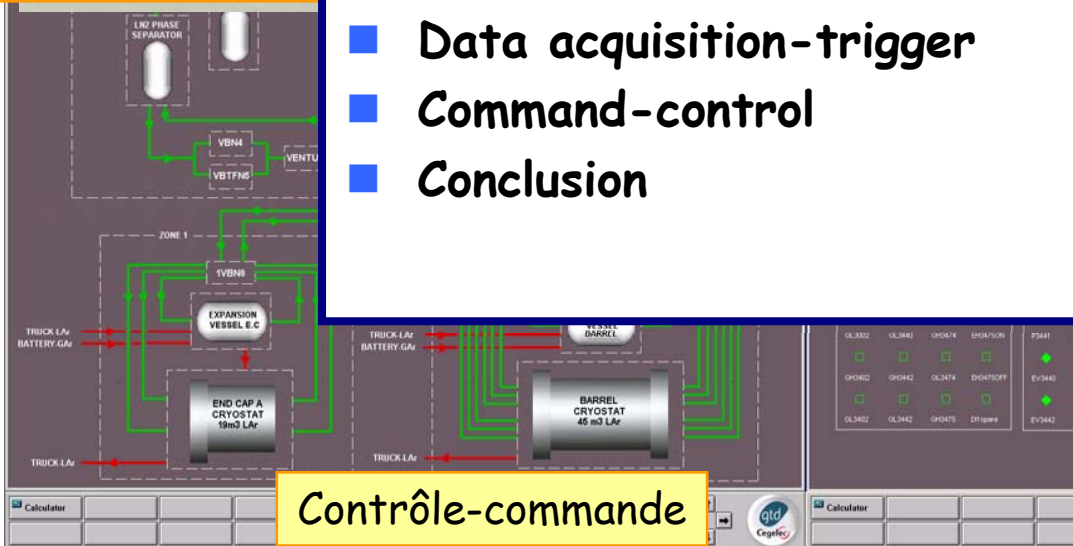


ELECTRONICS DEPARTMENT 2005

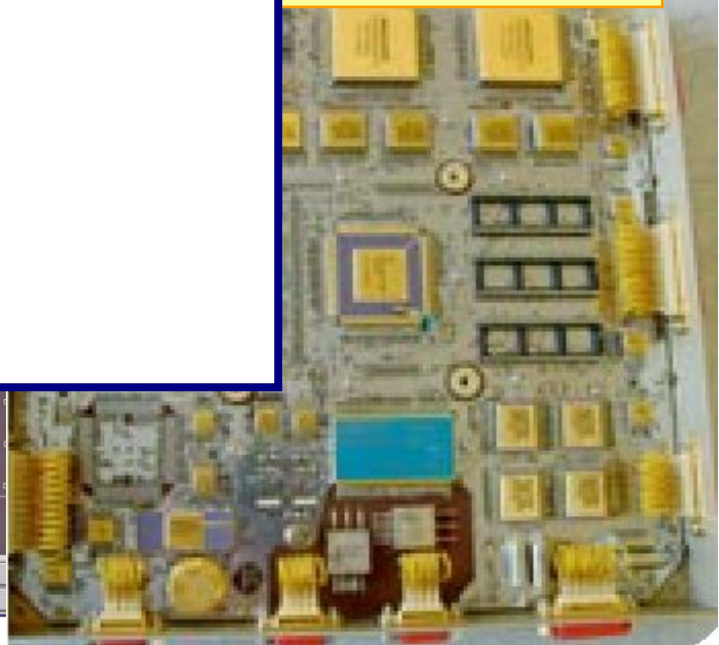
- Microelectronics
- Data acquisition-trigger
- Command-control
- Conclusion

acquisition-Trigger

Micro-électronique

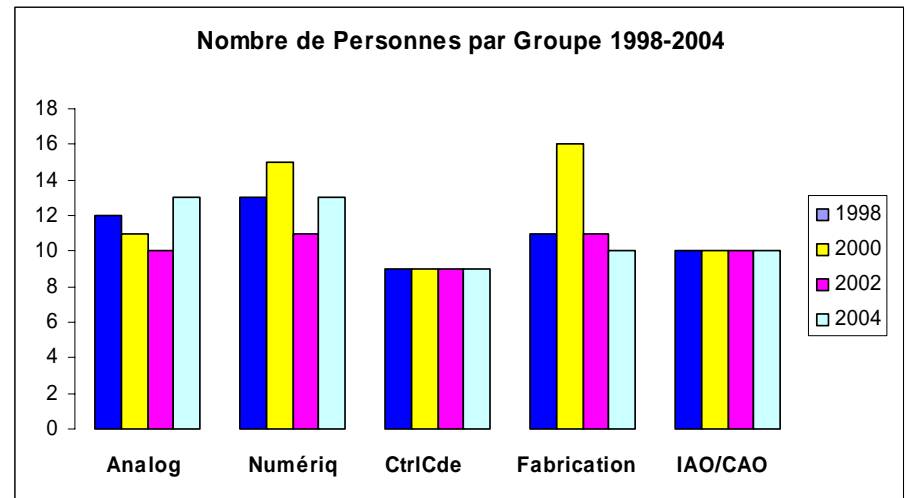
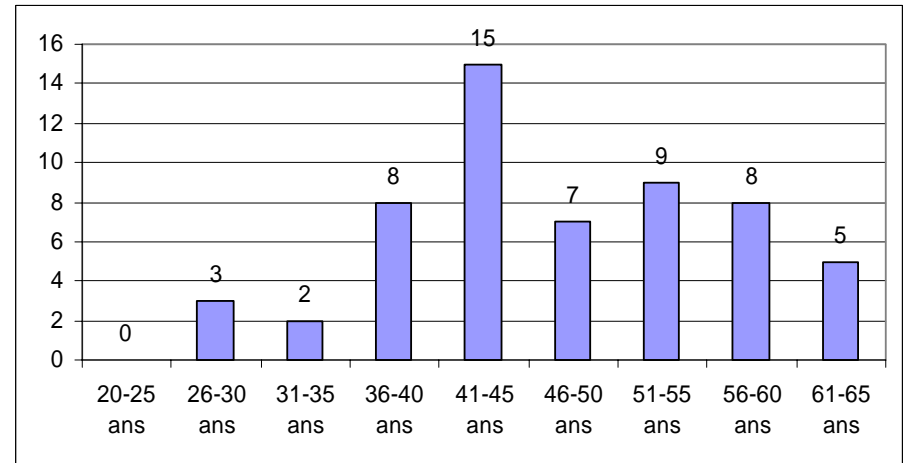


