The electronics for AFTER

and not ….

Outlines

- Instrumentation at IPN Orsay
- Granularity issues
  - Detectors segmentation
  - Integrated circuits
  - Data analysis methods
  - Data transfert issues
- Conclusion

INSTRUMENTATION & COMPUTING DEPARTMENT

D 2 I

Director

V. Chambert (IRHC)

Secretary: L. Berthier (TCS)

Computing

B. Préciado (IR1) (+linux 50%)

Secretary : P. Guarnaccia (TCS) (+windows 80%)

DAQ

X. Grave (IR1) (+chef de projet AGATA/NARVAL)

ALICE

S. Rousseau (IR2) (Chef de projet)

V. Lafage (IR2) (+calcul 30%)

TANDEM/ALTO

K. Nguyen-Kim (IE2) (+NARVAL 30%)

AGATA

D. Delbourg (IE2) (+MAC 50%)

Support & développement applications CERN

I. Hrivnacova (IR2) (+Alice 50%)

Andromède

J. Peyré (IRHC) (+animation groupe support)

Applications graphiques WEB

JL. Coacolo (IR2) (+DA 25%)

Calcul parallèle

Luz Guevara (IR2)

Exploitation

Y. Aubert (IR2) (+linux/AGATA 20%)

WINDOWS
F. Yahia (IE2)
S. Du (IE2)
E. Cabrera (CDD T)

LINUX
L.-A. Couturié (IR2)
G. Lalu (I2) (+ALICE 30%)

GRILLE DE CALCUL
Ch. Diarra (IR1)

RESEAU & TELEPHONIE IP
N. Barré (IE2)

BASES DE DONNEES
F. Mellac (IE1)
(+windows 30%)

Electronics

E.Wanlin (IR1)

Deputy : E. Rauly (IR2)

Secretary : L. Berthier (TCS)

Analogue electronics

E. Rauly (IR2)*

G. Brulin (AI) (50%CAO)

J.J. Dormard (IR2)*

E. Wanlin (IR1)*

* *microélectronique*

Digital electronics

B.-Y. Ky (IE2)

L.Faurlini (IR1)

A. Lermitage (AI) (50%)

G. Noël (AI) (50% CAO)

C. Oziol (IE1)

F. Salomon (IE2)

K.M.M. Tun Lanoë (IE2)

Technology

A. Lermitage (AI) (50%)

D. Lalande (TCS)

S. Tanguy (TCE)

F. Tcha (TCN)

F. Dorangeville (AI) Achats

Detectors

P. Rosier (IR1)

Adjoint : B. Génolini (IR1)

Secrétariat: L. Berthier (TCS)

Mechanics

Ph. Rosier (IR1)

J. Bettane (IR2)

BE Mécanique

C. Le Galliard (IE2)

G. Minier (AI)

E. Rindel (AI)

Construction de Détecteurs

A. Maroni (IE1)

C. Domagalik (AJTPU)

M. Imre (TCN)

L. Séminor (TCS)

C. Théneau (TCE)

B. Geoffroy (TCN)

C.F.A.O. - Tôlerie

L. Vatrinet (IE2)

B. Mathon (AI)

C. Domagalik (AJTPU)

Instrumentation

B. Genolini (IR1)

G. Hull (IR2)

T. Zerguerras (IR2)

Groupe détecteurs à semi-conducteurs

T. Faul (IR CDD)

J.L. Cercus (AI)

