Total luminosity uncertainty through August 2004 & beyond

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GP meeting 9/15/04

Uncertainty sources

- Inelastic p-pbar Xsec
- CLC acceptance:
  - Geometry & generator
  - Beam position
  - CLC simulation
  - SPP calibrations
- Acceptance stability
- Online → offline transfer
- Beam losses
- Statistical uncertainty

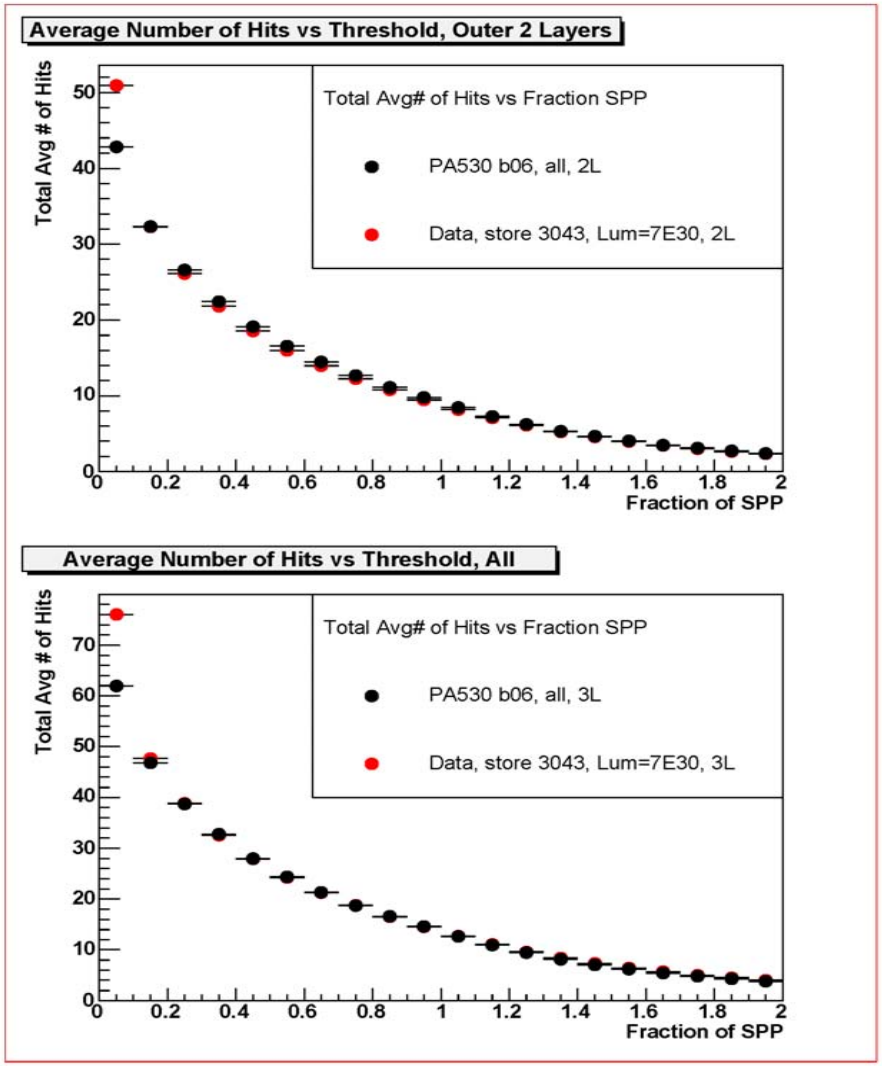
Cross checks

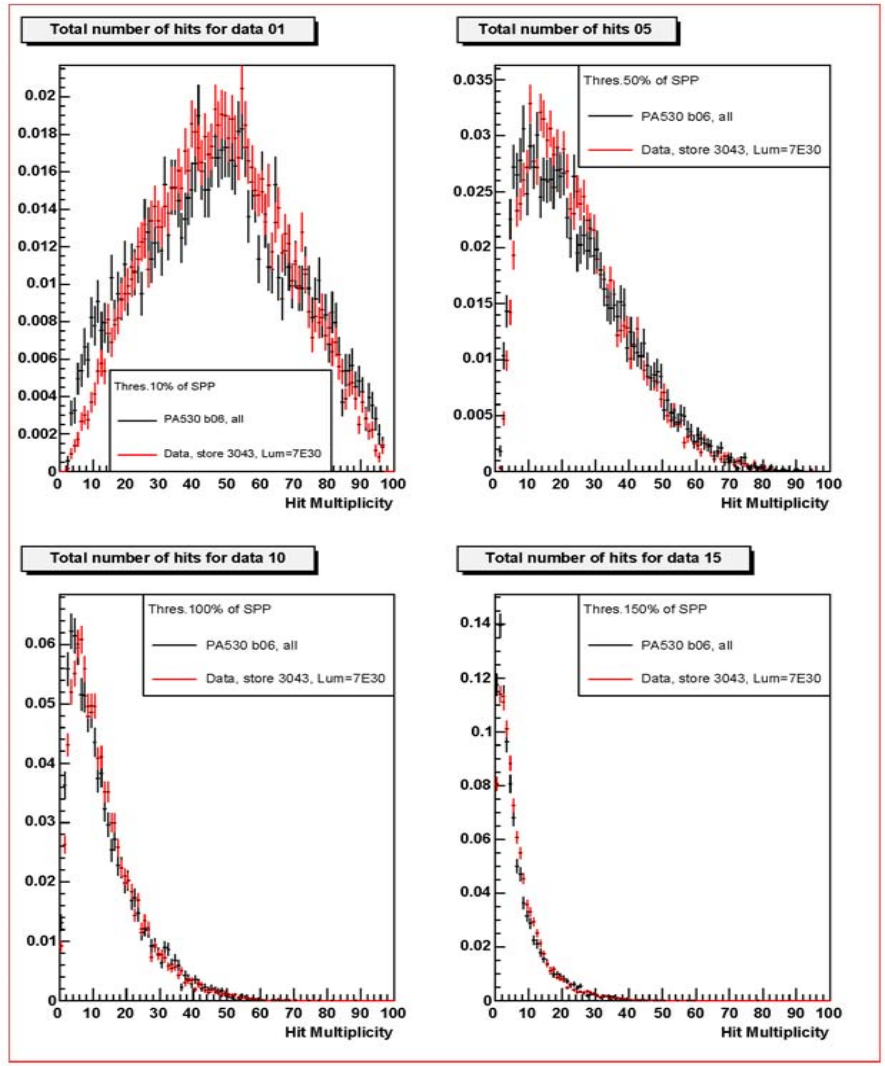
- CDF J/ψ yield VS inst luminosity
- CDF W yield VS inst luminosity
- *CDF luminosity VS COT currents*
- *AD estimated initial lum VS CDF luminosity*
- *0-counting VS particle-counting (underway)*

Uncertainty sources

Geometry and generator

(May 12 2004)

