CALICE France

Organisation du projet – Historique et calendrier

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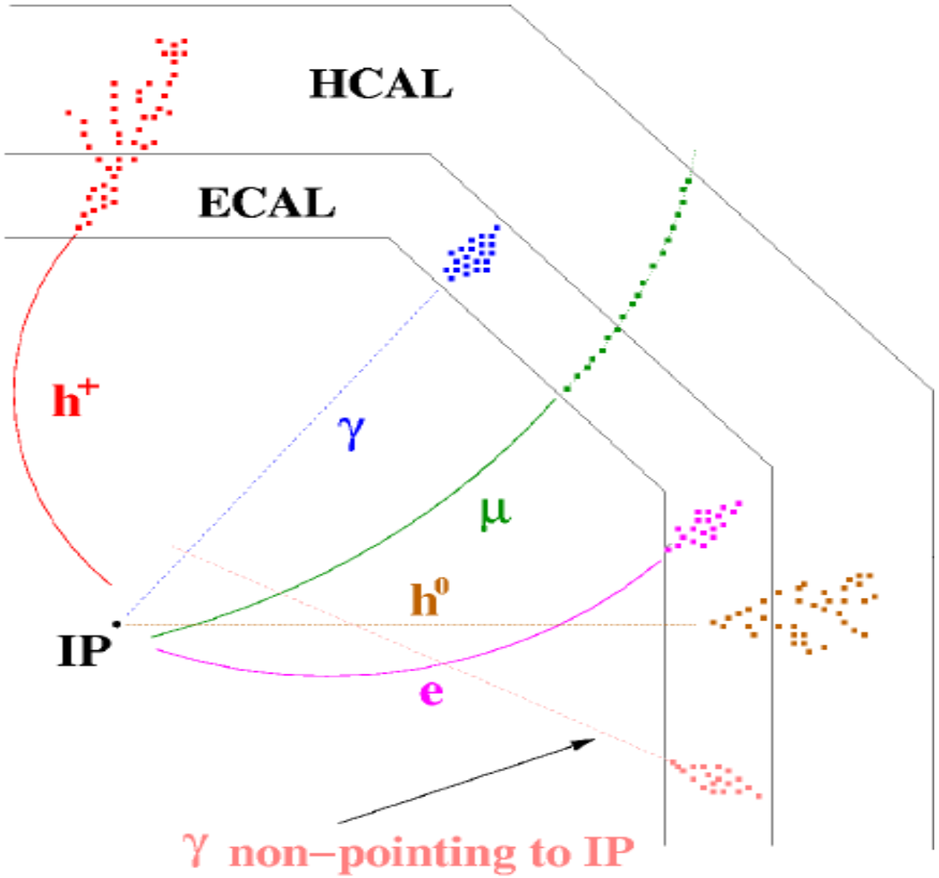
Particle Flow Calorimetry

