

Search for new physics phenomena with the ATLAS and MoEDAL experiments at the LHC

Research Project / Research Group Description:

The subject of the thesis involves the ATLAS and MoEDAL experiments currently in operation at the Large Hadron Collider (LHC) at CERN, an international laboratory situated in Geneva. The PhD student will be part of the IFIC ATLAS and MoEDAL groups, both particularly active in data analysis and operation. She/he will be incorporated into the project for new physics in high-energy-physics colliders, which has made strong contributions to searches for physics beyond the Standard Model and to studies of the top quark. In addition, it is deeply involved in the international effort to construct a highenergy, linear electron-positron collider.

The group is fully engaged in searches for supersymmetry (SUSY), having pioneered the searches for SUSY with R-parity violation in ATLAS and in particular for models with implications for neutrino physics. It is also involved in various lepton-based searches, some with challenging signatures. In MoEDAL, it leads studies for highly-ionising supersymmetric partners.

IFIC has been one of the founding institutes of the MoEDAL Collaboration with leading theoretical, phenomenological and experimental contributions on the exploration of magnetic monopoles. The participation of several theorists from the University of Valencia represents provides added value to the purely experimental aspects, such as the simulation software. IFIC plays a leading role in the MoEDAL management by holding the Chair of the Collaboration Board.

The group collaborates with several theoretical physics groups, proposing new signatures and models to test in LHC experiments and strengthening the interpretation of experimental results, in yet unconstrained theoretical scenarios. The project activities are funded through the Spanish National Programme for Particle Physics; several EU projects; the regional government of Valencia via PROMETEO Excellence Grants and a specific grant for MoEDAL; and the Excellence Programme "Severo Ochoa".

Job position description:

Supersymmetry (SUSY) is a theoretical framework providing answers in an elegant manner to several open issues, such as the hierarchy problem, the nature of dark matter and the grand unification. It is in the forefront of the physics goals of the Large Hadron Collider (LHC) operating at CERN at the highest collision energy achieved so far. Both ATLAS and MoEDAL experiments target these scenarios in a complementary manner: the former as a general-purpose experiment and the latter as a dedicated to highlyionising particles detector.

The existence of a magnetic charge in Nature would be sufficient to explain the quantisation of the electric charge. Magnetic monopoles are predicted in certain theories and such solutions would restore a dual electric-magnetic symmetry to the laws of electromagnetism. The search for monopoles is one of the main objectives of the MoEDAL experiment.

The fellowship will focus on analysis from (already collected) LHC Run-2 data and future Run-3 data taking. The successful candidate is expected to have a strong involvement in the following research topics, besides his/her contribution to the ATLAS operations:

- SUSY searches with ATLAS data with emphasis to R-parity violating scenarios and long-lived particles with possibility to collaborate with theorists on related phenomenological studies.
- Contributions to the MoEDAL experiment at the LHC, including software development, physics simulation and data analysis.

The dual involvement in a large (ATLAS) and a smaller (MoEDAL) experiment will be beneficial for the student's education and future professional prospects, providing him experience in a complex detector and complete understanding of a stand-alone project, respectively. Prior knowledge of C++/Python programming and HEP common software, such as ROOT, would be desirable.

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Research project/Research Group website

<http://webific.ific.uv.es/web/altasenergias>