V. Le Ven (AI)

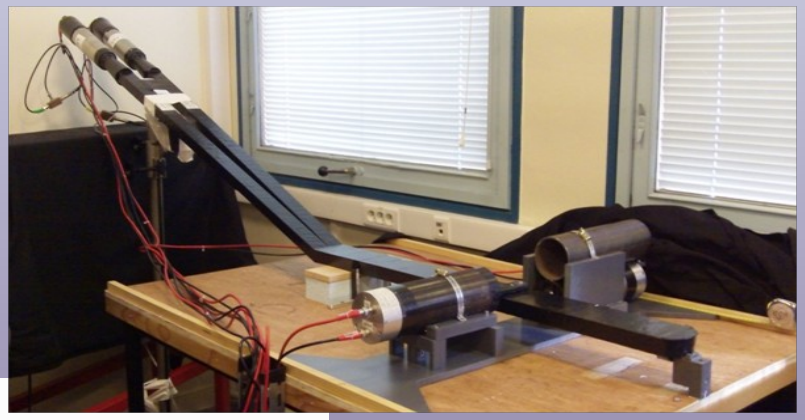
BE Electronique

T. Nguyen Trung (AI)

M. Josselin (AI)

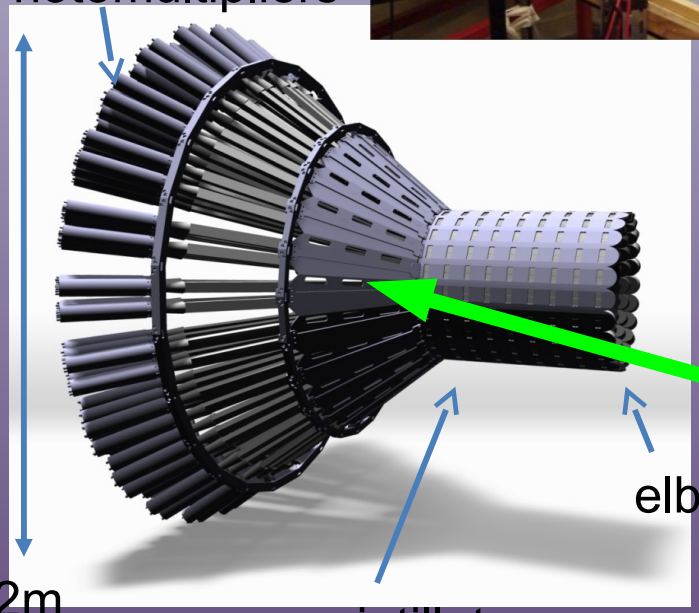
Photodetection

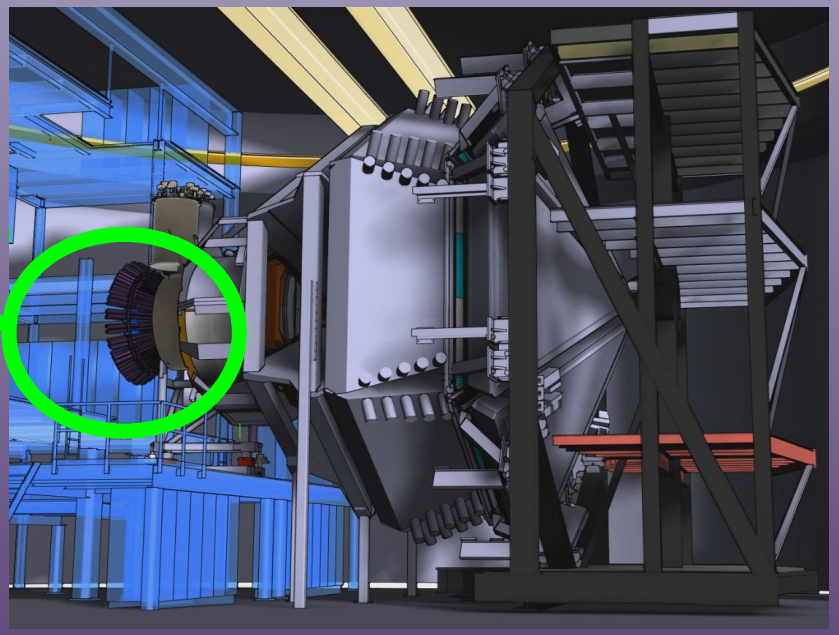
Neutron detector
CLAS12 JLAB 2014



EXELR3B prototype

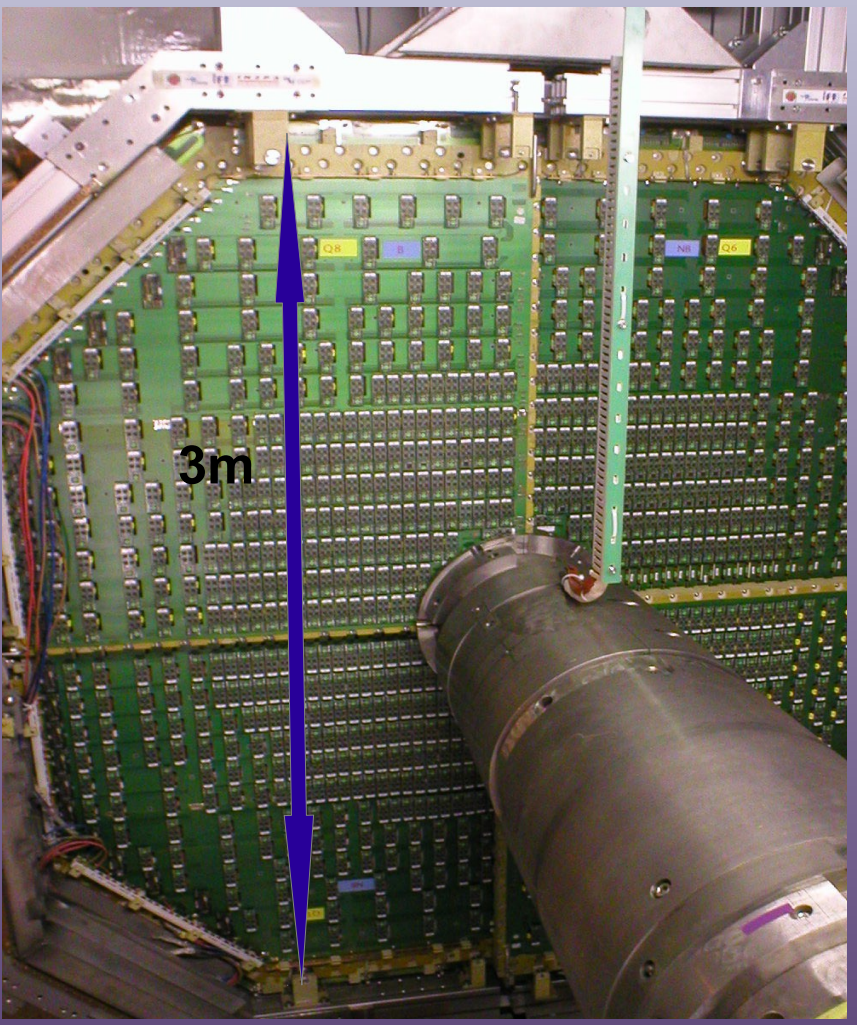
Photomultipliers



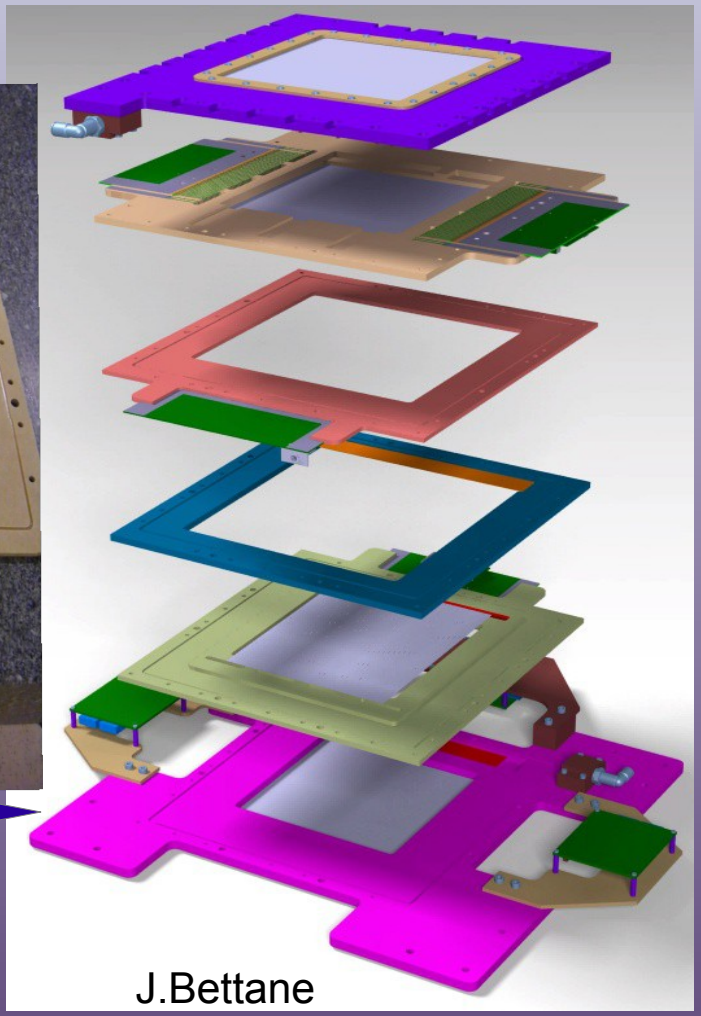


Gazeous detectors

ALICE Dimuon arm wires chambers

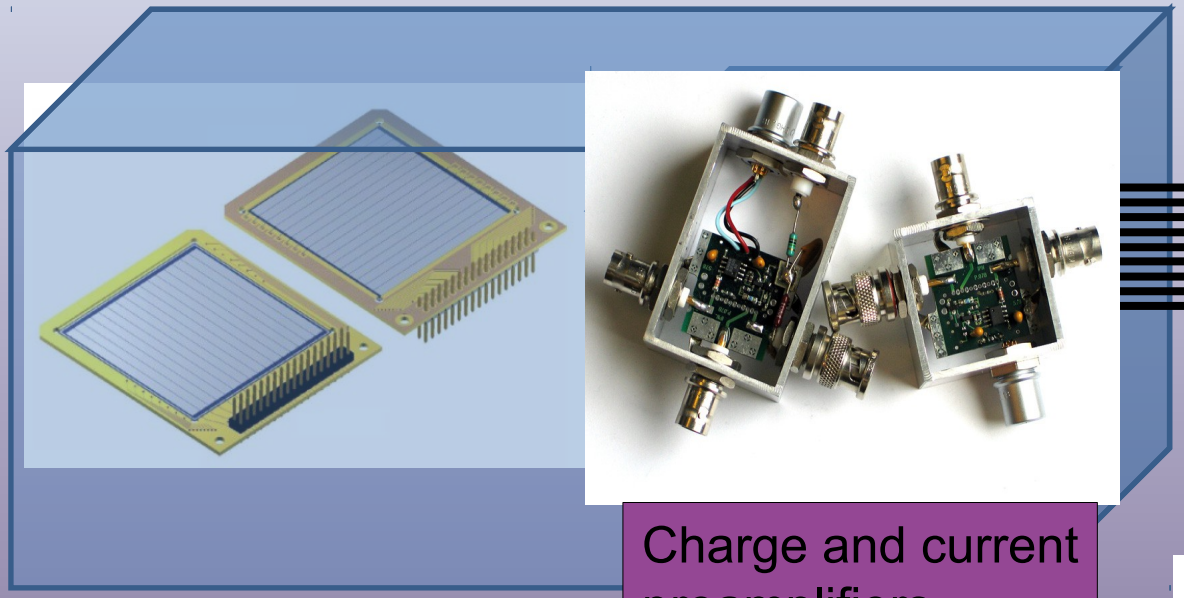


Wire chambers for exotic actinides fission study



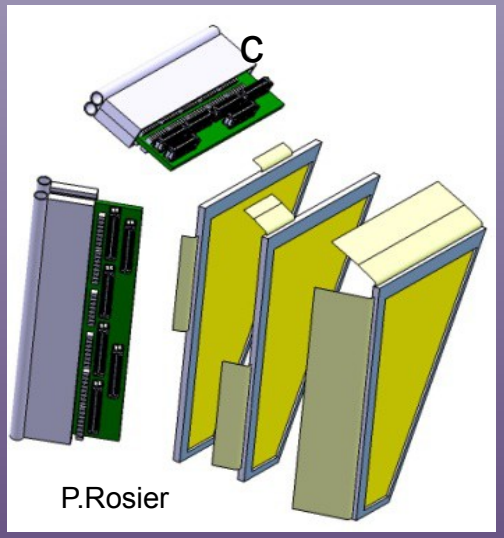
J.Bettane

Multistrip silicon detectors

