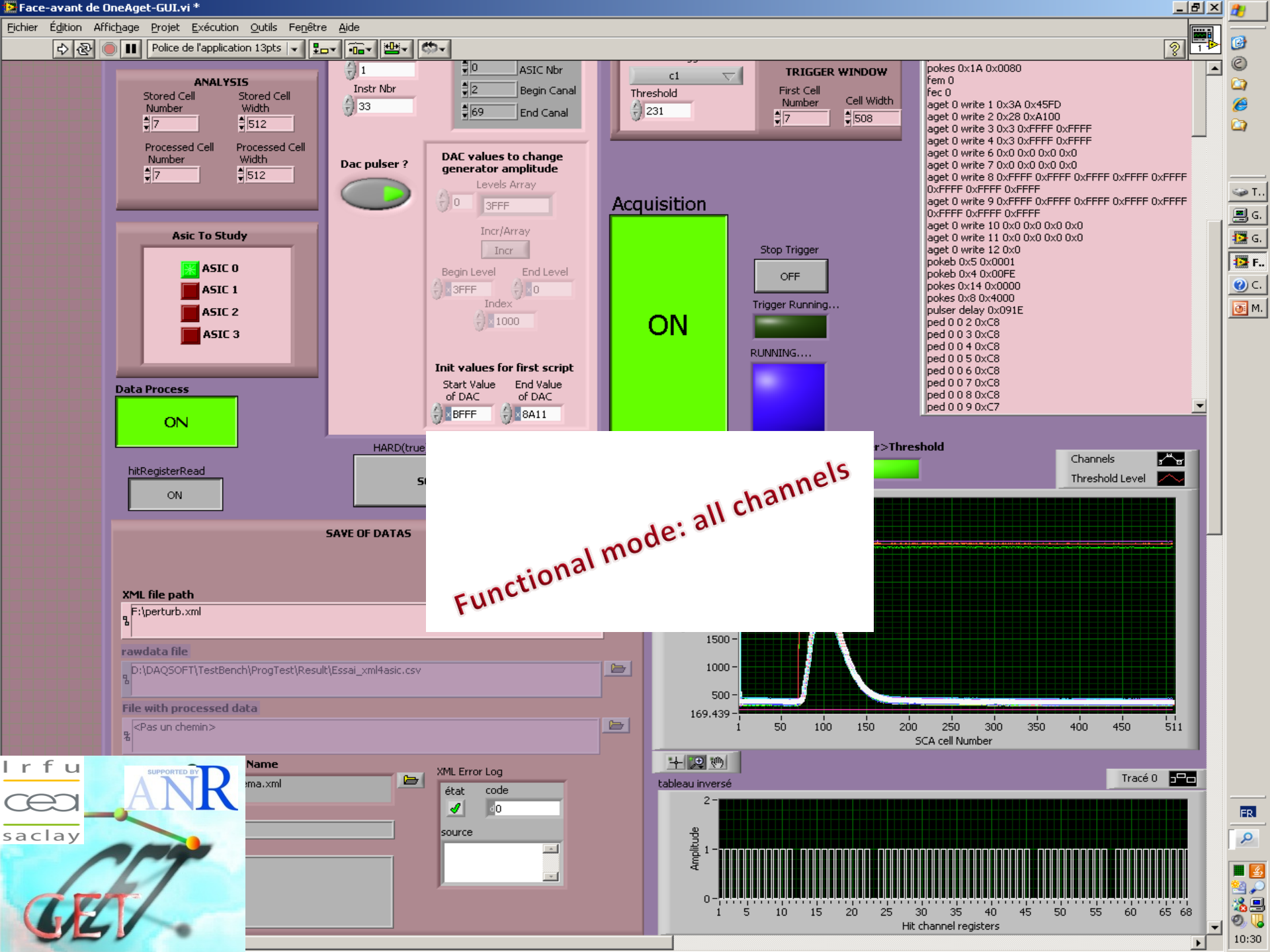


AGET: Charge Channel

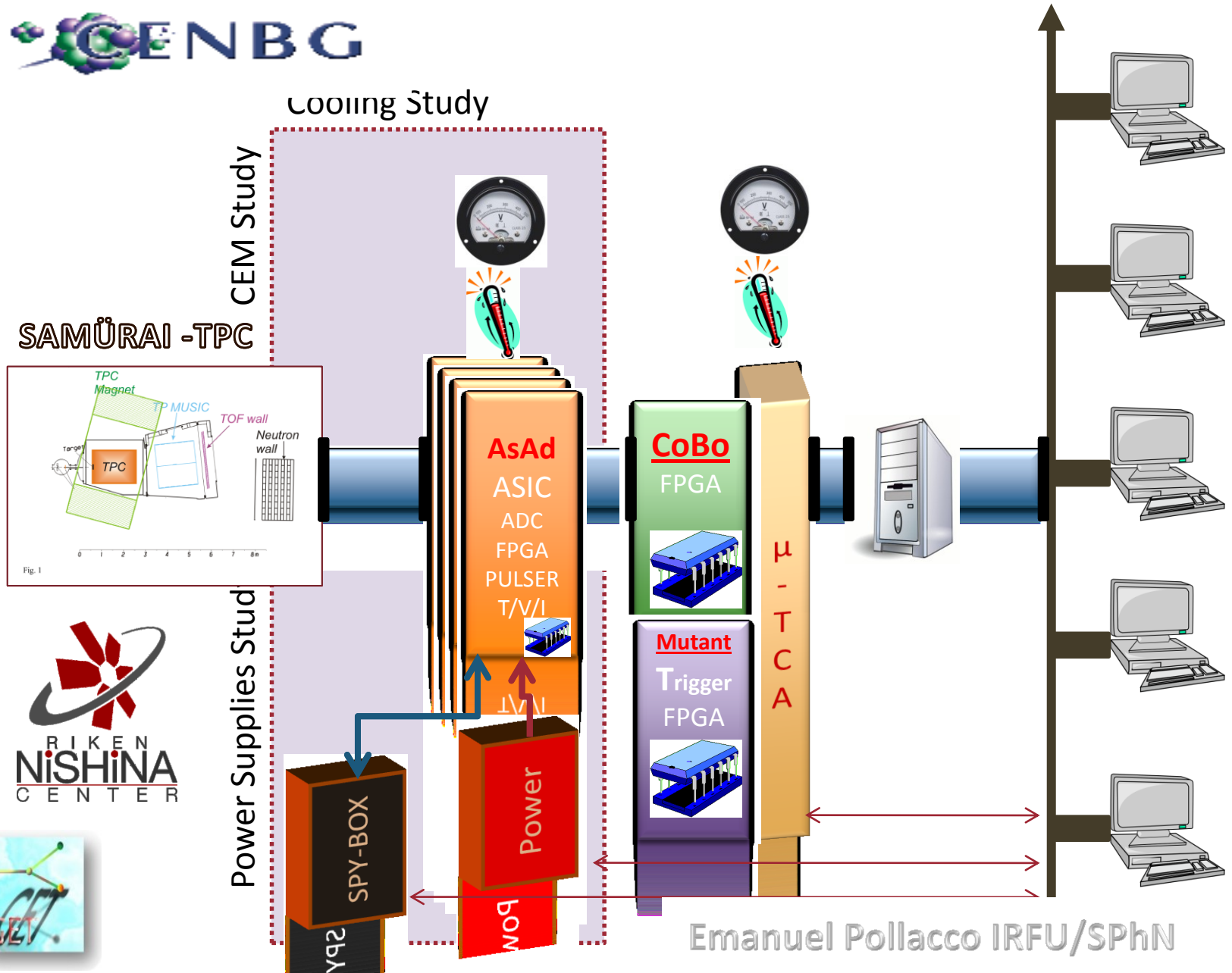
- **Some numbers:** Simulation results

Charge resolution: *versus input capacitor and peaking time*



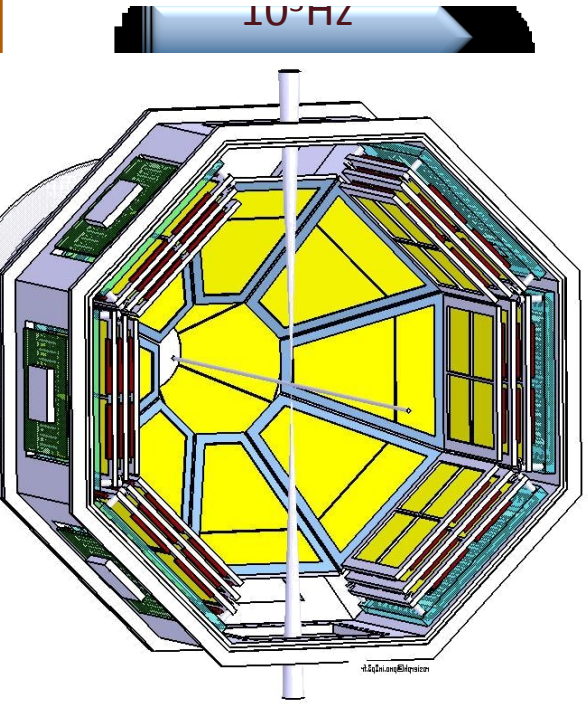

Face-avant de OneAget-GUI.vi *
Fichier Édition Affichage Projet Exécution Outils Fenêtre Aide
Police de l'application 13pts
ANALYSIS
Stored Cell Number
Stored Cell Width
Processed Cell Number
Processed Cell Width
Asic To Study
ASIC 0
ASIC 1
ASIC 2
ASIC 3
Data Process
ON
hitRegisterRead
ON
Instr Nbr
33
ASIC Nbr
Begin Canal
End Canal
Dac pulser ?
DAC values to change generator amplitude
Levels Array
3FFF
Incr/Array
Incr
Begin Level
End Level
Index
1000
Init values for first script
Start Value of DAC
End Value of DAC
BFFF
8A11
Threshold
231
TRIGGER WINDOW
First Cell Number
Cell Width
508
Acquisition
ON
Stop Trigger
OFF
Trigger Running...
RUNNING....
pokes 0x1A 0x0080
fem 0
fec 0
aget 0 write 1 0x3A 0x45FD
aget 0 write 2 0x28 0xA100
aget 0 write 3 0x3 0xFFFF 0xFFFF
