Search for Dark Matter and New Physics in the top quark sector with the ATLAS experiment of the LHC

Research Project / Research Group Description:
The IFIC ATLAS Silicon group participates in the operation and physics exploitation of the ATLAS experiment of the Large Hadron Collider (LHC), being at the same time deeply involved in the R&D silicon detector developments towards the High Luminosity upgrade of the LHC.

The IFIC ATLAS Silicon group consists of 7 seniors, 3 postdocs and 6 PhD students and has a close collaboration with the IFIC theory department for what concerns physics analysis and with the Barcelona Institute of Microelectronics CNM for what concerns silicon R&D.

The group has important responsibilities in the current ATLAS Semiconductor Tracker, the Inner Detector alignment and R&D for silicon tracking devices. It is also fully engaged in data analyses, with a main interest in top quark physics and searches for new physics phenomena including supersymmetry.

The project proposed here will focus on searches for new physics in the top quark sector. Related with this topic, the group has taken important coordination responsibilities at both ATLAS and LHC levels, as: Convening the ATLAS Top Physics group and the LHC Top Working group.

Job position description:
The nature of the dark sector of the Universe constitutes one of the major mysteries in fundamental physics. After successfully finding the Higgs boson in 2012, the LHC has turned its attention to the hunt for dark matter. Dark matter is so named because it does not emit or absorb light -- or any other electromagnetic radiation. Its presence is inferred by how its gravity impacts stars, galaxies, dust and other visible matter.

During the first run period of the LHC, the IFIC group has led and pioneered various top quark precision measurements sensitive to new physics effects. The group had a significant contribution to the measurement of the top quark mass, as well as in the measurement of the top quark pair production cross section with tau leptons in the final state, especially sensitive to the presence of new particles such as a charged Higgs boson. The group has also led in ATLAS measurements of the top quark and W boson polarisation observables, sensitive to possible anomalous couplings in the Wtb vertex, using t-channel single top quark produced events. Such measurements are sensitive to CP violation effects in the top sector.

The data from the second data taking period of the LHC at an unprecedented center-of-mass energy of 13 TeV allows to explore a new energy territory. Therefore, in addition to performing high precision measurements of the top quark production and decays, direct searches for dark matter and exotic physics are particularly attractive.

In this context, the project will focus on the search for dark matter candidates in associated production with top quarks. In this way we take profit of the extensive knowledge of the group on the subject and using promising and interesting discovery channels involving this quark. These analyses with LHC data are complementary to those performed with dark matter

"la Caixa" Foundation
IFIC INSTITUT DE FÍSICA CORPUSCULAR
EXCELENCIA SEVERO OCHOA
This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No. 713673.

dedicated experiments as LUX, COGENT or CDMS, and will profit from the energy and luminosity increased of the second LHC data taking period.

Group Leader: Carmen García García
Carmen.Garcia@ific.uv.es
Research project/Research Group website
https://ific.uv.es/sct/

"la Caixa" Foundation

IFIC INSTITUT DE FÍSICA CORPUSCULAR

EXCELENCIA SEVERO OCHOA

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No. 713673.