



# Institut national de physique nucléaire et de physique des particules

[www.in2p3.fr](http://www.in2p3.fr)



Introduction/News from IN2P3 since 2021

IN2P3

Joint Workshop TYL/FJPPL & FKPL 2022

Laurent Vacavant & Berrie Giebels

16/05/2022



# IN2P3: a CNRS institute

## Key figures for CNRS:

- 10 institutes covering a very broad spectrum of science topics
  - 3 of them with national missions, including IN2P3
- over 1000 research units, 95% jointly operated with a university
- over 32000 employees
  - > 11 000 permanent scientists
  - > 13 000 permanent engineers, technicians, administrative staff
- yearly budget of \$3.4 billion



## A global actor for scientific research:

- 80 international research labs
  - 6 in Japan
  - 1 in Korea
- 8 CNRS representation offices worldwide
- 60% of publications co-signed w/ international partner



# IN2P3: a CNRS institute



**CNRS**  
IN JAPAN  
2022

## CNRS COOPERATION WITH JAPAN KEY FIGURES

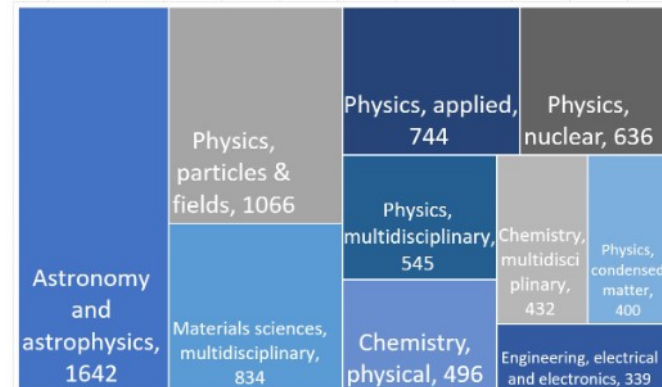


60+ STRUCTURED COOPERATIONS WITH JAPAN



2,117 COPUBLICATIONS WITH JAPAN IN 2019

52% of Japan's publications with France



Top 10 areas of research for CNRS-Japan, by number of copublications in 2015-2019.

Source: InCites

<https://tokyo.cnrs.fr/wp-content/uploads/2022/03/cnrs-in-japan-2022-web.pdf>



# IN2P3: a national institute

MISSION : COORDINATE RESEARCH IN THE  
FIELDS OF **NUCLEAR, PARTICLE and**  
**ASTROPARTICLE PHYSICS**

## OPERATE

Research Units,  
many in  
partnership with  
Universities  
and/or Research  
Organisations

## COORDINATE

National Research  
Programs and  
French  
participations in  
major Research  
Infrastructures

## EXPLORE

The Physics of the *two  
infinities*: from  
elementary particles  
to cosmology

## DEVELOP

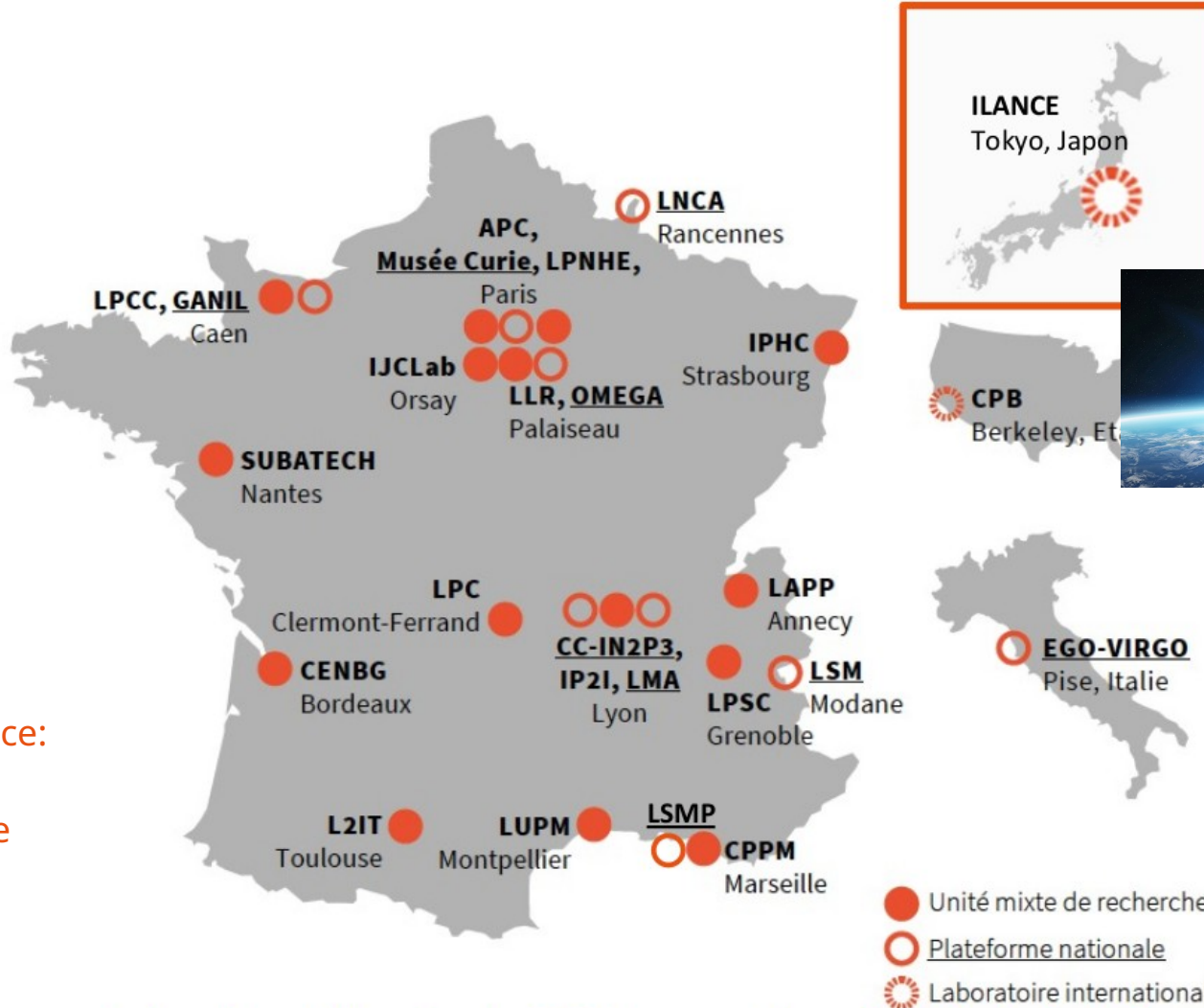
Associated technologies,  
Applications and  
Interdisciplinary research

