



DØ Instantaneous Luminosity

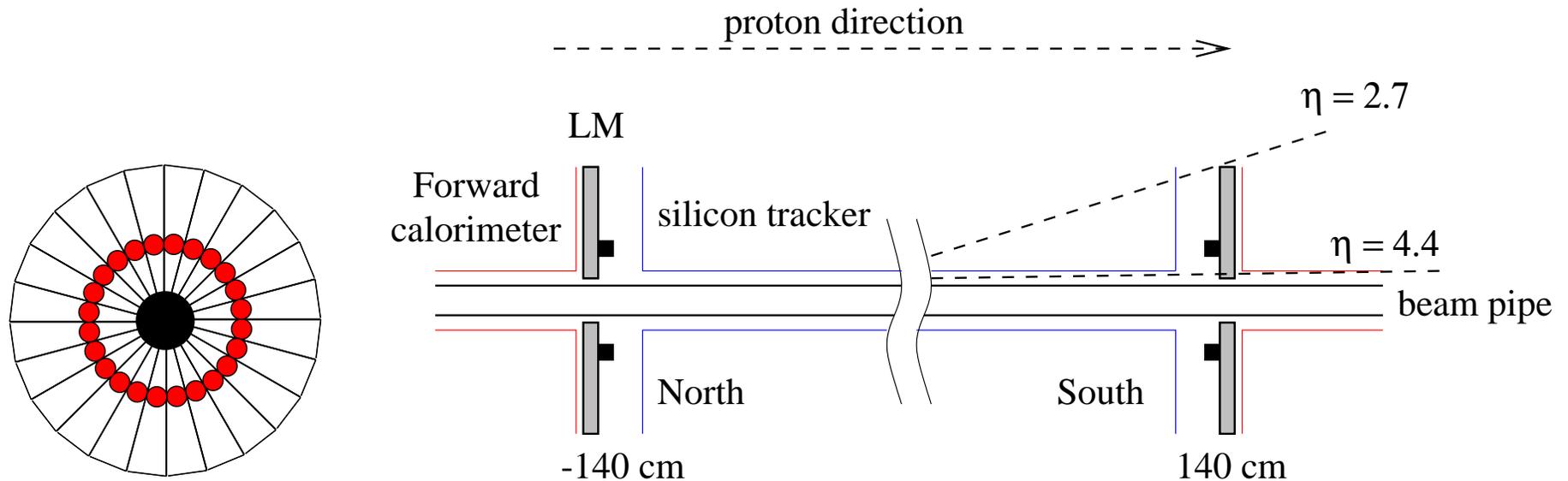
Brendan Casey

April 27, 2005

- Overview
- Baseline shift
- Deadtime
- Cross-checks

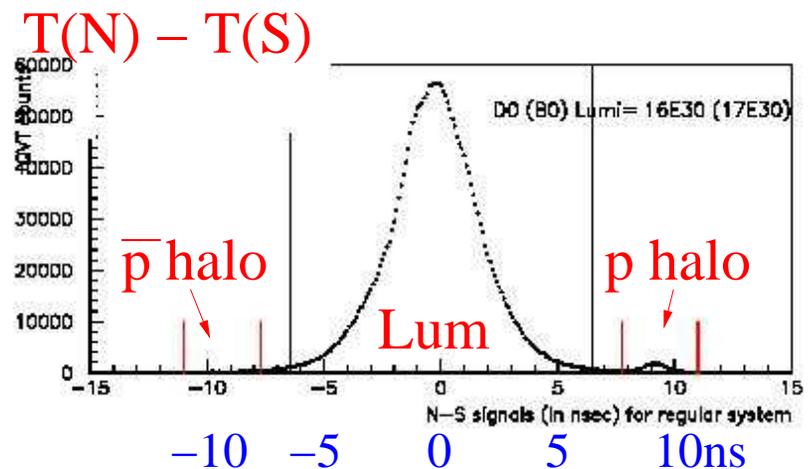


DØ Luminosity Measurement



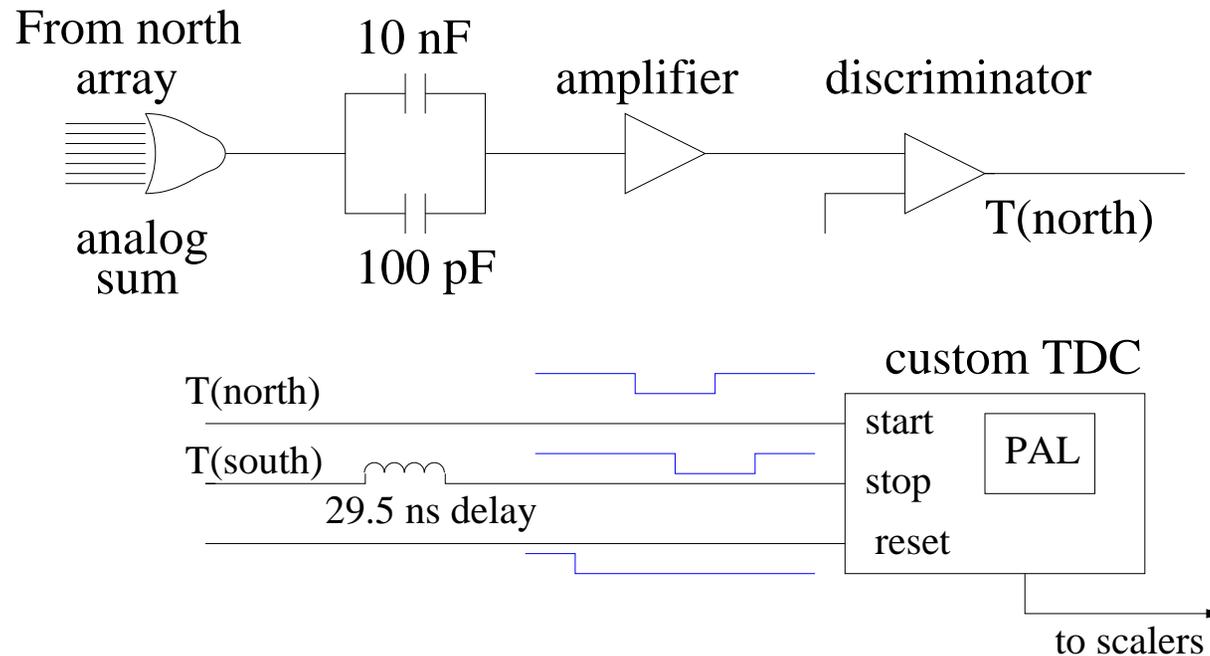
Inelastic collisions identified by coincidence in north and south scintillator arrays.

Timing info used to separate inelastic collisions from beam halo.





Detector Readout



PMT signals summed then discriminated → one timing signal each for north and south.

