

# A Fast Gas Cerenkov Calorimeter for Luminosity Measurement and Machine Monitoring

## Classification (subsystem)

Machine Detector Interface (MDI)

## Personnel and Institution(s) requesting funding

John Hauptman, Sam Ose, Youn Roh, Matt Stemper

Iowa State University, Ames IA 50011

Virgil Barnes, Alvin Laasanena, Abe Spinelli

Purdue University, West Lafayette, IN 47907

## Collaborators

Nural Akchurin Texas Tech University, Lubbock TX 79409

Vladimir Atramentov, NIPT, Kharkov, Ukraine

Thomas Markiewicz, Michael Woods, SLAC, Stanford CA 94025

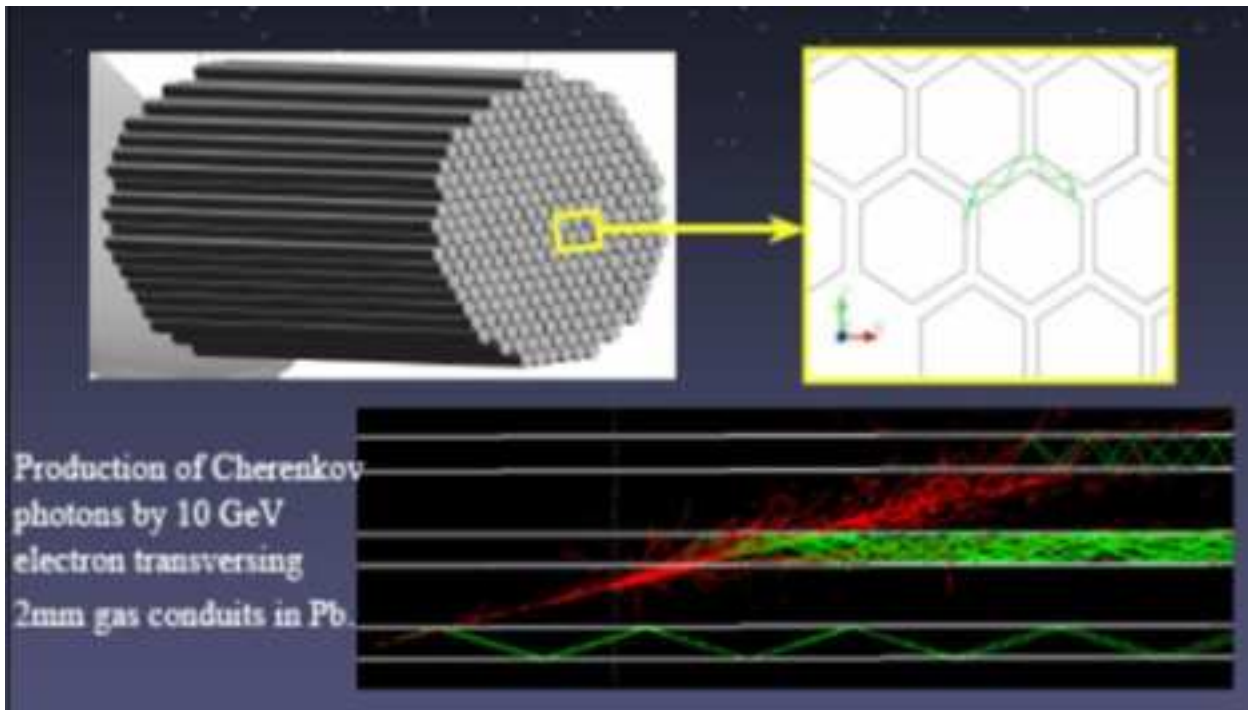
## Project Leader

John Hauptman

hauptman@iastate.edu

515-294-8572

**Project Overview** We have proposed a gas Cerenkov calorimeter for beam luminosity measurement that is emptied of Čerenkov light in about 2 nanoseconds, thus becoming quiescent very soon after the bunches have crossed, that is explicitly radiation hard, and that is completely insensitive to both radioactivation of the calorimeter mass and to  $e^\pm$  and  $\gamma$  IR backgrounds below 10 MeV. A detailed description was given in previous reports in which the main motivation was the 1.4 ns crossing time of the warm machine that is no longer relevant. Nevertheless, a fast and rad-hard detector very near the beams during commissioning of the machine, during physics running for backgrounds assessments, and even as an 'instrumented mask' deep inside 5 mrad may still be a useful device for the Linear Collider. Specifically, this instrument would provide continuous nanosecond measurements of electromagnetic activity during the collision and between collisions as a measure of machine activity during beam setup and tuning. A simple figure that best describes this calorimeter is



