

Luminosity Monitor Update

A. Ratti
for the bran/lumi team

Apr. 26 2010

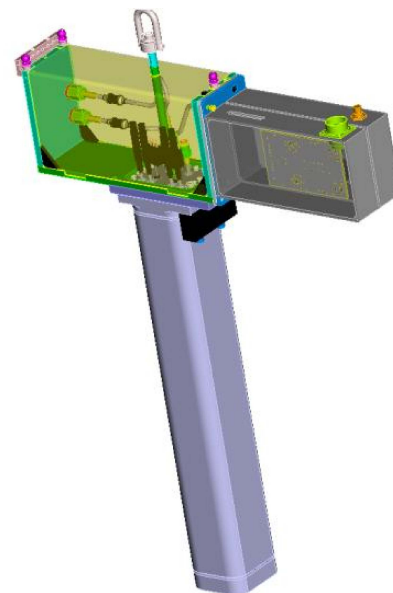


Outline

- Highlights
- Beam measurements
- Modeling studies
- Summary

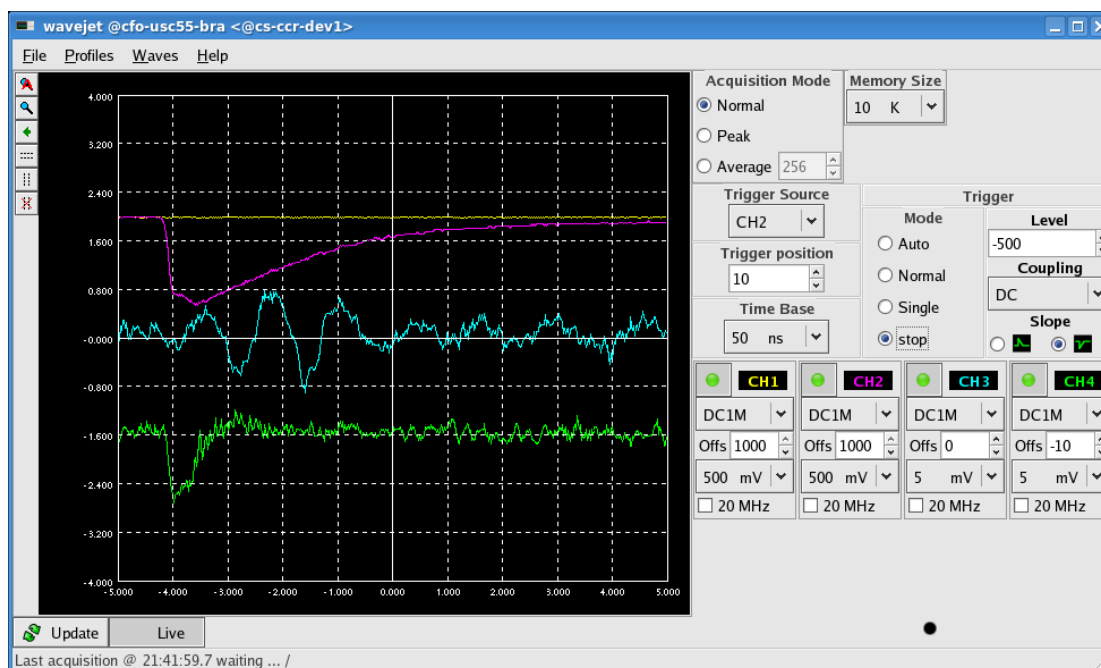
Lumi highlights

- All systems taking data
 - Signals since day 1 of collisions
- Modeling efforts to support LHC operations
 - Indicates 3.5 GeV operation is possible