**PROVIDE** Expertise  
Teaching Training

LINKS WITH  
SOCIETY



# IN2P3: the research units



latest int'l lab:  
Apr 1<sup>st</sup> 2021  
Univ. of Tokyo



latest lab in France:  
Sept 1<sup>st</sup> 2019  
Univ. of Toulouse

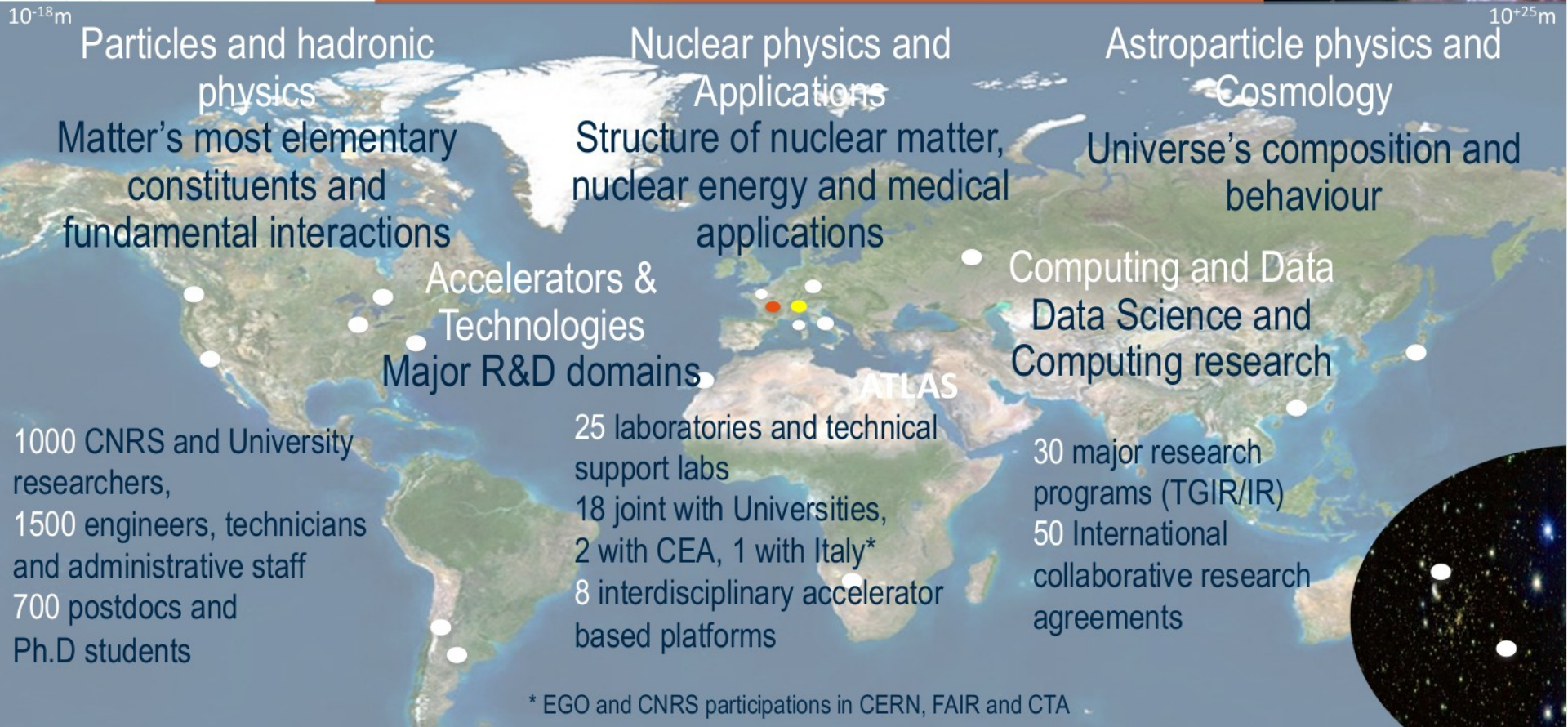
+ another new international laboratory in 2021 in association with Helmholtz in Germany  
+ meeting in June 2022 @KEK regarding the option to transform TYL into an int'l lab





