DE LA RECHERCHE À L'INDUSTRIE

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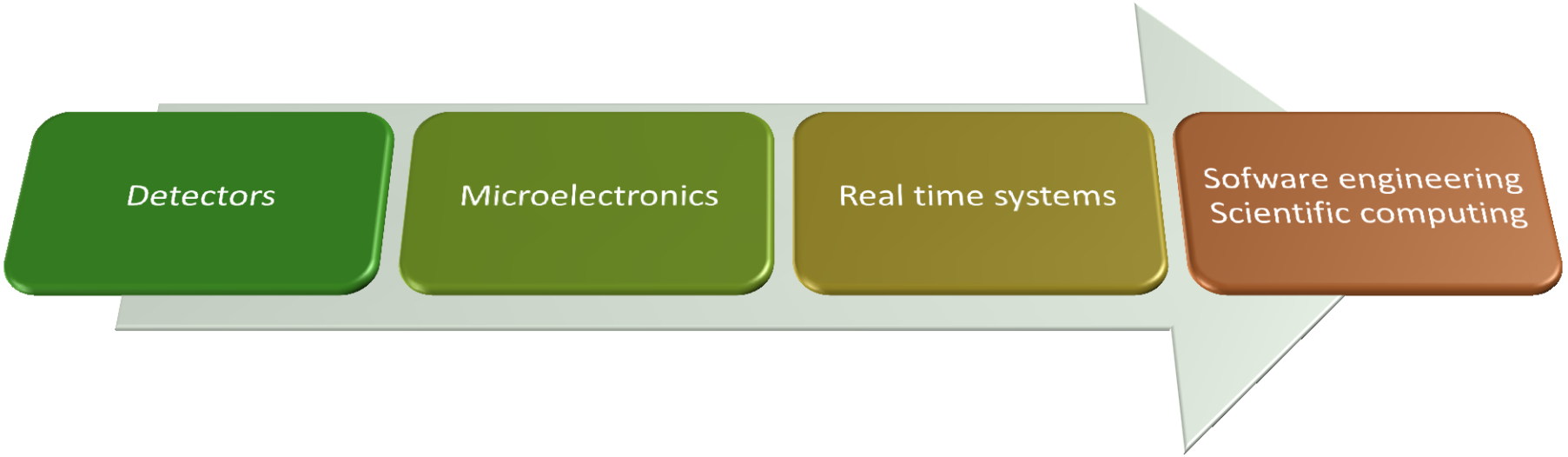
SEDI DIVISION

ERIC DELAGNES



DETECTORS, ELECTRONICS & COMPUTING DIVISION
SERVICE D'ELECTRONIQUE, DES DÉTECTEURS, D'INFORMATIQUE

Irfu

www.cea.fr

DE LA RECHERCHE À L'INDUSTRIE

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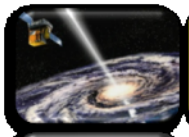
Head of Institute

Philippe Chomaz
Assistant: **Josiane Parnas**
Deputies: **Nicolas Alamanos**
Marie-Cécile Aubert

Larsim
Research on sciences matter lab
Etienne Klein

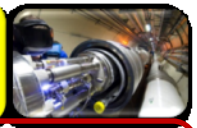


SAp
Astrophysics and
Space Technologies
Anne Decourchelle
Dep. Head: Michel Talvard

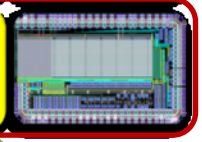
SPhN
Nuclear Physics
Héloïse Goutte
Dep.Head: Jacques Ball

SPP
Particle Physics
Anne-Isabelle Etienvre
Dep. Head: Georges Vasseur

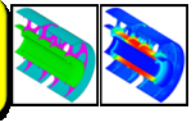
SACM
Accelerators, Cryogenics
and Magnetism
Pierre Védrine
Dep. Head: Ph. Chesny / O. Napoly



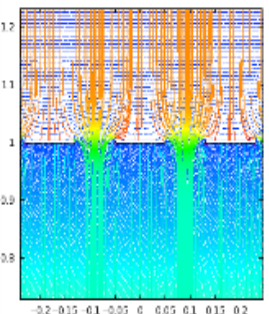
Sedi
Detectors, Electronics
and Computing
Eric Delagnes
Dep. Head: Philippe Bourgeois

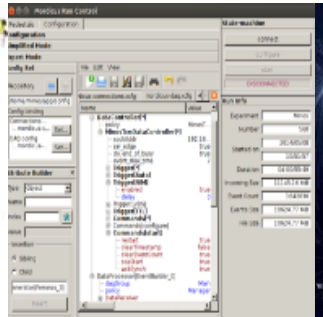


SIS
Mechanical Design
and System Engineering
Florence Ardellier
Dep. Head: Frédéric Molinié



Expertise covering the full detector signal processing chain.





SEDI: NEW ORGANIZATION

New head : E. Delagnes (April 2014).
New deputy head : Ph. Bourgeois (Sept 2014)
New organization: Jan. 2015 => 9 teams working in synergy

Delegates

- Detectors;
- Electronics;
- Computing;

Cohesion between the teams of the same domain

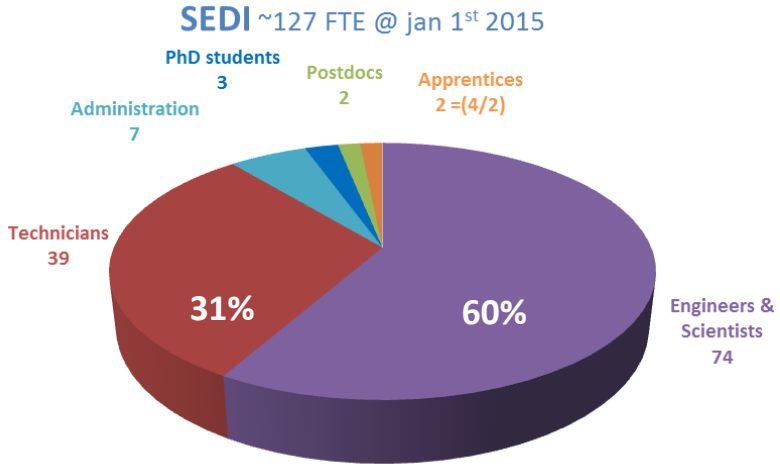
- **Quality;**
- **Valorization.**

Sedi management

Leaders of large projects (5p)

Innovative Detectors	Detection Systems	Detectors Mechanics & Integration	Real Time electronics & ASICs	Electronics Systems & Integration	Software Engineering	Cosmology & Statistics (common with SAp)	Computing & Support	CERN – LSM on-site support
Detector physics	Design & test of detection systems	Mechanical design	Architecture	Electronics Design	Software for physics	Signal & image processing	Computer infrastructure	On-site support for Irfu experimts
Simulation	Innovative accelerator diagnostics	Prototyping	Programmable Logic	CAD	Software engin.		Computer system operation & administration	
Detector R&D	Test benches	Subcontract	Real Time Electronics	Test Benches			Purchase support	
Design of detector sensitive part	Metrology	Vacuum	ASICs	*Production Manag.*				
		Gluing & Assembling		*Integration*				
		Mechanical Integration						

SEDI STAFF



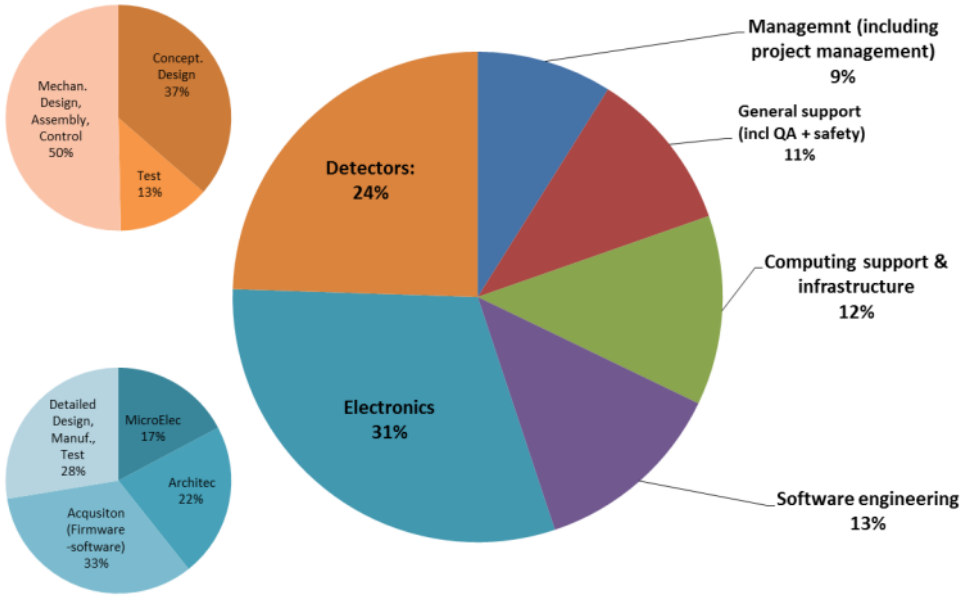
Not taking into account non-permanent staff from physics divisions, hosted and managed by Sedi.

PHDs: Recommendation from AERES committee to increase the number of technical PhDs

In 2014

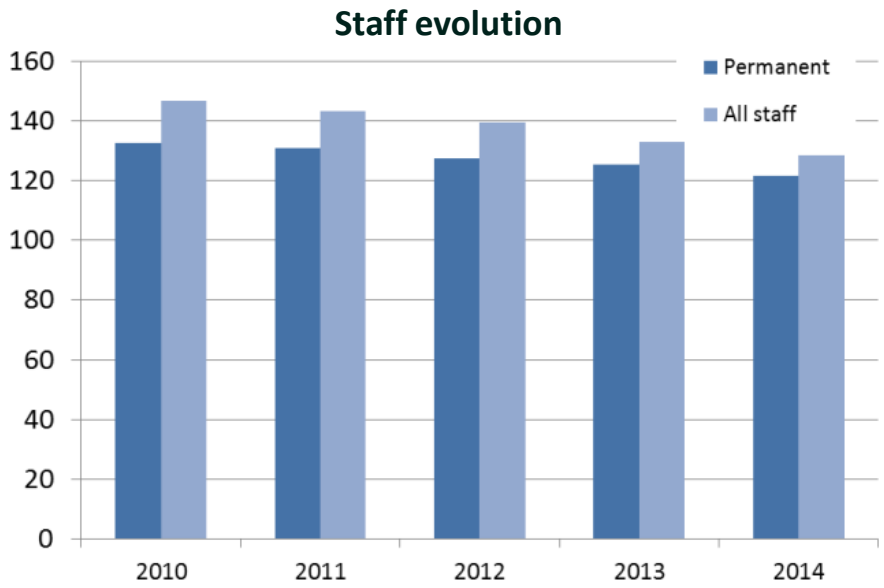
- 3 PhD defenses;
- 1 HDR defense (for supervising PhD students);
- Large mobilization of SEDI's staff:
  - 9 PhD subjects proposed, mostly in strong collaboration with physics divisions ;
  - 3 PhDs funded, started in fall 2014.
- Already 7 subjects proposed for 2015.