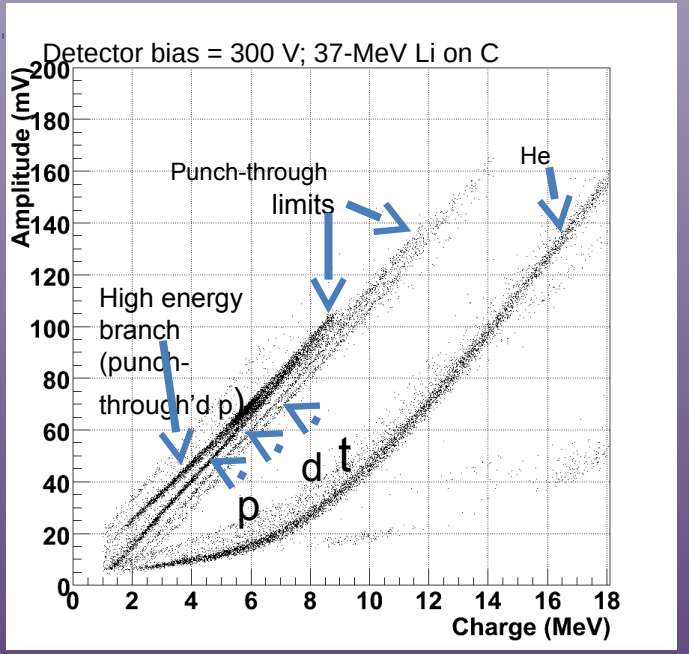


Charge and current preamplifiers

Digital Data Processing
- **Signal acquisition**
- **+**
- **Digital Pulse Processing**



Gaspard experiment proposal



Some numbers

- 60 persons including 36 engineers
- 40 projects in progress
- Collaborations with: GANIL, CERN, Jlab, GSI, …
- Publications 2012:
  - 1st autor : NIM (PARIS), NDIP [résolution with charge of Phoswich LaBr3/NaI - G. Hull, T. Zerguerras, B. Genolini]
  - 2nd autor : M. Chabot, Rev. Sci. Inst. (AGAT/CCD/X) [montage, calcul étalement charges] [B. Genolini] ; PMm2, NIM [PMTs, measurement] [B. Genolini]
- Conferences:

  1st author : poster NDIP'11 (PARIS) (G. Hull), ANSIP 2011 (X.Grave), CHEP 2010(I. Hrivnacova)

  2nd author : poster NDIP'11 (PMm2) (B. Genolini, E. Wanlin, BY. Ky)

  Participation : IEEE-NSS-MIC (scintillateurs, détecteurs gazeux, traitement du signal, FEE) (G. Hull, B. Genolini), Tweep 2011 (E. Wanlin, B. Genolini), ACES 2011 (V. Chambert),

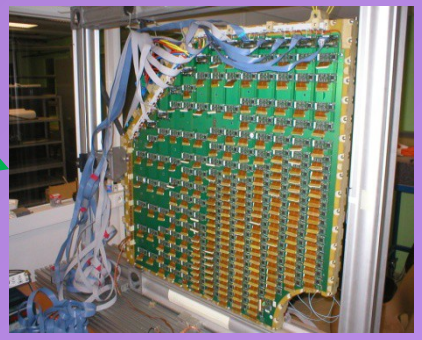
  Organisation PhotoDetection'12 (B. Genolini)

From detector to measurements

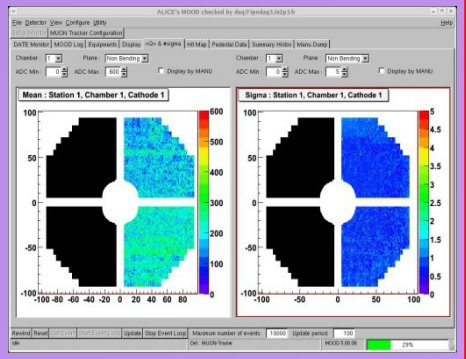
DAQ

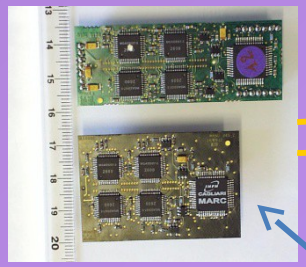
Détectors

ST12



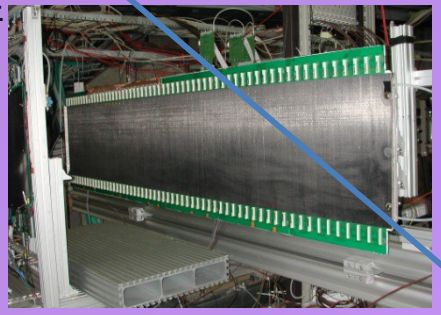
DAQ
ECS
Slow
Control





MANU : FEE

CROCUS : Readout



ST345

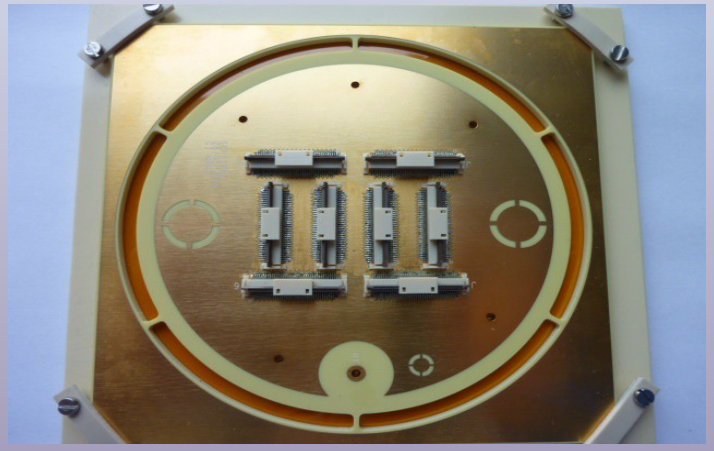
TCI : distribution of the trigger signals and busy management

Electronics

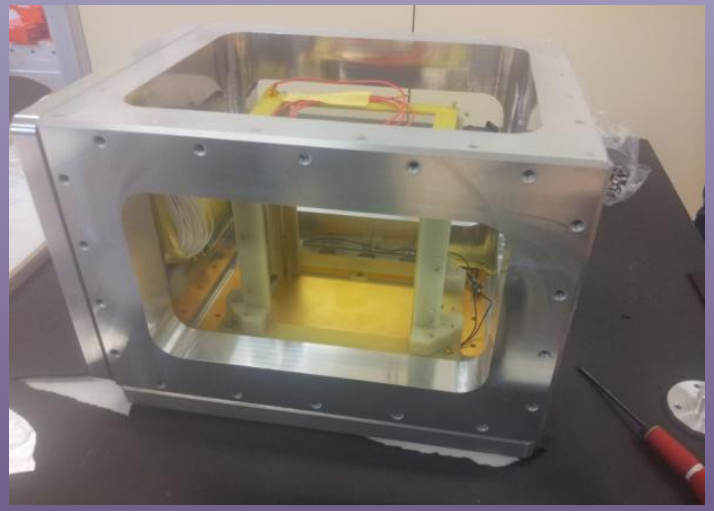
Granularity issues

- Detectors segmentation
- Integrated circuits
- Data analysis methods
- Data transfert issues

