

# Updated inputs for luminosity projection curves in the Dave McGinnis model

Vaia Papadimitriou  
November 1, 2006

Using information between June 15 2006 and October 9 2006. Stores 4772-5008 and pbar shots 4047- 4605 were used. Some studies required more stores.

# Inputs for First model

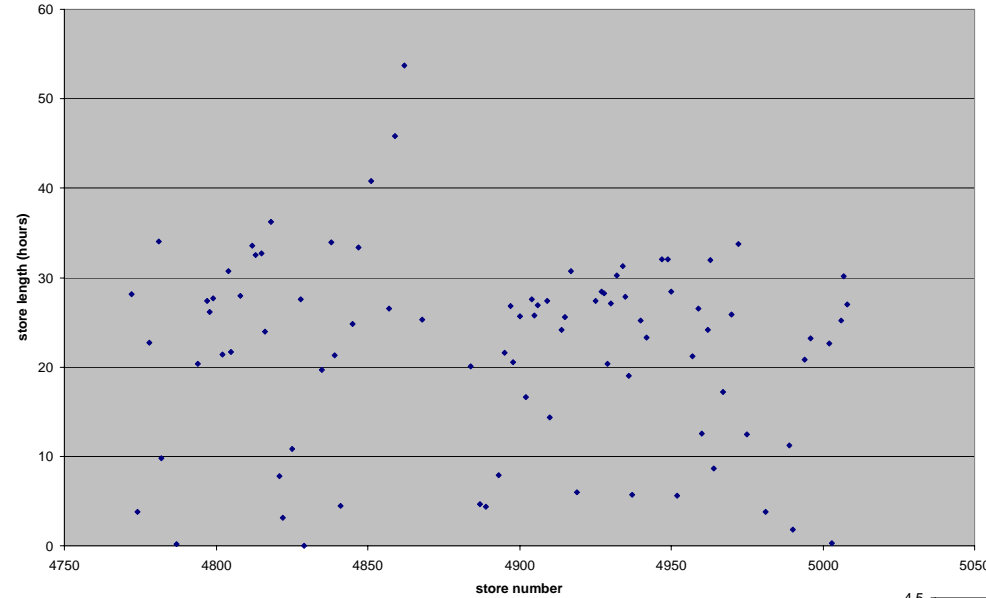
- ❖ Shot setup time
- ❖ Store length
- ❖ HEP Up time per week
- ❖ Pbar Production
- ❖ Protons on target
- ❖ Pbar cycle time
- ❖ Pbar Up time fraction
- ❖ Initial stack size
- ❖ Stack size at ½ stacking rate
- ❖ Pbar transfer eff to low beta
- ❖ Number of protons per bunch
- ❖  $\sigma_{pp}$
- ❖  $\sigma_{pa}$
- ❖ Proton emittance
- ❖ Pbar emittance
- ❖ Initial Lifetime **As in Beams-doc-1091**
- ❖ Lifetime slope
- ❖ beta\*
- ❖ Transfer interval
- ❖ Acc to RR transfer efficiency
- ❖ Transfer time