Contrôle-commande

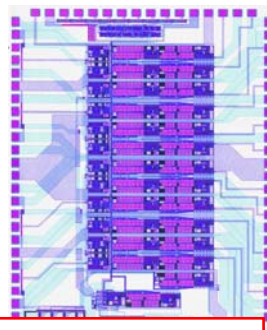


Staff : 54 persons

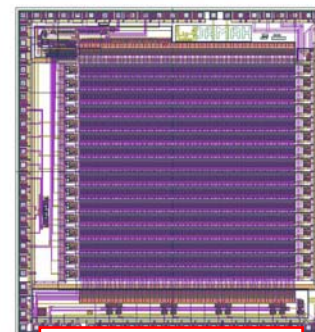
- half engineers / half technicians
- Pyramid of ages in 2004 :
- 5 main fields of activities :
 - **Analog** : low-noise front-end and mixed signal ASICs
 - **Digital** : acquisition, trigger of large experiments
 - **Command-control** : large systems, spatial, accelerators.
 - **IAO/CAO**
 - **Fabrication** : prototypes and detector assembly.



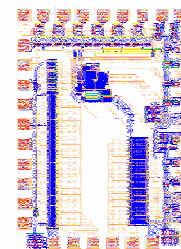
- Low noise preamps
- Fast shapers
- Multi-channel circuits
large dynamic range
- Analog memories
- Precision calibration pulsers
- Low power design
- Radiation tolerance



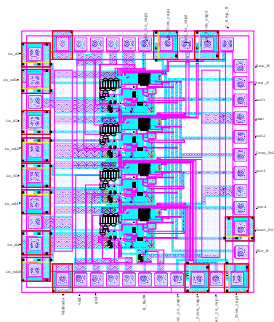
1999
SHAPER_V3
BiCMOS 1.2 μ
70 000 chips



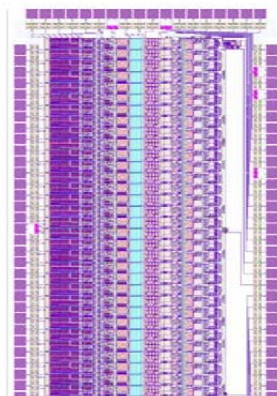
2000
HAMAC
DMILL 0.8 μ
84 000 chips



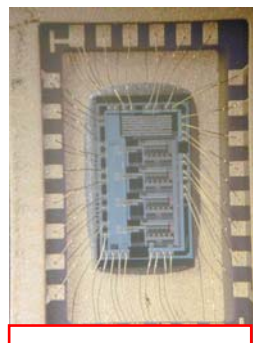
2001
pulser
DMILL 0.8 μ
40 000 chips



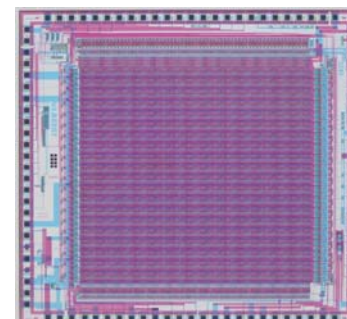
2001
LHCb shaper
BiCMOS 0.8 μ
3 200 chips



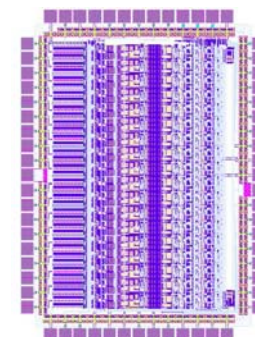
2002
OPERA_ROC
BiCMOS 0.8 μ
3 600 chips



2003
Delay chip
CMOS 0.8 μ
3 300 chips



2004
Pipeline_V3
CMOS 0.8 μ
Indust.

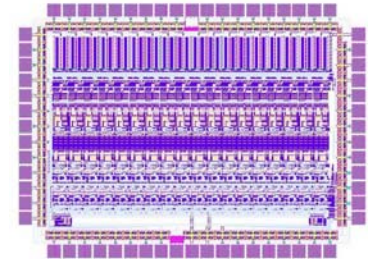


2004
FLCPHY3
BiCMOS 0.8 μ
1000 chips

ILC (ex FLC) calorimeter prototype

■ Readout of Silicon-Tungsten calorimeter

- 14 bit dynamic range readout ASIC, MIP/noise = 9
- 9000 readout channels produced
- Testbeam in 2005 : DESY, FNAL



■ R&D on technological prototype

- Larger dynamic range : 3000 MIPS (16 bits)
- Lower power : $\sim 100 \mu\text{W}/\text{ch}$ (pulsed power), Autotrigger mode
- ADC integrated : collab. LLR/LPCC
- Pioneering position, 2 prototypes in 2005, talks at IEEE and

[J. Fleury LCWS 2004, CdLT Calor 2004]



