



**NUCLÉAIRE
& PARTICULES**

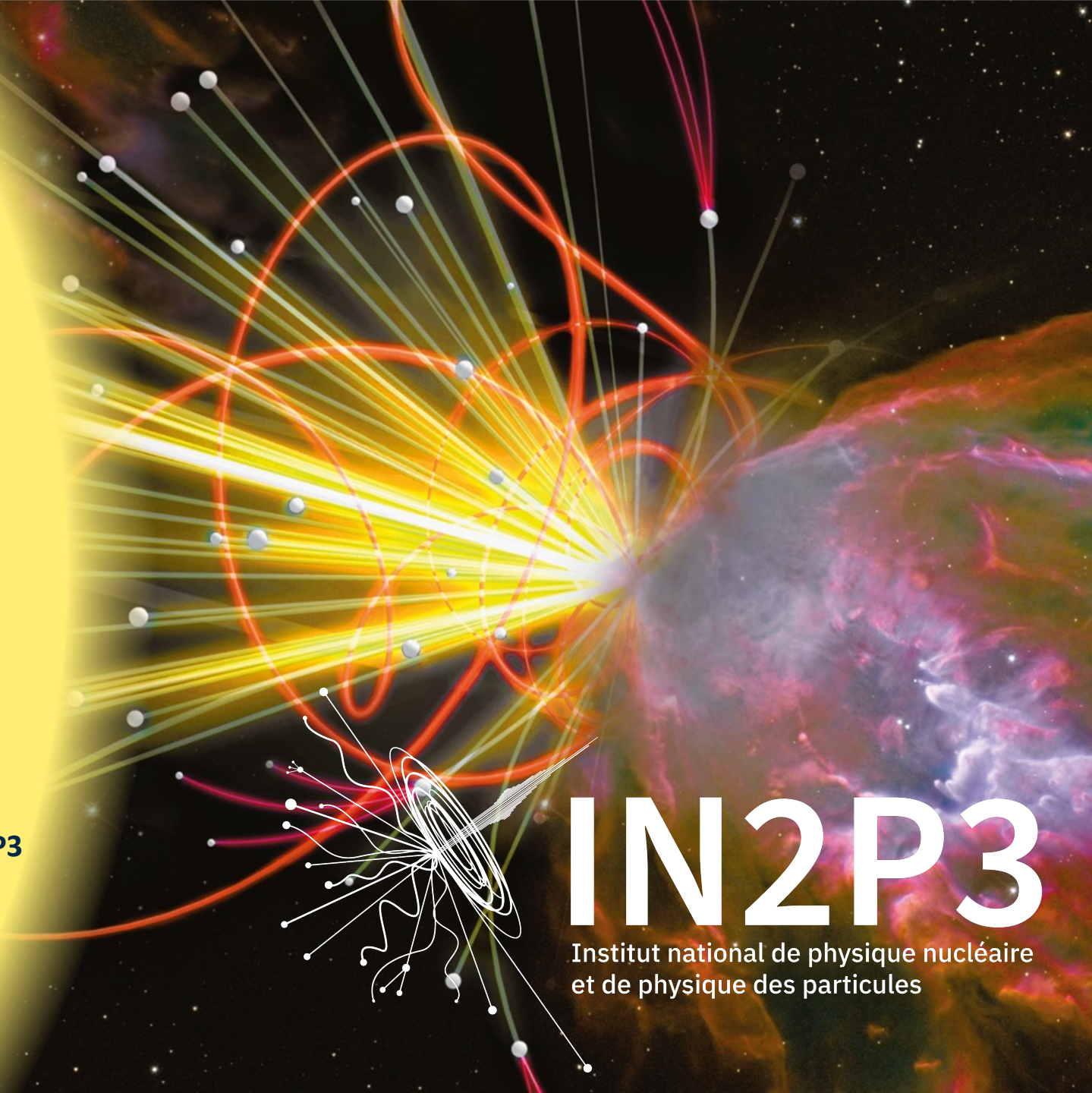
2024 FCPPL Workshop

On behalf of

Laurent VACAVANT

Scientific Director for Particle & Hadronic Physics at IN2P3

10 June 2024



IN2P3

Institut national de physique nucléaire
et de physique des particules

Introduction



Welcome to this new edition of the workshop in Bordeaux !

Building on the success of previous years : 2023 Zhuhai @ Sun Yat-sen, China:



Looking forward to very interesting talks and lively discussions !