# Store length and shot setup time, stores 4772-5008

06/15/06-10/09/06

# 7 store length (hours)

## 4772-5008



AVG: 22.13 h

STD DEV: 10.79 h

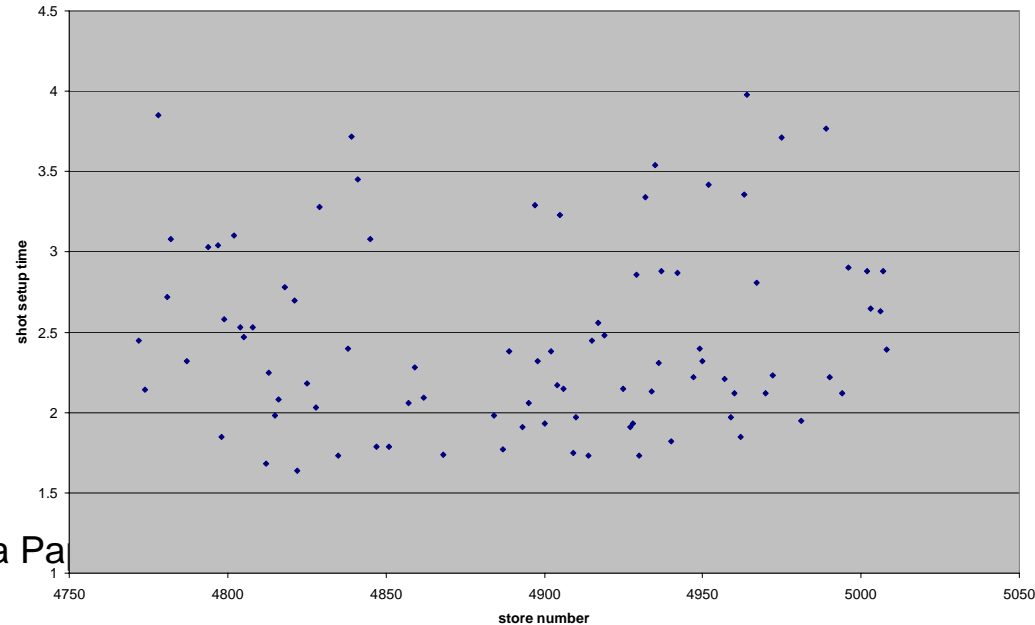
Last 50 FY06: 22.07 h

AVG: 2.47 h

STD DEV: 0.58 h

Last 50 FY06: 2.4 h

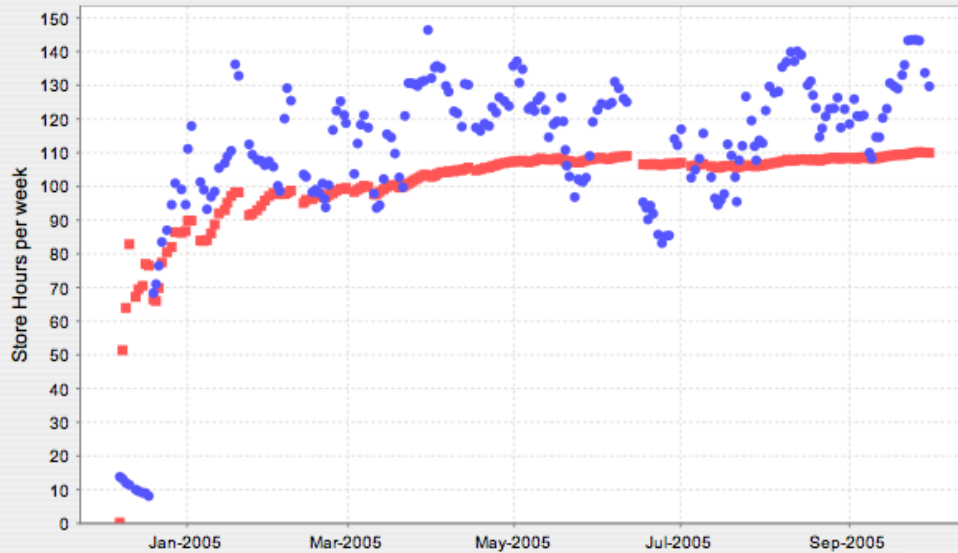
shot setup time in hours



/aia Pa

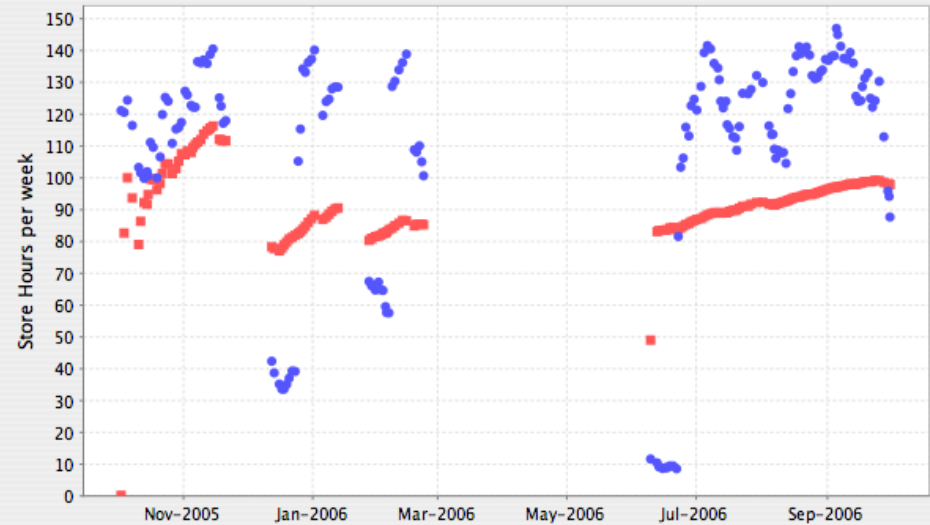
# Store hours per week, FY05 and FY06

FY Average Store Hours per week



■ FY Average Store Hours per week    ● 10X Average Store Hours per week

FY Average Store Hours per week

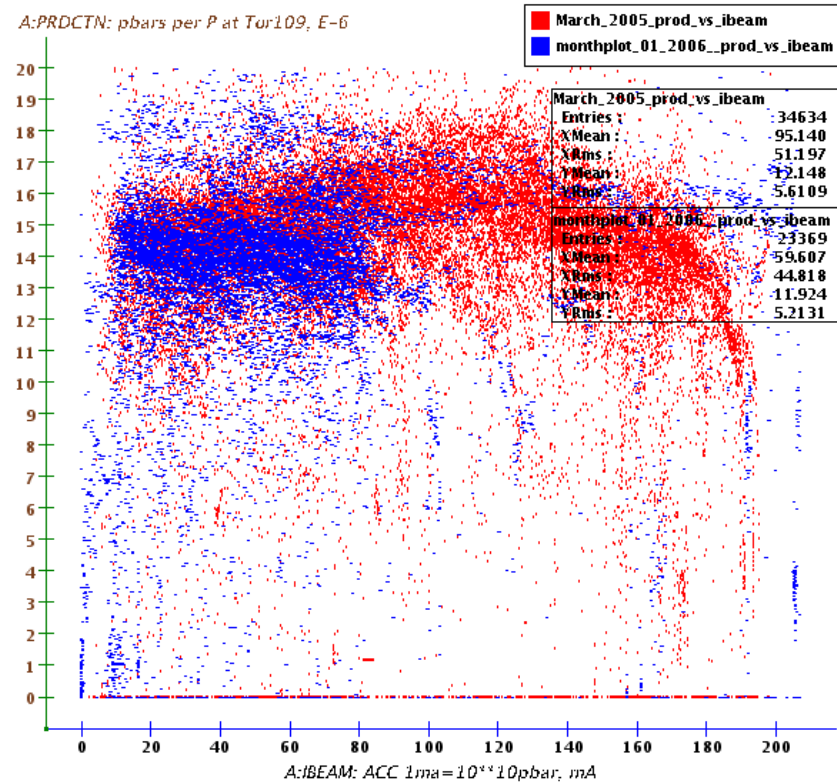


■ FY Average Store Hours per week    ● 10X Average Store Hours per week

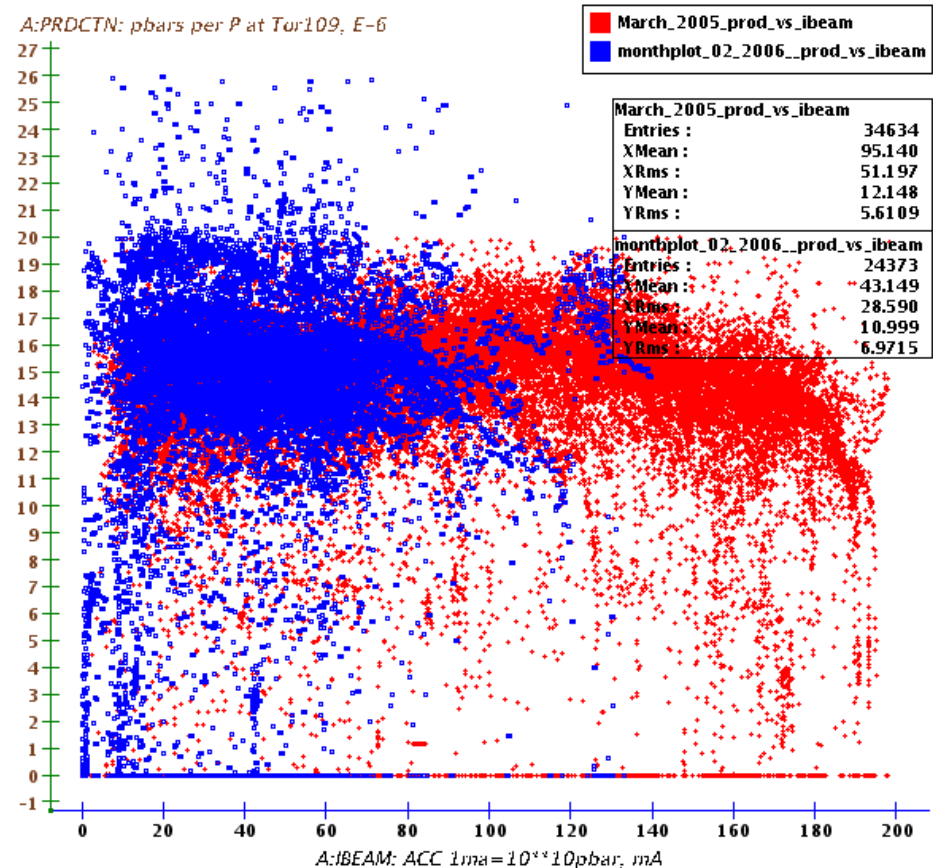
Vaia Paq