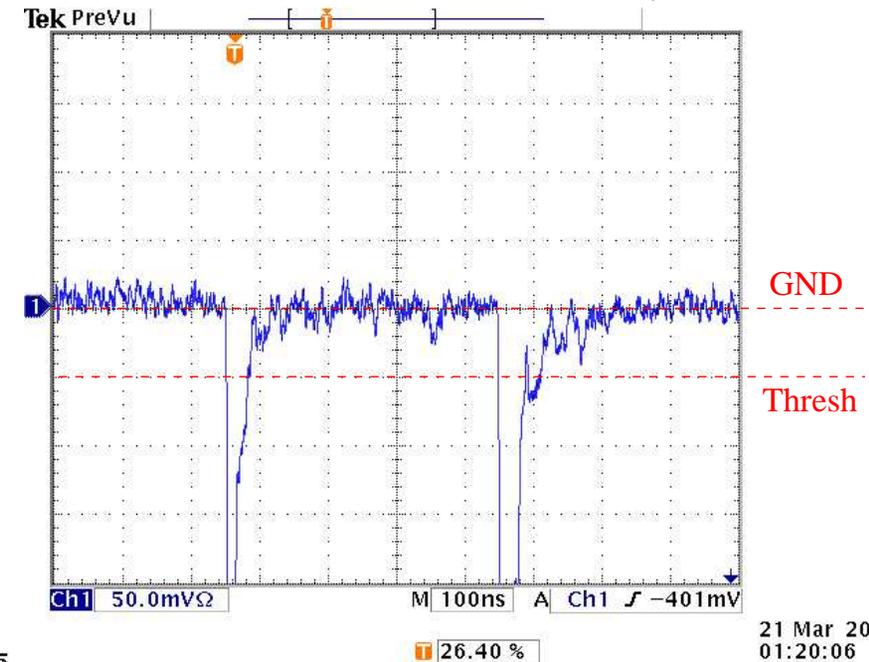
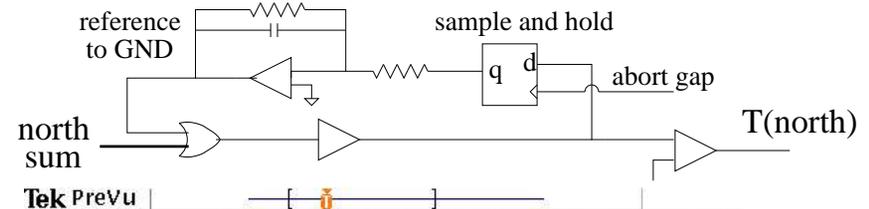
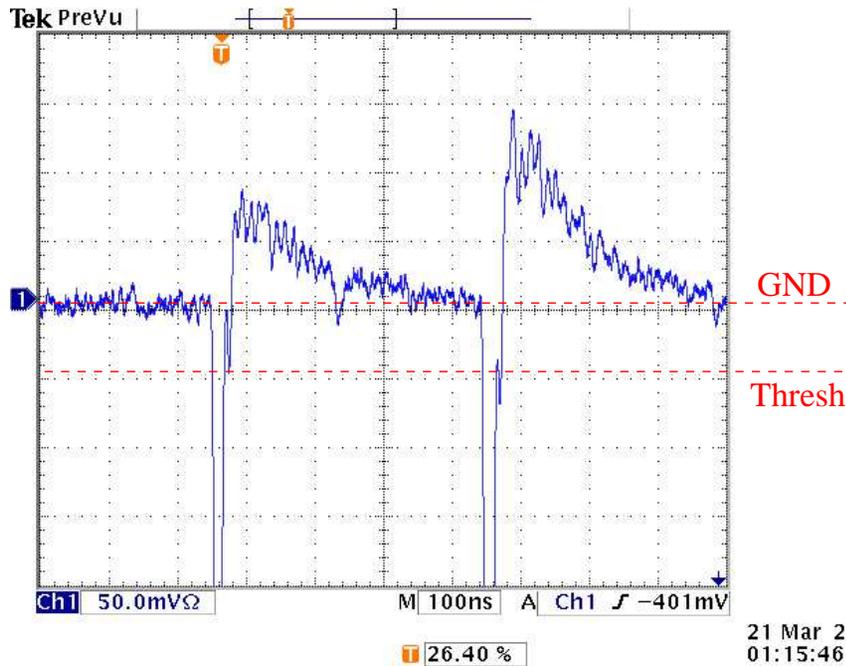
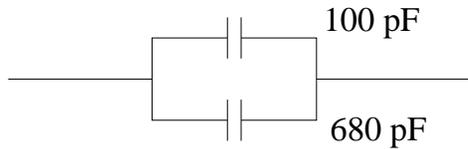
AC coupled after sum to remove any time dependent baseline shifts on detector and in summers

Fed into custom TDC: north = start, south = stop.

LUT in PAL to identify valid time differences.



