

## **Quarknet Summer 2008 Report**

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### **Abstract:**

During the summer of 2008 the Quarknet group performed the following tasks: Prepared Quartz plates for test beam at CERN, constructed a prototype light guide interface for a detector at CERN, built and operated three Cosmic Ray Muon Telescopes (CRMT) from Quarknet, gave a weeklong workshop for 10 teachers and developed a directional detector for use at the LHC at CERN. The group came to Iowa City daily for a period of 7 weeks and worked with other physicists at the Van Allen building. Some time was spent at Fermi Lab during the time of the floods in Iowa City when the University was closed.

### **Quartz plate preparation:**

## 2008 Quarknet Summer Report



The group prepared 20 Quartz plates for test beam at CERN. These plates were coated with p-ter-phenyl at Fermi Lab to increase their Cherenkov light. The group polished the edge of the quartz plate and machined frames to



fit the edge for close contact with a photomultiplier tube (PMT). A “keeper” was formed to hold the plates in the frames. Plastic tubes were glued to the frames to safely mount the PMT’s to the plates and insure they



PMT’s kept optical contact with the plates during the tests. After the plates were mounted in the frames, they were wrapped in Mylar and Tyvec



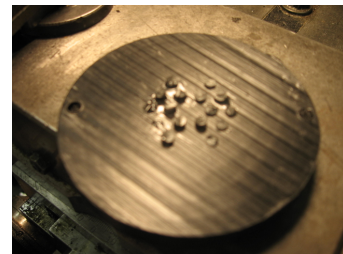
and taped to be light tight. They then went to CERN to be put in the test beam

### Prototype Light Guide:

The barrel calorimeter of CMS at CERN needed to replace their photo-sensors because of a problem with the present ones in the high magnetic fields in that detector. The new photo-sensors needed to connect with the optical fibers in the detector, so an interface was proposed and tested last year by our group. The group in charge of the calorimeter decided on a



model and we were asked to build the prototype. This disk consisted of a Delrin plastic disk with holes filled with plastic light guides. These light

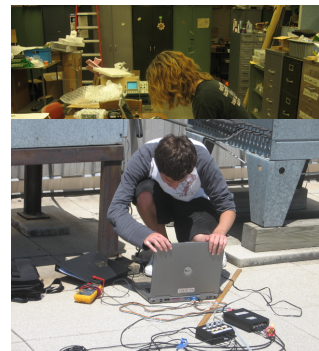


guides had to be in a pattern to match the photo-sensors to the fibers that brought the light from the calorimeter. The Quarknet group machined and polished the “cookie”-like device and delivered it to the detector group for evaluation.

### Cosmic Ray Muon Telescopes (CRMT):



Over the past years, the Quarknet group had obtained and constructed three CRMT’s for use in high-school labs. The first one was primitive and retired in light of the improved ones obtained during the summers of 2006 and 2007. The group never had confidence in the reliability of the data from these devices until this



## 2008 Quarknet Summer Report

summer. We received a fourth scope in 2008 so we constructed that scope which brought our complement of functioning scopes to three. R.E. Peterson from Fermi Lab visited us and showed us how to use the scopes with his e-lab Internet site. We did some experiments in preparation for our weeklong teacher in-service and gained confidence in their use. They became the focus of our institute so our teachers could effectively use the scopes during the year.

### Teacher Institute:

Eight science teachers joined our two lead-teachers during a weeklong institute to share the work of the Quarknet facility at The University of Iowa. The institute began with background information on the Standard Model, accelerators and detectors. The teachers then broke into three groups and did experiments using the three CRMT's and e-lab on the



Internet. We were visited by Ginny Beal, an independent evaluator, Beth

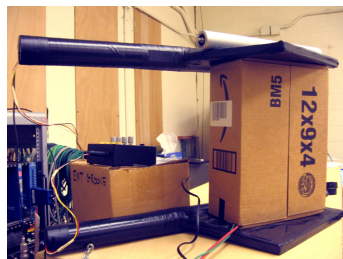


Marchant, Quarknet Director and Steven Grosland, CRMT expert from Fermi lab. The participants successfully posted data, wrote posters and completed an experiment



using the equipment. The institute also featured a trip to Fermi lab for a day of tours and lectures.

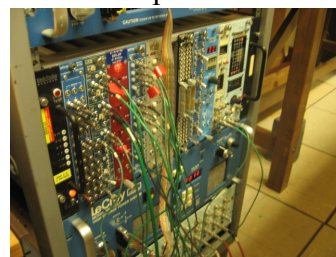
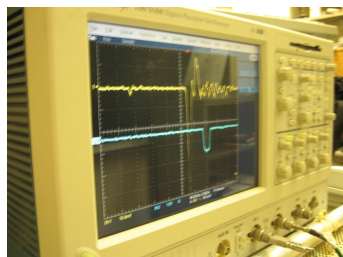
### Development of Directional Detector for LHC:



Dr. Edwin Norbeck proposed a detector for use along the beam line at the Large Hadron Collider (LHC) at CERN. This "Halo" detector would detect the presence of muons



along the beam pipe that would measure background activity that would be fed into the main detectors as noise. This detector would discern the presence of muons and the direction



## 2008 Quarknet Summer Report

they travel before the beams entered the collision point. The Quarknet group assisted Dr. Norbeck in construction and testing of the detector using the counters of the CRMT as muon sensors. Our work with the CRMT enabled us to use cosmic muons as a source of signal for the detector and determine from them that the detector worked as designed and yielded the presence of the muons and their direction in the detector.