# Production (A:PRDCTN) January, February 2006

March\_2005\_prod\_vs\_ibeam - monthplot\_01\_2006\_\_prod\_vs\_ibeam



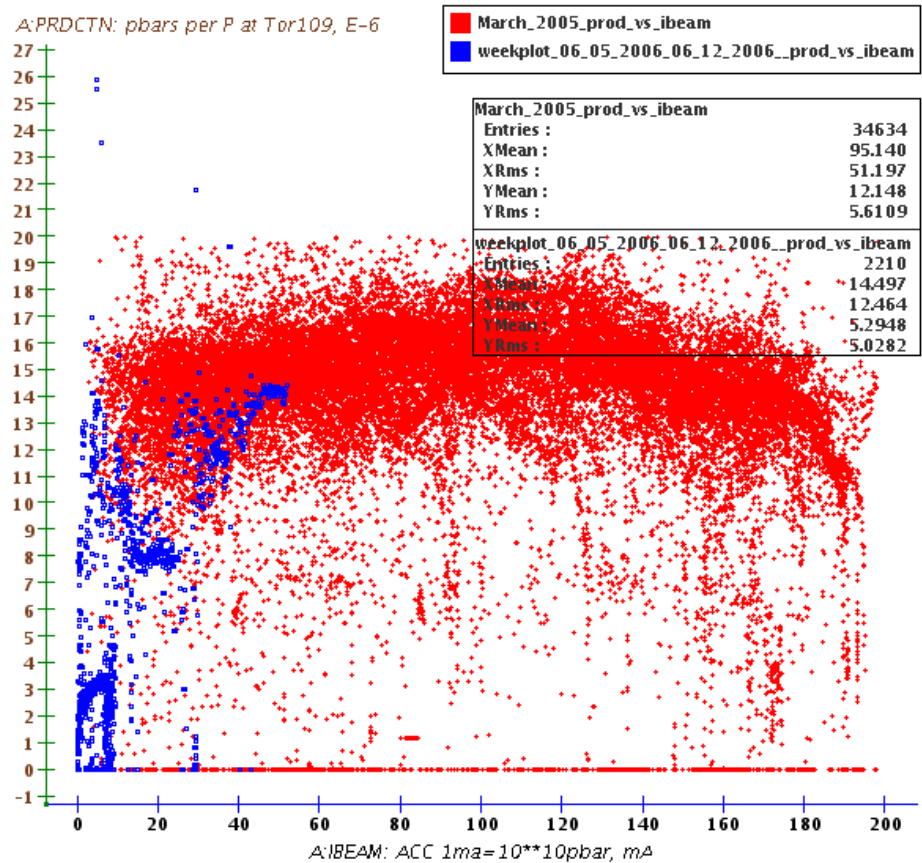
March\_2005\_prod\_vs\_ibeam - monthplot\_02\_2006\_\_prod\_vs\_ibeam



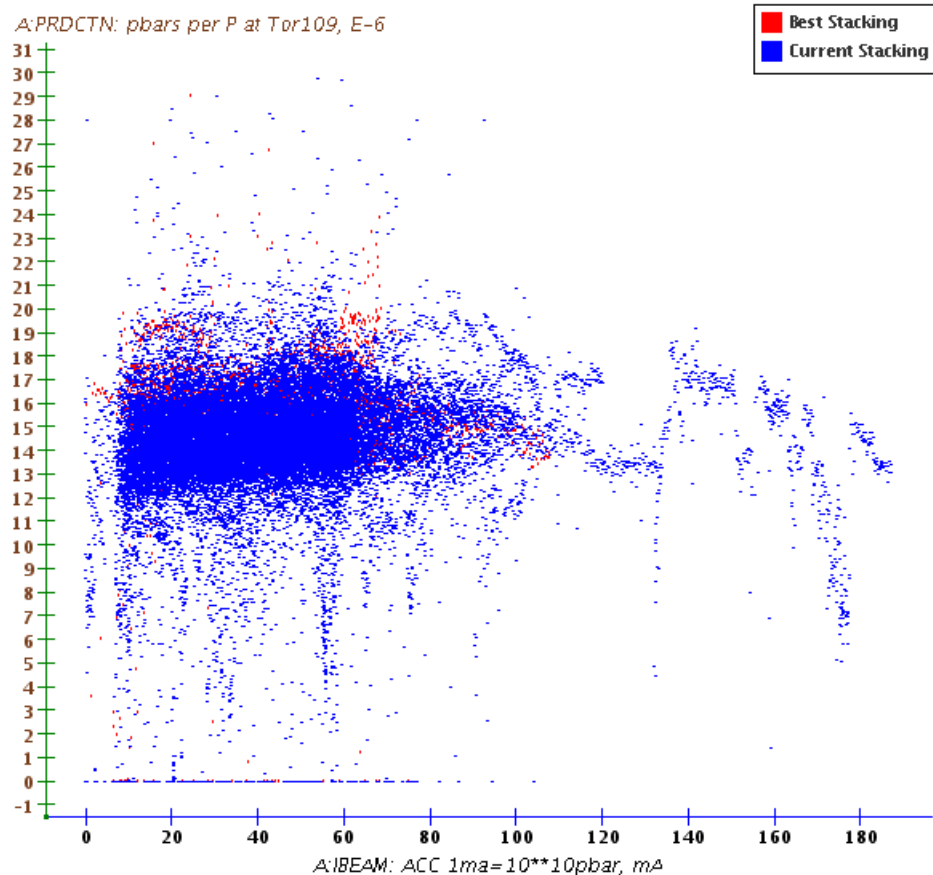
# Production (A:PRDCTN)

## June, July 2006

March\_2005\_prod\_vs\_ibeam - weekplot\_06\_05\_2006\_06\_12\_2006\_\_pro...



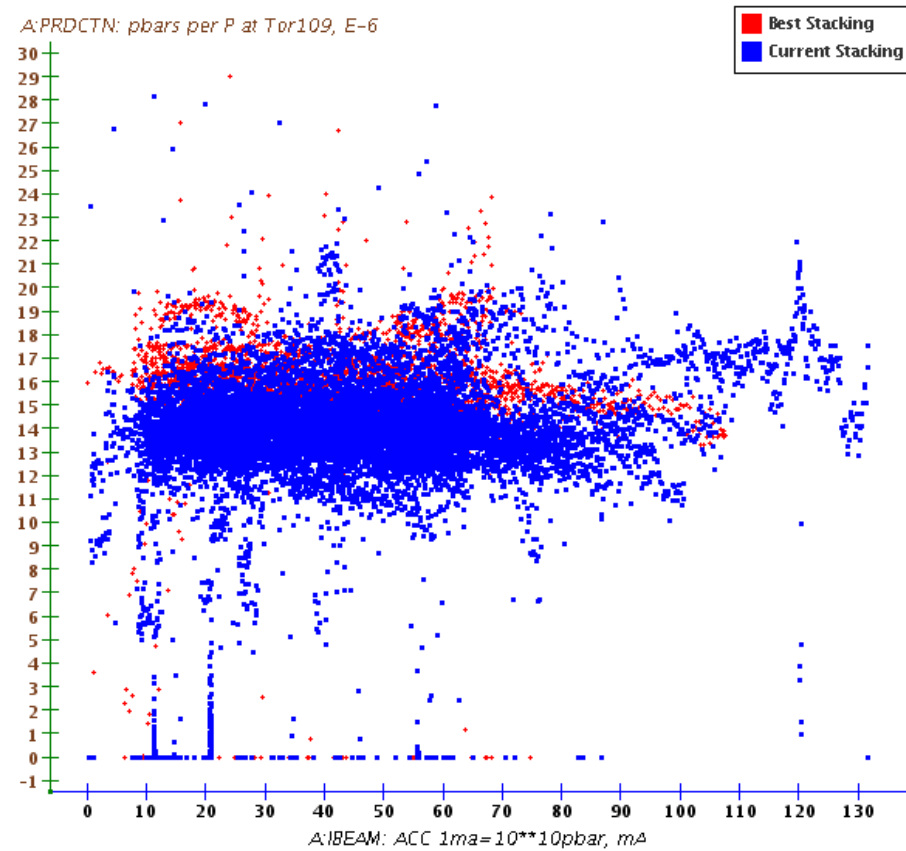
month 7 2006 prod vs ibeam



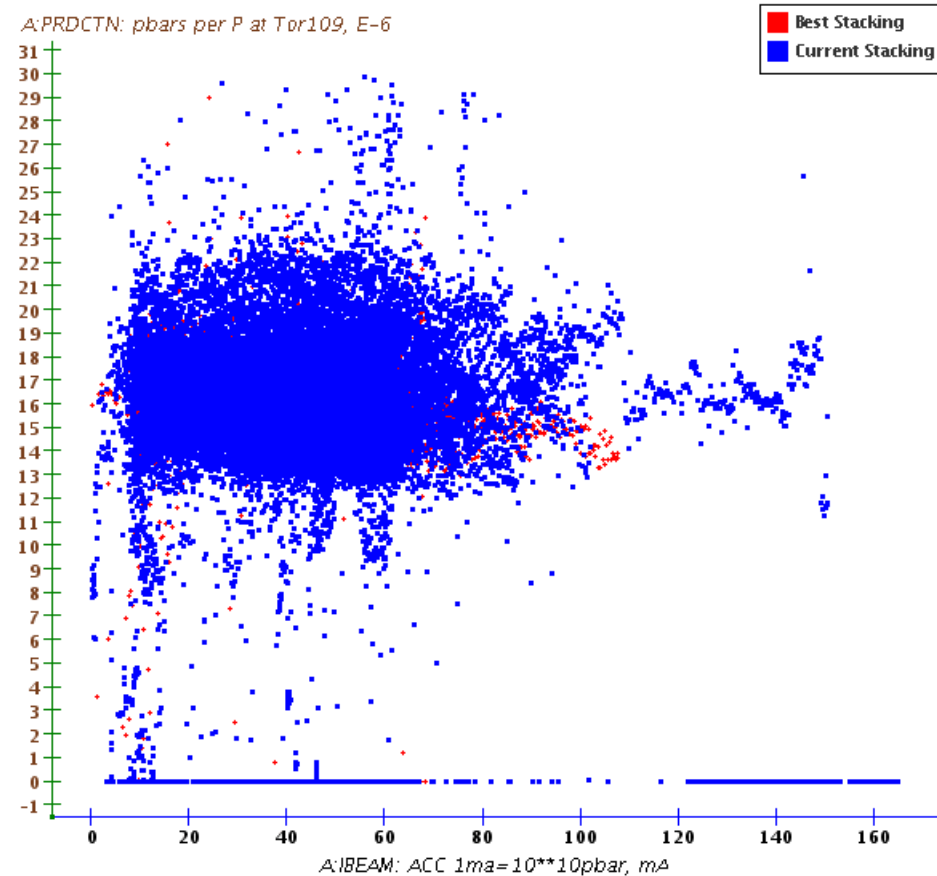
Vaia Pap:

# Production (A:PRDCTN) August, September 2006

month 8 2006 prod vs ibeam



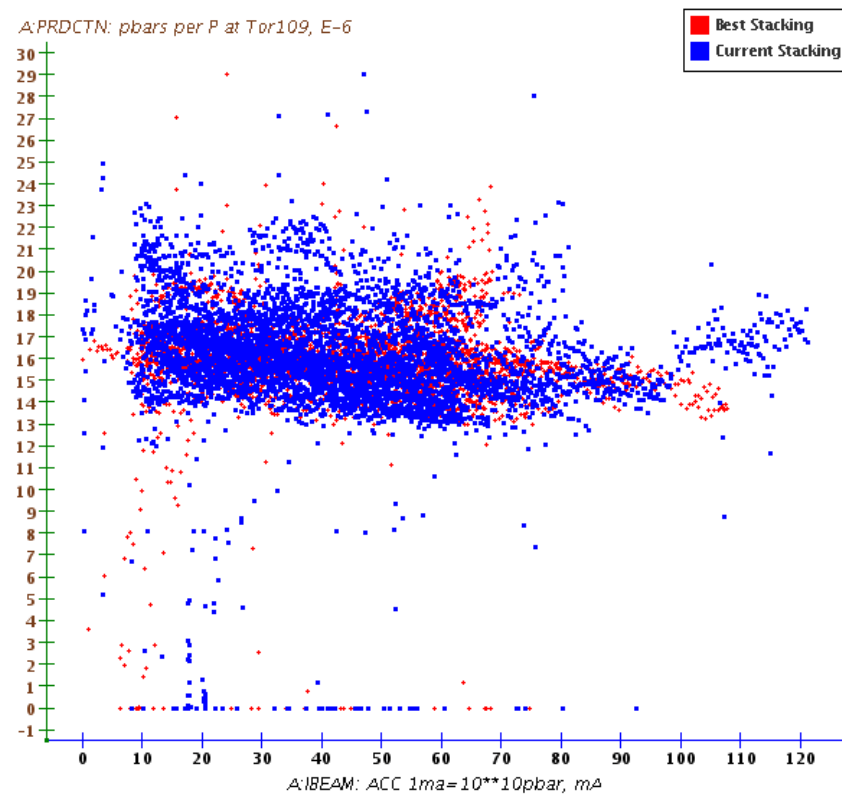
month 9 2006 prod vs ibeam



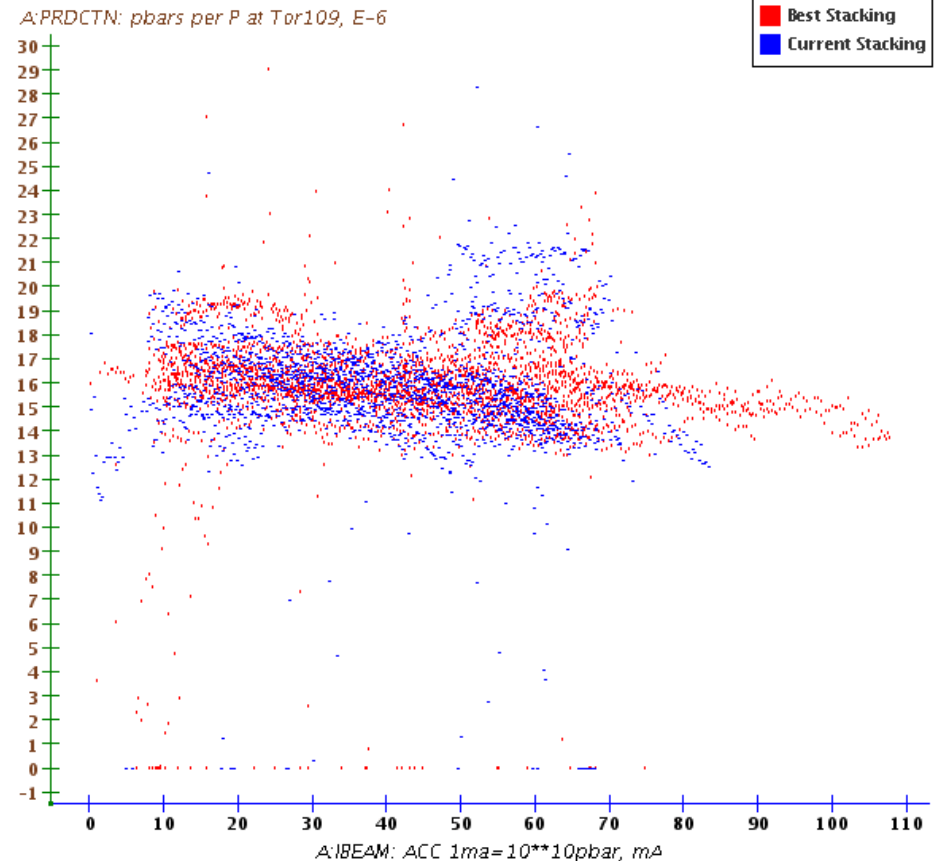
Vaia Pap:

# Production (A:PRDCTN) first 2 weeks in October

week 40 2006 prod vs ibeam



week 41 2006 prod vs ibeam

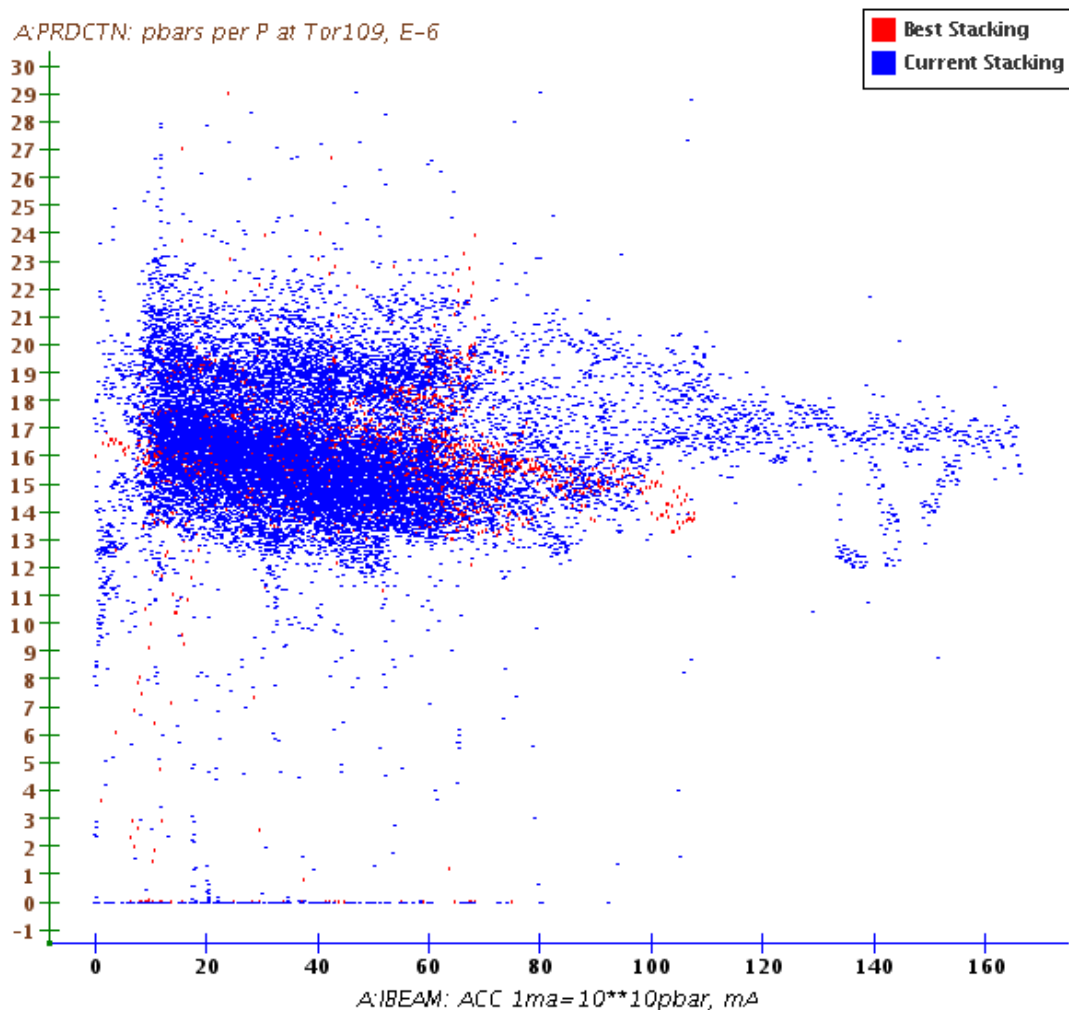


Vaia Paq



# Production (A:PRDCTN) in whole October 2006 – studies period included

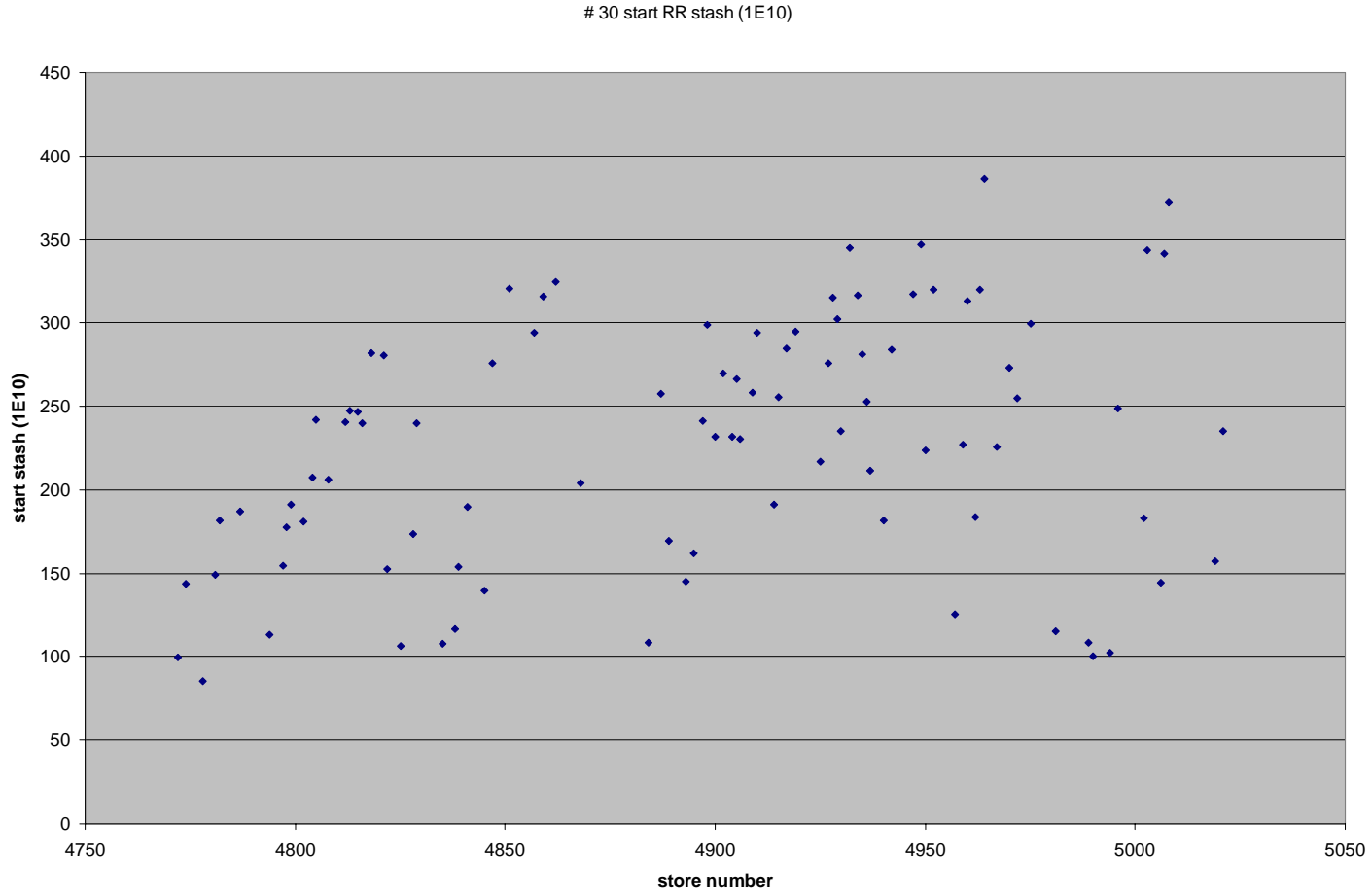
month 10 2006 prod vs ibeam





# Initial stash size, stores 4772-5021

06/15/06-10/24/06

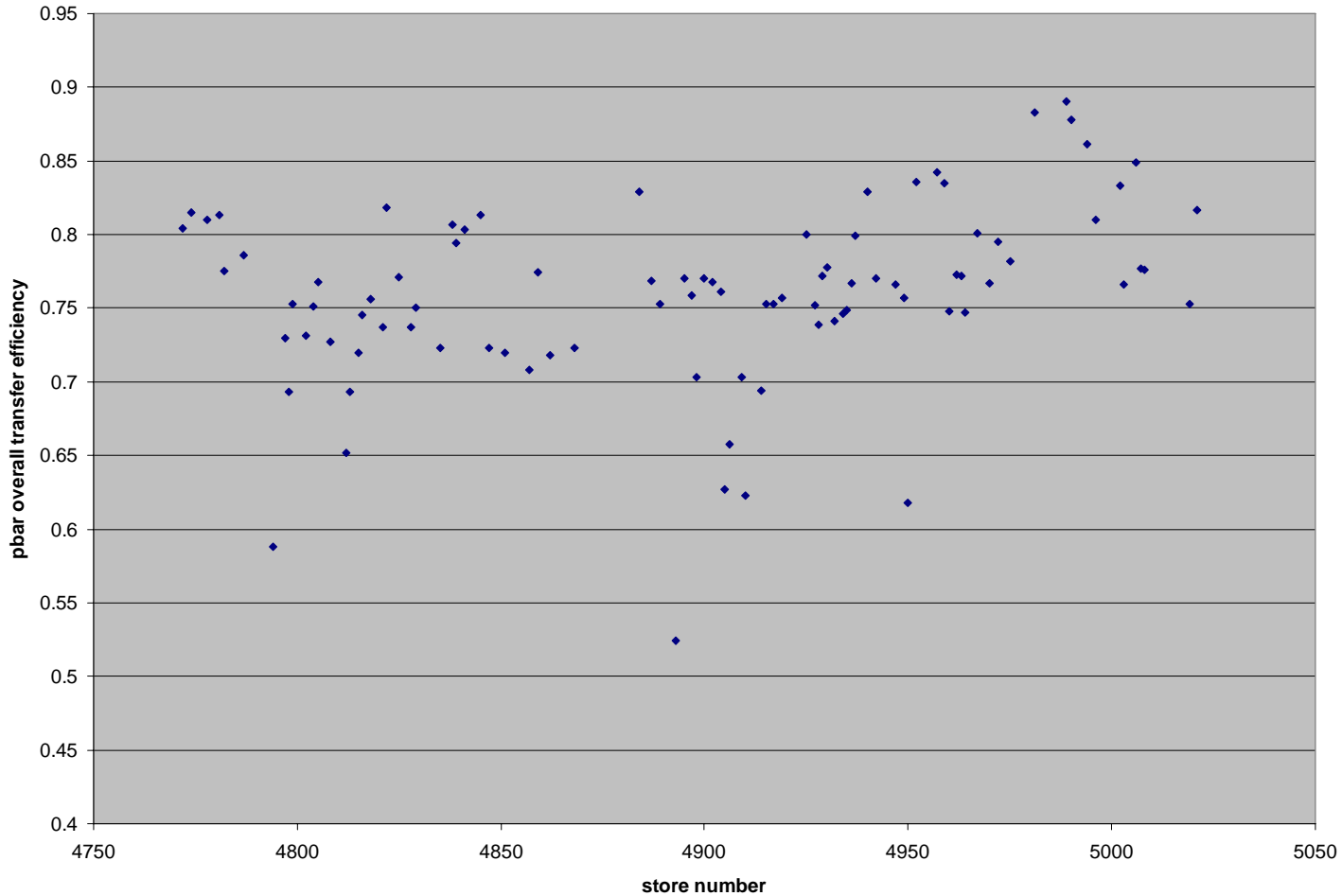


AVG: 226.92  
STD DEV: 74.27

# Pbar overall transfer eff. to HEP, stores 4772-5021

# 187 pbar overall RR+Accum.->HEP

06/15/06-10/24/06



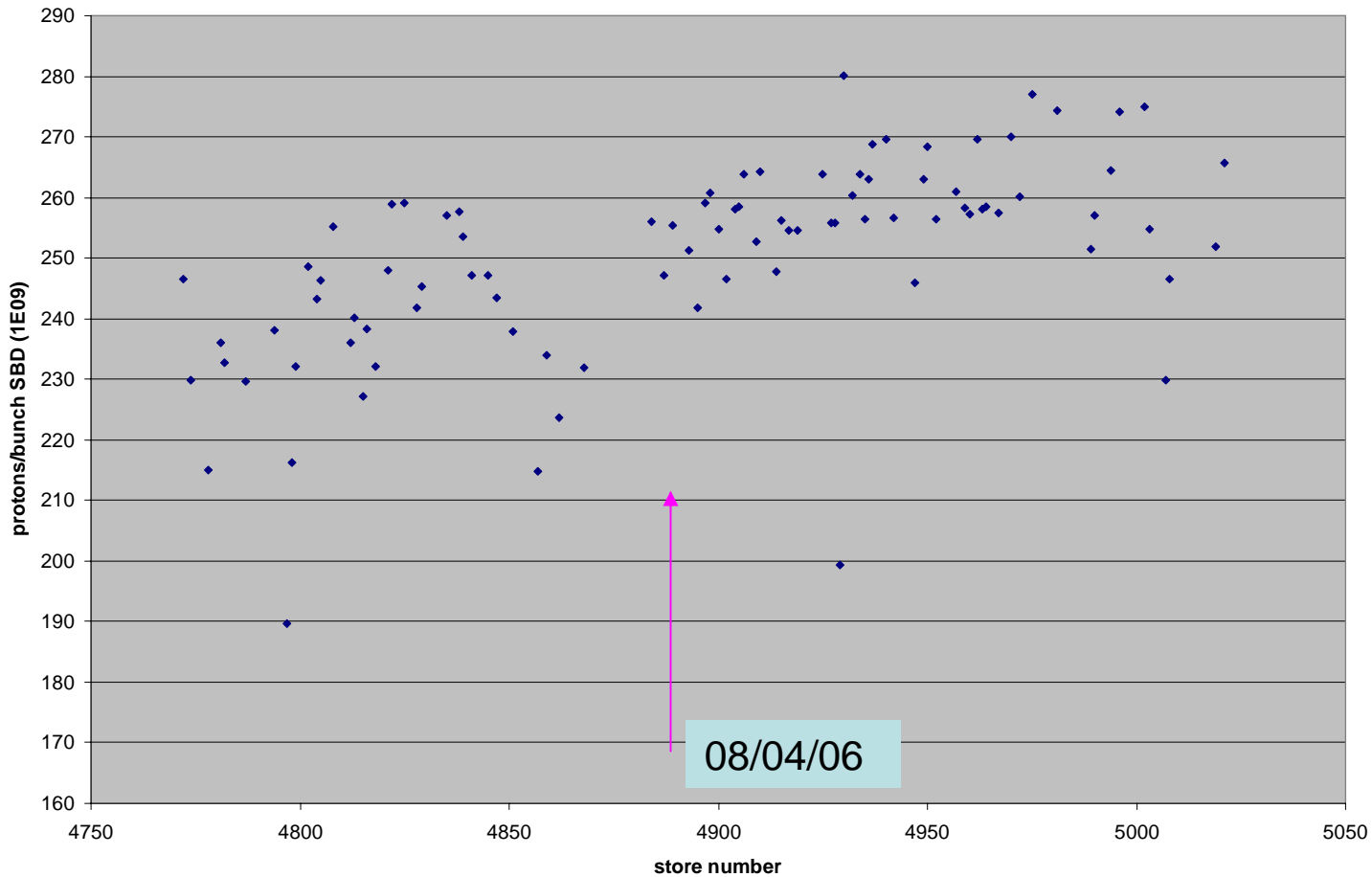
AVG: 0.76, AVG in last 50 of FY06 also 0.76  
STD DEV: 0.06

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# Protons per bunch at Remove Halo, stores 4772-5021

# 58 SBD p/bunch at Remove Halo (1E09)

06/15/06-10/24/06



AVG: 250.2 1E09

STD DEV: 16.28 1E09

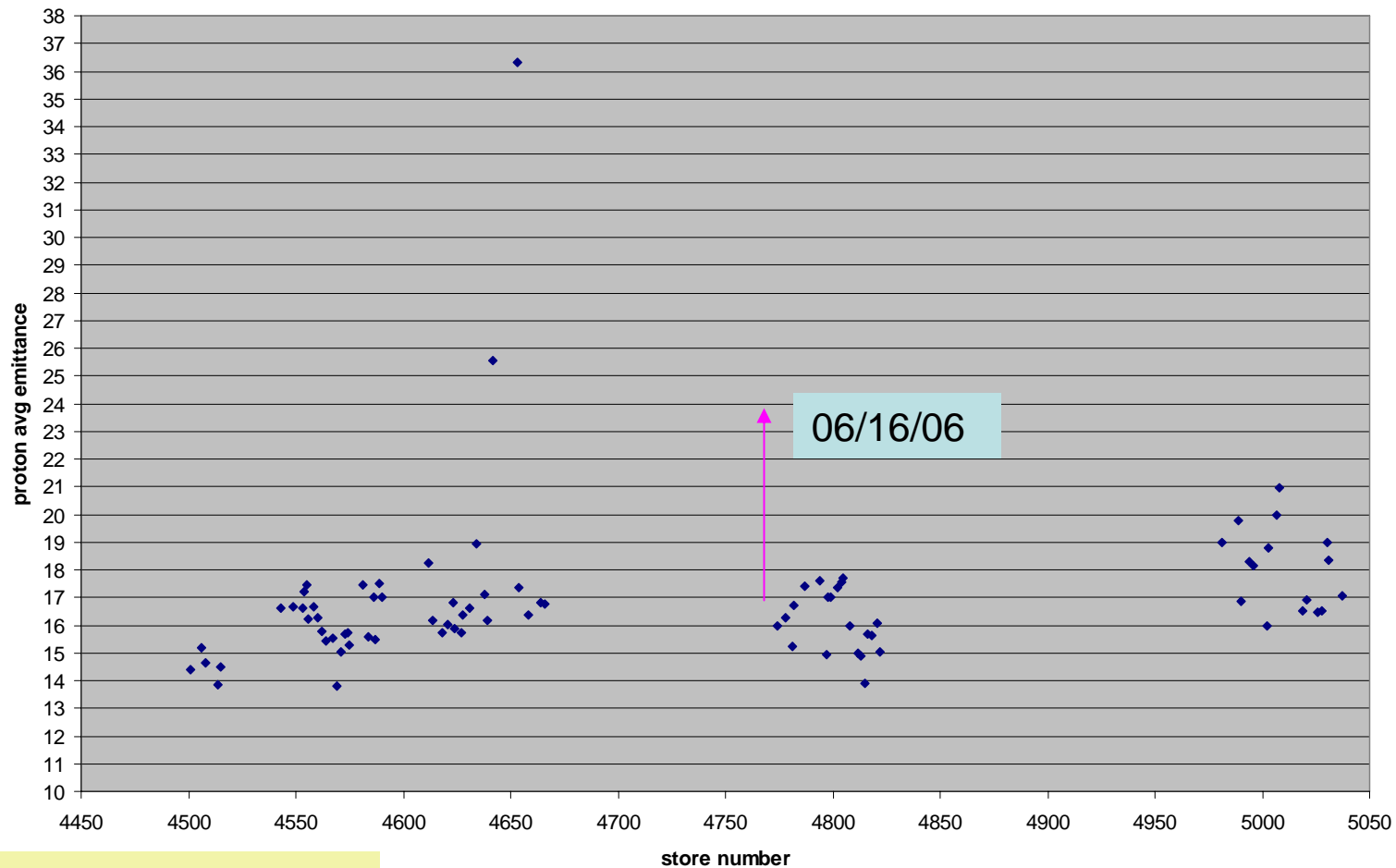
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AVG for last 50 stores in FY06  
(4859-4994): 256.4

# Proton emittance at Remove Halo, stores 4501-5037 (several removed)

# 108 p avg (H+V)/2 emitt, Remove Halo (pi-mm-mrad)

11/15/05-10/29/06



AVG: 16.98 since June 16

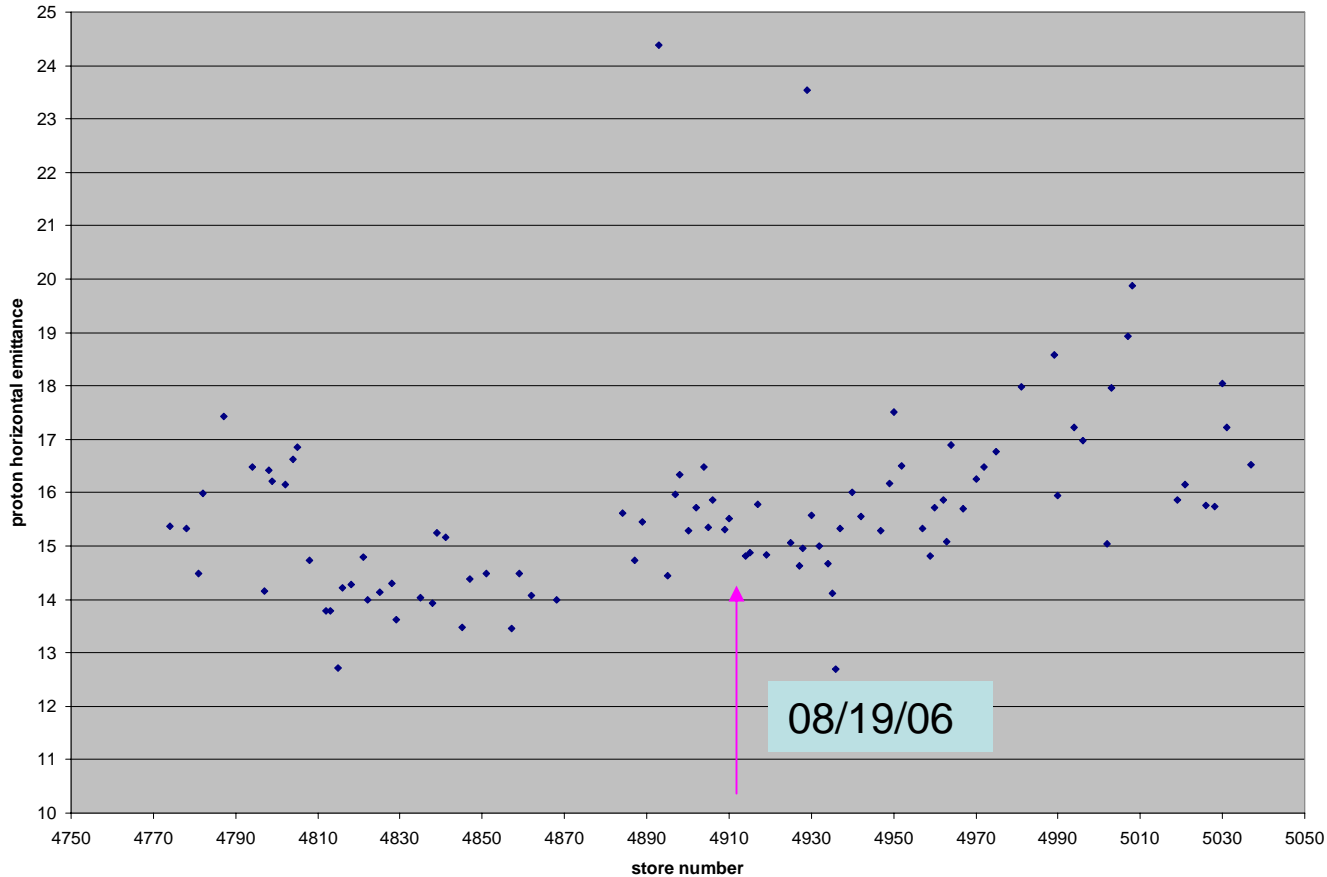
STD DEV: 1.58

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# Proton Hor. emittance at Remove Halo, stores 4774-5037