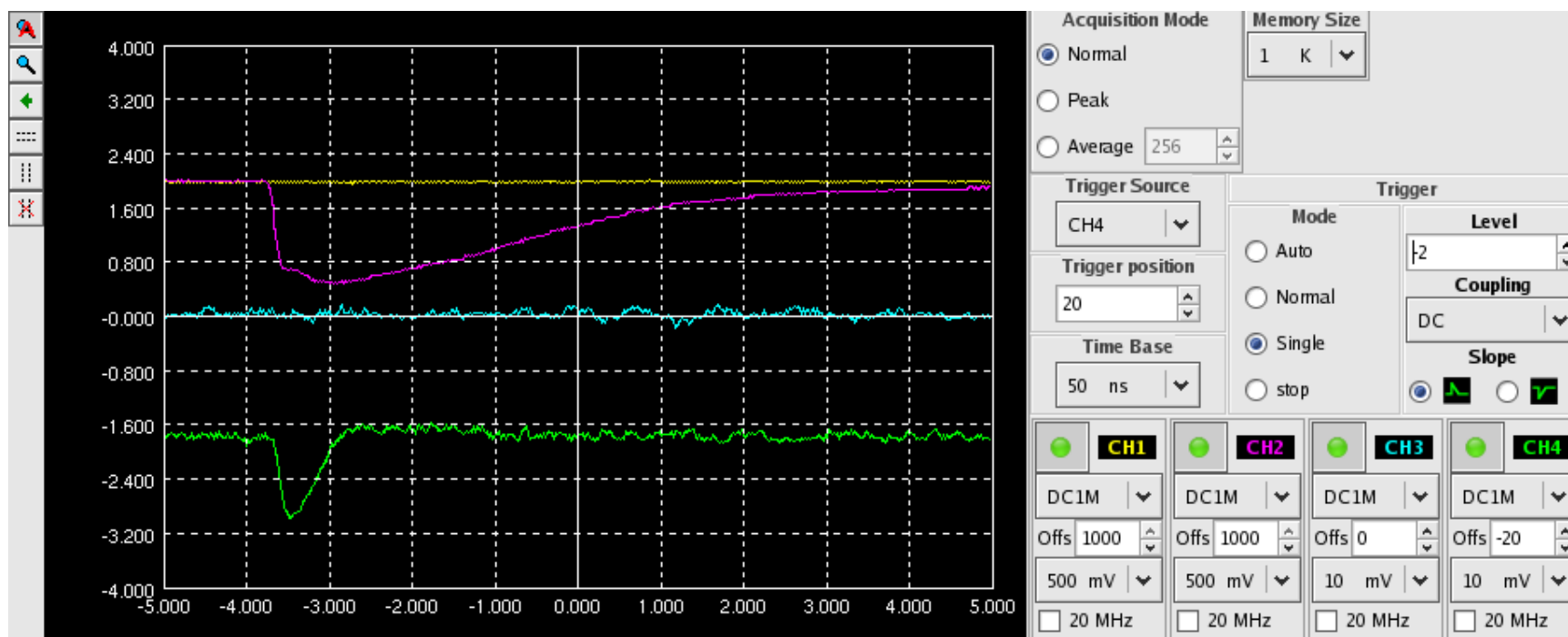


Early Signals @ 450 GeV

- Collimation Scan
 - Mar. 26, 2010



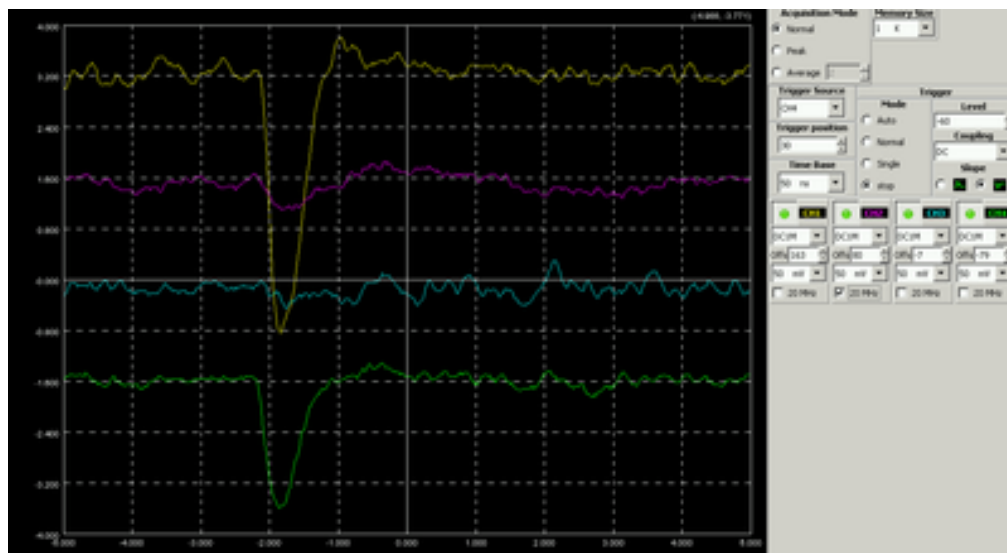
First Collisions @ 3.5 TeV



PMT Left– Yellow PMT Right – Purple Lumi Left – Blue Lumi Right - Green

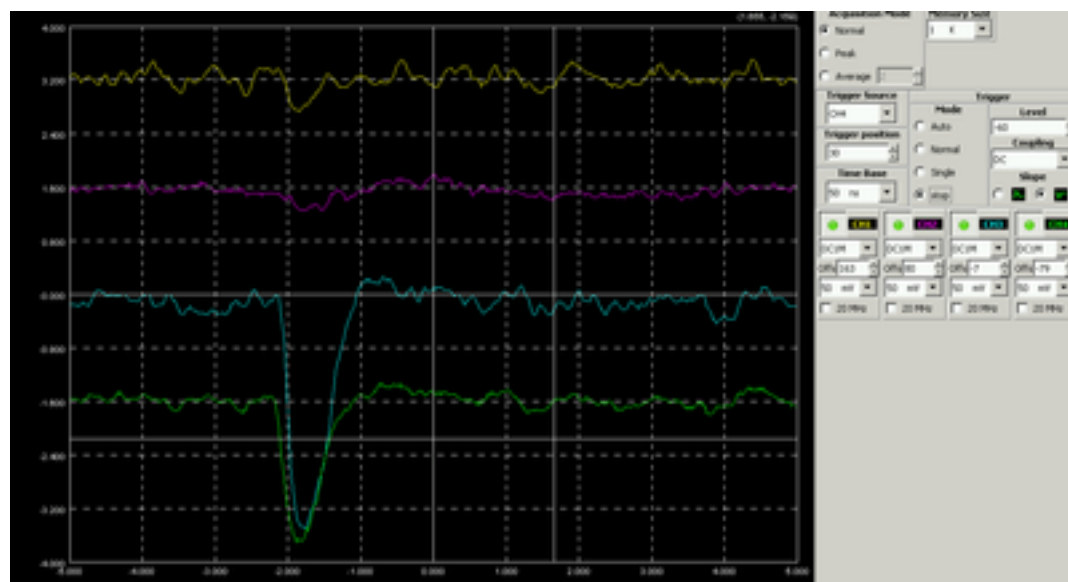
Event on the Right side – IP 5

All Quadrants Involved

