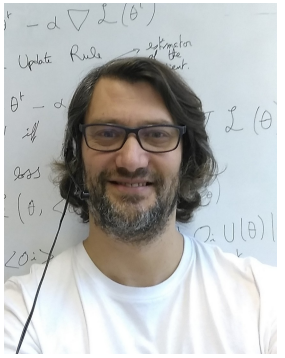
LLR IT Group

- 4 ecole polytechnique engineers, 7 CNRS engineers, 1 PhD student
- Missions
  - IT developments for experiments
  - Infrastructures administration
- 4 activity poles
  - Data and computation
  - Simulations
  - Online
  - Machine Learning



Manager F. Magniette

Deputy Manager A. Beck

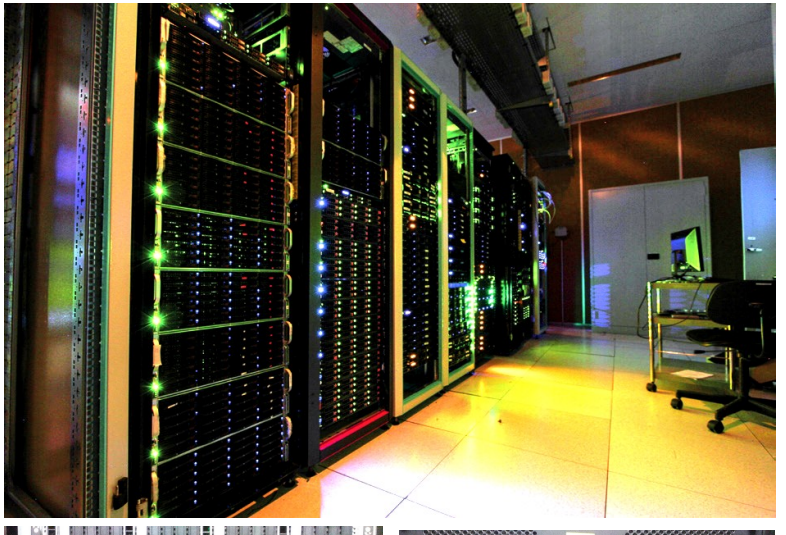
Data & Computation

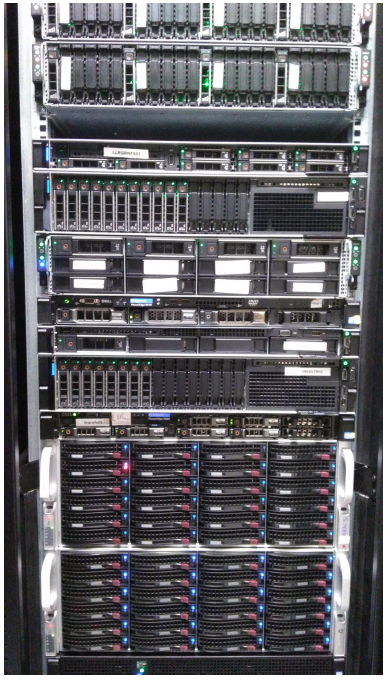

A. Garcia


M. Mellin


M. Lastes

- Grid Tier2 et Tier3, 1700+700 cores, 2.3 PB of storage
- Cluster HPC LLR-LSI-LULI, 1500 cores, 36TB of storage
- Plateform GPU GridCL + Machine learning
- Computation servers
- Infrastructure : web, network and personal computers
- Collaborations LCG-France, GRIF, CERN, IJCLab