# 102 p H emitt, Remove Halo (pi-mm-mrad)

06/16/05-10/29/06



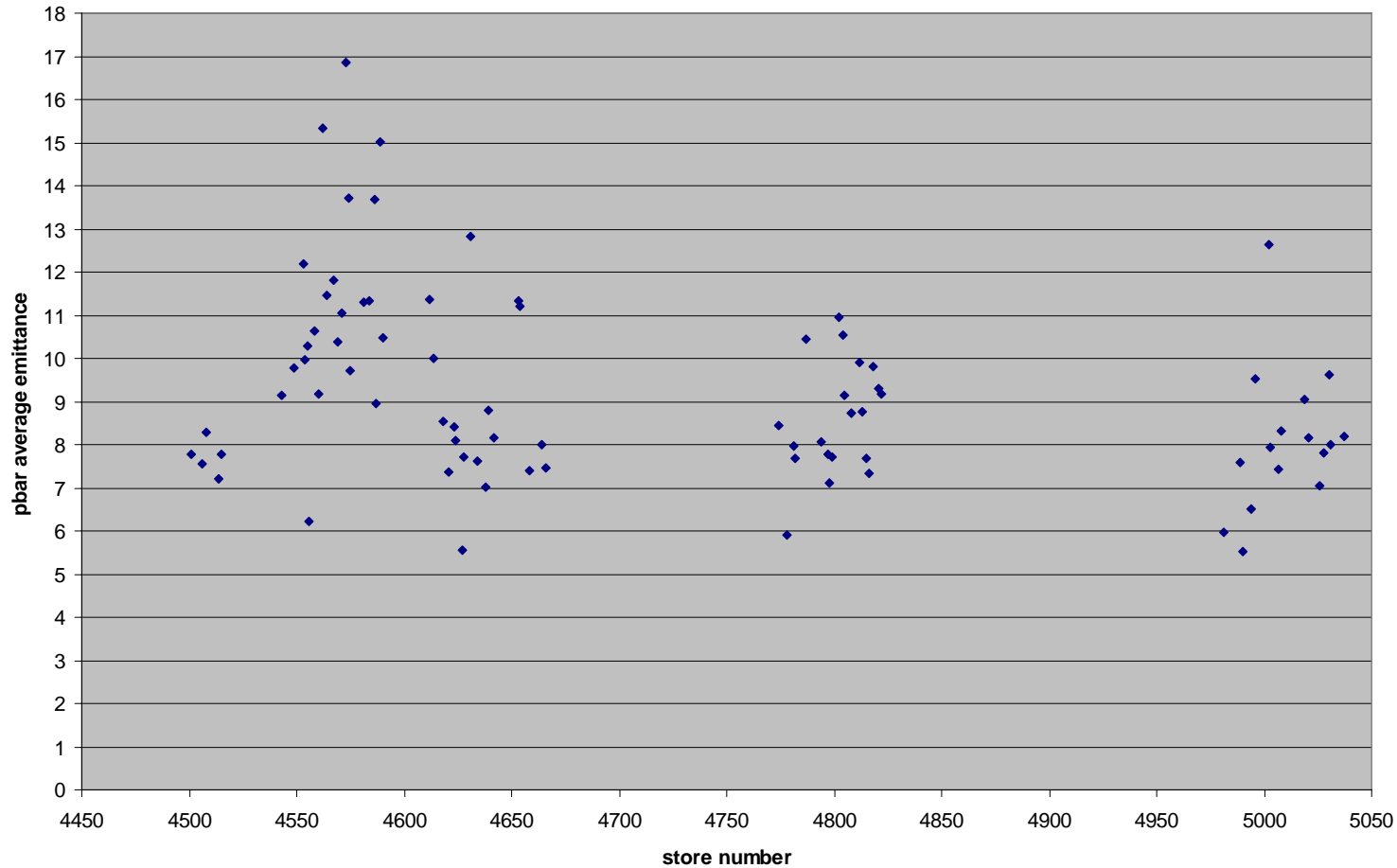
To check trends since vertical wire broken

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# Pbar emittance at Remove Halo, stores 4501-5037 (several removed)

# 95 pbar avg (H+V)/2 emitt, Remove Halo (pi-mm-mrad)

11/15/05-10/29/06

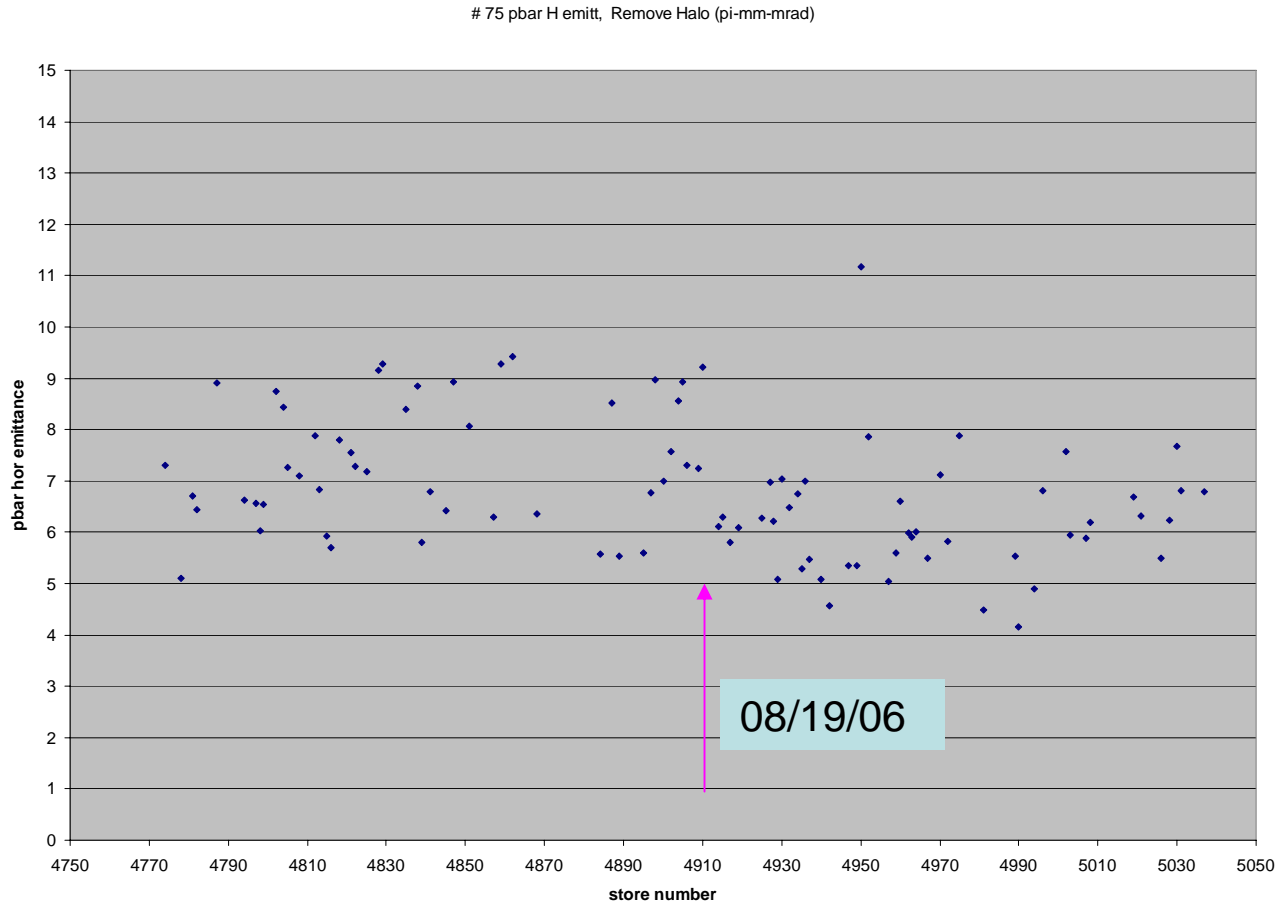


AVG: 8.38 since June 16  
STD DEV: 1.48



# Pbar Hor. emittance at Remove Halo, stores 4774-5037

06/16/05-10/29/06

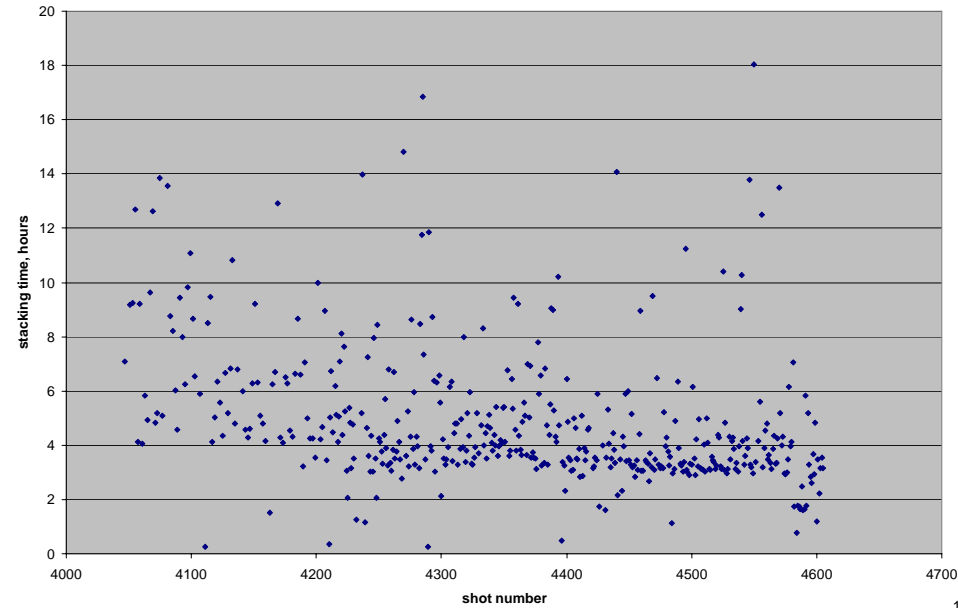


To check trends since vertical wire broken

# Stacking time, shots 4047-4605

stacking time hours, shots 4047-4605

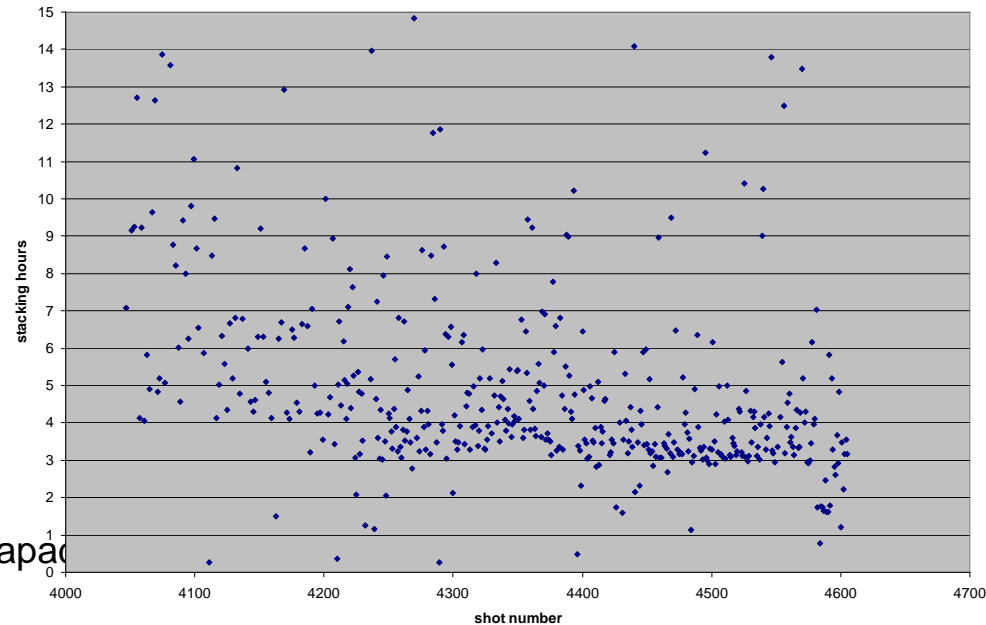
Pbar Shots 4047-4605,  
06/15/06-10/09/06