**Status Report** The impediment was the treatment of optical reflections from metallic surfaces in GEANT4 which we believe is now fixed, and therefore we are simulating the performance of this monitor. We are now fully set up with Scientific Linux, G4, etc. We continue to seek manufacturers of highly reflective metals, 98% or better, at grazing incidence of less than a few degrees. We have succeeded in measuring reflectivity at small angles in a small lab setup.

**FY2006 Project Activities and Deliverables** We will completely finish the simulation with specific deliverables including (i) energy resolution of electrons from 25 GeV to 500 GeV; (ii) angular resolution of electrons; (iii) an assessment of the ability of this device to reject the 3 TeV of lower energy electron/gamma debris each crossing, and the efficient tagging of an energetic electron from two-gamma processes; and, (iv) an assessment of the ultimate radiation hardness.

**FY2007 Project Activities and Deliverables** The selection of the cold machine means, to me, that this project should not receive high priority in LCR&D funding, primarily because of the two main original motivations (absolute radiation hardness and nanosecond signal acquisition) the speed requirement is no longer necessary. The price for these two strengths was stated at the beginning: poorer energy and spatial resolutions. The requirements of 0.1% absolute precision in luminosity measurements cannot be met by this gas Čerenkov device.

Should it be desirable in future years to wrap such a calorimeter around the beam pipe at 100m intervals to assess the beam transport during commissioning, or to assess beam losses, then this device would be perfect, and also easily built on short notice.

**Budget justification:** Iowa State University: The small-scale testing of reflecting surfaces, identification of processes for the manufacture of metallic reflectors, and the calculations and design of a module are all within the capabilities of this group. Most funds for hourly

wage support of undergraduate physics majors (\$8K/y), a month of summer support for a beginning graduate student (\$2K/y) and nominal equipment, travel and supplies for a lab. (Most equipment, e.g. NIM bins and fast electronics, are borrowed from Fermilab).

**Three-year budget, in then-year K\$****Institution:** Iowa State University

Item	FY2005	FY2006	FY2007	Total
Other Professionals	0	0	0	0
Graduate Students	2.0	2.0	0.0	4.0
Undergraduate Students	8.0	8.0	0.0	16.0
Total Salaries and Wages	10.0	10.0	0.0	20.0
Fringe Benefits(11.3%)	0.2	0.2	0.0	0.5
Total Salaries, Wages and Fringe Benefits	10.2	10.2	0.0	20.5
Equipment	2.0	3.0	0.0	5.0
Travel	2.0	2.0	0.0	4.0
Materials and Supplies	2.0	2.0	0.0	4.0
Other direct costs	0	0	0	0
Total direct costs	16.2	17.9	0.0	33.4
Indirect costs(46% of TMDC)	6.5	6.5	0.0	13.0
Total direct and indirect costs	22.7	23.7	0.0	46.4

**Budget justification:** Purdue University: The manufacture of SS tubes as light conduits, testing and measuring reflectivities, and the design and manufacture of (3cm)<sup>2</sup> conduits for the transport of light to PMTs is mostly done by undergraduate physics majors (\$8k/y).

**Three-year budget, in then-year K\$****Institution:** Purdue University

Item	FY2005	FY2006	FY2007	Total
Other Professionals	0	0	0	0
Graduate Students	0	0	0	0
Undergraduate Students	8.0	8.0	0.0	16.0
Total Salaries and Wages	8.0	8.0	0.0	16.0
Fringe Benefits (11.3%)	0.2	0.2	0.0	0.5
Total Salaries, Wages and Fringe Benefits	8.2	8.2	0.0	16.4
Equipment	2.0	4.0	0.0	6.0
Travel	2.0	2.0	0.0	4.0
Materials and Supplies	2.0	2.0	0.0	4.0
Other direct costs	0	0	0	0
Total direct costs	14.2	16.2	0.0	30.4
Indirect costs	5.6	5.6	5.6	11.2
Total direct and indirect costs	19.8	21.8	25.8	41.6