The new FCPPL → FCPPN International Research Networks

FCPPL: success stories since 2007

Very fruitful collaborations, seeding larger cross-participations in several projects

Structures adapted last year to follow evolution of CNRS international tools :

FCPPL in transition towards:

- **a network : FJPPN International Research Network**
 - *network with many partners/institutions*
 - *funding of collaborative research projects*

In addition ?

Creation of an IRL@ IHEP:
International Research Laboratory

IN2P3 : a national institute of CNRS

Mission : to coordinate research in nuclear physics, particle physics, and astroparticle physics

COORDINATES

national research programs
and French participations in
major infrastructures

OPERATES

research units, mostly in partnership
with universities and/or research
organizations

EXPLORES

the physics of the two infinities :
from elementary particles to
cosmology

Links with society :

DEVELOPS

associated technologies,
applications and interdisciplinary
research

PROVIDES

expertise, teaching, training

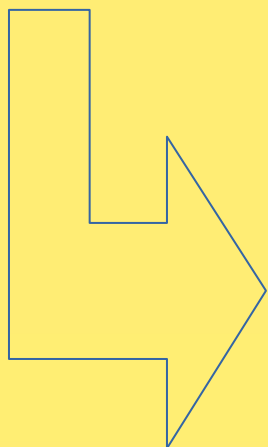


A new Director for IN2P3 :



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Reynald PAIN



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Christelle ROY



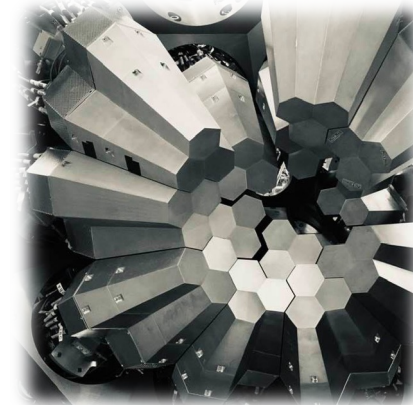
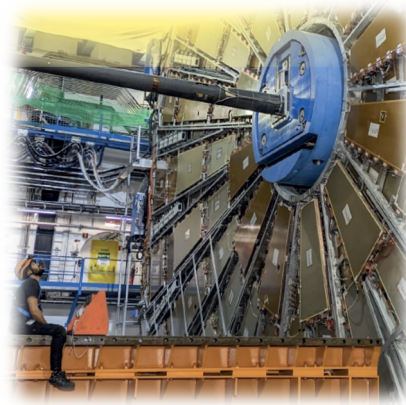
IN2P3

Institut national de physique nucléaire
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Areas of research

- Particle & Hadronic Physics
- Nuclear Physics
- Astroparticle Physics & Cosmology

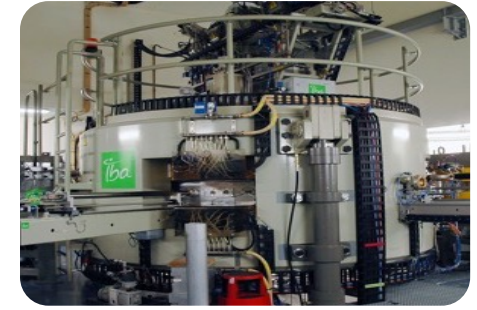
- Nuclear Science for Society
- Accelerators, Detectors, Technology
- Computing & Data



Highlight : nuclear science for society (health, energy, environment)

Health

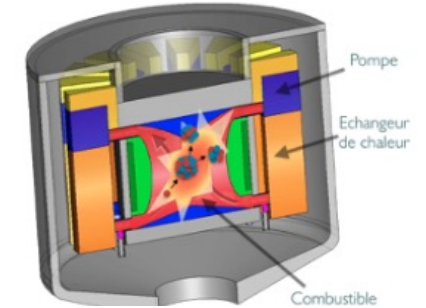
- New radiation modalities for internal and external radiotherapy: + efficacy, - toxicity
- Innovative (bio)medical imaging: + sensitive, + fast, - patient dose
- Biological effects of ionizing radiation (experimental radiobiology, simulation): towards a mechanistic understanding of effects
- Production of new radioisotopes: towards personalized medicine (diagnosis & therapy)



ARRONAX / Subatech

Energy

- Future nuclear energy and its impact on resources, waste and costs: from nuclear data & new reactor systems to electronuclear scenarios
- Nuclear materials and fuel cycle: understanding the behavior of current and future nuclear materials, including long-term waste storage
- Interactions of ionizing radiation in the cosmic environment: understanding the formation of the solar system and the emergence of life