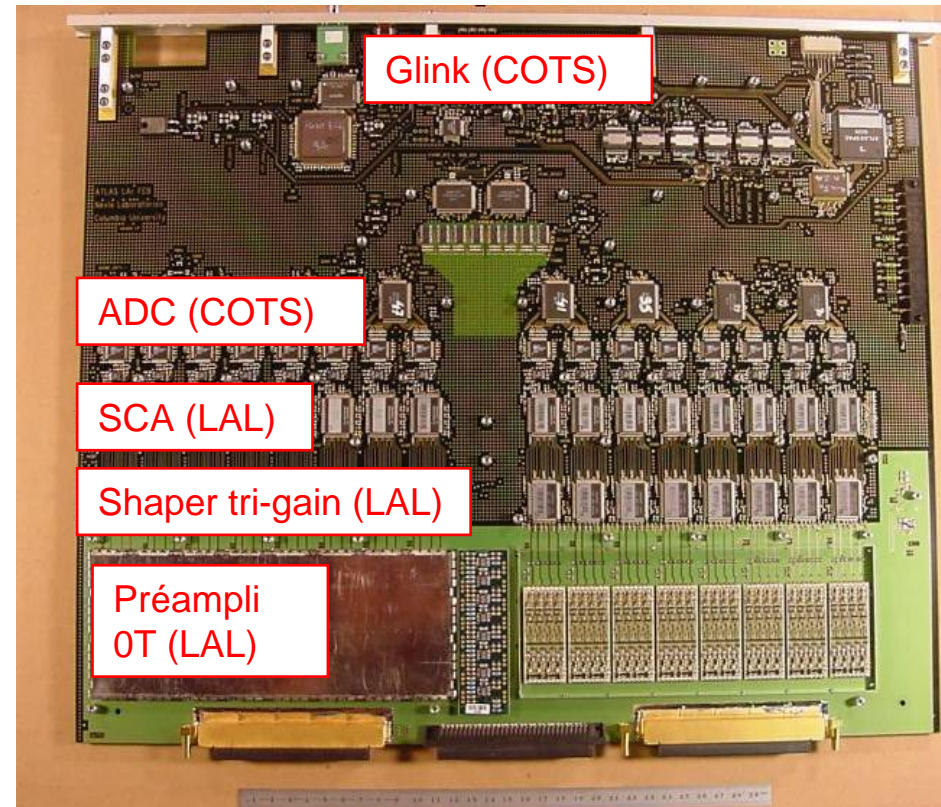
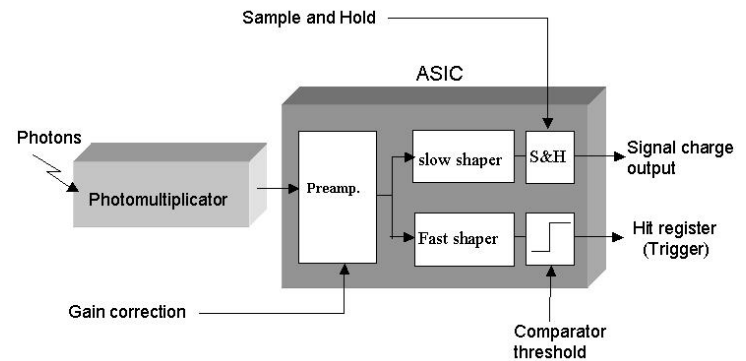
Future developments on LHC

Luminometry

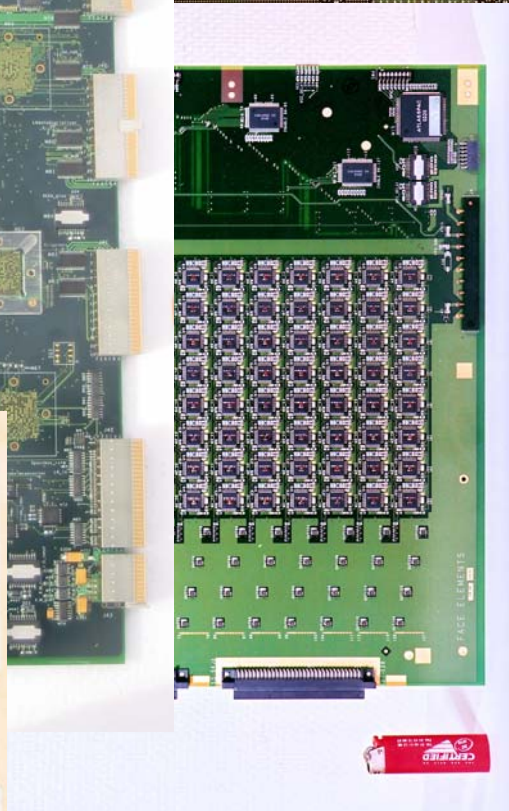
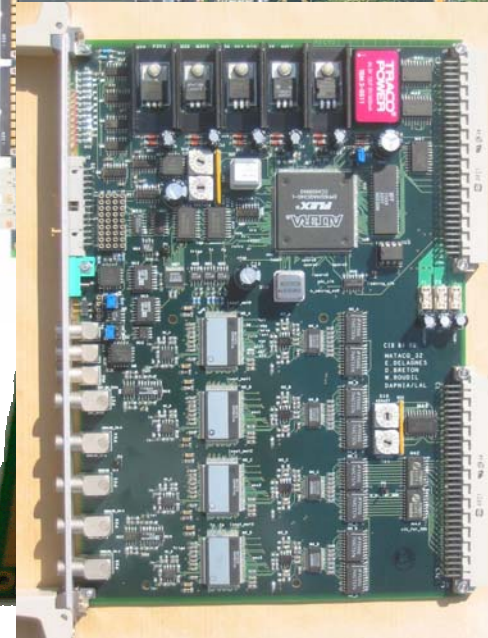
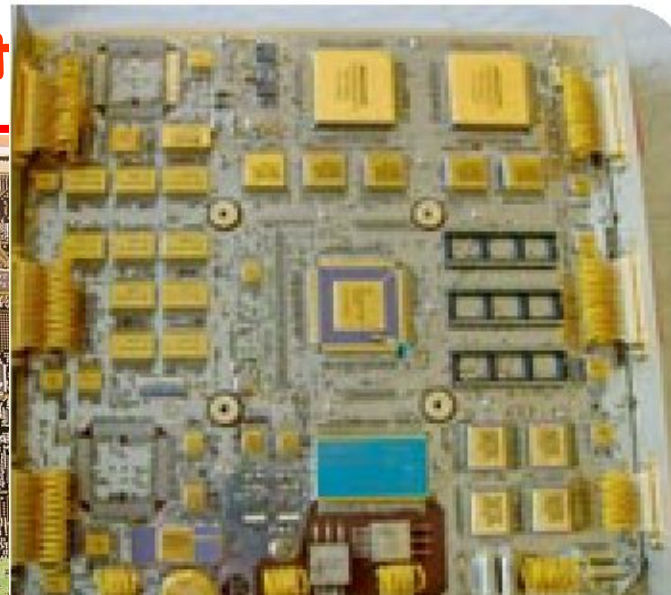
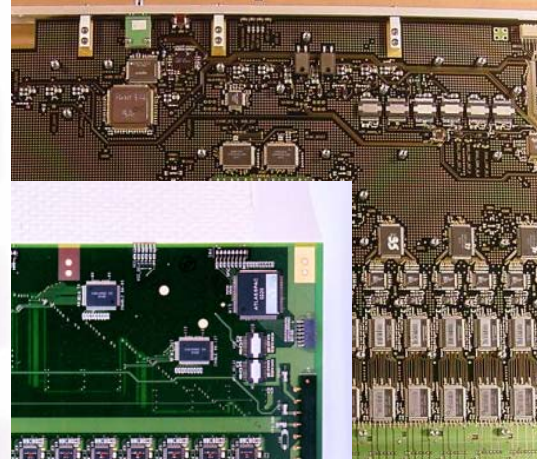
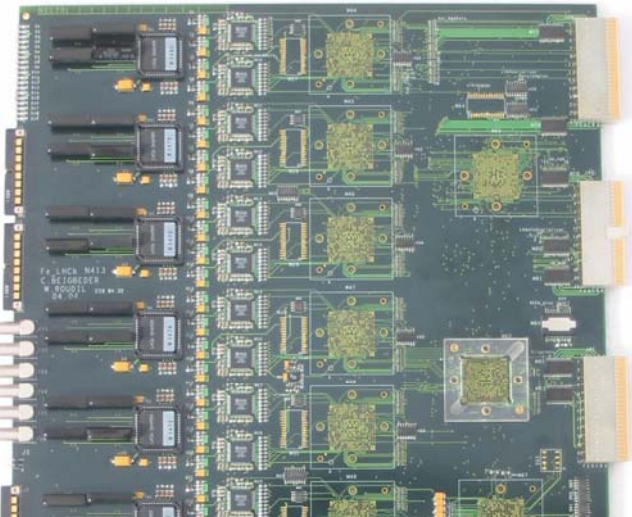
- Roman pots + PM 64anodes
- Tests with 2 PM and OPERA_ROC ASIC
- Digital buffering + DAQ
- Test beam in 2005
- Discussions (only) to adapt chip to ATLAS needs

