Laboratory of Subatomic Physics & Cosmology

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JAN-2021

LPSC GRENOBLE | MODANE

Grenoble INP

UNIVERSITÉ Grenoble Alpes

LPSC PLATEFORME NATIONALE LSM

Presentation of the laboratory

- Organization and personnel
- Infrastructures and scientific equipments

Science at the LPSC : priorities

- Particule and hadronic physics
- Astroparticle and cosmology

Conclusion and perspectives

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LPSC : a laboratory on two sites

Grenoble Site

Personnel

67 physicists (38 CNRS, 29 from university)
30+ PhD. students & 10 post-docs
95 engineers and technicians (89 CNRS) + 15 CDD

Infrastructures (UGA)

9 buildings (offices, workshop, accelerator halls...)
20,000 m^2

Modane Site

Personnel

1 Executive Director + 1 Scientific Director
8 technical staff

Infrastructures (CNRS)

1 surface building (bureau, atelier)
1 Underground site (450 m^2)

Three funding agencies

CNRS - Institut IN2P3
Université Grenoble Alpes (UGA)
Grenoble-INP (G-INP)

LPSC organization

Funding Agencies

Mixed Unit of Research from CNRS, University Grenoble Alpes and Grenoble-INP

CNRS : National Institute For Nuclear and Particle Physics (IN2P3)

Grenoble-Alpes University (UGA)

Engineering School Grenoble-INP (G-INP)

Organization of the reasearch activities

14 Research Teams

67 Permanent staff physicists (38 CNRS researchers, 29 university staff)

30 Phd Students and about 10 post-docs

Each team is involved in 1 to 3 projects

10 Technical support Departments

95 permanent staff Engineers, Technicians and Administrative in 5 technical Departments

→ Common support services dedicated to ALL research activities (projects)

Mechanics – Electronics – Computing - Instrumentation - Accelerator & Ion sources …

Technological Platforms & Facilities

LSM – National Infrastructure of Modane (LSM)

GENESIS – Neutron Source for rapid neutrons (nuclear data, irradiation for industrials)

FEST – Fluids Experiments and Simulations in Temperature (reactor physics activities)

PLASMA – Platform of micro-wave plasma reactor (materials, procedees)

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Science at the LPSC : 4 lines of research

Particle and Hadronic Physics

Beyond Standard Model : ATLAS (LHC), Neutron electronic dipolar momentum (n2EDM)
Quark-Gluon Plasma : QGP characterization (ALICE)
Neutrino physics : sterile neutrino (STEREO), PMNS determination (DUNE), CNNS (RICOCHET)
Phenoménology in particle, hadronic physics and cosmology linked to experimentalists

Astroparticle, Cosmology and Direct detection of Dark Matter

Cosmic rays : UHE at Pierre Auger Observatory, HE at AMS (ISS), phenomenology
Cosmology, dark energy : multi-wave length approaches (mm, IR, visible, X) with NIKA, EUCLID,LSST
Galaxy clusters as probe to Cosmological models
Dark matter : Direct detection of dark matter (MIMAC, NEWS-G)

Accelerator and ion sources

Accelerator : Accelerator Driven System accelerators, MYRRHA, neutron source (GENESIS) neutrons
Ion sources : Heavy ion beams (Spiral2 Q/A 1/7), charge boosters, Spiral2, intense ECR 60 GHz

Nuclear for Energy and health

Reactor Physics : Accelerator Driven System and Generation IV nuclear reactors simulations
Health : innovative cancer therapy (proton therapy, BnCT therapy) and associated technologies

Science at the LPSC : 4 lines of research

ENIGMASS

Particle and Hadronic Physics

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Particle & Hadronic Physics

ATLAS team

Research fields : Higgs boson physics, New Physics search (LLP, DM)

ALICE team

Research fields : γ-Jet, γ-hadron correlations, b-flavoured jet

Ultra-Cold Neutron team (UCN)

Project n(2)EDM : Search for neutron electrical dipolar momentum at PSI

Neutrino team

Research field : PMNS element determination with DUNE and R&D ProtoDUNE

Theoretical Particle Physics team

Research fields : Higgs boson Physics, New Physics search, axions, QCD lattice, nPDF