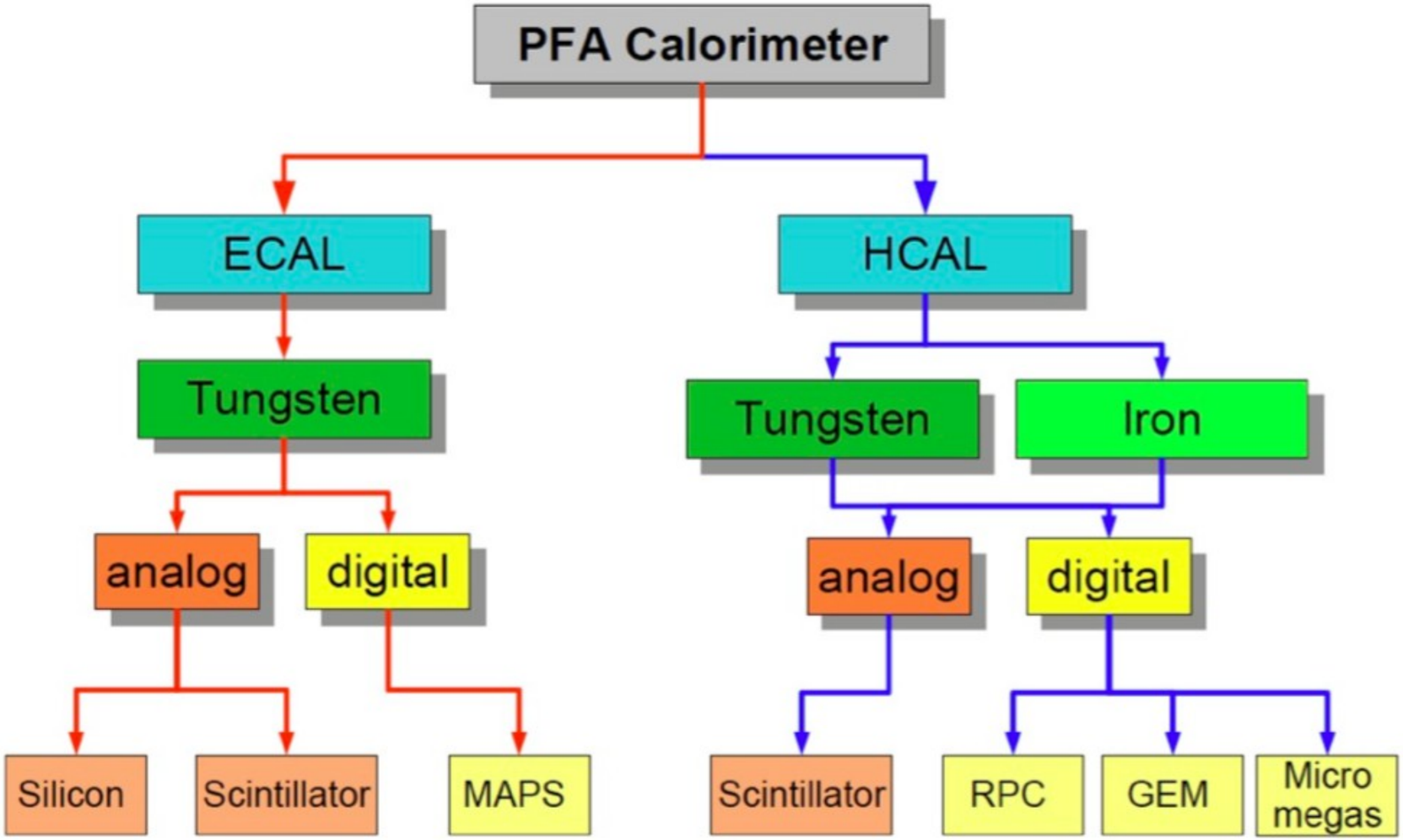
Jet energy measurement by measurement of **individual particles**
Maximal exploitation of precise tracking measurement

- large radius and length
  - → to separate the particles
- large magnetic field
  - → to sweep out charged tracks
- “no” material in front of calorimeters
  - → stay inside coil
- small Molière radius of calorimeters
  - → to minimize shower overlap
- **high granularity of calorimeters**
  - → to separate overlapping showers



Particle flow as privileged solution for experimental challenges
=> Highly granular calorimeters!!!
Emphasis on tracking capabilities of calorimeters