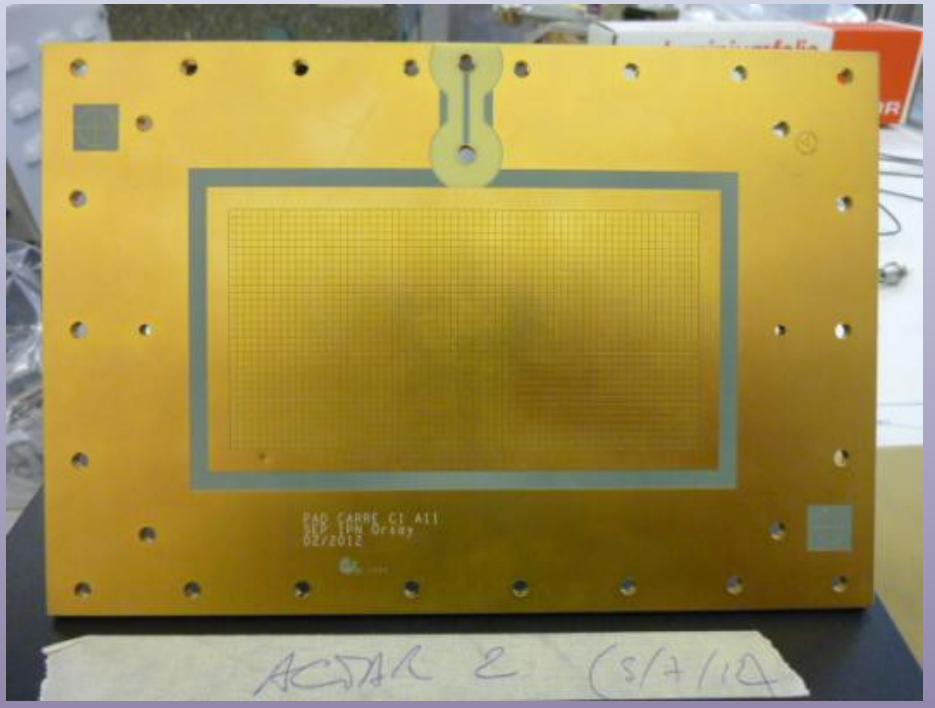
ACTAR at Ganil



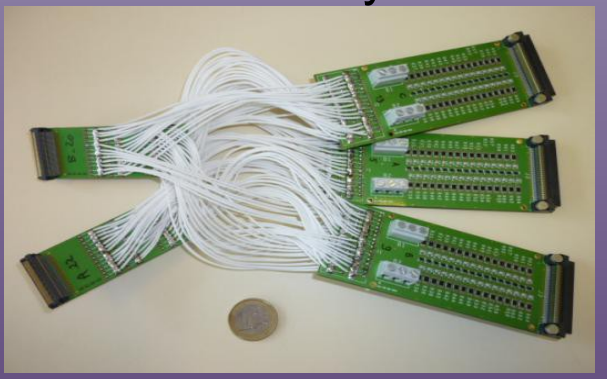
High granularity connectors



TPC mounting



2500 2x2mm2 pads for MICROMEGAS
CEA Saclay

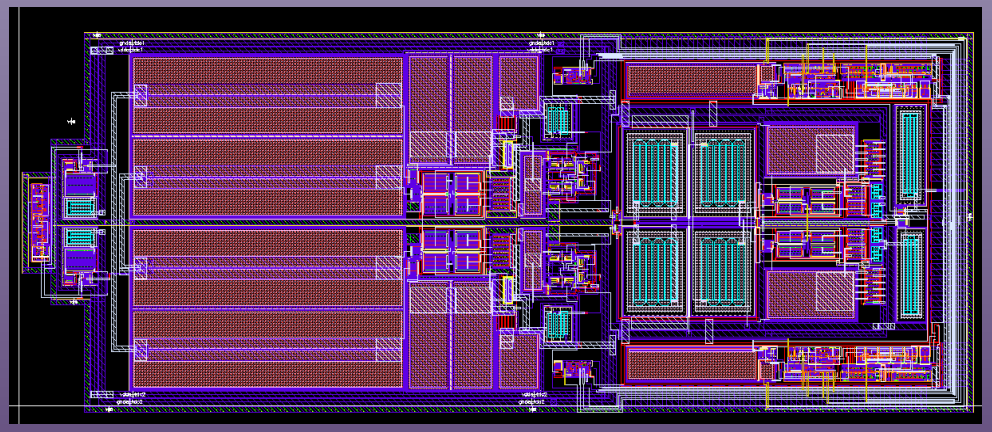


Connection with electronics

J.Pancin et al., submitted to NIM Phys. Res. A (February 2013).

Integrated circuits

- An integrated circuit is a small (1x1mm2 for analogue, 10x10mm2 for the biggest digital) piece of silicon where many electrical functions/channels are implemented
- For physics we design dedicated circuits a kind of « Haute couture » electronics (ASIC)
- When we succeed in reusing them for an other experiment they become « prêt à porter »
- Generally package and not integrated circuit is seen



TDC circuit

IC advantages & *drawbacks*

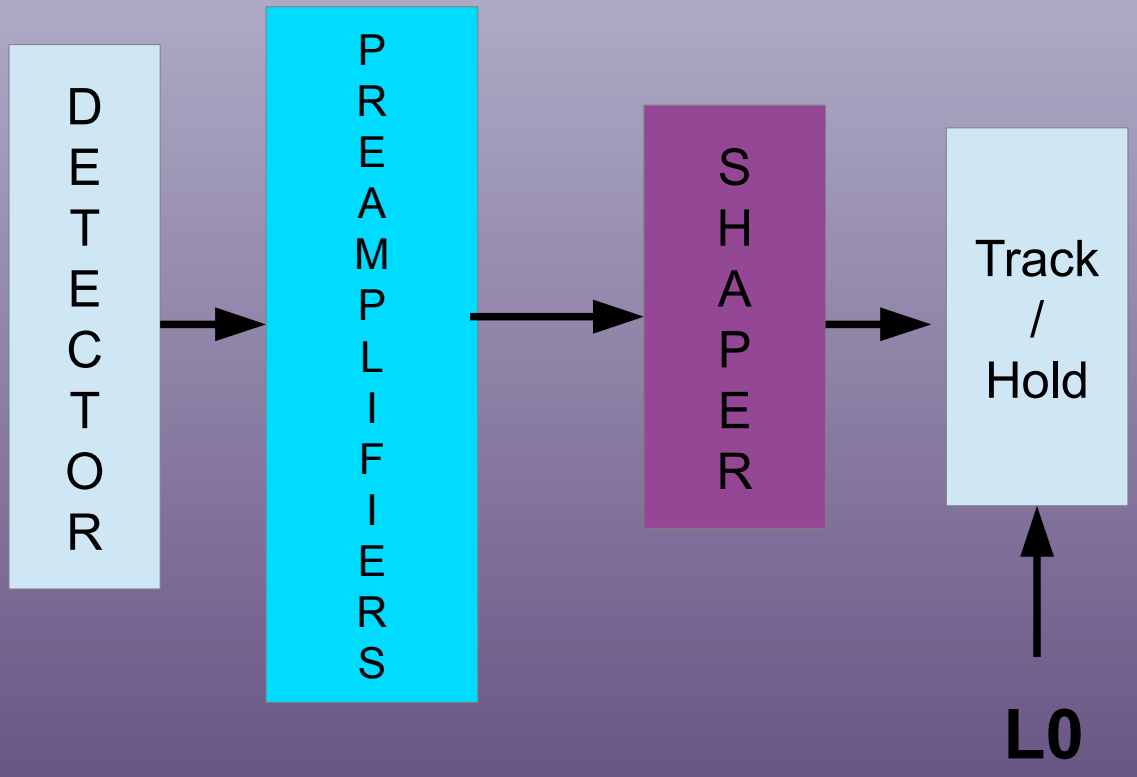
- Many channels on one chip
- Lower power consumption per channel
- So less cooling problems
- Small transistors so faster signals
- New technologies more radiation hard
- *Long design*
- *No possible modification : long redesign*
- *Research circuits availability*

