Contribution ID: **29** Type: **not specified**

Search for long-lived neutral particles that decay into displaced jets in the ATLAS detector

Monday 8 April 2019 14:00 (15 minutes)

Long-lived particles feature in many extensions to the Standard Model that have been proposed to address some of its open questions. Decays of long-lived particles created in collider experiments would produce unique signatures that may have been overlooked by previous searches for promptly decaying particles.

A search for pairs of neutral long-lived particles (LLPs) decaying in the volume of the ATLAS detector (mainly in the hadronic calorimeter) is presented, which probes LLP decay lengths ranging between a few centimetres and a few tens of metres. The analysis uses a simplified Hidden Sector model as a benchmark, where scalar LLPs are pair-produced from decays of heavy bosons, and eventually decay to SM fermions (mainly b-quarks). If this decay occurs in the calorimeters, the two resulting fermions are reconstructed as a single displaced jet with unusual features compared to jets from SM processes. A series of machine learning techniques were employed to identify the displaced jets and reduce the contamination from background in the search region. A data-driven estimate of the remaining background was performed and limits were set on the production cross section times branching ratio, extrapolated as a function of the decay length of the LLPs. These are presented combined with limits from a search which looks for displaced jets in the ATLAS muon spectrometer.

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Session Classification: Parallel stream 2