Removing the Baseline Shift

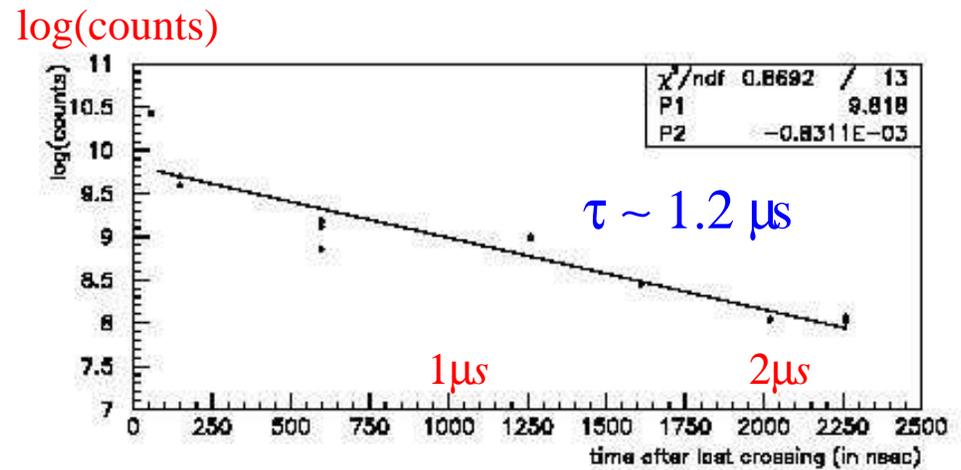
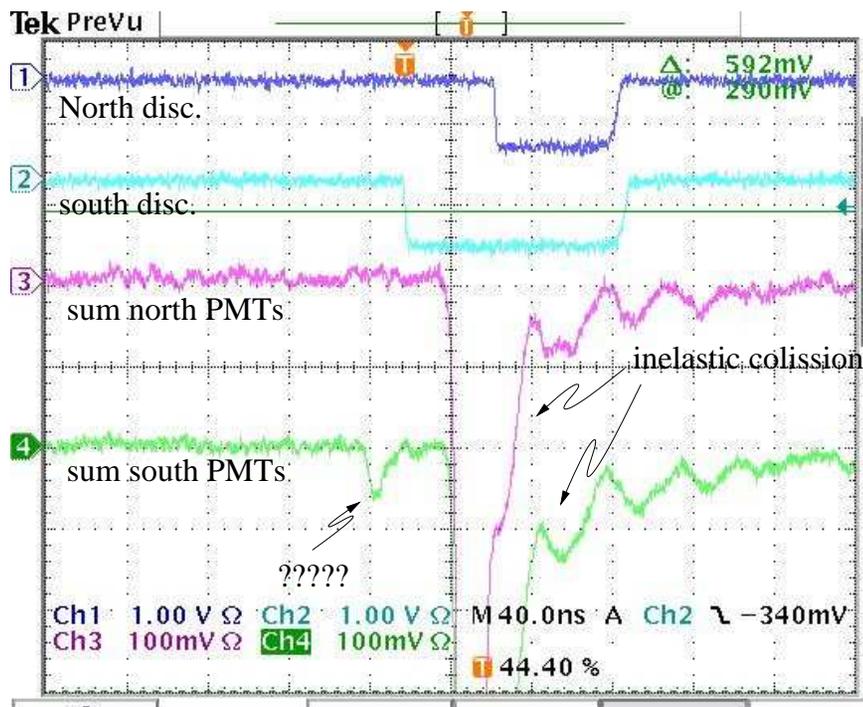


Use either smaller blocking capacitor or DC coupling with active baseline restoration to address impact of baseline shift.



Deadtime

Early hits trigger the start or stop on the TDC \Rightarrow readout is off until next reset. Corrections already in place for backgrounds in-time with bunches (halo).

