

# PhD Proposal in the PICSEL team :

## New generation of CMOS pixel sensors for future colliders

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*Summary: The main scientific goal of the PhD will be to contribute to the R&D, the realization and the tests of a large scale prototype of a **CMOS pixel sensor** to detect charged particles in order to build beam telescopes and to use it in various applications. Indeed, this prototype will allow obtaining the state of the art of a granular CMOS large size sensor and reaching unprecedented performances that will make this sensor a demonstrator for inner tracking systems for future colliders.*

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The PhD will be welcomed by the PICSEL team (Physics with Integrated Cmos Sensors and ELection machines) which works closely with the microelectronic platform C4PI of IPHC. Together, they've been proposing, designing and testing CMOS pixel sensors since 1999. In the last 20 years, they played a pioneer role in using this technology in subatomic physics. The PICSEL group has been engaged in a long term effort to equip vertex detectors in e+e- machines with CMOS pixels sensors, and in particular in the future Higgs factory (FCCee, ILC, etc.), considered as the highest priority next collider beyond LHC. Historically, the PICSEL group has been involved in the ILC project and is now working also in the FCCee context. Today the CMOS sensor technology is widely used in High Energy Physics experiments. Nevertheless, the CMOS technology has not yet reached its full potential in terms of detector performances. That's the reason why a very active R&D will be pursued in the coming decade.

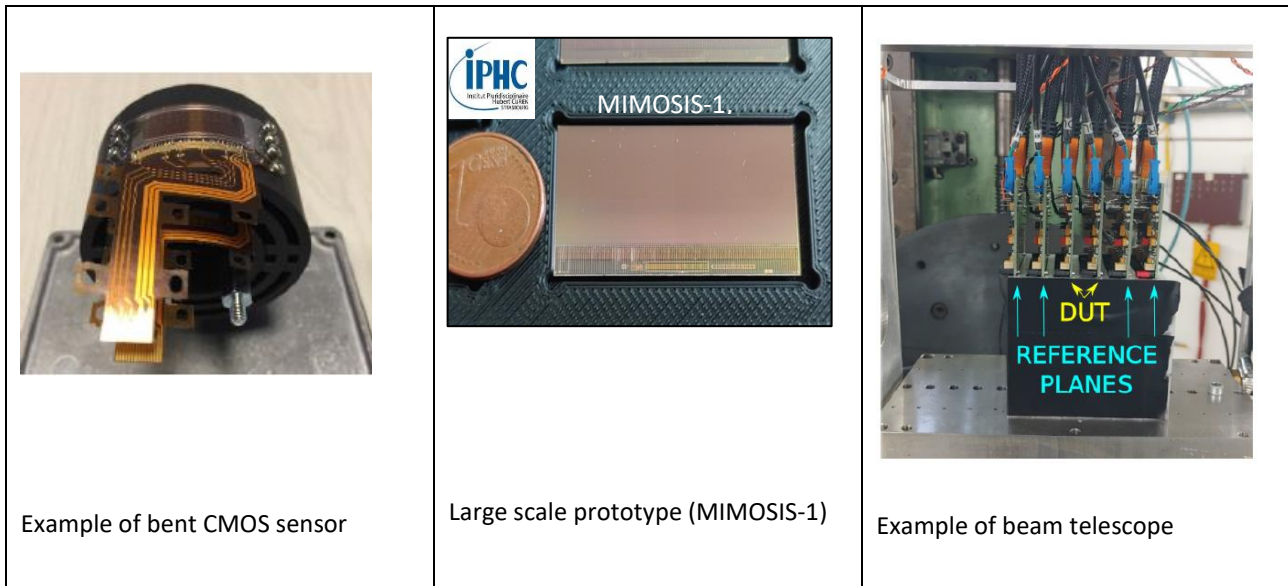
Recently, the detector R&D community started to organize under the supervision of the [ECFA Detector R&D roadmap](#) in order to build R&D collaborations (like the Task Force 3 for solid state detectors) targeting the development of detectors in line with the European Strategy in Particle Physics. One possible goal of the Task Force 3 could be to realize a large scale CMOS sensor prototype considered as a demonstrator for future colliders.

The PICSEL team and the C4PI platform are engaged in a very ambitious program of R&D both in the long term and in short/mid-term applications (such as the Belle-II upgrade and ALICE ITS-3 programs). Therefore, they will naturally participate to the European R&D effort through the task force 3. The goal will be to reach unprecedented

combined performances in spatial and time resolution, controlled power consumption and a high data flow management capability.

In addition to this effort, the PhD student will be involved in different aspects of the generic R&D pursued at IPHC such as:

- CMOS 65 nm feature size technology R&D:
  - ✓ Prototype tests with Beam test analysis,
  - ✓ Test on low power and new read-out architectures.
- Bent sensors and Stitching R&D:
  - ✓ Bent sensor performances,
  - ✓ Material budget optimisation.
- Integration R&D:
  - ✓ Ladder prototypes,
  - ✓ Power scheme & cooling.
  - ✓ Connectors, wireless sensors, etc.
  - ✓ Low material and compact beam telescope demonstrator.



At the end of the PHD, the student will have covered a wide range of activities and therefore developed a various range of skills in silicon detectors. At IPHC, he will benefit from a privileged environment gathering a unique and world class range of expertise in CMOS sensors R&D.