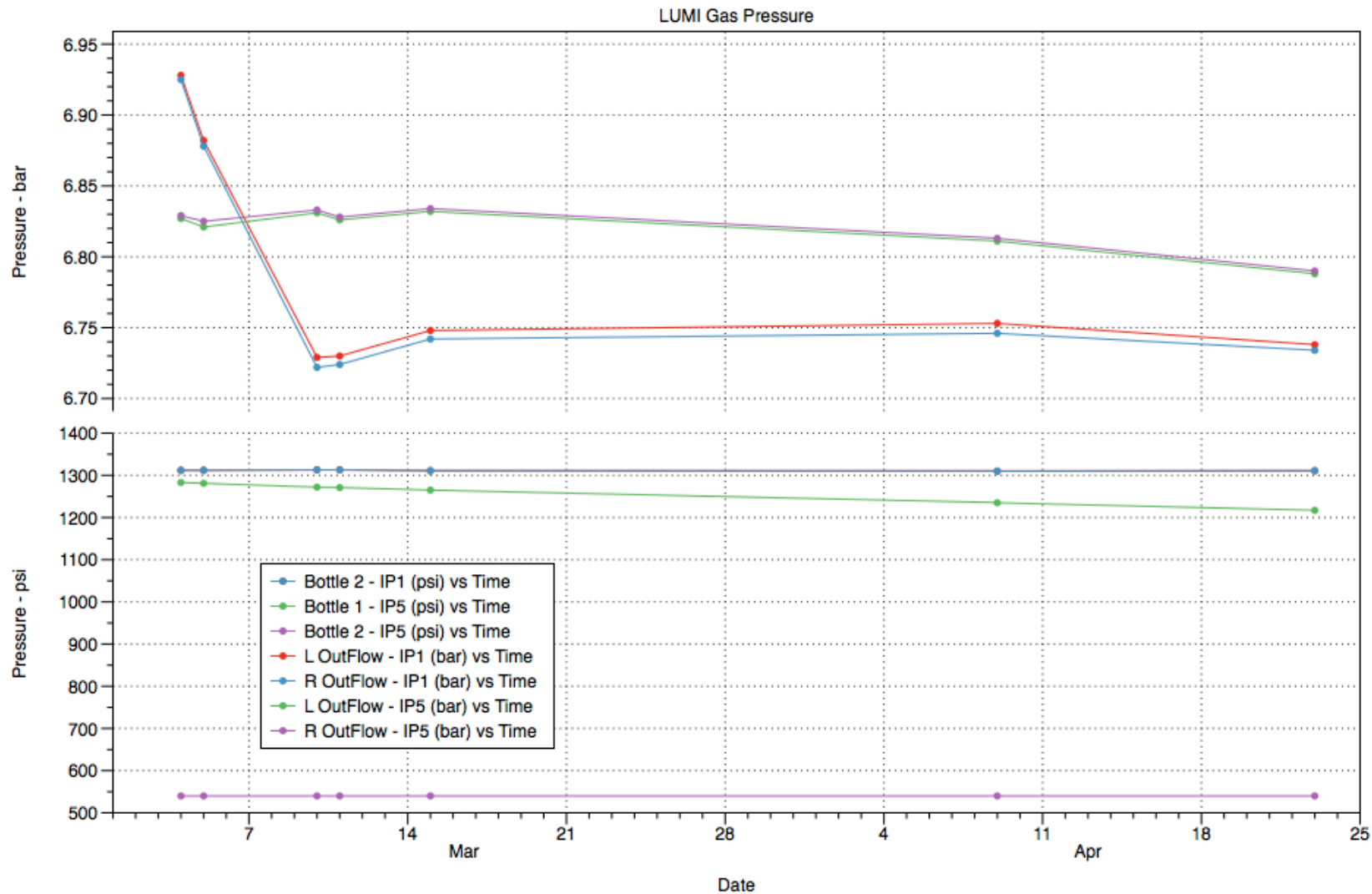


Different shots hit different Qs

IP5 – Left Shown



Gas System





System Studies with Beam

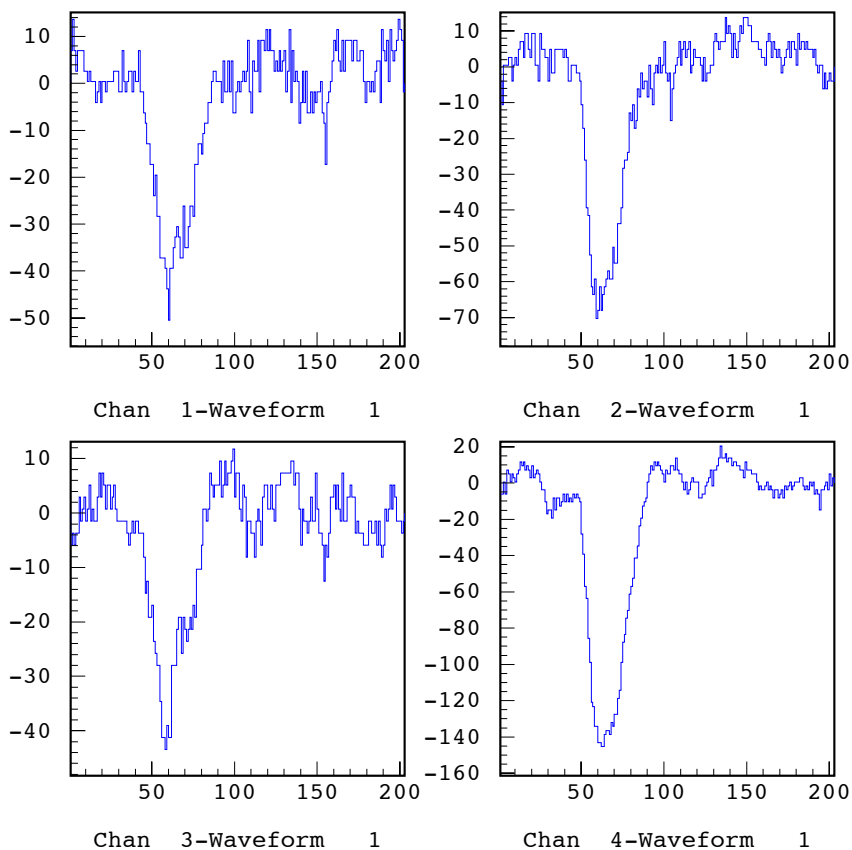
Two type of studies

- Analog measurement after shaper
 - Characterize collisions + understand showers
 - Validate and develop models
- Counting rates
 - Compare with PMT
 - Validate detector for operation



