Future DHCAL Activities

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CALICE Meeting, CERN, May 19 – 21, 2011

Test Beam Activities

Run period	Date	Configuration	Muon events [10^6]	Secondary beam events [10^6]	Secondary beam momenta [GeV/c]
1	Oct 2010	**DHCAL**	1.4	1.5	2,4,8,10,12,16, 20,25,32
2	Jan 2011	DHCAL **+ partial TCMT**	1.6	3.6	2,4,6,8,10,60
3	Apr 2011	**ECAL** + DHCAL + **TCMT**	3.5	4.8	4,8,12,16,20,25,32,40,50,60,120
4	Jun 2011	DHCAL + TCMT			32,40,50,60,120, rotation
5	Being discussed	DHCAL with **Tungsten** + TCMT			4,8,12,16,20,25,32,40,50,60,120
6		DHCAL **w/o absorber**			0.50,0.75,1.00, 1.25,1.50,2.00
TOTAL			**6.5**	**+ 9.9**	**= 16.4M**

Only cassette covers (2mm Cu + 2 mm Fe)
Corresponds to ~ 1.23 interaction lengths

Tertiary beam as built for the Minerva test beam

Test Beam Data Analysis

Instrumentation paper (Gary, Jim, John, Burak, Kurt, Daniel, Jacob, Lei, José)

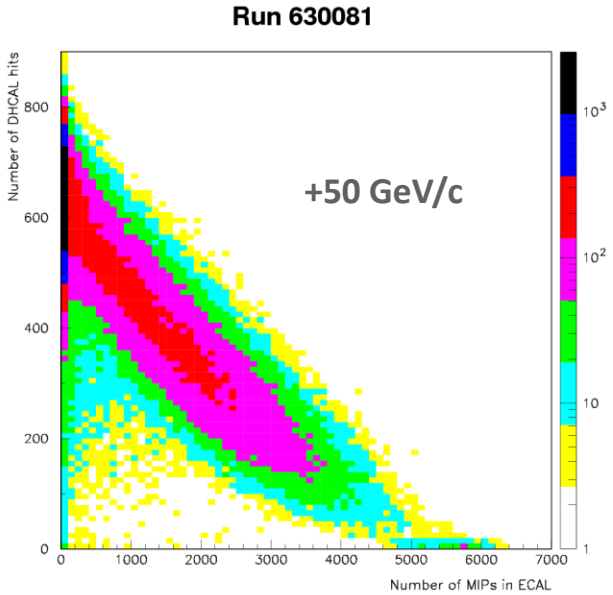
Almost all ingredients in hand

Noise paper (Qingmin, Lei)

Rate, correlated noise, uncorrelated noise…

Muon papers (Daniel, Kurt, Lei, José)

Alignment, response, response across plane and across pad
Tracks, track segments, calibration, simulation…



Positron papers (Burak, Jacob, José)

(Non)-linearity, resolution (corrected), shower shapes, simulation, software compensation…

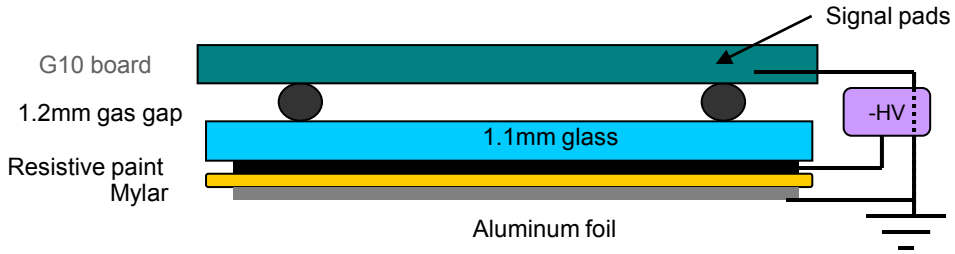
Pion papers (Burak, Jacob, José)

Linearity, resolution, shower shapes, simulation, software compensation, leakage correction…