Particle & Hadronic Physics

Higher priorities with ENIGMASS

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Particle & Hadronic Physics

LHC experiment @ CERN

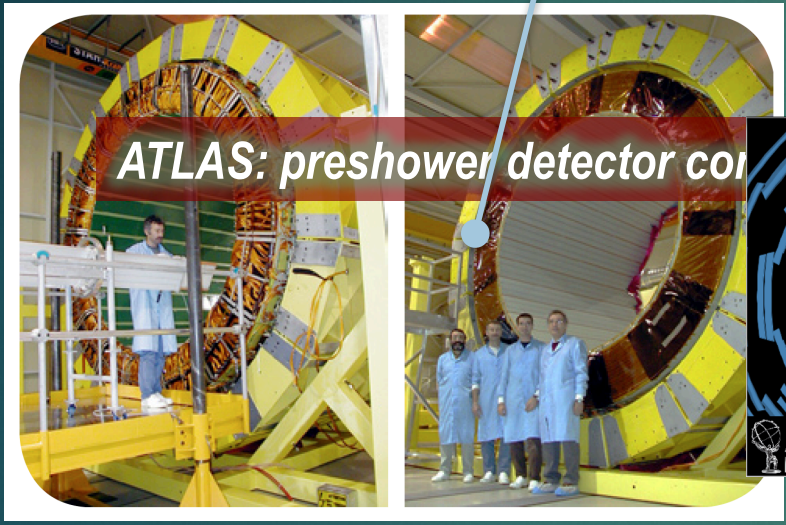
ATLAS team

…since 1983

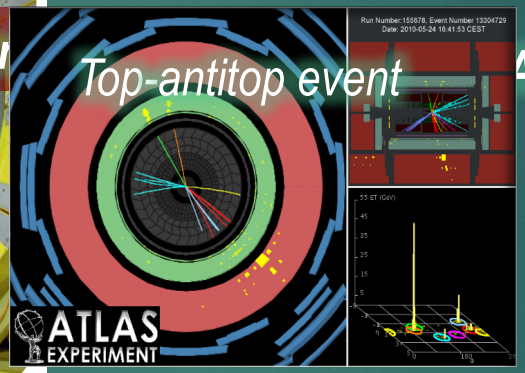
Research fields : Higgs boson physics, Top quark physics, Beyond SM search

Main contributions : Preshower construction, calorimeter cryogeny, γ/e/jet reconstruction

Future Project : Internal Tracker / alpine config. sensors, module loading, validation



ATLAS: preshower detector co



Top-antitop event

ATLAS-ITK : ladders and sensors

Priority for the LPSC

Maintain staff physicists of the team with many engagements & responsibilities :

-- Few physicists involved in the ATLAS Itk project for the HL-LHC

while LPSC is expected to become an officiel center for module loading (& testing)

-- Reorientation for physics analysis in regard of Run3 and HL-Physicists

implications in LLP, dark matter searches within Exotics Working Group to develop

Particle & Hadronic Physics

LHC experiment @ CERN

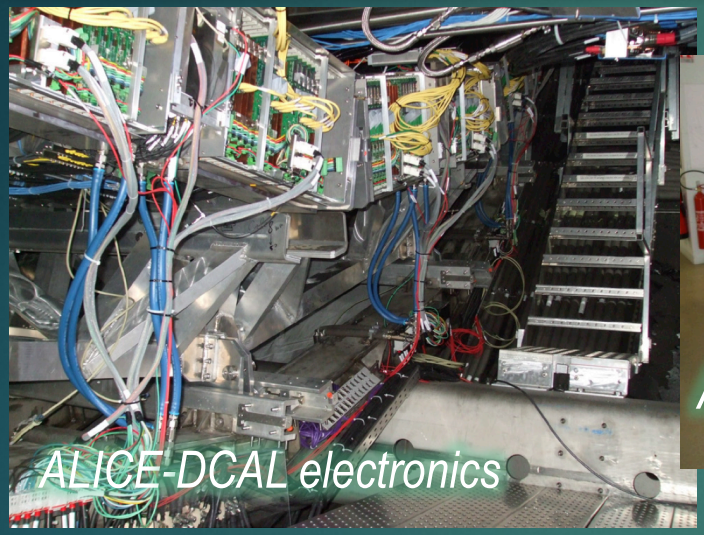
ALICE team

…since 2007

Research fields : γ-Jet, γ-hadron correlations, b-flavoured jet reconstruction

Main contributions : EMCal and Dcal assembling & mounting; Triggering & RO electronics ;

Future project : ALICE-O2 upgrade , R&D FOCAL (Forward Calorimeter)



ALICE-DCAL electronics

ALICE-DCAL supermodules at LPSC

ALICE-EMCAL supermodules

Priority for the LPSC

Team of only 4 permanent physicists while many engagements foreseen :