« Molten Salt Fast Reactor » concept. / LPSC

Environment

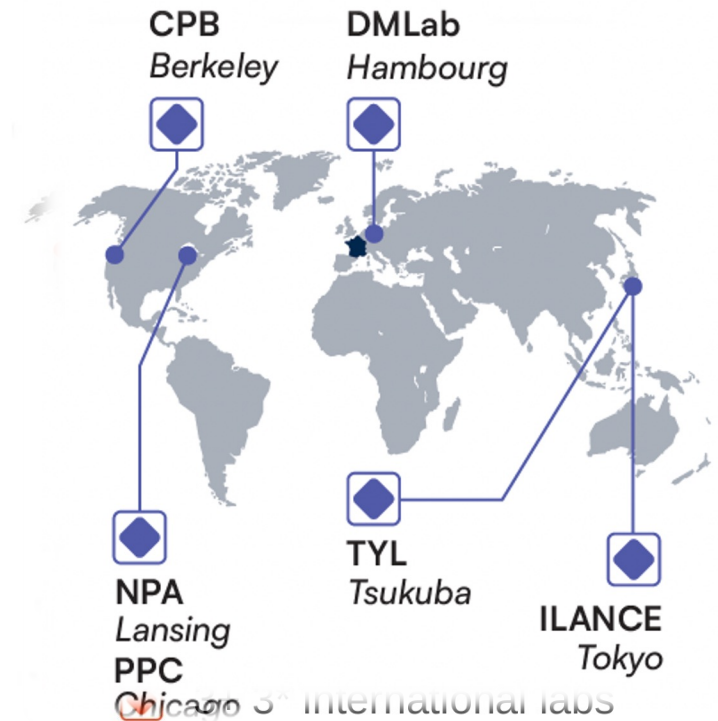
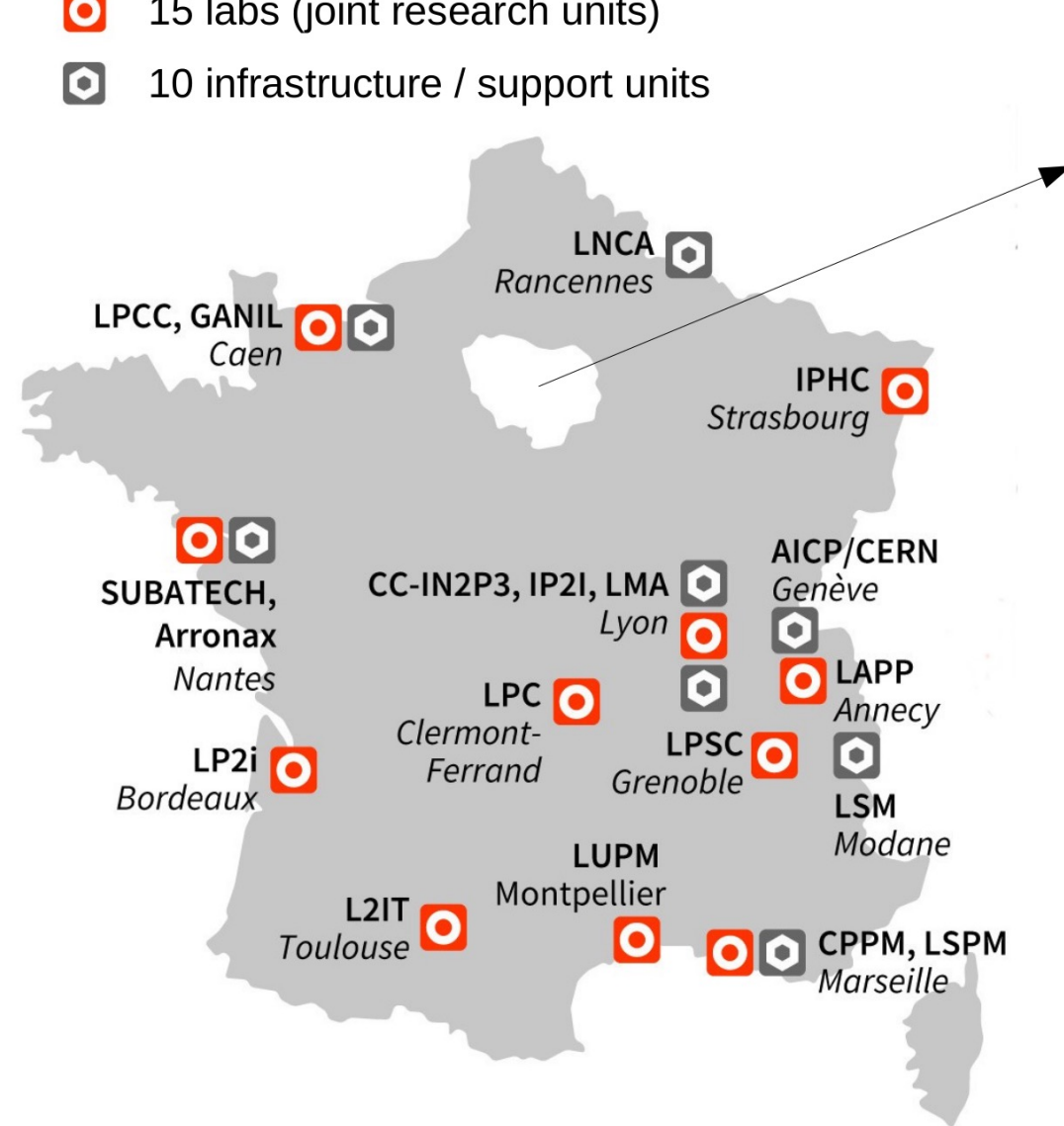
- The Earth system: multi-scale (Ocean - Earth - Atmosphere) and multi-disciplinary (geology, archaeology, etc.) exploration and monitoring
- Radioactivity in the environment: behavior and impact on ecosystems, from fundamental chemistry to remediation



