Introduction

ET-PP WP8 workshop: On site infrastructure, computing and data model

Centre de Calcul de l'IN2P3

Juin 30th, 2025

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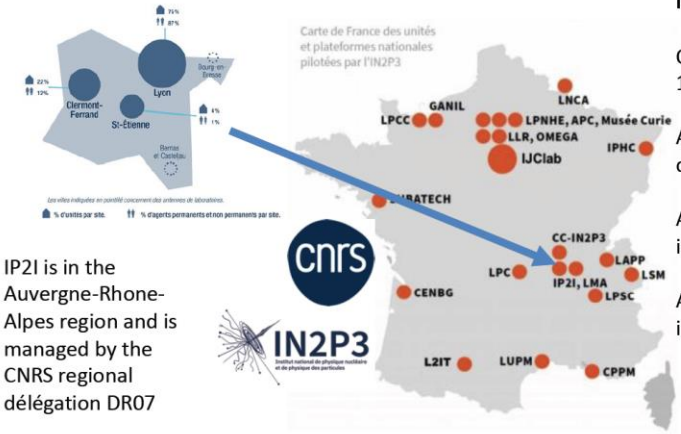
Institut de Physique des 2 Infinis de Lyon



IP2I is in the Auvergne-Rhone-Alpes region and is managed by the CNRS regional délégation DR07

IP2I is one of the 22 laboratories of the CNRS National Institute for Nuclear & Particle Physics

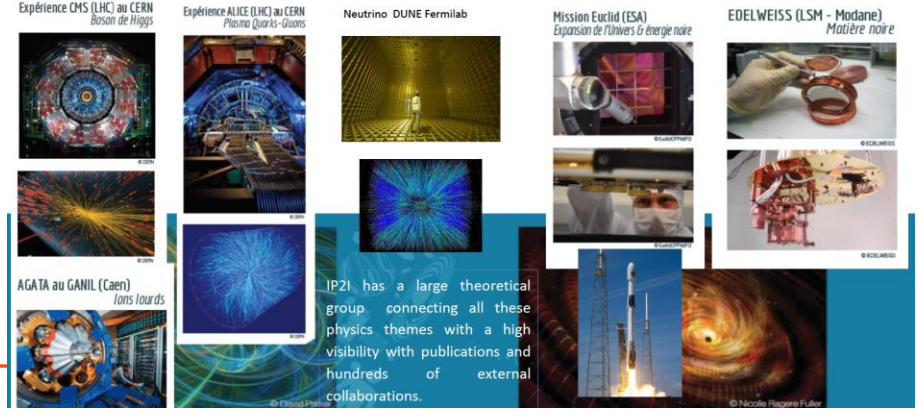
One of the 10 institutes of CNRS, established in 1971.

A network of 22 laboratories working in a shared dynamic.

A structure focused on major projects and international collaborations.

A strong force towards CERN, large facilities, and international physics.

Infinitely small



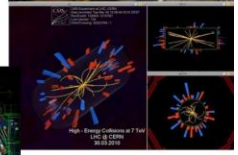
Infinitely large

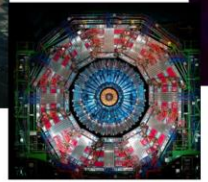
Institut de Physique des 2 Infinis de Lyon

Deep into the infinitely small

IP2I is a major partner of CERN (~130 km from Lyon)

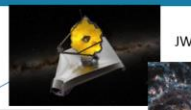
CMS and Higgs boson prix Nobel 2013



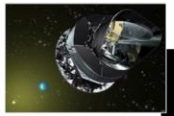


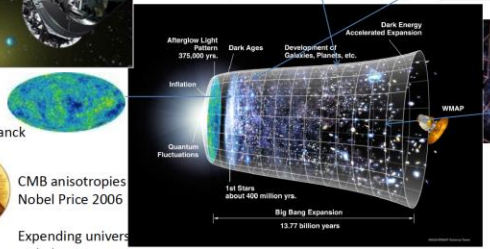
LHC= The largest accelerator in the world at CERN, near Geneva.

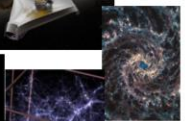
Far into the infinitely large : understanding the Universe.