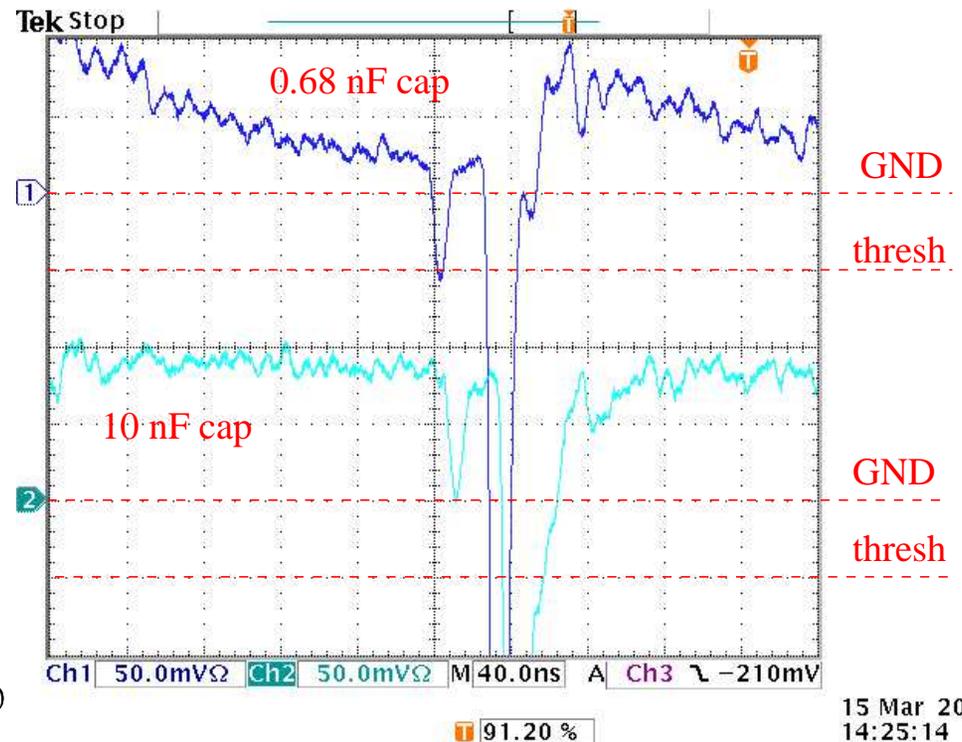
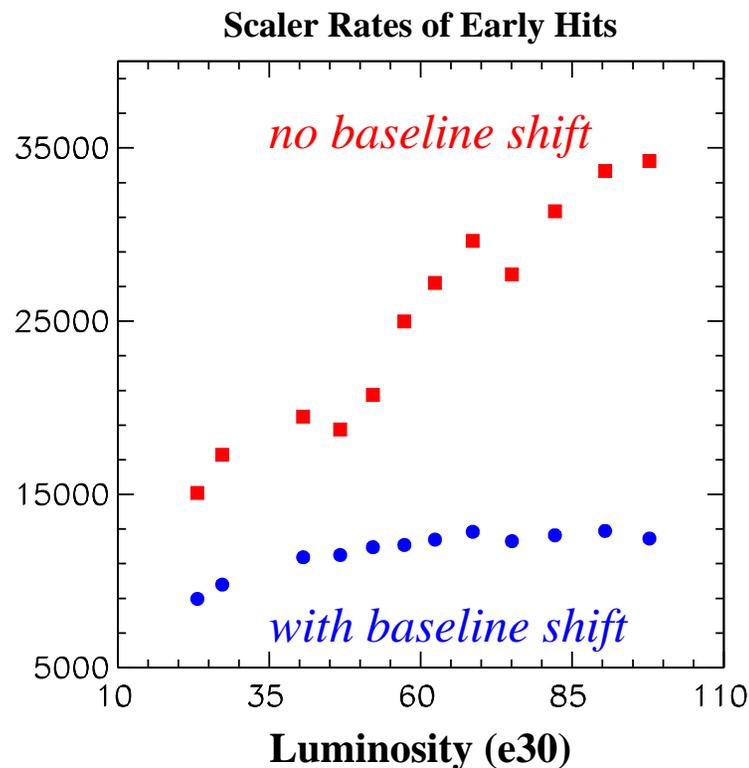


Time after last crossing in super bunch

Additional background observed in January 2005. Luminosity dependent but not in time with bunches. Most likely due primarily to detector activation.



Baseline Shift and Deadtime



Drastic increase in sensitivity to additional background once baseline shift removed.



