Project name

Study of Resistive Plate Chambers as Active Medium for the HCAL

Classification (accelerator/detector:subsystem)

Detector

Institution(s) and personnel

Argonne National Laboratory: Gary Drake (electronics engineer), José Repond (staff scientist), Rik Yoshida (staff scientist)

Boston University: John Butler (professor), Meenakshi Narain (professor)

University of Chicago: Mark Oreglia (professor) et al., see proposal submitted to NSF

University of Illinois at Champaign – Urbana: Jon Thaler (professor)

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Project Overview

The optimal application of Energy Flow Algorithms for the measurement of hadronic jets requires a finely segmented electro-magnetic and hadronic calorimeter (HCAL). The latter is envisaged to be a sandwich type calorimeter and to contain cells of the order of $1cm^2$, read out separately for each layer. The resulting number of readout channels is approximately $5x10^7$. Detector simulation studies have demonstrated that, given the fine segmentation, the energy resolution is preserved with a digital only readout of the HCAL.

Our aim is to develop an active medium for the HCAL, which is reliable, simple to build, comparatively thin (under 10 mm), and affordable. Resistive Plate Chambers (RPCs) have been utilized in a number of HEP experiments over the past decade and appear to satisfy all of the above requirements. We propose to study the suitability of RPCs as active medium for the HCAL.

Description of project activities

We will initiate a detailed R&D program to evaluate the merits of RPCs as active medium of the HCAL:

1) We will complete the evaluation of a small number of RPCs which we obtained from other experiments.
2) We will construct a small number of test chambers with various

  - glass and gas gap thicknesses
  - resistivity of the layers of ink (distributing the high voltage onto the glass)
  - geometries of the readout pads.
3) We will develop a readout system based on a one-level discriminator. This system will be used to evaluate the different chamber designs and pad geometries.
4) We will test these chambers in a cosmic ray test stand and evaluate their:
  - noise characteristics
  - signal strength versus applied high voltage and for different gas mixtures
  - efficiency for the detection of minimum ionizing particles
  - cross talk between adjacent channels
  - long term stability
5) Following the completion of the above tests, we will design and build a small test section of an (electro-magnetic) calorimeter, approximately 25 cm in all three dimensions. This test section will feature of the order of 10,000 readout channels. The electronic readout system will be based on a custom chip.
6) We will test this calorimeter in particle beams which are available at the major particle physics laboratories, such as DESY and CERN. These tests will be important in verifying the functionality of the chambers and their electronic readout system.
7) Following the successful tests of our small (electro-magnetic) calorimeter, we will design and build a test section of the hadronic calorimeter, sized approximately 1 m^3, which is sufficient to contain hadronic showers both laterally and longitudinally. This calorimeter section will again be subjected to extensive tests in particle beams.

We expect to complete items 1) – 4) in FY 2003, items 5) – 6) in FY 2004 and initiate item 7) in FY 2005.

Budget requests

Institution	Item	FY 2003	FY 2004	FY 2005
Argonne	Summer students, other professionals	$11,000	$55,000	$55,000
Argonne	Materials to build chambers /readout	$2,000	$10,000	$40,000
Boston	Students, other professionals	$0	$11,250	$11,250
Boston	Engineer	$10,000	$10,000	$10,000
Boston	Materials to build chambers / readout	$3,000	$32,500	$62,500
Illinois	Students	$3,000	$3,000	$3,000
Illinois	Engineer / Technician	$0	$10,000	$30,000
All	Travel	$3,000	$10,000	$10,000
Total		$32,000	$141,750	$221,750