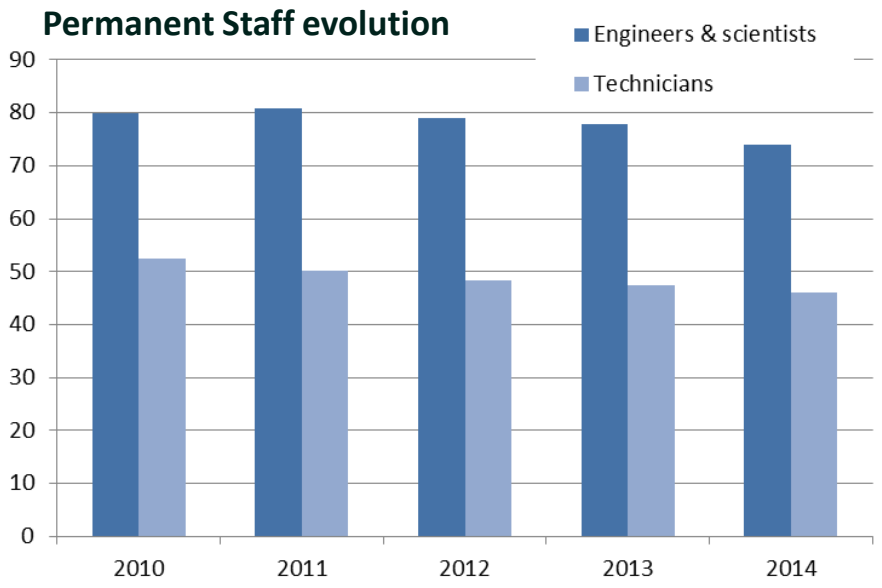
Sharing by branch



- ~ 23% involved in general or computing support.
- ~ balanced sharing between detector/electronics/computing
- For detectors & electronics: 40% architecture, 60% implementation, integration & tests.

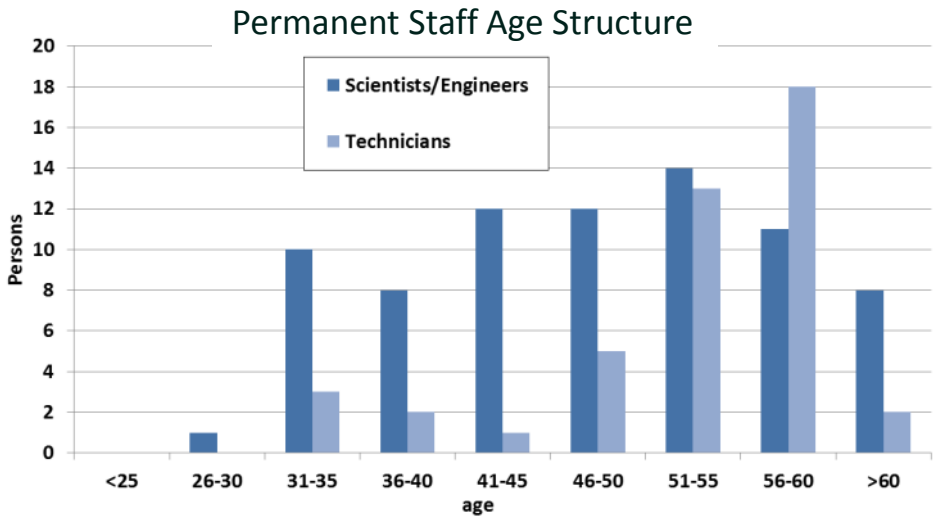
SEDI STAFF EVOLUTION



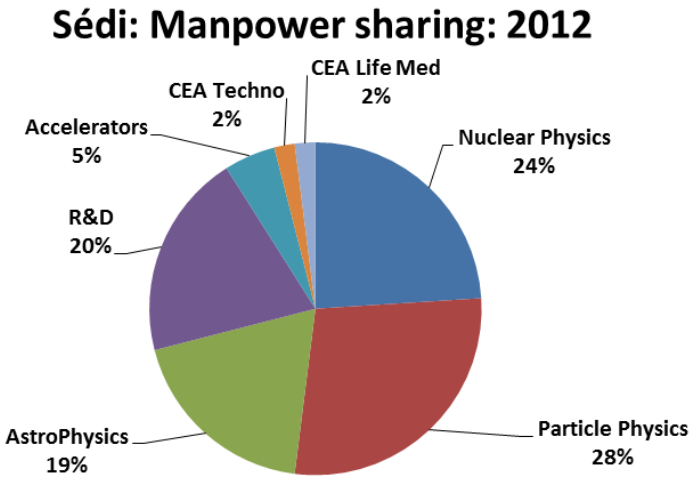


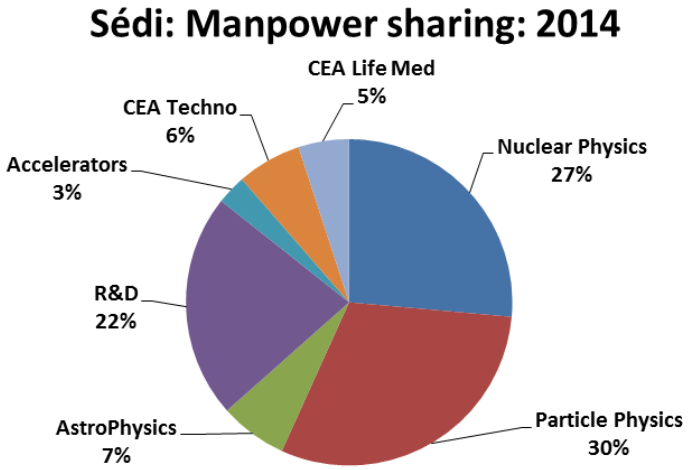
- Decrease of permanent staff during last years
- As much for engineers/scientists as for technicians
- Increase of productivity during the last years

- More than 20 retirements in the next 4 years
- Mainly technicians or field engineers
- Risk of loss of technical expertise
- **Priority for 2015 recruitment:**
  2 technicians (detector).



SEDI'S PARTNERS/CUSTOMERS





but

- ***SVOM/ECLAIR was frozen.***
- ***R&D programs for astrophysics are labelled as "R&D"***

- Staff mainly working on instrumental projects of the physics divisions
- Work within integrated teams with staff of physics division + other technical division
- Slight increase of beam diagnostics labelled here "CEA technology"
- **20 % of R&D + extra R&Ds within projects**
- **Mandatory to reach a high TRL, more and more required for (competitive) projects.**

Life @ Sedi

Sedi's newsletter

- Monthly
- Mainly information about changes in staff (including students, postdocs)

Cafés du Sedi

- 2 every months
- Seminars on internal or external instrumentation development
- Very open. Can be presentations by technicians

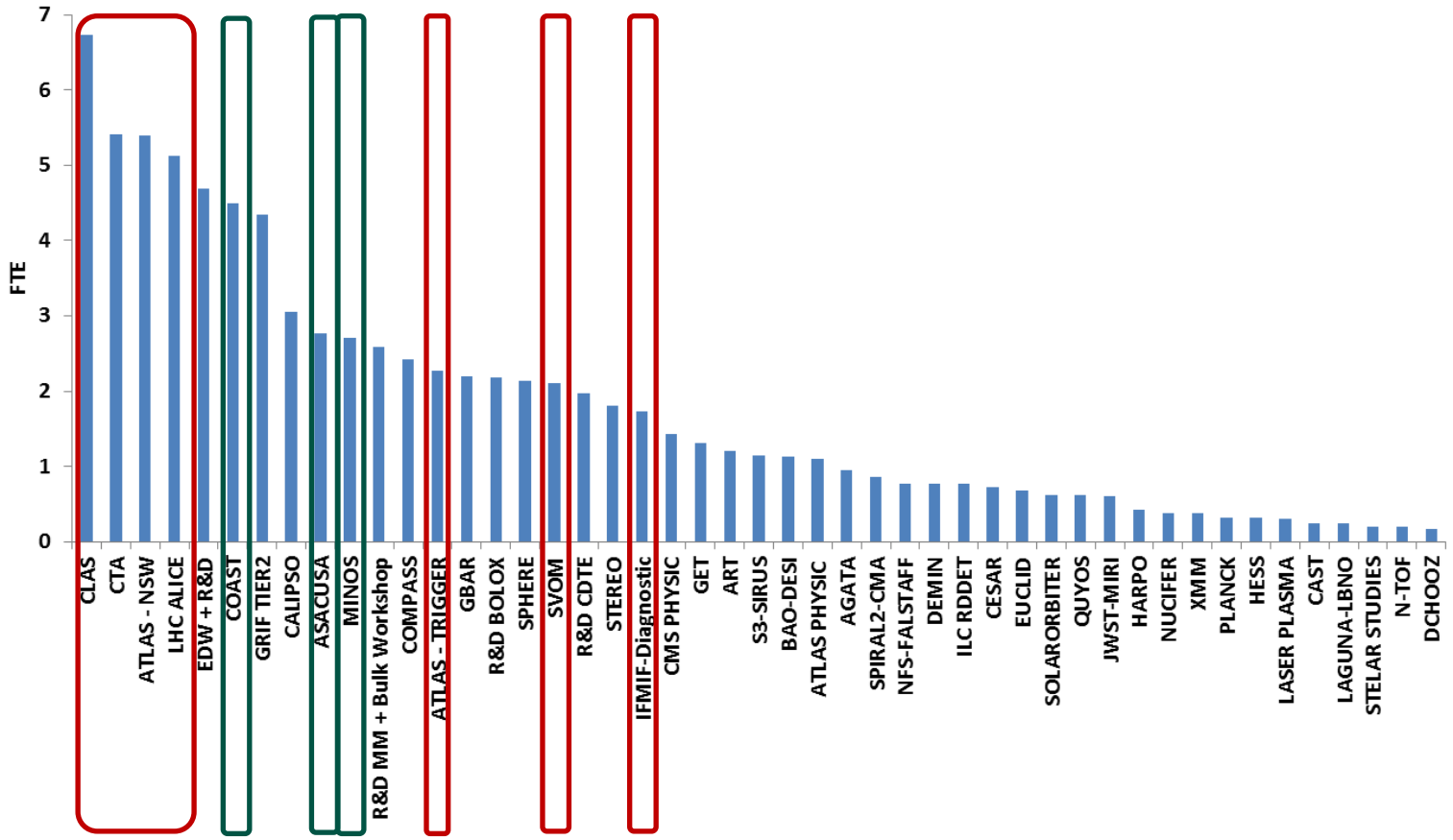
Scientific and Technical Council

- Goal = yearly
- First foreseen next June

Sédi's General meeting

- Yearly

SEDI: PROJECT SHARING



- Sedi staff involved on ~ 50 projects
- 4 priority programs (2 of them for LHC upgrades) with critical-mass manpower
- Keep space for smaller projects; often very innovative R&D

