The Level 1 Jet Trigger for ATLAS and a Preliminary Study of R-Parity violating Supersymmetry

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Synopsis

This thesis covers work carried out by the author as part of the Level-1 Calorimeter Trigger Group for ATLAS. ATLAS (A Toroidal LHC ApparatuS) is a general purpose particle physics experiment currently being developed for use in the Large Hadron Collider (LHC) which is due to begin taking data in 2005.

Three main areas are discussed reflecting the author's main contributions.

- A range of potential jet trigger algorithms were investigated using a Monte Carlo simulation with a parameterised detector response. The performance of a number of algorithms was studied for single and multi-jet events for a range of physics processes. The baseline solution proposed in the ATLAS Technical Proposal was found to have a significantly degraded performance for multi-jet events and was discarded; two other candidate algorithms were found to provide an incorrect multiplicity count and were also discarded. The set of algorithms that gave the best performance now forms the current proposal; their overall performance was measured and the trigger efficiency for a realistic trigger rate given.

- The architecture of the Level-1 demonstrator system is described, and its performance in the September 1997 test beam discussed.

- Supersymmetry in the framework of the SUGRA model was studied in the case where explicit R_P violation causes the lightest supersymmetric particle to decay. Two decay modes

were considered: $\chi_1^0 \rightarrow eud$, and $\chi_1^0 \rightarrow \nu_e d\bar{d}$. The ability of ATLAS both to isolate an inclusive supersymmetric signal and to make precision measurements of the particle masses in this scenario was investigated using ATLFAST to model the expected performance of the ATLAS detector. It was found that ATLAS would be able to isolate an inclusive signal within the first year of low luminosity running for both scenarios, and in the case of charged lepton decays it was demonstrated that the masses of a complete decay chain could be directly reconstructed and used to constrain the parameters of the SUGRA model. In the case of neutral lepton decays precision measurements are more problematic and this is flagged as a potentially troublesome scenario for ATLAS.