Muography of « la Soufrière » volcano / IP2i

IN2P3 2024 : a distributed institute

- 📍 15 labs (joint research units)
- 🏠 10 infrastructure / support units



IN2P3 2024 : key figures

25

laboratories and technical support units, jointly operated with universities*, CEA**, and INFN*** in Italy

*incl UC Berkeley et UTokyo, **GANIL, ***EGO

10

interdisciplinary research platforms (accel.)

90 M€

annual budget (w/o salaries)

20 M€

yearly for very large research infrastructures

30

national research programs

50

international research agreements

1 000

staff scientists & faculties

1 500

engineers, techs and admins

300

post-docs

450

PhD students



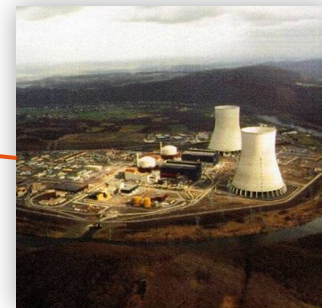
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IN2P3 2024 : research infrastructures in France



GANIL
Spiral 2

LNCA
DChooz



IJCLab
Alto



© D. Longieras/IJCLab

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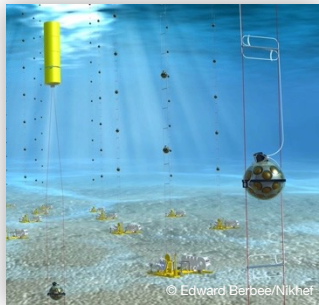
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ILL
Stereo



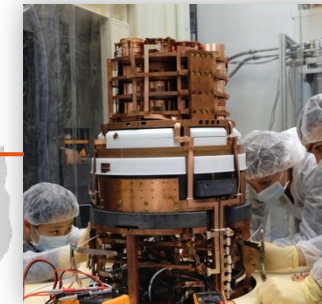
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LSM
Edelweiss
SuperNemo

