SCIENCES & BIOENGINEERING SCIENCES

The Research Group

Elementary Particle Physics

has the honor to invite you to the public defense of the PhD thesis of

Dominic SMITH

to obtain the degree of Doctor of Sciences

Joint PhD with University of Bristol

Title of the PhD thesis:

Search for new physics in sqrt(s)= 13 TeV proton-proton collisions, using jet substructure techniques with the CMS detector at the LHC

Promotors:

Prof. Dr. Freya Blekman
Prof. Dr. Henning Flaecher (Univ. of Bristol)

The defense will take place on

Tuesday January 30 2018 at 16:00 h

in Auditorium D.2.01 at the campus Humanities, Sciences and Engineering of the Vrije Universiteit Brussel, Pleinlaan 2 - 1050 Elsene, and will be followed by a reception.

Members of the jury:

Prof. Dr. Steven Lowette (chairman)
Prof. Dr. Jaap Velthuis
Prof. Dr. Filip Moortgat (CERN en UGent)
Prof. Dr. Victoria Martin (Univ. of Edinburgh)

Curriculum vitae

Dominic Smith obtained his Masters degree at the University of Glasgow in 2013 and subsequently started his joint PhD at the University of Bristol, before concluding at the VUB. He has numerous contributions to the detector, including an important contribution to the Level 1 trigger, while at CERN, and to an analysis searching for signatures of new physics in jets+MET final states. In this analysis he focused on the use of jet substructure techniques as a means to enhance sensitivity. The analysis has led to several publications in international peer reviewed journals.

Abstract of the PhD research

The Standard Model of Particle Physics has been a hugely successful and influential model, used to describe the fundamental particles that govern our universe. Where it succeeds in its beauty, it fails in explaining certain phenomena. Such shortcomings, to name a few, address the composition of dark matter, a mysterious entity whose presence is only inferred from observation, the inclusion of gravity with respect to the other known forces, and why the mass of the Higgs boson is much lighter than what was theoretically predicted.
This thesis focuses on a search for signatures of new physics, using data obtained at the CMS detector at the LHC, CERN. Of the plethora of theoretical extensions to the SM, Supersymmetry (SUSY) has been most sought. At its core, each particle from one group in the SM has an associated superpartner that differs from its original partner by a half-integer of spin. As these proposed particles are unknown, they can acquire large masses and yield final states with highly energetic particles. The reconstruction of such particles can often be complicated, yet the ability to detangle such topologies provides strong discrimination between signatures of new physics and physics associated to the SM. In this thesis, the use of jet substructure techniques, as a means to tag jets from boosted particles decays, has been employed.
The results are found to be compatible with the expected contributions from Standard Model processes, and from which are interpreted in the context of supersymmetric simplified models, and a dark matter mediated simplified model. While no sign of new physics processes has been observed, the use of jet substructure techniques demonstrates a gain in sensitivity in the exclusions limits and underlines the potential for future analyses.