Super LHC (L=1035)

- Redo FrontEnd Boards (FEB)
- Design OK, but rad-tol only up to 1 kGy
- Integrate PA + shaper + ADC
- 10 years of expertise at LAL



Front-end boards, Trigger, readout



end b



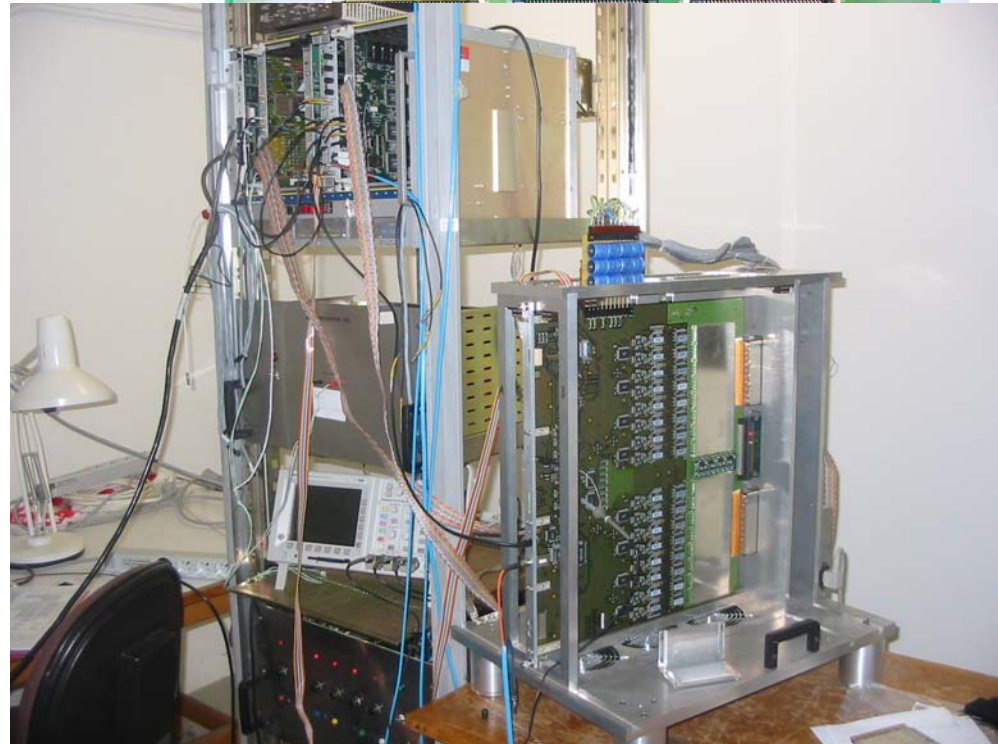
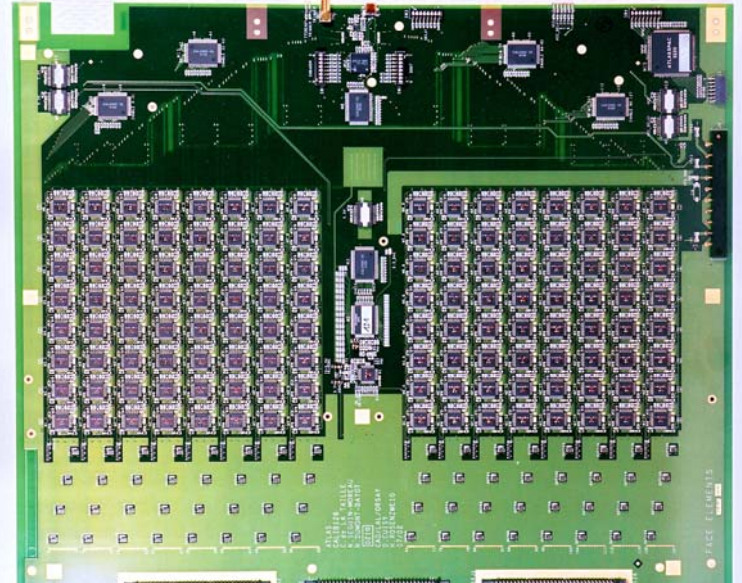
Front-End boards

