Tracking Detector R&D at Cornell University and Purdue University

Cornell University	Purdue University
D. P Peterson	J. Miyamoto
R. S. Galik	I. P. J. Shipsey

We have requested funding for this research from NSF through UCLC.

Information available at the web site:

 $http://w4.lns.cornell.edu/~dpp/tpc_test_lab_info.html$

* this presentation

* presentation to UCLC meeting at Santa Cruz 30-June-2002,

* project description from the NSF proposal, 29-August-2002

The project description can also be found at the UCLC site:

http://w4.lns.cornell.edu/public/LC/UCLC/projects.html



Detector Development, Cornell/Purdue Program

Systematic study **spatial resolution** and **signal width** using **GEM and MicroMegas TPC readout** devices

details of spacings and gain, pad size and shape gas mixture applied signal spreading

Spatial resolution and signal width studies using

traditional anode-wire-amplification read-out devices

Investigate a readout using smaller wire spacing to reduce the **ExB** effects. Establish a baseline for the MPGD studies.

Ion Feedback measurements

Instrument the high voltage plane, or an intermediate grid.

Tracking studies in a high radiation environment

Tracking studies in a magnetic field

Cornell has the expertise and utilities to build and operate a superconducting test magnet.





LABORATORY FOR ELEMENTARY-PARTICLE PHYSICS

what Purdue offers

Years of experience with MPGDs

Micro Pattern Detector Aging (Radiation Hardness) Example: triple GEM with PCB readout Gas Ar/CO₂ 70/30 (99.99%)

GEM1= 400 V GEM2= 390 V GEM3 = 380 V PCB as e⁻ collector

Cr X-rays (5.4 KeV) @ 6 x 10^4 Hz/mm² for 750hrs

Gas gain 6,000

Detector performance small (~15% gain loss) after ~ 8 years @LHC 10 cm from IP. (~ 130,000 years @LC on 1st 20cm of TPC) Minimal signs of aging.

Best aging result obtained with a GEM.

Similar result obtained with a MicroMEGAS + GEM Miyamoto/Shipsey 2001 IEEE NSS Conference Record ISBN 0-7803-7326-X (CD ROM)



All publications at: http://www.physics.purdue.edu/msgc/

Accumulated charge (mC/mm²) Stolen from I. Shipsey, NIM A 478 (2002) 263

25

20

10

15

14.5

14

13.5

30



D. Peterson, "Tracking Detector R&D at Cornell University and Purdue University" LC-TPC-LBL 18-Oct-2003

what Purdue offers



Chicago/Purdue/3M 1st mass production of GEMs, hep-ex/0304013. Talks: Imaging 2003, ALCW Cornell July 03, next talk by Juan Collar. Preliminary studies: performance is equivalent to GEMs made at CERN.

Summary Comparison CERN and 3M GEM Table stolen from

Zanti Romerica	I Shinsey ALCV		
	3M GEM	CERN GEM	Cornell July 03.
I _{leak}	0.02nA/cm ² @ 600V, air at 40% R.H.	0.005 nA/cm ² @ 500V in N ₂	00
Gain $\Delta E/E$ $\Delta G(x,y)/G(x,y)$	~1,000 @ 500V Ar/CO2 7:3 ~16% 9%	~1,000 @ 500V Ar/CO2 7:3 ~18%(typical) 	
Electron Transparency Ion Transparency	0.9 0.9	0/9 0.6	
Ion Feedback	0.1 at G=20 E _{drift=} 150V/cm	0.08 E _{drift=} 150V/cm	
Ageing	result at IEEE next week	25 mC/mm ² Triple GEM @ Purdue 2000	

New: Purdue/3M prototype run of mass produced MicroMEGAS has begun. Detectors available in a few weeks.

After initial evaluation, will distribute to all who would like to test them.



TPC Test Chamber R&D at Cornell University and Purdue University 3 Year Plan, from UCLC proposal

		Plan	Purchases	
(at Cornell)	1 st Year	track definition scintillator trigger small drift chambers test device, TPC power supplies data acquisition	VME crate Computer and LabView controller discriminators for drift chambers TDCs for drift chambers FADCs for TPC (limited) power supply frame power supplies electronics boards \$52,000 equipment	
	2 nd Year	expanded TPC superconducting magnet	expanded DAQ	\$ 121,000 equipment
	3rd Year	expanded TPC superconducting magnet	expanded DAQ	\$ 74,000 equipment
(at Purdue)	1 st Year	MPGD readout modules	printed circuit pad read GEMs, MicroMegas	lout planes \$ 10,000 equipment \$ 16,000 student support
	2 nd Year 3rd Year	advances in MPGD readout r advances in MPGD readout r	nodules modules	 \$ 10,000 student support \$ 10,000 equipment \$ 16,000 student support \$ 10,000 equipment \$ 16,000 student support
(at Purdue)	2 nd Year 3rd Year 1 st Year 2 nd Year 3rd Year	expanded TPC superconducting magnet expanded TPC superconducting magnet MPGD readout modules advances in MPGD readout r advances in MPGD readout r	power supplies electronics boards expanded DAQ expanded DAQ printed circuit pad read GEMs, MicroMegas nodules modules	 \$ 52,000 equipment \$ 121,000 equipment \$ 121,000 equipment \$ 74,000 equipment \$ 10,000 equipment \$ 10,000 equipment \$ 10,000 equipment \$ 16,000 student s \$ 10,000 equipment \$ 16,000 student s \$ 10,000 equipment \$ 16,000 student s



Short Term Activities

Cornell:

Electronics Purchase: Lab funds, Sept 2003 VME Crate and Interface FADC, 100 MHz, 32 channels HV crate and interface HV supplies: GEMS Drift = 66cm

Set-up and testing of electronics (14 weeks)

Construct a first TPC device. Construct telescope drift chambers and trigger scintillators.

> Technical staff and machine shop staff are available, some residual competition from the CESRc Wiggler production.

Purdue:

Ready to construct a readout module.