Technologies for PFA Calorimeters



Mainly organised within the: Collaboration

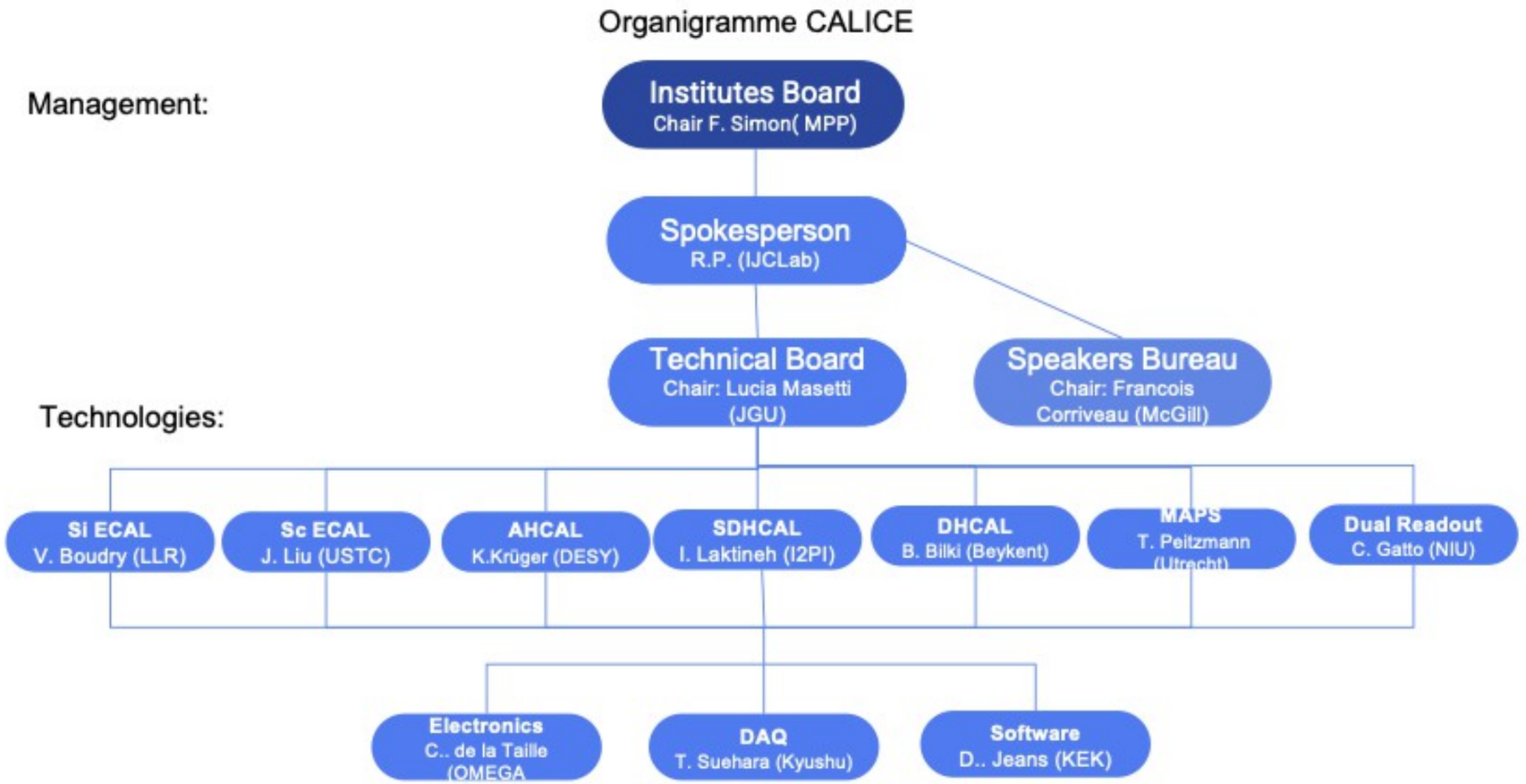
The CALICE Collaboration

Calorimeter R&D for large imaging calorimeters

~270 physicists/engineers from 62 institutes and 18 countries from 4 continents

- Integrated R&D effort
- Acceleration of detector development due to *coordinated* approach
- MOU 2005
  - IN2P3 among founding members, first Spokesperson Jean-Claude Brient