JWST (2022)







Euclid (2023)
LSST(2024)

Planck

CMB anisotropies
Nobel Price 2006

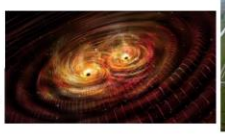
Expending univers
Nobel Price 2011

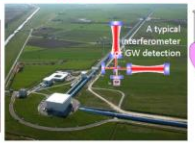
A new window to connect the infinities.

Gravitational waves and LMA

THE MOST PERFECT MIRRORS IN THE WORLD ARE FROM LYON

VIRGO et LIGO
Gravitational waves discovery
Nobel price 2017





LMA is a major partner of this discovery with VIRGO and LIGO mirrors coating
LMA is part of the IP2I as an IN2P3 national platform.
LMA has a worldwide expertise on large optical and best coating in the world.

Expert since 20 years
Realization of the mirrors of the VIRGO project and of all interferometers in the world.

The only laboratory currently capable of producing large optical mirrors coating with the precision required for gravitational waves.

Plateform director : Laurent Pinard

A unique infrastructure including a large clean room (150 m², ISO class 3) with custom-made deposition and characterization machines

Lyon future equipements

We prepare to have the ability to produce mirrors on the order of a meter, weighing several hundred kilograms, and homogeneous at the micron scale.

This is supported in a large project at Lyon now funded

New polishing machine

New large IBS machine
(for illustration only)

This includes sapphire substrate growth, mechanical and optical polishing, and finally, surface treatment with thin layers, for which we are the only specialists in the world.

New large clean room
And integration area

New building extension

Description and missions

- National research infrastructure for IT resources dedicated to our research fields
  - main experiments LHC/HL-LHC T1, LSST, Belle II, CTA, KM3NET, DUNE,…)
- Provides storage (disk+tape) and computing resources with the more appropriate architecture
  - Mainly HTC but increasing part of GPU and small HPC resources included
- Provides IT related services
  - IN2P3 sites connexion in relation with Renater
  - Tools for software developments, set of collaborative tools

CC-IN2P3 Datacenter

- 2 computer rooms: 1700 m^2 up to 390 racks
- 929 kHS23 ~ 57 664 cores
- 80 PB disks + 180 PB tapes
- 80 staffs
- Users :
  - CPU 104 teams/930 users
  - STO 221 teams/4596 users

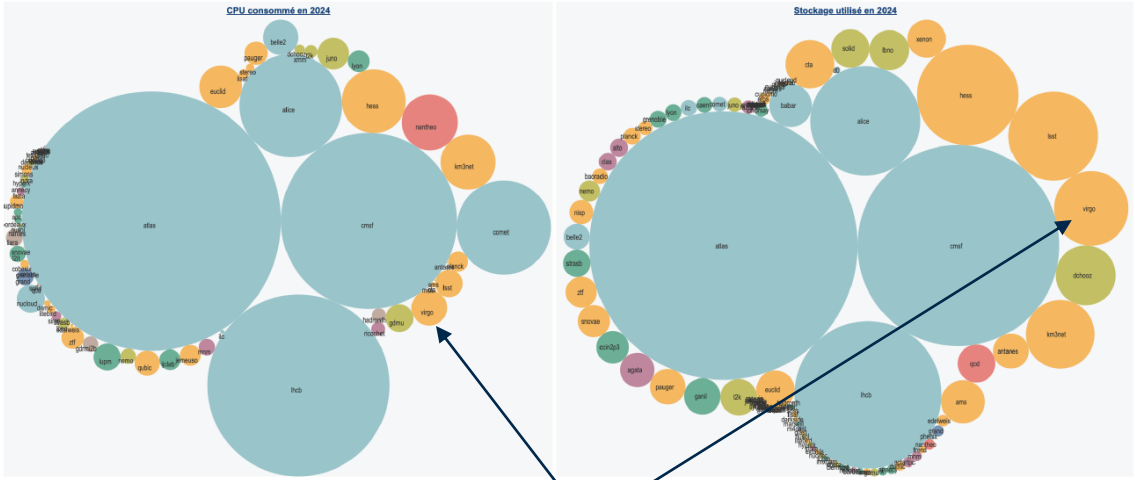
CC-IN2P3 and experiments

CC-IN2P3 supports 80 experiments

- each collaboration is asked by IN2P3 to provide plan for ressource needs for their lifespan and DMP
  updated regularly
- resource requests reviewed each year
- computing needs discussed and evaluated for all new experiments before approval

