

# Luminosity Monitor Commissioning Results

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for the bran/lumi team

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# Outline

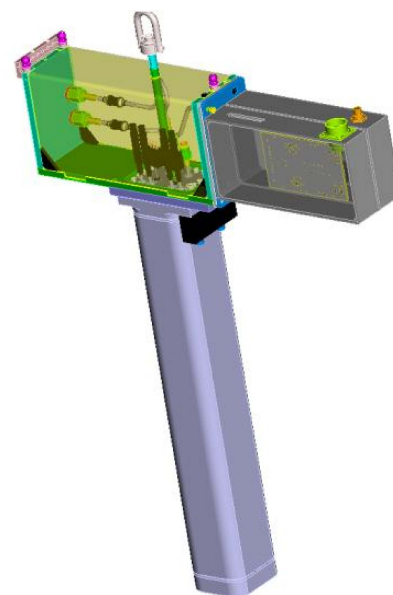
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- Highlights
- Modeling studies
- Beam measurements
- Summary

# Lumi highlights

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- Device is routinely used in operation
- Very good agreement with experiments
  - Work in progress
- Models Completed
  - Not for Pb-Pb run



# System Modeling

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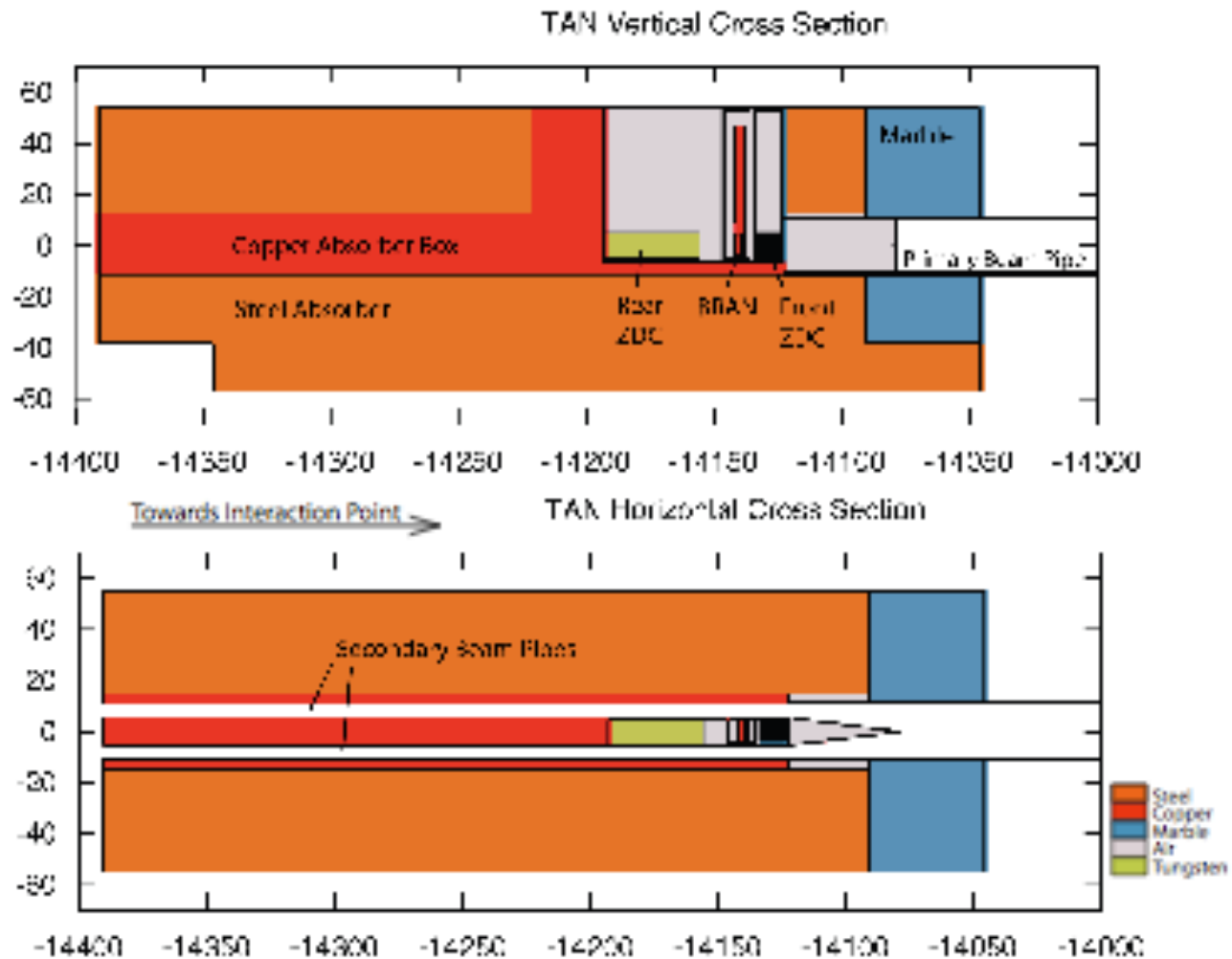
- Summer student completed full model
  - P. Humphreys – Cambridge U.
    - Supervised by H. Matis
  - Continues work done by two students in the past
- Progress:
  - Detector details
    - ZDC and TAN details added
  - Particle description
    - Improved input file from LHCf
  - Added crossing angles

# Modeling Setup

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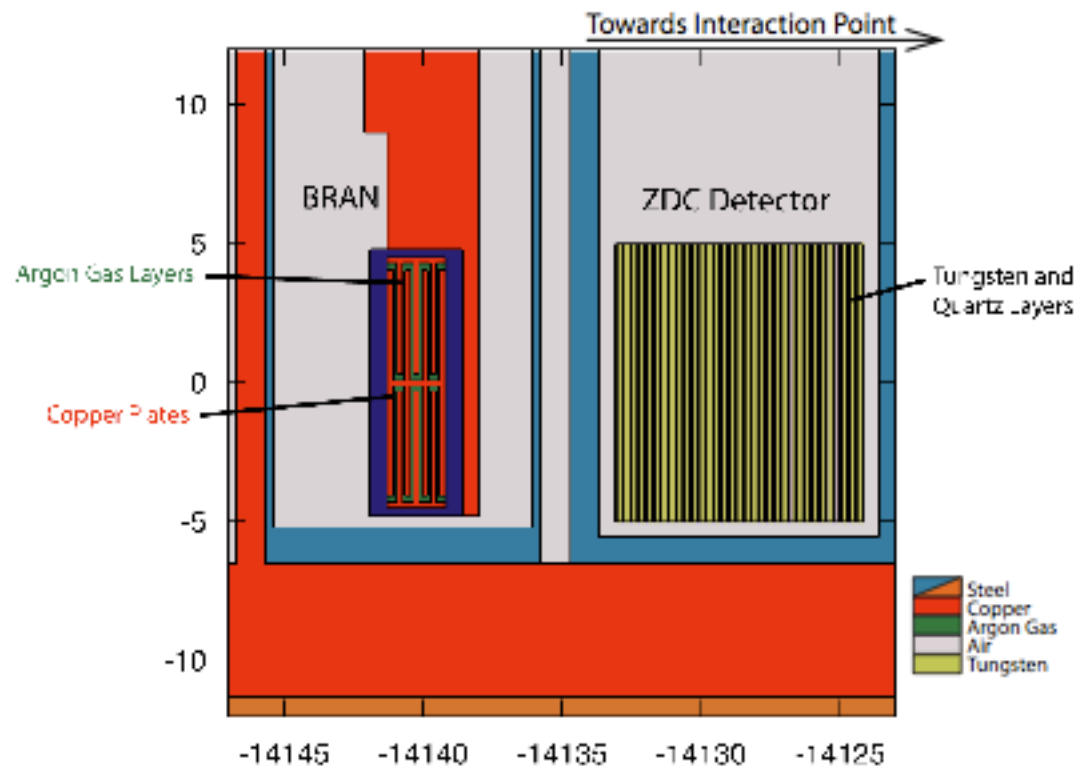
- Using events provided by LHCf with DPMJET3
  - Beam pipes between IP and TAN, and TAS located at 20 m from IP are taken into account
  - Includes D1 dipole but not quadrupoles
  - No fluctuations of beam energy or position
- Normalized to # of pp interactions
- Study for IP5 and IP1
  - Different operating conditions due to the difference in ZDCS
    - ATLAS ZDC is asymmetric