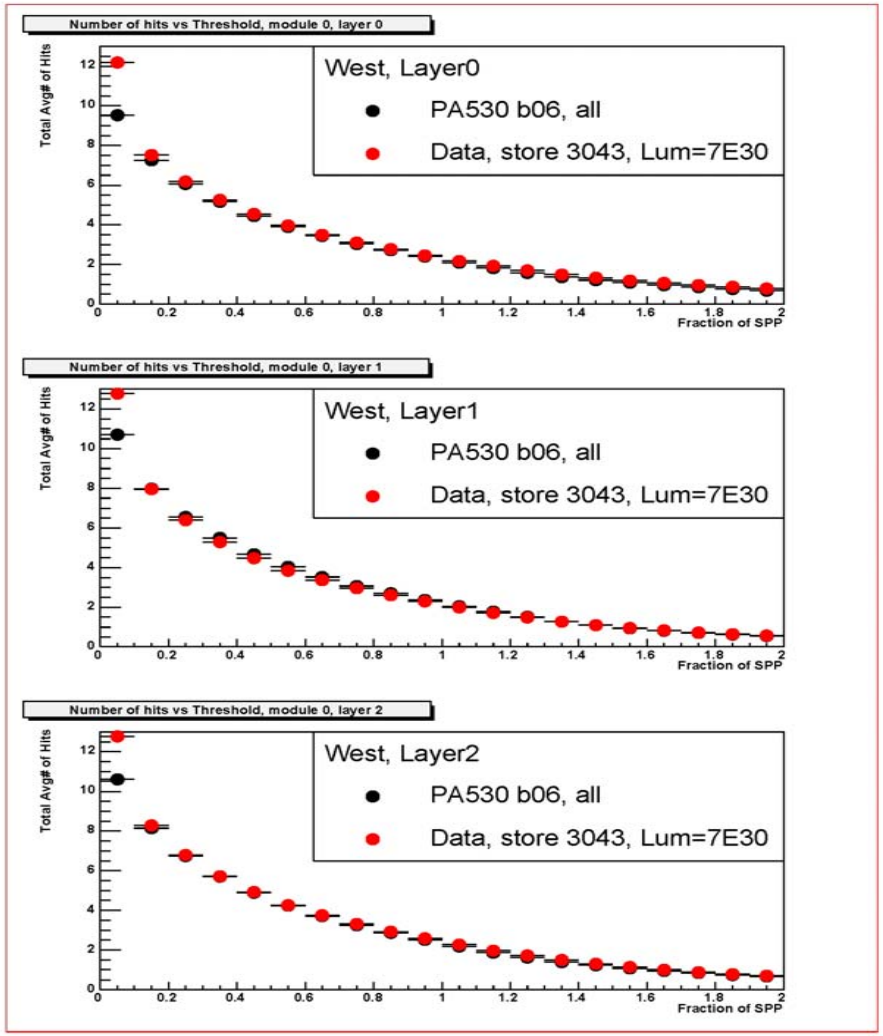


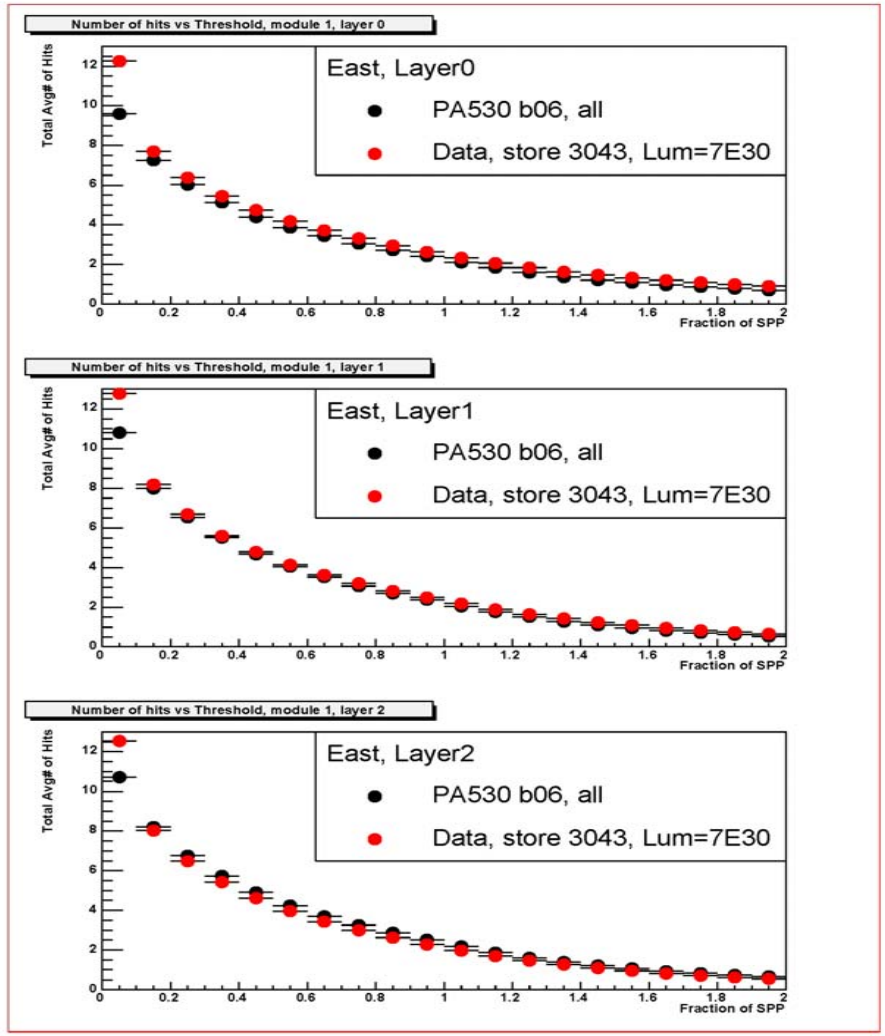


Pythia generator. hc, sd, dd processes.

Geometry and generator

(May 12 2004)