■ ATLAS calibration boards

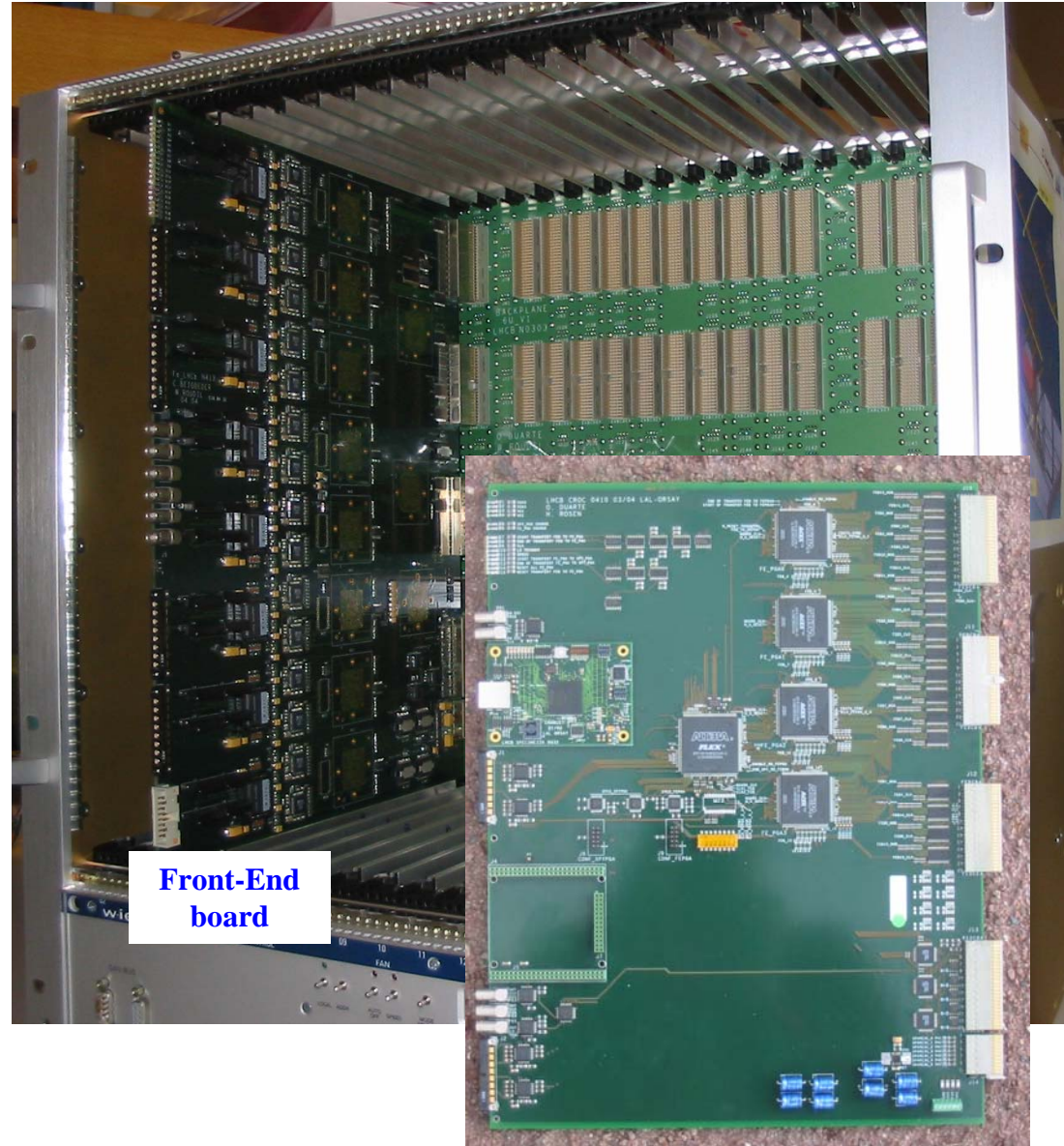
- High precision (0.2%) large dynamic range (16bits) high speed pulse generators
- Design and production of 130 boards 400x500mm
- Installation at cern in 2006

■ ATLAS FEBs

- Readout of liquid argon calorimeter : low noise, large dynamic range amplification /digitization boards
- Production and test of 1800 boards in 2005
- Dedicated test bench



