IN2P3

Institut national de physique nucléaire et de physique des particules

Physique des particules et Astroparticules à l'IN2P3
Biennale du LPNHE, Berck, mai 2014

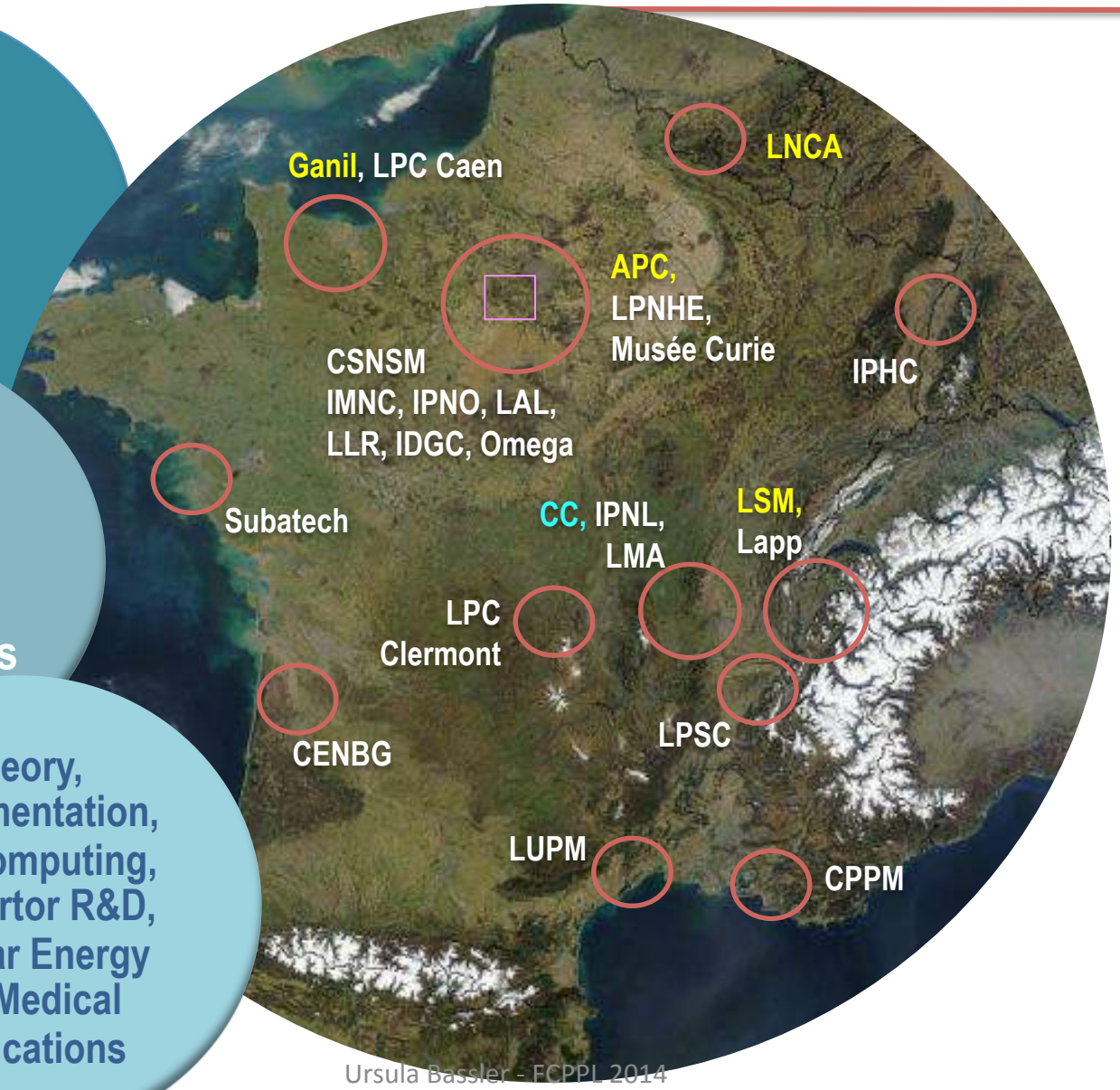
Gabriel Chardin
CNRS/IN2P3

IN2P3

3100 *researchers, engineers and technicians*

Research in Astroparticles, particles and nuclear Physics

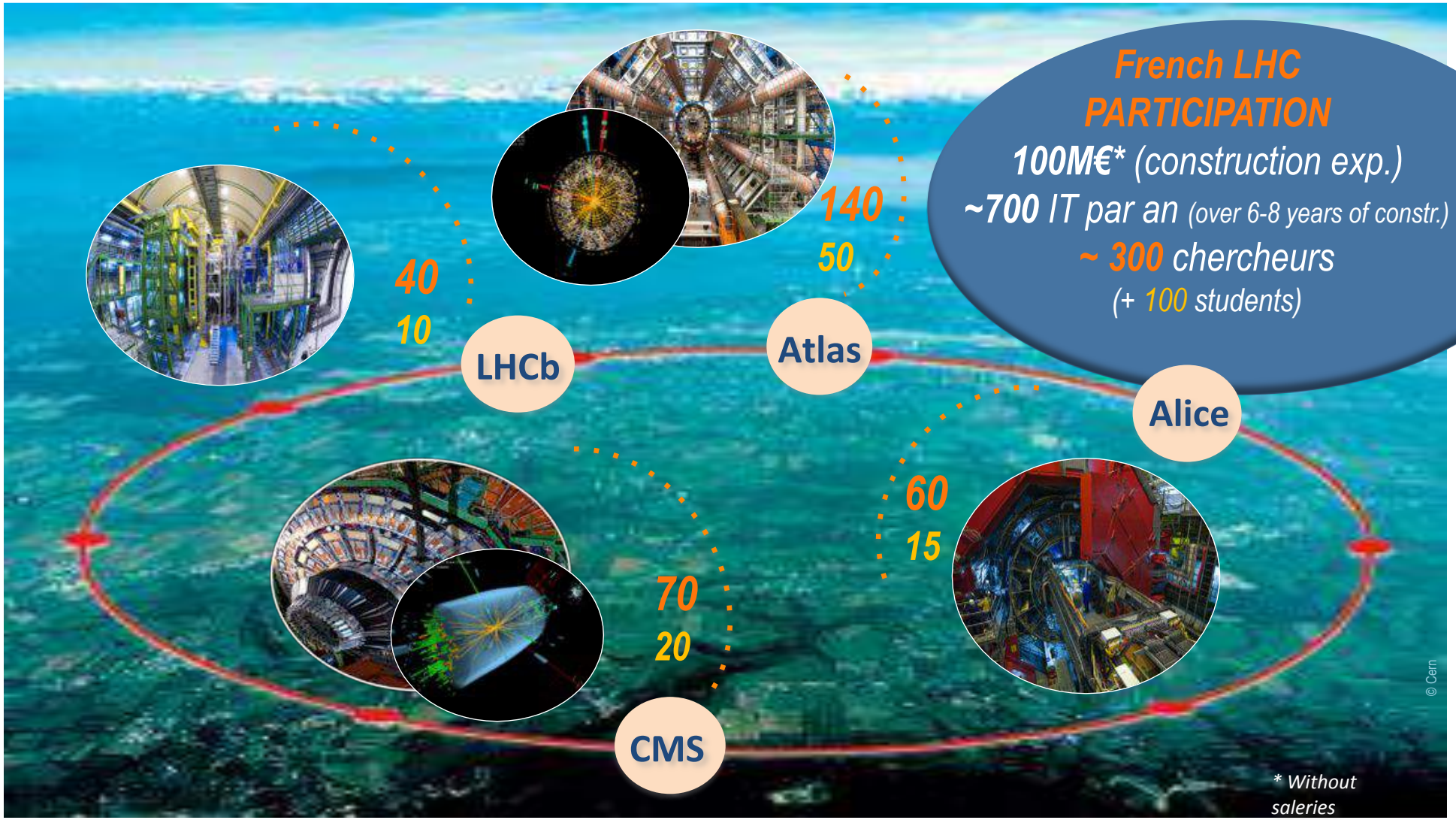
Theory, Instrumentation, Grid computing, Accelertor R&D, Nuclear Energy and Medical Applications



Research infrastructures

European Collaborations

LHC collaborations



International Collaborations

« Giens 2012 » – prospectives

20 joint working groups to elaborate on a common view

→ 50 pages document

→ input to and from:

- ASPERA Roadmap
- NUPECC long range plan
- European strategy in particle physics

