**Overview**

In FY2011 and FY2012 we propose to continue with the development of upgraded electronics for the readout of HCAL based on the microTCA standard adopted by CMS for SLHC. We have developed a partnership with the microTCA hardware manufacturer NAT. We are developing mezzanine boards to provide CMS-specific clock/controls distribution and DAQ functions using an NAT-MCH base board. A block diagram of the baseline back-end layout is shown for reference below.

The “SuperHTR” modules (being developed at University of Minnesota) provide similar functionality to the existing HCAL Trigger and Readout (HTR) cards. The SuperHTR will receive high-speed optical links from legacy or new front-end (FE) circuits.
data from the updated HCAL front-end electronics at a raw rate of 4.8 Gb/sec, time align the data, calculate trigger primitives, and send data on new high-speed optical links to the upgraded CMS calorimeter trigger. DAQ data will be stored on the SuperHTR in response to each level 1 trigger and made available for readout over the microTCA backplane.

The DAQ/Timing/Control module (DTC) is being developed at Boston University. This module provides the following functions:

• MicroTCH hub controller functions (MCH) including Ethernet communication with other modules in the crate, control of power modules, and I2C management interface. This functionality is provided by an NAT MCH base board.

• Timing and Control signal distribution (similar to current TTC fanout in ECAL and HCAL) on mezzanine board

• Data Acquisition over the microTCA backplane, and transmission of DAQ data to either legacy DAQ (SLINK) or new DAQ (optical fiber).

• Trigger rate control via the legacy TTS system or an upgraded trigger controls system.

FY10 Accomplishments

In FY 2010 we are designing and fabricating the first prototype DTC modules. These modules will provide the basic functionality required to operate a system with existing legacy interfaces. The initial DTC consists of two custom mezzanine boards mounted on a commercial MCH base board, providing the CMS-specific required interfaces (TTC, TTS, DAQ).

Our development is guided by evolving standards addressing the needs of the DTC. Of particular interest is the work of the PICMG xTCA for Physics Coordinating Committee. A new working group (WG1: Physics xTCA I/O, Timing and Synchronization) has been formed, and are working closely with this group to ensure that the DTC is to the greatest extent possible compliant with proposed standards. We are also closely following the work on the GBT (giga-bit transceiver) project at CERN which proposes a replacement for the GOL and portions of the TTC system.

On the DAQ side, there is yet little guidance on upgrades. The DTC will have as it's primary DAQ output a 10GbE fiber transceiver, with a separate converter module providing SLINK-64 compatibility.

Personnel

The following Boston University Physics personnel will support these tasks:

James Rohlf (Faculty, P.I.)
Lawrence Sulak (Faculty)
Tulika Bose (Faculty)
Cory Fantasia (Graduate Student)
Michael Dimitriyev (Undergraduate Student)
Personnel from the Electronics Design Facility will perform the engineering tasks (tasks assigned to personnel within the facility by the Director).

**FY2011 and FY2012 Tasks**

**FY 2011 Tasks:**

- Develop a second-generation DTC module
- Develop a DAQ output adapter to provide SLink-64 and TTS outputs
- Produce a modest number of DTC modules for use by CMS collaborators inside and outside HCAL
- Develop and commission DTC firmware for readout of existing HCAL detector
- Develop and commission software to support operation of DTC in existing HCAL xDAQ
- Continue to participate in meetings, workshops and test-beam efforts

**FY 2012 Tasks:**

- Perform a large-scale test of DTC and SuperHTR modules at P5 with live HCAL front-end data.
- Develop a production prototype DTC module with DAQ interface compatible with CMS SLHC DAQ upgrade
- Develop and commission DTC firmware for readout of new HCAL front-ends
- Develop and commission software to support operation of DTC as required
- Continue to participate in meetings, workshops and test-beam efforts

**Proposed Budget**

A proposed budget for FY 2011 and FY2012 at Boston University is provided below. Labor is calculated at the currently effective BU shop rates (subject to change).