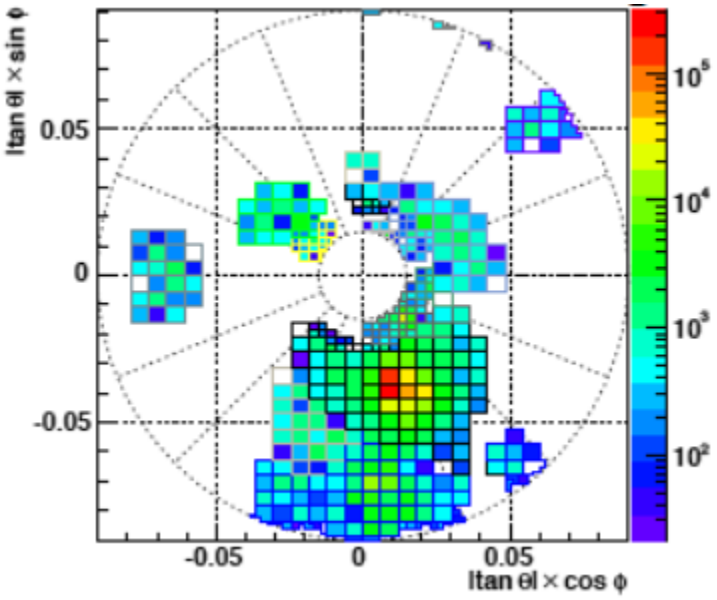
Density-based jet reconstruction

The analysis of hadronic final states at the LHC requires the reconstruction of "jets": clusters of energy in the calorimeter produced by the hadronization of quarks and gluons.

The first step, prior the reconstruction of jets, is to reject isolated calorimeter cells to suppress fake signals from electronic noise. Noise suppression is a crucial aspect of calorimeter jet reconstruction as it greatly determines the ultimate energy resolution that can be achieved for physics, and the sensitivity to detector effects, and calibration.

ATLAS has developed a topological noise suppression algorithm (similar to techniques used in the D0 and H1 experiments), based on energy thresholds. This technique is very effective in the current ATLAS simulation, but requires a precise knowledge of the noise distribution (mean and shape), cell-by-cell, which will be extremely challenging with the varying detector conditions expected at the LHC. An example of cells left after topological noise suppression is shown in the next figure:



This project consist of the development and implementation of an alternative noise suppression technique based on energy-density rather than absolute energy to select calorimeter cells. This is a novel idea, proposed originally for the Intenational Linear Collider Detector. This method has not only the potential to improve the jet energy resolution, but it can also provide an alternative jet reconstruction scheme to validate and cross check results with early data.

The first step is to study different calorimeter density definitions in randomly triggered events (noise only events) and simulated multi-jet events, and to determine an optimal criteria for calorimeter signal selection based on density. The second step is to study the physics performance of density-based jet algorithms and compare them with the standard jet energy reconstruction in ATLAS. Future applications inlcude the development of cluster-level density-based clustering methods for jet sub-structure analysis and calibration.