-- ALICE O2 electronics for the upgrade phase 1

-- R&D project FOCAL (Fwd Calorimeter) and possibly larger implications in the project

-- Physics of γ, jets and instrumentation in the framework of Collaboration with Univ. Tsukuba

Particle & Hadronic Physics

Fermilab, CERN

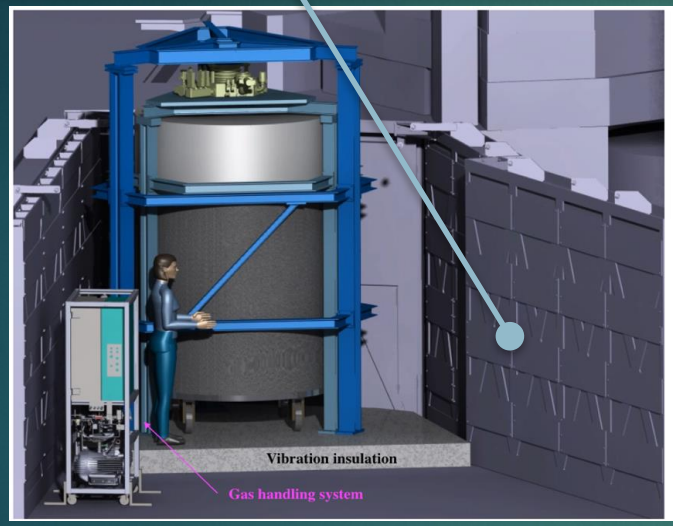
Neutrino team:

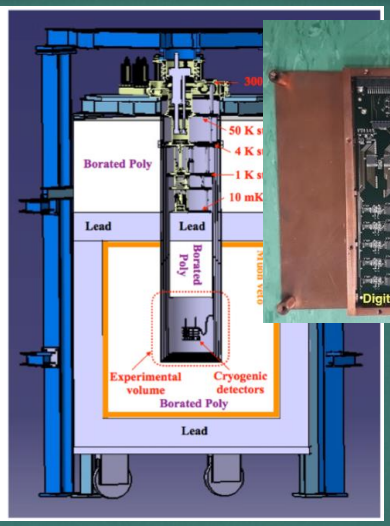
Actual project : finalize exploitation of STEREO and dismantling of the experiment at ILL

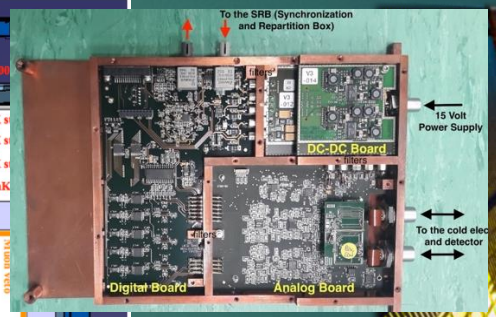
Future projects : DUNE and RICOCHET started both in 2019

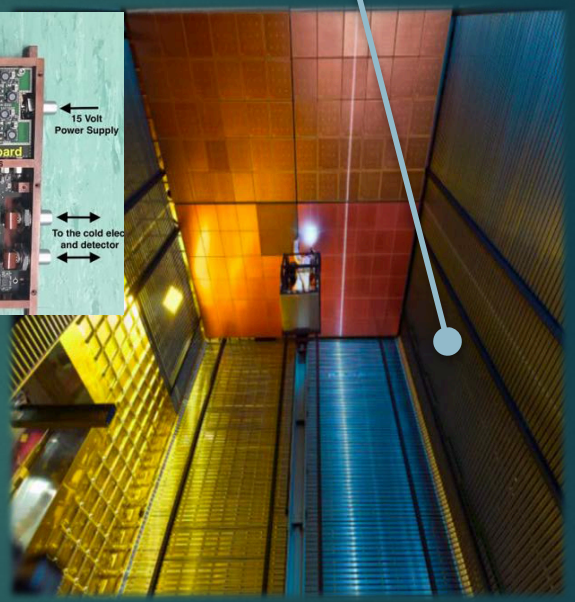
DUNE : Ultimate measurements of PMNS parameters (CP phase, mass hierarchy..)