# Model Details



# BRAN Model

- CMS model

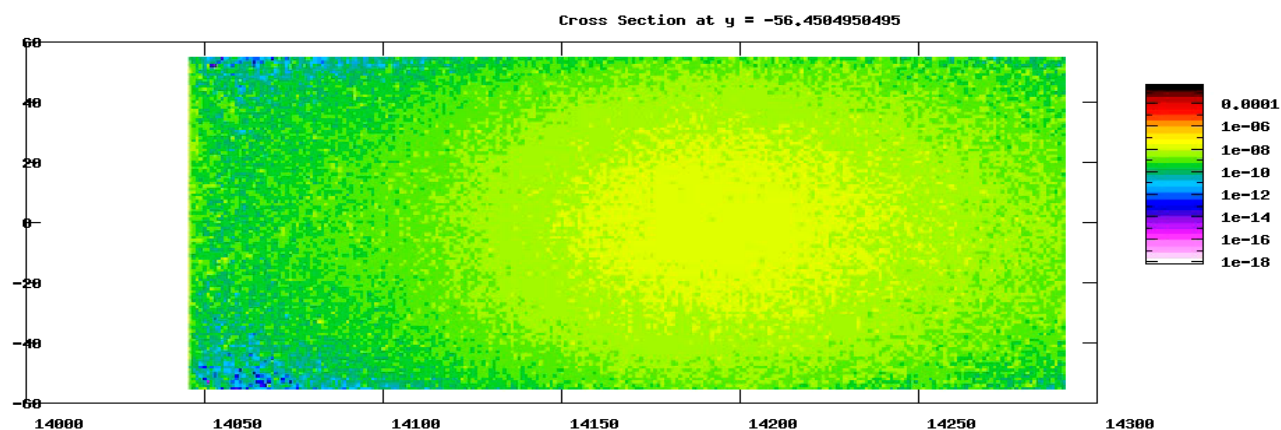






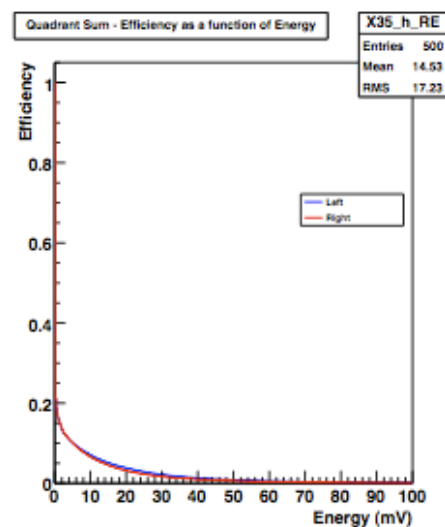
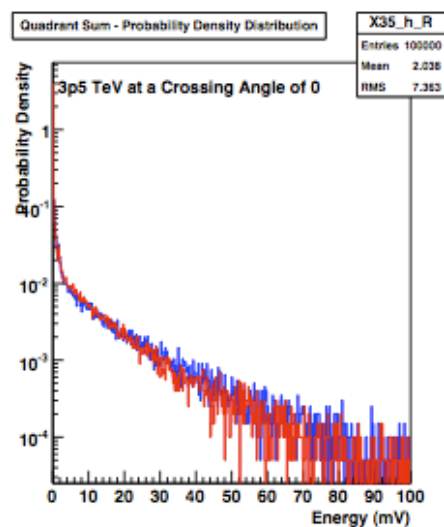
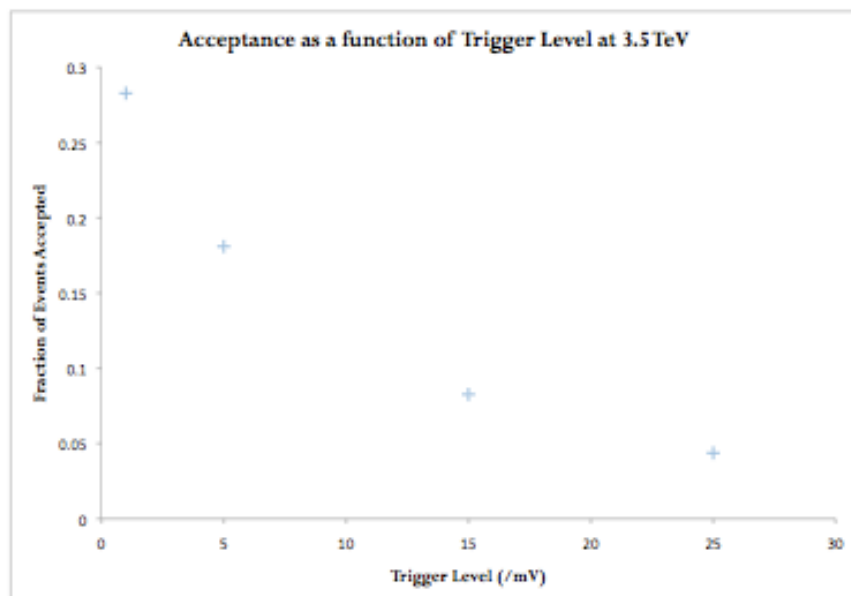
# Energy Deposition in TAN

\*Plots/DAT.



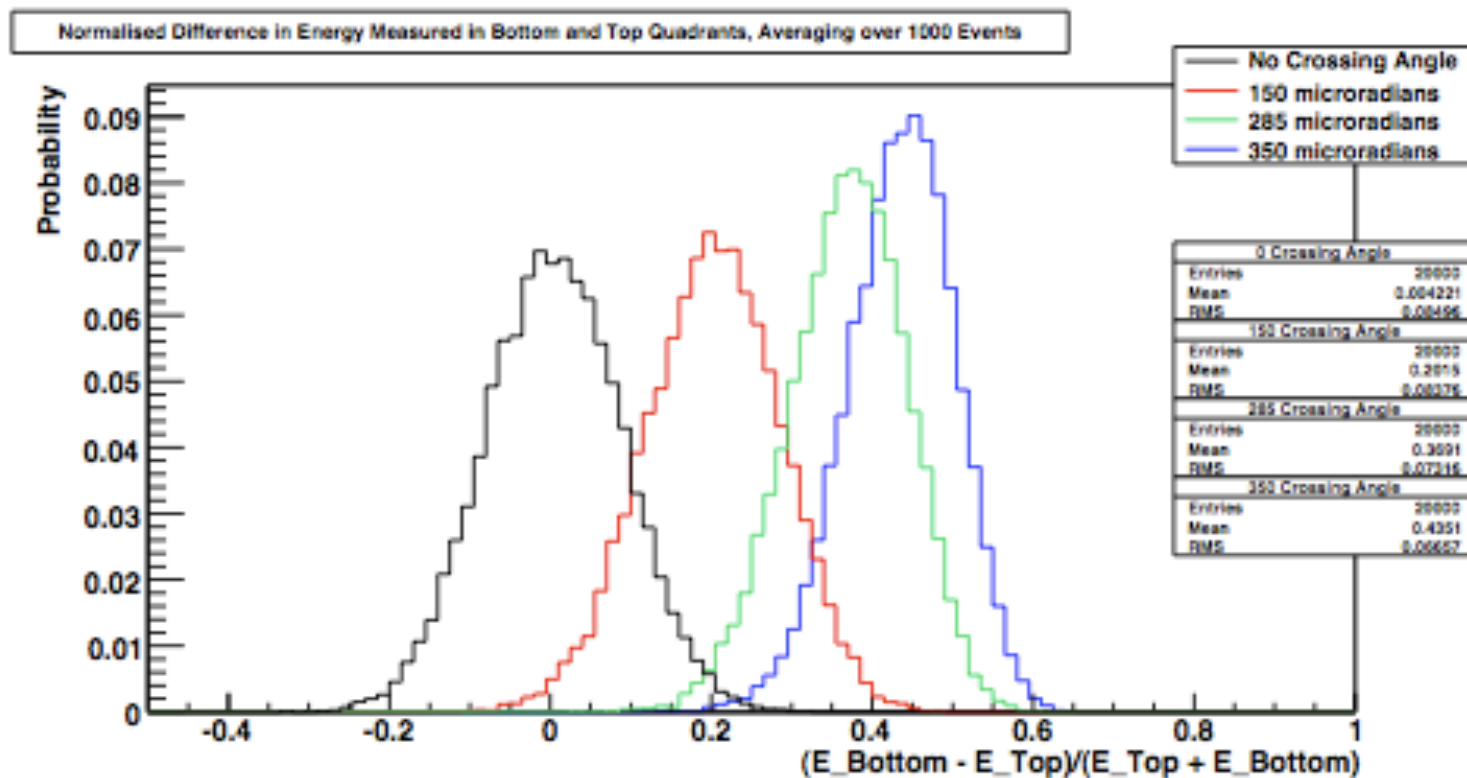
TAN horizontal cross sections, moving up  
Y=0 Beampipe center