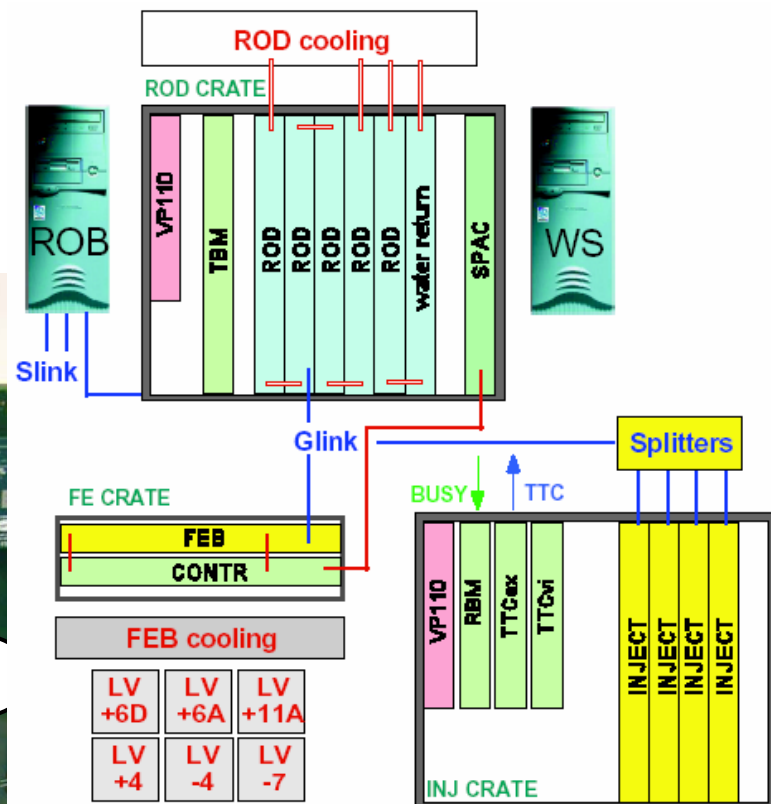
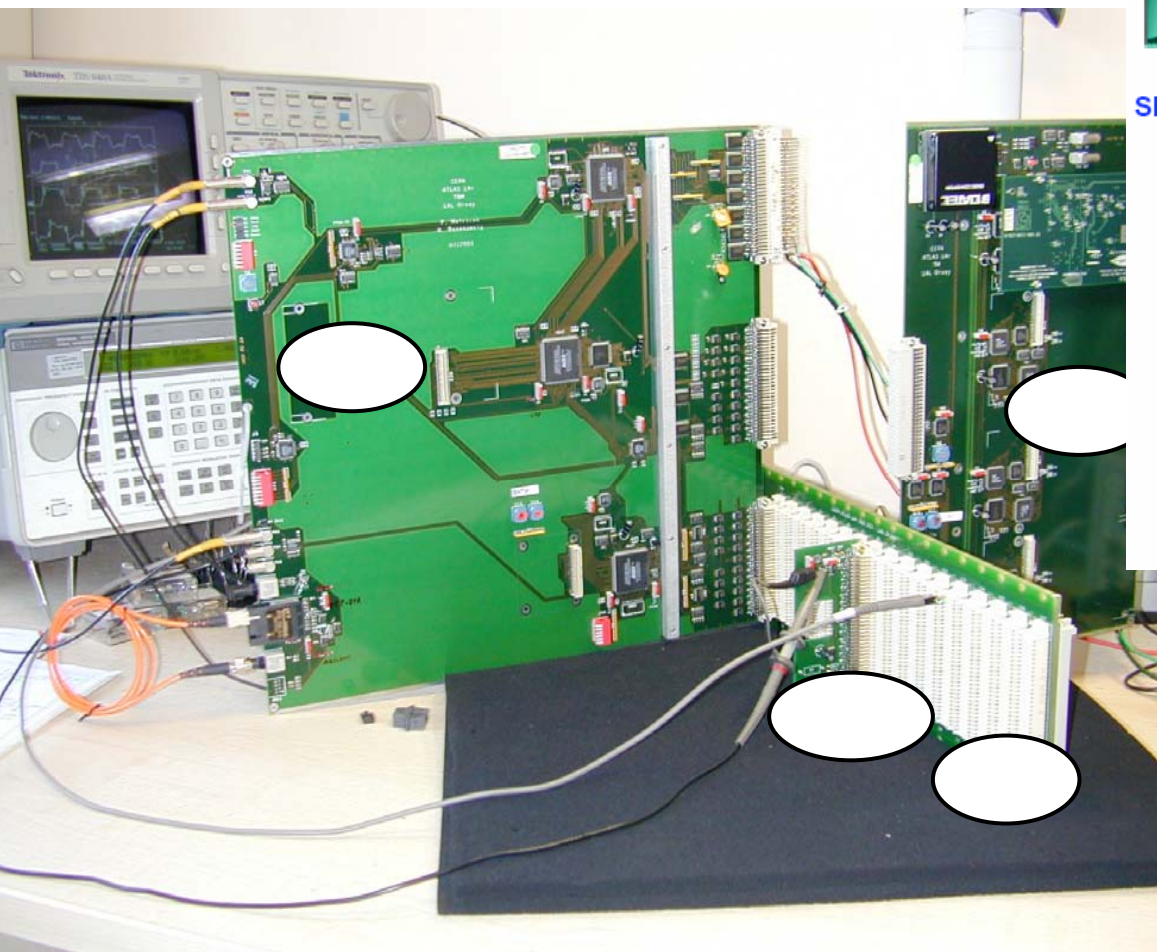
- **LHCb Front-end board ECAL**
 - Filtering and 40MHz digitization + LVLO Trigger formation
 - High speed links between boards via dedicated backplane
 - 250 boards
- **Controller board CROC**
 - Crate controller
 - Production en 2005



Data processing (ATLAS RODs)

[P. Matricon]

- Digital signal processing of FEBs data
- Dedicated DSPs and high speed signal routing
- Optical transmissions

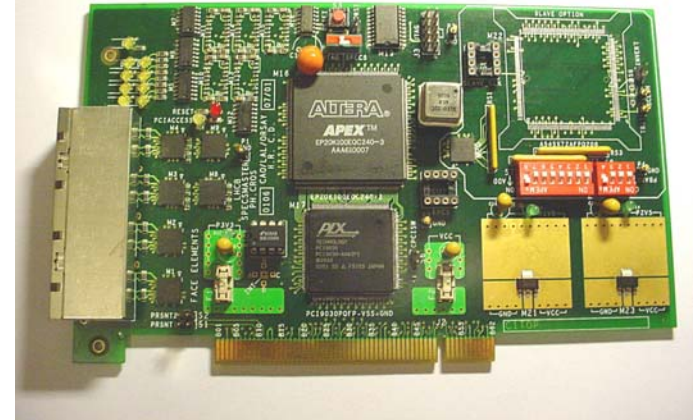


Detector control : LHCb, Planck

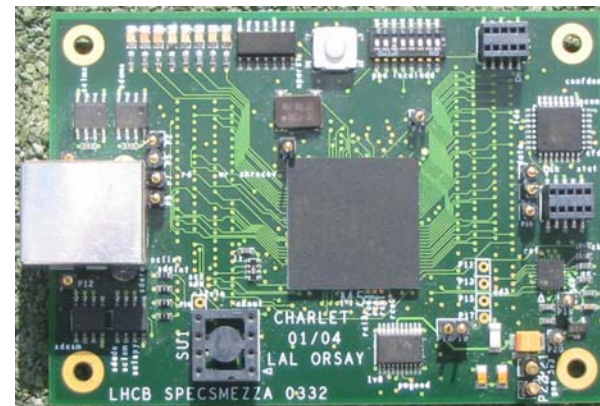
- **SPECS** : serial link for LHCb
 - PCI boards for detector control
 - 200 boards for all sub-detectors
- **Planck DPU** : board processor
 - Flight-model in production