AVG: 4.85 h

STD DEV: 2.54 h

stacking time, hours 4047-4605 expanded scale

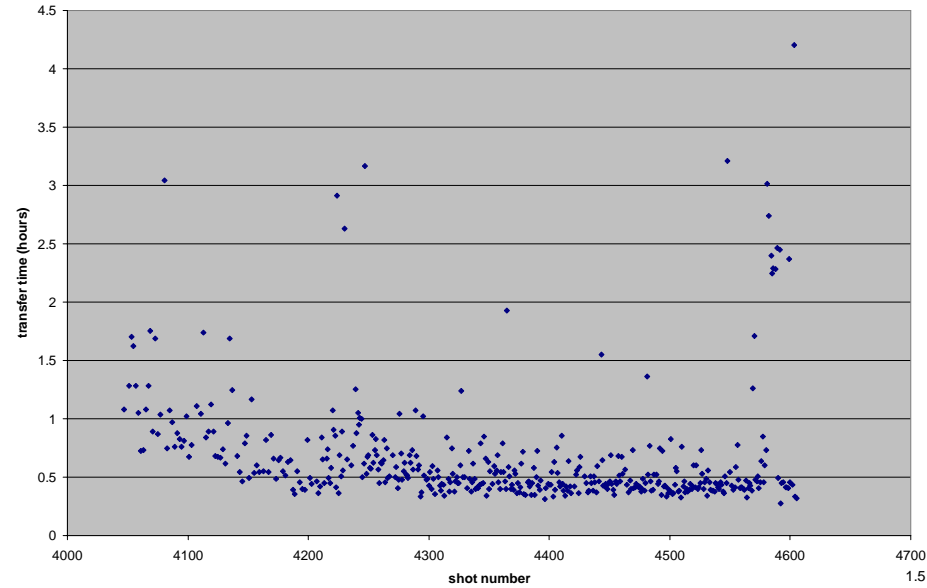


Vaia Papac

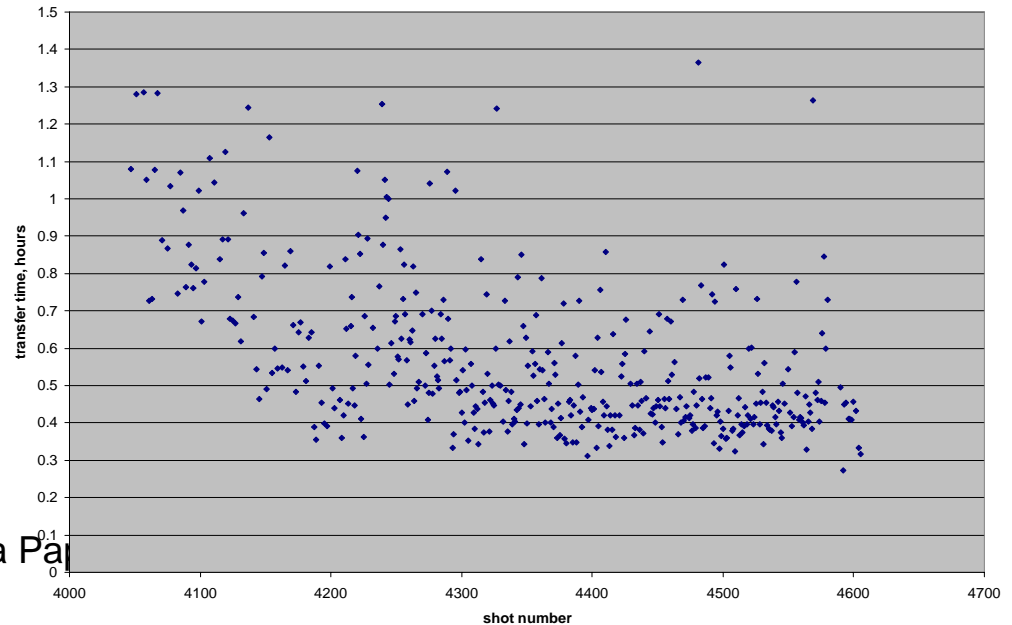
# Transfer time, shots 4047-4605

transfer time (hours), 4047-4605

Pbar Shots 4047-4605,  
06/15/06-10/09/06



transfer time, hours, vs shot



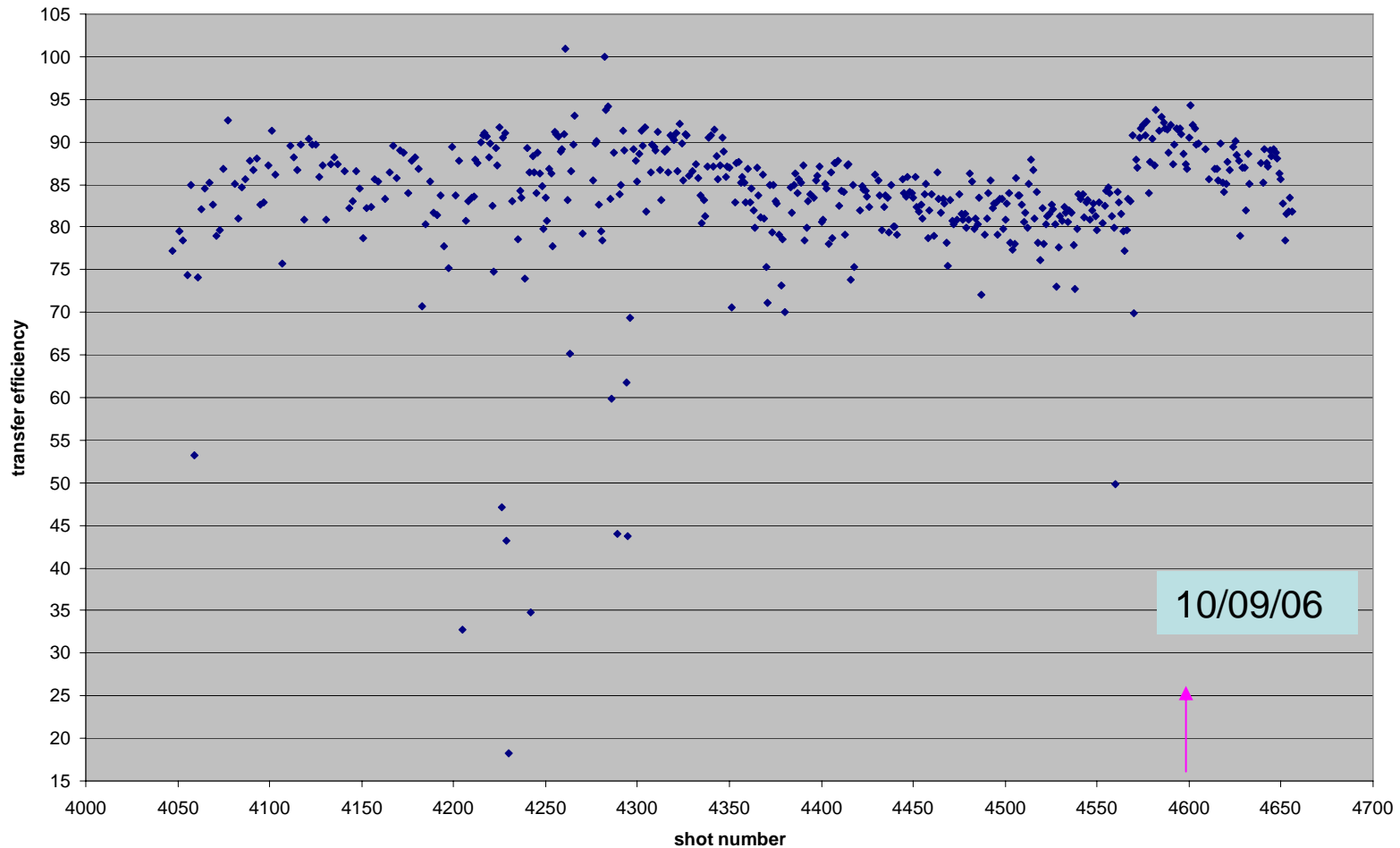
AVG: 0.66 h

STD DEV: 0.48 h

# Transfer efficiency for RR shots shots 4047-4656

06/15/06-10/29/06

Column 35 Total transfer efficiency (beg-end)



Inputs selected for First model with the goal to compare predicted luminosity with delivered in FY06 (selected from data in the end of FY06)

- ❖ Shot setup time 2.4 hours
- ❖ Store length 22 hours
- ❖ HEP Up time per week 109 hours (includes shot setup)
- ❖ Pbar Production  $15.5 \times 10^{-6}$  pbars per proton at Tor109
- ❖ Protons on target  $7.4 \times 10^{12}$
- ❖ Pbar cycle time 2.4 s
- ❖ Pbar Up time fraction 75%
- ❖ Initial stack size (left over)  $0 \times 10^{10}$
- ❖ Stack size at  $\frac{1}{2}$  stacking rate  $150 \times 10^{10}$
- ❖ Pbar transfer eff to low beta 0.76
- ❖ Number of protons per bunch  $255 \times 10^9$
- ❖  $\sigma_{pp}$   $0.5 \times 10^{-4}$
- ❖  $\sigma_{pa}$   $0.5 \times 10^{-4}$
- ❖ Proton emittance  $18\pi$ -mm-mrad
- ❖ Pbar emittance  $9\pi$ -mm-mrad
- ❖ Initial Lifetime 6.4 hours
- ❖ Lifetime slope 0.7 hours/hours
- ❖ beta\* 32 cm
- ❖ Transfer interval 4 hours
- ❖ Acc to RR transfer efficiency 83%
- ❖ Transfer time 0.5 hours
- 660 pb<sup>-1</sup> expected, 656 pb<sup>-1</sup> delivered

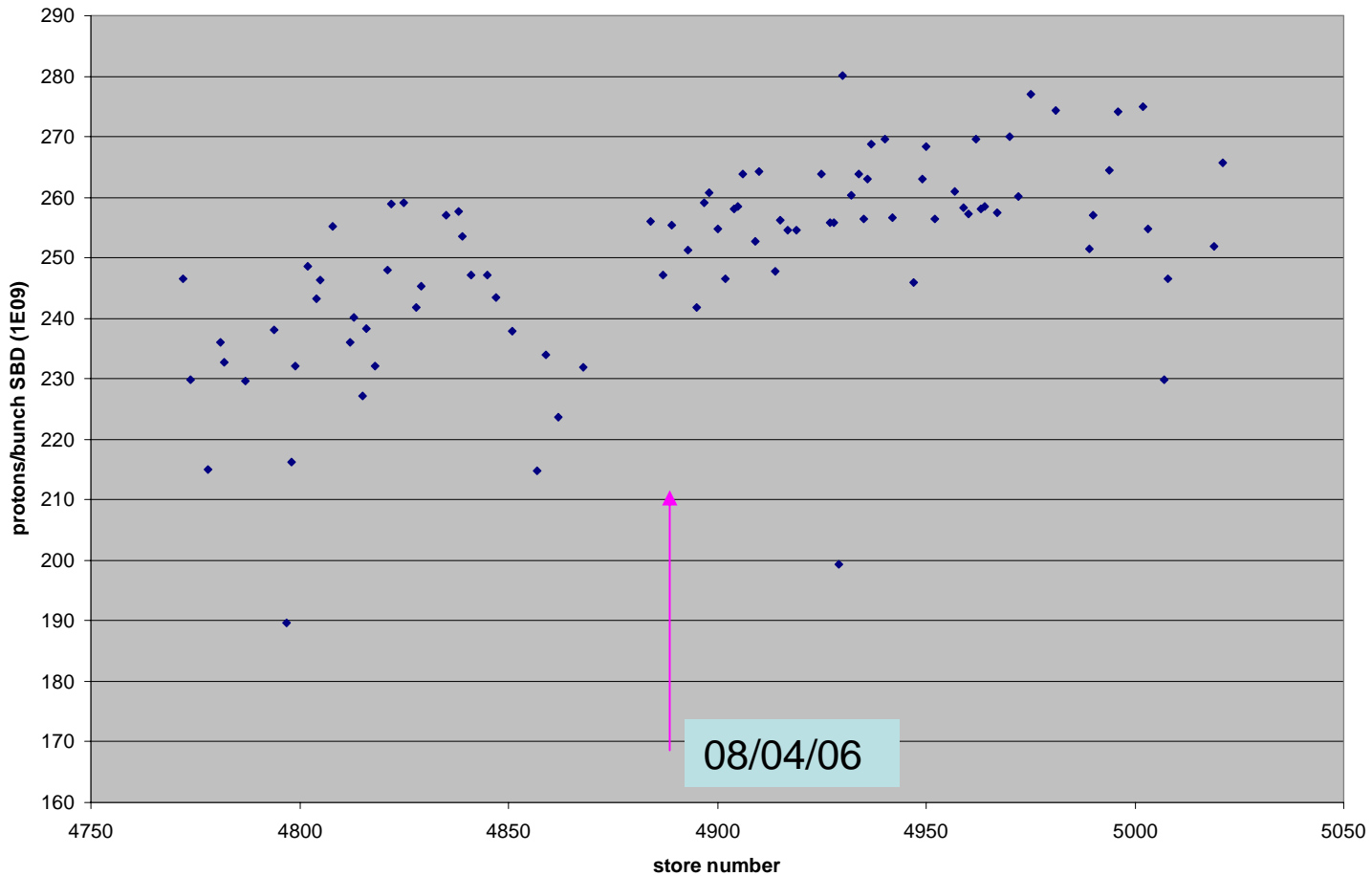
# Inputs for Second model

- ❖ Number of protons per bunch
- ❖ Luminosity Density @  $100 \times 10^{10}$
- ❖ Luminosity Density @  $300 \times 10^{10}$
- ❖ Init Tevatron Lifetime @  $80 \mu\text{b}^{-1}/\text{sec}$
- ❖ Init Tevatron Lifetime @  $160 \mu\text{b}^{-1}/\text{sec}$
- ❖ HEP store hours per week
- ❖ Acc-Rec Transfer Efficiency @  $0 \times 10^{10}$
- ❖ Acc-Rec Transfer Efficiency @  $300 \times 10^{10}$
- ❖ Acc-Rec transfer time
- ❖ Recycler lifetime
- ❖ Zero stack stack rate
- ❖ Half rate stack size
- ❖ Maximum stack size
- ❖ Timeline Utilization Factor
- ❖ Accumulator leftover factor

# Protons per bunch at Remove Halo, stores 4772-5021

# 58 SBD p/bunch at Remove Halo (1E09)

06/15/06-10/24/06



AVG: 250.2 1E09  
STD DEV: 16.28 1E09

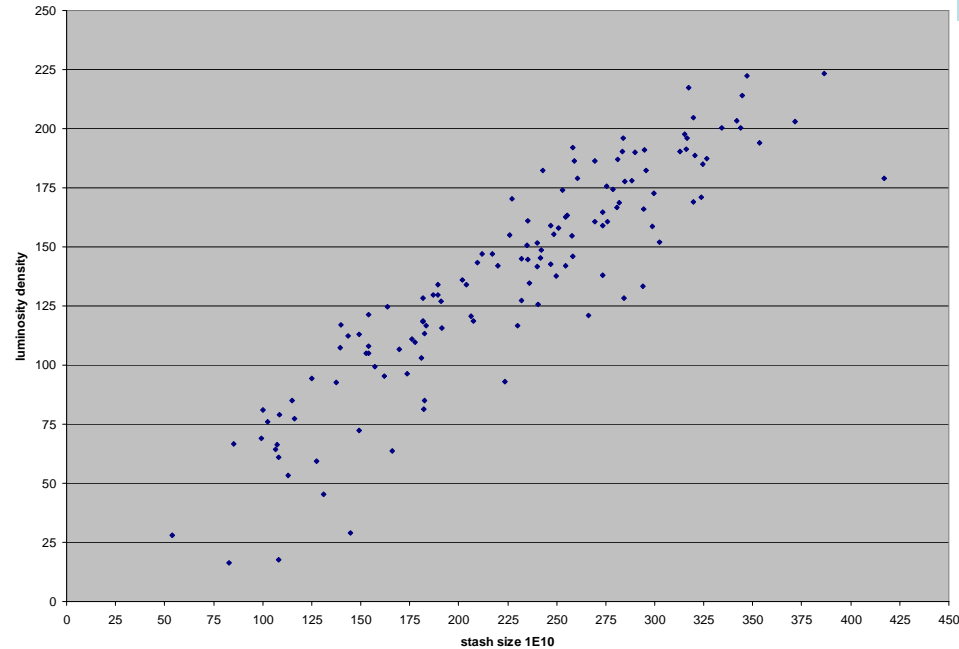
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AVG for last 50 stores in FY06  
(4859-4994): 256.4