# IN2P3: a national institute

Institute of the 2 infinities



## 5 Main Research Areas - 25 Research Units



# IN2P3 turns 50 !



# IN2P3

## 50 ans de physique des deux infinis

<https://50ans.in2p3.fr>





# 19-22 October: Roadmap week!

Institut national de physique nucléaire  
et de physique des particules







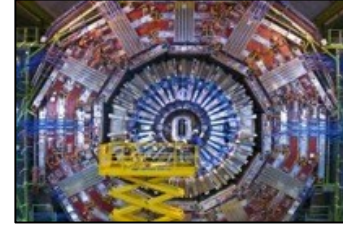
# PP@IN2P3: Scientific Programs & Projects

## Standard Model of PP & Beyond (SMPP):

- ATLAS & CMS @ LHC

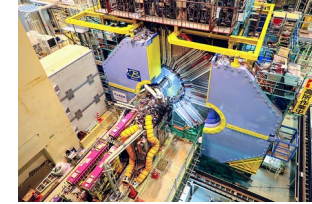
## Strongly Interacting Matter (SIMP):

- ALICE, CMS, LHCb



## Mixing & CP Violation in Quark sector (CPVQ):

- BELLE-II @ SuperKEKB
- LHCb @ LHC



## Neutrino nature, Masses & Mixing (NUMM):

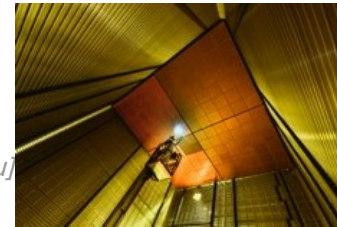
- DUNE
- T2K
- (ancillary: NA61)

Reactor-based:

- Double Chooz
- JUNO
- Stereo, Solid [Marcella Grasso]

Astro:

- KM3Net
- SuperNEMO
- SK [Vincent Poireau]



## Innovative Detectors (INDE):

- CALICE: SiW, SDHCAL ultragranular calorimetry ( $e^+e^-$ )
- CMOS: thin&granular CMOS pixels ( $e^+e^-$ , hh)

- DICE: monolithic MAPS & hybrid pixels ( $e^+e^-$ , hh)
- RD (50, 51, 53) collaborations @ CERN

## Precision Tests of Fundamental

### Interactions (PTFI):

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

## Theory:

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



# Particle Physics Portfolio

7 science programs

33 master-projects

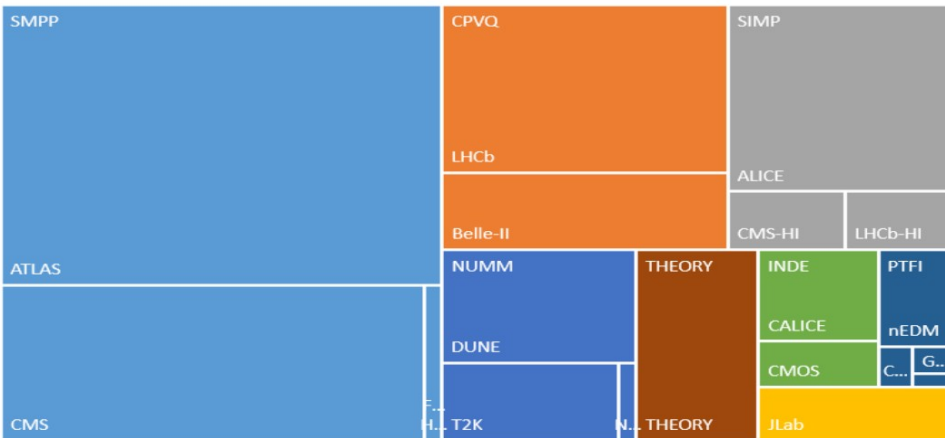
70 teams in 14 labs

PH: ~450 p (>300 FTE) [2/3 CNRS+1/3 U. | 100 PhD st. | 50 postdocs] E/Tech:~150 ETP