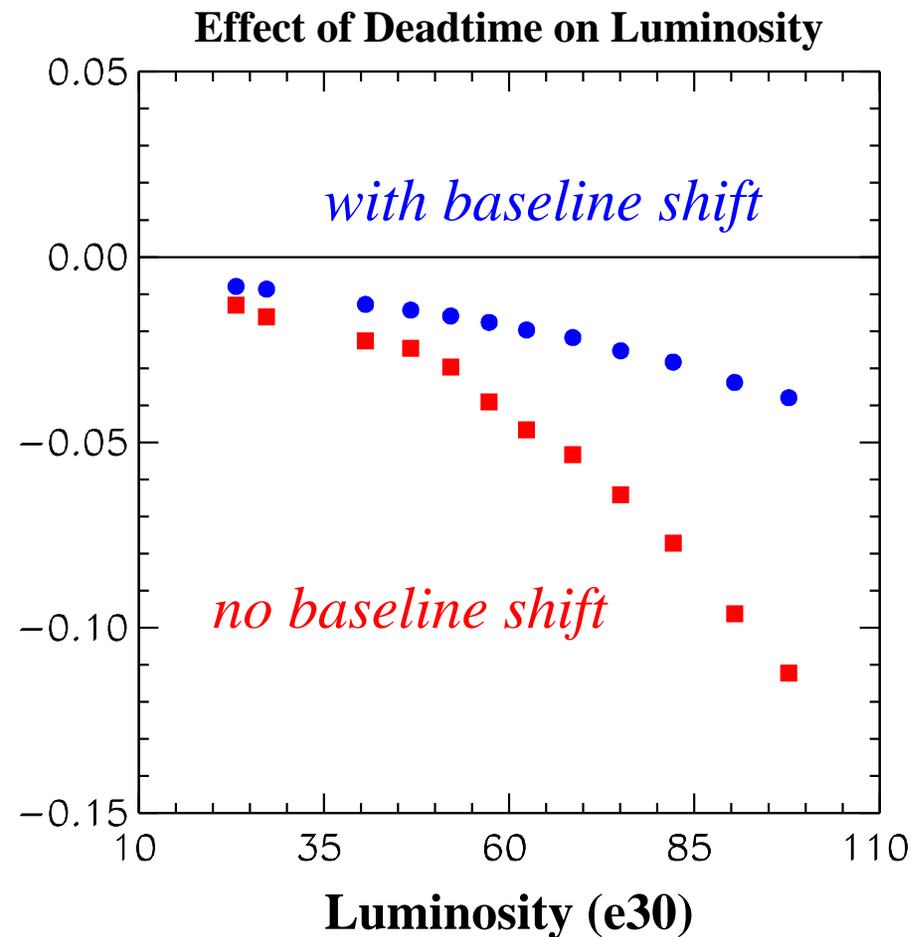
Deadtime and Luminosity



$$(L[\text{raw}] - L[\text{w/ deadtime correction}]) / L[\text{w/ correction}]$$

circles: effect of
deadtime on $L[10\text{nF}]$

squares: effect of
deadtime on $L[0.68\text{nF}]$



Deadtime: linear effect on scaler rate \rightarrow nonlinear effect on luminosity.