p-p collision signals @ 3.5 TeV

2010/04/26 00.12



Single shot

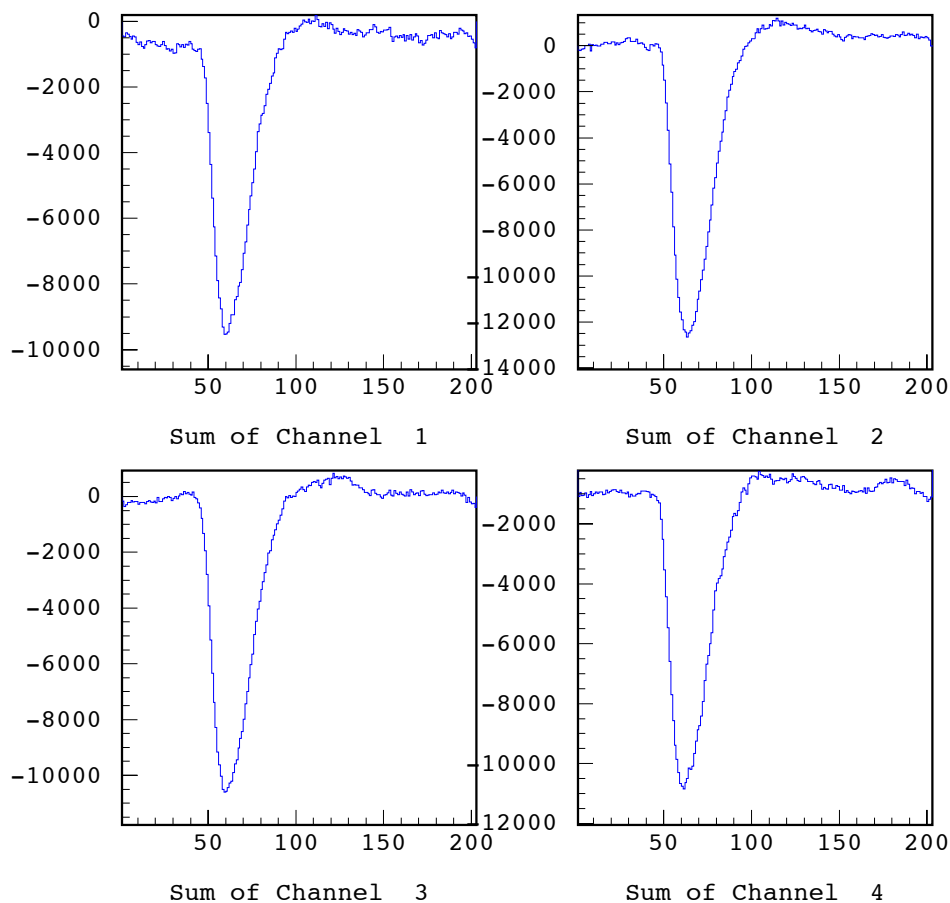
Q1 Q2
Q3 Q4

Left side
1400 V bias
Trigger on PMT



p-p collision signals @ 3.5 TeV

2010/04/26 00.07



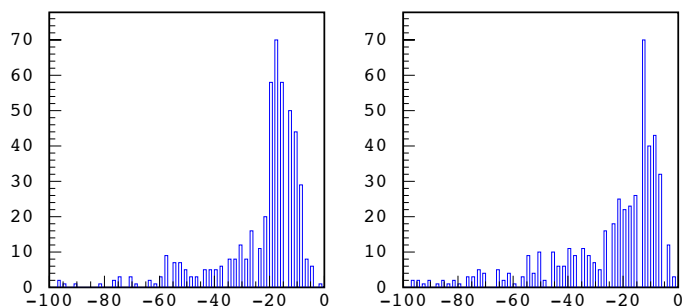
Sum of 500 pulses

Q1 Q2
Q3 Q4

Left side
1400 V bias
Trigger on PMT

Signal Histograms

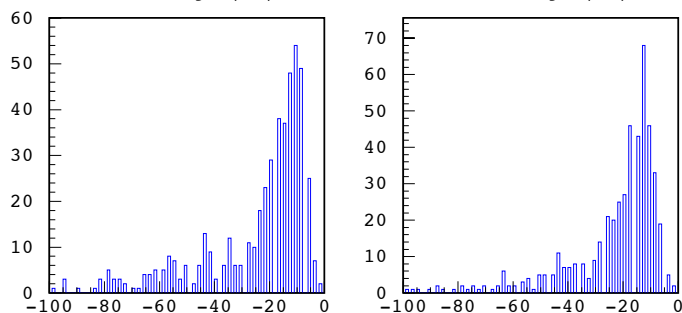
2010/04/25 23.59



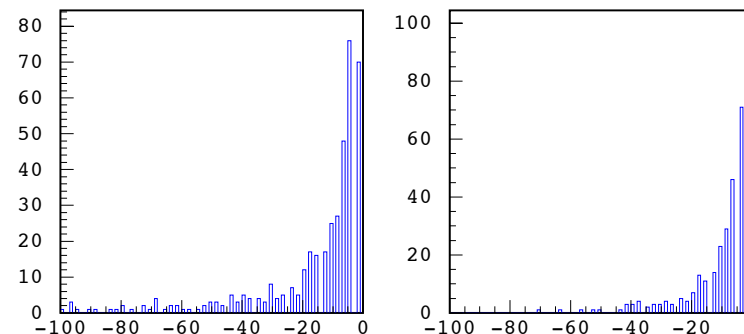
Left

2010/04/25 23.48

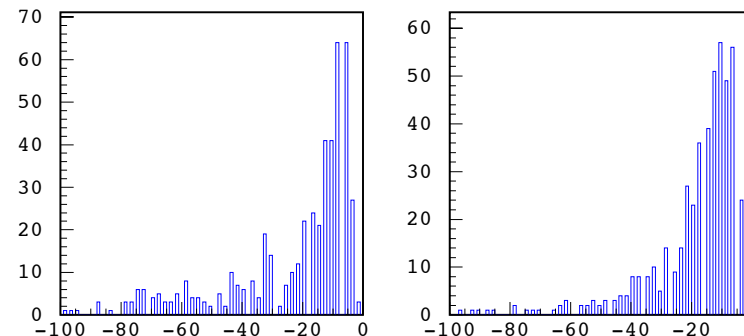
Q1-Minimum voltage (mV)-timecut Q2-Minimum voltage (mV)-timecut