aget 0 write 4 0x3 0xFFFF 0xFFFF
aget 0 write 6 0x0 0x0 0x0 0x0
aget 0 write 7 0x0 0x0 0x0 0x0
aget 0 write 8 0xFFFF 0xFFFF 0xFFFF 0xFFFF 0xFFFF 0xFFFF 0xFFFF 0xFFFF
aget 0 write 9 0xFFFF 0xFFFF 0xFFFF 0xFFFF 0xFFFF 0xFFFF 0xFFFF 0xFFFF
aget 0 write 10 0x0 0x0 0x0 0x0
aget 0 write 11 0x0 0x0 0x0 0x0
aget 0 write 12 0x0
pokeb 0x5 0x0001
pokeb 0x4 0x00FE
pokes 0x14 0x0000
pokes 0x8 0x4000
pulser delay 0x091E
ped 0 0 2 0xC8
ped 0 0 3 0xC8
ped 0 0 4 0xC8
ped 0 0 5 0xC8
ped 0 0 6 0xC8
ped 0 0 7 0xC8
ped 0 0 8 0xC8
ped 0 0 9 0xC7
HARD(true
SAVE OF DATAS
XML file path
F:\perturb.xml
rawdata file
D:\DAQSOFT\TestBench\ProgTest\Result\Essai_xml4asic.csv
File with processed data
<Pas un chemin>
Name
ma.xml
XML Error Log
état
code
0
source
Functional mode: all channels
>Threshold
Channels
Threshold Level
1500
1000
500
169.439
1 50 100 150 200 250 300 350 400 450 511
SCA cell Number
Tracé 0
tableau inversé
Amplitude
2
1
0
1 5 10 15 20 25 30 35 40 45 50 55 60 65 68
Hit channel registers
Irfu
cea
saclay
SUPPORTED BY ANR
GET
10:30