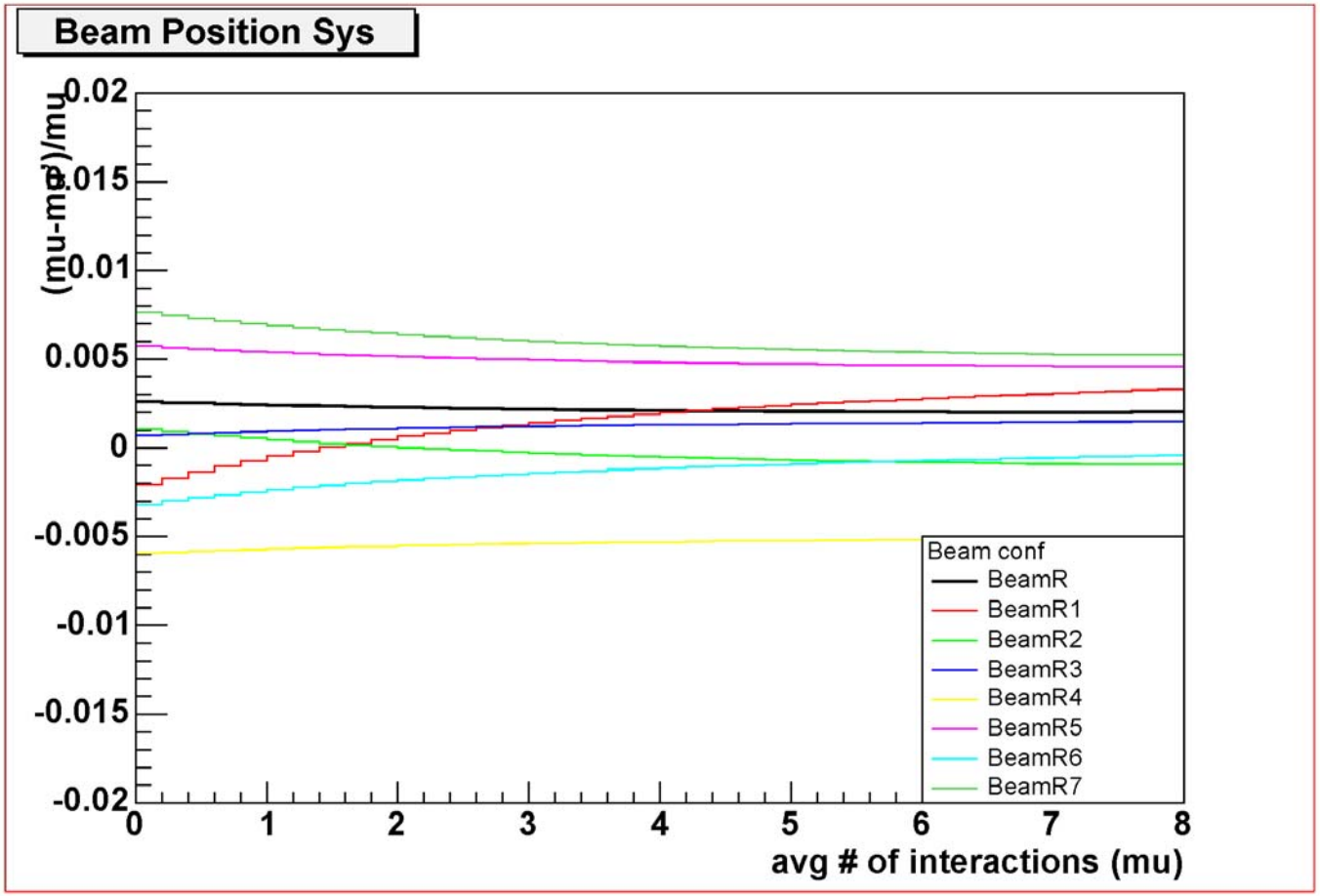




Systematics on luminosity due to detector simulation and generator have been evaluated to be in total **~ 3% (=3⊕2%)**.

Systematics from Beam Position

(May 26 2004)

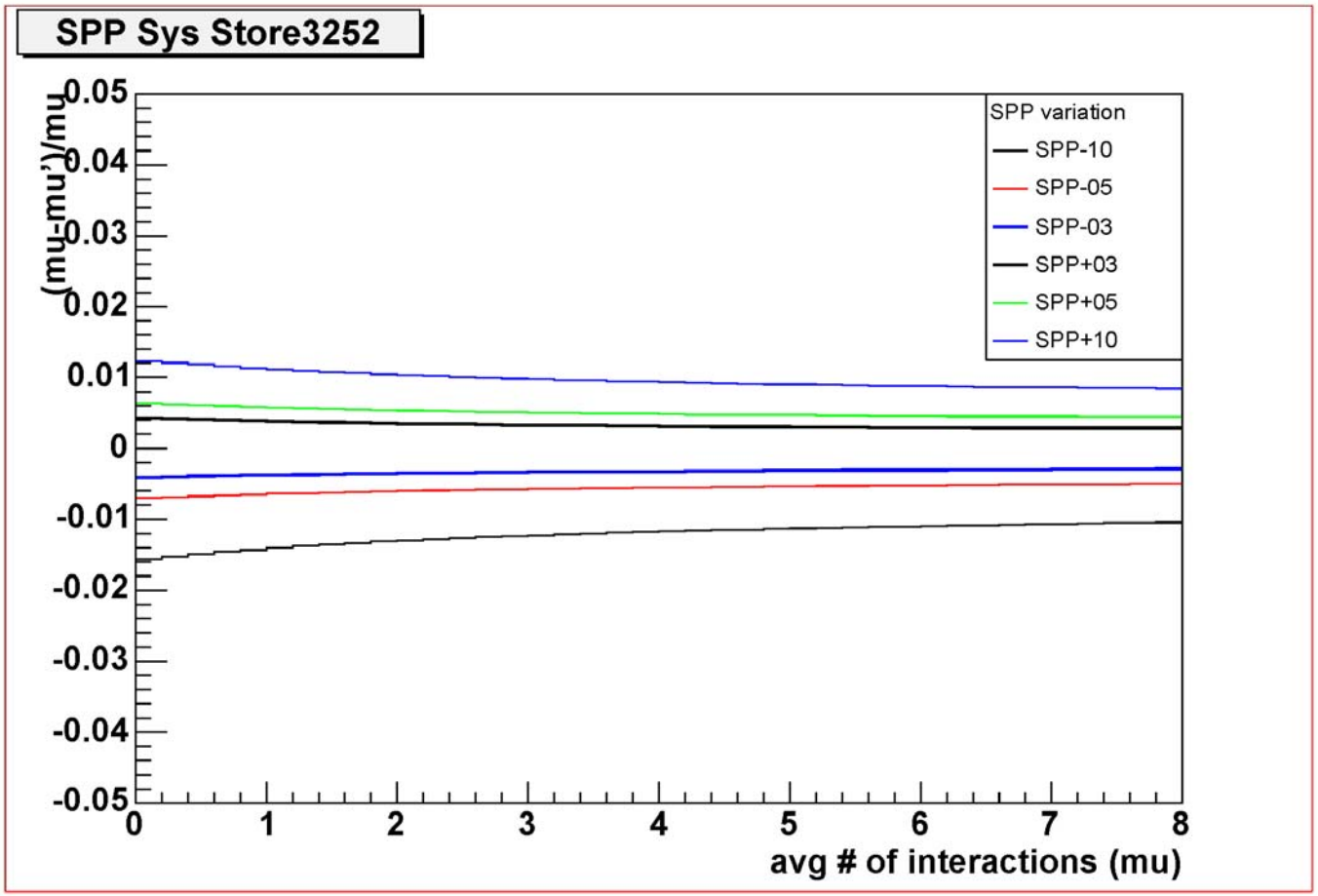


Systematics on luminosity due to beam position is **< 1%**.

Systematics from SPP

(May 26 2004)

	ISO cut	Lum dep.	Fit meth.	PED syst.	TOT
Systematics ON SPP	**2.1%**	**1.2%**	**1.3%**	**1.5%**	**3%**