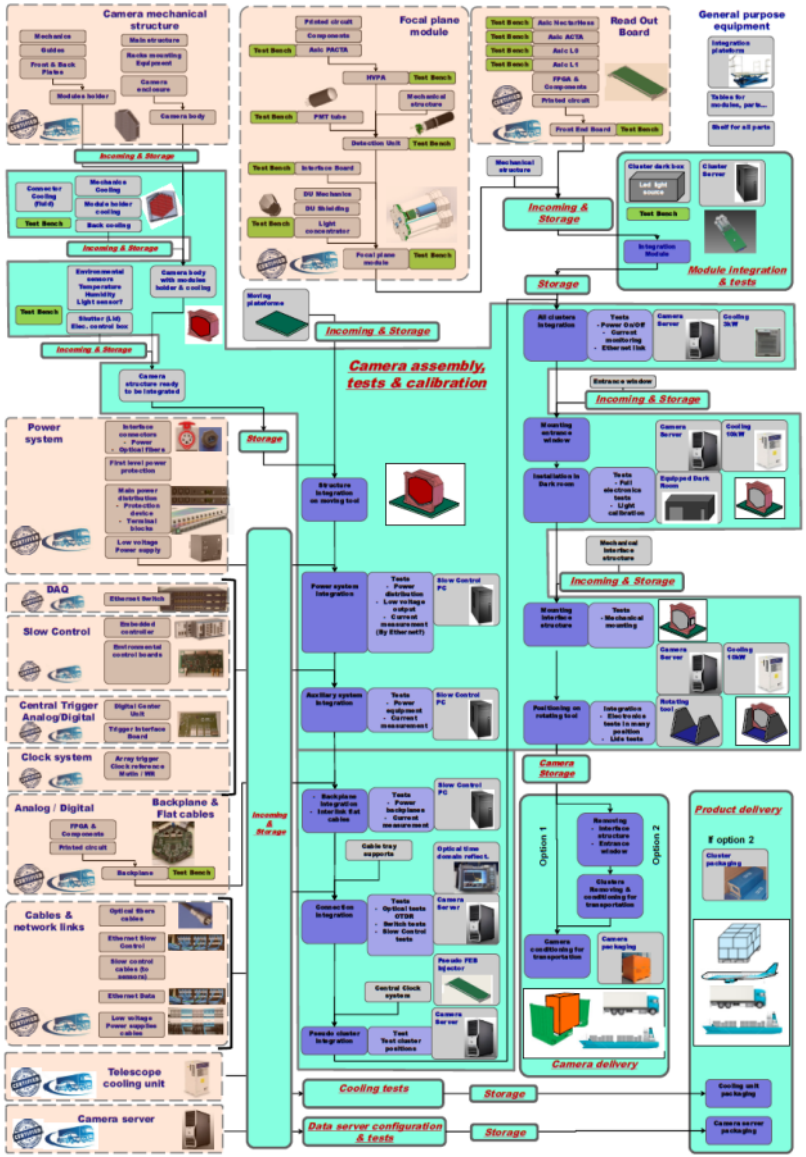
Quality Assurance / Quality Control (question from last CSI)

Seen as (key) tasks of projects

- **Mandatory as we are often involved in quite large scale productions**
- **Procedures + production workflow definitions**
- **Quality control, tracking**
- **Risk assessment**
- **Examples (large productions):**
  - T2K TPC: Production of 72 micromegas modules
  - Double Chooz: integration
  - Clas12: 18 detectors, cables, electronics
  - Atlas NSW: 32 modules (3 m^2 ea), 640 PCBs
  - CTA: ~24 NectarCam + Mirrors

Workflow & processes (division)

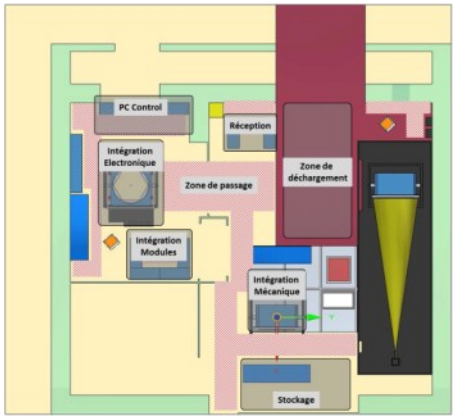
- Computer purchase procedure
- Electronic boards design & production
- Micromegas workshop operations
- Radioactive source procurement & usage
- …



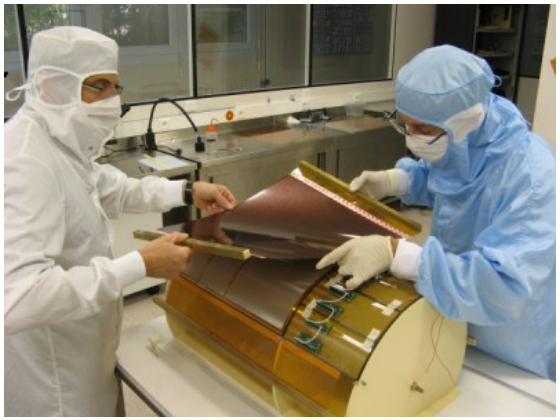
Workflow for NectarCAM integration

TECHNICAL PLATFORMS

Micromegas *Bulk* workshop



Large integration halls



60 m² clean room: ISO 7,6,5

100 m² ISO 7 room in 2015

Microelectronics lab

+ bonding machine, pinhead test machine (P2IO)

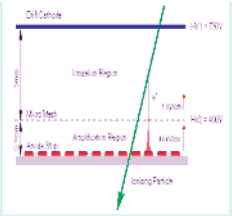
Advanced computer room

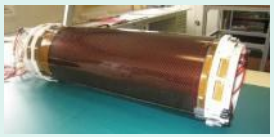
Mirror test facility

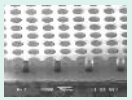
DETECTORS

CREATING DETECTORS

Gaseous detectors

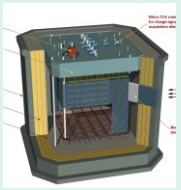




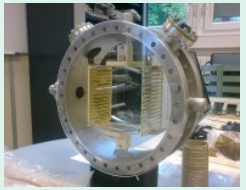


Micromegas (RD51 +CERN)

Liquid Argon Det for neutrino long baseline expts

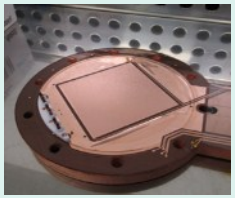


Innovative beam diagnostics



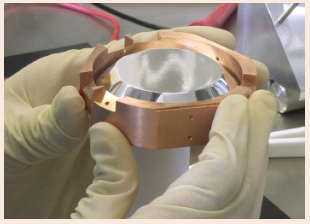
Rare Events. Low radioactivity

Cast µbulk



Spherical counter

Massive bolometers



InterDigit
Lumineu

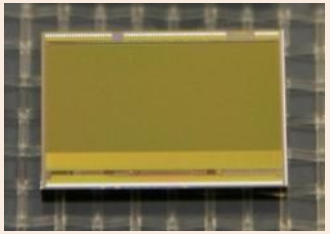
ANR

Hres Si Detectors for nuclear physics

ANR

Musett,
S³-Sirius

Monolithic Active Pixel Sensors

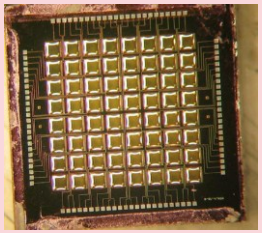


AIDA

R&D for space instruments

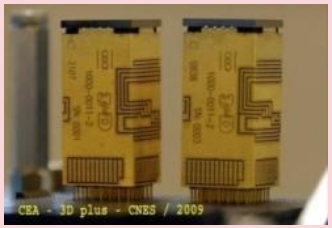
with SAP division

X-ray Microcalorimeters



CESAR

CdTe Spectro-imaging



MICROMEGAS DETECTORS ROADMAP

Trackers

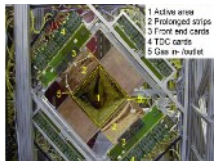
TPC

Low noise

Neutron

Compass2 : pads

Low X0, high rate

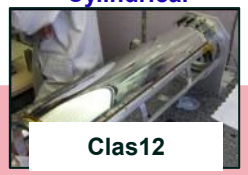


Compass: strip

μmégas + GEM

Resistive Strips

Cylindrical



Clas12

Very large size,

ATLAS NSW

Genetic mux

M3, GBAR

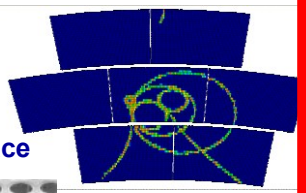
Bulk = robust & low cost

T2K: Pads

Small radius TPC

Minos

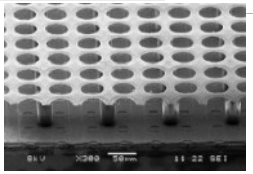
Resistive surface



LCTPC for ILC

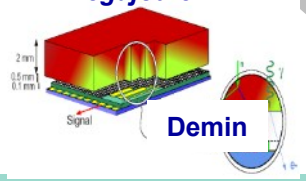
Microbulk

CAST



Timepix/Ingrid: silicon pixel anode

SpectroNeutron *Megajoule*



Demin

Converter

NTOF

NMI3

TRL, Reliability

ps timing

Large size, high rate, industrially manufactured detectors

Large size, 2D-low cost detectors for society (earth sciences, archeology, security)

Large TPCs for future colliders

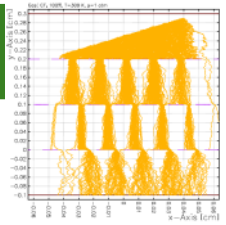
Piggy back: contactless readout sealed detector

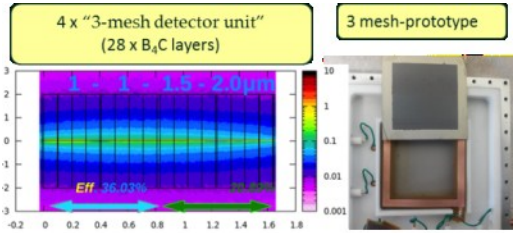
High efficiency detectors for ESS, He3 replacement

THERMAL NEUTRONS DETECTION R&D

Goal

- Alternative to ^{3}He detectors
- Large areas for spectroscopy measurement
- Competitive (50%) efficiency; reasonable cost
- Scientific & industrial needs

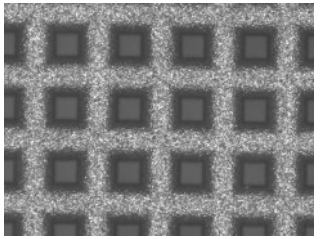




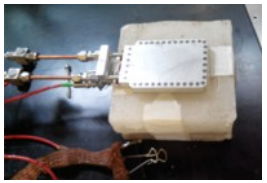
≈ 57% efficiency @ 25 meV

How ?

