FCPPL-CSC PhD proposal - 2015

Thesis title: Upgrade of the ATLAS Calorimeter and of its trigger system with high end readout.

Type of proposed PhD diploma: French□ Chinese □ French & Chinese X (tick correct answer)

French host laboratory: ***CPPM –Centre for Particle Physics Marseille***

Chinese laboratory (if applicable): IHEP,USTC,NANGING University, Shandong University…

Thesis advisor(s) and email(s): E. Monnier – monnier@cppm.in2p3.fr

Planned date of start of stay in French lab: Fall 2015

Planned duration of stay in French lab (months): 36 months

Expected date of thesis defense: fall 2018

Detailed description of the thesis subject:

The Large Hadron Collider (LHC) at CERN is today the only energy frontier machine in the world. ATLAS is one of the two general purpose experiments installed at the LHC that discovered in 2012 a Higgs boson, key piece for the understanding of the fundamental interactions and the origin of elementary particle mass. Its physics program extends beyond Higgs property measurements to the search for signs of physics beyond the Standard Model of particle physics.

In 2015, the LHC will restart its data taking at the new record 13 TeV center of mass energy. The record energy and high luminosity provided in the next three years will allow precise studies of the Higgs boson and its coupling properties in particular through multiboson final states or ttH final states. These key measurements, would allow confirming that the observed boson is the Standard Model Higgs boson, or could reveal New Physics. This scientific program will then be drastically increased by a major upgrade of the LHC that will be performed in the years to come combined to an equivalent upgrarde of the ATLAS detector and more particularly its calorimeter and trigger system.

CPPM and its ATLAS team is strongly involved in this scientific program. CPPM has contributed to the LAr Calorimeter design and construction as well as its operation and is now involved in its upgrade. CPPM has major responsibilities in all these parts as well as in the ATLAS pixel detector. CPPM also contribute heavily in every aspects of the data analysis with major responsibilities in it, being deeply involved in the recent Higgs discovery.

The PhD student will take part in the Upgrade program and is expected to make major contribution in the Liquid Argon (LAr) Calorimeter upgrade program. CPPM team is involved in the development of the caorlimeter trigger readout system. This system is based on high end data treatment electronic boards developed by scientists form sevral institutes including CPPM and based on the latest generation of FPGAs and optical links The thesis will be to contribute to theses electronic development that are above the industrial state of the art standards. A demonstrator will be connected to the ATLAS detector during the 2015 to 2017 data taking campaign allowing for the performance test of developed prototypes and the development and tuning of all the related imbedded firmware. This system readout ~40k channels over 10 Gb/s optical links has to reconstruct and treat the information in less than a few micro seconds for the subsequent trigger steps. The Phd thesis will be to have a major roles in all of theses phase from firmware development to performance assessment as well as demonstrator operation and data analysis leading to a system to be deployed in 2018. This thesis will allow the student to work in an international highly competitive and stimulating scientific environment working with world class engineers and physicists.

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Candidates' requested qualifications: Experimental Physics, Electronics, FPGA, VHDL and advance software skills. Test system….

Tentative timeline of the PhD preparation

In fall 2015 the first prototypes will be available for firmware development and performances tests. These first prototypes will then be connected to a demonstrator on the LAr calorimeter front end electronic allowing advanced data taking and performance tests. In 2016 new prototypes will be developed and tested in the same ATLAS data taking demonstrator framework. Related FPGA firmware and surrounding software infrastructure will be developed and tested in parallel. In 2017, the final module will be produced and commissioned for an installation in 2018 and the global performances of the system will be assessed.

Publications related to the PhD subject:

ATLAS Liquid Argon Calorimeter Phase-I Upgrade Technical Design Report: http://cdsweb.cern.ch/record/1602230

ATLAS web site: http://atlas.ch/