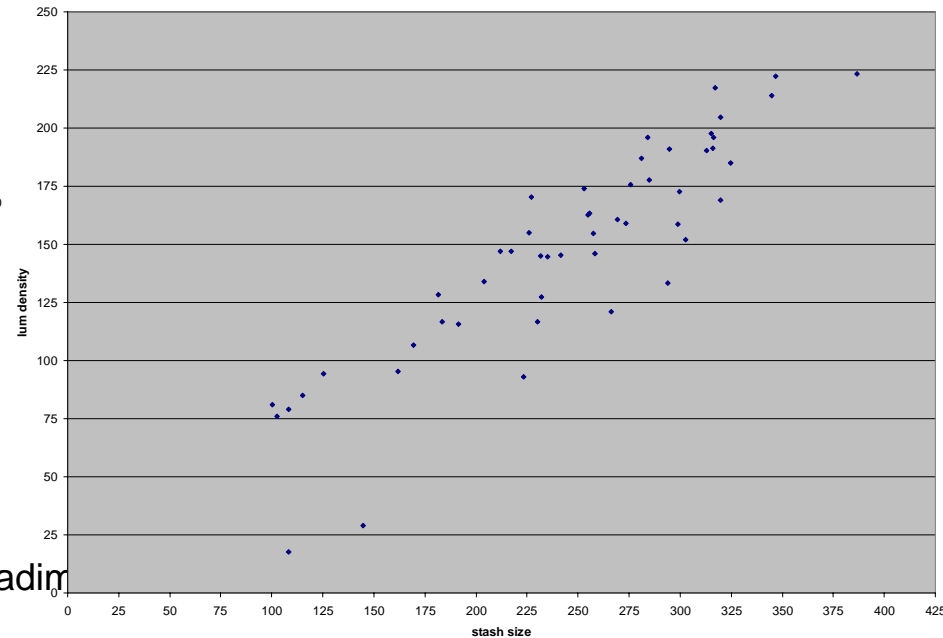
# Lum density vs stash size stores 4556-5037

lum dens vs stash size

12/19/05-10/29/06



lum dens vs stash size



last 50 stores of FY06,  
4859-4994

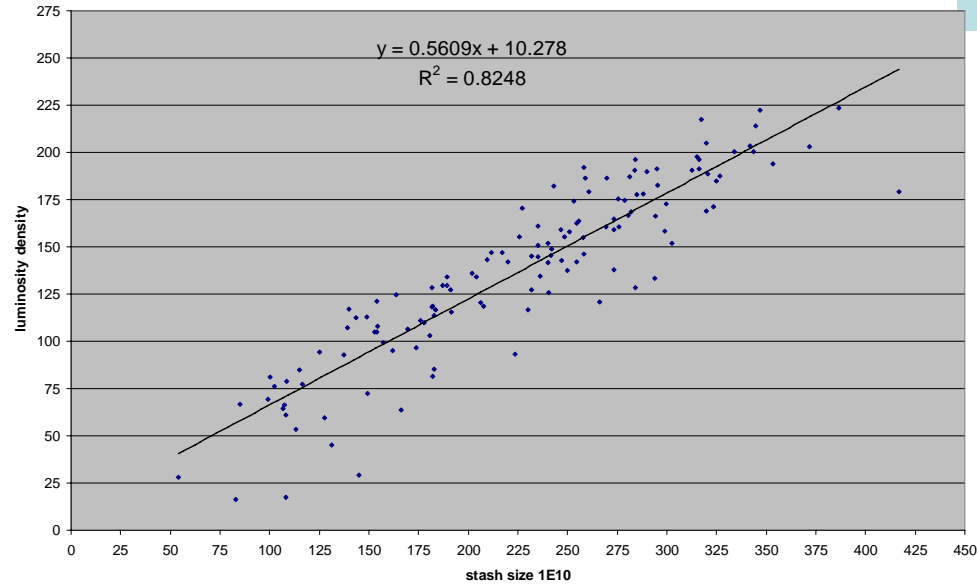
ia Papadim



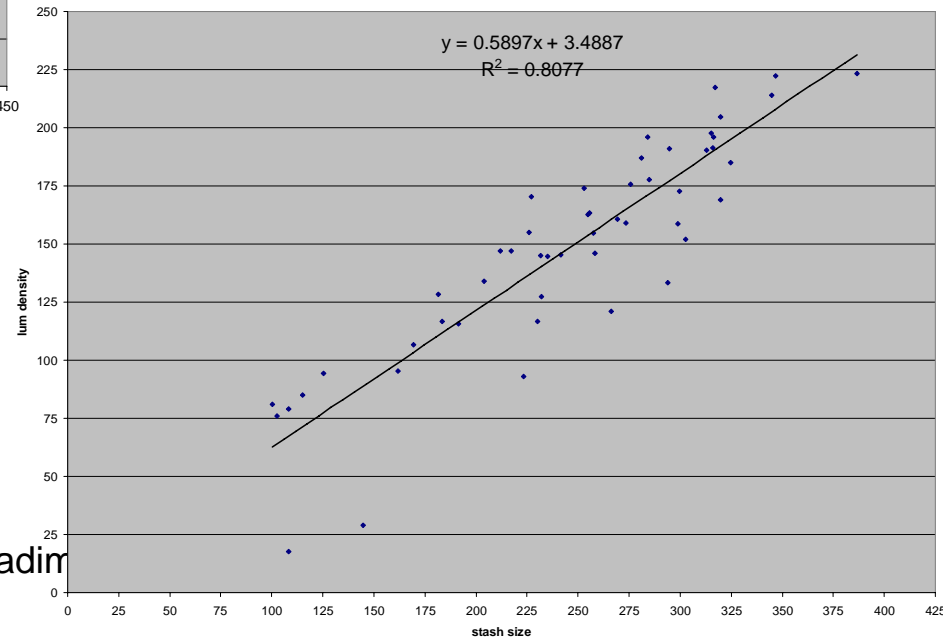
# Lum density vs stash size stores 4556-5037

12/19/05-10/29/06

lum dens vs stash size



lum dens vs stash size

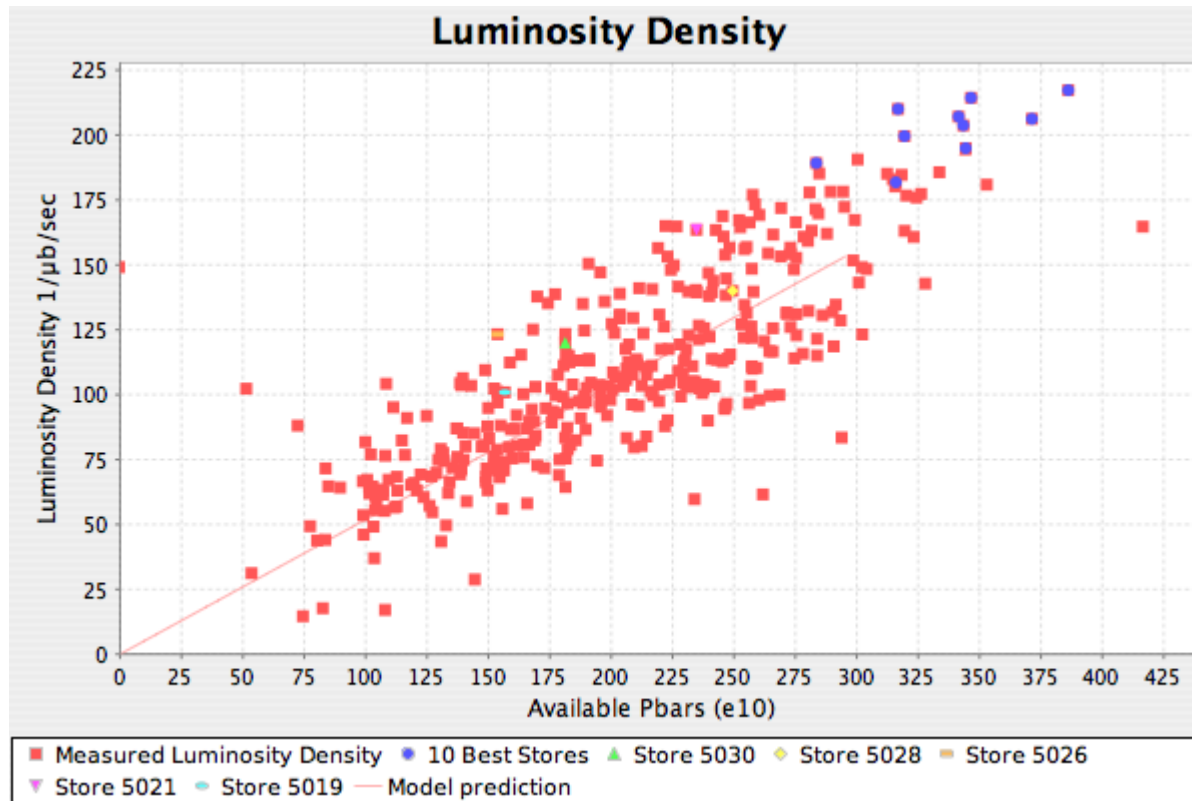


last 50 stores of FY06,  
4859-4994

ia Papadim

# Lum density

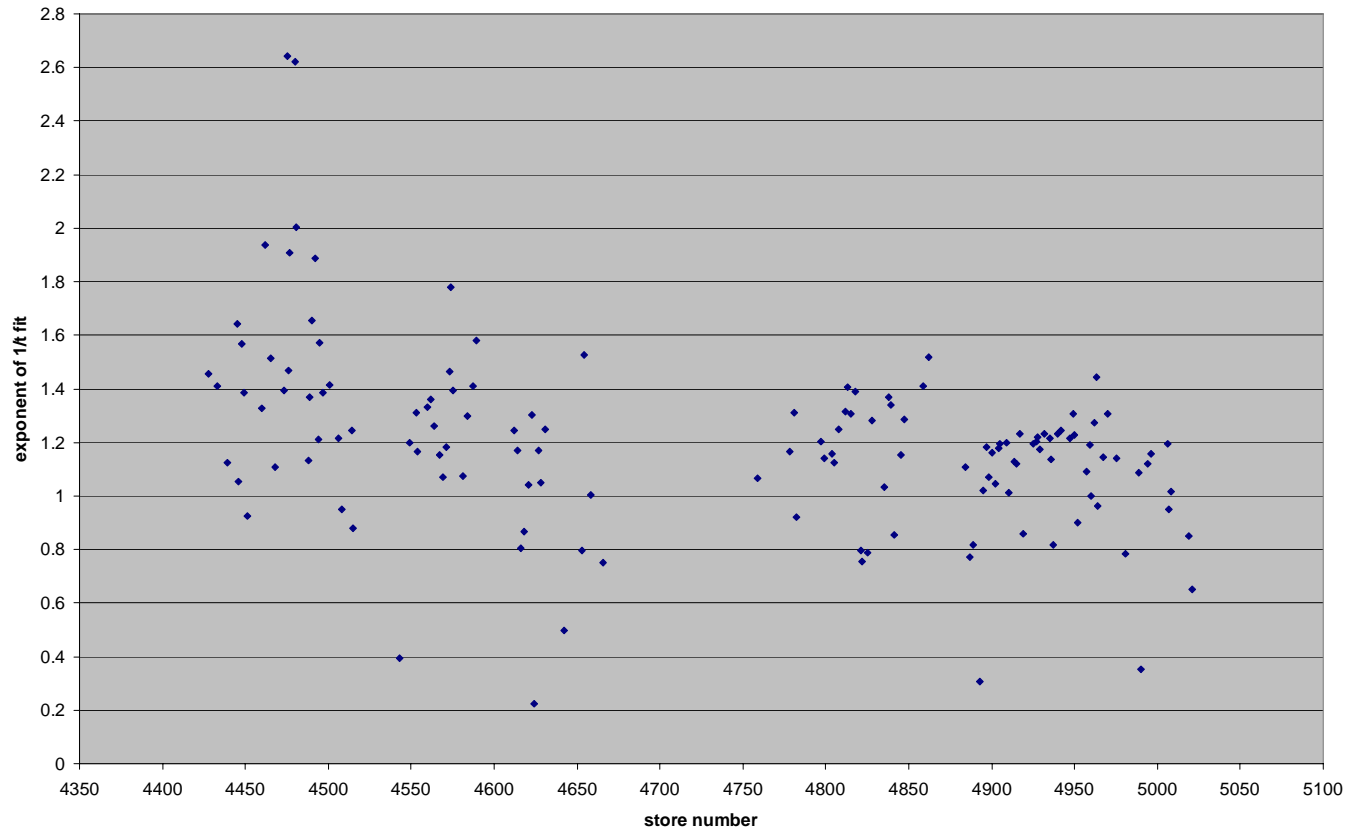
beginning of FY04- now



# CDF luminosity lifetime fits (exponent)

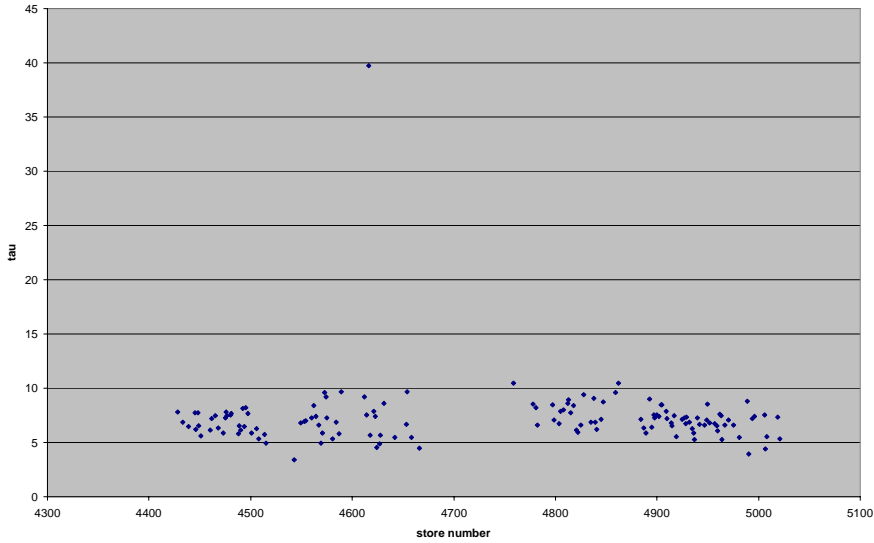
$$L(t) = \frac{L_0}{\left(1 + \frac{t}{\mu\tau}\right)^\mu}$$

