Final report

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Name of the recipient (Institution): Yale University

Project Title: Search for new phenomena in tt events with large missing

transverse momentum

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Abstract:
The ATLAS Run I data as provided by CERN's LHC has been systematically searched for the presence of supersymmetric partners of the top quark (stops) using the identification of charm-flavored jets and boosted top tagging. No signs of stop could be established yet.

Keywords: LHC, ATLAS, Supersymmetry, Stop

Report:

Finding signs of new phenomena is the most important goal of the ATLAS experiment at CERN's LHC. The search for stops is among the most promising ways to achieve this goal. I have established with my research group dedicated techniques to optimize the search for stops. Building on existing algorithms to identify b-flavored jets (so-called b-tagging) I designed a first dedicated algorithm at a hadron collider to identify charm-flavored jets (so-called c-tagging). I pioneered Deep Learning over the last two years within ATLAS and optimized and successfully applied it to design a generic jet-flavor tagger (separation of b-, c- and light-flavor jets) which has already been adopted by the ATLAS flavor-tagging group and which outperforms previous flavor-taggers in efficiency vs. rejection, speed and memory consumption. Preliminary studies show that the current data-driven calibration approaches for flavor-tagging also work for taggers which use Deep Learning.

Top-tagging refers to the identification of high-pT 'boosted' top quarks through the substructure analysis of three-prong hadronic top decays (t -> Wb -> qq′b) using large calorimeter jets, the so-called 'fat jets'. It has been pioneered in the ATLAS Top-Exotics sub-group that I convened for two years and where I gained

a lot of expertise. In addition, my research group contributed to top-tagging performance studies.

Both c-tagging and top-tagging is crucial for my ongoing searches for stop where the stop decays to a charm-jet and the Lightest Supersymmetric Particle (LSP), or to a top-quark and the LSP, respectively. Further journal publications for both stop hypotheses are imminent.

Publications:

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2. K. Agashe et al., "Snowmass 2013 Top quark working group report," arXiv:1311.2028 [hep-ph] (2013).

3. K. Agashe et al., "New Particles Working Group Report of the Snowmass 2013 Community Summer Study," arXiv:1311.0299 [hep-ex] (2013).

4. C, Delaunay, T, Golling, G, Perez, Y, Soreq, "Enhanced Higgs boson coupling to charm pairs," Phys. Rev. D 89, 033014, arXiv:1310.7029 [hep-ph] (2014).

5. T. Cohen, T. Golling, M. Hance, A. Henrichs, K. Howe, J. Loyal, S. Padhi and J. G. Wacker, "A Comparison of Future Proton Colliders Using SUSY Simplified Models: A Snowmass Whitepaper," arXiv:1310.0077 [hep-ph].

6. K. Agashe, O. Antipin, M. Backovic, A. Effron, A. Emerman, J. Erdmann, T. Golling and S. Gopalakrishna et al., "Warped Extra Dimensional Benchmarks for Snowmass 2013," arXiv:1309.7847 [hep-ph].

7. T. Golling [ATLAS and CMS Collaborations], "LHC searches for physics beyond the Standard Model with top quarks," J. Phys. Conf. Ser. 452, 012010 (2013) [arXiv:1302.0295 [hep-ex]].

8. F. Garberson and T. Golling, "Generalization of exotic quark searches," Phys. Rev. D 87, 072007 (2013) [arXiv:1301.4454 [hep-ex]].

9. ATLAS Collaboration, "Search for pair production of massive particles decaying into three quarks with the ATLAS detector in ps = 7 TeV pp collisions at the LHC," JHEP 1212, 086 (2012) [arXiv:1210.4813 [hep-ex]].

10. ATLAS Collaboration, "Search for a supersymmetric partner to the top quark in final states with jets and missing transverse momentum at ps = 7 TeV with the ATLAS detector," Phys. Rev. Lett. 109, 211802 (2012) [arXiv:1208.1447 [hep-ex]].

11. ATLAS Collaboration, “Search for direct top squark pair production in final states with one isolated lepton, jets, and missing transverse momentum in ps = 7 TeV pp collisions using 4.7 fb−1 of ATLAS data,” Phys. Rev. Lett. 109, 211803 (2012) [arXiv:1208.2590 [hep-ex]].