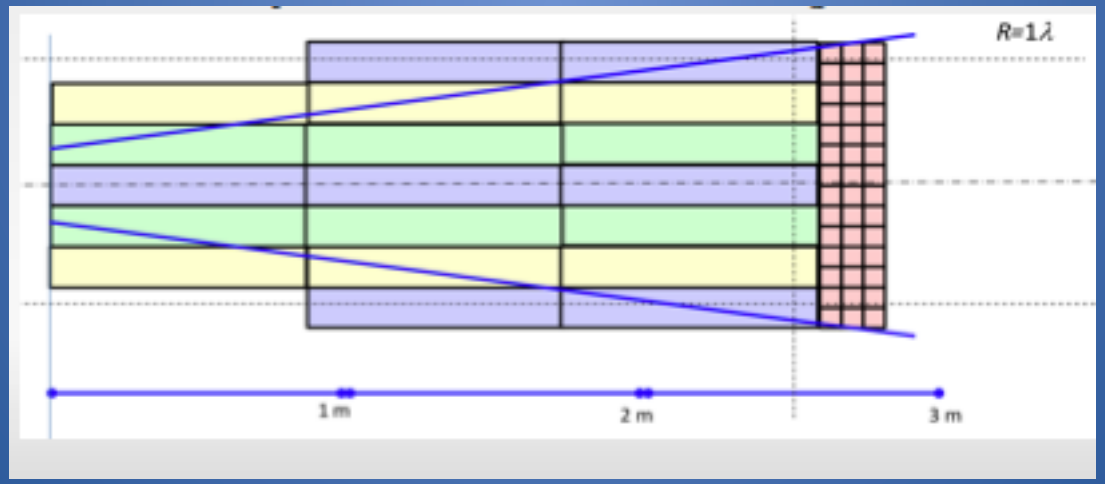
T1015:

Total Absorption Dual Readout Calorimetry: Test of SGC1 scintillating glass



Glass Main Properties

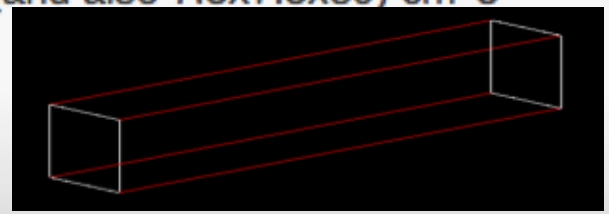
- Our glasses are composite materials:

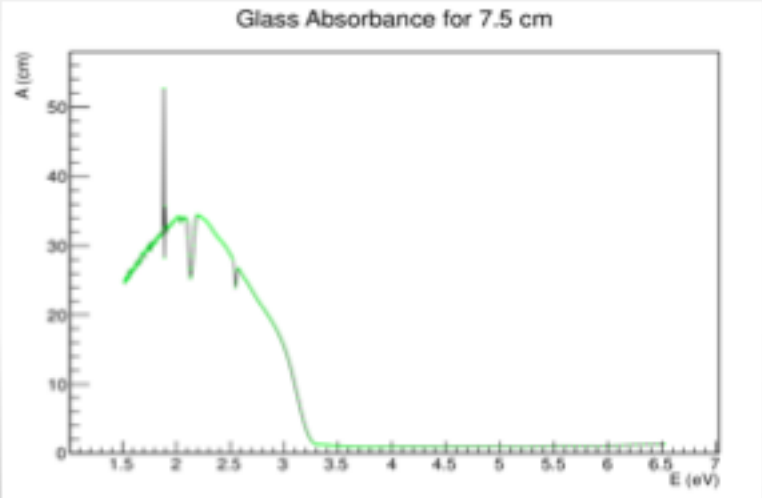
BaO	43.4%
SiO2	42.5%
Li2O	4.0%
MgO	3.3%
K2O	3.3%
Al2O3	2.0%
Ce2O3	1.5%

Density	3.36 g/cm3
Radiation Lenght	4.25 cm
Interaction Lenght	45.6 cm
Refractive index	1.61 (we have to improve this data)
Cherenkov angle	51.6
Scintillation decay time	70 ns