Offline / Simulations

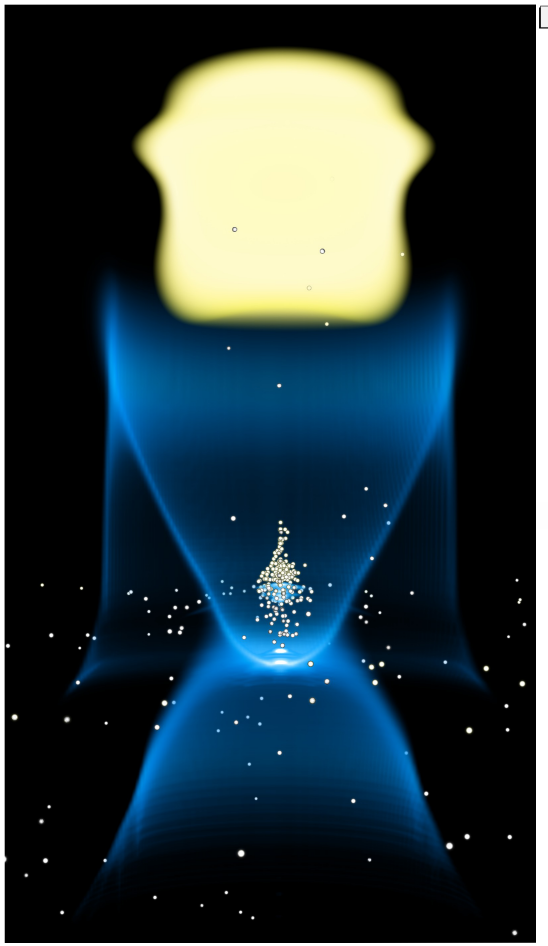

A. Chiron


E. Becheva

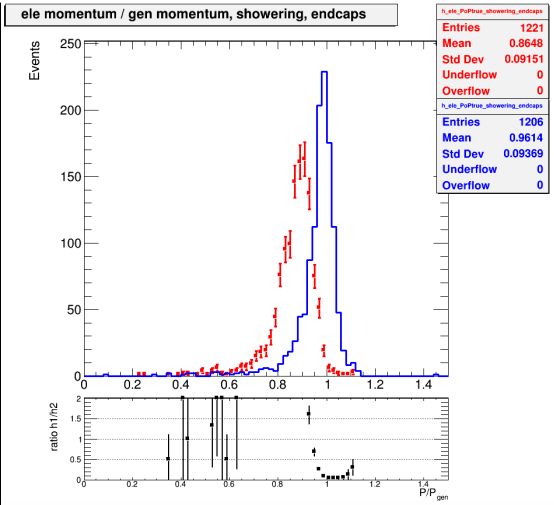

I. Semeniouk

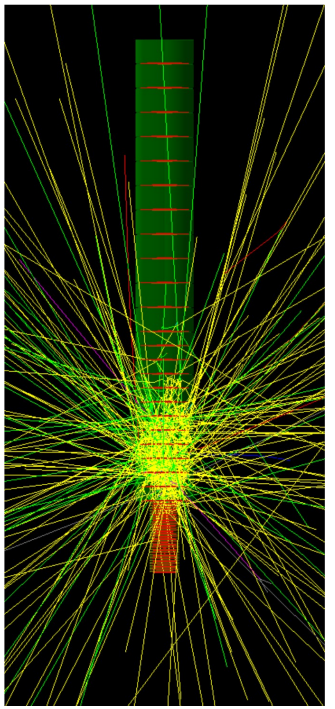

A. Beck

- Laser-Plasma interaction (PIC), SMILEI framework, Apollon facility, GENCI
- Core development of GEANT4
- Ultra-granular calorimetry simulations
- Physics model validation