The European strategy
for particle physics

The LHC will be the energy frontier machine for the foreseeable future, maintaining European leadership in the field; *the highest priority is to fully exploit the physics potential of the LHC, resources for completion of the initial programme have to be secured such that machine and experiments can operate optimally at their design performance.* A subsequent major luminosity upgrade (SLHC), motivated by physics results and operation experience, will be enabled by focussed R&D; *to this end, R&D for machine and detectors has to be vigorously pursued now and centrally organized towards a luminosity upgrade by around 2015.*

LHC physics

Physics goals:

- Discover new physics !
- Get most insight into the Higgs sector
- Precision Electro-weak and flavor physics
- Gain understanding in QCD and hadronic physics
- Important milestone: circa 2017, SUSY observed or not, multiple Higgs or not ?
- Important impact on strategy if answer to these 2 questions is negative…

LHC upgrades in France

Phase 0 upgrades:

Atlas : Inner B layer – pixel detector

Phase I upgrades:

Atlas : New Small Wheels (forward muon detector)
Calorimeter trigger electronics
Fast Track trigger
CMS: vertex detector
Trigger electronics
LHCb: Fiber tracker
Calorimeter electronics
DAQ system

Phase II upgrades R&D :

Atlas : inner pixel detector
Calorimeter electronics
CMS : track trigger
Calorimeter: endcap detector, barrel electronics
Forward muon syste

2009-2012: Run I

2013-2014: LS I

2015-2018: Run II

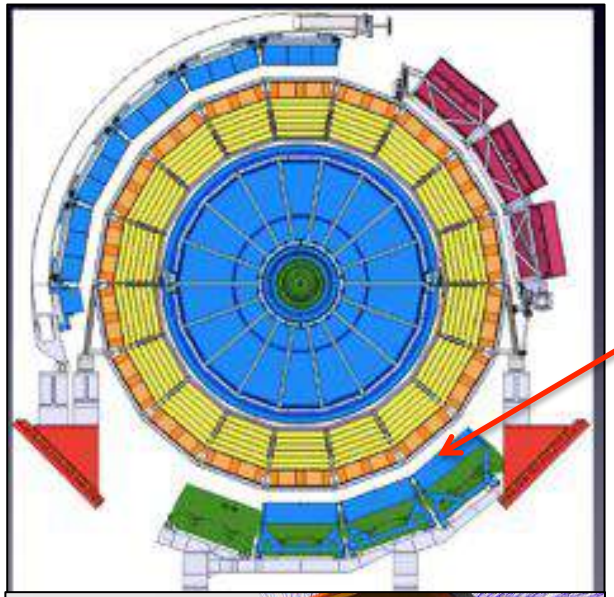
2019 : LS II

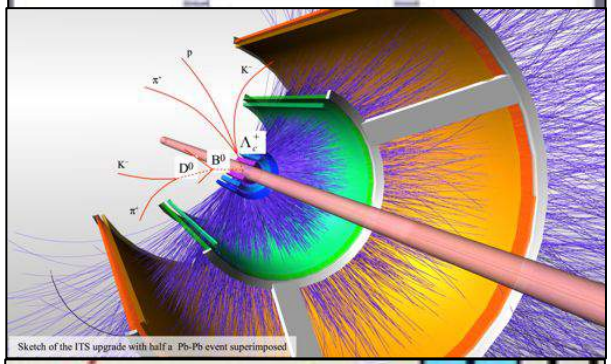
2020-2022: Run III

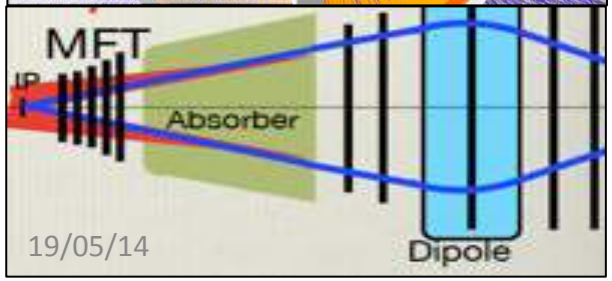
2023-2025: LS III

2026….

