Simulations and physics analysis with c-quarks final states for a vertex detector optimization at the International Linear Collider (ILC).

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The thesis will be welcomed by the PICSEL group (*Physics with Integrated Cmos Sensors and ELectron 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 for charged particle detection. The PICSEL group is engaged in a long term effort in order to equip the **vertex detectors of experiments in future electron-positron** (e^+e^-) machines with CMOS pixels sensors, and in particular in the future International Linear Collider (ILC) expected to start in the beginning of the 2030s. The ILC will run with a center of mass energy of sqrt(s) = 250 GeV and could be upgraded up to 1 TeV in a subsequent phase. The physics program of the ILC will cover a wide spectrum, including **studying the Higgs boson and measuring its properties very precisely** but also top physics, electroweak physics and searches beyond the Standard Model. The expected precision of the measurements in the Higgs sector will be typically at the per mil level, improving significantly the HL-LHC measurements. This will allow to constrain or exclude unambiguously the different theories beyond the Standard Model.

To accomplish this ambitious program, the foreseen detectors will have to reach unprecedented performances. The vertex detector, possibly equipped with CMOS pixels sensors, will play a crucial role to tag heavy flavour particles (b and c quarks, tau leptons), to allow jet charge measurements and to reconstruct low momentum tracks with a high efficiency. The c-tagging capability is therefore an excellent benchmark for this detector.The vertex detector requirements are well established. However a fine optimization remains to be done and can only be performed thanks to a complete physics analysis where the vertex detector plays a prominent role, like in analysis where the final states contains c-quarks. Therfore, **the main goal of the PhD will be to perform a complete physics analysis using full simulation tools which will allow to optimize the vertex detector.** To do so, the student will have first to characterize the performances of the vertex detector by using dedicated analytical tools and simulation softwares. The student will then set up and tune the heavy flavour tagging softwares in order to finally perform a complete physics analysis with c-quarks final states using the full simulation tools of ILC. The student might also perform comparative studies between different Higgs factories (ILC, FCCee, CLIC, etc.). Short visits in foreign labs to work with our international collaborators may be planned (DESY in Germany, Japan, etc.). The student will have to present his work regularly in international conferences and workshops. In addition, the student will be able to participate to the R&D effort on CMOS pixels sensors through beam test campaigns and beam test data analysis complementing perfectly his thesis with a hardware component.