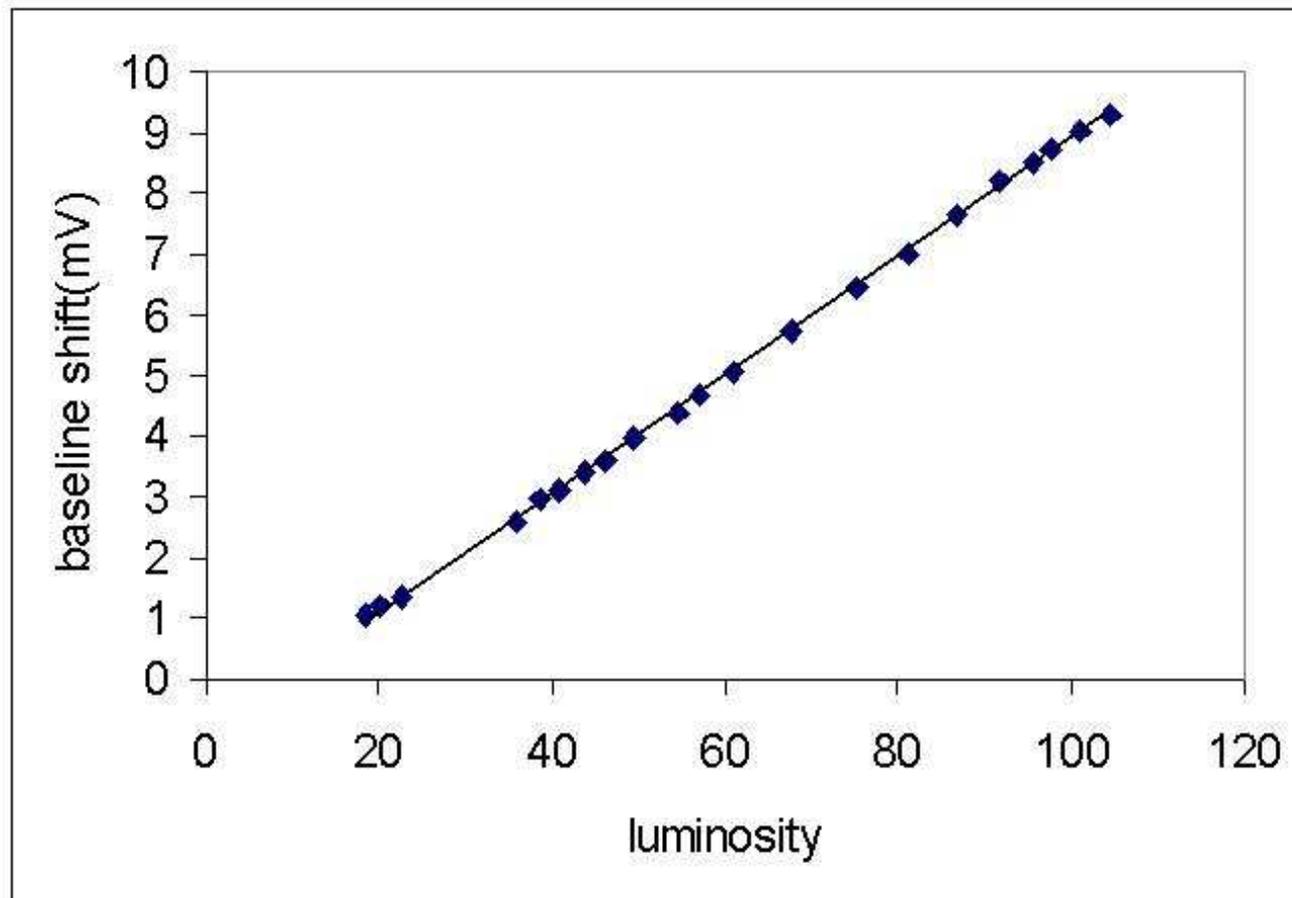
New Deadtime Correction

- First minimize deadtime:
 - reduce discriminator widths
 - delay reset: assert just before next collision
- measure deadtime online:
 - count crossings where both discriminators fire and one is not in time.
 - * these are ambiguous crossings where we can not rule out the presence of an inelastic collision.
- correct the scaler rates for the deadtime online. (Same as previous correction for backgrounds from halo.)