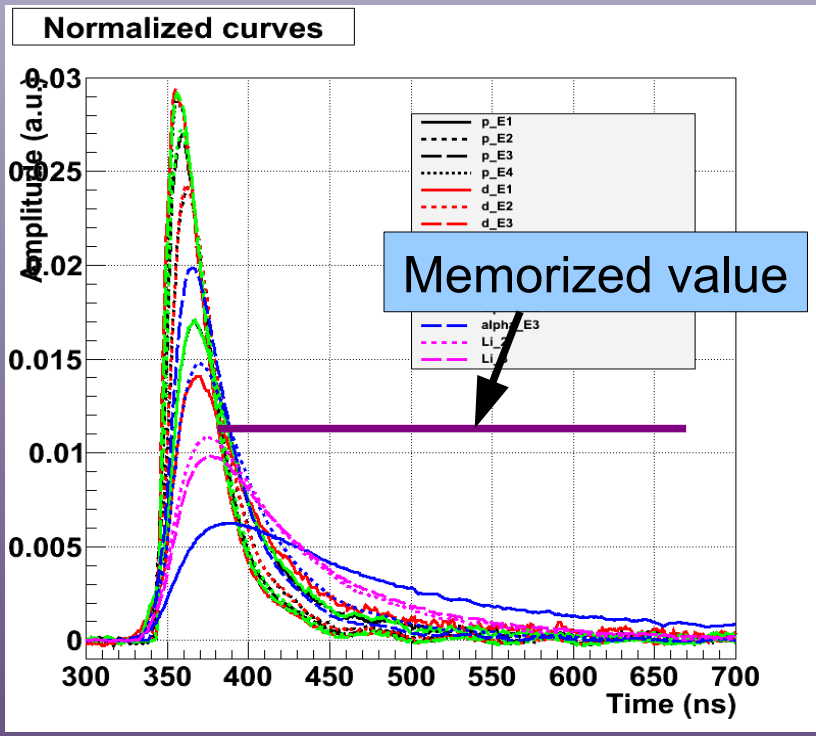
Few ongoing circuits

- We are integrating a Charge and Current preamplifier (PACI) for multistrip silicon detectors purpose IPACI, available within 2 years for Gaspard type experiments
- ALICE is looking for a multipurpose IC for many subdetectors : super Altro,..
- All the LHC electronics upgrade include asic design