- Stacks of Micromegas detectors using ^{10}B enriched B_4C converting layers
- Simulation; study of deposition processes; prototyping; characterization



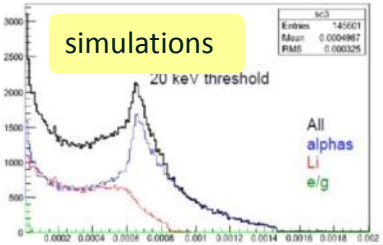
5µm Ni mesh + 2 µm B_4C on both sides sputtering @ Linköping Univ.

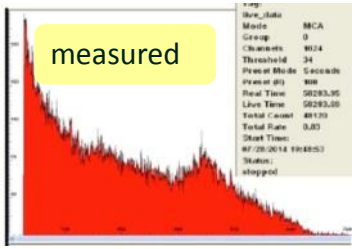


Single layer **sealed** prototype

Status

- (2014) Concept validated on a single layer prototype
- Interest of Schlumberger for oil drilling:
  - sale of a detector prototype in 2014
  - R&D collaboration under discussion for 2015
- Further R&D funded in 2015 (FP7/NMI3 program) for ESS detectors





≈ 5% efficiency for 1 layer

LHC Upgrades: Atlas New Small Wheel

Atlas muon detectors

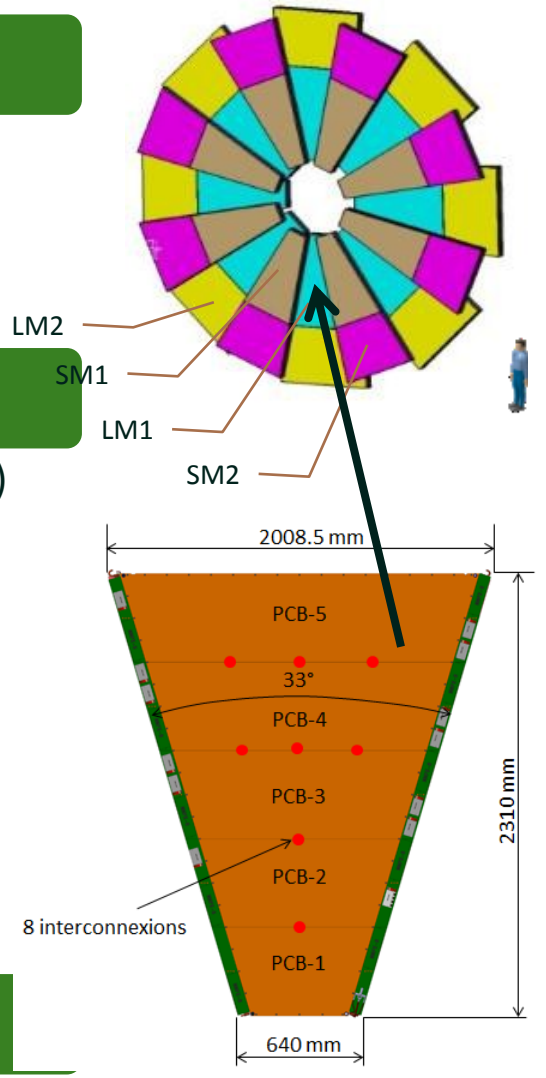
- 12 m “wheels”, ~1200 m^2 active surface
- Micromegas with resistive anode for high flux
- Qualified after ageing studies in 2013-2014
- Irfu (Sis + Sédi): project manager & technical coordinators

Mechanical design, production

- Modular design based on 4 different quadruplets (stack of 4 detectors)
- Assembly shared between 4 international teams
- **Micromegas technology transfer to industry (respons. Irfu)**
- **Irfu: production of the 34 largest quadruplets** => installation in 2018
- Mechanical design is now nearly complete
- **Large work of QA/QC in progress**
  - Integration procedures
  - PCB control & acceptance tests
  - Production monitoring

In 2015

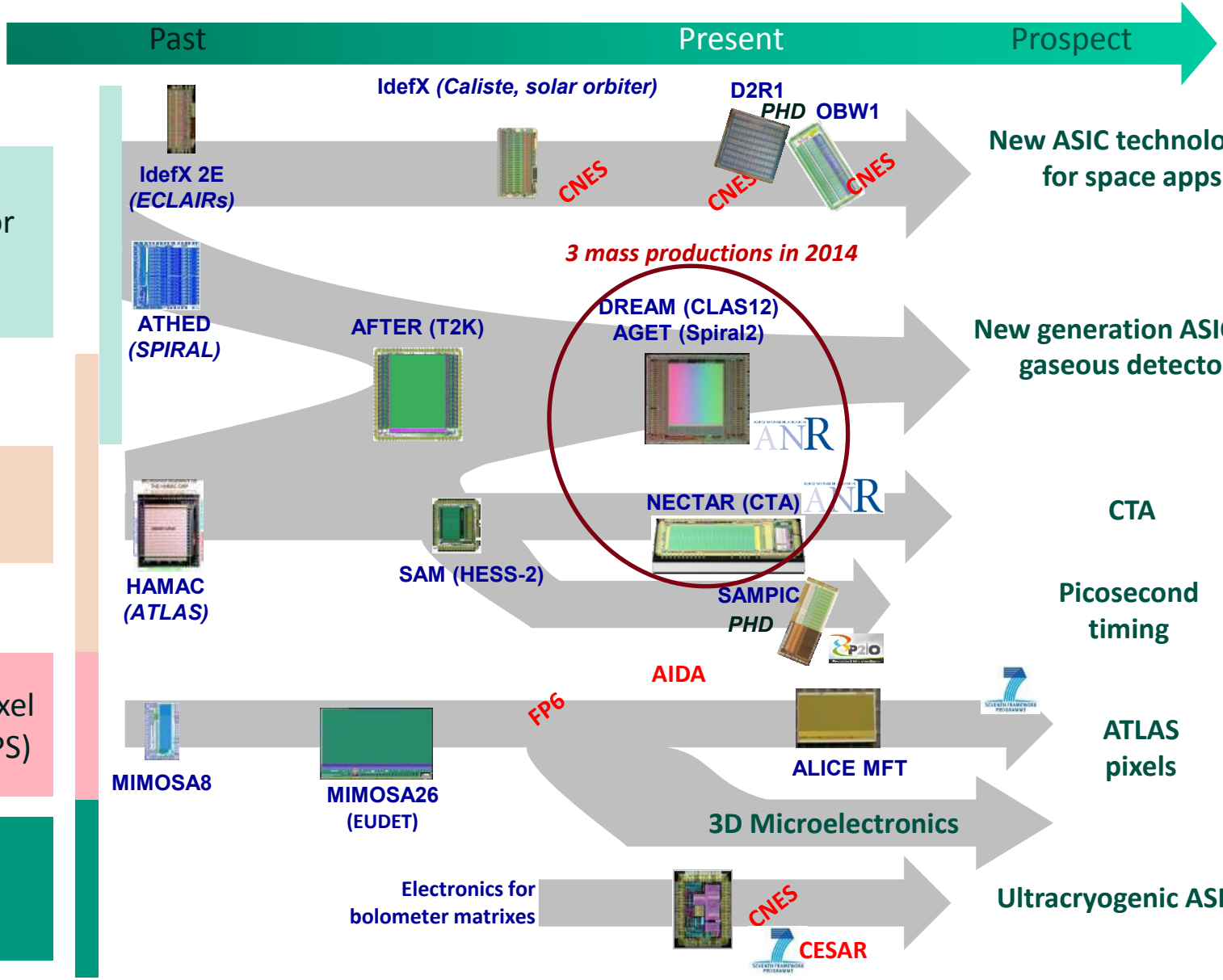
- Assembly of a large scale pre-prototype in progress (Q1)
- Setting up of the infrastructures for the production
- Construction and test of the qualification module (M0)



LM1 quadruplet modules to be produced by Irfu
Strip position known to 30 µm
Stack planarity within 80 µm

MICROELECTRONICS

MICROELECTRONICS ROADMAP

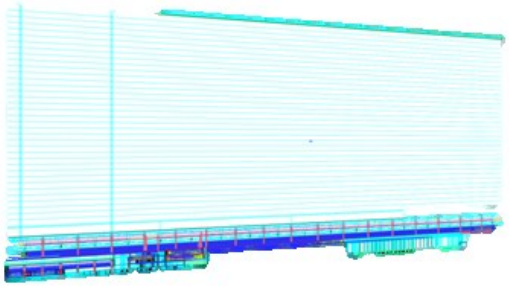


Monolithic Active Pixel sensor for ALICE MFT

R&D on MAPS detectors

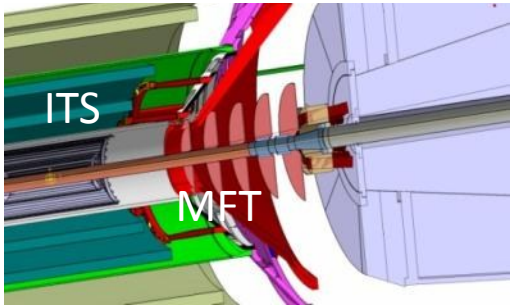
- Detection of particles in substrate of electronics
- R&D started in 2004
- EUDET sensor in 2009 → core of the Desy/Hambourg telescope (world standard for detector qualification)

2009: EUDET sensor :0.7Mpixels
3.5µm resolution, 99.7% MIP efficiency)



Alice *Muon Forward Tracker*

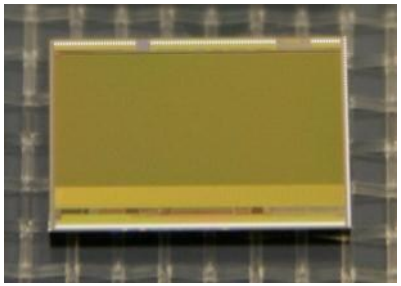
- New pixel detector, CMOS MAPS technology chosen
- 5 planes, total active surface ~ 0.4 m^2
- 900 sensors (ITS = 23000) → 516M pixels;
- Increased complexity (digital)



MFT: 5 disks between the barrel & the hadron absorber

Project status & involvement of Irfu

- Irfu : Technical Coordination
- 2013-2014: (R&D) design of a 1/3-size sensor (PIXAM)
- Summer 2014: decision to join the ALPIDE design team (CERN)
  - common sensor between Alice Internal Tracker and MFT
  - cost & manpower optimization
- 2015: design and manufacturing of the final sensor
- Involvement in the hybridization process of chips on ladders



PIXAM prototype: 30 x 6.3 mm^2

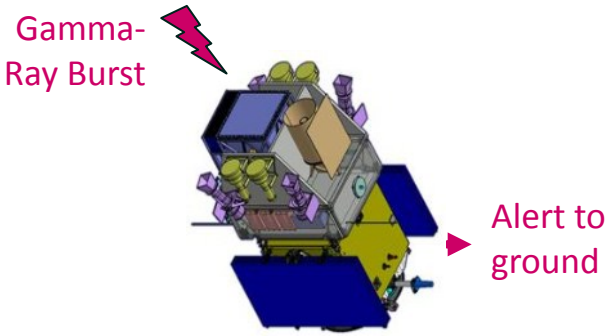
Real Time

Real time systems: SVOM-Eclairs.