EMC, Connectors, Cables, Temp. Monitoring & Security

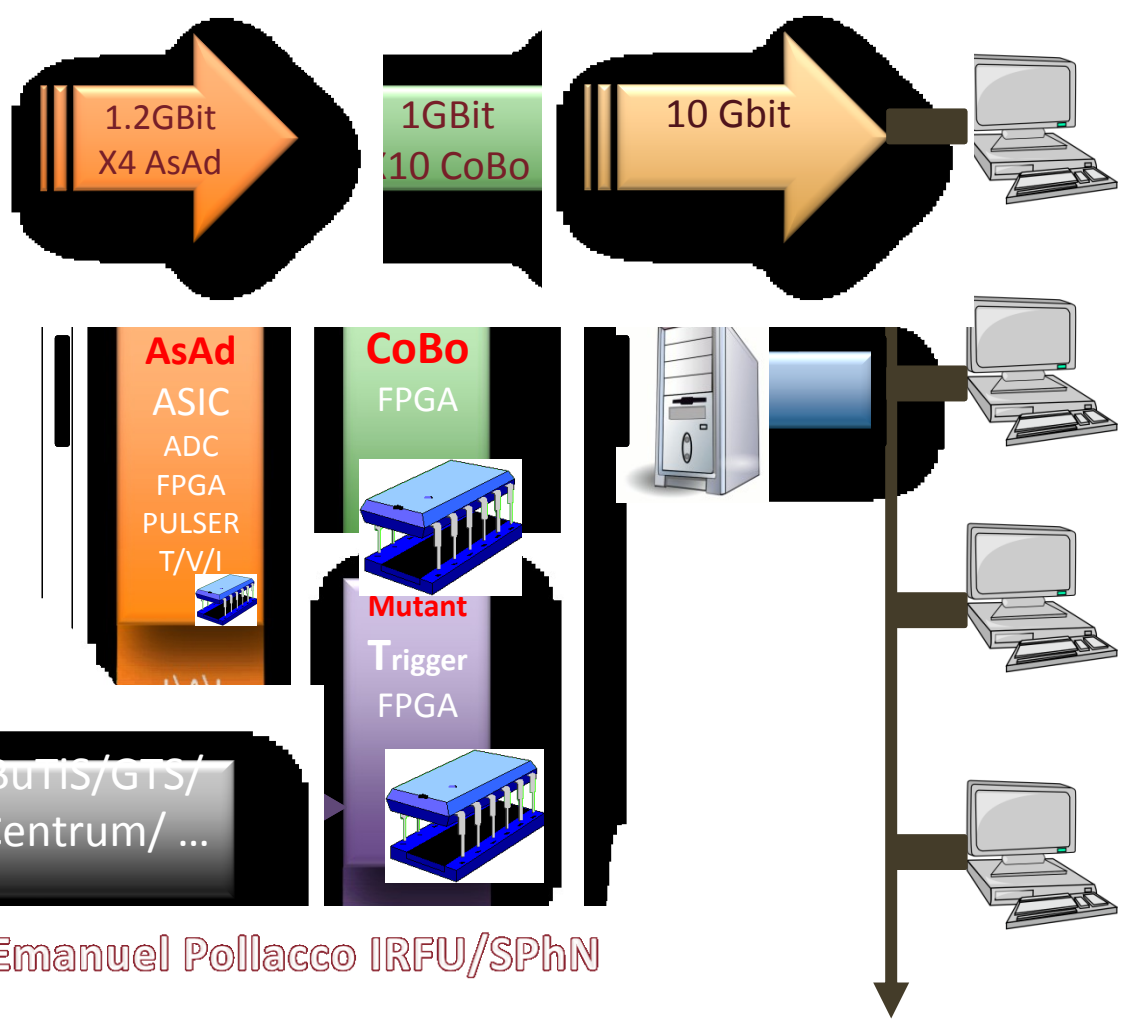


Band Width & Trigger

Common Dead Time
Or
Individual AsAd Dead-Time

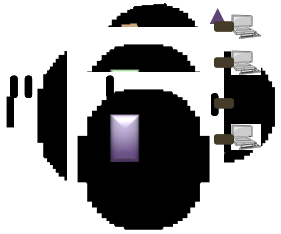


GASPARD



Emanuel Pollacco IRFU/SPhN

MUTANT (Multiplicity Trigger and Time stamp)



Nucl. Phys. Have Limited Experience ➔ Scenarios/Simul.

