Paris-Saclay and its P2I department

https://www.universite-paris-saclay.fr/fr/recherche/departement/physique-des-deux-infinis-p2i

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Research at UPSaclay is structured in thematic departments whose primary mission is to contribute to the development of a strategic vision shared by all members in their area of expertise and to coordinate its implementation.

Education at UPSaclay is structures in "schools" organizing training in a particular scientific field. Each School has a close relationship with one or more of the research departments.

10,000 permanent staff members
300 laboratories
UPSaclay research strategy

Research in key areas ranging from fundamental research to applied sciences and industrial topics. Complemented by cross-cutting initiatives on socio-economic issues and the development of shared platforms.

• Maintain an outstanding research in all fields of knowledge — science, engineering, humanities, social sciences, medicine, business and management —
  • Maintain our leadership position in some fields: maths, physics, engineering, plants,…
  • Reinforce future leading domains
• Facilitate interdisciplinarity and internal synergies
• Increase international impact and visibility
• Bring forward research and innovation in all fields of knowledge
• Play a vital role in undertaking actions aimed at public goods and at transitions in society
Research at UPSaclay

Several key initiatives selected in 2013 and 2014, together with strategic science and equipment projects ("laboratoires d'excellence" and "équipements d'excellence") and interdisciplinary PhDs.
About 1500 people in 16 laboratories (about 50% of the national community)

Research on fundamental questions of the physics of the two infinites and the interdisciplinary topics health and energy.

Particle physics, nuclear physics, astroparticles and cosmology from both experimental and theoretical points of view, and associated instrumentation.

P2I researchers and engineers have scientific and technical expertise in a broad range of advanced fields (accelerators, detectors, simulations, computing).

P2I scientists participate to more than 60 research infrastructures and experiments.

These research activities yield about 70 PhD thesis per year.

These research activities are supported by

- Two Equipex: Andromede and ThomX
- LabEx P2IO (80% LabEx) with 14 M€, distributed over 9 years (2011 – 2019)
- 18 local platforms
- More than 50 contracts with industry
- A great number of international contracts and collaboration agreements

Courtesy: Yves Sirois
Research topics
Observations of high-energy radiations and particles from cosmos (HESS2, CTA, FERMI, SVOM, Auger).
Research on gravitational waves (VIRGO, Advanced VIRGO, LISA).
Cosmology (Planck, LSST, BOSS, BAO-Radio, QUBIC, EUCLID)
Dark matter (EDELWEISS, EURECA, PandaX, Xenon)
Theory

Nobel Price for gravitational waves!

Gravitational waves from a binary black hole merger observed by LIGO and Virgo

Cosmic rays with energies $> 10^{18}$ eV are extra-galactic, Science on 22 September 2017, the Pierre Auger Collaboration.

All messengers have now been detected -> towards multi-messenger observations!

Building new research infrastructures
Research highlights

Research topics
Physics of the Higgs boson
Leptonic CP violation
Search for new particles, supersymmetry at high energy
Neutrino physics
Theory

Important efforts in theory

Upgrade of LHC detectors (Atlas, CMS, LHCb for LS2 2019-20)

Increasing efforts in neutrino physics

1.5 million Higgs produced (2016)!

Determination of the parameters of the CKM quark-mixing matrix

Phases of the CKM matrix

- $\Delta m_d$ & $\Delta m_s$
- $\sin 2\beta$
- $\rho$
- $\eta$

Muon spectrometer of Atlas

T2K
P2I - Research highlights

Research topics: Strong interaction at different scales
Ultra-relativistic HI collisions (ALICE, CMS, LHCb)
Hadron physics (COMPASS, JLAB, HADES/FAIR, PRAE)
Nuclear physics: structure and reactions (ALTO, GANIL/SPRAL2, GSI, Riken...)
Nuclear theory
Nuclear Astrophysics

The $p_\perp$ dependence of the nuclear modification factor $R$ measured in PbPb collisions at the LHC exhibits a universal shape, which can be well reproduced in a simple energy loss model.

Local support for ALTO in view of SPIRAL2: innovative mass measurements with high-resolution mass spectrometer MLLTrap

Upgrade of Alice muon spectrometer

Efforts for SPIRAL2

ALTO – Tandem at IPNO
Research topics
Accelerators (ILC-CLIC, XFEL, HL-LHC, FCC, FAIR, ESS, MYRRHA, SPIRAL2, IFMIF...)
Detectors
Simulations and data analysis
High Performance Computing

Development of couplers for XFEL

Paris-Saclay offers a great number of research platforms, infrastructures, and expertise that can be shared!

Local support for development of neutron scattering facility (IPHI-neutron)
Conclusions

• P2I scientists work on two major questions:
  – Unveil the ultimate components of matter and their interactions
  – Elucidate the origin of the Universe, its constituents and their evolution
• They offer an important contribution also for two interdisciplinary topics: energy and health.
• *Nuclear physics plays an important role in these research topics.*
• P2I laboratories gather knowledge in both experimental and theoretical research combined to high technical potential and expertise.
• The new Paris-Saclay University offers:
  – Increased sharing of expertise and research platforms
  – Increased attractiveness and visibility of our research
  – Better possibilities for connections and collaborations between different research fields
  – Better connection between research and education
  – Stronger coupling to industry