Eclairs scientific payload

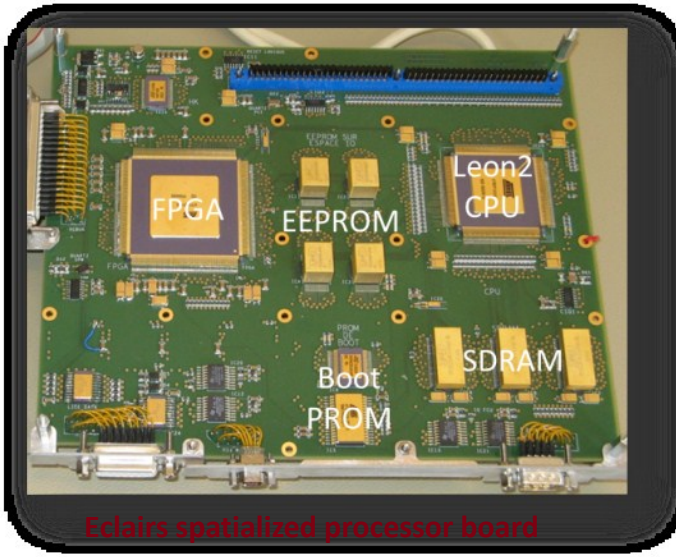
- 6400-pixel coded-mask CdTe gamma-camera
- IdefX Asic developed at Irfu, produced & qualified in 2012

See B. Cordier's talk



Scientific processing unit

- Embedded processing: coded mask deconvolution for GRB localization within few ms
- CPU processing board (ITAR free)
  - Laboratory model validated in 2014
  - Embedded real-time software for trigger validated
- Functionality merged with camera control on a new CPU board in 2015
- Test benches simulating events



Eclairs spatialized processor board

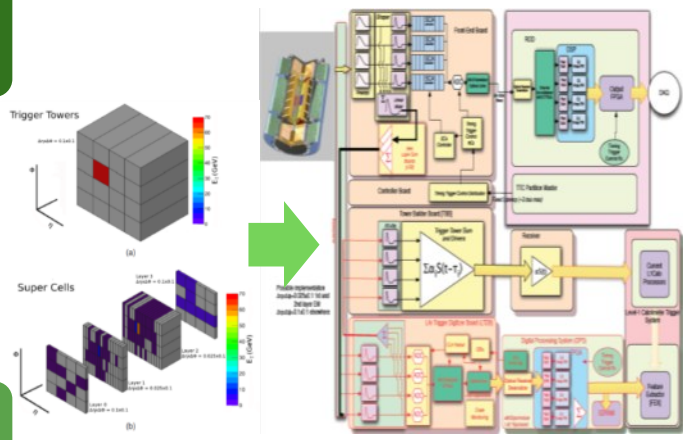
Scientific ground segment

- Alert distribution (few sec to few minutes)
- Scientific processing
- Data Center

UPGRADE OF THE ATLAS L1-TRIGGER CALORIMETER: LTDB

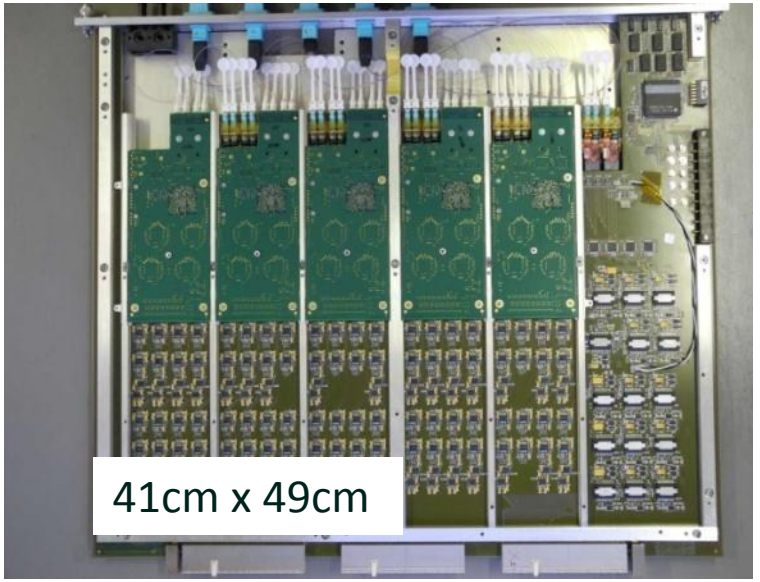
x5 luminosity: better trigger with highest granularity

- Compatibility with existing (TBB) trigger system
- Mixed mode analog-digital architecture
  - Perform sums and digitized signals from ECAL
  - ~300 ADC channels/ board => 200 Gbit/s throughput



Demonstrator board designed & integrated

- Irfu - IN2P3/LAL Orsay co-design in a 1-year time
- Excellent performance
- Technological feasibility assessed
- Demonstrator integrated in ATLAS (8/2014)



Future

- Final rad-hard board design (2015)
- Co-design with US groups (BNL…)
- Irfu commitments:
  - Analog part; test bench
  - Production of ~150 boards (2017)

SOFTWARE DEVELOPMENT

SOFTWARE ENGINEERING & DEVELOPMENT

See D. Pomarède's talk

Sédi software team

Acquisition frameworks

Development of application servers

Visualization of complex data

Reconstruction & analysis pipelines:

cta cherenkov telescope array

ALICE

SVOM

CMS

CERN

ATLAS EXPERIMENT

Dedicated SW

Contributio to FW

WEB technologies & GUI

Databases Big Data

ATLAS EXPERIMENT

SINCE 2006: PROFESSIONALIZED DEVELOPMENT PROCESS

CODE VERSIONING, WIKI, TEAM DEVELOPMENT MANAGEMENT, CONTINUOUS INTEGRATION

Trac's projects :

- BOSS
- CAO Micro
- CaLIPSO
- CATS
- CConfig
- CeLAND
- Clas12
- CMS Soft
- COAST
- colloque Irfu
- CTA
- Demo
- doublechooz
- fieldbus
- GeALS
- General Interface
- GET
- GPulse
- GRIF
- guild
- HESS
- Km3
- MINOS
- MIRImSim
- Mordicus
- muscade
- Nucifer
- PHoCEA
- PROPHET
- Routage IXOS
- Scratch
- SimuSvom
- snif
- Svom
- SvomFsc
- sparseastro
- T2K
- Xmm
- Xsmurf

Software lifecycle management
Software project management

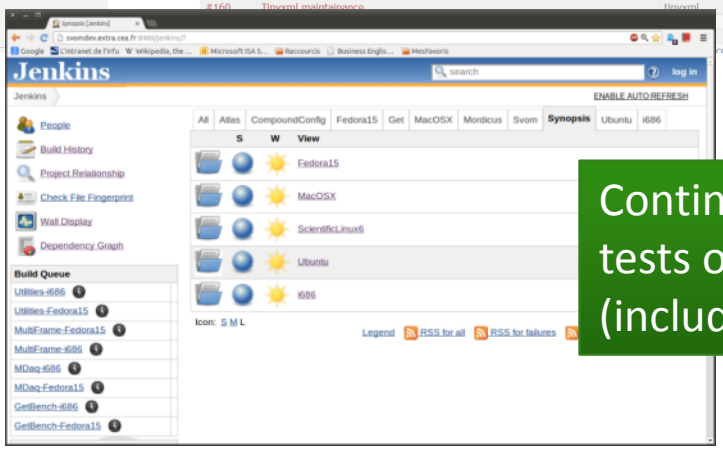
News | Wiki | Timeline | Roadmap | Browse Source | View Tickets

{1} Active Tickets (42 matches)

- List all active tickets by priority.
- Color each row based on priority.

Edit report | Copy report | Delete report

Ticket	Summary	Component	Version	Milestone	Type
#200	Link of CompoundConfig Test Functions Fail under VxWorks 6.3	compound config			defect
#155	Build system improvements	all			enhancemen
#157	Changes in the projects structure	all			enhancemen
#193	CConfig easy-to-use serializer / deserializer	compound config			enhancemen
#162	Binary serialization format	compound config			task
#163	Basic Configuration Server	CConfigServer			task
#171	Add notions of Site, Run, ConfigurationSet	database config		database mapping library	task
#195	Apply change in ld default linking behavior	all			defect
#158	Adaptation to Eclipse environment	all			enhancemen
#159	RTEMS portability	all			enhancemen
#168	Example XML file	compound config			enhancemen
#169	ElectronicsControlCore	CConfigServer			task
#187	Fix Mac OS X - specific build issues	all			task
#177	Add support for automake silent building	all			enhancemen
#178	Enable automake silent rules to make build output clearer	all			enhancemen
#186	Add Eclipse support for MacOSX	all			enhancemen
#196	Enforce subversion repository layout and naming policies	all			enhancemen
#152	VxWorks portability	all			task
#189	tagging	all			task
#194	Upgrade Eclipse CDT projects to version 2.X of Autotools plugin	all			task
#206	Dialog to edit a configuration	config gui			task
#97	Read only configuration editor	config gui	1.0	basic config editor	enhancemen
#88	Copy&Paste	config gui	1.0	basic config editor	task
#89	Drag&Drop	config gui	1.0	basic config editor	task
#92	Search action and dialog box	config gui	1.0	basic config editor	task
#160	Tinyxml maintainance	tinyxml			defect
					enhancemen
					enhancemen
					task

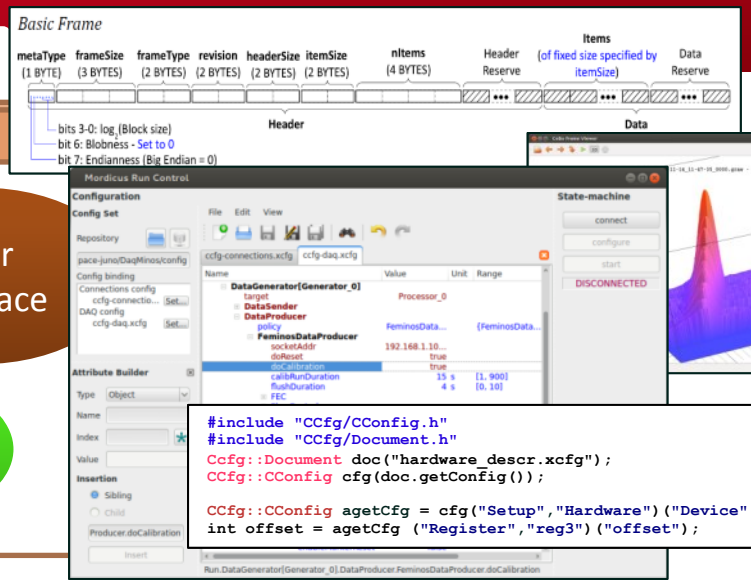


Continuous non regression tests on multiple platforms (including embedded systems)

Control, Configuration & Acquisition Processes

Acquisition & Control Network

- front-end acquisition
- front-end control & config
- user interface
- back-end acquisition & processing
- back-end control & config