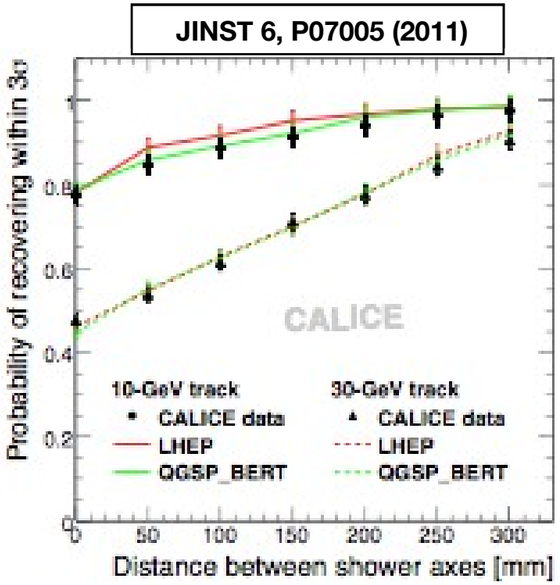
CALICE Collaboration - Organigram



Steps of R&D

Physics Prototypes

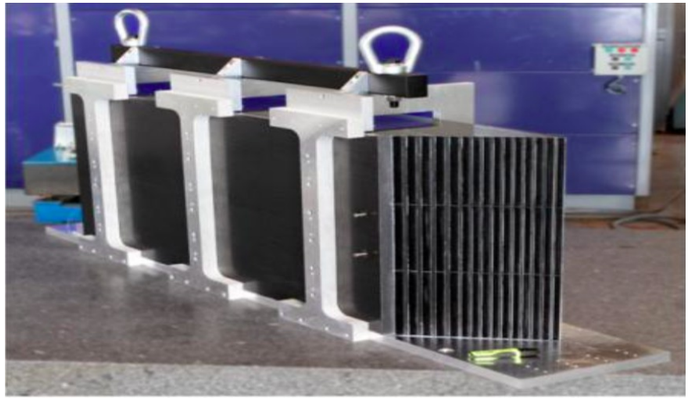
2003 - 2012



- Proof of principle of granular calorimeters
- Large scale combined beam tests
- Inspiration for CMS HGCAL

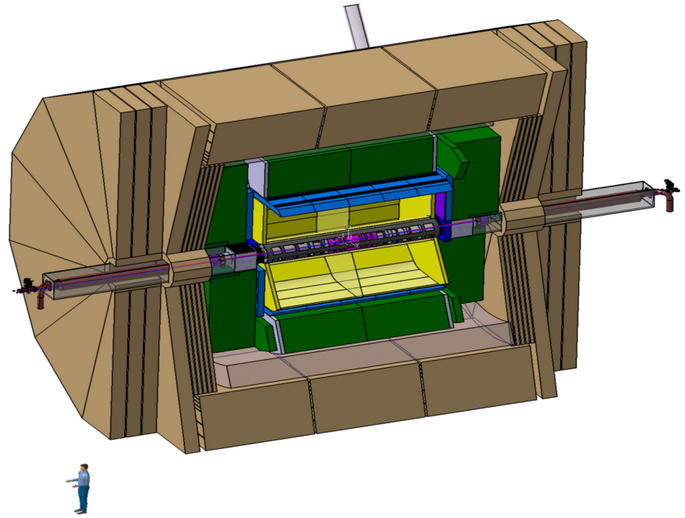
Technological Prototypes

2010 - ...



- Engineering challenges
- Higher granularity
- Better sensitivity (lower noise)

