Overlap Removal at the ATLAS Experiment

E. Ting[a]

[a]*Department of Physics, The University of Adelaide, Adelaide, South Australia 5005, Australia.*

ATLAS is a general-purpose particle detector that aims to constrain the Standard Model (SM) and probe for signs of physics beyond the SM by utilising CERN's Large Hadron Collider (LHC) facility. High-energy proton-proton (pp) collisions occur at the centrepoint of the detector, and on the occassion that a hard-scatter interaction occurs, the resulting products subsequently propagate through and interact with various detector subsystems depending on the properties of the particle produced. Based on the signatures measured within the detector systems, the type of particle can then be inferred by means of reconstruction algorithms that are optimised for the measurement of each given particle.

In ATLAS, these reconstruction algorithms are studied by dedicated working groups. As such (with the exception of photons and electrons that oft intertwine), the reconstruction of physics objects within the detector is performed largely independently of one another. Ambiguity in the expected signature left by particles in the detector can then lead to a double-counting of signals for the definition of multiple physics objects; for example, charged particle tracks within the ATLAS inner tracking volume, accompanied by energy deposits within the calorimeters, could be interpreted as a signature of both an electron and of a hadronic jet. This could be due to a mis-identification of one of these objects (duplication); or it could be that particles have been produced in close vicinity (non-isolation), in which case the reconstruction of one or both of them could be biased.

Overlap removal is an integral step of all ATLAS analyses that vetoes physics objects in the event of such reconstruction ambiguities. In analyses of Run 2 data, this was done using the geometric proximity (ΔR) between reconstructed objects as a means of identifying and discriminating between cases of overlap. A recent development within the ATLAS core software is the implementation of Global Particle Flow (GPF) links between jet constituents and physics objects that share a common detector element (track or calorimenter cluster) with those constituents. These links offer a cleaner alternative for implementing jet–object overlap removal: one can explicitly check if double-counting of energy has occurred by looking for shared detector signals between physics objects, and if found, implement a set of criteria for deciding which of those objects should be vetoed.

Options for implementing overlap removal between jets and physics objects using GPF links will be discussed, and studies of their performance as compared to ΔR-based methods will be presented.