# System Acceptance



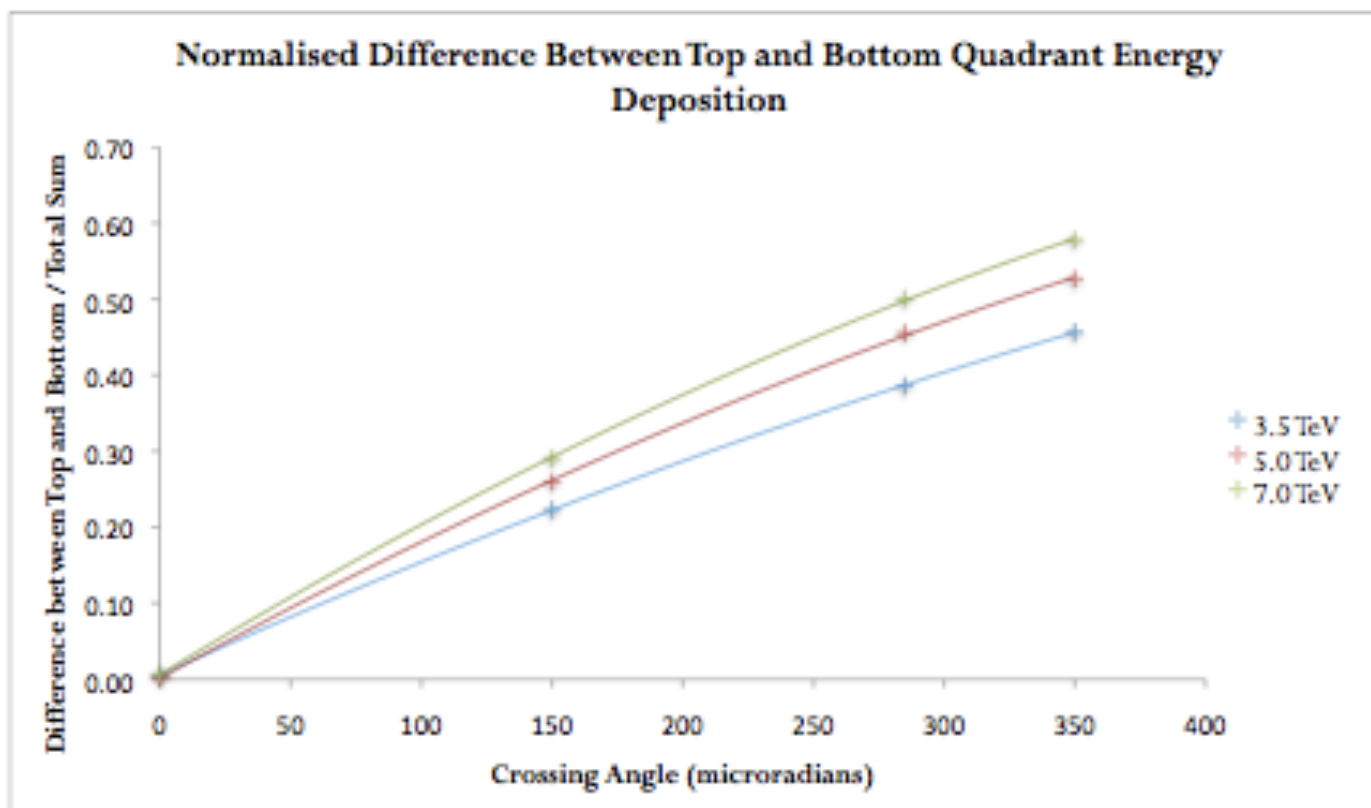
# Modeling - Crossing Angles

- Fixed Energy – 3.5 TeV



# Crossing Angles

- Shower more focused at 7 TeV, as expected





# Modeling Results Summary

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- Improving model from simple Cu/Tungsten block to the actual ZDC gave smaller signals
  - Agrees with measured results
  - Acceptance is  $\sim 5\%$
- Completed studies at 3.5, 5 and 7 TeV
- Expect to see crossing angles at these energies