Alice Upgrades







Phase 0 :

Consolidation of

- DAQ, HLT on line Systems
- Detectors (PHOS, EMCAL/CAL, TRD, TPC, V0, T0, MUON)
  - Ongoing DCAL installation

  ➔French-Chinese Technical activity
  - EMCAL new read out

Phase 1:

France and China participate in the following upgrades :

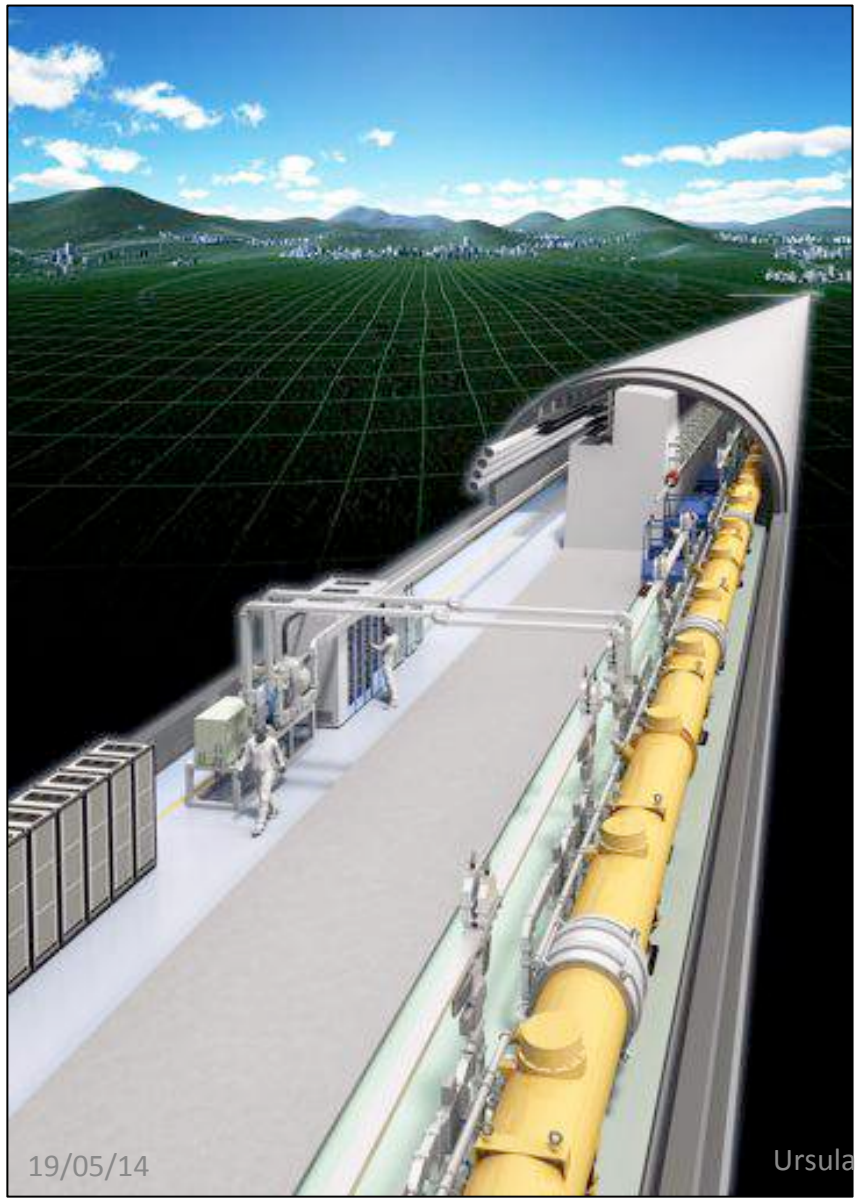
- Inner Tracking System
- MUON Forward Tracker (only France)

  → LOI approved in September 2013 by LHCC,

  TDR to be ready in 2014

  → Ongoing discussion on an involvement of Chinese teams in the MFT?

ILC



Accelerator:

- Coupler and cryo-module assembly for XFel→ valuable know-how
- Contribution to ATF2 project
- R&D on positron sources

Detector:

- Calorimeter :

- High granularity calorimeters – particle flow:
  ECAL – SiW – concept
  HDCAL – Digital Calorimeter with GRPC
  - Semi-digital Calorimeter with µmegas

- Vertex detector :

- CMOS detector development

- TPC detector:

- µmegas development

FCC design studies

"This meeting is the starting point of a five-year international design study called "Future Circular Collider" (FCC) with emphasis on a hadron collider with a centre-of-mass energy of the order of 100 TeV in a new 80-100 km tunnel as a long-term goal. The design study includes a 90-400 GeV lepton collider, seen as a potential intermediate step. It also examines a lepton-hadron collider option."