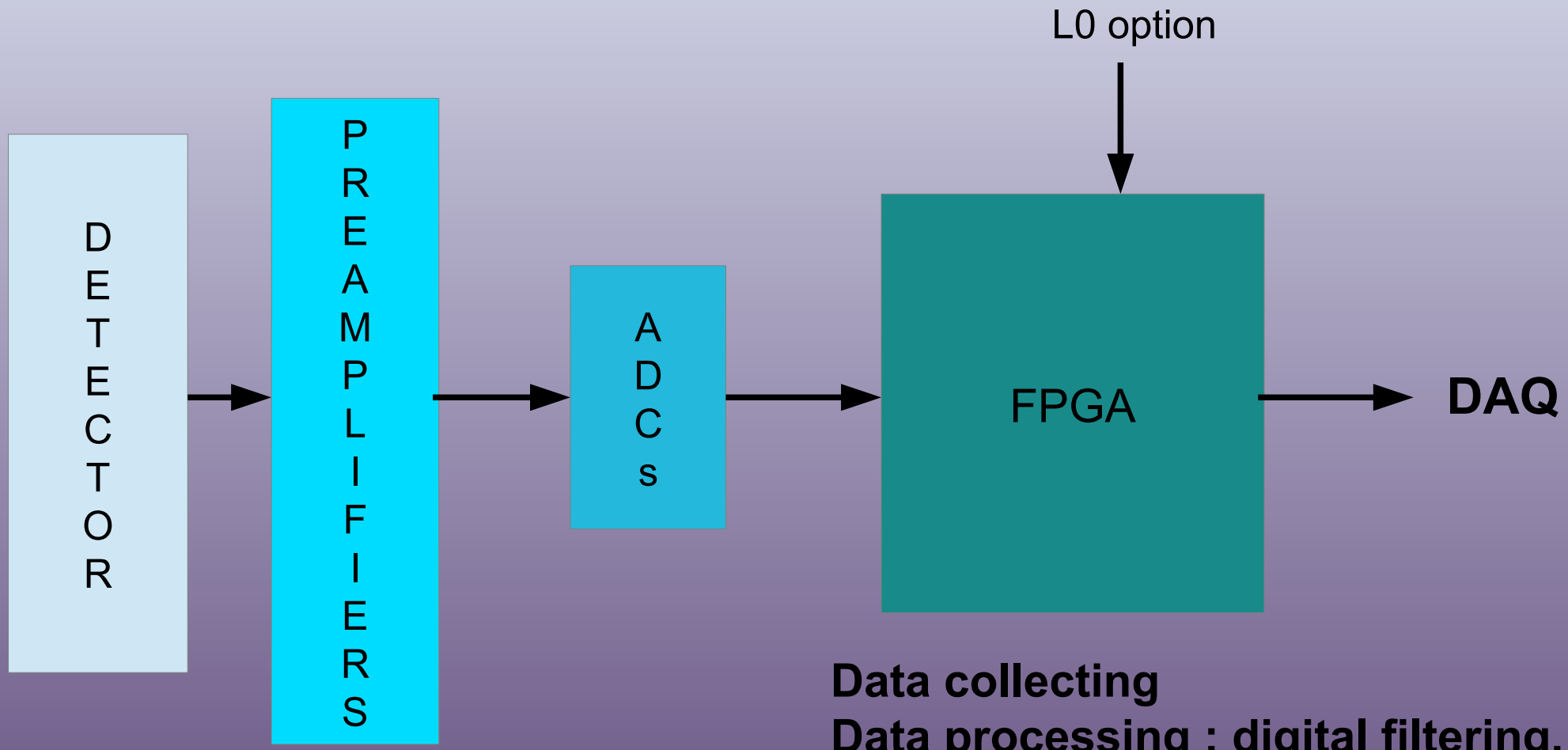
Data analysis methods

- Till now : a long analogue chain + one or few points digitized with an ADC



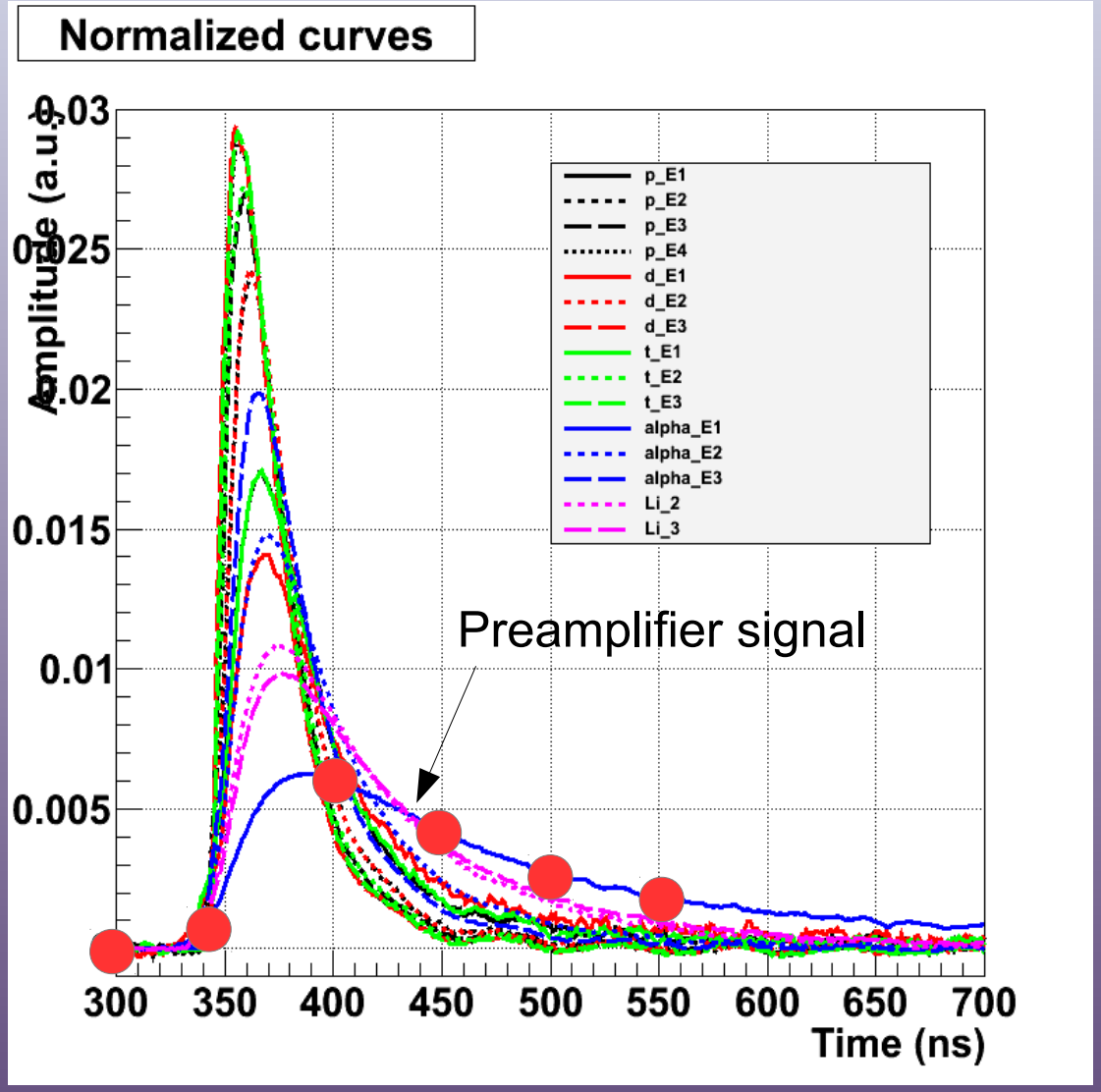


« Full » digitization with fast ADC



Data collecting
Data processing : digital filtering, 0 suppress, etc..
Data shaping for transfert to DAQ

« Full » digitization (2)



ADC dynamic range
ADC conversion frequency

20MHz ADC = bad choice

Advantages&*drawbacks*

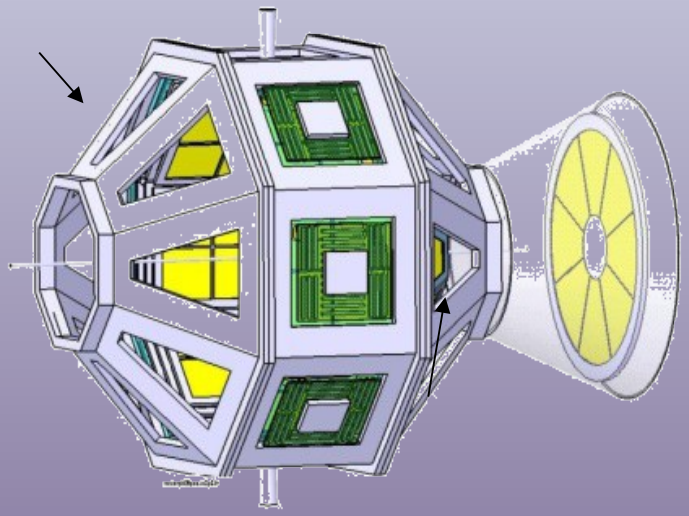
- Lot of information on the signal
- Pulse shape analysis for particules ID
- « on line » data processing : pedestal substract, 0 supress, digital filtering...