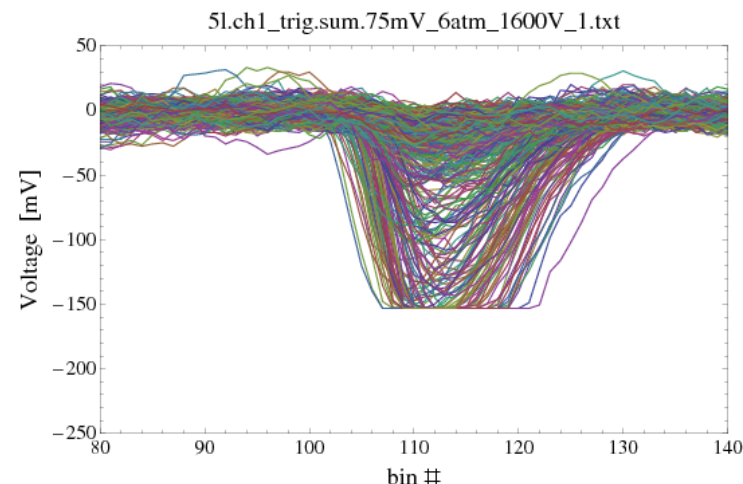
# System Studies with Beam

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

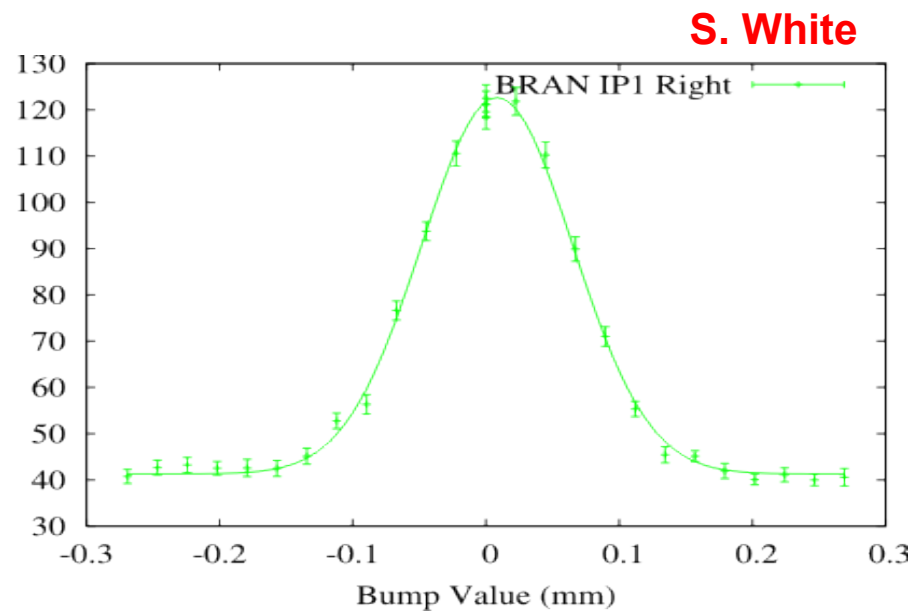
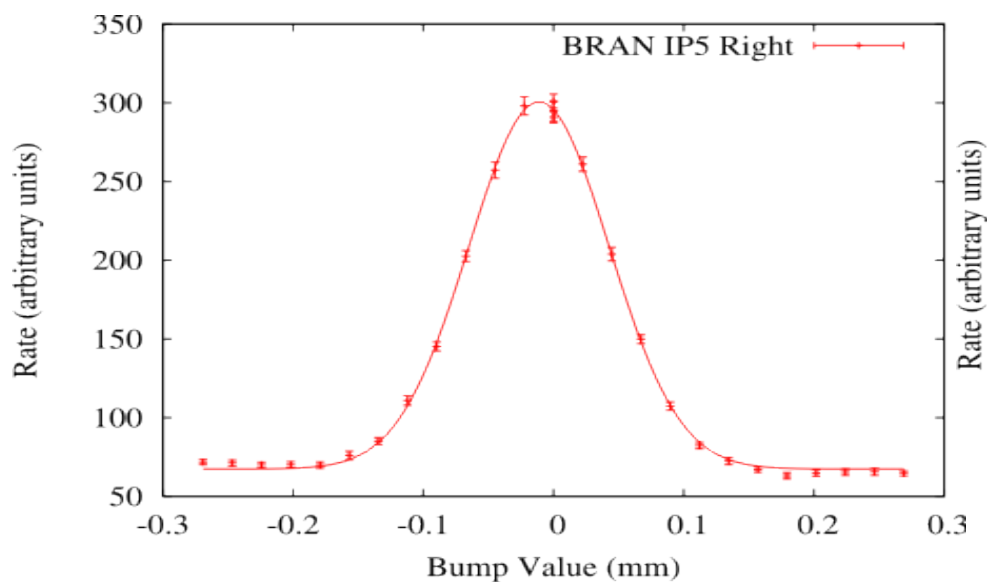
# Beam Measurements - Analog

- Signals at  $10^{32}$ 
  - Histograms from July data
  - Noise histograms
  - Bunch spacing
- Plan to add attenuation to analog signals



# Beam Measurements - Counting

- Profile measurements from lumi scans





# BRAN vs Experiments

- Fit results comparison between BRANs and experiments:
- Constant added to the fit parameters to get a reasonable Chi2. Effect larger in IP5.
- Take only the best fit for each scan.

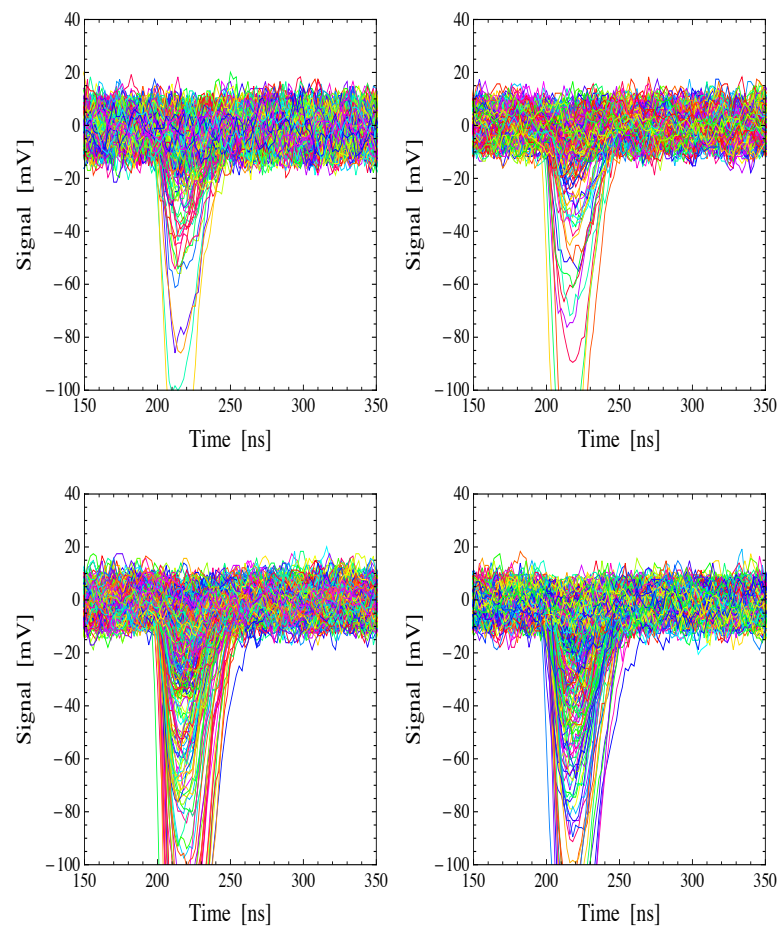
**S. White**

	$\sigma_{\text{effx}}$ (mm)	$\sigma_{\text{effy}}$ (mm)	Mean x (mm)	Mean y (mm)
BRAN IP1 (1)	0.0591+/-0.002	0.0624+/-0.0034	0.007+/-0.0001	0.002+/-0.0001
BRAN IP1 (2)	0.0585+/-0.034	0.0618+/-0.0034	0.006+/-0.0001	4e-5+/-0.0001
ATLAS (1)	0.0589+/-0.0004	0.0622+/-0.001	0.007+/-0.0001	0.002+/-0.0001
ATLAS (2)	0.0590+/-0.0005	0.0623+/-0.0009	0.006+/-0.0001	4e-5+/-0.0001
BRAN IP5 (1)	0.0548+/-0.0018	0.0596+/-0.0022	-0.01+/-0.0001	0.003+/-0.0001
BRAN IP5 (2)	0.0556+/-0.0018	0.0598+/-0.0022	-0.01+/-0.0001	0.002+/-0.0001
CMS (1)	0.0553+/-0.0006	0.0596+/-0.0005	-0.01+/-0.0001	0.003+/-0.0001
CMS (2)	0.0554+/-0.0005	0.0602+/-0.0004	-0.01+/-0.0001	0.002+/-0.0001

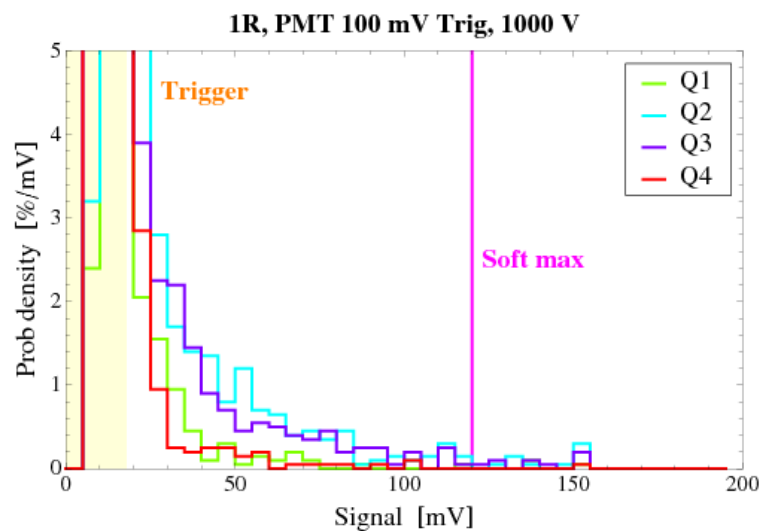
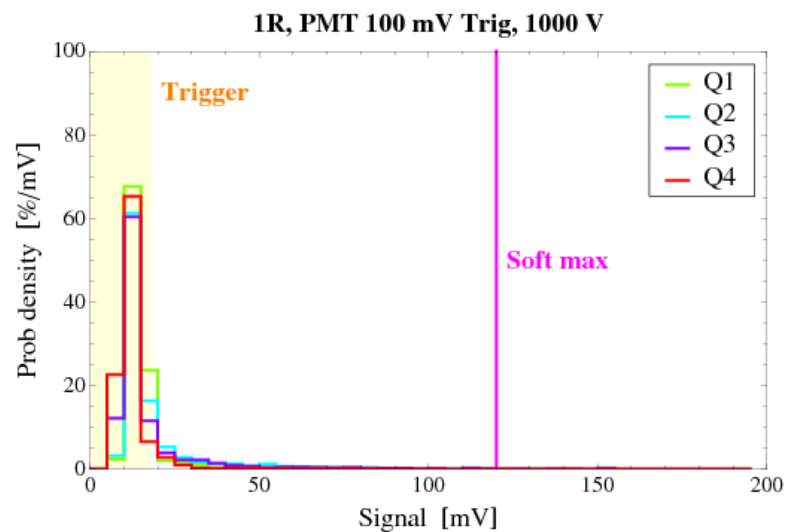
- Excellent agreement on the optimum : initial purpose of the BRANs.
  - Large error bars on the effective beam size. Still consistent with experiments data.
- ⇒ In general good agreement with experiment, large error bars due to background component
- and lower efficiency.