4-level triggers

L0: External trigger

L1: Time dependent Multip. trigger

➔ Self Trigger, …

L2: Hit Pattern trigger ➔ Self Trigger, calculated read pattern …

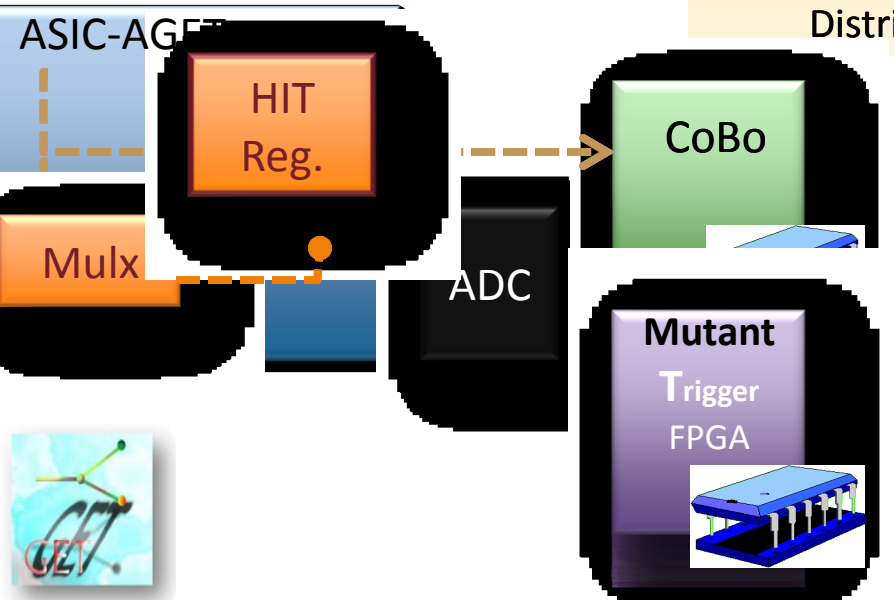
L3: Soft trigger

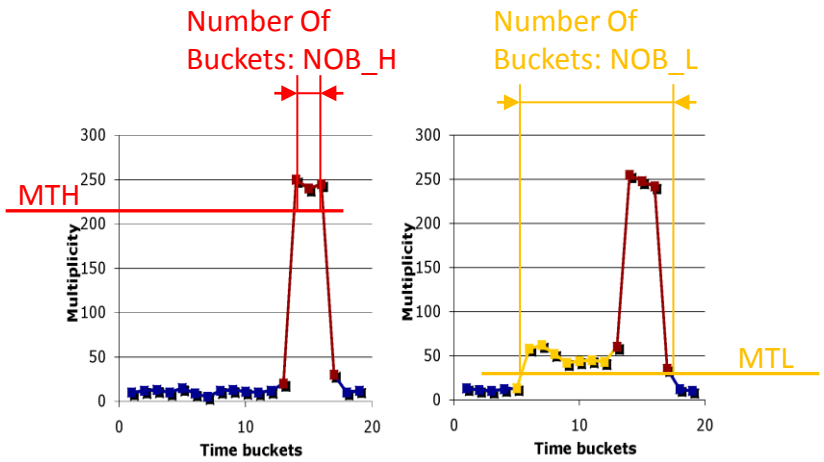
Compute the digital trigger from CoBos (25MHz)

Time stamp (48b, 10ns) and event N° (32b)

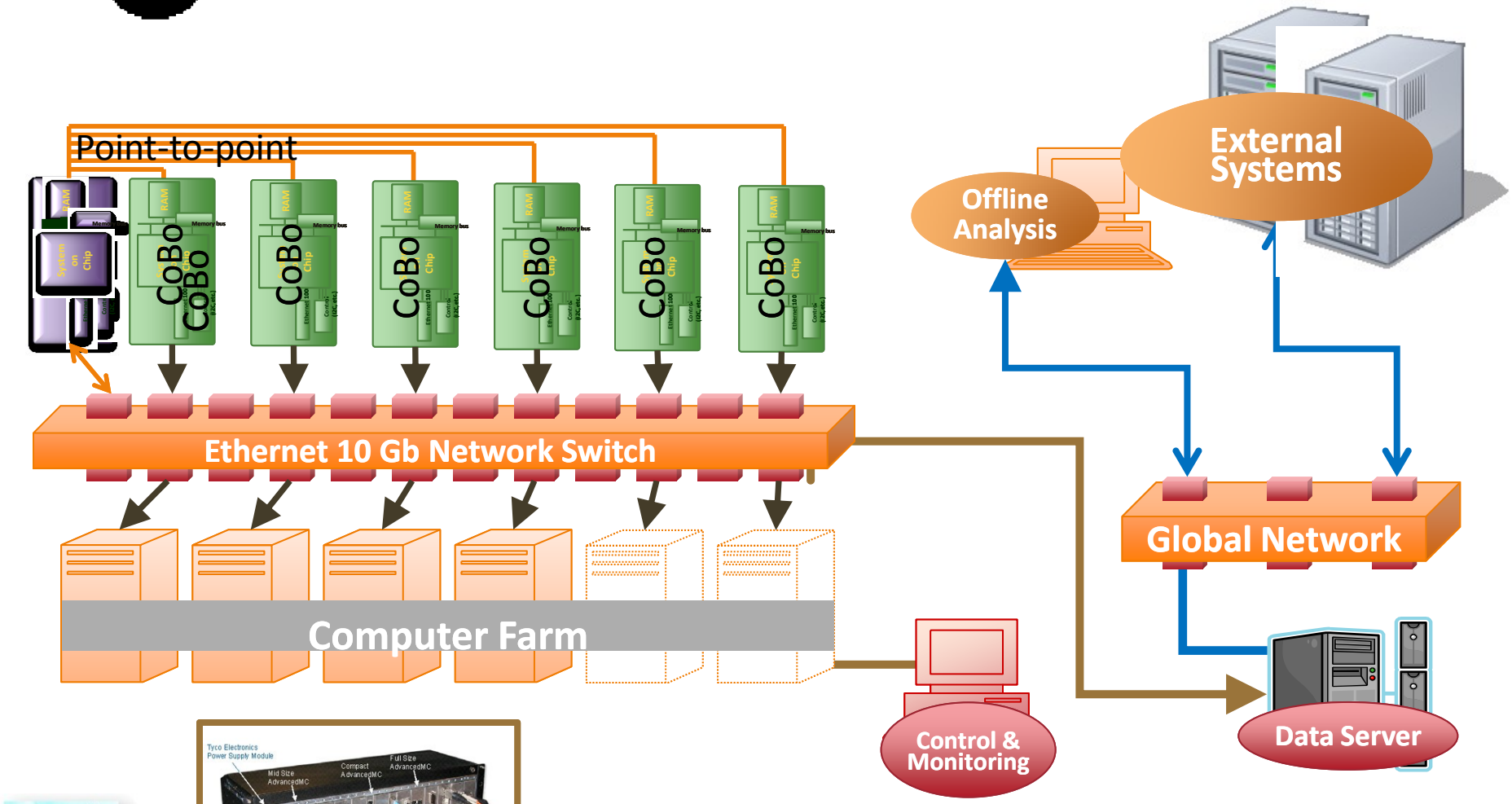
Distribute the 100MHz clock for the synchronisation