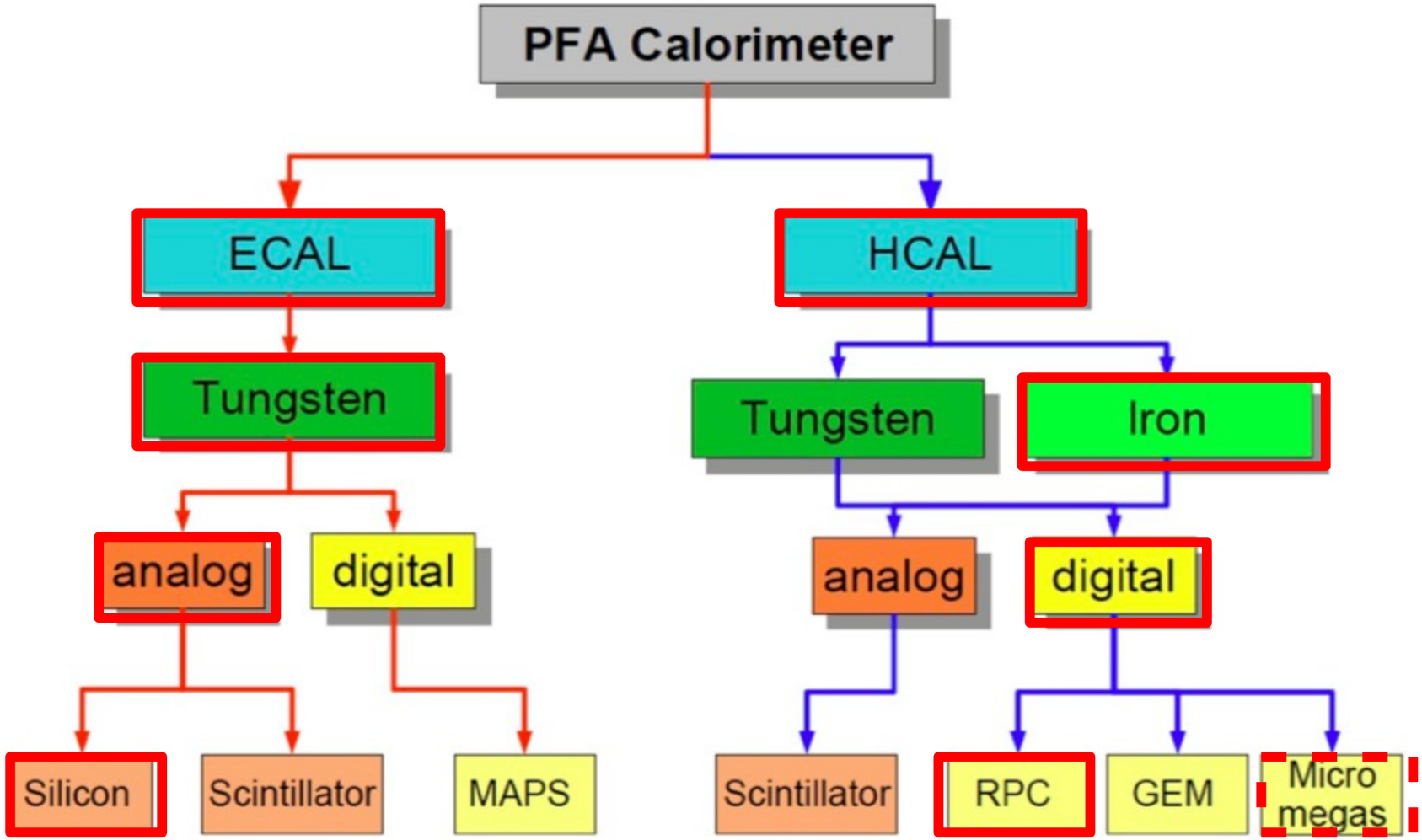
Higgs Factory Detector



- The goal
  - Typically 10^8 calorimeter cells
- Compare:
  - ATLAS LAr ~10^5 cells
  - CMS HGCAL ~10^7 cells