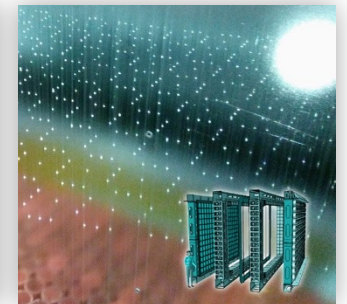


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LSPM
KM3NET



© Mathis Koroglu



© SuperNEMO Collaboration

Highlight : research infrastructures in France : GANIL

- From past :
 - 40 years from first beam
 - in March 2023

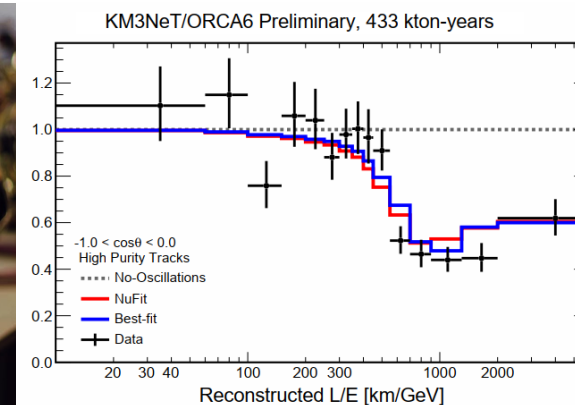
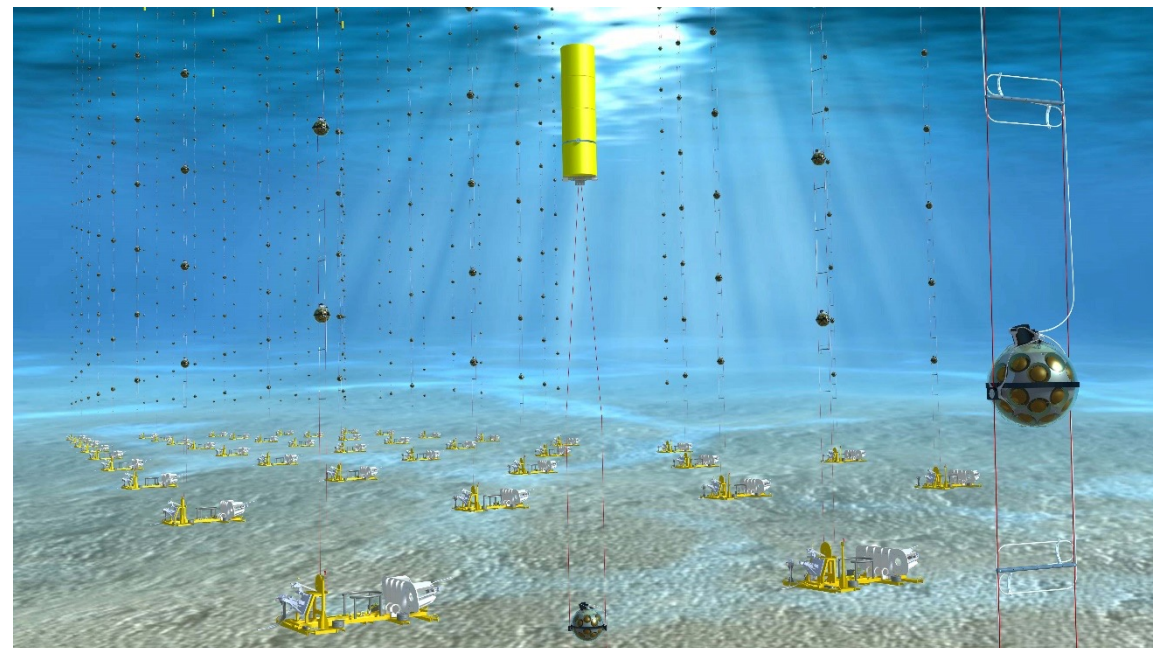


- To future :
 - ceremony for the « 1st stone » for DESIR
 - at GANIL-SPIRAL2
 - in November 2023
 - DESIR (Decay, Excitation and Storage of Radioactive Ions) is a "low-energy" facility that will work with beam energies down to a few tens of keV and will use the SPIRAL1 and SPIRAL2 beams as well as the exotic nuclei produced by the S3 separator.



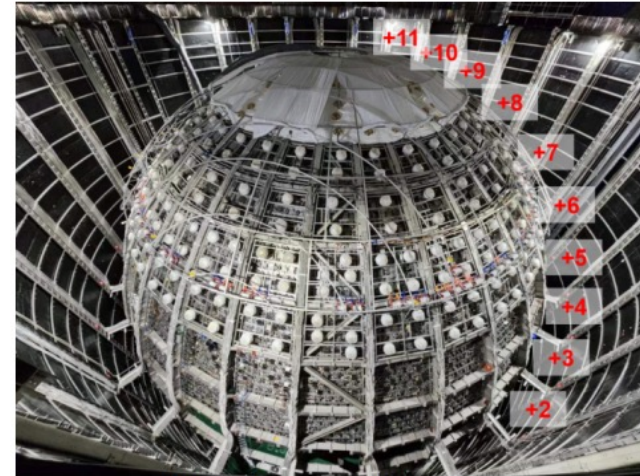
Highlight : research infrastructures in France : KM3NeT