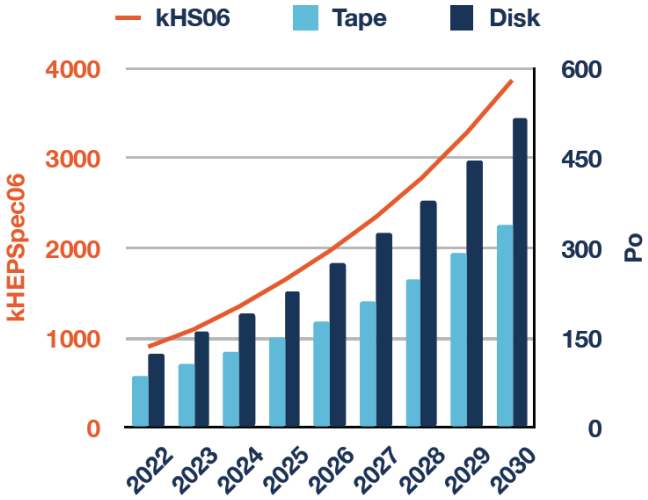
Experiment resource usage at CC-IN2P3

- LHC is still the biggest user and will stay but others are growing => important to prepare and organize



Virgo

Projection of ressource evolution



FITS project

A new computing room at CC-IN2P3

2025

05/01: start of work

15/05: end of structural work and beginning of second work

December: qualification and delivery

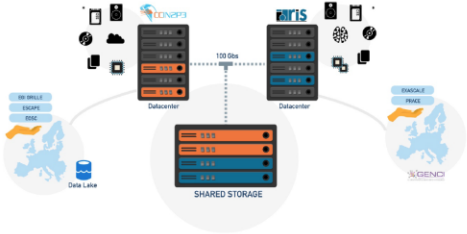
This project aims to federate these two computing centers, respecting their specific missions and know-how through the implementation of a distributed infrastructure for data storage, processing and provision as well as their dissemination and enhancement. Hosted in environmental conditions with a low carbon footprint, this infrastructure will provide research infrastructures with computing and data processing resources combining high-performance computing and high-throughput computing, supercomputing with graphics accelerators and data processing farms, containerization and cloud computing.

FITS

CNRS Federated IT services for Research Infrastructures

cnrs / GENCI	FRANCE 2030 / ANR-21-ESRE-0009	IDRIS CC-IN2P3 partnership with GENCI
Total Budget **15 520 000 €**	**75 %** **Building works**	**25 %** **Hardware**

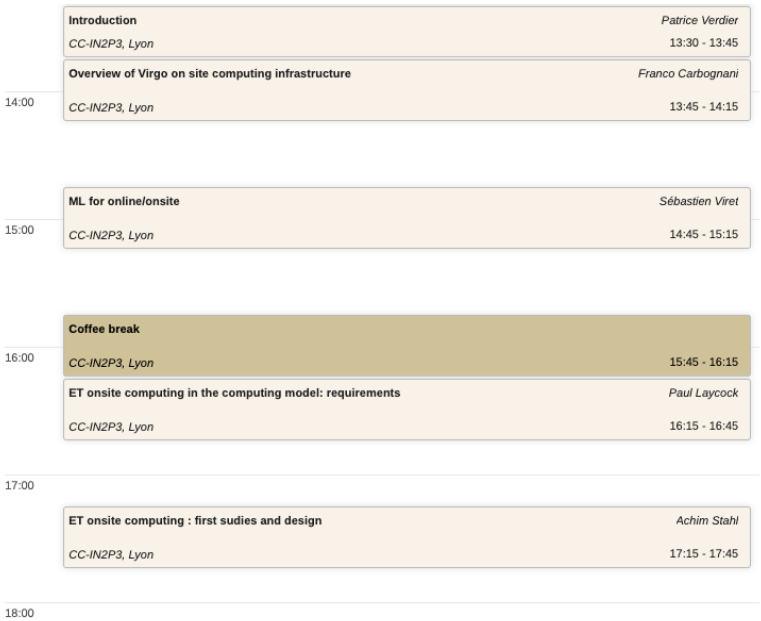
Upgrade hosting/housing capacities of both sites
Shared storage infrastructure
Access portal
Sustainability