# Analog Signals

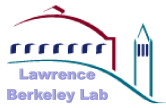
Collected 1000 shots with external  
Trigger (PMT)



# Signal Histograms



Atlas case shown

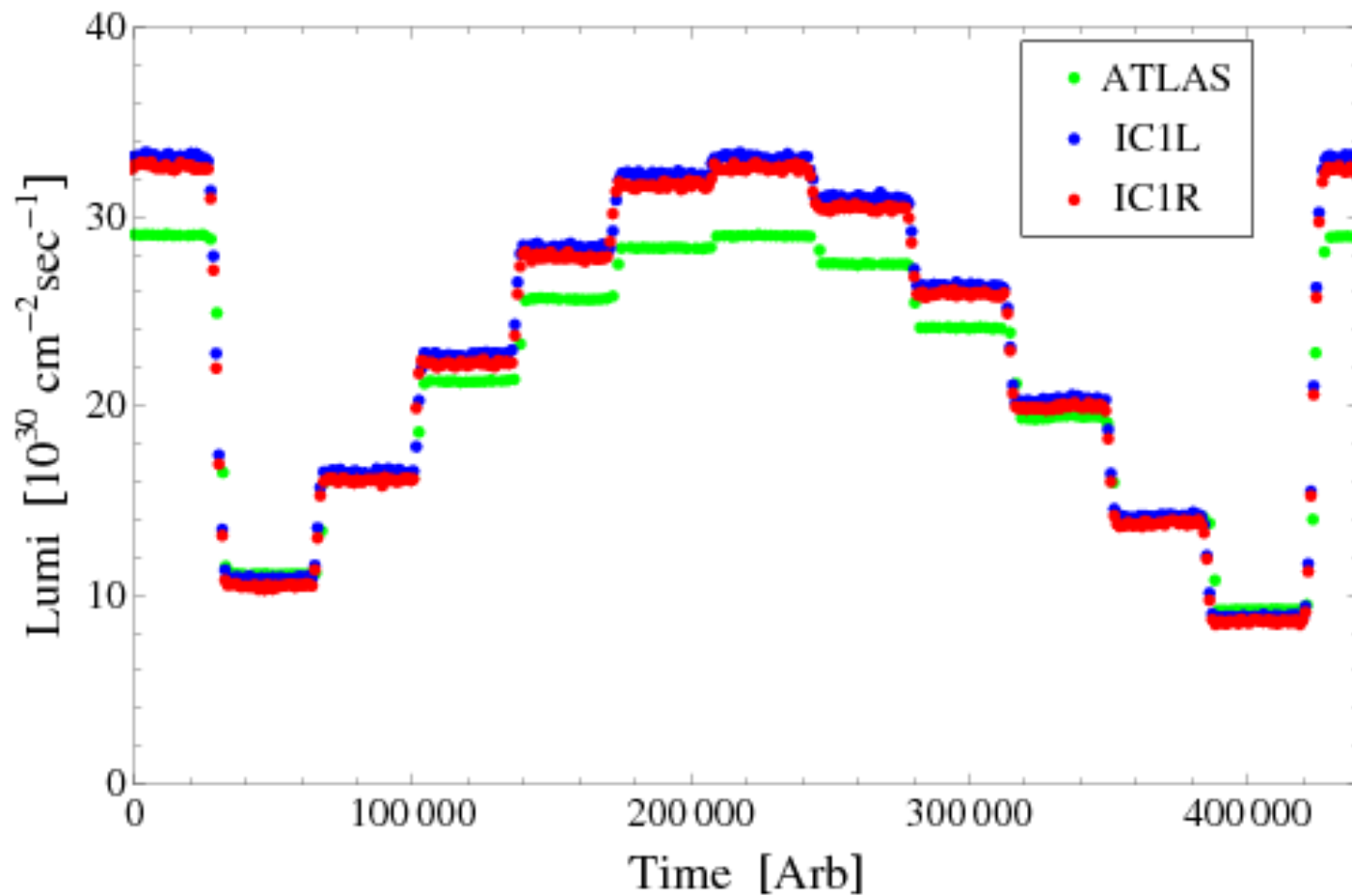


# Beam Measurements - Counting

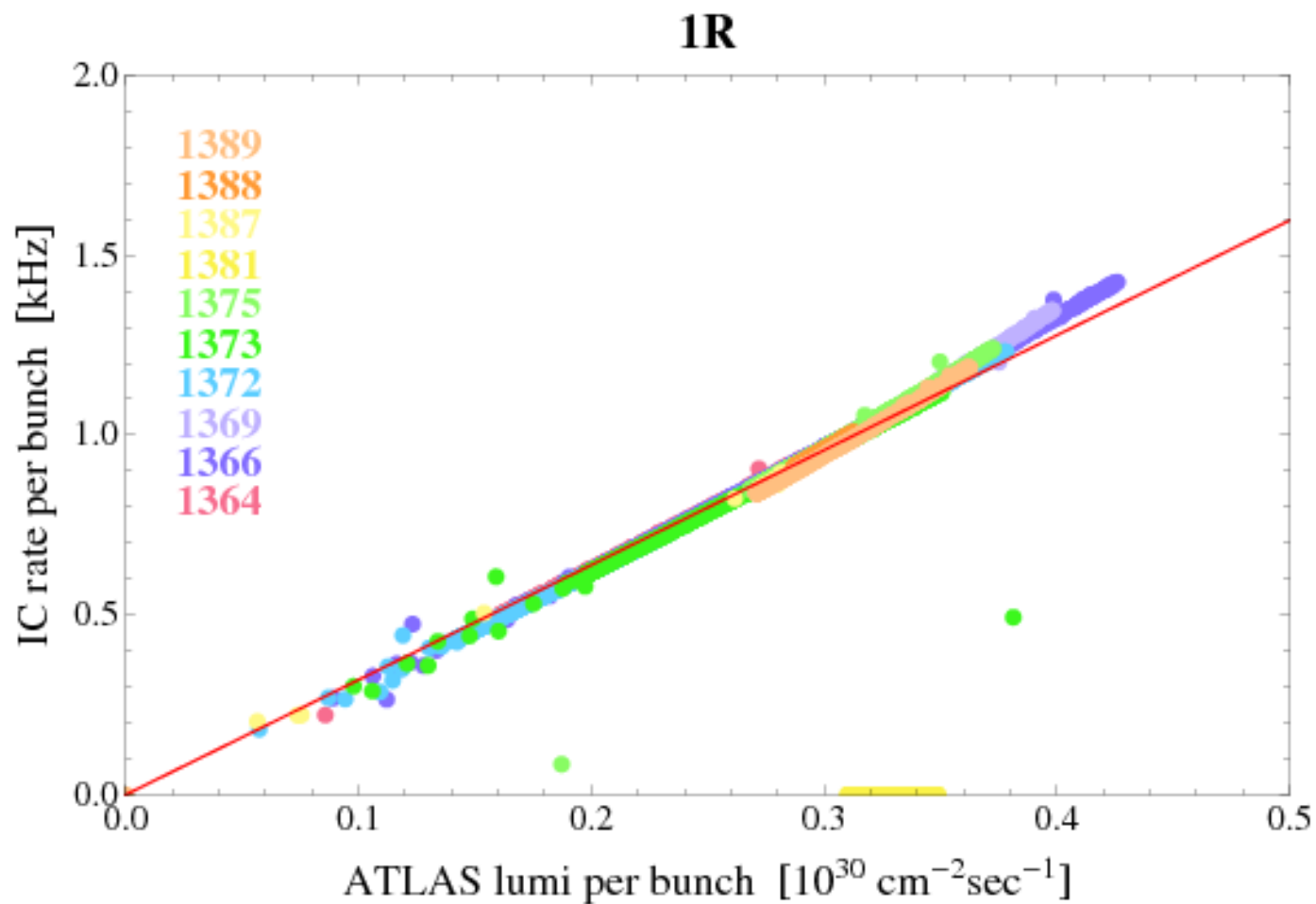
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- Counting rates
  - Linearity
  - Scatter plots with PMT (low L), Experiments (higher L)
- Crossing angles
  - ATLAS, CMS
  - Check cabling
- Bunch by Bunch