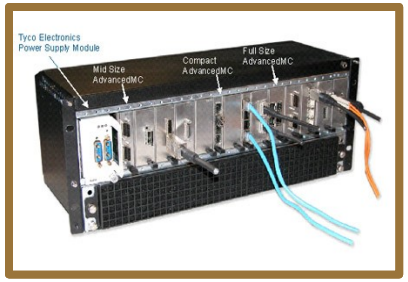
Trigger Building Data Transfer





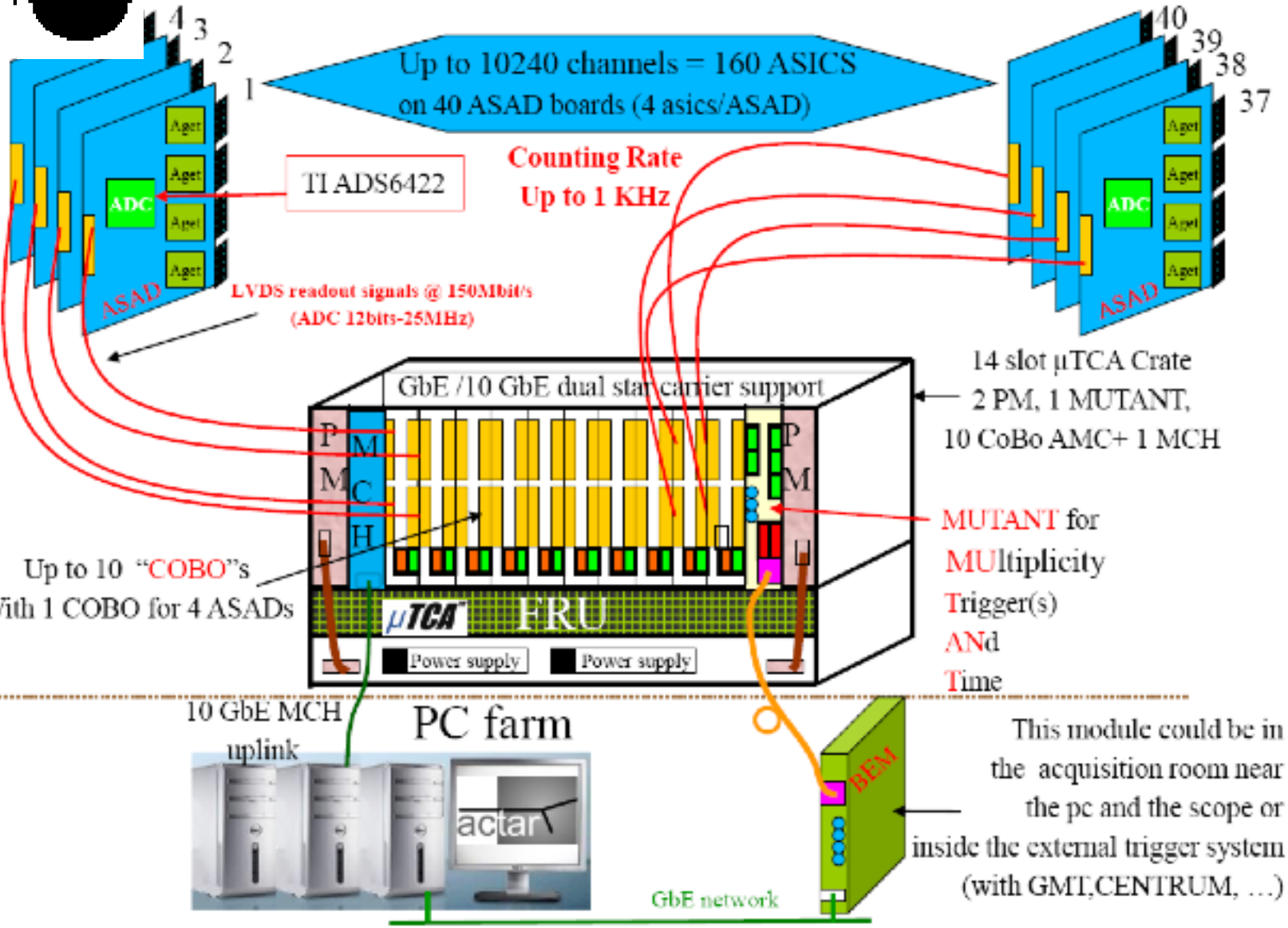
Global View of DAQ Hardware Infrastructure