Q3-Minimum voltage (mV)-timecut Q4-Minimum voltage (mV)-timecut



Q1-Minimum voltage (mV)-timecut Q2-Minimum voltage (mV)-timecut



Q3-Minimum voltage (mV)-timecut Q4-Minimum voltage (mV)-timecut

Right

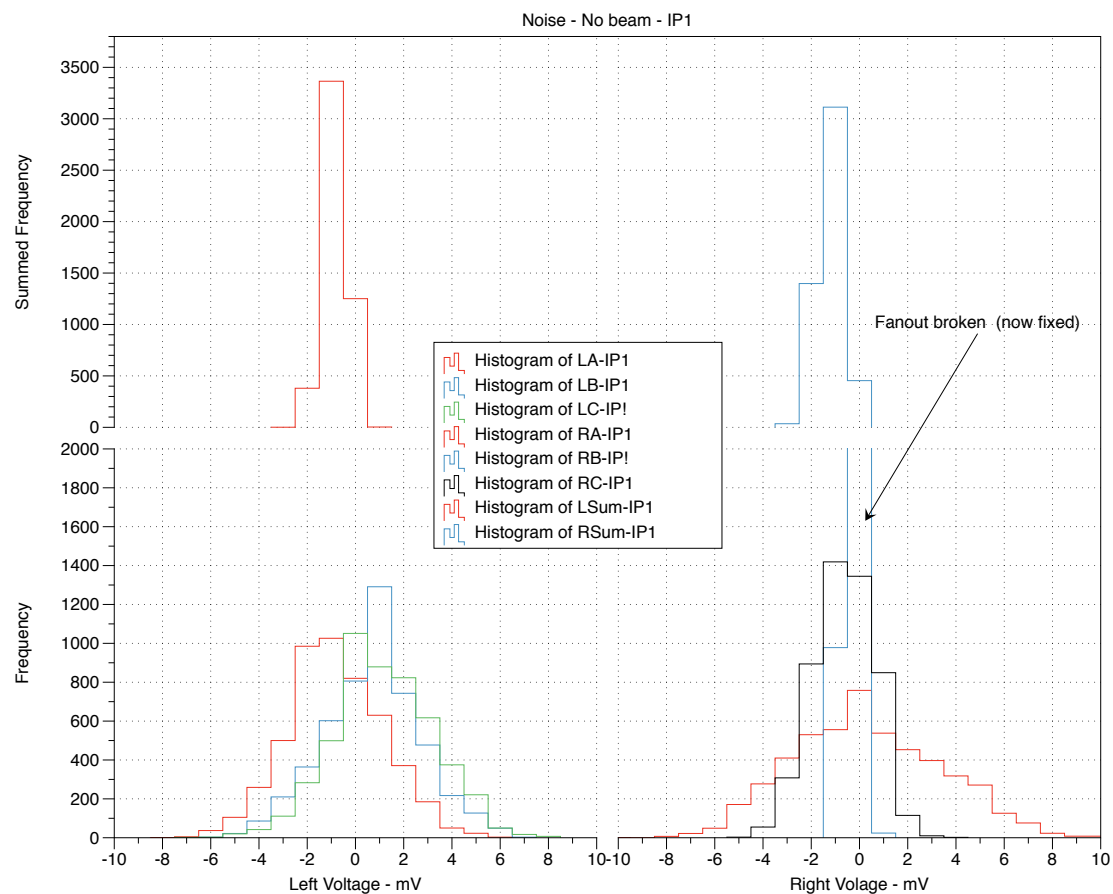


System Noise

With high energy shaper
(less gain)

No beam

IP1 shown



System Modeling

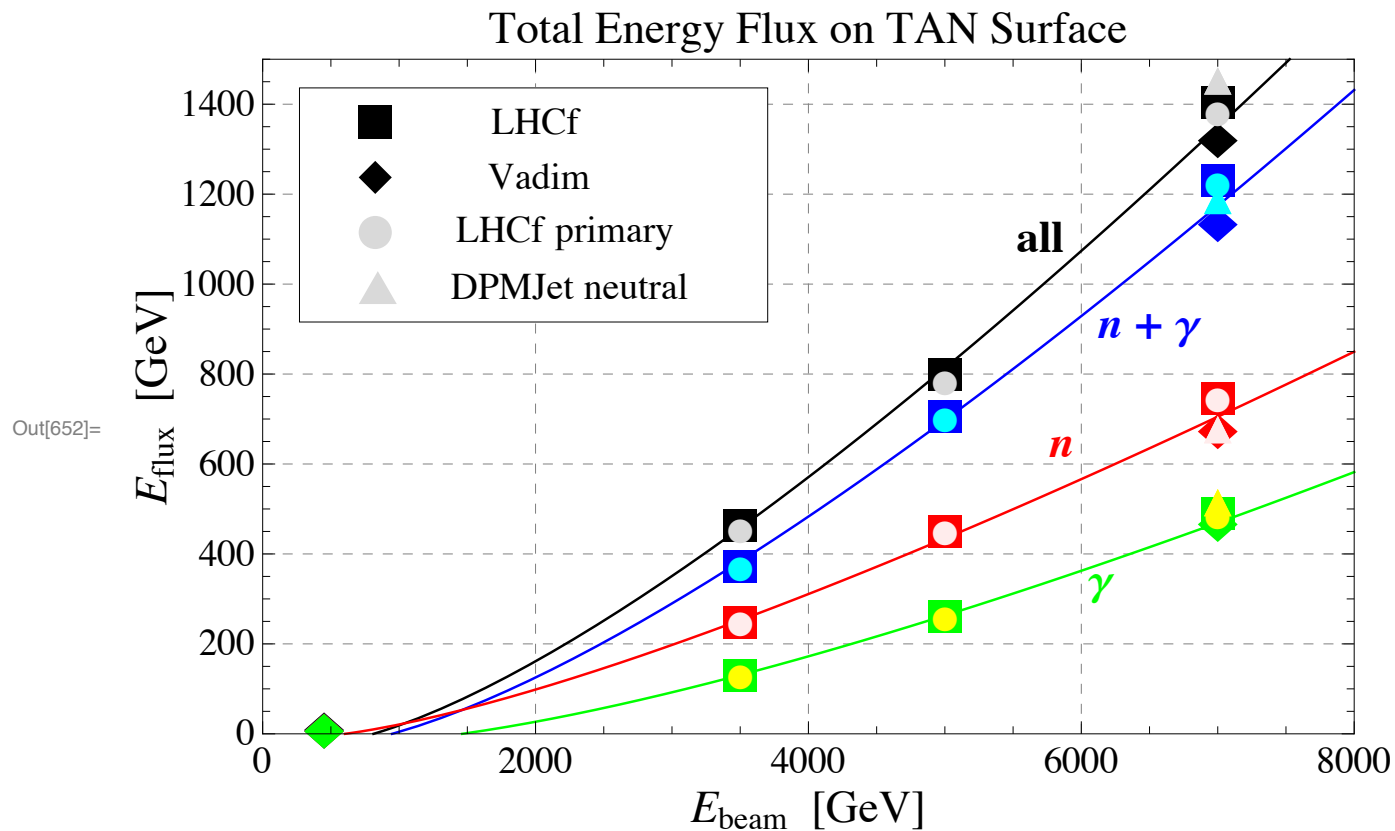
- FLUKA model developed over time during the construction project
 - Model presented at CM13 by H. Matis
 - R. Miyamoto
 - J. Stiller (Heidelberg U) 2009 summer student
- Model full detector with particle jets
 - Input files from LHCf and CERN (V. Tanalov)