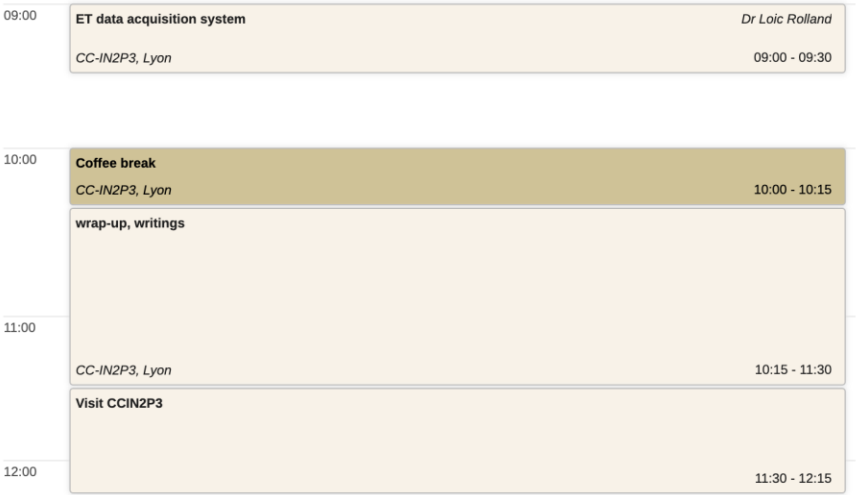
Introduction

Agenda and presentations: https://indico.ego-gw.it/event/820/overview

Monday



Tuesday



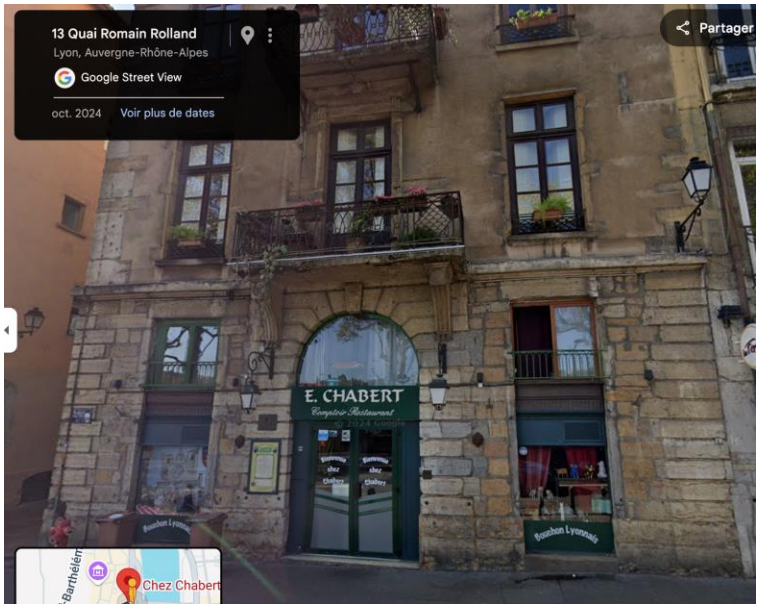
A room at LMA is booked on Tuesday afternoon for people willing to continue working on the document.

