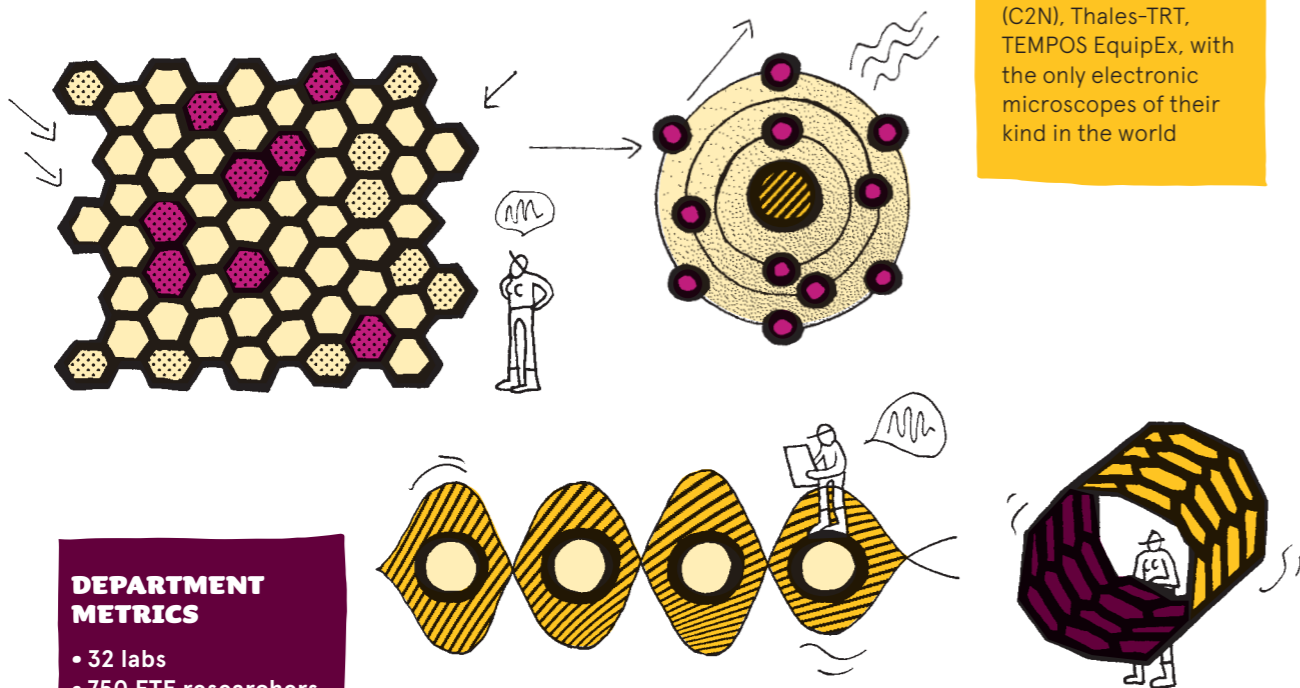


# PHYSICS OF LIGHT AND MATTER (PHOM)



## PLATFORMS, VLIS AND TECHNOLOGY CENTERS

Université Paris-Saclay's key strength here lies in the unique range of VLIs/large instruments and experimental platforms: SOLEIL synchrotron, neutronics, technology centers, ultrafast science infrastructure/ extreme light, electronic microscopy, Centre for Nanoscience and Nanotechnology (C2N), Thales-TRT, TEMPOS EquipEx, with the only electronic microscopes of their kind in the world

## DEPARTMENT METRICS

- 32 labs
- 750 FTE researchers and around 1500 permanent scientific staff
- 10 Université Paris-Saclay member institutions and organizations
- 250 theoretical physicists
- Around 650 Master's students, 322 PhD students (50% progress to doctoral studies)
- The Pascal Institute
- 2 LabEx: PALM and NanoSaclay
- Around 25% of national potential in this field of basic research

The research carried out on "light" physics in this department ranges from atoms to daily-life phenomena, including nanoscience, optics, photonics, radiation-matter interaction and materials. It focuses on the way new complex phenomena arise from the numerous interactions among a large number of particles or components in a system. Physics at Université Paris-Saclay covers the entire spectrum of basic research on materials, applications and new devices and represents the main hub for this discipline in France.