Cross Checks I

Luminosity counter PMT current versus luminosity

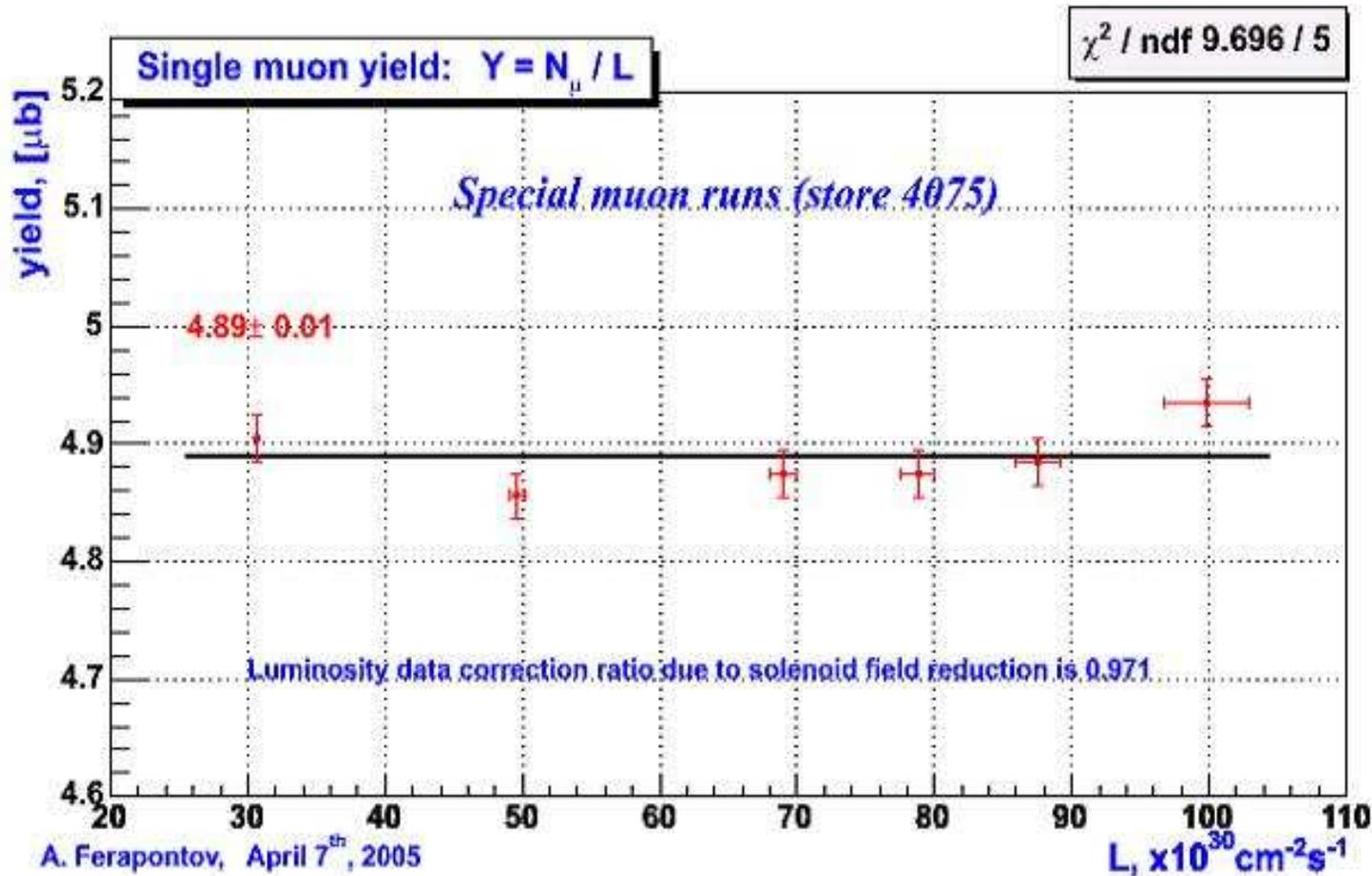


PMT current measured by looking at the baseline shift on a $10 \mu\text{F}$ capacitor in an independent path.



Cross Checks II

Forward muon cross-section versus luminosity



Possible systematic shifts at the few % level.



Conclusions

- Additional deadtime correction put online March 17, 2005
- Also switched from AC coupling with short time constant to DC coupling with active baseline restoration.
- These changes introduce a small shift in the overall luminosity scale at low luminosities.
- In the process of re-evaluating absolute efficiency of detector to account for new coupling scheme, additional deadtime correction, and new DØ solenoid magnetic field value.



Plans

New readout electronics are now calibrated \Rightarrow huge increase in our ability to perform fundamental tests of every aspect of the luminosity measurement

- much less sensitive to backgrounds from activation and halo
- higher efficiency than current readout chain
- charge and time information available for each PMT offline
 - allows better determination of the absolute efficiency
 - allows better cross-checks of MC inputs into the acceptance

Focus for the next several months on comparing results from new and old systems and redetermining efficiency and acceptance with new and old methods.