- They have dimensions 15x15x89

  (and also 7.5x7.5x89) cm^3

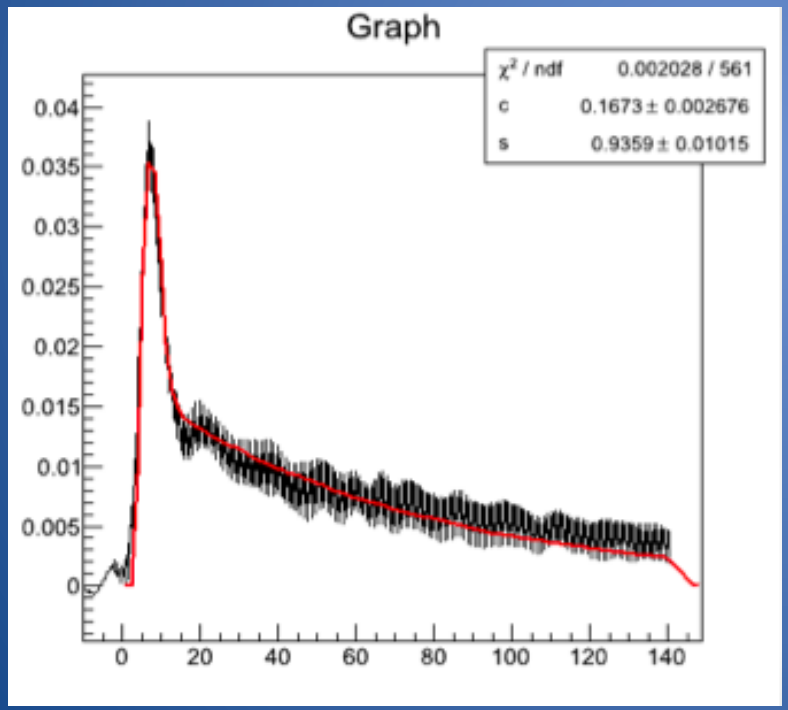




Need to separate Cerenkov signal (C) from Scintillation (S) for D.R. Correction to the calorimeter response

$$f = \frac{c - s(C/S)}{(C/S)(1-s) - (1-c)}$$

No problem for cosmic muons



Cosmic data and simulation

Purpouse of T1015 (SGC1):

Investigate

- response of SGC1 glass to hadron showers (e.g. C/S ratio)
- determine whether this ratio can be extracted reliably
- alternative means of light collection/amplification (SiPMs, PMTs)
- readout electronics (e.g. TB4, CAEN N7642 digitizers)

To this end, we need:

- proton, pion, electron and muon beam
- Gas Cerenkov to distinguish between pions and electrons
- MWPC to investigate dependence on hit position of glass response
- Remotely moveable table so we can investigate attenuation

We took data with 3 different glasses, equipped with :

- EMI 9714, 2” phototubes
- Hamamatsu H10721 , 1 cm phototubes
- Hamamatsu R1450 , 1 cm “

- AdvanSiD SiPMs : 4x4 mm^2 , 2,8 mm diam, 1,2 mm diam
- Hamamatsu MPPCs: 4 x 3x3 mm^2 array

All detectors werein direct optical contact with the glass face (exept for som “bare” SiPMs which were positioned at 1mm from the galss surface

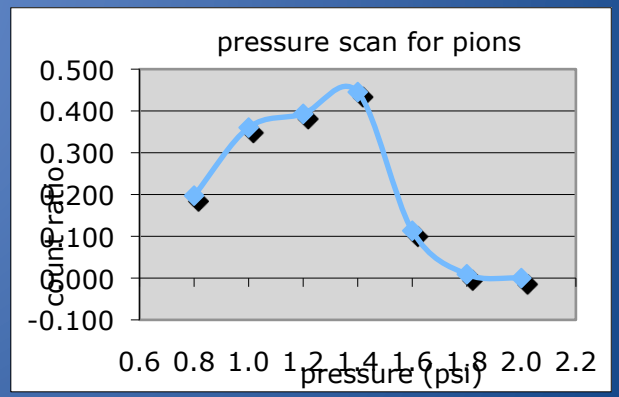
For readout, we used:

- TB4 electronics (courtesy of Paul Rubinov, FNAL):
  ~ 200 MHz digitizers

- CAEN N674, 1 – 5 GHz digitizer system

We had planned to integrate the CAEN system with the MWPC readout S/W but this wa not availble, so Lorenzo Santi Kluged up a LabView readout which we used to take data asynchronously