1-glass RPC

Advantages

Pad multiplicity close to unity
Chamber thickness reduced by ~1 mm
Surface resistivity not critical
Rate capability x2 better

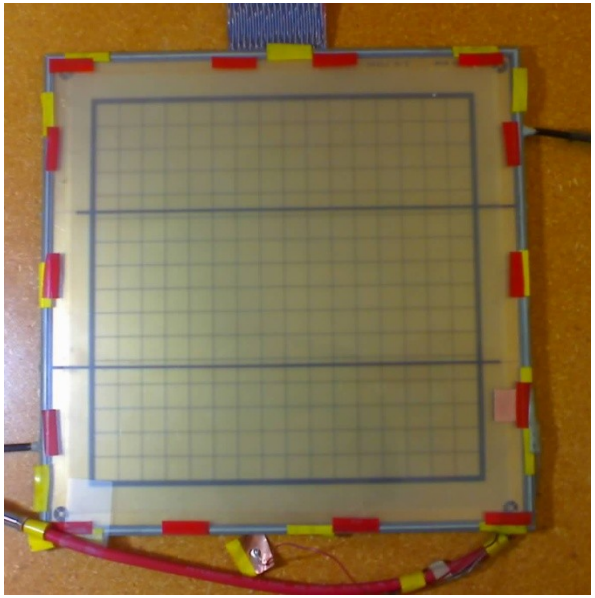


Disadvantages

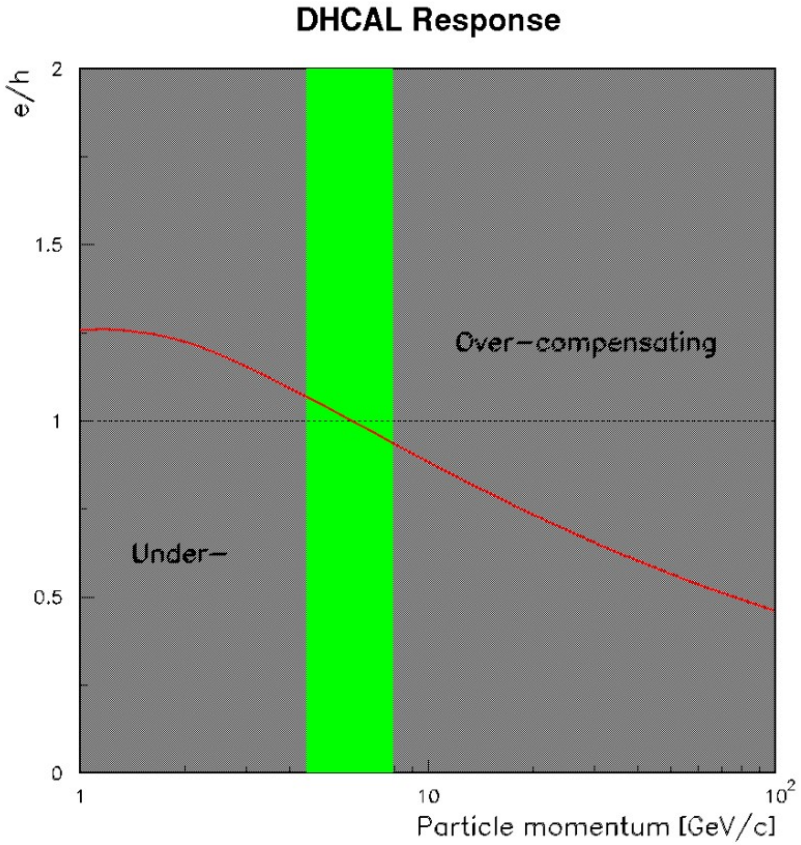
Readout board part of chamber

Status of development

Have built 4 small size chambers
Operated these for several months w/o problems
Assembly technique for larger chambers to be developed



Pad sizes



Preliminary measurement

DHCAL

We chose 1 x 1 cm^2
→ Compensation around 4 – 8 GeV/c

1 – glass RPCs

Smaller pad sizes would make sense
→ Extend region of **compensation**?