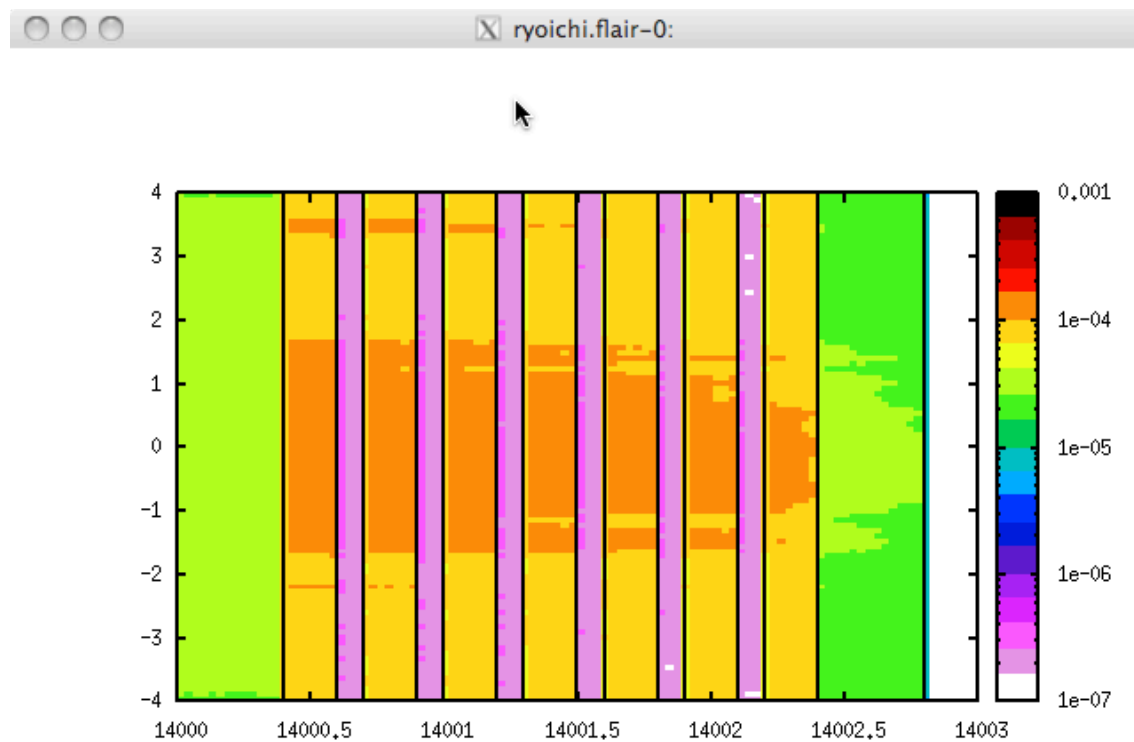
Modeling Setup

- Using events provided by LHCf with DPMJET3
 - Beam pipes between IP and TAN, and TAS located at 20 m from IP are taken into account
 - Includes D1 dipole but not quadrupoles
 - No fluctuations of beam energy or position
- Normalized to # of pp interactions
- Simplified geometry of the TAN
- Study for IP5
 - Absorber in front of IP1 not constant due to LHCf operating mode