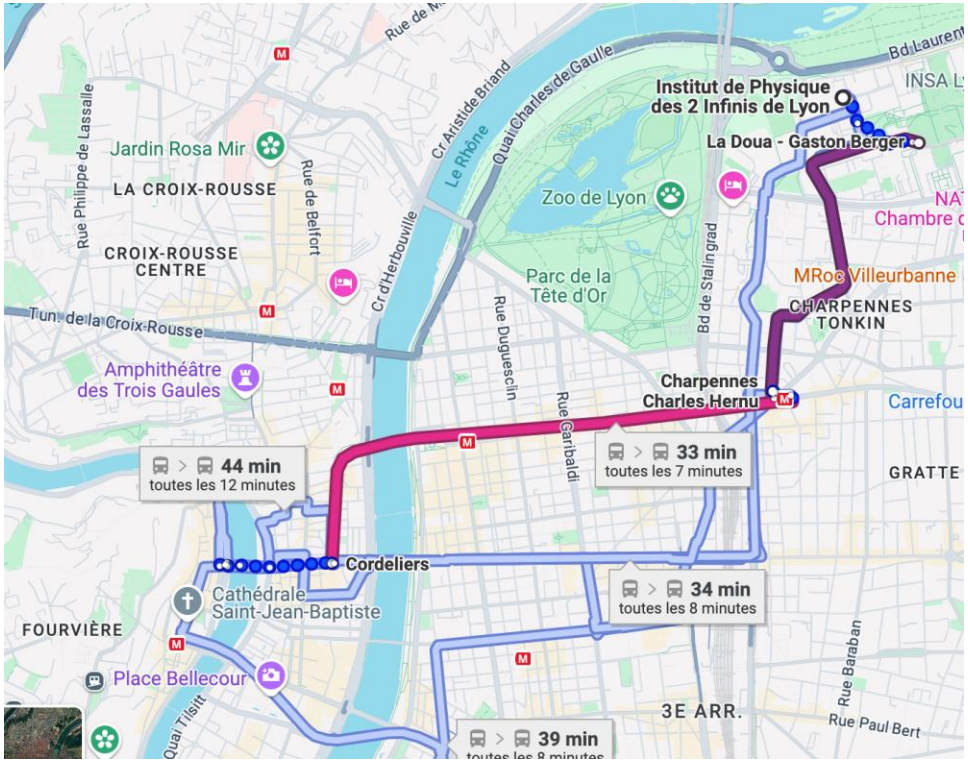
Also possible to visit LMA for those interested.

Workshop diner

Chez Chabert, 13 / 14 Quai Romain Rolland, 69005 Lyon

19h30





Introduction

@ Nadia, Oscar, Paul

Successful coordination and organization of the activities of WP8 with the ET e-Infrastructure Board (EIB).
Chairs and all-hands online **regular meetings**.

		WP8 Tasks			
		T8.1 T0 data center	**T8.2 Computing and data model**	**T8.3 Resources**	**T8.4 Data access implementation**
ET EIB Divisions	D1 SW frameworks and Data Challenges		Computing frameworks domains and data formats	Resources for frameworks execution and data storage availability	Data availability Data releases format
	D2 Services and collaboration support				Tools for monitoring, AAI (IAM) data access
	D3 Computing and data models, resources estimation	T0 storage and computing resources estimation	Computing model Data model	Resources estimation	
	D4 Multimessenger alerts infrastructure				Tools for multi-messenger alerts
	Technology tracking working group				

8.1 T0 data center / CNRS - Patrice Verdier

Design the T0 data center and define the on-site services.

- Define Tier-0 storage and computing **requirements** to contribute to D8.1
- **Collaboration with other ET-PP** WPs (ET site related) and ET Boards EIB/ISB/OSB
- Close **collaboration with ISB and other Boards** about the conceptual design of the Tier0.

Content	Type	Status	Date
M8.3 on-site infrastructure, computing and data	Milestone	In preparation	July 2025
M8.4 low-latency and offline workflows, computing and data model	Milestone		Dec 2025
M8.5 data management, data access policy and implementation	Milestone		July 2026
D8.2 Computing and data model for ET	Deliverable		Feb 2026
D8.3 Data access policy implementation	Deliverable		July 2026

Introduction

ET-PP Deliverable 8.1 -- Computing and Data Requirements : https://apps.et-gw.eu/tds/?r=19444

Online

Data storage requirements are dominated by the temporary storage of DAQ outputs and derived data which, together with the computing power, memory and network requirements, are taken from section 3.1.1. The online computing requirements are summarised in Table 7.

In addition to the baseline requirements, an "Operational safety margin" scenario is also shown. For data storage, only those data which are kept on-site are considered in this "Online" requirements summary. The "Operations storage buffer" includes all datasets for 10 days at 80 TB / day, i.e., not full DAQ bandwidth as only one copy of "Raw" data is needed for operations. A factor of two is used for the Operational safety margin, allowing e.g. for more days of data to be kept on this buffer, and for experts to produce their own datasets.