RICOCHET : Coherent Neutrino Nucleus Scattering with cryogenic Ge bolometers at ILL









Priority for the LPSC

DUNE project :

-- Team of 3 permanent staff physicists recently formed

-- Instrumental responsability in discussion with IN2P3 nationally on ProtoDUNE requires support

-- Simulation and analysis program being defined in view of TDR participation

Astroparticle and Cosmology

DARK team

Research field : Dark matter, dark energy; cosmological constraints; BAO;

COSMO-ML team

Research field : Cosmology using galaxy clusters; KIDs development

AUGER team

Research field : UHE cosmic rays, Search for UHE photons, nature of CR (primary)

MIMAC team

Research field : Dark Matter Direct directional Detection; low mass searches;

Astroparticle and Cosmology

Higher priorities
with ENIGMASS

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MIMAC team

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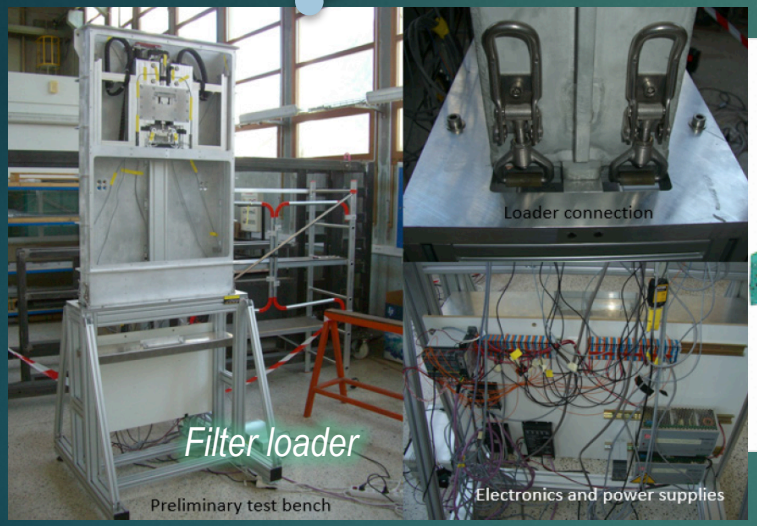
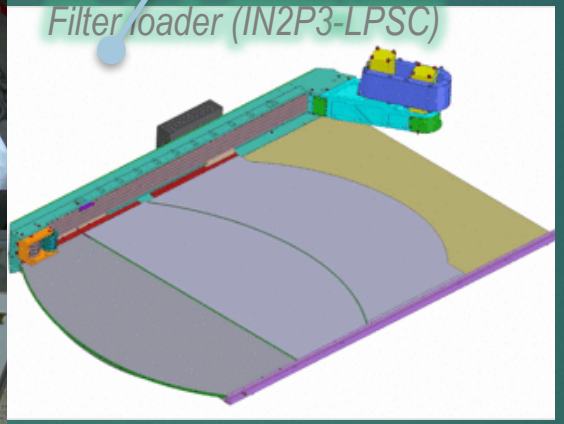
Astroparticle and Cosmology

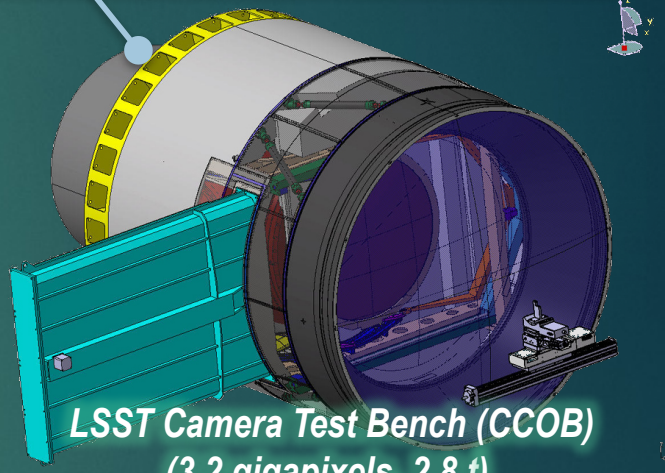
Telescope in Chile

DARK

LSST Research field : Dark matter, dark energy; galaxy clusters as probe to Cosmology;
LSST Instrumental contribution : Filter loader; Camera Calibration Optical Test Bench;
LSST scientific contribution : photometric-redshift reconstruction; simulation of BAO on photo-z;
AMS : data exploitation of CR antimatter searches







LSST Camera Test Bench (CCOB)
(3.2 gigapixels, 2.8 t)

Priority for the LPSC

LSST project :

-- Mainain the level of excellence of a team with only 4 permanent staff physicists
Finalize instrumental implications (Filter loader, Camera calibration)
-- Reinforce implications in physics preparation & exploitation in DESC and Transient