Flux on Tan surface



Energy Distribution



Chamber model

6 gaps

Copper and ceramic

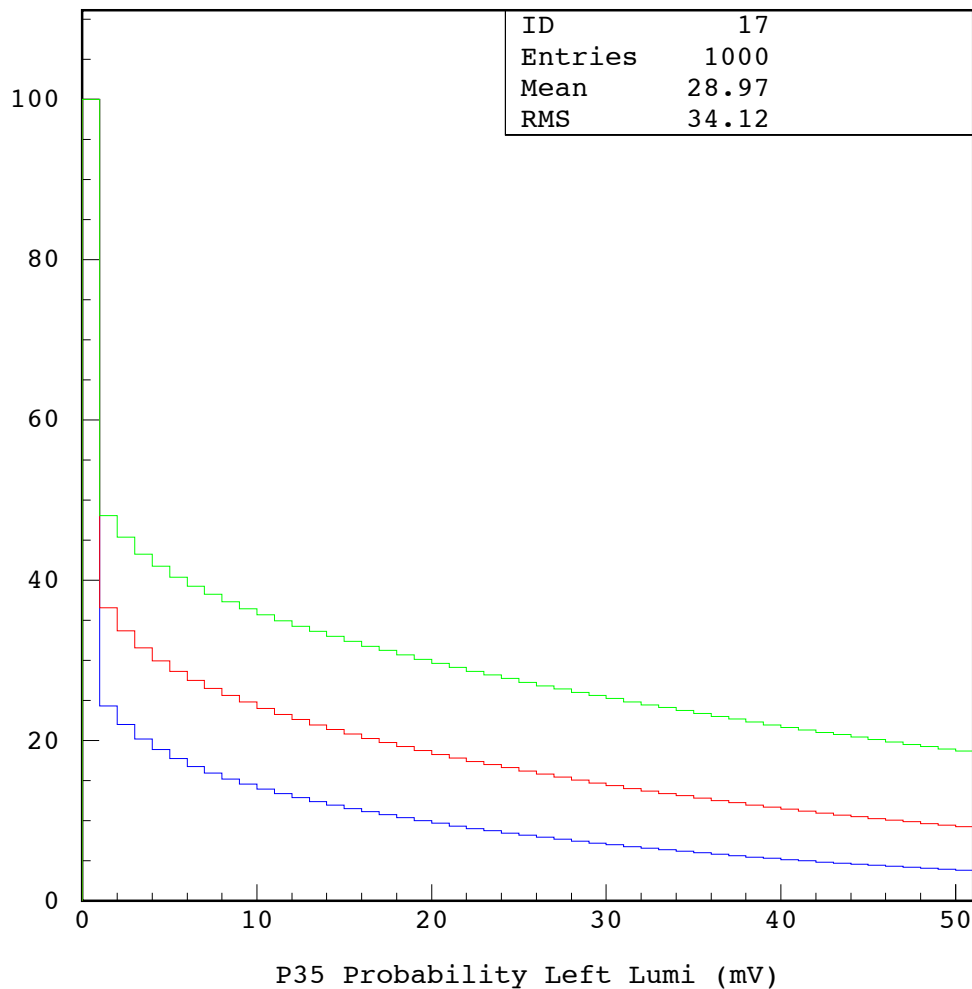
14001,3, 5.43834





Trigger probability on single events

2010/04/22 16.35



7 TeV - Green

5 TeV - Red

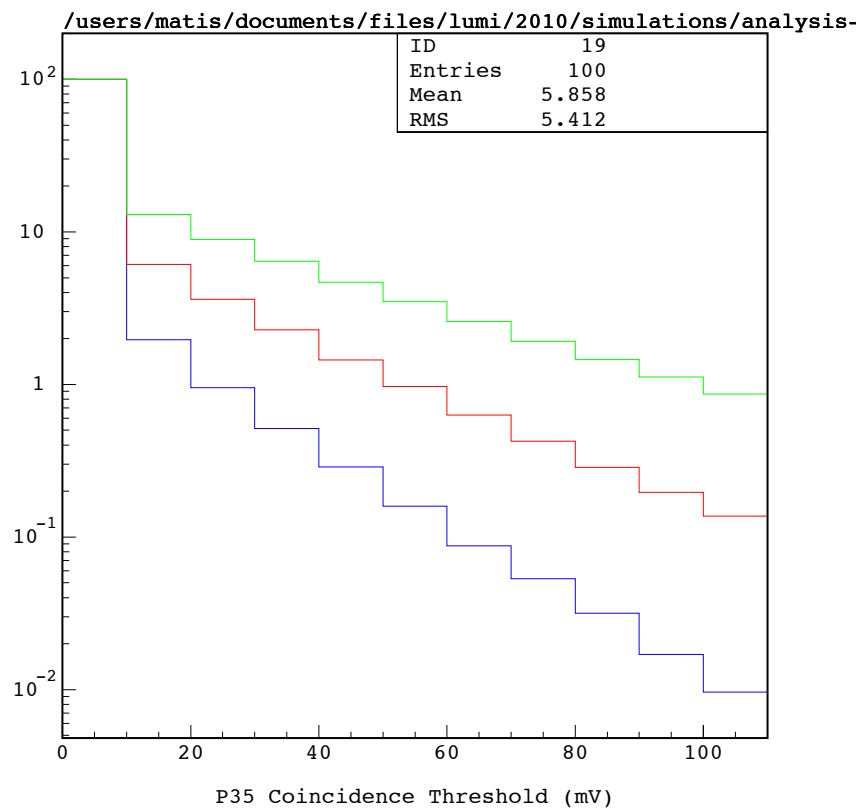
3.5 TeV - Blue

As a function of
threshold

Coincidence

Coincidence Trigger as
a function of energy
and threshold per p-p
interaction

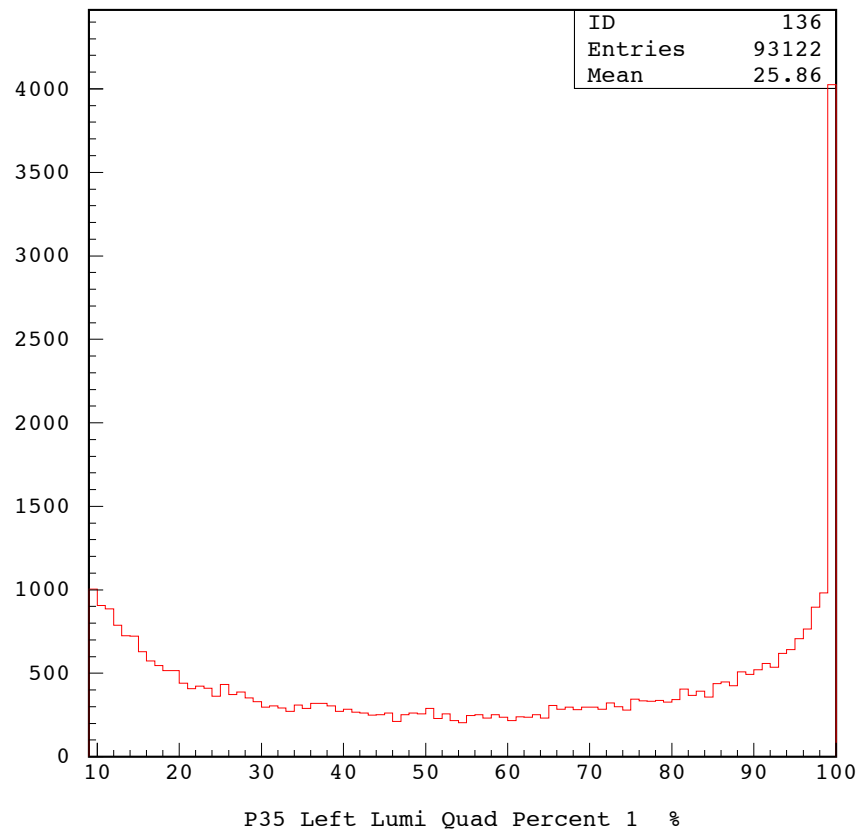
2010/03/29 16.38



Quadrant Sharing

2010/03/23 10.23

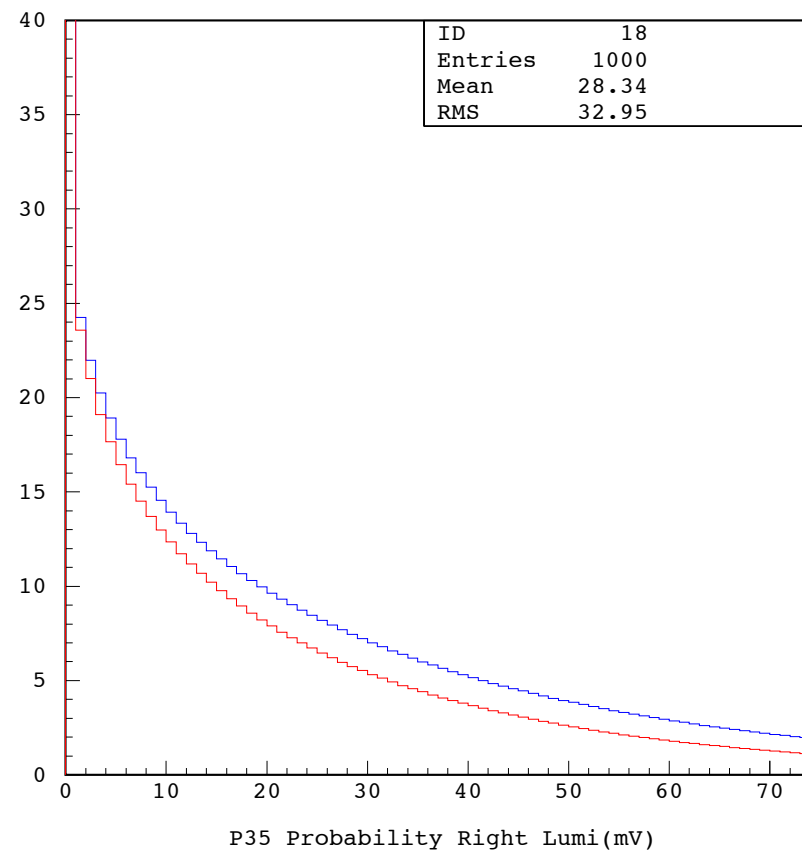
Fraction of a shower
seen by a quadrant

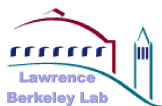


3.5 TeV trigger efficiency

2010/04/22 17.19

- Trigger on **Sum** vs.
Trigger on the **OR**





Calculated Event Rates

Sheet1

Revolution frequency [Hz] =	11245				
Beam sigma @ 7.0 TeV [cm] =	0.00167				
pp inelastic cross section [cm^2] =	1.0E-25				
Lumi efficiency @ 3.5 TeV [%] =	7				
Lumi efficiency @ 7.0 TeV [%] =	25				
Reference:	http://lhc-commissioning.web.cern.ch/lhc-commissioning/luminosity/M				
Operation type	Lowest	2010 step 3	2010 step 5	2010 step 1	Nominal
Beam energy [TeV]	3.5	3.5	3.5	3.5	7.0
Bunch intensity	5.00E+9	2.00E+10	5.00E+10	7.00E+10	1.15E+11
Number of bunches	1	2	43	796	2808
Beta* [m]	11.00	2.00	2.00	2.50	0.55
Geometrical reduction factor	1.000	1.000	1.000	0.836	0.836
Luminosity (bunch) [cm^-2 s^-1]	2.0E+26	1.8E+28	1.1E+29	1.4E+29	3.5E+30
Luminosity (total) [cm^-2 s^-1]	2.0E+26	3.5E+28	4.7E+30	1.2E+32	1.0E+34
Interaction rate (bunch) [Hz]	2.0E+1	1.8E+3	1.1E+4	1.4E+4	3.5E+5
Interaction rate (total) [Hz]	2.0E+1	3.5E+3	4.7E+5	1.2E+7	1.0E+9