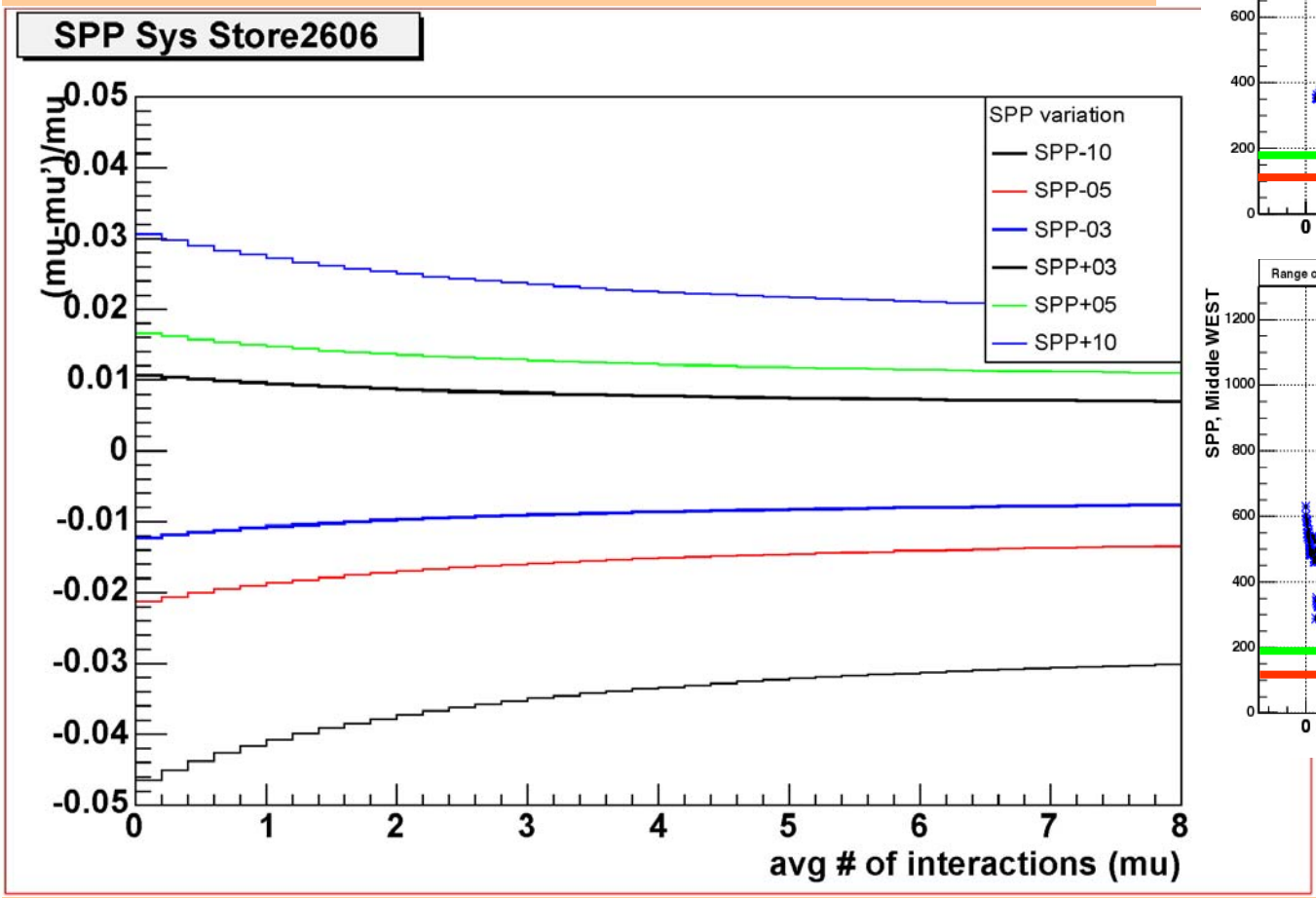


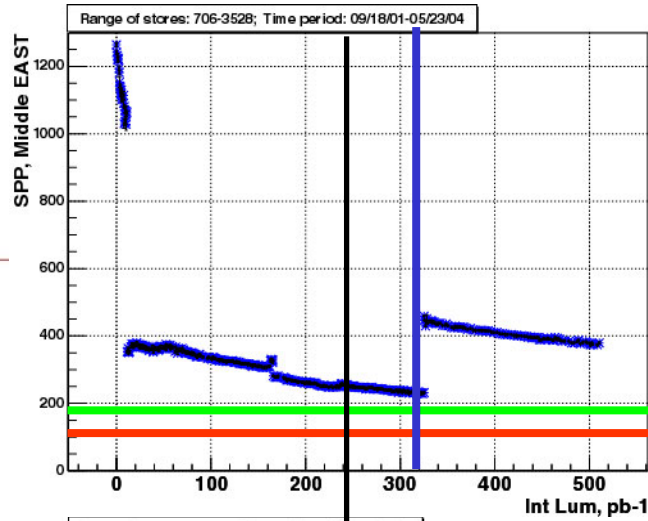
Systematics from SPP

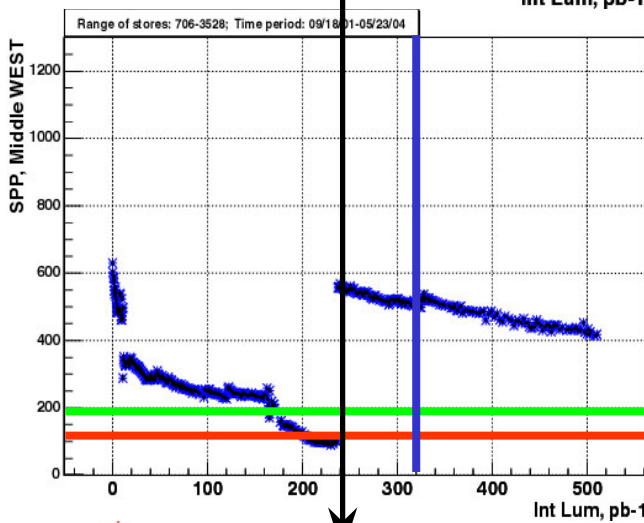
(May 26 2004)

Worst case scenario

At very low gain regime, the impact on luminosity is more significative.







Store 2606

Systematics on luminosity due to SPP uncertainty is **< 1%**.

Acceptance stability & online→offline transfer

(June 23 2004)

Acceptance varies with time, online code uses same effective x-sec over some period.

Values updated in order to keep:

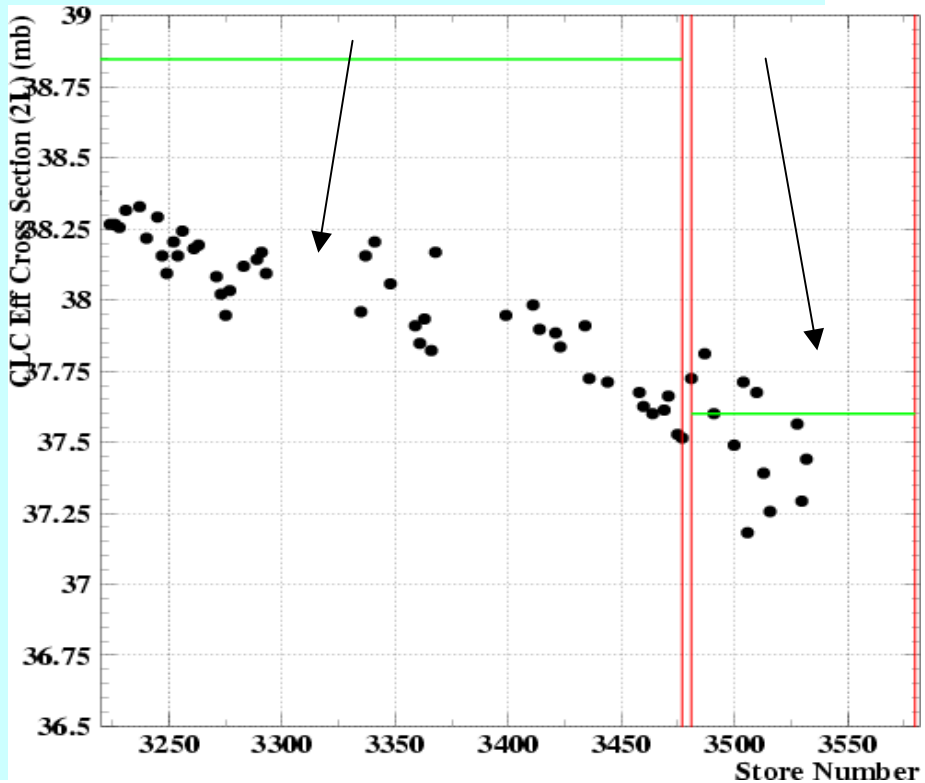
$$\left|L_{online} - L_{true}\right| < 2-3\%$$