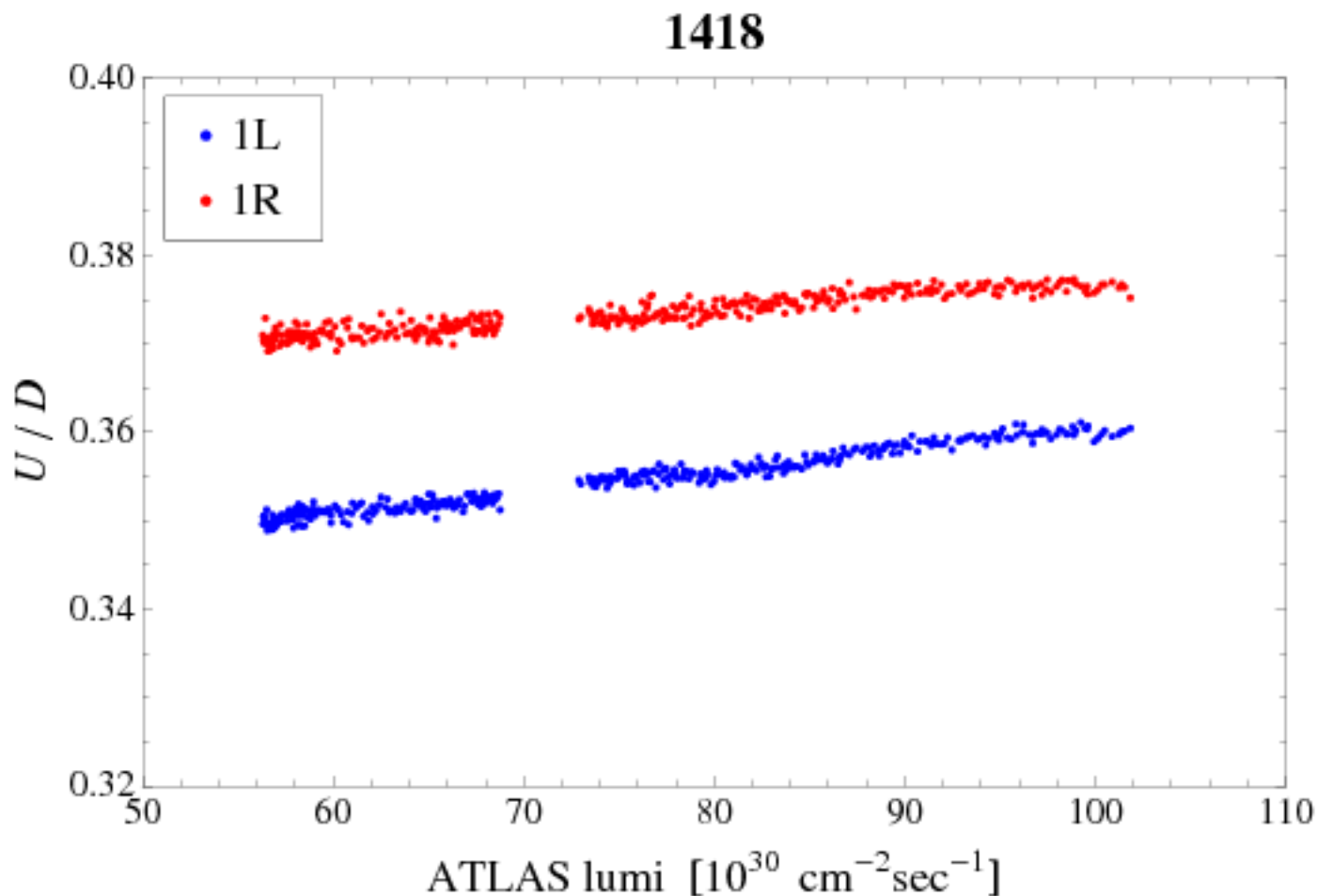
# Vernier Scans



# Linearity

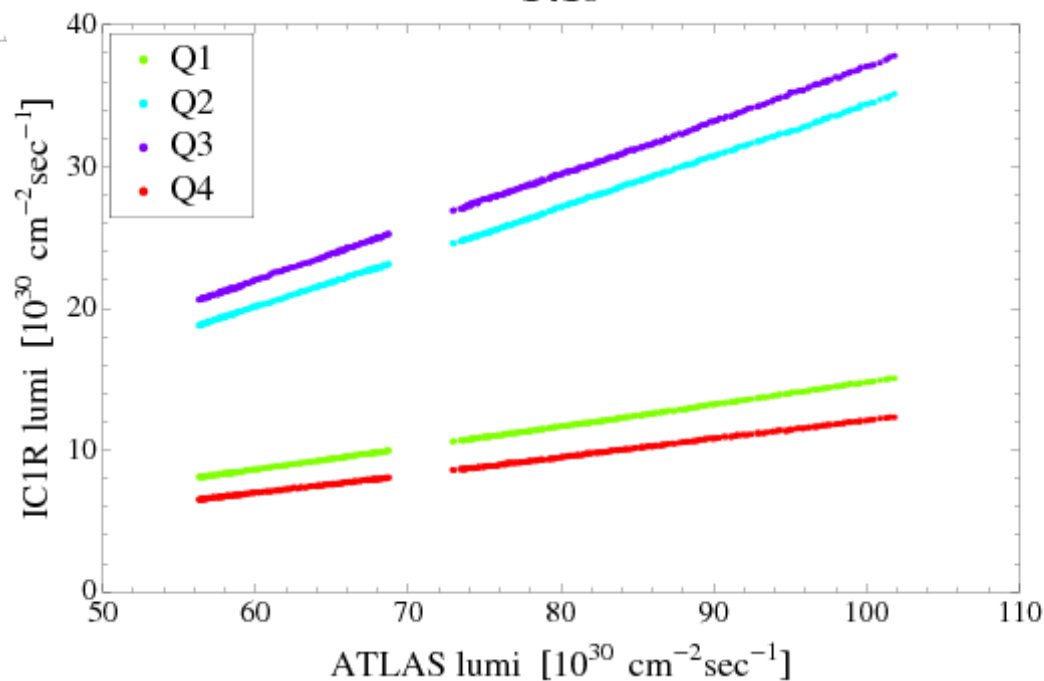
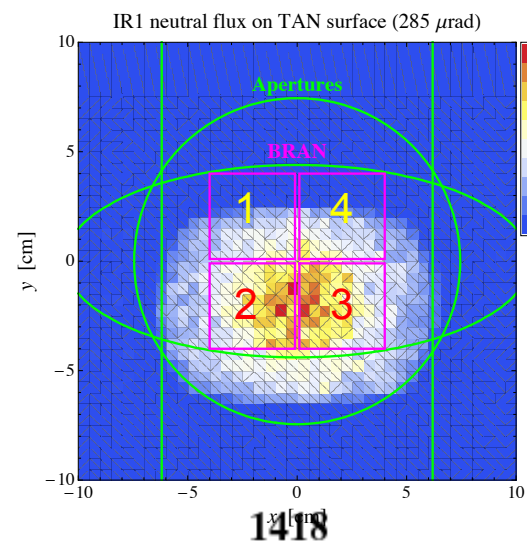
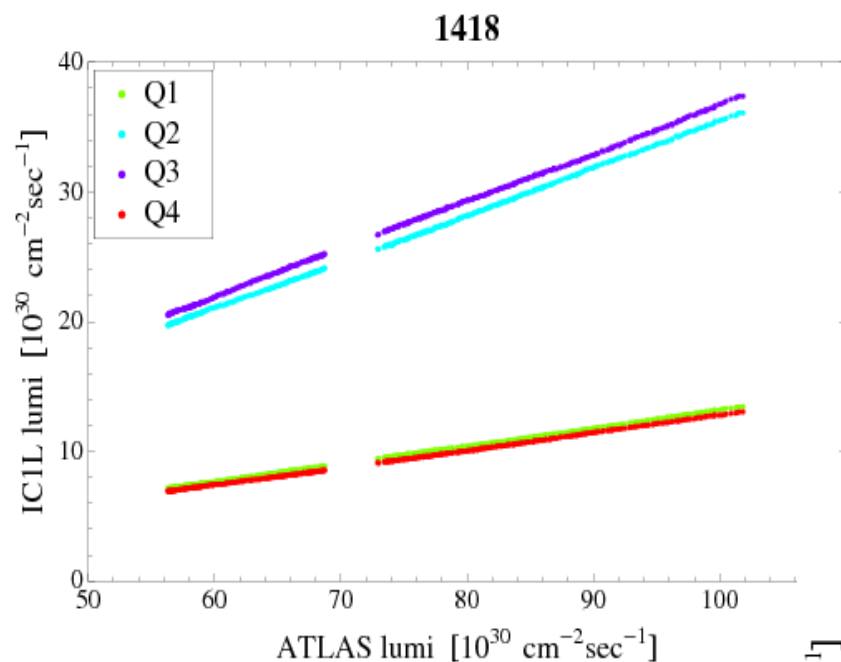