Mordicus Software Packages

MORDICUS

- mordicus-hw
- mordicus-acq
- mordicus-cfg
- mordicus-ctrl
- mordicus-gui

Generic Framework
(re-usable software modules)

application parameters
extension mechanisms
class specializations
plugins and other
hot spots

Actual DAQ Application

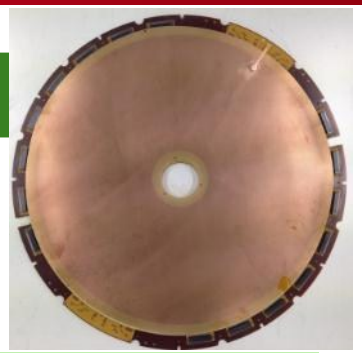
- Minos
- Asacusa
- Svom test bench
- Calipso
- • • •

SYSTEM APPROACH

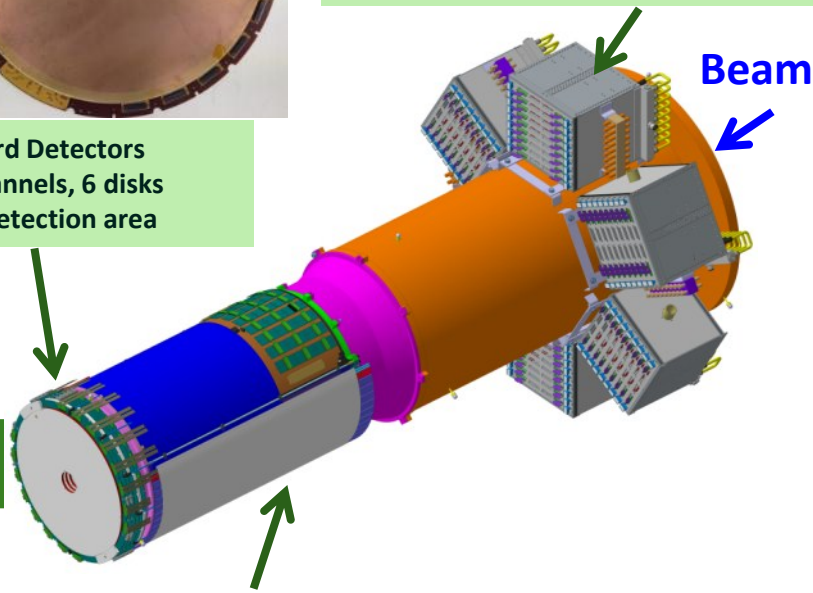
MICROMEGAS VERTEX TRACKER (JLAB)

Innovative central detector

- Cylindrical + disk tracking system
- Large area (4m^2), tracking precision of few 100 µm
- Low matter budget; 5T magnetic field
- Compact, fast and CEM-robust electronics
  - R&D on light low capacitance cables
  - DREAM: deadtime-free ASIC
  - Mixed-mode high-end FE + BE boards
- Slow control & DAQ software



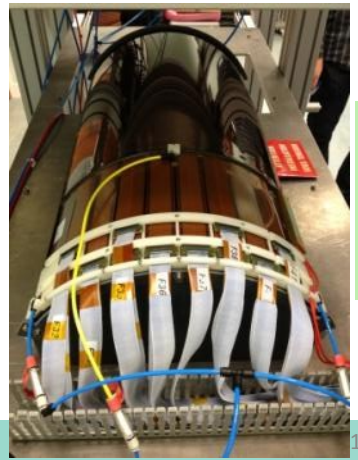
512-channel front-end unit (x 50)



Forward Detectors
6k channels, 6 disks
1 m² detection area

Status

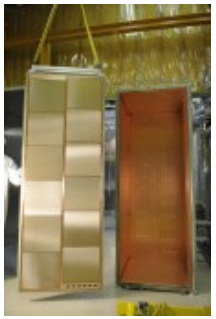
- Mechanical design is now complete
- Final detectors are being produced
- DREAM ASICs produced in 2014
- Electronic boards + cables: ½ produced
- Readout architecture validated (ASACUSA)
- **Q4 2015**: half barrel + forward detectors at JLab
- Many building blocks re-used on other systems



Barrel detectors
20k channels, 6 layers,
3 m^2 detection area
Self-sustained curved tiles

GASEOUS DETECTOR PROJECTS: BUILDING BLOCKS REUSE STRATEGY

T2K TPCs

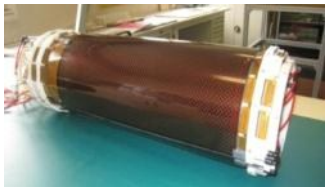


GET ANR, ACTAR
(valorization of AGET chips)

CLAS12
(hadronic physics)

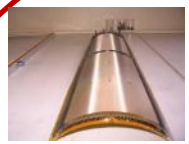
P. Legou's talk

ASACUSA (valo anti-matter)



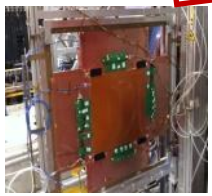
A-M. Corsi's talk

Minos (nuclear structure)



Detectors

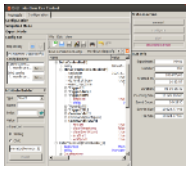
ATLAS NSW)



Compass pixel/SPLAM ANR
(hadronic physics)

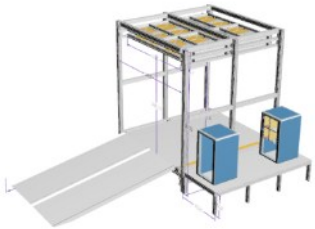
Electronics

ASICs

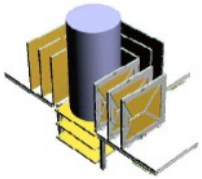


Software
+ Analysis

H. Goutte's talk



Muon tomography programs
Homeland security + earth
sciences, archeology

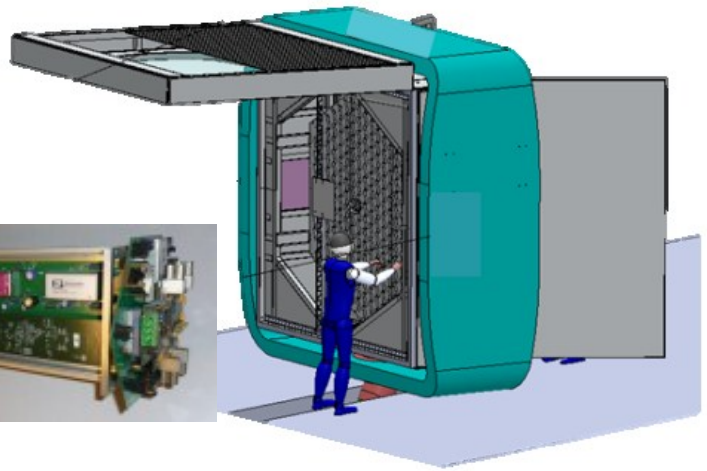


GBAR GMT (anti-matter)

CERENKOV TELESCOPE ARRAY: NECTARCAM

Scope

- Design, production, test and delivery of 24 cameras for the Medium S
- Modular design with ~1800 PMT

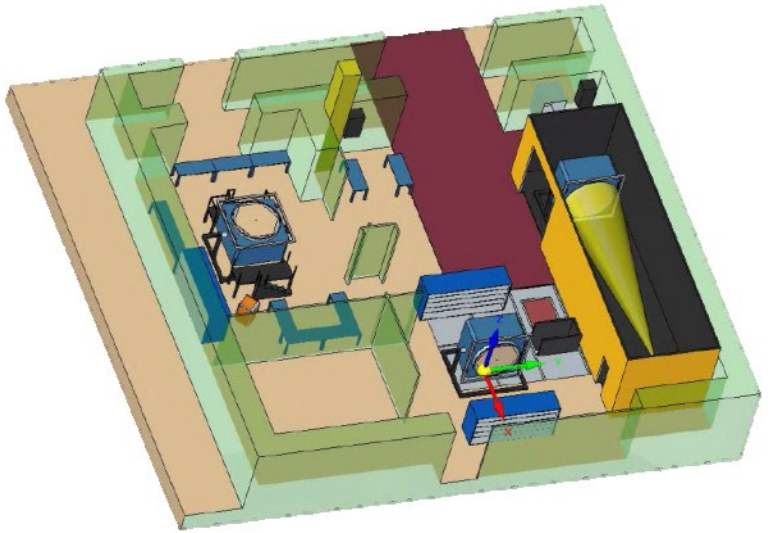


Project Status

- Qualification of a 7-pixel prototype module (2013-2014)
- Final design of all the main elements (2014)
- 2015: qualification model (equipped with 133 pixels)

Irfu Involvment

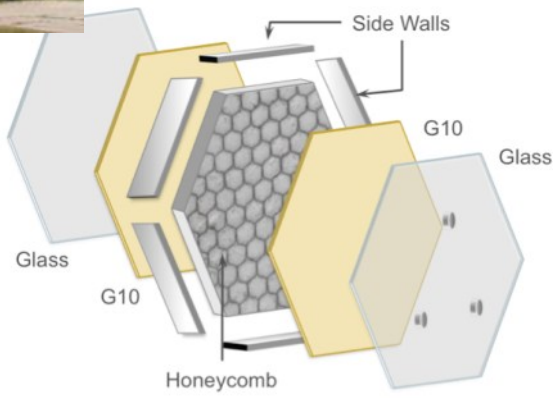
- **Project Management**
  - Consortium of 14 European laboratories, 29M€, 90FTE
- **Design**
  - Cooling system (SIS)
  - GHz digitizer Nectar chip (6000 produced in 2014)
- **Camera Integration**
  - 500 m^2 assembly building (2015)
    - Simultaneous operation on 3 cameras
    - 65 m^2 dark room for qualification calibration
  - Development of QA/QC procedures
  - Description of all the integration processes



CTA: MIRRORS

1.2 m Composite Mirrors (x 180 / telescope)

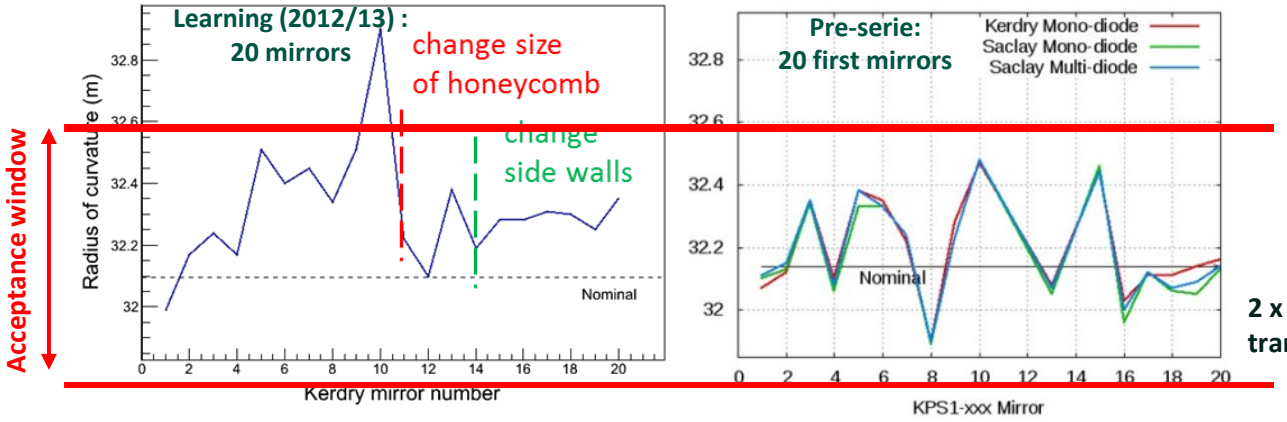
- Goal: supply 1/2 the mirrors for Medium Size Telescopes (~2000)
- Assembly of composite compounds and coated glass: low cost
- 2010-2013: process development phase
- Qualification including harsh environmental tests
- Optical test bench at Saclay => Test platform for CTA