- KM3NeT/ORCA (Toulon, FR) :
 - Depth of 2500 m
 - 115 detection lines to be deployed by 2028
 - 19 lines already taking data
 - *Study of mixing and masses of neutrinos*
- KM3NeT/ARCA (Sicilia, IT) :
 - Depth of 3500 m
 - 230 detection lines to be deployed by 2030
 - 28 lines already taking data
 - *Search for neutrinos from distant astrophysical sources such as supernovae, gamma ray bursts, or colliding stars*



Highlight : neutrino physics with JUNO

- Construction reaching completion
- cf. dedicated session tomorrow afternoon
- IN2P3 contributions well-advanced :
 - sPMT electronics installed
 - TopTracker installation to begin very soon



View from outside



View from inside

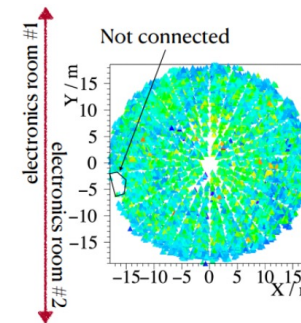
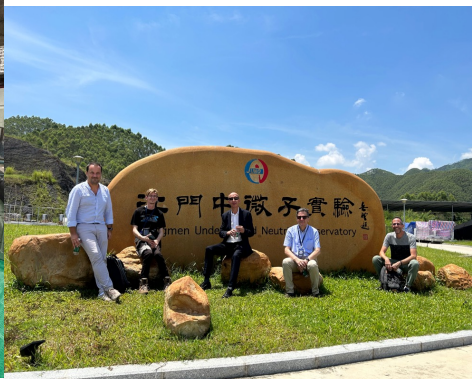


Installed underwater electronics & cables

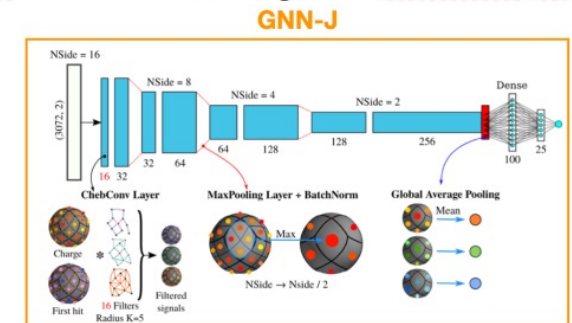


underground electronics room

Visit of IN2P3 direction (July 2023)



Dark count rates of sPMTs



reconstruction with GNN

NB : a lot of progress also on T2K, DUNE, HyperK

International research infrastructures



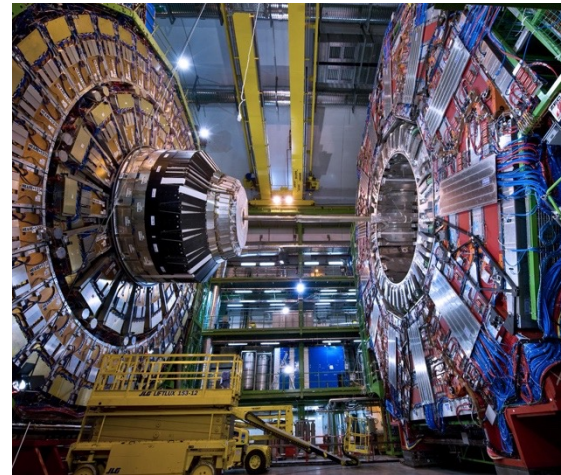
Particle physics and hadronic physics

Elementary constituents and fundamental interactions

- Searches for new physics beyond the Standard Model
- Higgs boson & EWSB
- Matter/antimatter asymmetry & CP violation
- Quark/gluon interactions
- Neutrinos from accelerators or reactors
- Precision measurements
- Tests of fundamental interactions

Priorities :

- LHC experiments and upgrades for HL-LHC
- Belle-II
- Neutrino LBL experiments (DUNE, T2K/HK)
- JUNO



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Standard Model of PP & Beyond (SMPP):

- ATLAS & CMS @ LHC

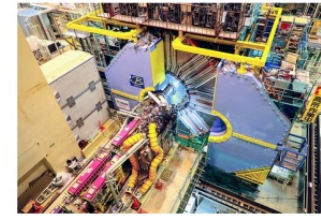
Strongly Interacting Matter (SIMP):

- ALICE, CMS, LHCb



Mixing & CP Violation in Quark sector (CPVQ):

- BELLE-II @ SuperKEKB
- LHCb @ LHC



Neutrino nature, Masses & Mixing (NUMM):

Accelerator-based:

- DUNE
- T2K and HyperK
- (ancillary: NA61)