New pad board with 0.5 x 0.5 cm^2

Can be used with same Front-end board
To be designed…

High Voltage System

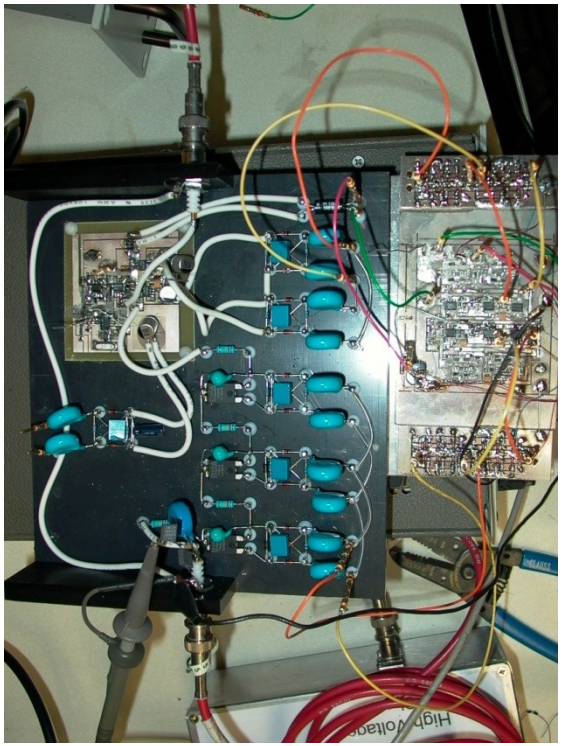
Development of a HV distribution system

Control of individual channels
Measurement of currents

Status

First successes

Turn on/off channels w/o tripping HV supply



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Gas Recycling System

DHCAL's preferred gas

Gas	Fraction [%]	Global warming potential (100 years, CO_2 = 1)	Fraction * GWP
Freon R134a	94.5	**1430**	1351
Isobutan	5.0	3	0.15
SF_6	0.5	**22,800**	114

DHCAL pollution to date

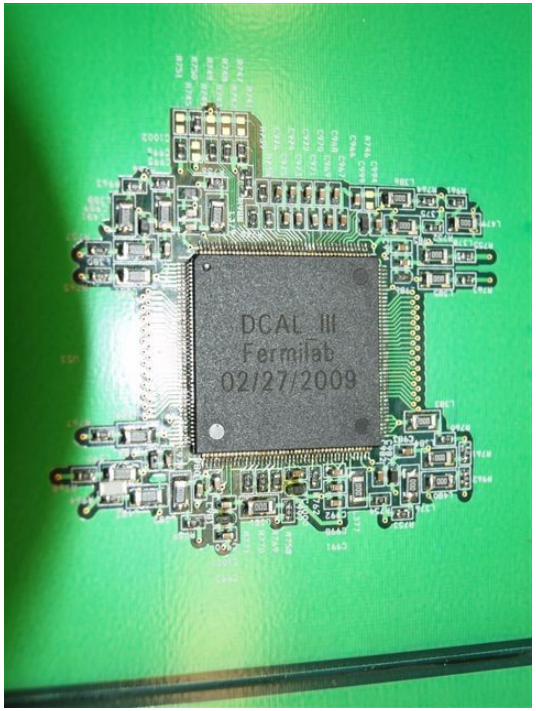
300 lbs of R-134a or
200 tons of CO_2 or
22,000 gallons of gas or
545,000 miles in an average car or
22 times around the globe

Recycling mandatory for larger system

Status

CERN has recycling systems operational (not exactly what we need)
Interest worldwide in RPC community to develop viable system
Starting to pull together various interest groups in US, Asia…
Discussions with industry, chemical engineers…