- Offline luminosity recalculated so that:

$$\left|L_{offline} - L_{true}\right| < 1\%$$

- Online → offline transfer systematics is **negligible**

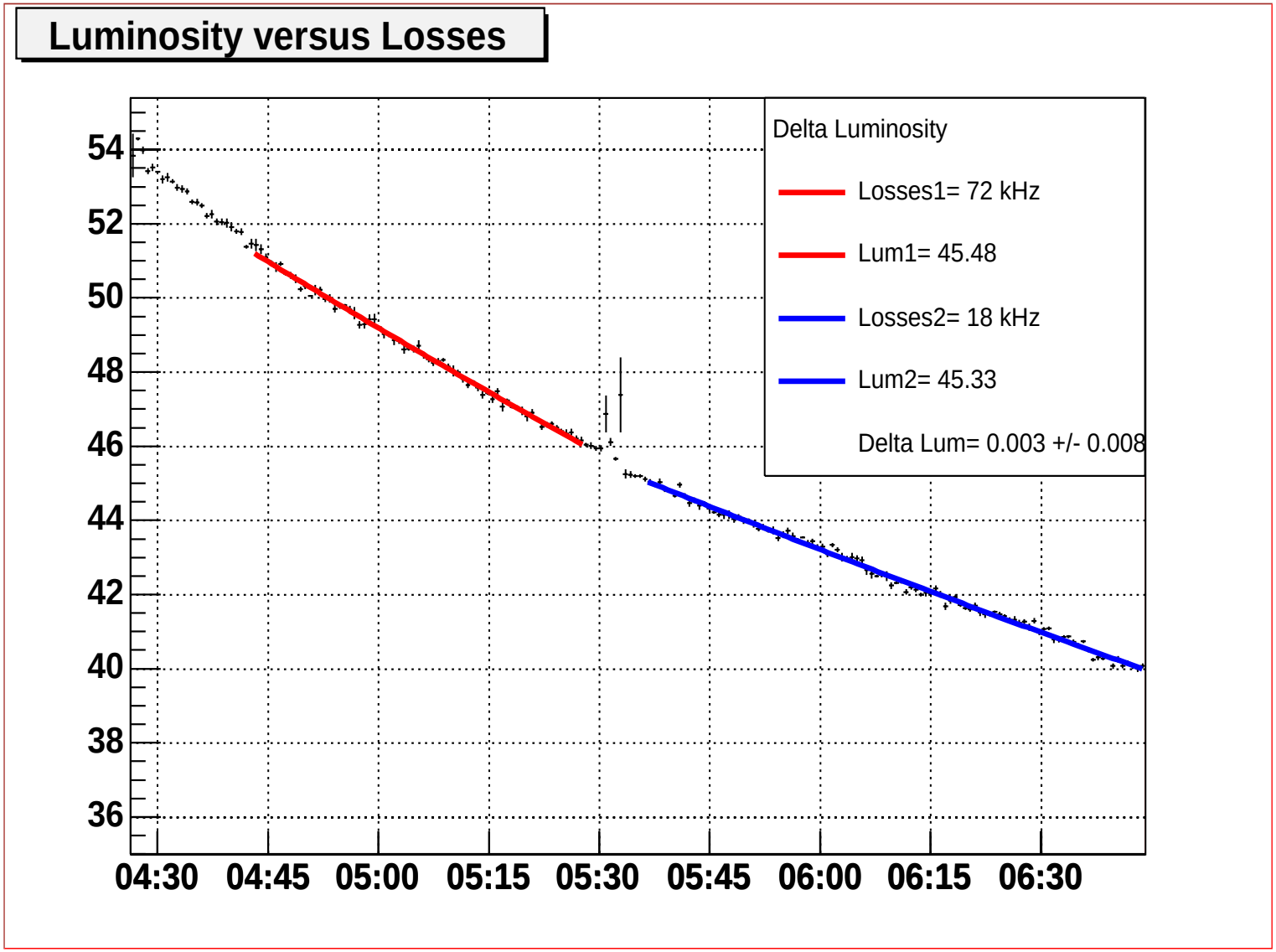
Store ranges for averaging



Systematics on luminosity due to acceptance stability and Online → offline transfer is **< 1%**.

Contribution from beam losses

(June 23 2004)

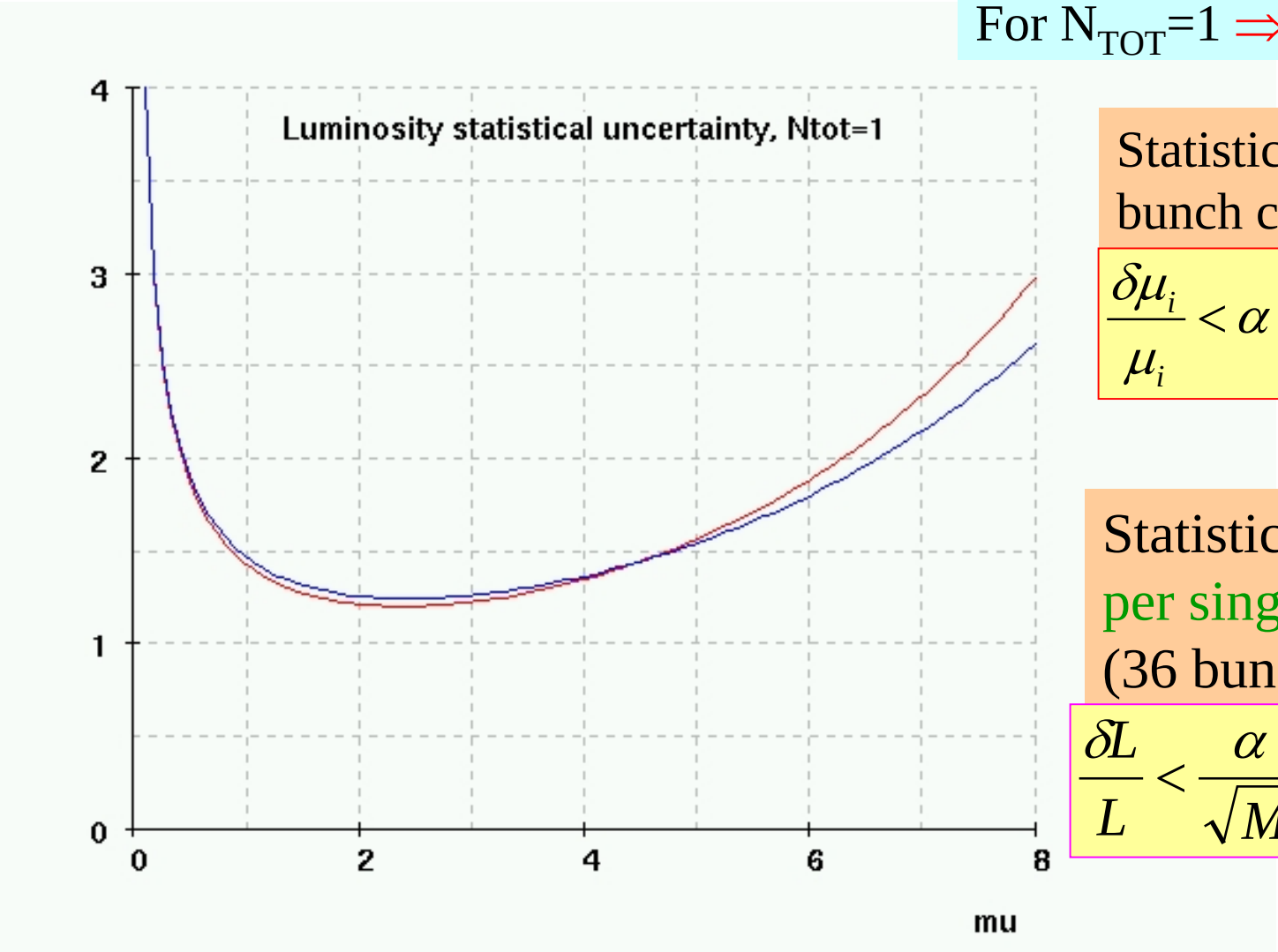


Contributions to luminosity due to beam losses is **< 1%**.