Smilei





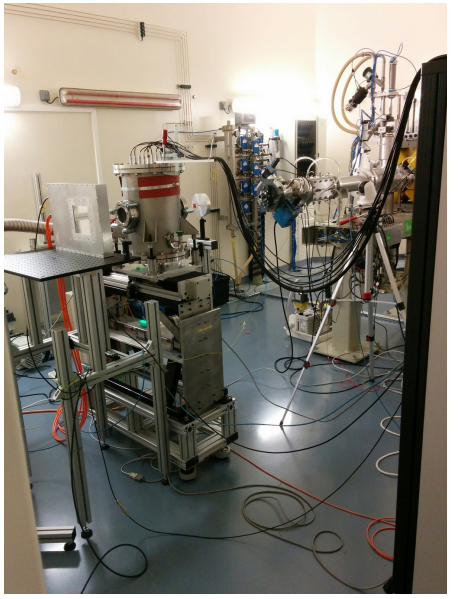
GEANT4 A SIMULATION TOOLKIT

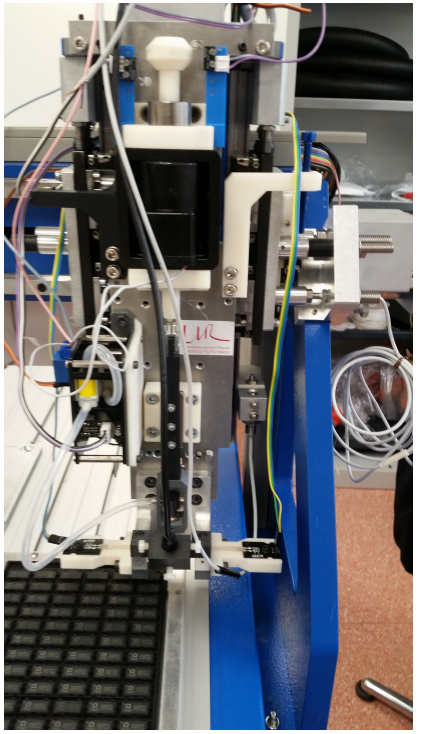
Online

L. Bernardi

L. Eychenne

- Control-command, acquisition and real-time analysis for experiments and test-benchs
- Kamiokande experiments (SK, HK, T2K)
- Control-command of the Chip test robot (HGCRoc)
- Control-command for Pepites experiment
- Pyrame framework development

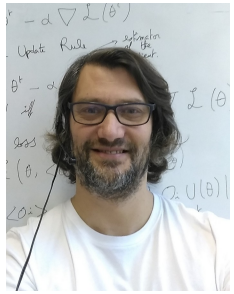




S. Ghosh

M. Melennec

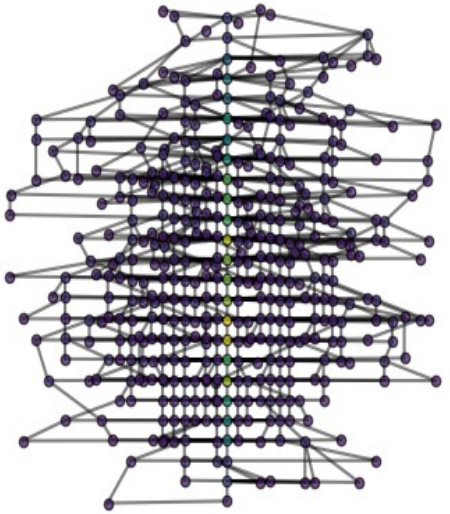
M. Mellin

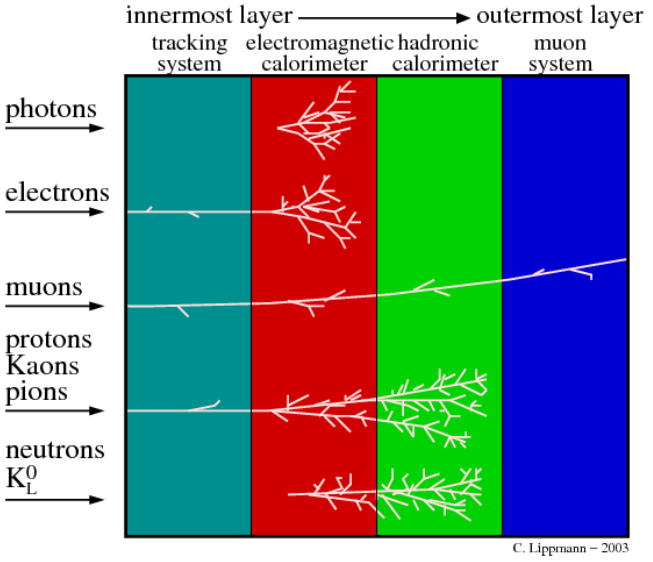


F. Magniette

Machine Learning

- Particle Id & parameter regression from raw data
  - CMS/HGCal
  - Hyper-Kamiokande
  - Pepites
- Adapted neural-network
  - Calibration
  - Fit
- Quantum machine learning