Astroparticle and Cosmology

30m-IRAM telescope, Néel

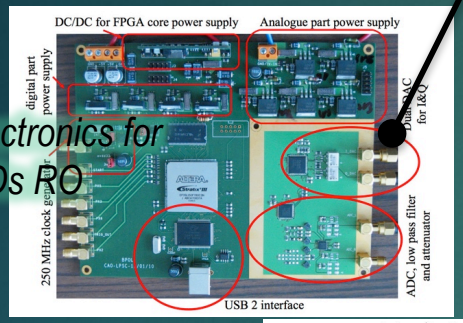
COSMO-ML team

Research field : Cosmology using galaxy clusters with mm detectors, IR/visible, X;

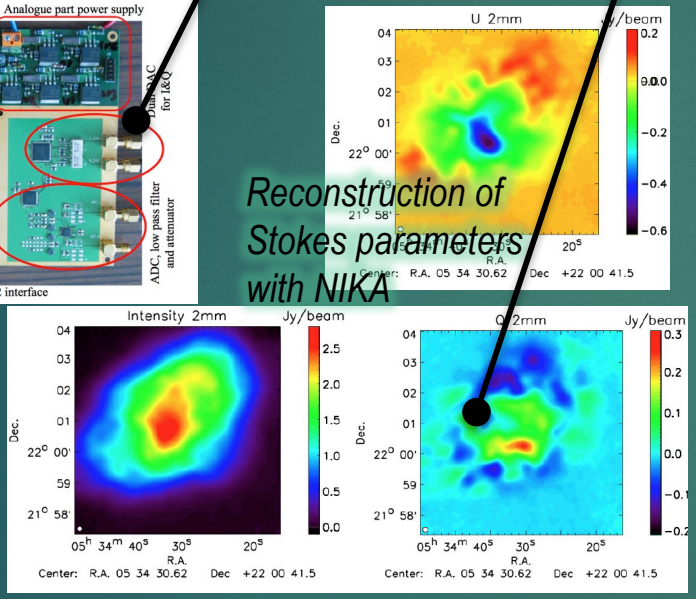
Main contributions : NIKA : electronics for mm polarised KIDs camera; processing pipeline;

Scientific contributions : first polarization measurement; galaxy cluster analysis using tSZ

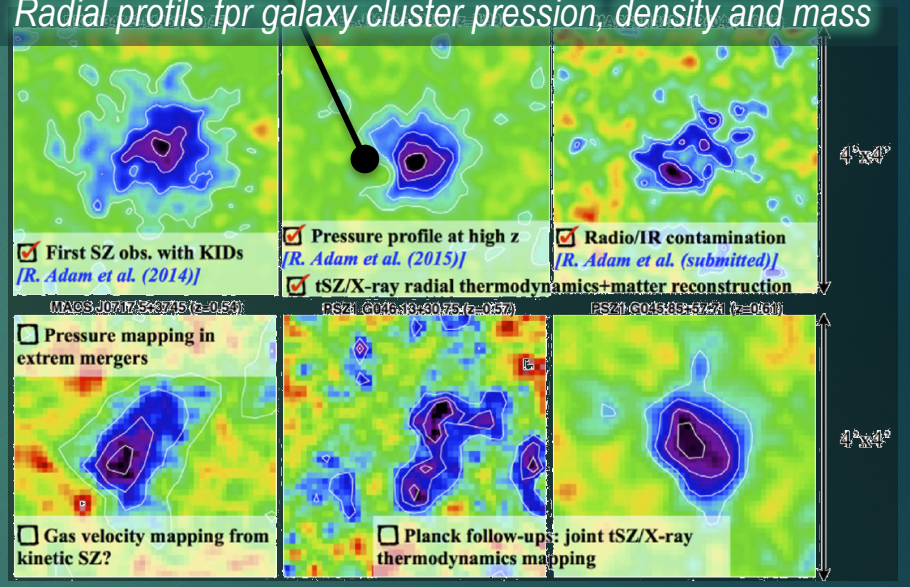
Electronics for KIDs RO



Reconstruction of Stokes parameters with NIKA



Radial profils fpr galaxy cluster pression, density and mass



Priority for the LPSC

NIKA and EUCLID projects :

-- Mainain the level of excellence of a team with 4 permanent staff physicists
Finalize instrumental implications in NIKA (KIDs), EUCLID (NSIP)