New Front-end Readout



DCAL III

0.25 μm technology
No (known) design faults
Power consumption not minimized → requires active cooling
Each chip has its on readout lines
Relatively reliable (lost very few chips in test beam so far,
reasons not yet known)

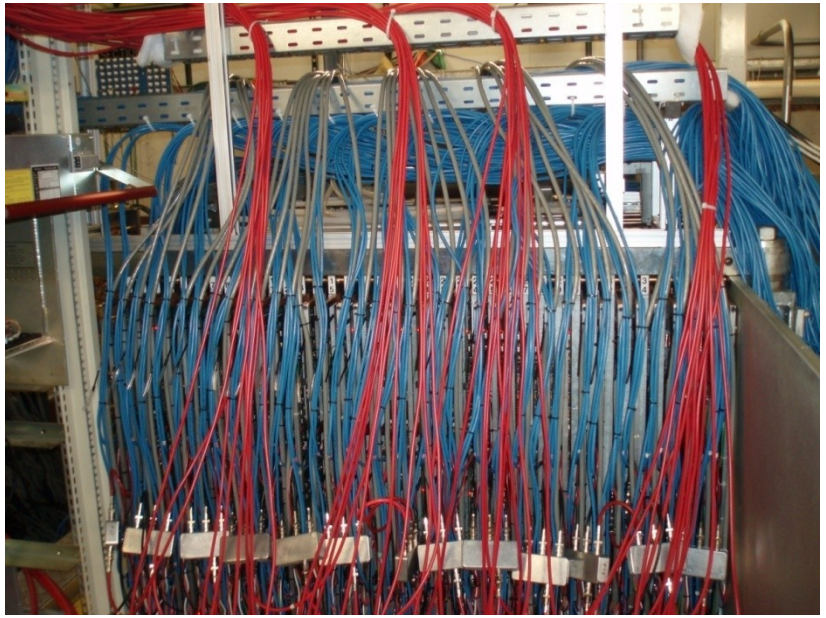
DCAL IV

Minimize power consumption (not power pulsing!)
Double readout channels???
Token ring passing
Additional reliability/redundancy
Not packaged? With 1-glass RPCs reduces active layer thickness to 4 mm!!!
Smaller feature size (0.25 μm technology obsolete by now)

Status

Agreement for future chip development between FNAL and ANL
Ready to start design work…

Cable-less Transmission



Signal transmission

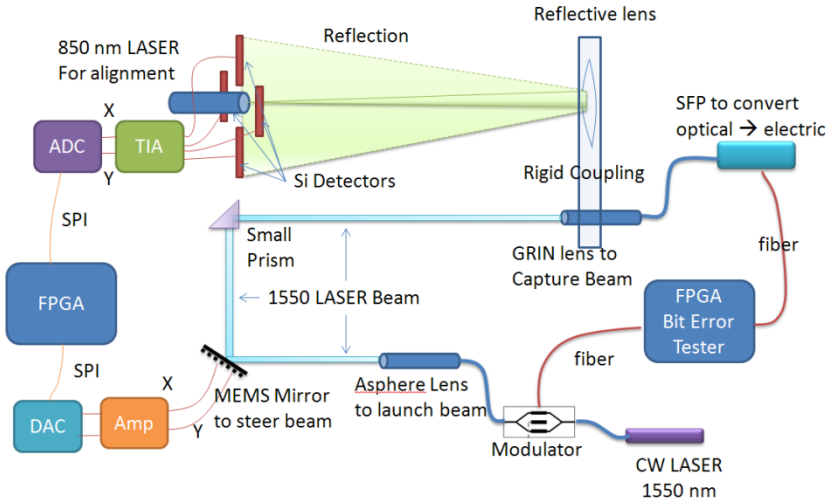
Currently via Ethernet cables
6 cables/layer

Cable-less transmission

Being developed at Argonne
Collaboration of HEP and Center for Nanoscale Materials
Using lasers and light modulators

DHCAL

Ideal test bed for new technologies
Proposal submitted to DOE…



Summary

Too much to do…