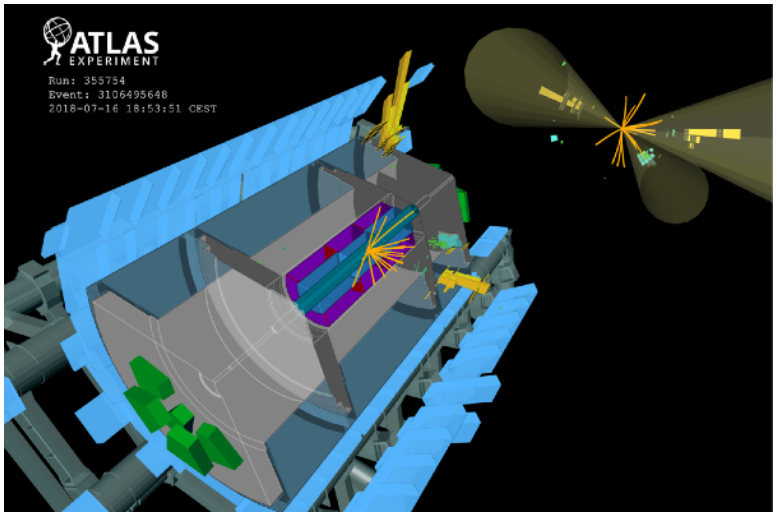
Searching for long-lived particles associated to top quarks with the ATLAS detector at the LHC



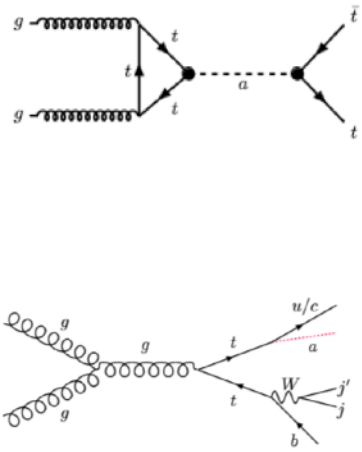


Figure: a visualisation of a candidate long-lived particle collision event in ATLAS data collected in July 2018, and some examples of diagrams where a LLP (*a*) is produced in association with a top quark or decays into a pair of top quarks. If the *a* is sufficiently long-lived the decay would be missed by standard reconstruction techniques.

Exotic long-lived particles (LLPs) appear in many well-motivated extensions of the Standard Model (SM) of particle physics, and could explain the nature of dark matter (DM), solve the hierarchy problem and explain neutrino masses. However, LLPs may have been missed by the traditional Large Hadron Collider (LHC) search programme, due to their energy deposition characteristics that would often be rejected by standard reconstruction techniques. LLP signatures could be hiding in a 'blind spot' of the LHC! The search for these unusual signatures could be a new route to a revolutionary discovery. The subject of this topic will be to help prototype a search for LLPs with the ATLAS data from Run 3 of the LHC. In particular, the student will work on the search for an LLP that produces displaced activity in the ATLAS calorimeters, either disintegrating into a top quark or produced in association with a top quark. The student will help to develop analysis software for LLP searches with Run 3 data, and could help to define machine-learning strategies tailored to quark decays of long-lived particles, as part of the ATLAS team at the Laboratoire de Physique de Clermont Auvergne (LPCA).

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