Multiplicity	0.002	0.157	0.981	1.286	31.563
Event rate (bunch) [Hz]	2.0E+1	1.8E+3	1.1E+4	1.1E+4	1.1E+4
Event rate (total) [Hz]	2.0E+1	3.5E+3	4.7E+5	9.0E+6	3.2E+7
Lumi rate (bunch) [Hz]	1.4E+0	1.2E+2	7.7E+2	7.9E+2	2.8E+3
Lumi rate (total) [Hz]	1.4E+0	2.5E+2	3.3E+4	6.3E+5	7.9E+6



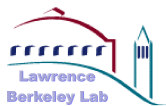
Counting Rate Experiments

- Work to start as time permits
 - Must be done without interfering with the operational device
- Some software improvements needed by CERN
 - SW section very busy to support LHC commissioning
- Plan to have scatter plots of PMT vs Gas System as soon as software is ready



Ongoing activities

- Systems modeling
 - Understand collisions at 3.5 GeV
 - Study detector configuration
- Beam measurements
 - Analog measurements
 - Counting rates
- Performance tests
 - Speed optimization
 - System configuration



Involvement in FY10 and later

- The lumi construction project ended in July 2009
 - Deliverables are at CERN, installed and operational
- LARP funded activities in FY10 in support of the detector development and early beam operations
 - Ryoichi Miyamoto (Toohig fellow) is an essential part of the plan
- LARP Funds could be available in future years to continue this effort in support of operations
 - Both funds and personnel availability are not guaranteed at the moment

Conclusions

- First data from collisions at 3.5 TeV give very encouraging results
- Modeling efforts are ready to support data analysis
- Preparing to take the detector into operation as the PMT system will start deteriorating with radiation damage