## Physicists:

ETPT 2021: CH

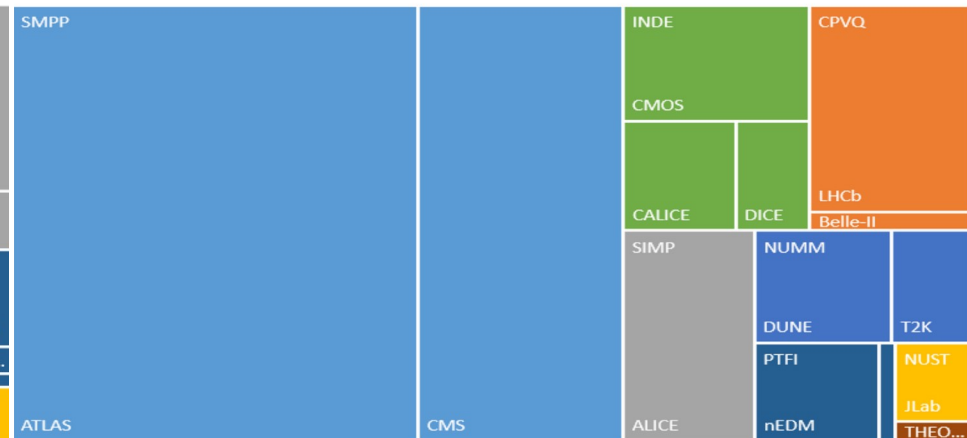
■ SMPP ■ CPVQ ■ SIMP ■ NUST ■ NUMM ■ INDE ■ PTFI ■ THEORY



## Engineers/technicians:

ETPT 2021: IT

■ SMPP ■ CPVQ ■ SIMP ■ NUST ■ NUMM ■ INDE ■ PTFI ■ THEORY



NB: change in portfolio in 2022, addition of JUNO & loss of JLab/EIC (swap with MG/NA)



12/05/2022

STFC-IN2P3 - 2022 - PH





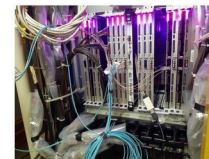
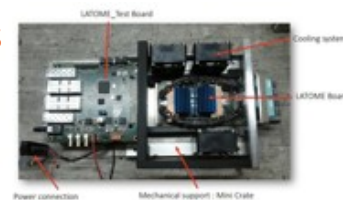
# Highlights about LHC: upgrades

## Phase 1 upgrades completed, LHC restarted:

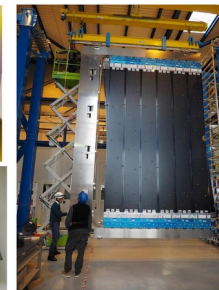
- ATLAS: IBL (2014), LAr EM calorimeter trigger/readout electronics
- LHCb: important involvement at IN2P3 (CORE M&S 5 MCHF) related to:
  - EM calorimeter mechanics and FE readout electronics
  - new SciFi tracker
  - 40 MHz readout of the detector: PCIe40 cards
  - Event Filter with mixed architecture (CPU/GPU)
- ALICE: important involvements at IN2P3 (CORE M&S 5 MCHF) related to:
  - ITS (ALPIDE chip, production of 400 modules, installation, commissioning)
  - MFT (same chips, ladders, mechanics, co-management w/ CEA of full project)
  - MUTRK (DualSampa and PCB cards, station integration), MUID (FERIC FE ASIC)
  - O2 acquisition & (indirectly) CRU cards



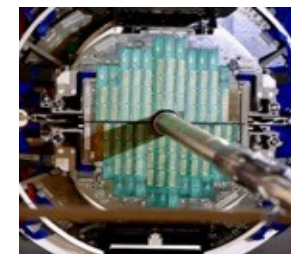
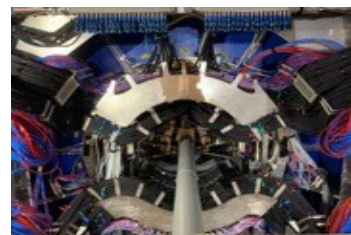
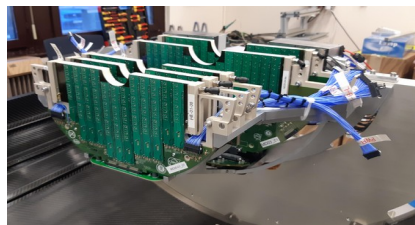
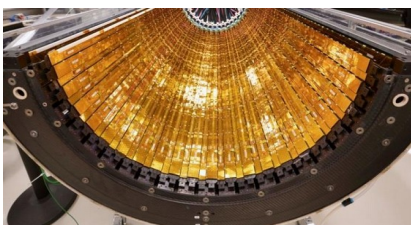
ATLAS



LHCb



ALICE



## Phase 2 upgrades for ATLAS and CMS:

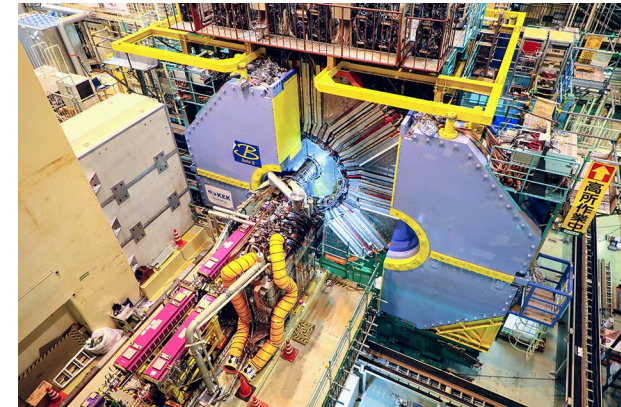
- ATLAS: LAr EM calorimeter electronics, Tile HAD calorimeter electronics, ITk pixels (sensors, ASICs, meca), HGTD (ASIC, meca)
  - effort in full swing, CORE M&S commitment of 17 MCHF
- CMS: HGCAL forward calorimeter (ASIC FE, mecha CE-E, trigger), tracker strips (mecha, module integration, ASIC CIC), Muon RPC
  - effort in full swing, CORE M&S commitment of 12 MCHF