Current period

Technologies – French Activities



IN2P3 Groups working on Highly Granular Calorimeters

Silicon Tungsten Ecal

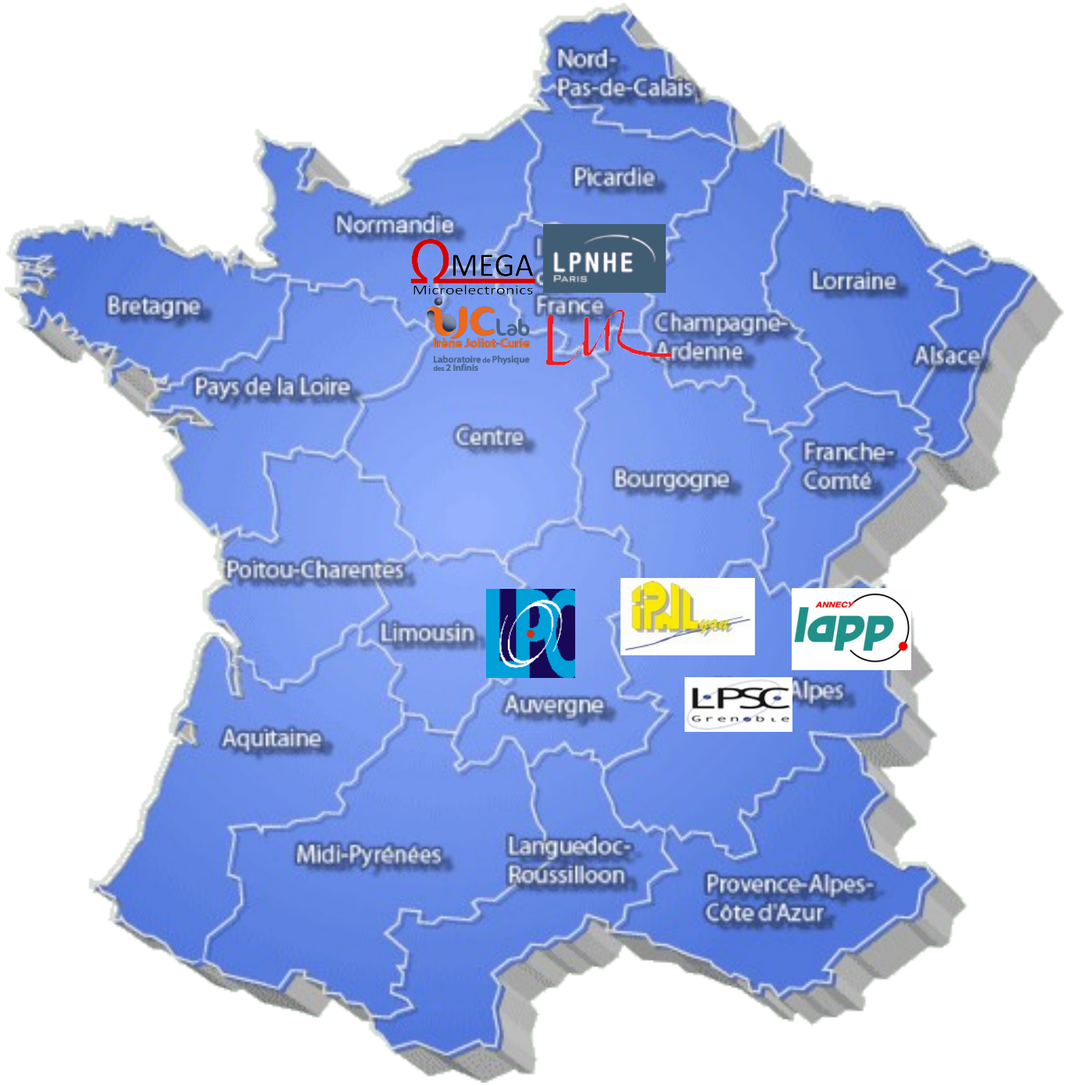
Scientific Responsible:
Jean-Claude Brient

IN2P3 Groups:

LAL/IJCLab
LLR
LPC (until ~2012)
LPNHE
LPSC
OMEGA

International partners

KEK (JP)
Kyushu University (JP)
IFIC (ES)
SKKU (SK)
CERN



Semi digital Hcal

Scientific Responsible:
Imad Laktineh

IN2P3 Groups:

IPNL
LPC (since ~2012)
LLR (until ~2013)
LAPP (until ~2015)
OMEGA

International partners

U Louvain (B)
U Ghent (B)
CIEMAT (ES)
SJTC (CN)
U Tunis (TN)
Others ?