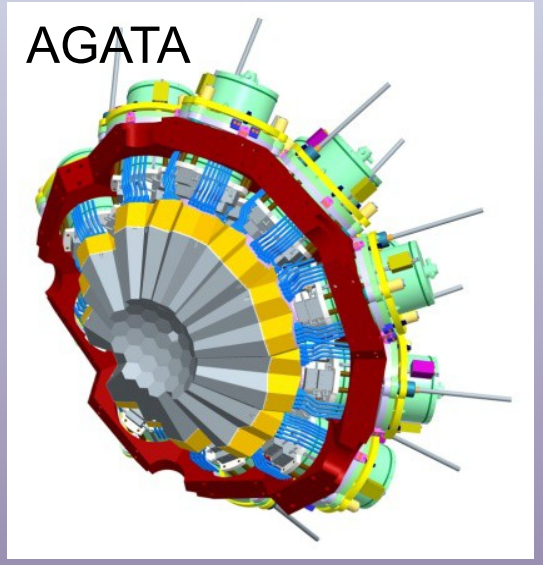
  But for high granularity détectors
- *Power consumption*
- *Cost*
- *Available space for electronics*
- *Data flow*
- *Cabling...*

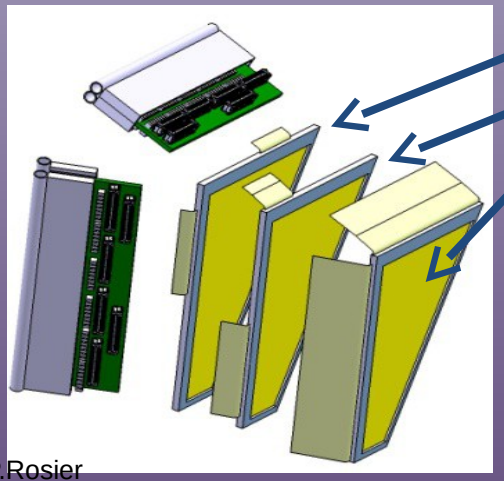
Gaspard experiment

Trapezoidal shapes for endcaps

Option: Annular detectors



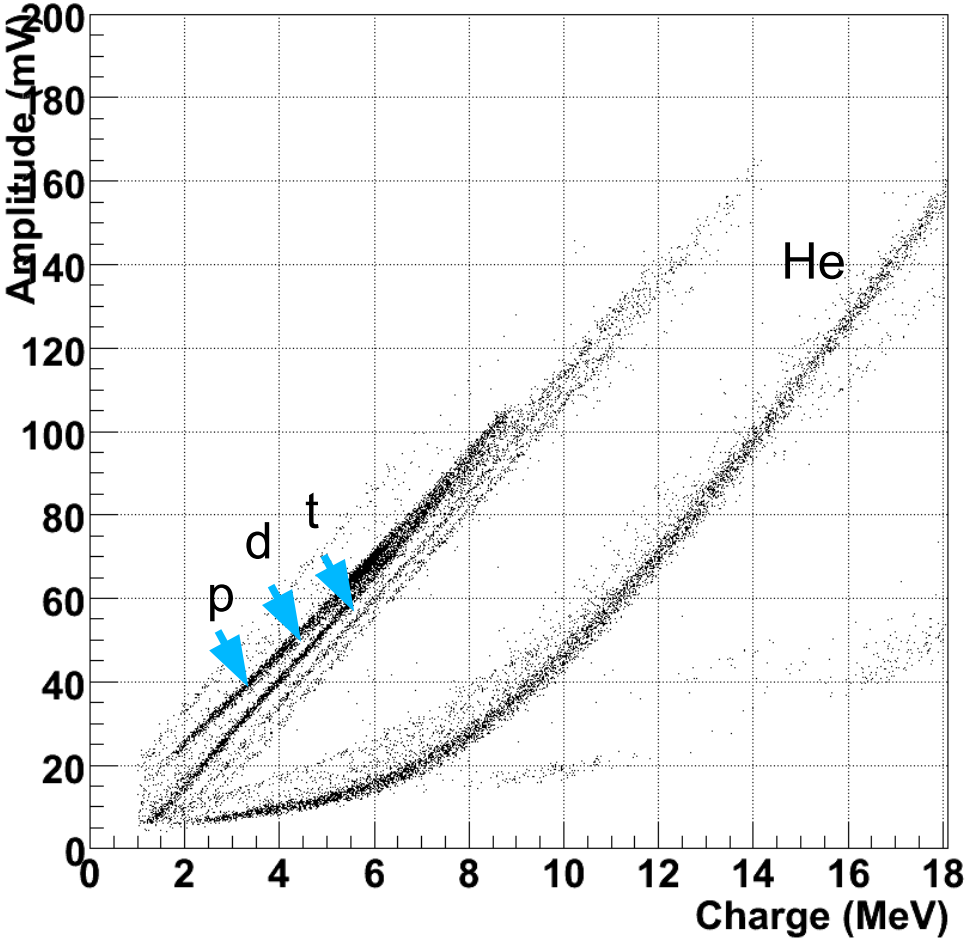




- Small ball of silicon detectors for light particules from 1MeV identification
- Inserted in AGATA detector
- Few cm between Gaspard and AGATA
- GASPARD must « transparent »
- **15 000 channels including more than 2600 PSA channels**

P.Rosier

Identification without full digitization



We measure charge and amplitude
For each event only 2 points per Channel
Possible multiplexing

Data transfert

- ALICE dimuon wants to go from 160µs to 10µs
- Competition between serie and parallel
  - Serie slower but less wires
  - Parallel faster but more wires
- Till few 100Mbytes/s not too complicated
- Few Gbytes/s more complicated (GBT boards developped at CERN)
- It is important to optimize what is essential to transfer

Conclusion

- Thank you to having invited me
- It is important to think about technique very early in an experiment design (it is very early)
- Environement is key issue (radiation, magnetic field, EMC, ..)
- Context is a key issue (money, existing stuffs..)