Overall effort on LHC upgrades @ IN2P3: total investment of 140 M€ over 10 years

# Highlights about BELLE-II

## Involvement growing since 2017

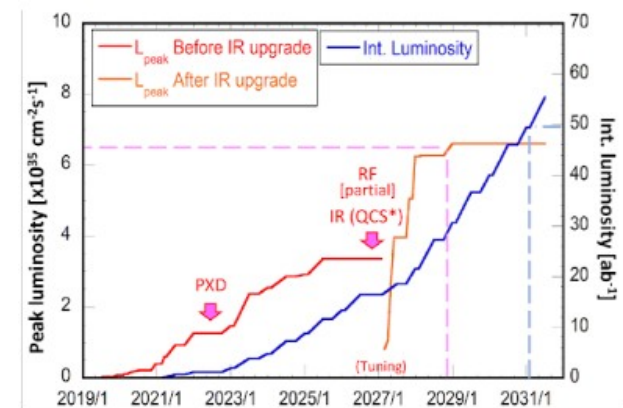
currently 16 physicists + 8 PhD students (IJCLab, IPHC, CPPM)



- relatively new project at IN2P3, very successful
- rare/forbidden decays, b to s transitions  $K\pi(\pi)\gamma$  & LFV, tau decays
- contributions:
  - ARICH (cooling, simulation, monitoring)
  - SVD (calibration, now shifts as well, optimisation cluster position)
  - DAQ upgrade with PCIe40 cards (end of installation this summer)
- also some R&D and studies @SuperKEKB:
  - beam stabilisation
  - characterisation @IP: PLUME background monitor, luminometer
- CC-IN2P3 as a Raw Data Center for the experiment (15% of data)
- successful operation in 2020-2021 despite Covid, world record luminosity

## Further contribution under discussion:

- interest for a VTX upgrade (during LS2, in 2026)
- proposal based on our expertise with CMOS pixel detectors
- EoI submitted by physicists

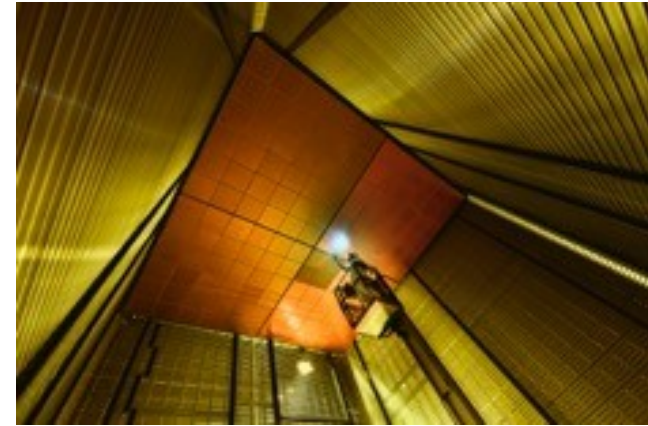
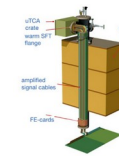
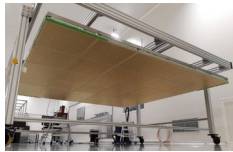
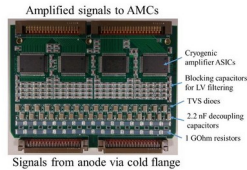




# Highlights about Neutrinos (LBL)

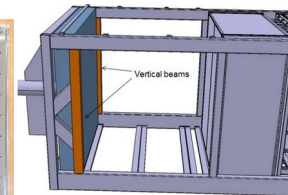
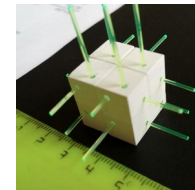
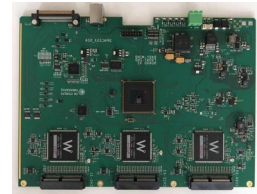
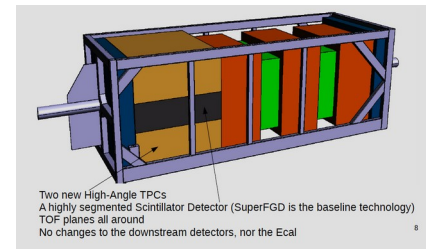
**DUNE:** 25 physicists (APC, IJCLab, IP2I, LAPP, LPSC)

- major contribution to 2<sup>nd</sup> far detector module: Vertical Drift
  - charge read out (electronics, mechanics), HV cathode, light readout, computing @ CC-IN2P3
  - almost 50% of the instrumentation to be provided by IN2P3
- significant efforts at CERN neutrino platform:
  - prototypes tested in cold-box in 2021
  - construction of Vertical Drift Module0 started, to be tested in 2022-2023



