European Organization for Nuclear Research
Organisation européenne pour la recherche nucléaire

Steinar Stapnes
steinar.stapnes@cern.ch

Lucie Linssen
lucie.linssen@cern.ch

Harry Weerts
HEP Division
Argonne National Laboratory
USA

Geneva, 22nd June 2012

Tests of the digital HCAL with glass RPC and tungsten absorbers at CERN

Dear Harry,

We are writing to you to give you some feedback on the ongoing beam tests of the glass RPC digital HCAL in a tungsten absorber structure in the CERN PS and SPS test beams.

CERN joined the linear collider physics and detector studies in 2009. At that time ANL had already a strong presence in the ILC physics and detector studies, in particular through its participation in the SiD concept and in the CALICE activities for fine-grained calorimeter R&D. Here at CERN our first large objective was to study the feasibility of performing precision physics measurements at a multi-TeV CLIC e^+e^- collider despite challenging beam-induced background conditions. As the physics objectives for ILC and CLIC are very similar, the best approach was to use the ILC detector concepts and their simulation frameworks as a starting point. This revealed itself to be a very good strategy. The ILC concepts could indeed be adapted in a rather straightforward manner to CLIC. Moreover, this approach offered lots of opportunities for collaboration and synergy between the ILC and CLIC detector studies. The Argonne HEP group has been one of the most prominent partners in this collaborative effort with mutual benefit between the ILC and CLIC detector studies, for example through the preparation of milestone technical reports, like the CLIC CDR and the ILC DBD, and more recently through the calorimeter R&D in a common test beam effort.

Over the past years ANL and other USA partners within CALICE have built a large calorimeter prototype based on >50 glass RPC active planes of ~1m^2 surface and 1 cm^2 readout cells with digital readout. These were assembled in a steel absorber stack to form the Fe-DHCAL, and were successfully tested in test beam campaigns at Fermilab in 2010 and 2011. One of the conclusions of the CLIC study was that a very dense HCAL would be needed in the barrel region to provide full containment for high-energy jets, while limiting the superconducting coil radius in its detector concepts. For this reason, tungsten absorber plates replace the steel absorber plates in the CLIC barrel HCAL. Glass RPC's are a good candidate for the readout of a CLIC HCAL, as they can provide fast signals and as the RPC gas is insensitive to the slow neutron component in the hadronic shower. This provides good opportunities for using signal arrival time as a discriminant against beam-induced background particles. However, it requires confirmation

through extensive hardware tests in a test beam, which then also provides validation of the Geant4 models used in the detector concept simulations.

It was therefore decided to assemble a so-called W-DHCAL, composed of the glass RPC's and tungsten absorber plates, and to test it in the CERN PS and SPS test beams. Therefore >50 glass RPC detectors were transported to CERN and, in a collaborative effort between ANL, CERN and other CALICE partners, assembled to form the W-DHCAL test beam set-up, including beam-defining equipment and tail catcher. So far, the W-DHCAL beam tests have been a great success, following a 2-week test beam campaign in the PS in May 2012 and a 2-week test beam campaign in the SPS in June 2012. A huge data set has been taken, and much was learned about the hardware response and signal formation in tungsten. We particularly appreciate the very active participation of the team from ANL who have spent much time and effort on the preparations, on the actual data taking and on the assessment of the results. The exchanges between the CERN and ANL teams have been very collegial and highly efficient, bringing much added value to both teams. We are looking forward to further beam tests in the summer and to a fruitful collaboration on the detailed analysis and publication of the data. The W-DHCAL tests are a good example of a win-win situation, bringing much added value to both the ILC and CLIC projects.

We very much appreciate the overall collaboration between ANL and CERN on linear collider matters and we are looking forward to a continuation of our common efforts in the coming years.

Prof. Dr. Steinar Stapnes
CERN, DGP
CERN Linear Collider Study leader

Dr. Lucie Linssen
CERN, PH department
CERN Linear Collider Detector project leader