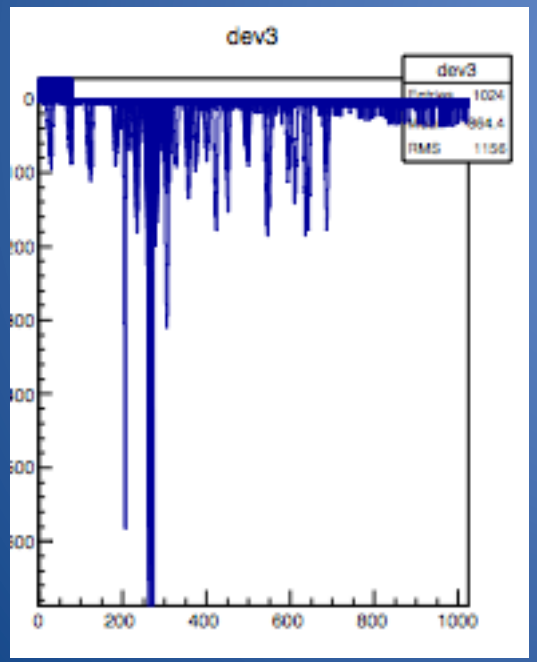
Cerenkov system seemed to be working
e.g. 30 GeV pion pressure scan :



Some problems with remote positioning table: horizontal readout unstable

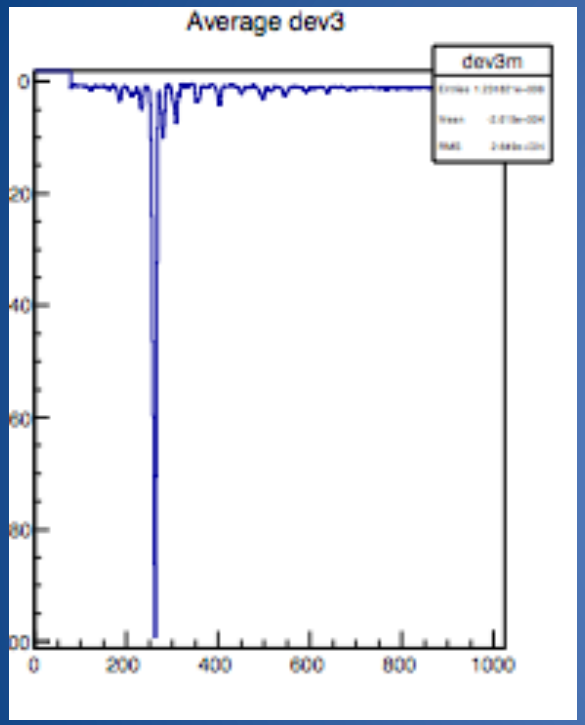
We took data with:

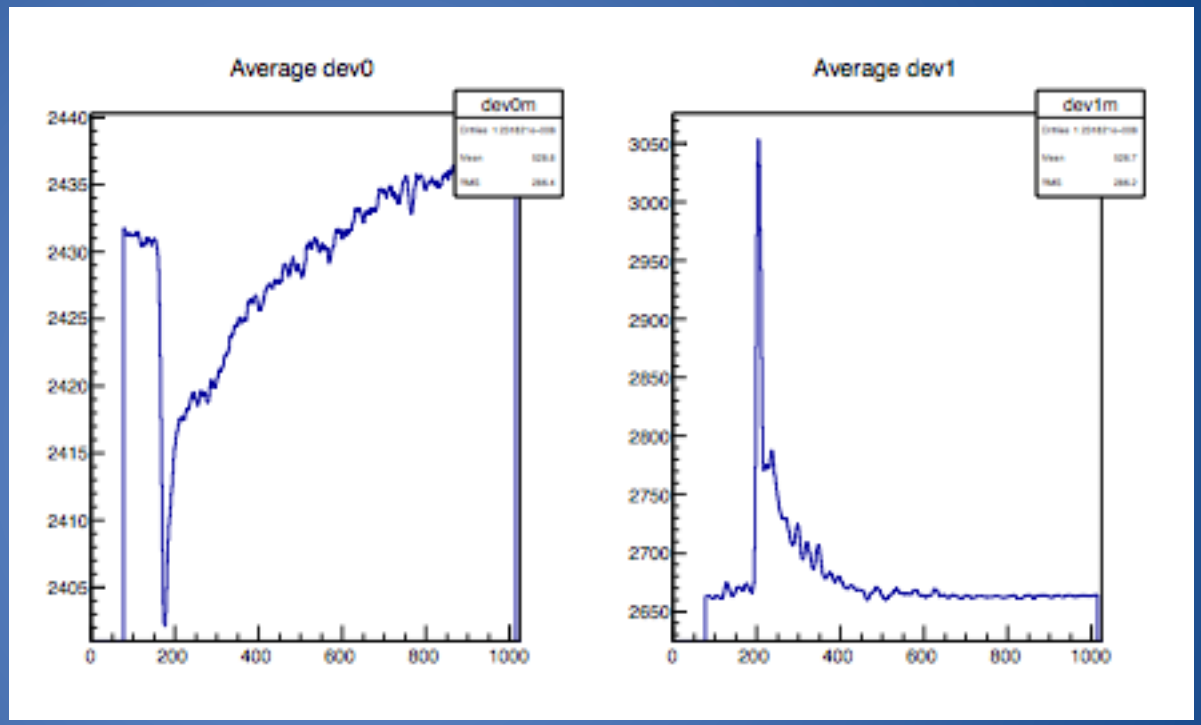
- 120 Gev protons,
- 30 Gev muons and pions
- 10 GeV pions