Industrial Transfer

- Knowledge and process transferred to the **Kerdry** company (Britanny)
- 20 mirrors produced in 2012-2013 (process transfer)
- Pre-series of 50 final mirrors being produced (20 already received)
- 2015: KERDRY industry will reach readiness for high quality 'mass production' (~2000 facets in 4 years)

Mirror being removed from vacuum chamber after coating at KERDRY



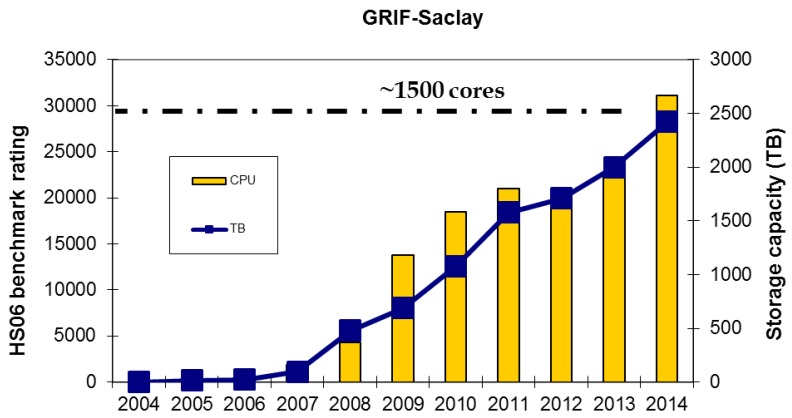
2 x focal lengths measured for transfer and pre-series mirrors

COMPUTING INFRASTRUCTURE

COMPUTING SERVICES & INFRASTRUCTURE

Grid computing

- Shared between national Tier1/Tier2 center at Lyon and Regional *Ile de France* Tier2/Tier3 center
- Local Irfu infrastructure accounts for 40% of regional center
- Irfu contributes to ~25% of french effort, ~2.5 % of worldwide effort;
- 93% LHC- 7% CTA/HESS



High performance computers

- Local intermediate size: **IrfuCoast (astrophysics)** machine (1200 core nodes, Infiniband) allows for program preparation and validation before large submissions
- Simulations run on very large parallel national (GENCI) and European (PRACE) HPC
- New HPC cluster for **SACM**: 256 core nodes, 30 TB storage

COMPUTING SERVICES & INFRASTRUCTURE

Local infrastructure (Irfu)

- Common environment for LHC Grid, IrfuCoast and interactive analysis machines
- Liquid coolant technology, 500 kW thermal, 25 racks
- Free chilling thermal capability, energy efficient (PUE factor = 1.3)
- New capabilities in 2015/2016 for Coast upgrade

Computing support (DSM)

- 1500 Windows computers
- 300 Mac
- 300 Linux
- CEA security

Network (DSM)

- 38 different buildings (Irfu, Iramis…)

VALORIZATION
TECHNOLOGY TRANSFER

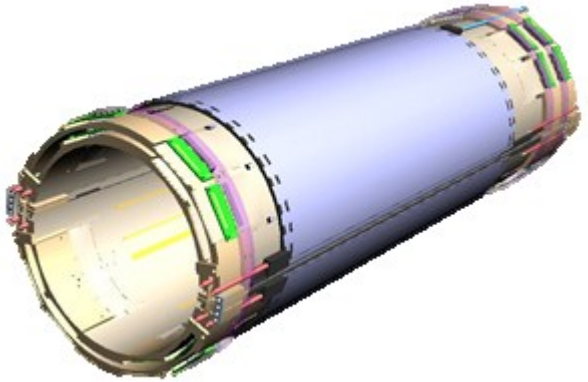
Extensive effort for valorization & technology transfer

C. Porcheray's talk

Micromegas

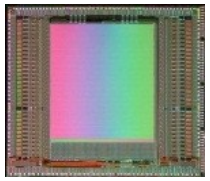
- *Detectors: Bulk* workshop production → selling detectors
- *Detector systems*
  - Cylindrical tracker for ASACUSA coll. (Riken)
  - Neutron detection: oil drilling
  - Prospects for muon tomography: homeland security, earth sciences
- *Technology transfer to industry → Elvia*

Asacusa Micromegas Tracker



Electronics boards & ASICs

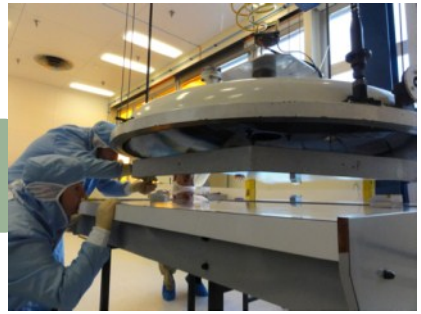
- *Sales*
  - AGET ASICs (laboratories worldwide)
  - Idef-X ASICs (satellites, developments for homeland; security/ medical imaging through CEA/LETI)
  - Digitization and DAQ boards (laboratories worldwide)
- New CAEN digitizer *modules* (patent licensing)



AGET ASIC

Mirrors

- Technology transfer to Kerdry French SME



CTA Mirrors

SUMMARY

SUMMARY & PROSPECTS

Expertise on the full signal detection processing chain

- Detectors
  - Continuous R&D
  - Micromegas has now reached a high TRL
- Clear roadmap for ASICs
- High-end electronics systems(HW/SW, real time)
- Optimized methodology for software development

Create complex systems

- Create = Design/simulation/integration of complete instruments
- Capability to operate in integrated, multi-skilled teams
- Able to integrate large scale instruments

Prospects

- 2015 will be a key-year for Sedi
- We have strong commitments on large projects in the next few years
- Benefit from the new dynamic of Paris-Saclay University to increase links with local Schools of Engineering

PARIS-SACLAY

THANK YOU FOR YOUR ATTENTION

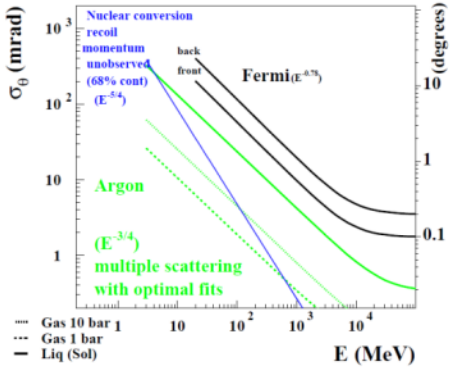
BACKUP SLIDES

THE HARPO (HERMETIC ARGON POLARIMETER) PROJECT

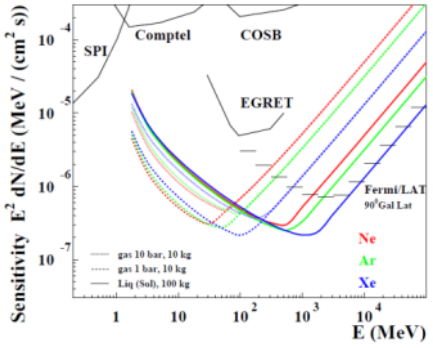
- **Motivations:** no γ-polarimeter sensitive above 1 MeV in space astronomy
  - Comology/New Physics: search for Lorentz Invariance Violation (LIV) sensitivity $\propto E^2$
  - Astrophysics: understand mechanic(s) in γ cosmic sources
- **Instrumental method:**
  - Use a Time Projection Chamber for Pair Production ($\gamma Z \rightarrow Z e^- e^+$) & Triplet Production ($\gamma e \rightarrow e^- e^+ e^-$)
  - 3D reconstruction in a "thin" homogeneous pressurized argon-based gas mixture
- **Innovation:** new high-resolution & high sensitivity way to perform MeV-GeV γ-ray astronomy & for the first time polarimetry

Simulations

- Angular resolution

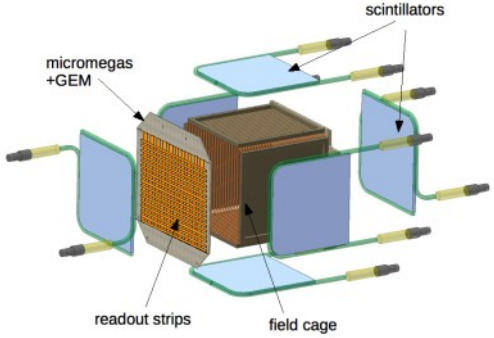


- Point-source differential sensitivity in 3 years

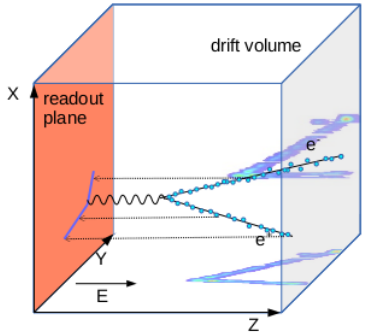


Demonstrator

- Micro-Patterned Gas Detector triggered by plastic scintillators



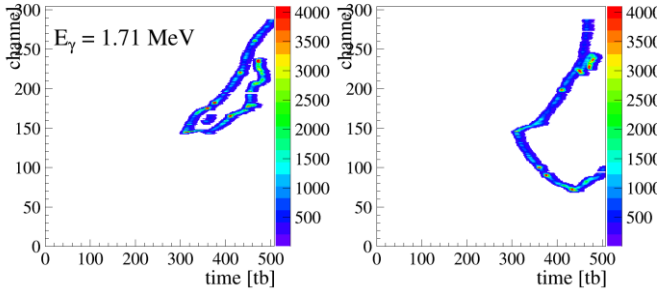
- Cubic detector with 2×1D (x,y)+z readout for 3D tracking