# Crossing Angles



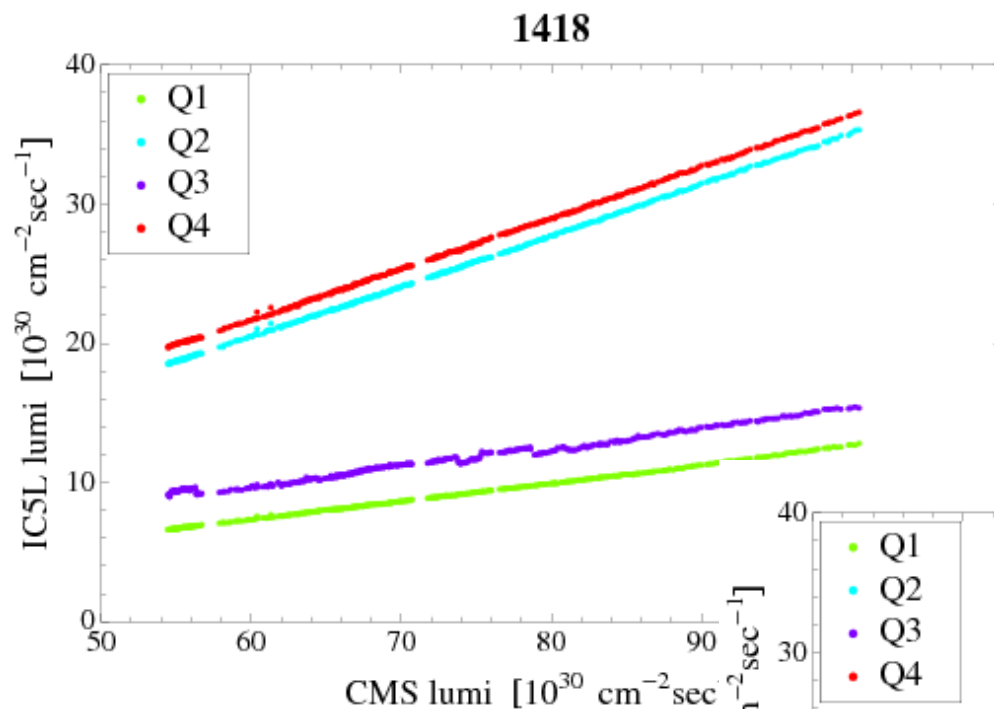
- Different paths for each beam at ATLAS