-- Reinforce implications in physics preparation & exploitation

Astroparticle and Cosmology

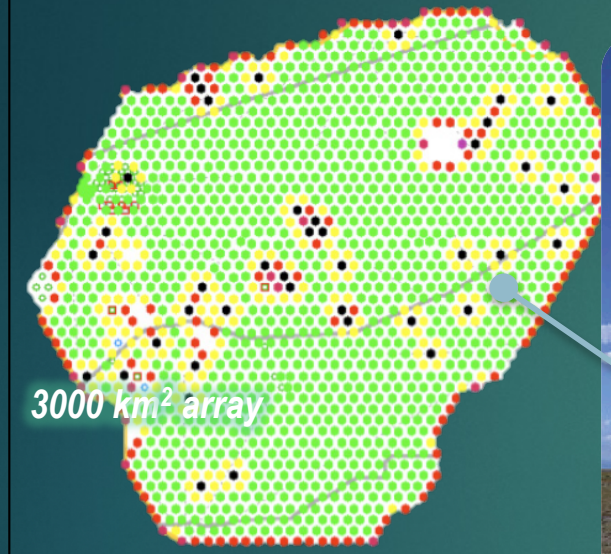
Cosmic Rays on ground

AUGER team

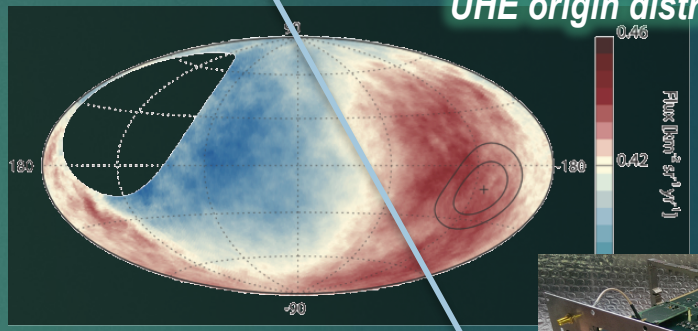
Research field : UHE (>10^{18}eV) cosmic rays origin & propagation; Search for UHE g

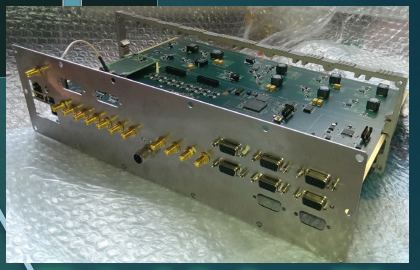
AUGER contributions : UHE CR distribution: Radio detection of showers;

AUGER-PRIME : Construction of 100 scintillator modules + FE electronics; national coordination



UHE origin distribution





Electronic for Auger-Prime Surface Detectors

Priority for the LPSC

Maintain our implications

-- National coordination for the IN2P3 in France
-- Finalize instrumental implications in SD electronics
-- Improve our coverage of UHE photon physics

Presentation of the laboratory

- Organization and personnel
- Infrastructures and scientific equipments

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Conclusion and perspectives

Conclusion and perspectives

LPSC scientific strategy

Maintain & develop our presence in Very Large Research Infrastructures (national TGIR)

ATLAS, ALICE, DUNE, LSST, Auger

Develop our participatio to cosmology projects

NIKA2, CMB on ground, LSST, EUCLID

Reinforce our implications on new technologies

Kinetic Inductance Detectors (KIDs), diamond detectors, neutron detectors and source

Increase our involvements in platform/facilities dedicated to research and industry

LSM National facility, GENESIS neutron sources, ions source facility

Reinforce the link between Phenoménology and experimental projects

Higgs, BSM, QCD lattice, nuclear PDF with ATLAS, ALICE, UCN, AMS…

LPSC site context with ENIGMASS

Development of the synergy with ENIGMASS partners LAPP, LAPTh

Coordination on major projects in the framework of IN2P3 and internationl collaborations

Structure links to University of Grenoble Alpes and Grenoble engineering school

Coordination between LabEx and IN2P3/CNRS and with University Resarch pole

Reinforce our collaborations with the Grenoble labs and Research Infrastructures

Institut Néel (material, technologies), IRAM, IPAG (astrophysics), LNCMI (High current magnet)

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Increase our invol

LSM Natio

Reinforce the link

Higgs, BSI

ENIGMASS obviously plays a central role in our scientific program in mid (long-)-term plans

…

…and should be an key actor helping us structure and promote our research activities with universities and international collaborations

LPSC site contex

Development of th

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