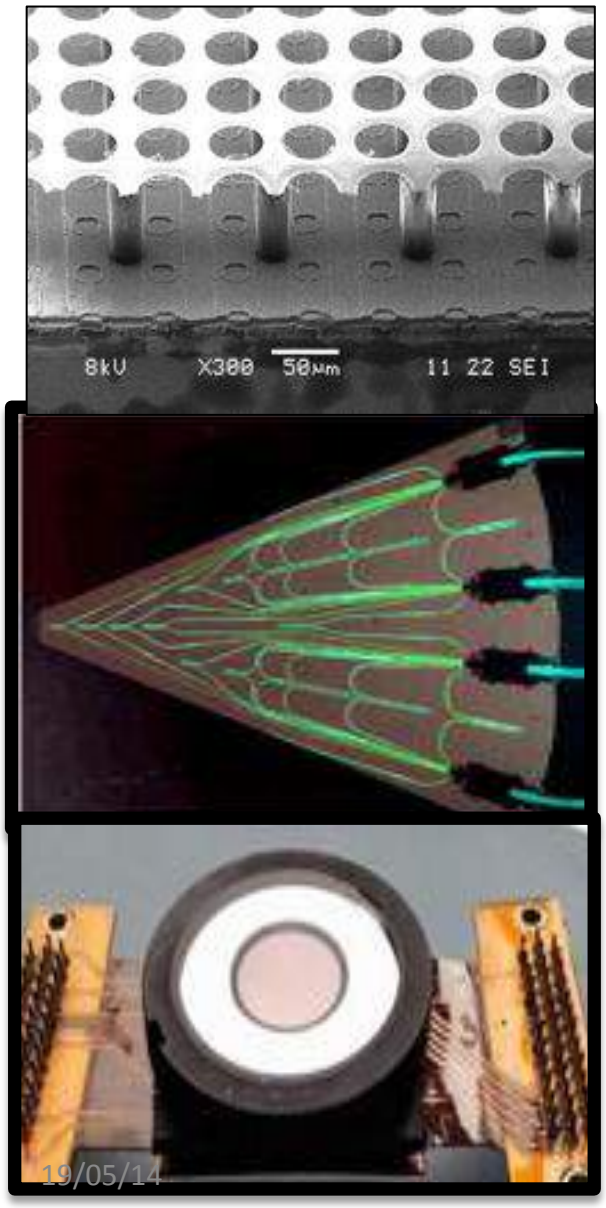
VHE-LHC - TLEP

- Participation is getting together
- Contribution to detector & physics studies

→ Possible synergies with ongoing R&D

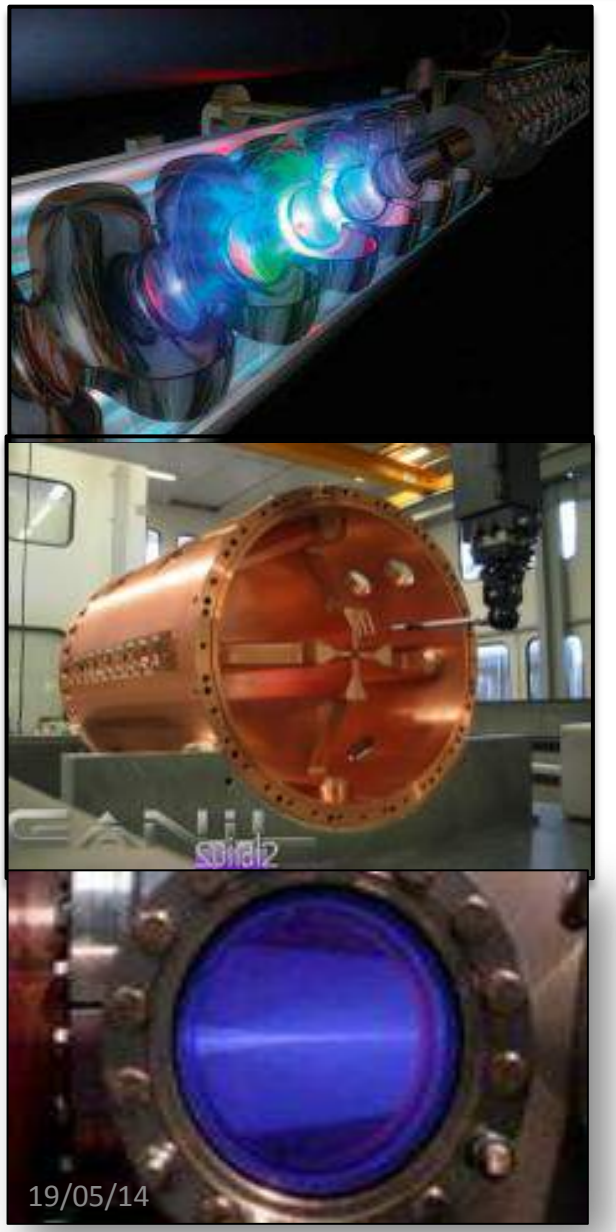
- VHE-LHC : crucial point accelerator R&D
- TLEP: contacts also with Chinese 50km project