Statistical uncertainty

(July 7 2004)

For $N_{TOT}=1 \Rightarrow \delta\mu_i/\mu_i < 4 = \alpha$



Statistical uncertainty per bunch crossing is

$$\frac{\delta\mu_i}{\mu_i} < \alpha := \frac{4}{\sqrt{8243}} \cong 0.044$$

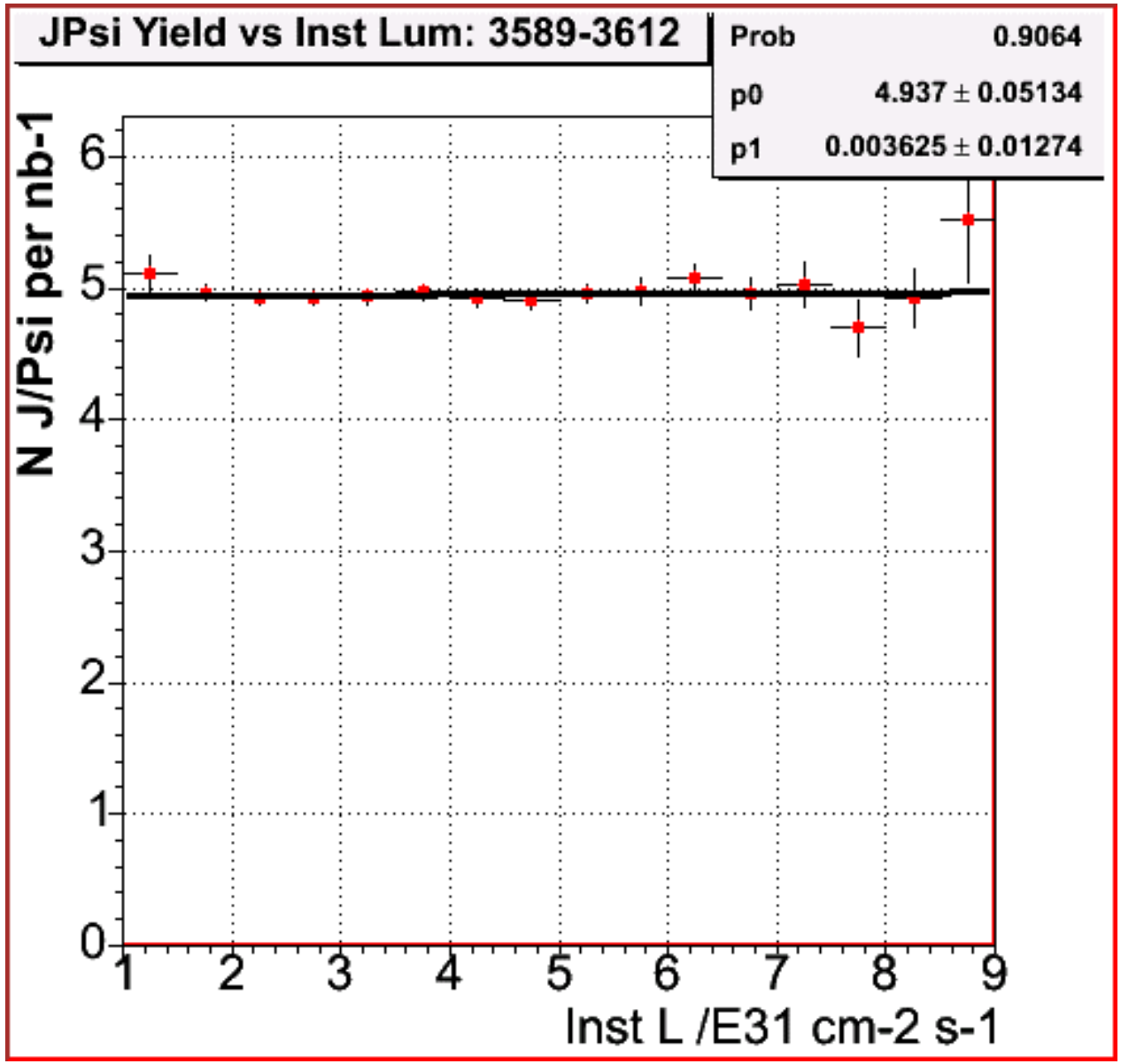
Statistical uncertainty per single measurement (36 bunches) is