Open-source software at LLR

Smilei

Complete framework of Particle-In-Cell (PIC) simulation.
Co-founder & Resp : Arnaud Beck
Winner of the prize « Science ouverte du logiciel libre de la recherche »

PYRAME

Online framework for control-command, data acquisition and real-time analysis
Resp : Lorenzo Bernardi

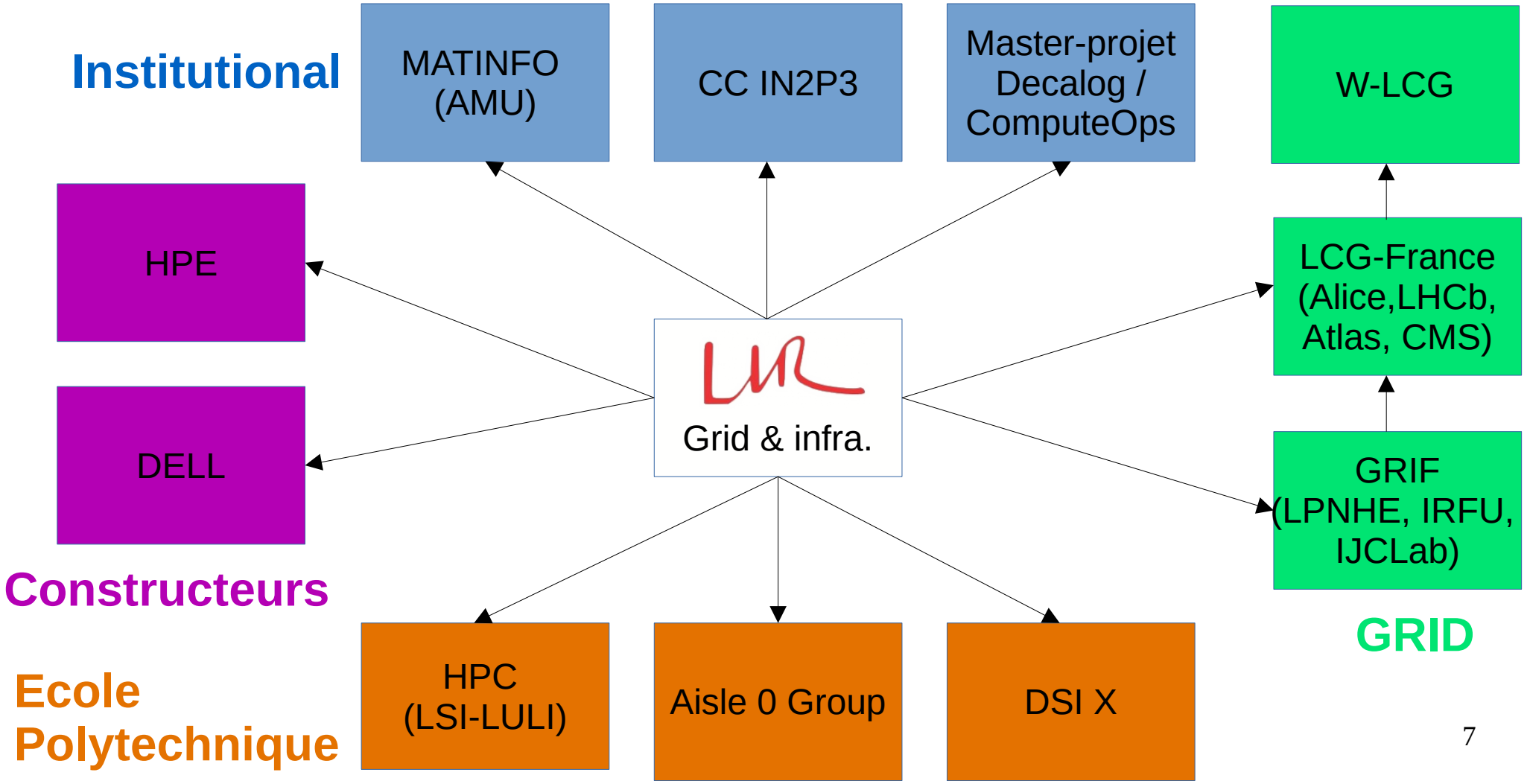
G4

Geant 4

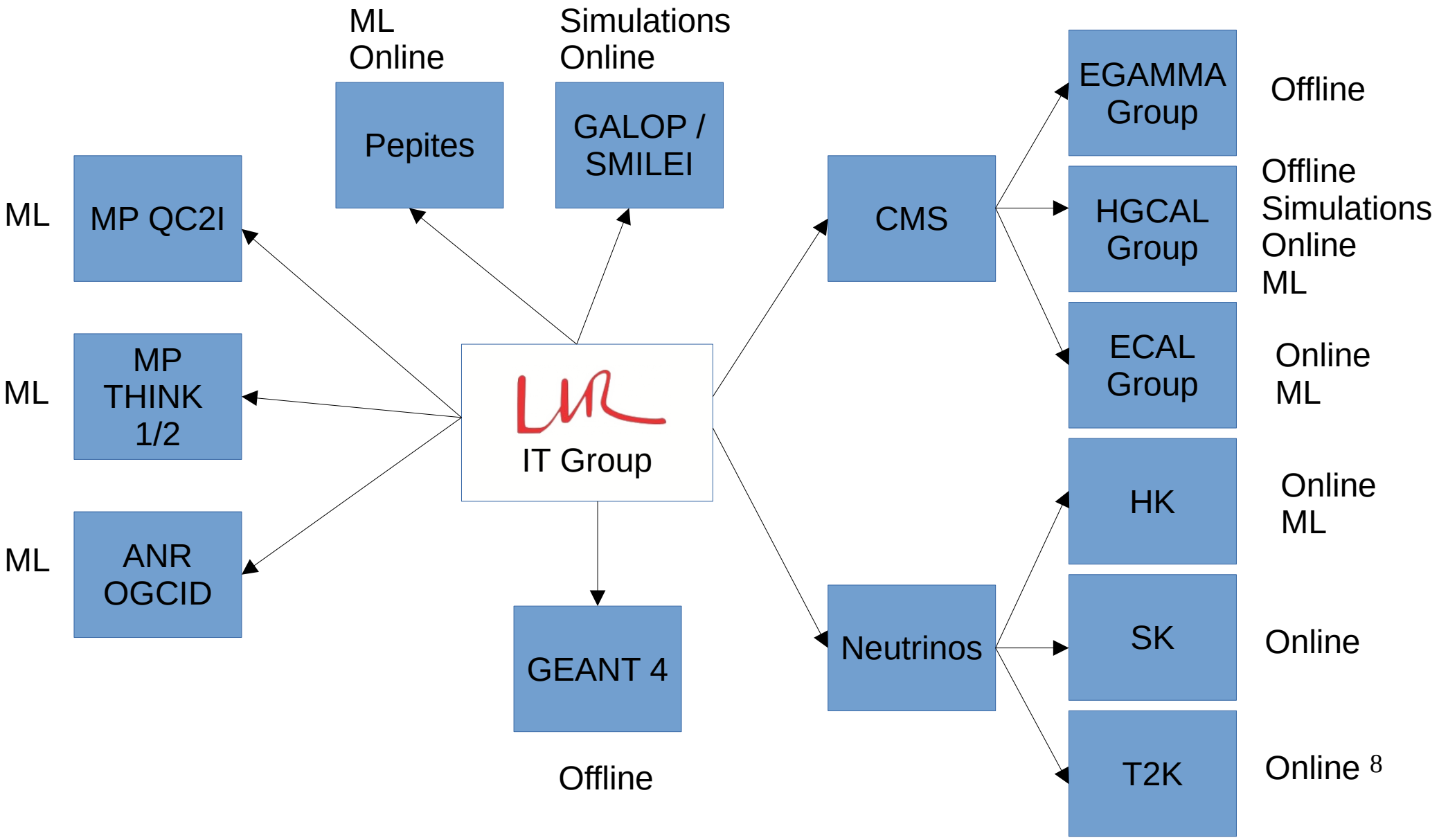
Worldwidely used toolkit to create simulations of the passage of particles or radiation through matter.
Spoke-person : Marc Verderi
Core developper : Igor Semeniouk