Instrumentation and detectors



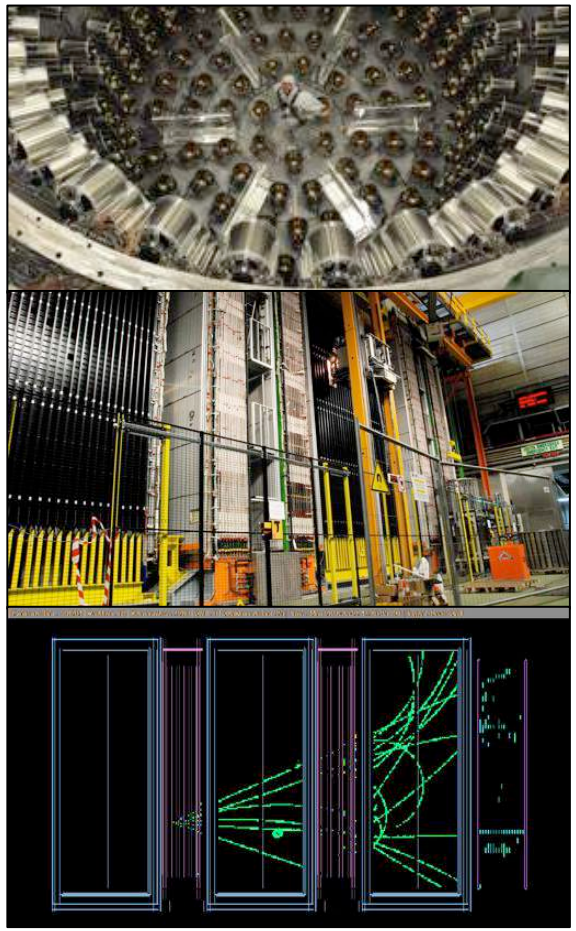
- Silicon detectors
- Calorimeters
- Photo-detectors, new generation scintillators
- Gaseous detectors
- Bolometers
- Microelectronics

Accelerator R&D



- Superconducting accelerator cavities and cryotechnology
- High field magnets
- Ion and electron sources
- Target/source for radioactive beams
- Beam dynamics
- Laser acceleration