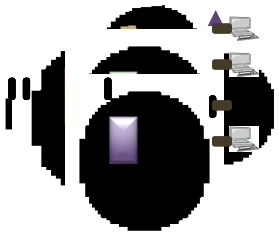


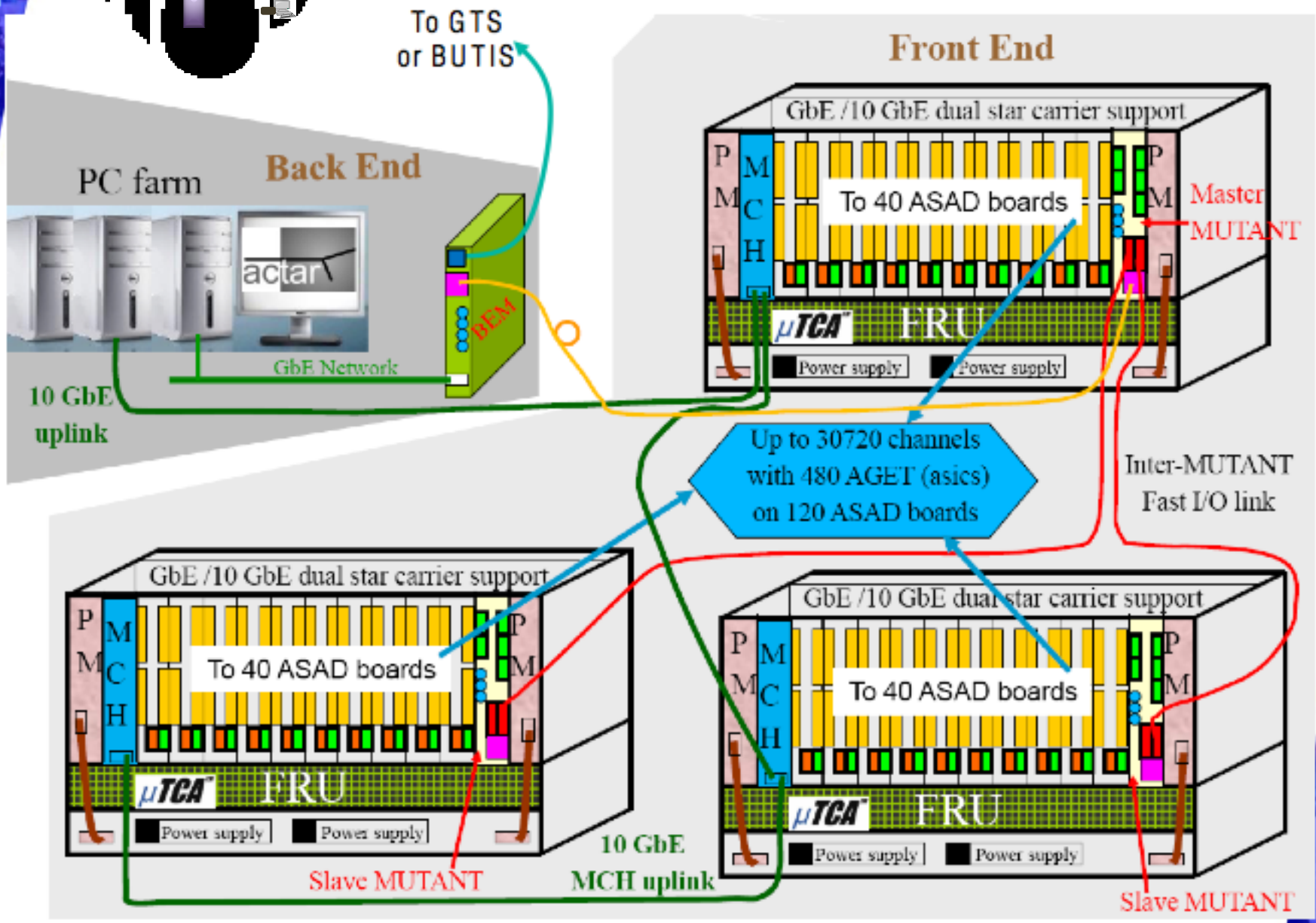
Shebli ANVAR, CEA Irfu

1 µTCA shelf typical architecture

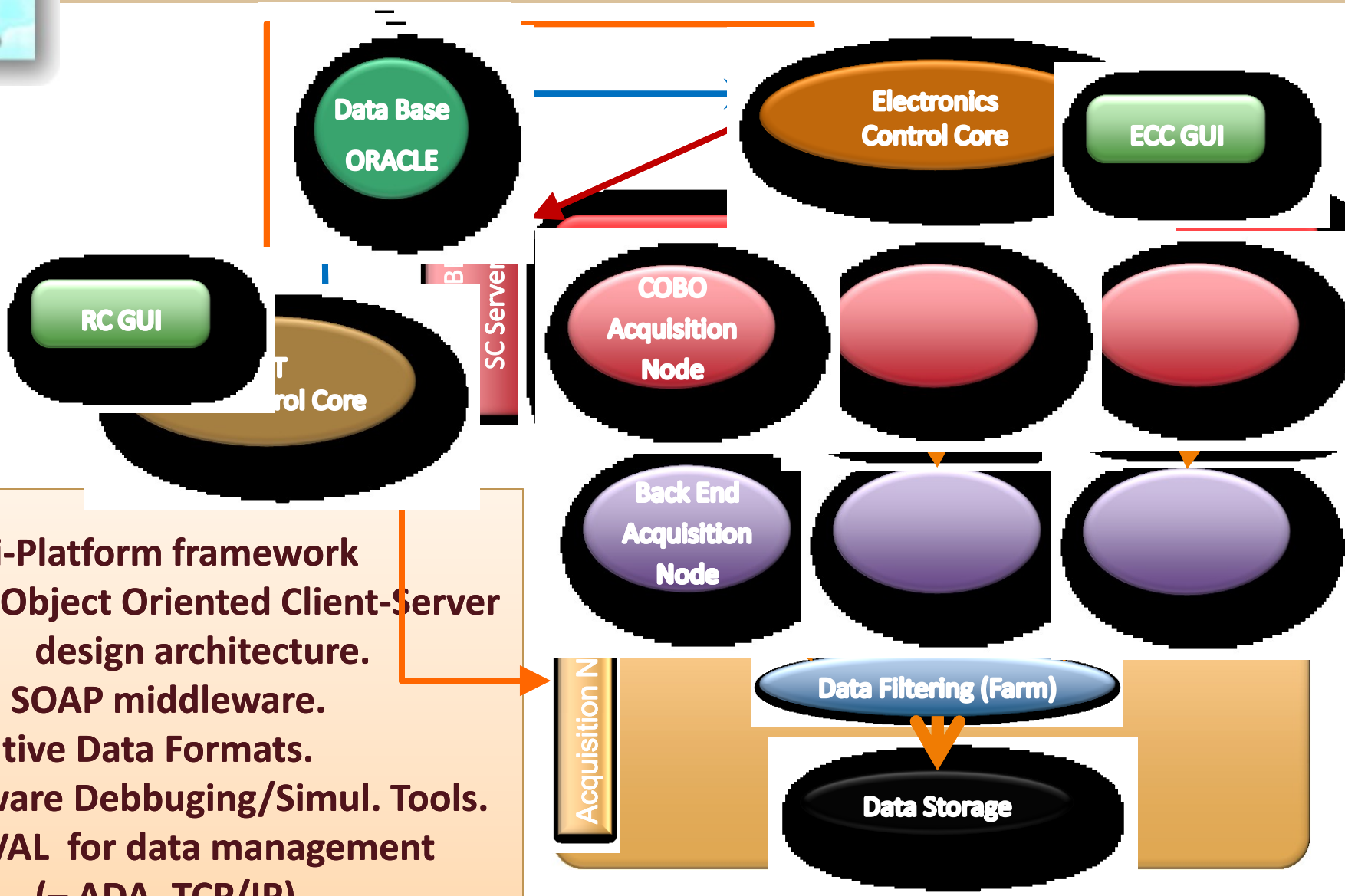


Full architecture – 3 μTCA shelves





Software/Firmware developments



- Multi-Platform framework
- Fully Object Oriented Client-Server design architecture.
- ICE & SOAP middleware.
- Evolutive Data Formats.
- Software Debbuging/Simul. Tools.
- NARVAL for data management (– ADA, TCP/IP).