Contact National CALICE France: Jean-Claude Brient

Publications with major CALICE-France Contributions

- 85% of all 28 full CALICE papers benefited from ASICs developed by OMEGA

- Si ECAL Papers

Design and Electronics Commissioning of the Physics Prototype of a Si-W Electromagnetic Calorimeter for the International Linear Collider, J.Repond et al., JINST 3 (2008) P08001; e-print: arXiv:0805.4833v1

Response of the CALICE Si-W Electromagnetic Calorimeter Physics Prototype to Electrons, C. Adloff et al., NIM A608 (2009) 372; e-print: arXiv:0811.2354

Effects of high-energy particle showers on the embedded front-end electronics of an electromagnetic calorimeter for a future lepton collider, C. Adloff et al., NIM A 654 (2011), 97; e-print: arXiv:1102.3454

Testing Hadronic Interaction Models using a Highly Granular Silicon-Tungsten Calorimeter, B. Bilki et al., NIM A794 (2015) 240-254; e-print: arXiv:1411.7215

Characterisation of different stages of hadronic showers using the CALICE Si-W ECAL physics prototype, G. Eigen et al., NIM A937 (2019) 41-52; e-print: arXiv:1902.06161

Beam test performance of the SKIROC2 ASIC, M.S. Amjad et al., Nucl.Instrum.Meth. A778 (2015) 78-84

Beam test performance of the highly granular SiW-ECAL technological prototype for the ILC, K. Kawagoe et al., Nucl.Instrum.Meth.A 950 (2020) 162969; e-print: arXiv:1902.00110

- SDHCAL Papers

Construction and commissioning of a technological prototype of a high-granularity semi-digital hadronic calorimeter, G. Baulieu et al., JINST 10 (2015) P010039; e-print: arXiv:1506.05316

First results of the CALICE SDHCAL technological prototype, V. Buridon et al., JINST 11 (2016) P04001; e-print: arXiv:1602.02276

Resistive Plate Chamber Digitization in a Hadronic Shower Environment, Z.Deng et al., JINST 11 (2016) P06014; e-print: arXiv:1604.04550

Tracking within Hadronic Showers in the CALICE SDHCAL prototype using a Hough Transform Technique, Z.Deng et al., JINST 12 (2017) P05009; e-print: arXiv:1702.08082

+ Two recent ones

- Numerous conference contributions
  - e.g. 2022: Talks at VCI 2022, CALOR 2022, Pisa Meeting, ICHEP 2022

Formation in CALICE-France

List of PhD Theses and PostDocs

CALICE-France – Third party funding

List of projects in last 15 years
CALIIMAX, HIGHTEC, EUDET, AIDA, AIDA-2020, etc.

Current commitments of French Groups

- European Project AIDAinnova (2021 – 2025)
  - WP 7 - Gaseous Detectors: I2PI, LPC, OMEGA
  - WP 8 - Calorimetry and Particle ID: IJCLab, LLR, LPNHE
    - WP Co-Coordinator R.P. (IJCLab)
    - Task 8.1 Coordinator V. Boudry
  - WP 11 - Microelectronics: OMEGA
    - WP Co-Coordinator C. De la Taille (OMEGA)
    - Task 11.3 Coordinator D. Thienport (OMEGA)

- IRL DMLAB with German Helmholtz Alliance
  - Workpackage Calorimetry – IJCLab, LLR, OMEGA, LPNHE
  - P.I.: K. Krüger (DESY), R.P.(IJCLab)

Towards Implementation of ECFA R&D Roadmap

- ECFA R&D Roadmap
  - Roadmap Document CERN-ESU-017 https://cds.cern.ch/record/2784893
  - CALICE-France Contribution to Task Forces
    - Task Force 6 Calorimetry
      - R.P. Co-convener
      - V. Boudry TF6 Symposium talk
    - Task Force 7 Electronics
      - C. de la Taille Expert Member

- The future R&D will be organised around DRD
  - ... identical to task forces for Roadmap Document
  - Expected to be in place at the beginning of 2024
  - R&D proposals for Summer 2023
  - Task Forces will oversee the transition phase

- CALICE will integrate into new landscape
  - Details to be worked out
  - Proposal with major contributions from CALICE-France
  - See also talks in SDHCAL and Si ECAL Sessions

- ECFA Higgs Factory Study
  - D. Zerwas: Co-Convener WG2 (Simulation and Reconstruction)
  - V. Boudry: Co-Convener WG3 (Calorimetry)

Conclusions