# KEY FOCUS

## Nanophysics

A very broad field with a wide range of technology transfer opportunities, including:

- **Spintronics:** ranked first in the world, initiatives led locally (IRS Spintronics Research Initiative) and in Europe (Spintronics Factory).
- **Nanophotonics:** unique photon sources, infra-red and visible sources; ranked first in the world for optoelectronic integration; two NanoSaclay LabEx Flagships; strong links with quantum technologies and engineering generally.
- **Nanomaterials:** a very large community working on the development and functionalization of nanoparticles, two-dimensional materials and thin layers.
- **Physics and surface functionalization:** SOLEIL synchrotron plays a key role.

## Optics

A large community that benefits all of physics research at Université Paris-Saclay, in quantum optics, imaging, laser science, sensors and materials science. Close ties with the business world.

## Correlated quantum systems

"More is better" is the motto for this area of research, where the multiple interactions among components, frustration, chaos and topology can lead to new properties of matter.

## Topological properties of matter

Area of research currently undergoing rapid development

## Quantum engineering

The Paris-Saclay scientific community is very active in "condensed matter", "diluted matter" and "optical" systems and is developing numerous initiatives locally (IRS IQUPS, PALM LabEx, SIRTEQ), nationally, and in Europe (Quantum Technologies Flagship). Close link with engineering (EOE)

## Materials

A very large community working on the development and physical characterization of all materials systems, including metals, semiconductors, insulators, glass, hybrid materials.

## Complex systems and matter

- A large community working on statistical physics studies multiple-component systems with a high degree of organization.
- Many interfaces with life sciences.
- The PALM LabEx hosts a large part of this community.
- Excellent interaction between experiments and theory.

## Neutral and ionized diluted matter

A unique grouping in France and Europe, resulting from the organization of several distinct communities and benefiting from key facilities (SOLEIL, ultra-short laser pulses)

## Extreme light

- Topics studied: very high intensity electromagnetic fields, ultra-short pulses, non-equilibrium diluted matter, non-equilibrium condensed matter.
- Key initiatives led in Europe, and further afield.
- Availability of extensive facilities and effective organization, with notably two EquipEx (CILEX-Apollon, ATTOlab), the Université Paris-Sud Laser Center (CLUPS), the LUMAT Federation, local LaserLab Europe hubs.
- Significant potential for applications (chemistry, physics, life sciences, across disciplines) and close ties with industry.

# INTER-DEPARTMENTAL PROJECTS

## Physics of living matter

- Active matter
- Assembly
- Environmental impact

## Physics of origins

- Self-replicating sustainable systems
- Emergence of life
- Artificial life

## Emergence of consciousness and artificial intelligence

Concepts and physical tools applied to healthcare, diagnostics and therapy

## Bioinspired technology, neuromorphic technology

## Networks and interactions

- Application of statistical physics to the environment, ecosystems and human activity
- Socio-technical systems
- Energy networks
- Information and communication networks and technology

## Physics of the Earth system and of climate, planetology and astrophysics

## Chemical physics and reactivity in gas state and on aggregates/nanoparticles/surfaces, nucleation and combustion processes

## Energy materials and processes

- Conversion and storage

## Electronic and optoelectronic materials, nanomaterials

## Sensors and applications

## TECHNOLOGY TRANSFER

- 350 patents and 10 start-ups created in the past 10 years via the NanoSaclay consortium
- The Air-Liquide / Université Paris-Sud "Another kind of physics" Chair ("La Physique autrement" - LPS)