**T2K:** 14 physicists (LLR, also on SK; LPNHE and now also at ILANCE)

- historical contributions to: Ingrid, Wagasci, ND280
- contributions to ND280 upgrades for T2K-II:
  - mass x2, acceptance  $\sim 4\pi$  → strong impact on systematics
  - FEB cards (chips CITIROC) for new SuperFGD (LLR, this fall)
  - FEC cards for TPC, support mechanics for SFGD+TPC (LPNHE, done)
  - CORE M&S IN2P3 700 kCHF, CC-IN2P3 as a computing T2 for T2K-II
- neutrino beam granted (best effort) for T2K-II for next years

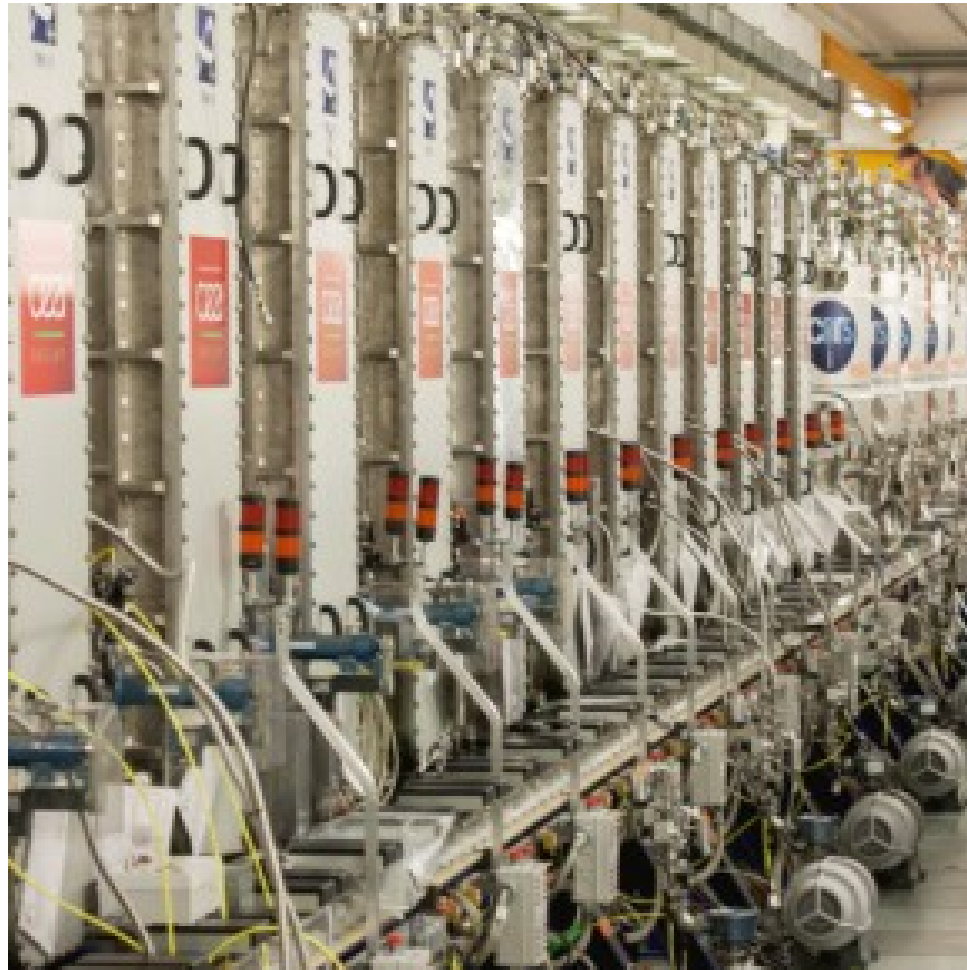


**HyperKamiokande:** IN2P3 has put in place new tools/instruments to prepare a possible contribution

- new International Research Project: PPHK (Preparatory Project for HyperKamiokande) [M. Gonin, ILANCE]
- new R&D project: RD4HK (digitization electronics for PMTs, clock system) [B. Quilain, LLR]
- expression of interest of physicists made known to IN2P3 Conseil Scientifique, will examine it soon