Reactor-based:

- Double Chooz
- JUNO
- Stereo, Solid

Astro:

- KM3Net
 - SuperNEMO
 - SK
- [Vincent Poireau]



Innovative Detectors (INDE): + preparation for DRDs @ CERN

- CALICE: SiW, SDHCAL ultragranular calorimetry (e^+e^-)
- CMOS/GRAM: thin&granular CMOS pixels (e^+e^- , hh)
- DICE/DEPHY: monolithic MAPS & hybrid pixels (e^+e^- , hh)
- PCIe400, LHCbCalo2: towards HL-LHCb

Precision Tests of Fundamental

Interactions (PTFI):

- nEDM/n2EDM (PSI)
- COMET (J-Parc)
- AEGIS & GBar (CERN)

Theory:

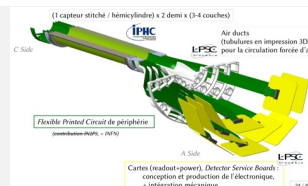
- very broad spectrum
- formal th, susy, strings
- SM, BSM, EFT
- lattice QCD



Highlight : physics at the LHC (and beyond...)

- Run 3 of LHC :
 - on-going, very good machine performance 2024
 - our contributions to Phase 1 (ALICE ITS2 + MFT + MUON + DAQ, ATLAS LAr, LHCb SciFi + DAQ + RTA) working well
 - analyses in full swing

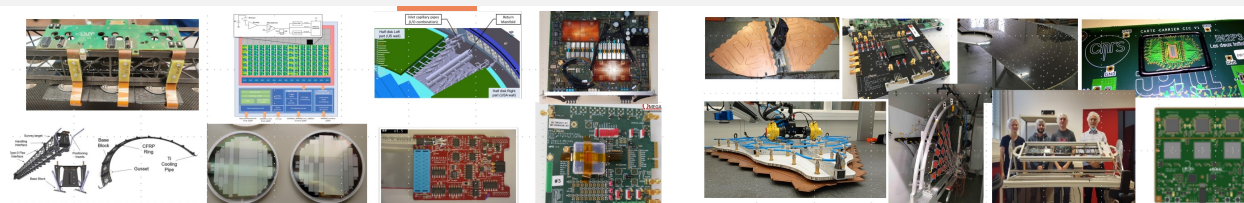
- Next upgrades for HL-LHC :
 - for LS3 : on-going for ALICE ITS3
 - major work on Phase 2 ATLAS & CMS for HL-LHC
 - 250 FTE engineers & techs
 - investment of 53M€ CORE, special IR* credits
 - mostly at pre-prod/early prod stage now ! schedule..
 - decision process for LHCb & ALICE Phase 2



- FCC feasibility study :
 - FS mi-term report out since Feb 2024
 - FR has set up an inter-ministry committee
 - aim : follow & prepare FR position/decision
 - excellent & thorough work, strong dedication
- ESPPU process : getting ready (new schedule)
- On-going reorganization & strengthening for FCC
 - new R&D Master-Projects at institute
 - mapping into ECFA DRD
 - **ECFA Higgs Factory workshop in Paris : 9-11 oct**

Presidents of CH and FR at CERN 16/11/2023

EM : « will & ambition to keep the leadership in the domain »