Current copper master prototype

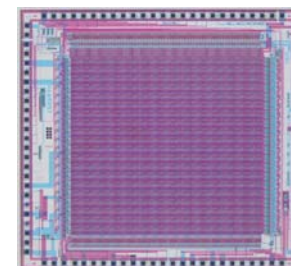


Current copper slave mezzanine (SRAM FPGA)



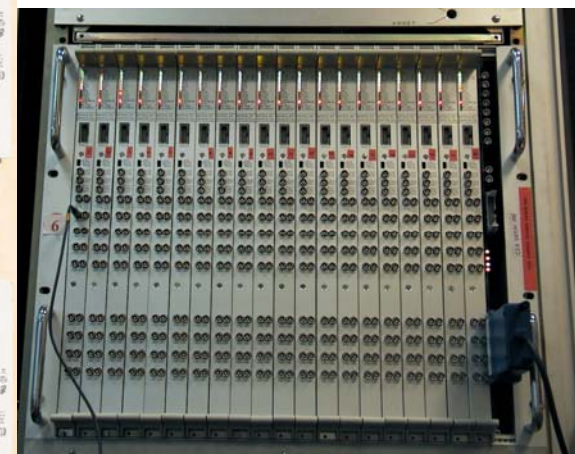
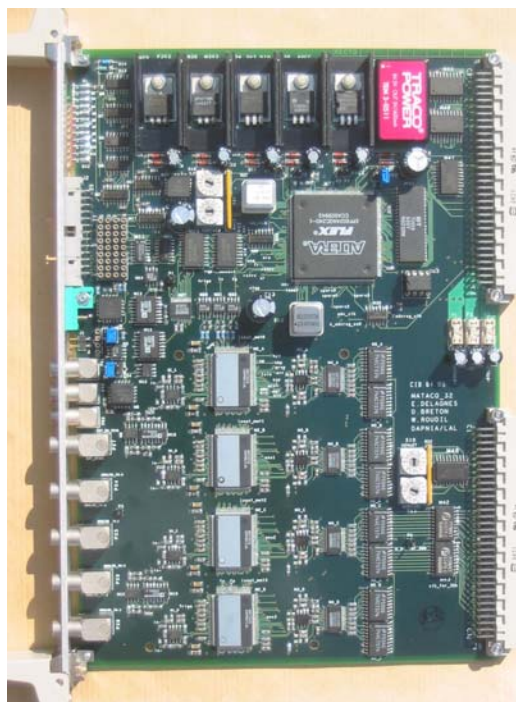
■ Analog Pipeline

- Switched capacitor array 12bits/40MHz (originally designed for ATLAS)
- Adapted to oscilloscope 2 Gs/s 12 bits
- Commercialized by Metrix



■ MATAQVME

- VME board with 4-8 ch.
- 2 GHz - 12 bits
- Auto-trigger mode
- Sold by CAEN



Activities

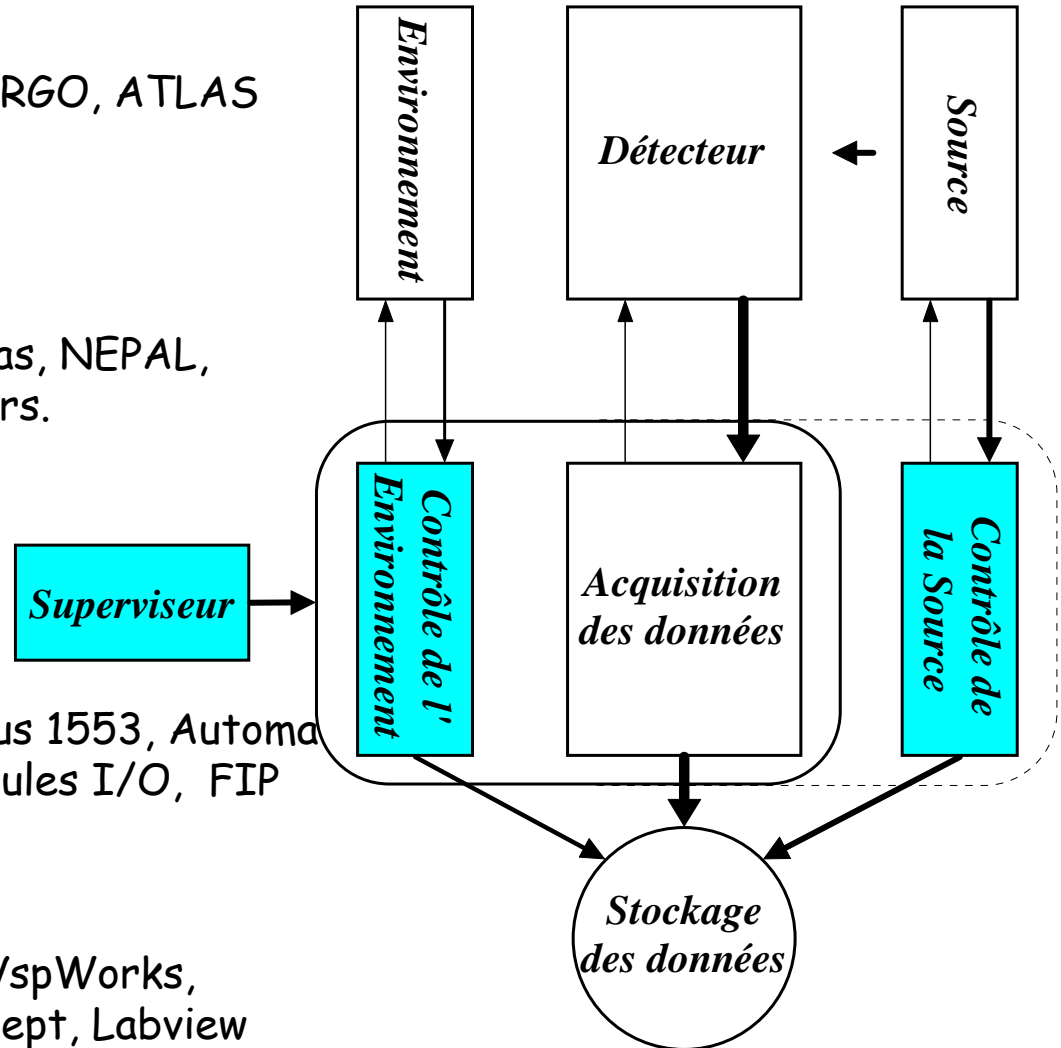
- Spread command/control
 - CLIO, CANDELA, TTF, VIRGO, ATLAS
- Spatial
 - Planck
- Test benches
 - Presse Atlas, Colleuse Atlas, NEPAL, NEMO3, Test des coupleurs.
- Real-time acquisition
 - VIRGO, Planck