# Nuclear physics & its applications



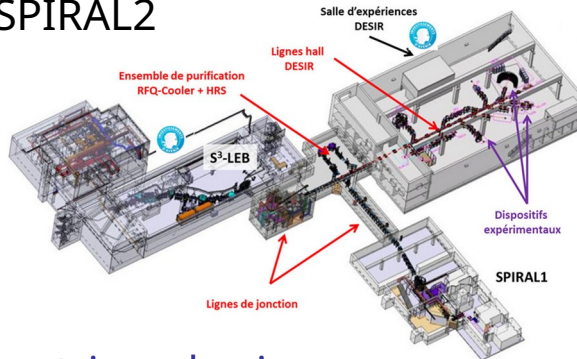
**July 2021 at GANIL:**

**20 MeV/A  $4\text{He}$  at LINAC - SPIRAL2**



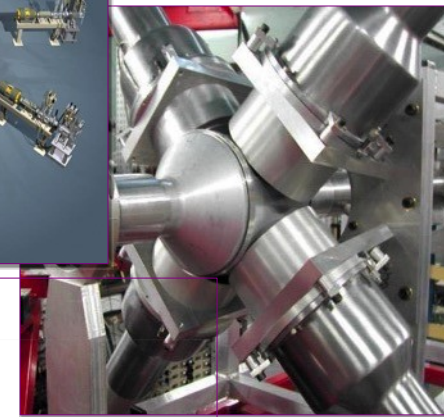
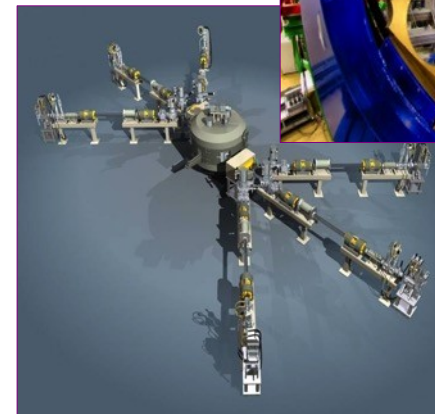
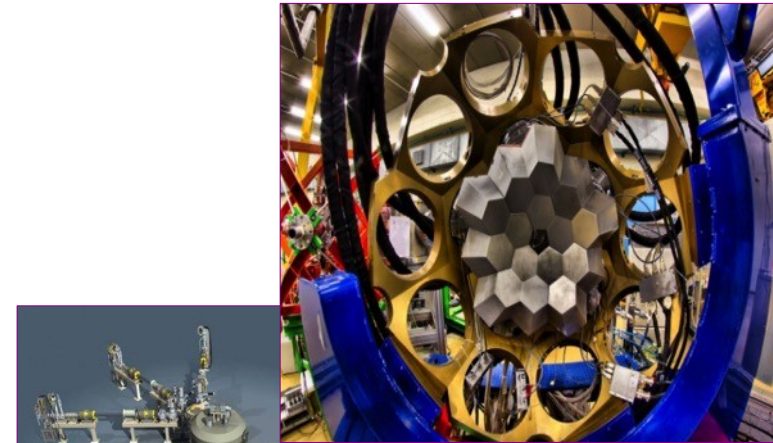
# Nuclear physics & its applications

- Nuclear physics and astrophysics
    - Study of exotic nuclei
    - Study of the nucleon structure
- h Top priority: SPIRAL2



- Reactor based neutrino physics
  - Double-Chooz, JUNO
  - Sterile neutrinos : STEREO, Solid

- Applications for
  - Health and life-science  
( Radiotherapy, radioisotopes, dosimeters, imaging technics, simulations)
  - Nuclear Energy  
(ADS transmutation, studies for Thorium-cycle)
  - Radiochemistry
  - Cosmic ray tomography



# Astro-particles & cosmology

## High-energy gamma rays

- HESS
- Fermi-LAT
- CTA
- HARPO
- SVOM

## High-energy cosmic rays

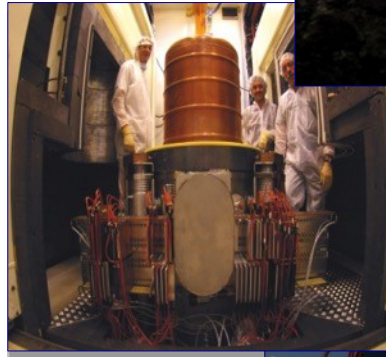
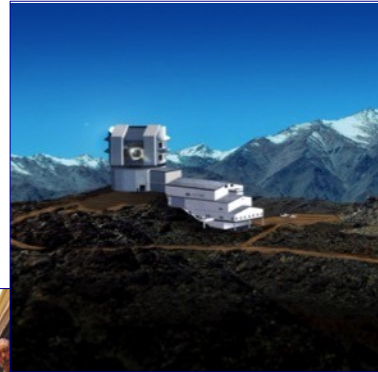
- AMS
- Auger Prime
- EUSO

## Gravitational Waves

- Advanced Virgo +
- LISA / LISA Pathfinder

## Non-accelerator neutrinos

- KM3NeT
- SUPERNEMO
- SuperKamiokande
- LUMINEU



## Direct dark matter detection

- Edelweiss
- XENON
- DAMIC
- DARKSIDE
- MIMAC

## Inflation and CMB

- QUBIC
- NIKA
- PLANCK
- **LiteBird**
- **Stage4 CMB (S4)**

## Dark Energy

- LSST
- DESI
- SDSS/BOSS/eBOSS
- EUCLID



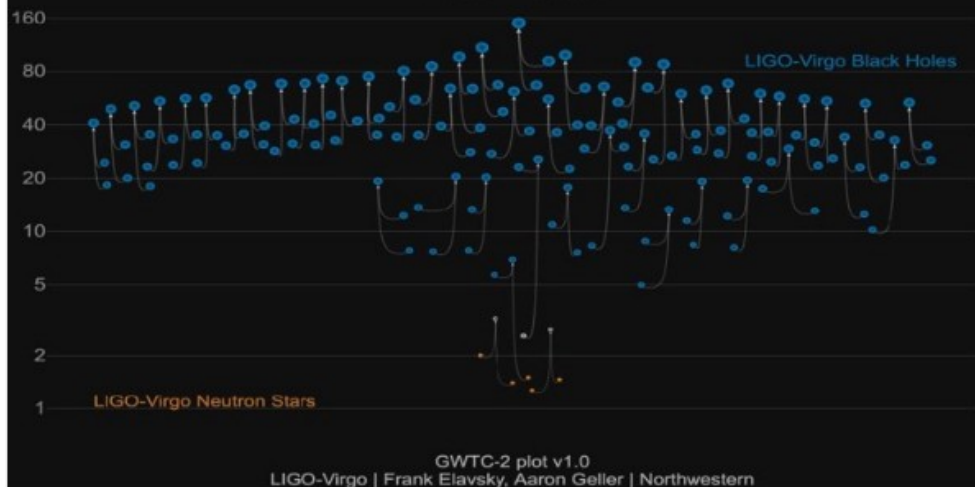
# Gravitational Waves : Virgo Adv+ funded