- Open-source problematics (for mature projects)
  - Difficulties to insure regular tasks (support) without dedicated resources (Smilei/Pyrame)
  - Difficulties of funding. No way to get donations for example (Smilei)
  - Difficulties to renew the team (GEANT 4)

Collaborations around infrastructures



Experimental & Scientific Collaborations



Collaborations around SMILEI

High Performance Computing

Maison de la simulation

IDRIS

CINES

LULI — Interfaces, diagnostics

CEA DAM — Boundary conditions

LPGP — Envelop models

Berkeley National Lab — Cylindrical spectral solvers

Development

Applications

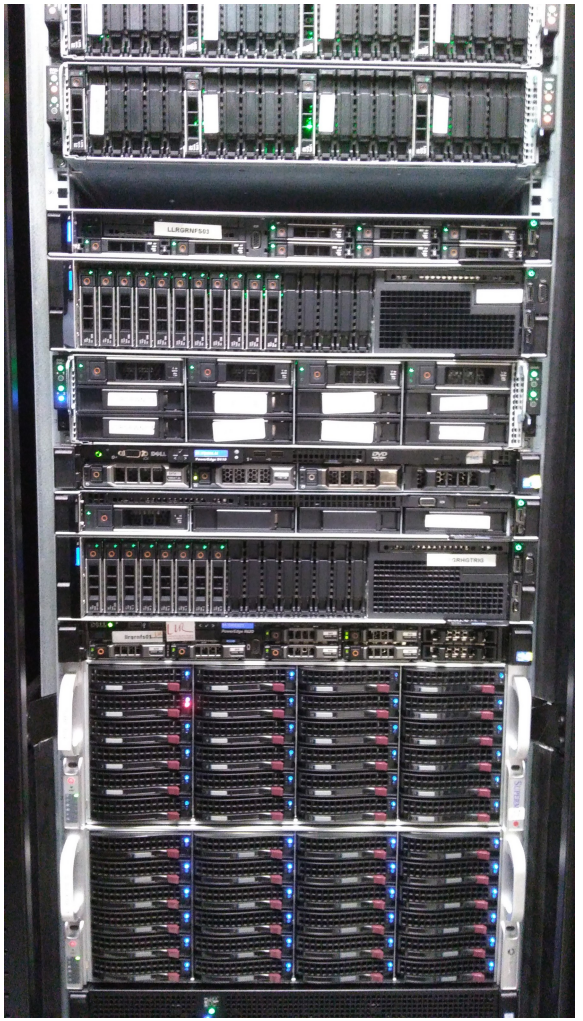
Design optimization — Pallas IJCLab

Solar wind plasma instabilities — LPP Observ. de Paris

Earth magnetopause — LPP

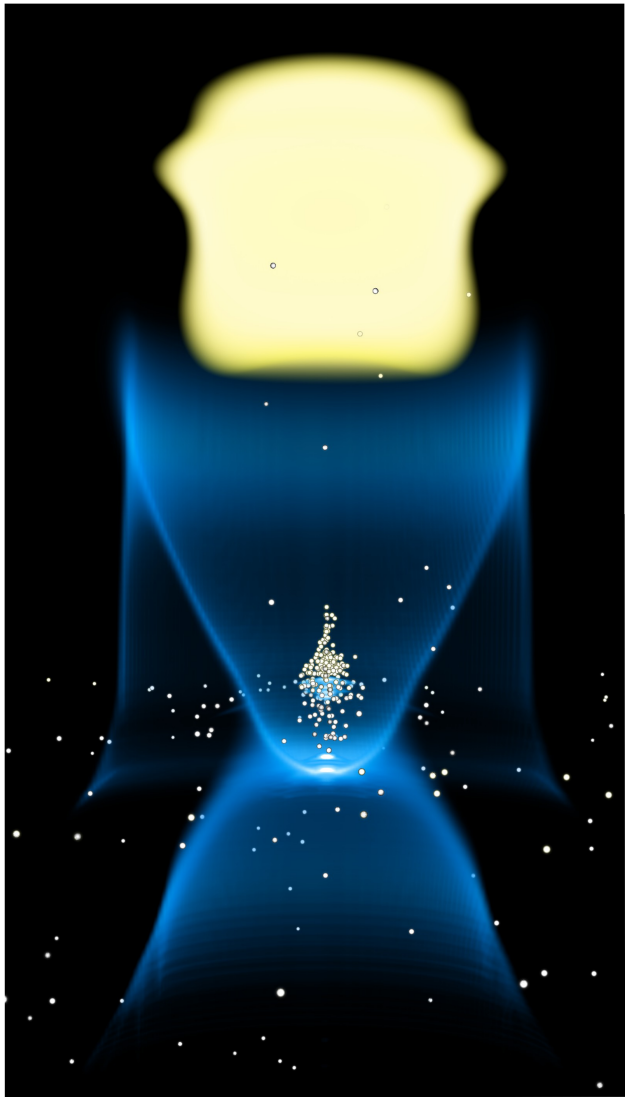
Perspective for infrastructures

- Bigger, Faster and Better !!!
- Increase the #procs and #mem of grid (presently half of the MIT)
- Increase and secure the storage
- Improve the network redundency