Hardware :

- Bus G96, Bus VME, Bus PCI, Bus 1553, Automate Quantum(Scheinder) , PC, modules I/O, FIP

Software :

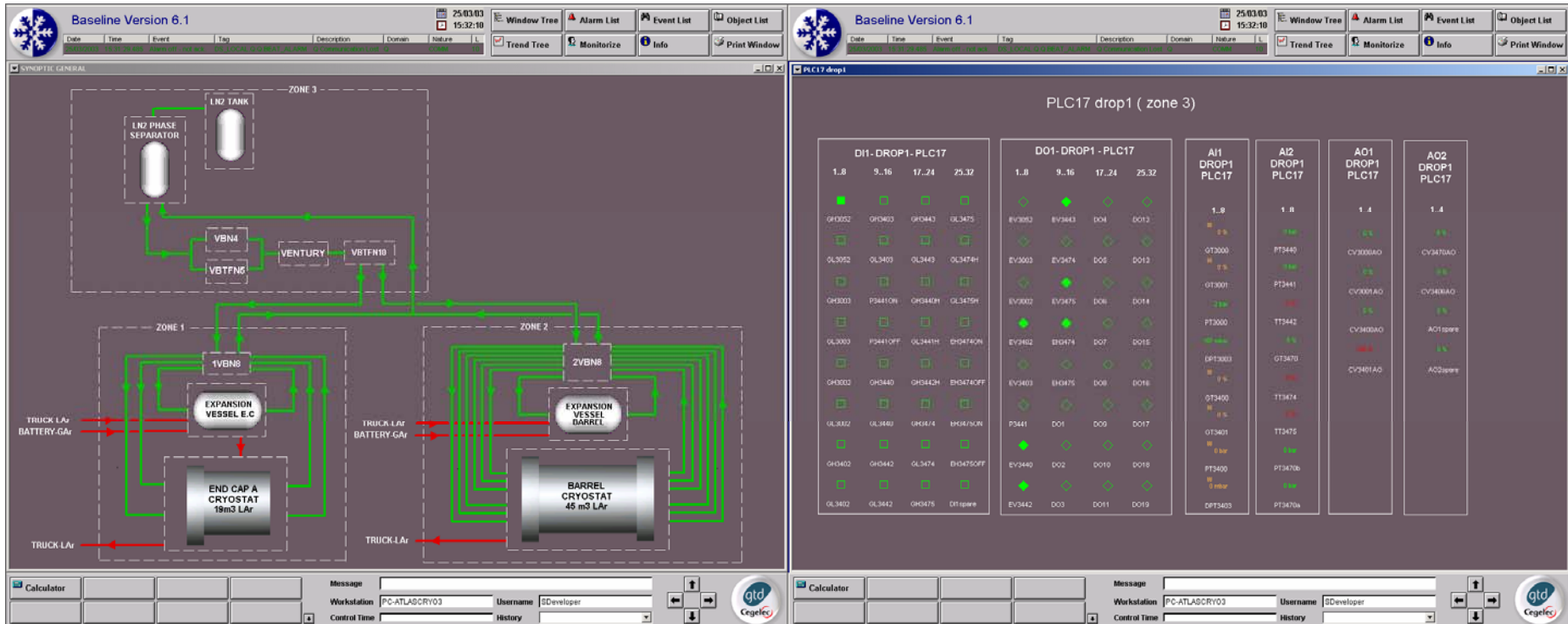
- OS9, Windows NT, Lynx OS, VspWorks, Environnement Automate Concept, Labview



ATLAS : cryogénie

■ Contrôle-commande sur 2005, mi 2006

- 6 personnes
- Beaucoup d'installations au CERN



- **Cadence tools for micro-electronics design**
 - Support for the whole institute
 - 6 work stations fully equipped for ASIC layout and design
- **A team of 7 persons for PCB design and layout**
 - 5 full-time layouters **full-time**
 - 40-50 boards designed per year, some of them very complex
 - 2 persons assigned to keeping libraries up-to date
- **Fabrication**
 - In-house facility for prototype assembly and repair (pick&place)
 - Follow-up of large series production which are externalized
 - Several technicians assigned to the on-site assembly of large detectors

Conclusion

- **Large department with strong experience in large projects**
 - Micro-electronics : analog and mixed-signal
 - Digital electronics : data processing, trigger, huge data flow from particle physics experiments
 - Command-control : real time DAQ and large system control
- **Interest for new projects after 2006**