S. Anvar, GET coll.

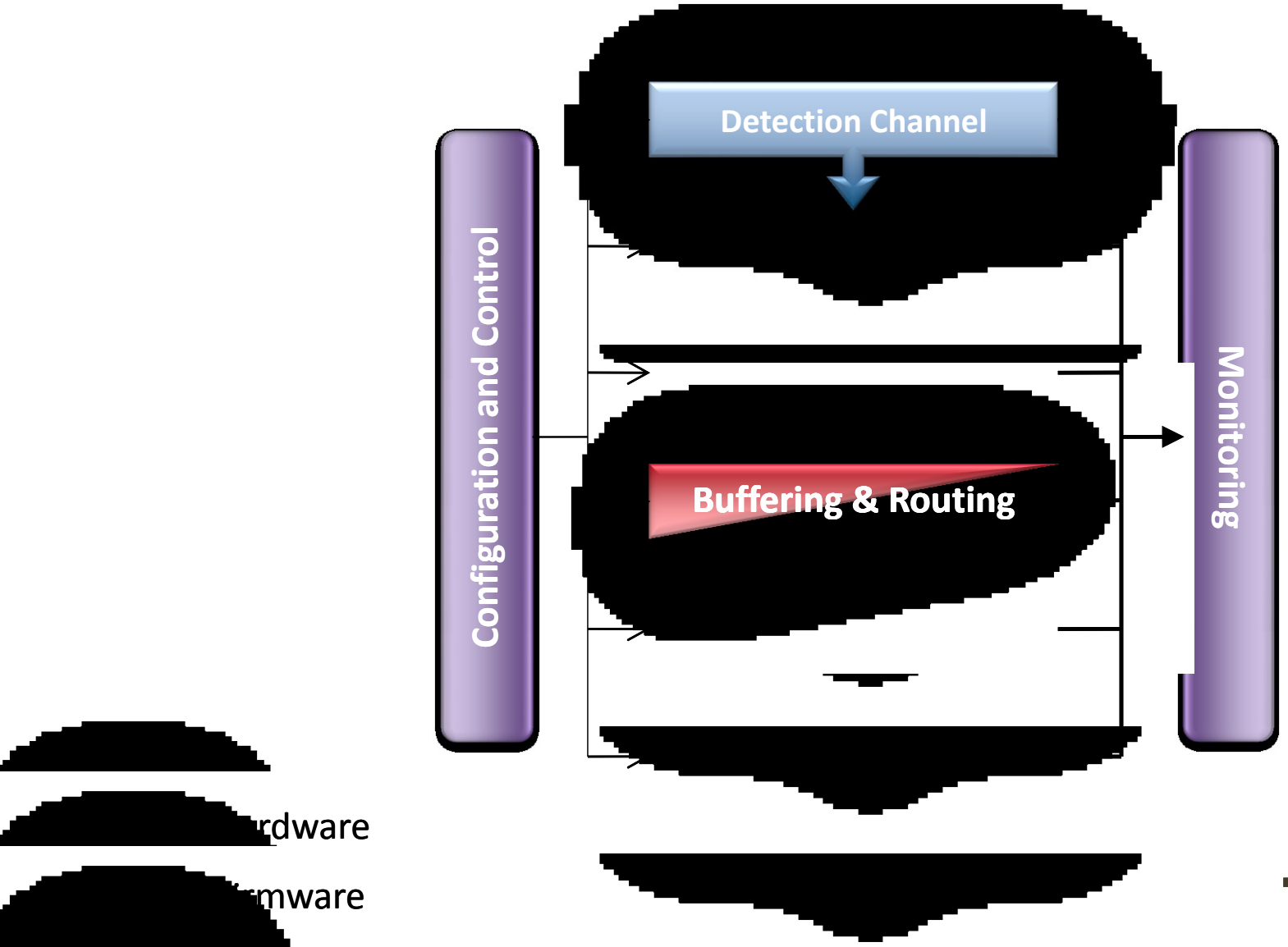
Reconfigurable Approach

Via:- Hardware - Software Architecture
Documentation & Simulation tools

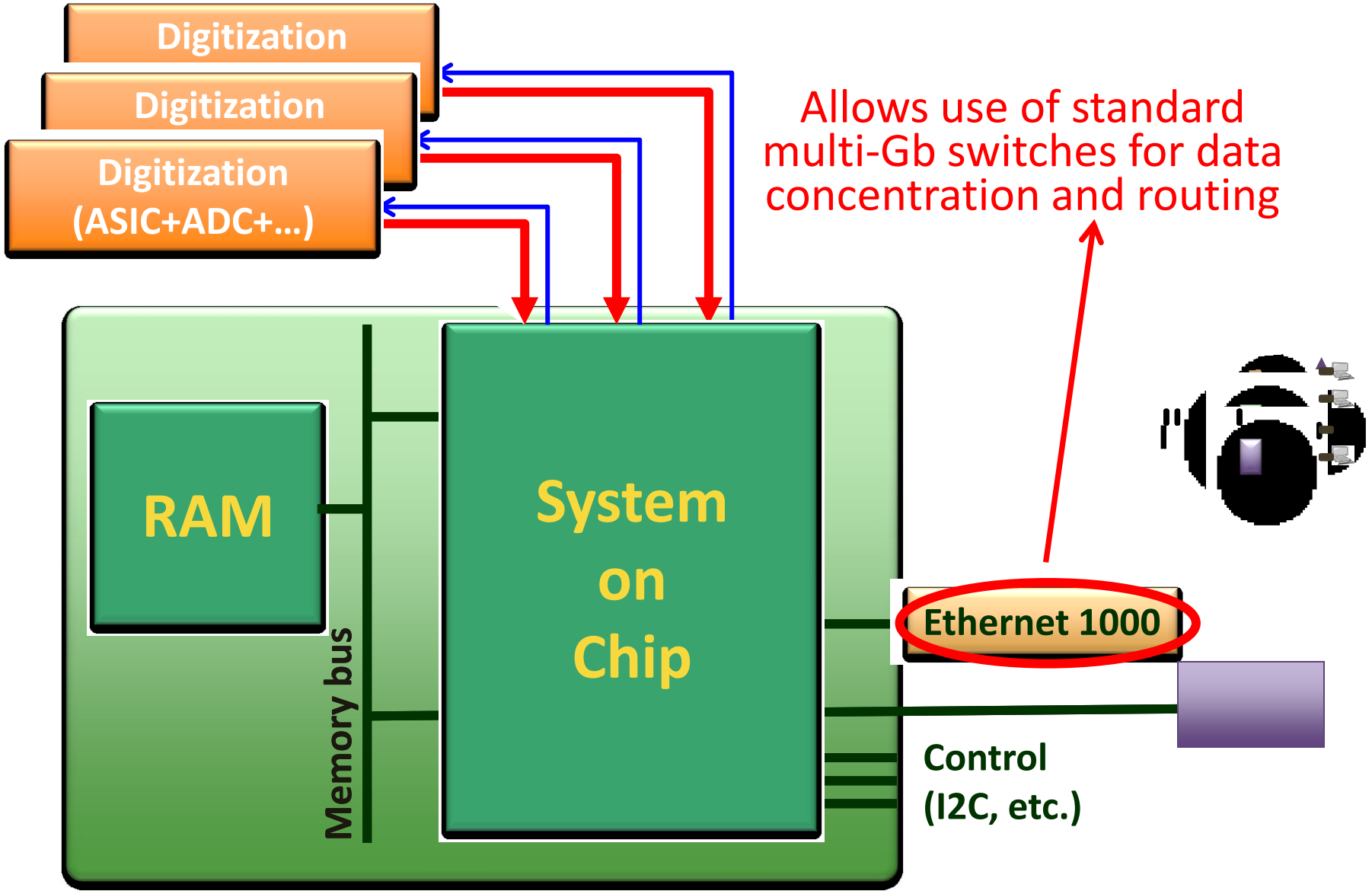
Genericity ➔ Multi-Platform (Linux, VxWorks, Windows, Mac) framework
Fully Object Oriented Client-Server design architecture.
ICE & SOAP middleware.
Evolutive Data Formats.
Software Développement /Debbuging/Simulation Tools.
NARVAL for data management (NARVAL – ADA, TCP/IP).

END

Control, Acquisition & Online Processing

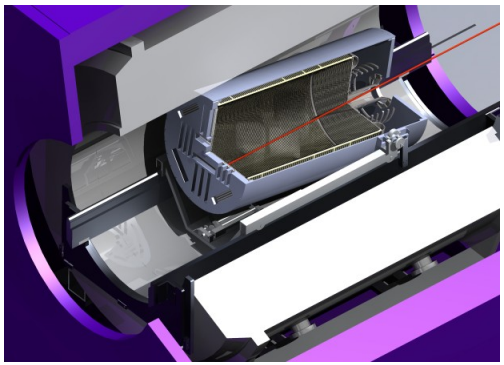


Embedded Implementation (Upstream)



Polarity of detector signal	Negative or Positive
External Preamplifier	Yes; access to the filter or SCA inputs
Charge measurement	
Input dynamic range	120 fC; 1 pC; 10 pC
Output dynamic range	2V p-p
Resolution	< 850 e- (Charge range: 120fC; Peaking Time: 200ns; Cinchannel. < 30pF)
Sampling	
Peaking time value	50 ns to 1 µs (16 values) [new]
Sampling Frequency	1 MHz to 100 MHz
Time resolution	
Jitter	60 ps rms
Trigger	
Discriminator solution	L.E.D
Dynamic range	5% of input charge range