- Better integration of development environments (python modules, jupyterhub, containers...)
- Polui replacement



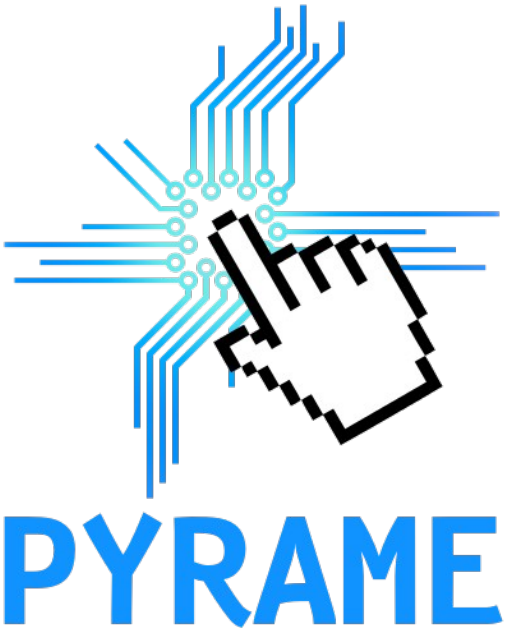
Perspective for Simulations

- Improvement of validation suites and continuous integration (GPU)
- GPU optimization (framework integration)
- Open data avaibility via dedicated platforms (Zenodo)
- Improve simulations efficiency
  - Boosted frame approach
  - multi-level resolution
  - Fast-simulation



Perspective for Online

- Pyrame 3
  - New major release
  - Full Python 3 support
  - Windows support
  - GUI Integration
  - Data fluxes integration (real-time)
- CMS HGCRoc Robot
- HK test-bench



Perspectives in Machine Learning

- Increasing interest from physics groups
- New technologies : Graph convolution auto-encoder, transformers, differential programming...
- New objectives : semantic segmentation, parallelization, event generation (FastSim), complex optimization, pile-up reduction…
- Develop quantum machine learning for HEP
- Creation of a ML task force to aggregate and mutualize all the efforts of the lab around ML.