# Crossing Angles - ATLAS

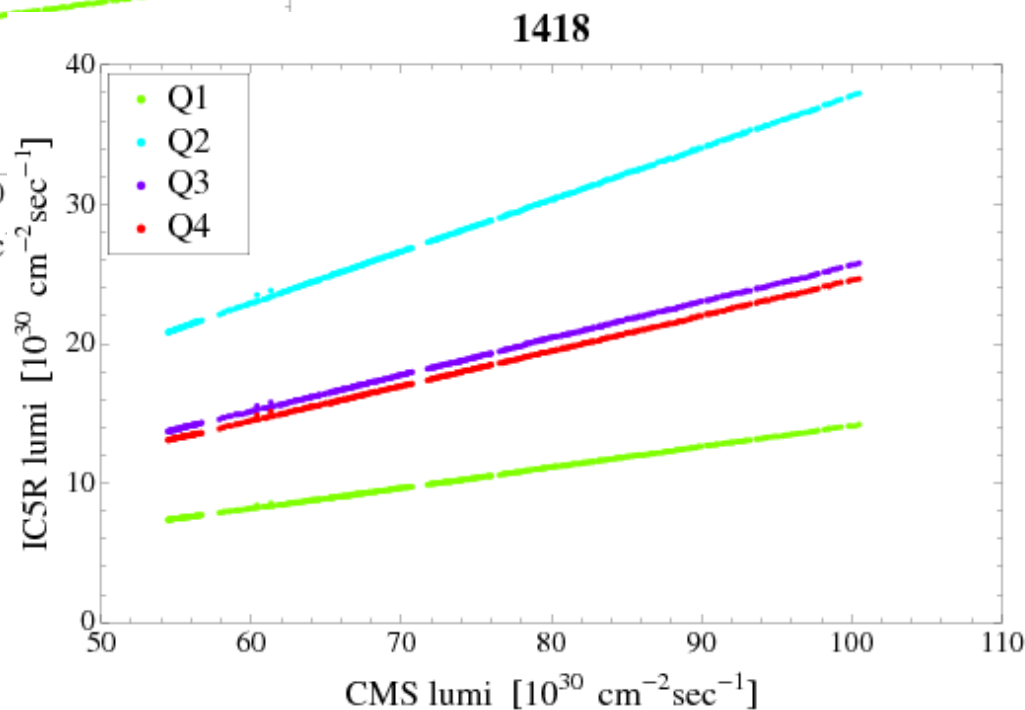




# Crossing Angles - CMS

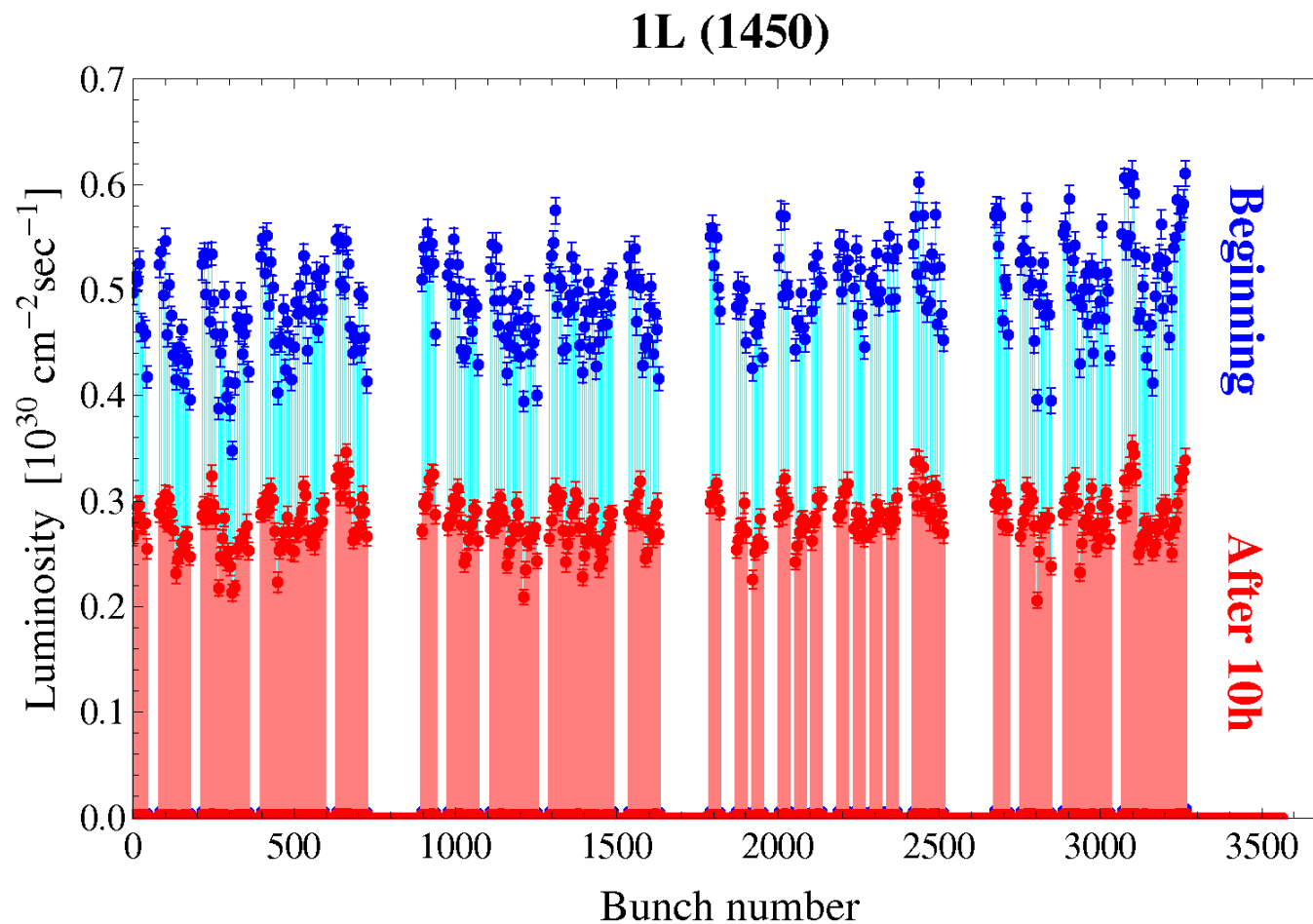


- Crossed signals?
- Expect 3,4 >> 1,2



Something wrong?

# Bunch Measurements – b-b



Plan to study normalized B-B luminosity by using current monitors

# Ongoing Development

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- Pulse height mode
  - Supporting software just provided
  - Troubleshooting single quadrant readout
- Deconvolution for bunch spacing  $< 75$  ns
- Four Q logging commissioning
- Heavy Ion Run

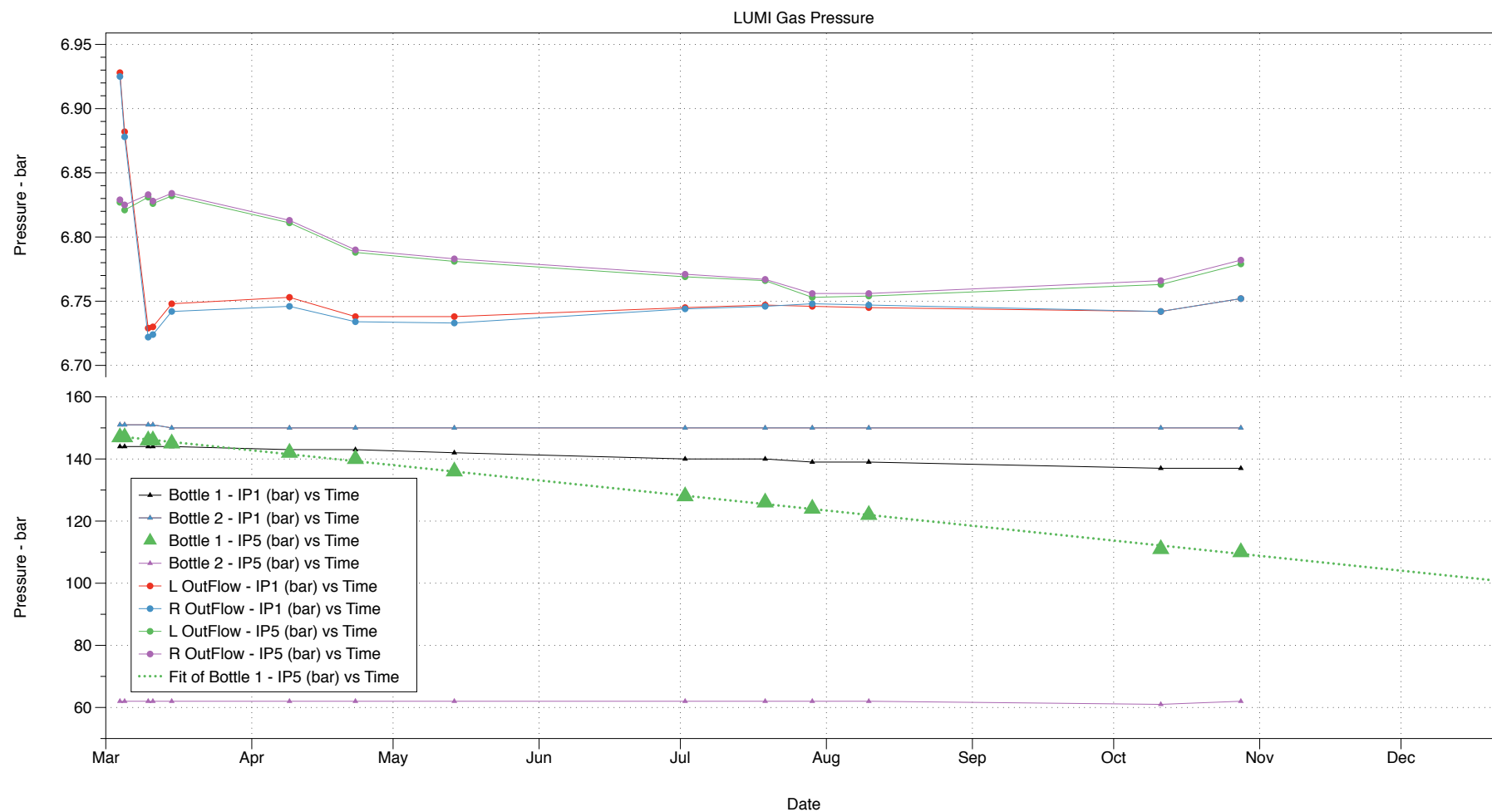


# Plans for Heavy Ions Run

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- Expect stronger signals
- Joined collaboration for HI physics
  - Initial modeling from ZDC groups shows lower acceptance
- Start with same configuration
  - Same pressure and voltage

# Gas System



# Plans for the next year

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- Continue to support devices into operations
  - $\geq 50$  ns mode
  - Crossing angles
  - Single quadrant monitoring
  - Develop operational procedures
- Complete handoff to CERN
- Ryoichi Miyamoto (Toohig fellow) remains an essential part of the plan
- Publish papers

# Conclusions

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- First data from collisions at 3.5 TeV give very encouraging results
- Modeling efforts are supporting data analysis
- The system has become operational as the PMT system is starting to deteriorate with radiation damage
- Few commissioning tasks still underway