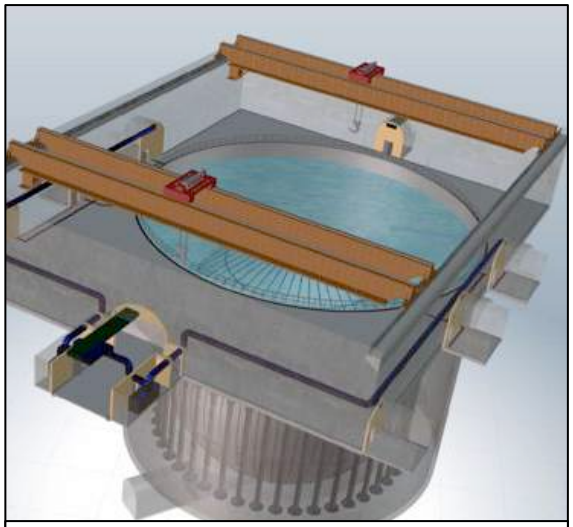
Neutrino physics

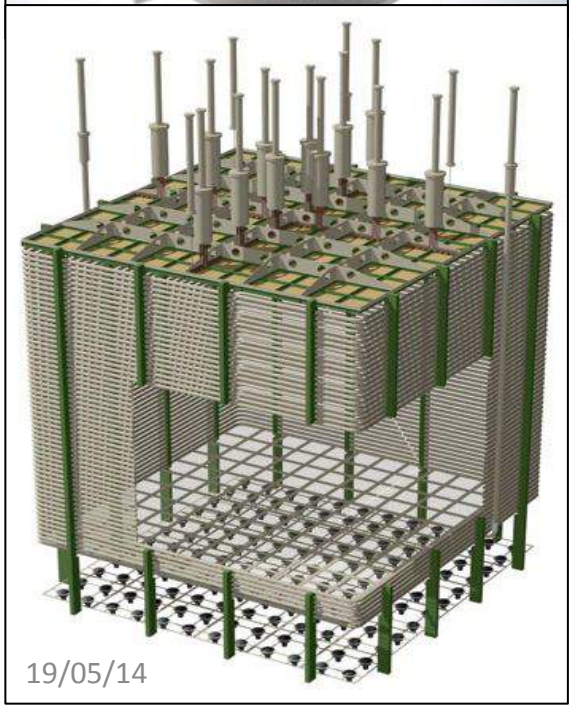


- Present programs: DCHOOZ, OPERA (close to completion), SuperNEMO, T2K, ANTARES
- DCHOOZ : following the success of CHOOZ, which gave the first indications of a non-zero θ_{13}, impressive success of Daya Bay program !

→ Double Chooz preparation triggered projects for sterile neutrino searches : Celand, Stereo

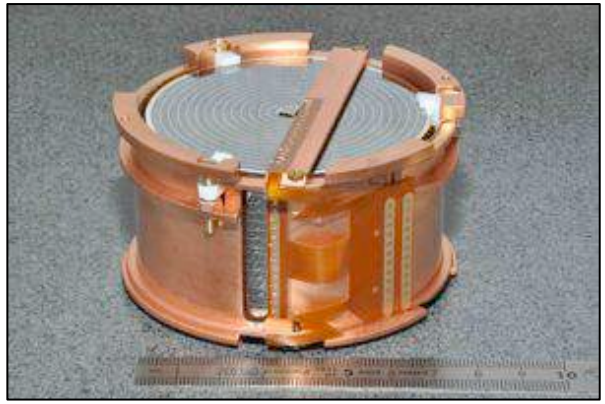
Future Neutrino physics

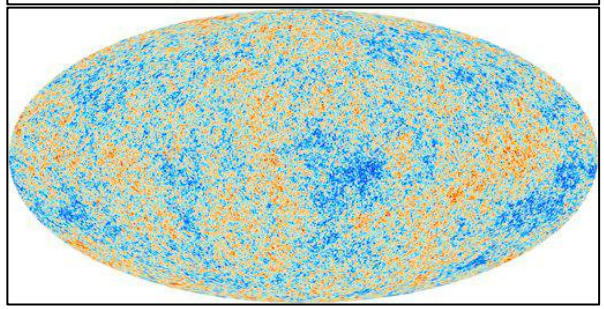




- **Beyond Daya Bay -JUNO** : challenge in terms of mass, energy resolution, mastering of systematics
- **JUNO:** Possibility to re-use the target tracker of OPERA studied by Marcos Dracos, collaboration on electronics, other possible contributions ?
- **Neutrino programs in competition:**
  - As much as possible, participate at a significant level to the R&D program towards LBNE/LBNO long baseline program (USA + Europe + ?): WA105 experiment at CERN (LBNO-DEMO)
  - SuperNEMO funded at the demonstrator level, construction of the full-scale experiment discussed late 2015 or 2016
  - Size of community will be a key element i

