Proposition stage M2 / thèse

Development and use of ultra-granular calorimetry at future collider experiments

Développement et exploitation de la calorimétrie ultra-granulaire pour des futurs accélerateurs

The next particle accelerator at the high energy limit is likely to be a lepton collider running at centre-of-mass energies around 1 TeV (e.g. ILC, CLIC). Such a machine will bring unprecedented precision to the measurement of particle physics at the tera-scale, for example the properties of the postulated Higgs bosons and supersymmetric particles.

Studies are underway to develop detectors which will record the products of the particle collisions at such an accelerator. Recent advances in technology, particularly in the field of micro-electronics, allow significant advances in the construction of these detectors.

The CALICE/ILC group at LLR is developing ultra-granular calorimeters to be used at future particle colliders. These will have a readout granularity several orders of magnitude finer than those of current-day detectors, allowing the optimal use of Particle Flow (PF) reconstruction techniques. PF promises to give significant improvements in the measurement of the results of particle collisions, in particular of hadronic final states.

The LLR group studies both the technical realisation of such calorimeters, including the design, construction and testing of prototype detectors and their associated data acquisition systems, and the PF reconstruction algorithms which can be used to best treat the information recorded by the calorimeters.

A first generation electromagnetic calorimeter has been tested in particle beams over the last few years. A second generation prototype, with several important improvements in design, is presently under development.

Subject of stage

Analysis of data collected by the 1st generation prototype electromagnetic calorimeter at Fermilab in 2011.

Subject of thèse

- Participation in and data analysis of test beam campaigns of 2nd generation ECAL prototype. First tests of a small system are planned for 2012, with large-scale tests forseen in 2013.

- Development of calorimeter reconstruction algorithms for Particle Flow. Dedicated pattern recognition algorithms are required to make the most of the very detailed information provided by the calorimeter detectors. These will be studied both in simulations of a complete detector, and in real data collected in test beams.
- Studies of the potential for physics measurements at a future collider. Numerous studies are possible, according to the wishes of the student. For example, measurement of Higgs boson couplings, tau lepton identification, search for supersymmetric particles...

Regular travel both inside and outside France will be required: CERN (Geneva) and/or DESY (Hamburg) for beam tests, as well as for regular meetings of the CALICE and ILC communities (typically in Asia, US, and Europe).

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