Beam distribution over spill i a probem

Using CAEN @ 2.5 GHz we will probably be able to remedy





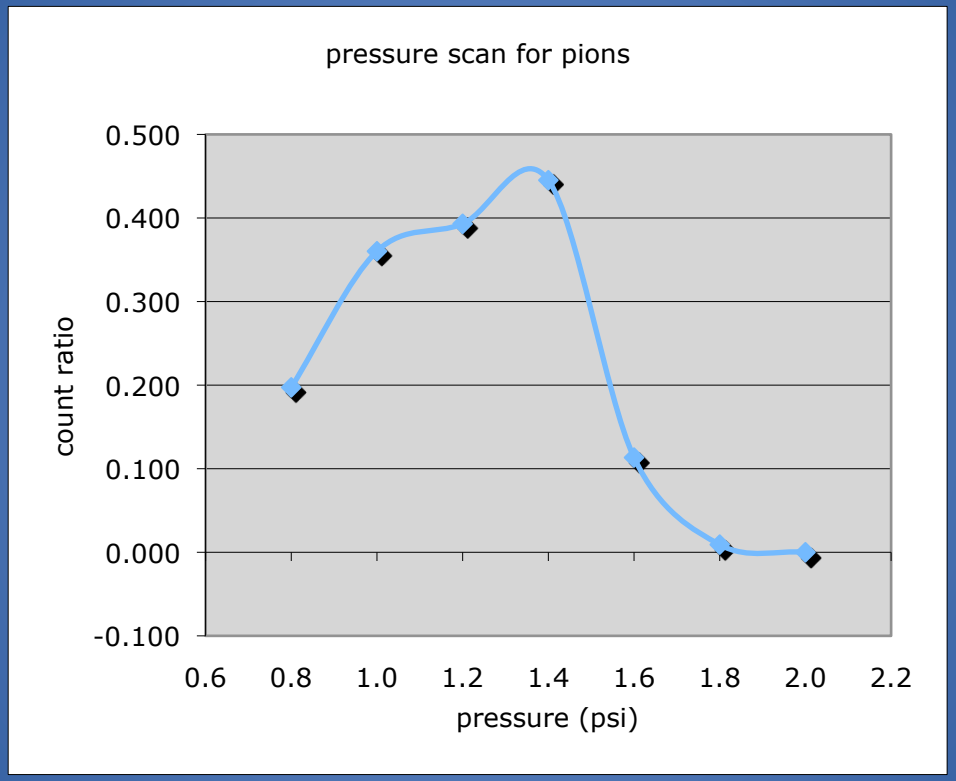
More difficult with TB4 (~200 MHz): Need to get CAEN system integrated into the DAQ so we can take data synchornously

What have we learnt so from preliminary analysis?:

1) SiPMs/MPPCs see more that enough light with 90 cm glasses → saturation. We could operate with 1 mm^2 SiPms --- or we could operate with finer longitudinal segmentation

2) Will need higher sampling frequency than available with TB4 to separate Cerenkov from Scintillation

3) Will also need it to operate with current beam structure (reject particles arriving within ~ 100 ns of each other)


pressure scan for pions
0.500
0.400
0.300
0.200
0.100
0.000
-0.100
count ratio
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
pressure (psi)