Polarized γ beam test

- Newsubaru (Japan), November 2014

- Candidates of γ conversion in gas mixture

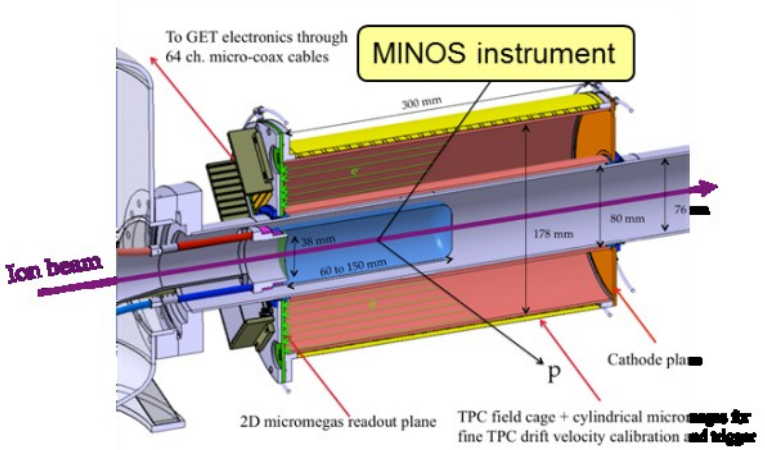


Data analysis is in progress

MINOS: A CYLINDRICAL TPC FOR THE STUDY OF EXOTIC NUCLEI (RIKEN, JAPAN)

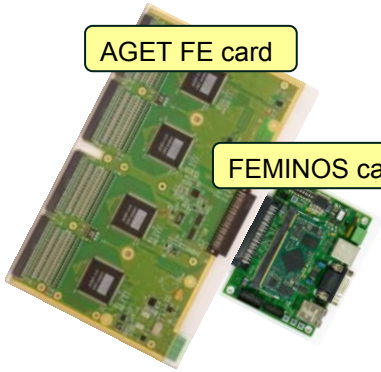
Minos innovation

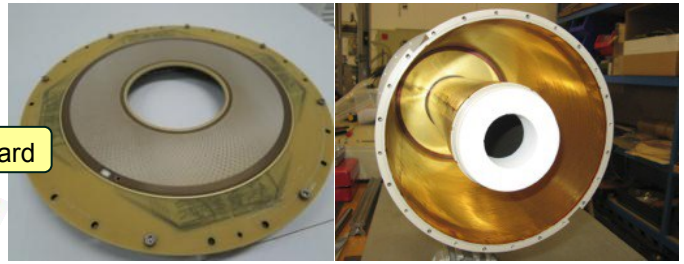
- Improve energy resolution for γ spectroscopy of knock-out reactions in thick target by using a TPC to localize the vertex.



Instrument design : 2010-2014

- H2 liquid target (SACM);
- Low-radius TPC;
- 3600 pads Micromegas endplate;
- AGET ASIC, FE & BE Electronics: evolution of T2K electronics;
- DAQ system .



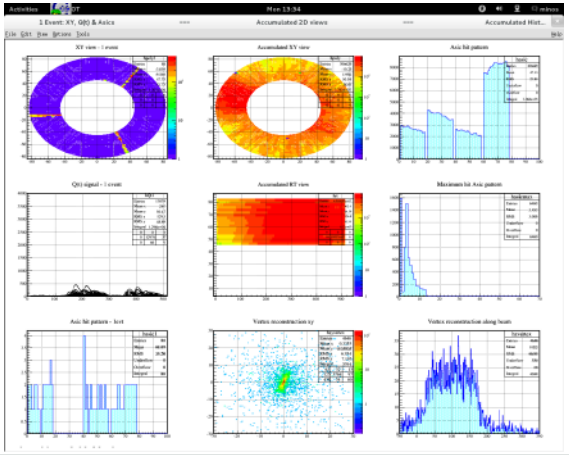


TPC End-Plate & field cage element. Internal R= 4cm

Instrument operation 2014-

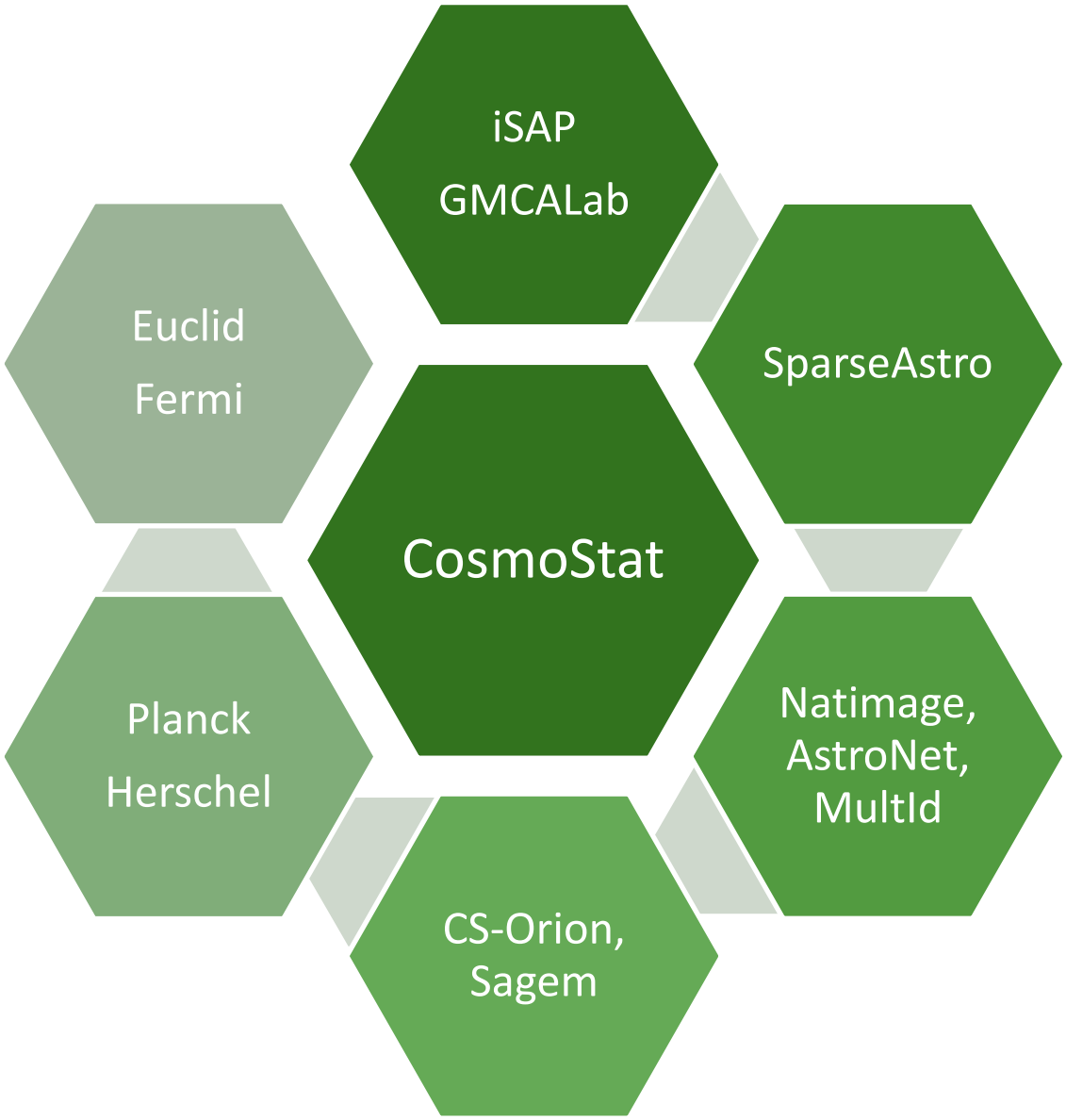
- 2 succesful experiment campaigns @Riken in 2014
- See A.M. Corsi's talk

Minos inside the DALI spectrometer @ Riken



On-line screenshot of TPC events (SAMURAI 018)

COSMOSTAT IMAGE & SIGNAL PROCESSING



CosmoStat image & signal processing

Cosmology

- Weak Lensing (HST, CFHT, Euclid) : *shear estimation, mass map reconstruction, cosmological model discrimination, non-Gaussianity*
- Surveys (SDSS, Euclid, etc.): *galaxy distribution, baryonic acoustic oscillations, integrated Sachs Wolfe effect (ISW)*
- CMB (WMAP, Planck) *: Sunyaev-Zel'Dovich cluster detection and map reconstruction, CMB map estimation, non-Gaussianity detection, isotropy, ISW*

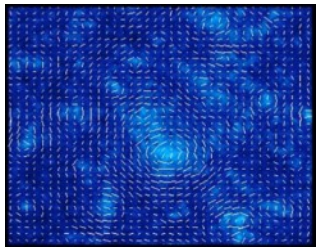
Statistics/Signal Processing

- Sparse data representations (Planck, Euclid)
- Component Separation (Plank, Fermi, MultID, Lofar)
- Sparsity and inverse problems (VISIR, Herschel)
- Missing data interpolation (Planck, Euclid)
- Object detection and Poisson denoising (XMM, Fermi, Euclid)
- Compressed Sensing (Herschel,CS-Orion, Lofar)

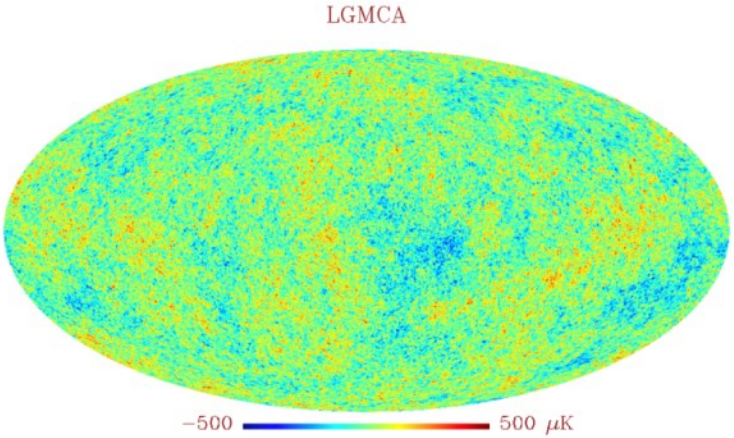
Applications and valorization

- Numerical methods for video processing (CS-Orion FP7 project), anomaly detection in multispectral data (MultID), component separation in biology (PhD in coll. with the DRT), etc.
- Softwares for signal/image processing (iSAP, GMCALab)

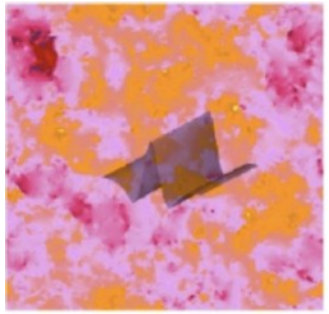
erc SparseAstro (J-L Starck) ANR MultID (J.Bobin)



Weak lensing mass map reconstruction



CMB estimation with LGMCA from Planck data



Curvelets for image analysis

CALIPSO: AN INNOVATIVE DETECTOR FOR PET IMAGING

Calorimètre Liquide Ionisation, Position, Scintillation Organométallique

- Optimised for ~Mev photon calorimetry
- Heavy organo-metallic sensitive liquid: Tri Méthyl Bismuth
- High potential gain in efficiency and spatial resolution (~1 mm^3) for PET
- A candidate for positron spectrometry applications
- Scintillation: trigger and timing (few 100 ps)
- Ionisation: energy measurement and 3D position (electronics based on IdefX Asic)
- Patented design, demonstration program 2010/14