Raw data (two copies) are kept in the Minimal scenario for one year on "Long-term storage", RDS for 5 years, and the other much smaller datasets permanently. As the units are PBs, the number has been rounded up to the nearest PB. The same, generous Operational safety margin of a factor of two is used here, allowing for more than one year's worth of Raw data to be retained on-site, and potentially multiple copies of partial datasets for debugging issues. For the CPU and memory needs, given the modest computing requirements, a factor of three is used. Finally, best practice indicates that there should be at least two independent network routes in case of failure.

	Minimal scenario	Operational safety margin
Operations storage buffer (TB)	800	1600
Long-term storage (PB)	20	40
CPU cores	2150	6450
RAM (GB)	6300	18900
Network	100 Gb/s	2 * 100 Gb/s

Table 7: Baseline online computing requirements per ET interferometer for data storage capacity, processing power, RAM memory and network speed.

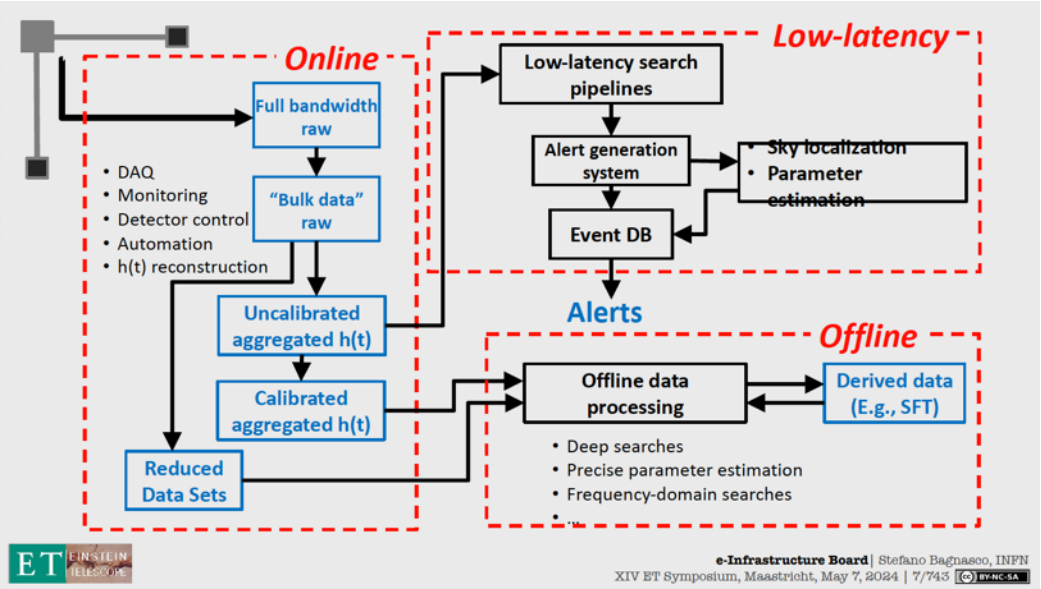
Low Latency

The following baseline requirements follow the discussion in Sec 3.1 and show the scale of the low latency computing needs. Assuming a factor of 100 in speedup can be achieved, the computing resource needs are comparable to an HL-LHC experiment trigger farm. In the case of ET and already for LVK, low latency computing has the advantage that it can be distributed over several data centres, albeit with static allocations to guarantee that latency requirements are satisfied. While there is a large uncertainty on the physics program requirements and corresponding computing needs, there is an equally large uncertainty on the computing architecture. Today, GPUs would be better suited for the AI/ML solutions being worked on for ET, and would need to provide throughput corresponding to that shown in Table 8.

Caching storage	Negligible
CPU	4×10^6 HS06
Latency	<10s

Table 8: Baseline low latency computing requirements. In addition to the CPU, a diverse set of GPUs are also used by LIGO and Virgo to accelerate computations. The usage of GPUs is expected to increase and will be particularly important for low latency computing.

Introduction



Questions:

- Resources for onsite computing
  - Interferometer data
  - Auxiliary data
  - Calibration
  - Monitoring
- online on site vs online off site