$$\frac{\delta L}{L} < \frac{\alpha}{\sqrt{M}} = \frac{0.044}{6} = 0.007$$

Statistical uncertainty on luminosity is **negligible.**

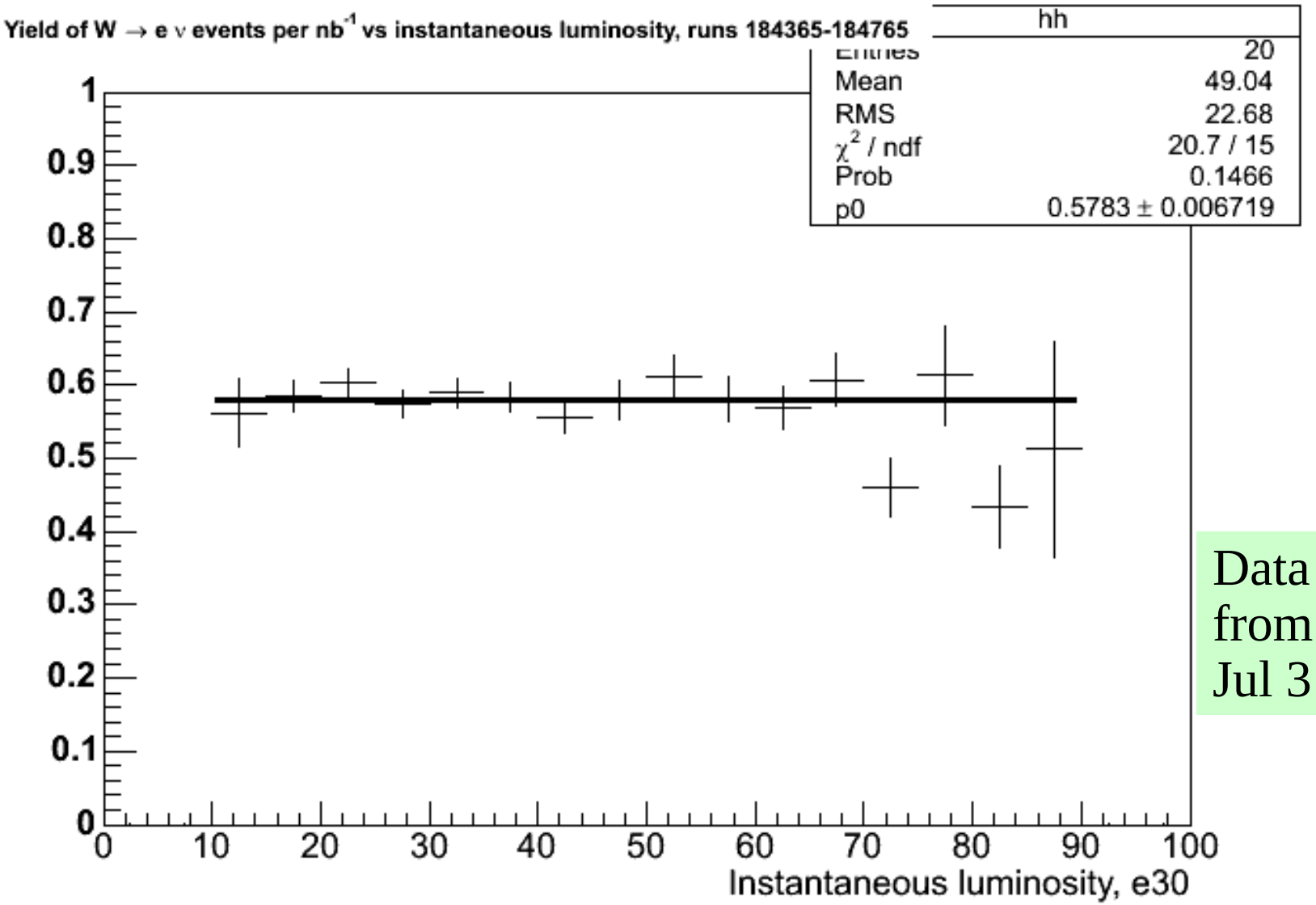
Cross checks

J/ψ →μμ yield versus luminosity



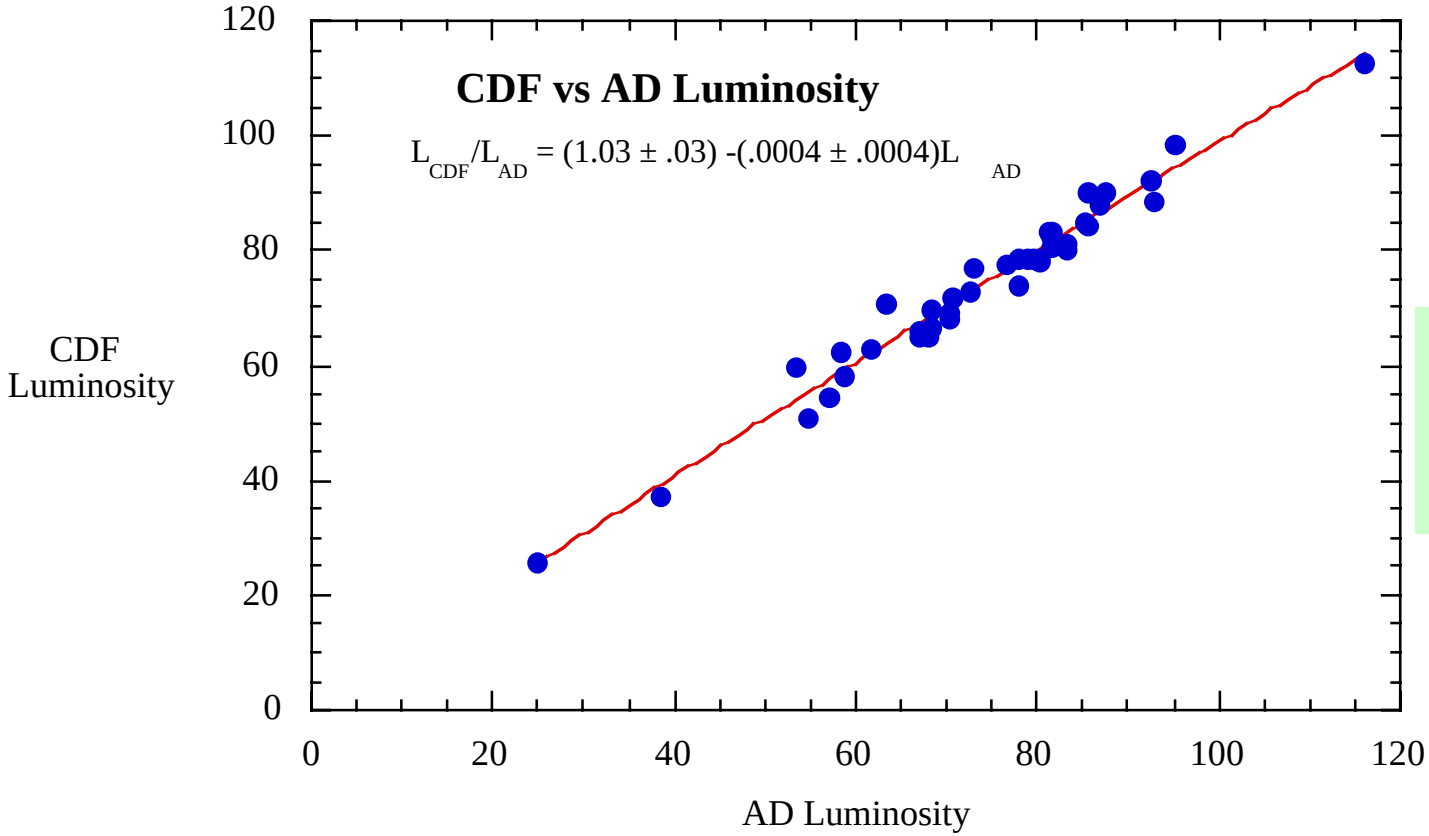
Data collected from Jun 23 to Jul 3 2004