Cosmology and the Dark Universe





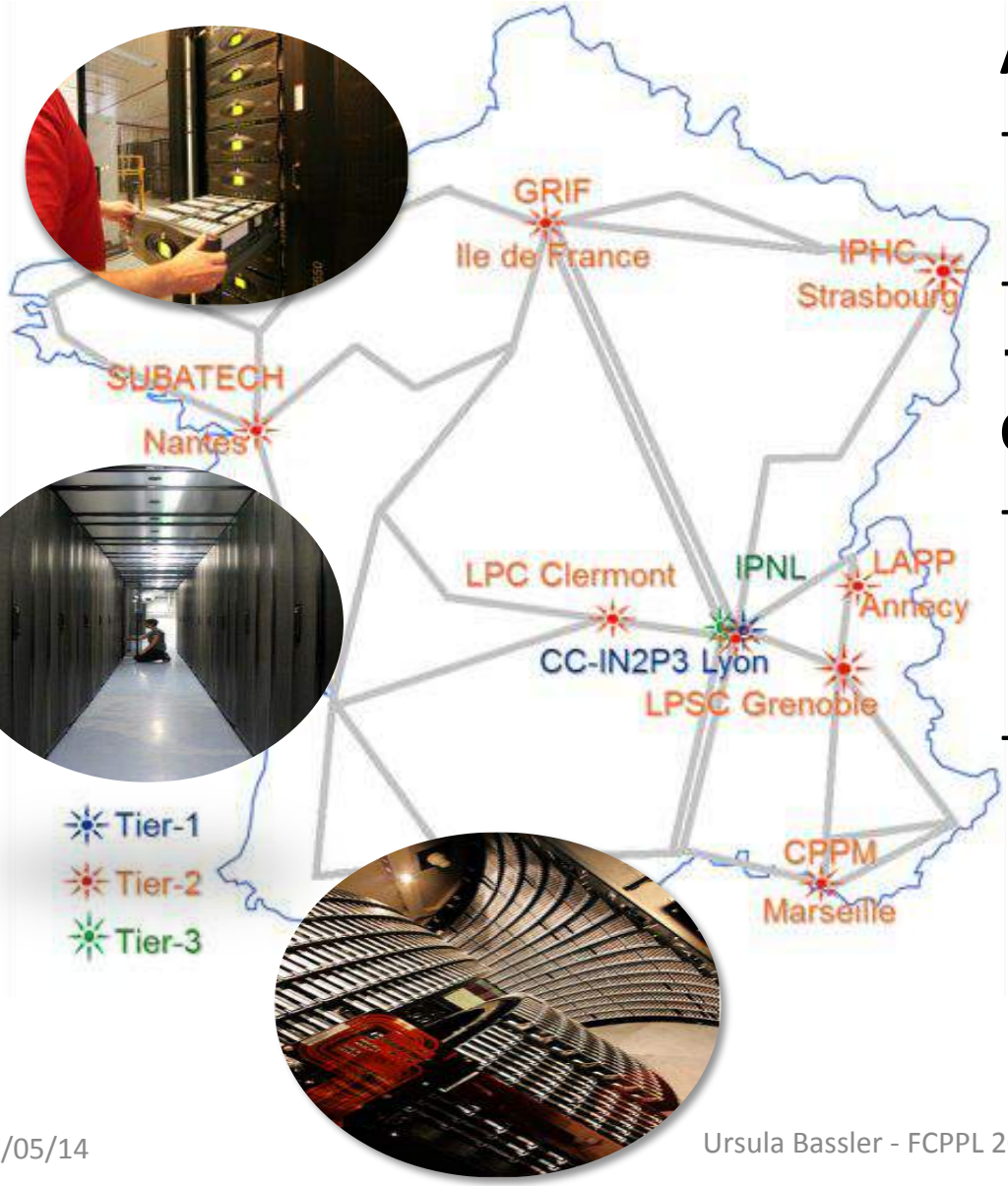
- **Dark Matter :**
  - Direct detection: **EDELWEISS-III**, XENON
  - Axion searches with CAST
  - R&D on new detector technologies (Sphere, Mimac)
- **Dark Energy:**
  - **SNLS** and **SNF** supernovae surveys
  - **BOSS**, **eBOSS** and DESi for BAO studies

  →Towards **LSST** and **EUCLID** (both started)
- **CMB:**
  - after the success of Planck, **QuBIC** (Chinese participation) and CORE

High Energy Universe

- **Gamma-ray astronomy :**
  HESS, **FERMI**
  ➔ Flagship program : **CTA**
- **Neutrino astronomy : Antares**
  ➔ km3 preparative studies
- **Cosmic-rays: AUGER**, **AMS**, (EUSO-Balloon, LHAASO, TREND)

Computing Challenges



Assets:

- Tier 1 Computing Center in Lyon
- National Grid/LCG-France

→ Open to other communities

Challenges:

- increase in data volume :
  LHC, but also LSST, Euclid, CTA
- Software developments to use new techniques (parallel computing)

Outlook

- Potentiel et visibilité importants des équipes françaises, mais ressources en forte diminution
- 2015-2017 risquent d'être des années encore plus contraintes
- Qualité des contributions françaises et des personnels chercheurs et ITs
- On parvient malgré tout à lancer des projets : LSST, EUCLID, et on espère bientôt CTA…
- LHC une forte priorité mais stratégie à long terme