## Physics of gravitational waves: LIGO-Virgo

- ⇒ Gravitational waves detection opened in a new era emergence of multimessenger **astroparticle** physics
- ⇒ Unique expertise at LMA in Lyon on **mirror coating** for GW interferometers



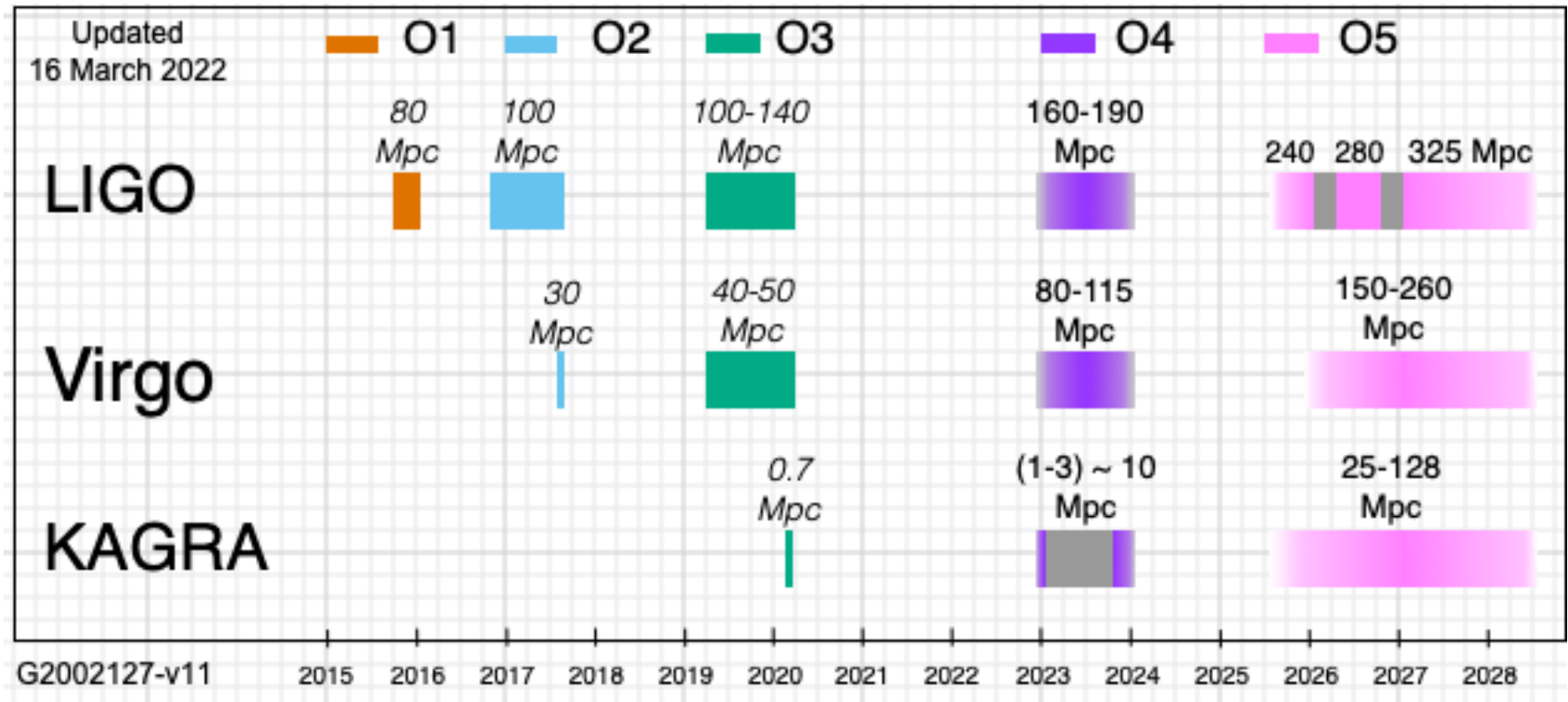
### Masses in the Stellar Graveyard *in Solar Masses*







# Gravitational Waves : Observation run 4





# Conclusion

## TYL/FJPPL & FKPPL

- Successful and very fruitful collaborations
- Seeding for larger cross-participation in projects demonstrated

## Strong commitment of IN2P3

- to support both projects
- to accompany their evolution and growth

I wish you a very fruitful workshop !

Looking forward to seeing the new collaborative projects proposed !

Thanks to the organizers, speakers and participants – see you in 2023!