W→eν yield versus luminosity



Data collected from Jun 23 to Jul 3 2004

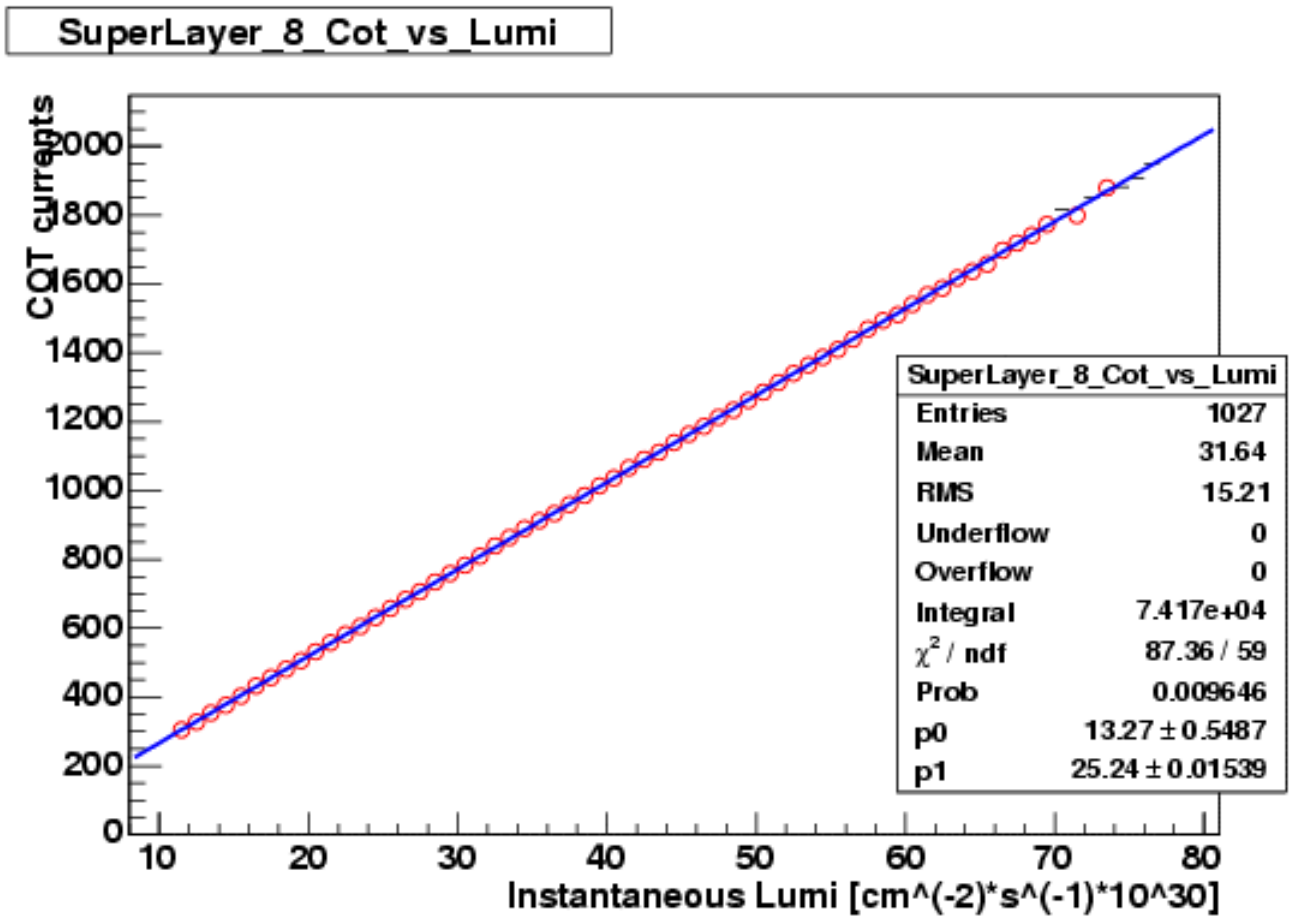
CDF vs AD Luminosity



Data collected from May 17 to Jul 16 2004

- AD calculation from Super-table (p, pbar, ε's)
- Slope compares AD estimate of β* with that observed at CDF

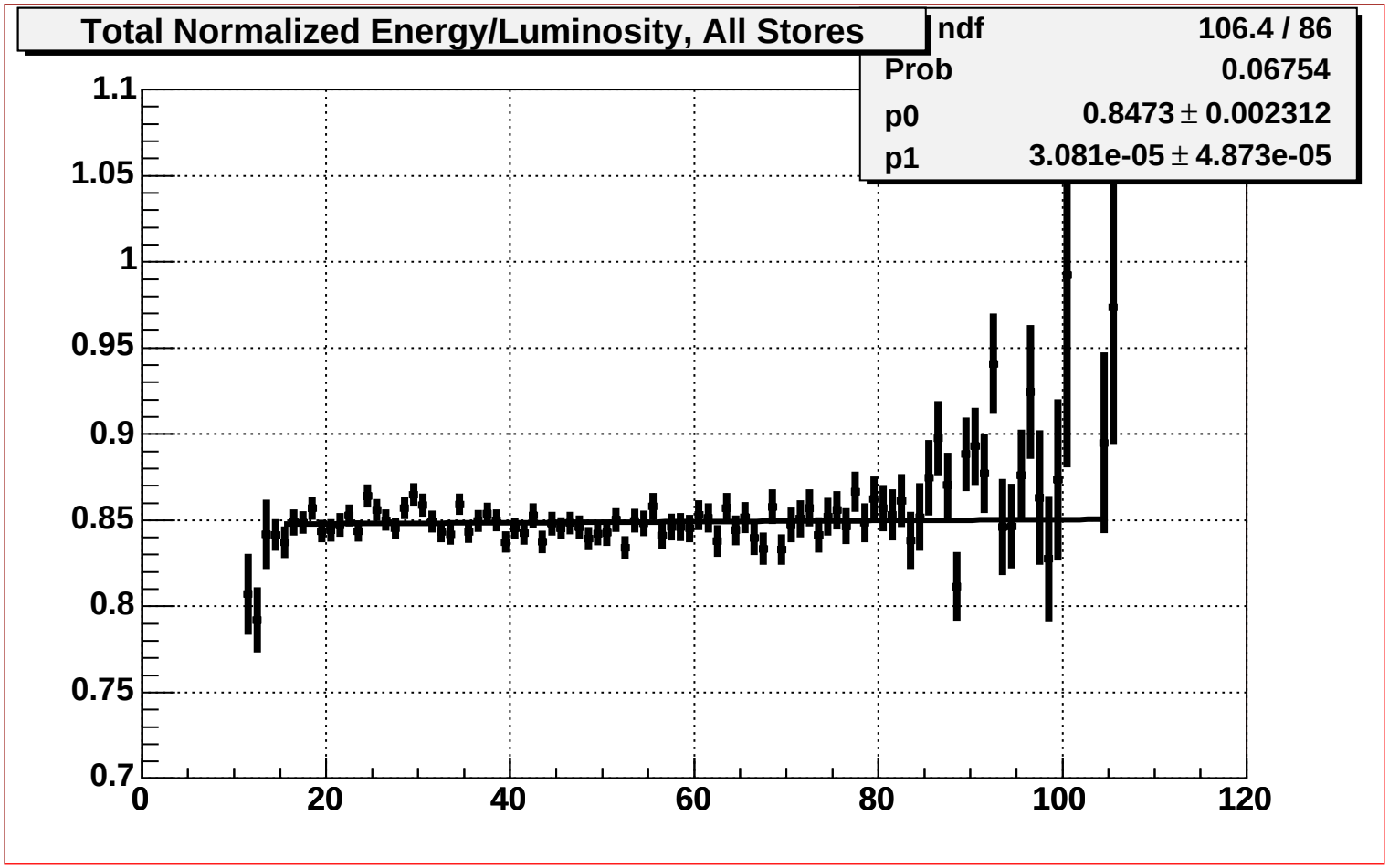
CDF Luminosity vs COT currents



Removed the first hour on each store to have stable COT currents.

Data collected from Jul 18 to Jul 31 2004

0-counting VS particle-counting (preliminary)



10 stores

Uncertainties summary

Systematic Error	*Current*	*Lum Range*	*Previous*
CLC acceptance:			
Geometry	<3%	$2x10^{32}$	3%
Generator	<2%	$2x10^{32}$	2%
Beam	<1%	$2x10^{32}$	<1%
CLC simulation	<1%		<1%
Spp calibration	<1%	$2x10^{32}$	<1%
Acceptance stability	1%	--	1%
Online –> offline transfer	--	any	
Backgrounds	<1%	--	1%
Non linearity@high L	--		1%
Statistical uncertainty	--	$2x10^{32}$	
Inelastic p-pbar Xsec	4%	--	4%
TOTAL	**<4.2%**		**4.4%**

CONCLUSION: currently quoted $\delta L/L=4.4\oplus 4\%$ **HOLDS** up to *L* through August 2004

New methods for future

- Particle counting
- Hit counting
- Time clusters counting