Threshold value	4-bit DAC/channel + (3-bit + polarity bit) common DAC
Readout	
Readout frequency	20 MHz to 25 MHz
SCA Readout mode	512 cells; 256 cells; 128 cells
Test	
calibration	1 channel / 64; external test capacitor
functional	1, few or 64 channels; internal test capacitor/channel
Counting rate	< 1 kHz
Power consumption	< 10 mW / channel

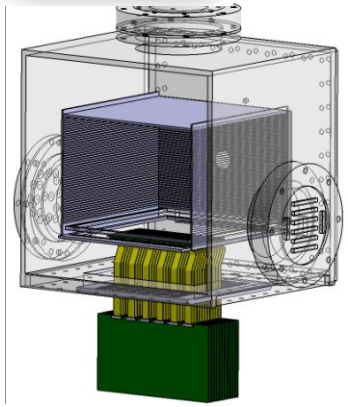
Number Channelling



AT-TPC

Channel Number – can be increased

GET Overview



Front-end boards
Asic+ADC
HV, I, T monitoring

Data Readout & Trig
Zero suppress
Time stamp
3-Level trigger

DAQ & Slow control
Run control
Online analysis
Electronics control

irfu cea saclay

CENBG

ZAP | Ext preamp | AGET | ADC

ASAD

NSCL

Readout | Signal process | CoBo | Gb transfer

Clock distrib | Trigger L0-2 | MUTANT | Process L1 -> L2

Inspection box time alignment (Riken)

Spy box

Time reference (GSI Butis)

Clock provider

irfu cea saclay

ECC | Config manager | SLOW CONTROL | Data base

Event builder | Run control | Event analysis | Storage

NARVAL

DAQ

GANIL spiral2

Micro-TCA standard