Particle physics projects portfolio

6 scientific programs

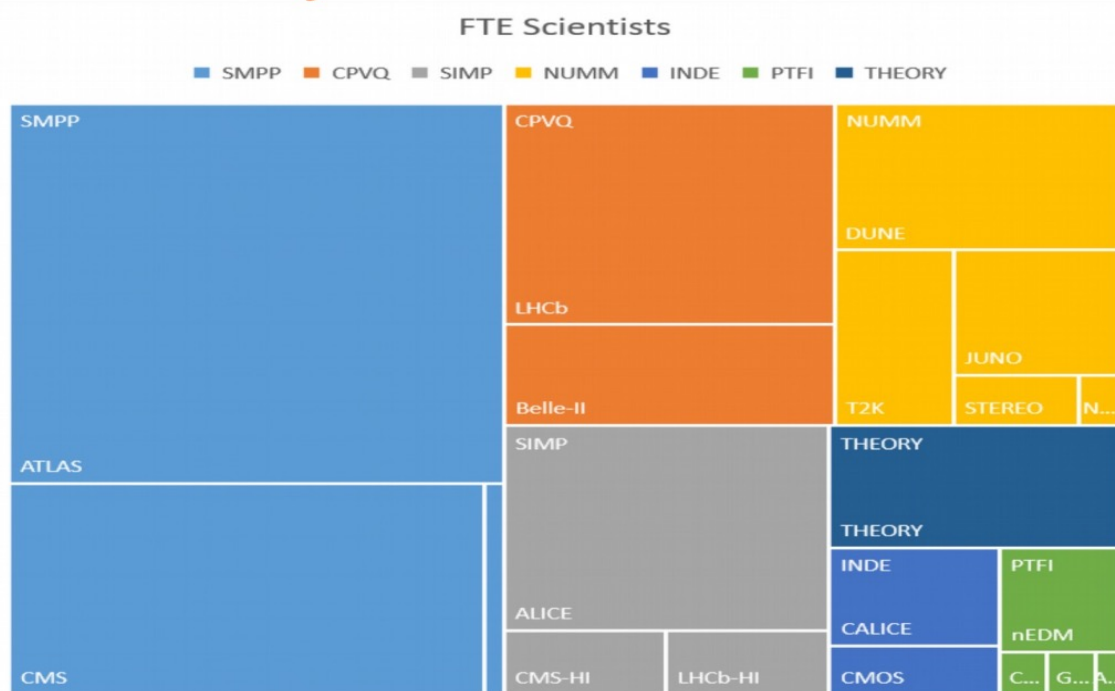
35 master-projects

70 teams, 17 labs

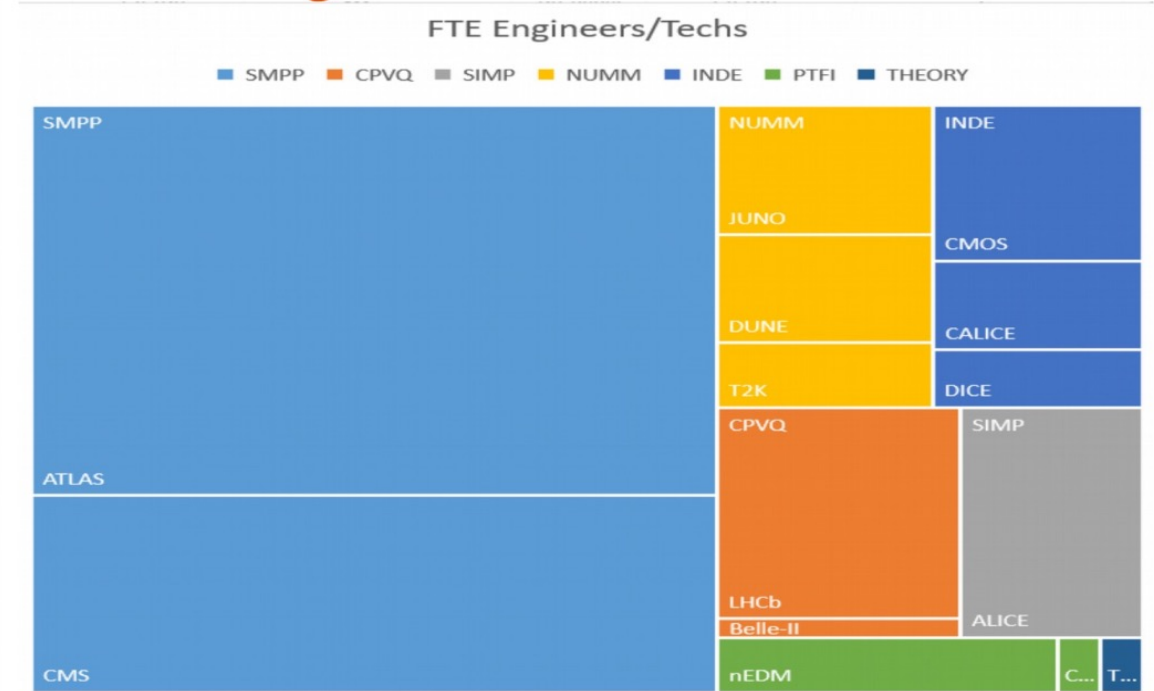
~450 PHY: 300 ch (200 cnrs+100 uni) + 100 doc+ 50 pdoc

+ ~450 E/T

Physicists:



Engineers/techs:



Conclusion

Strong commitment of IN2P3 to support the two networks

Will continue to accompany their evolution and growth

Best wishes for a fruitful workshop !

Many thanks to :



Directors & Steering Committees
International Organizing Committee
Local Organizing Committee and L2IB
Université de Bordeaux