exponent 1/time



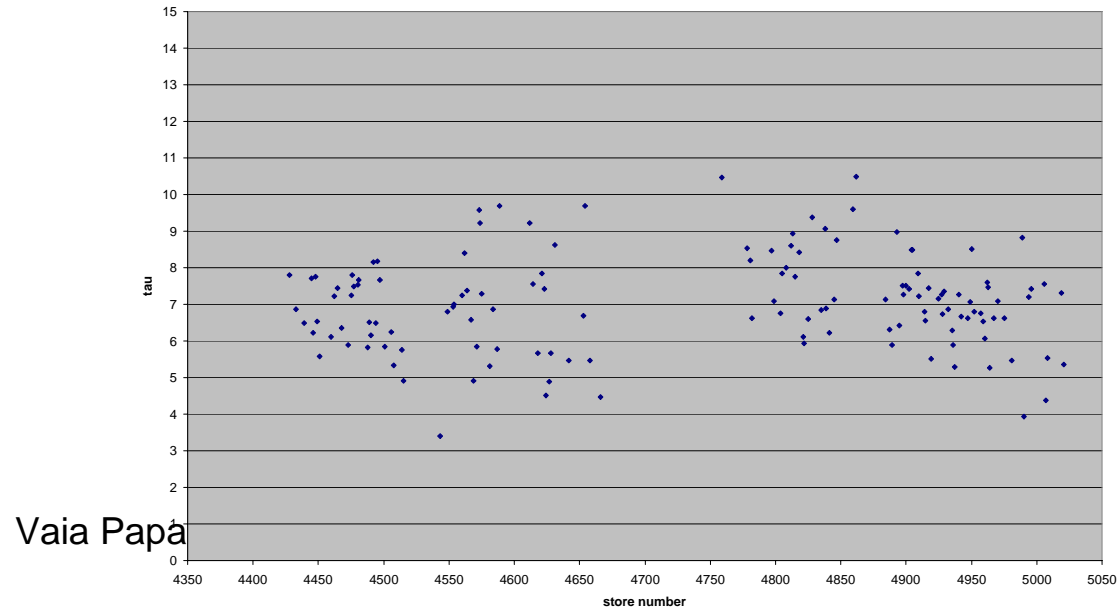
# CDF luminosity lifetime fits (tau)

TAU 1/time

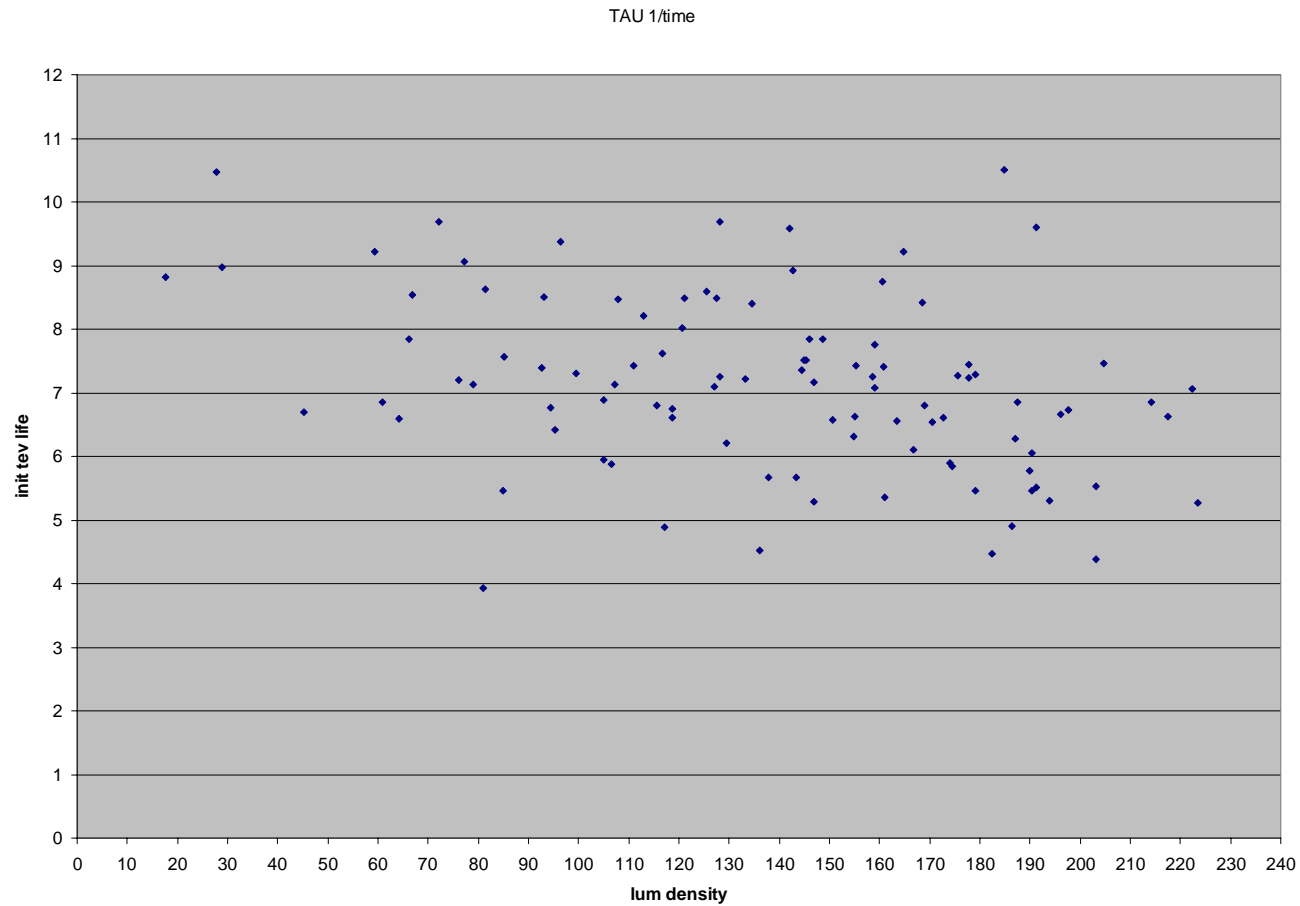


$$L(t) = \frac{L_0}{\left(1 + \frac{t}{\mu\tau}\right)^\mu}$$

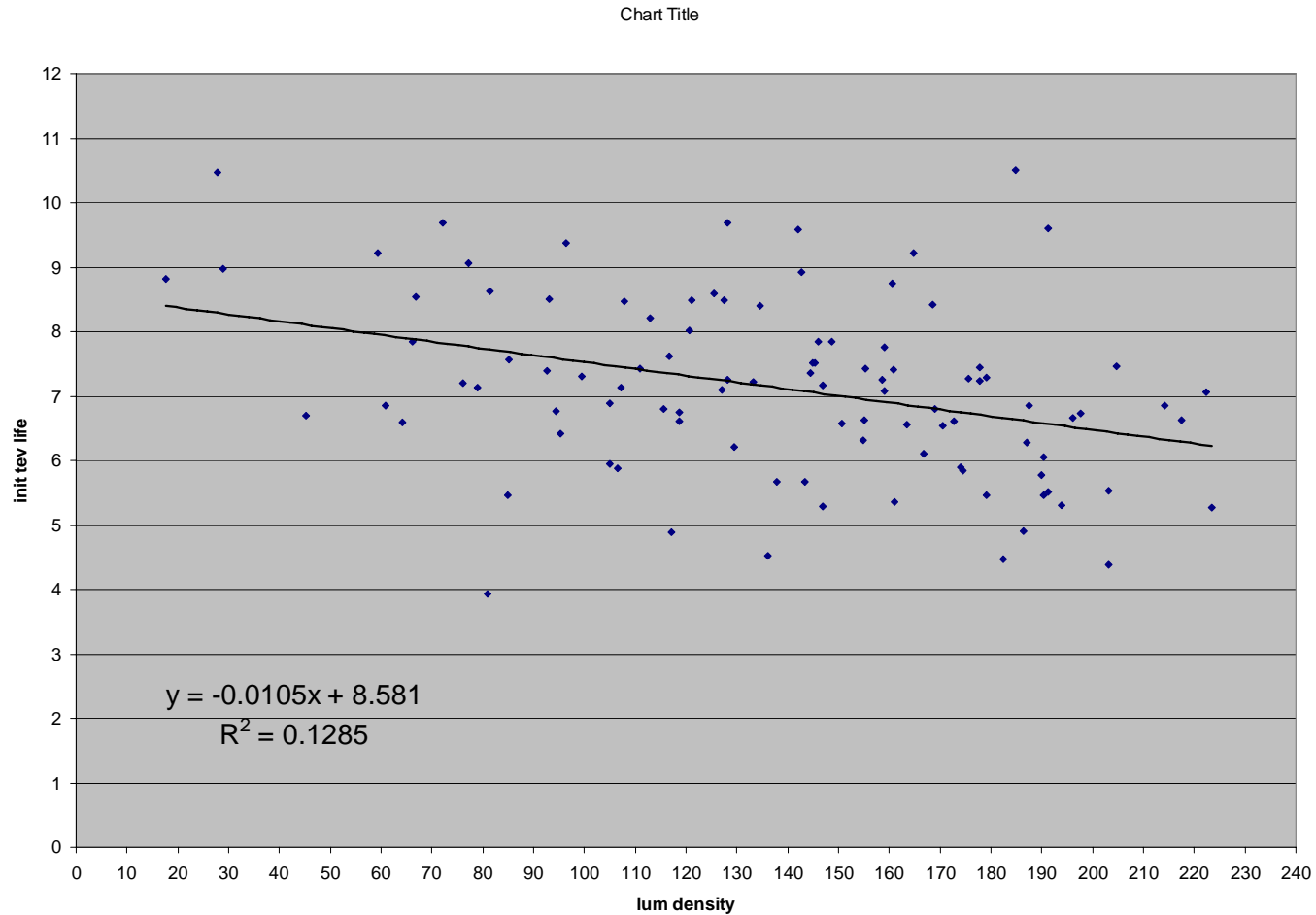
TAU 1/time



# CDF luminosity lifetime fits (tau) vs lum density

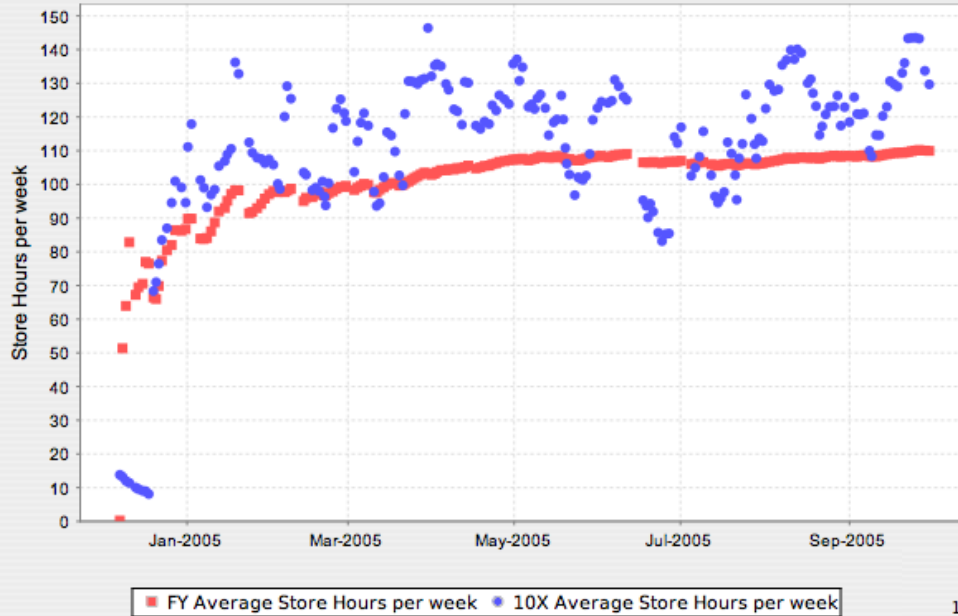


# CDF luminosity lifetime fits (tau) vs lum density

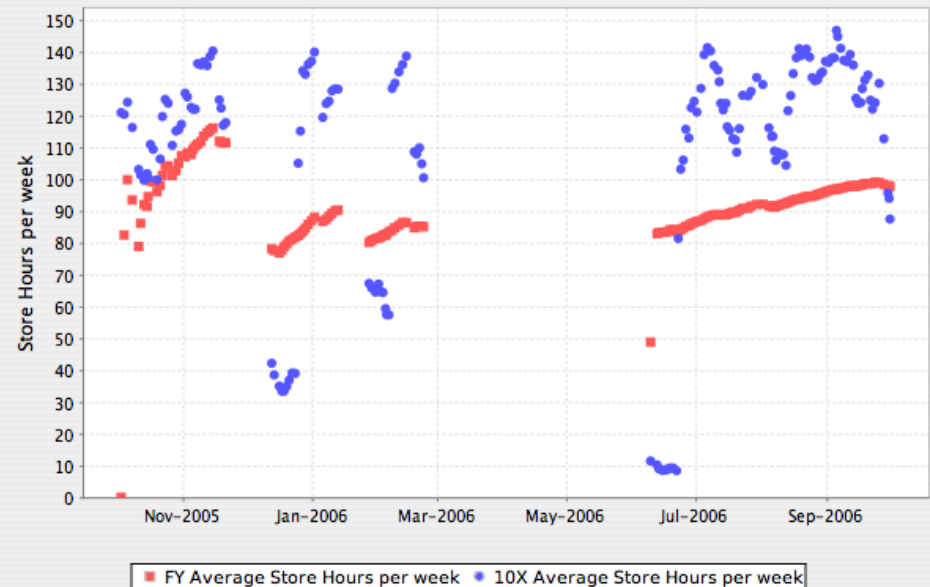


# Store hours per week, FY05 and FY06

FY Average Store Hours per week



FY Average Store Hours per week

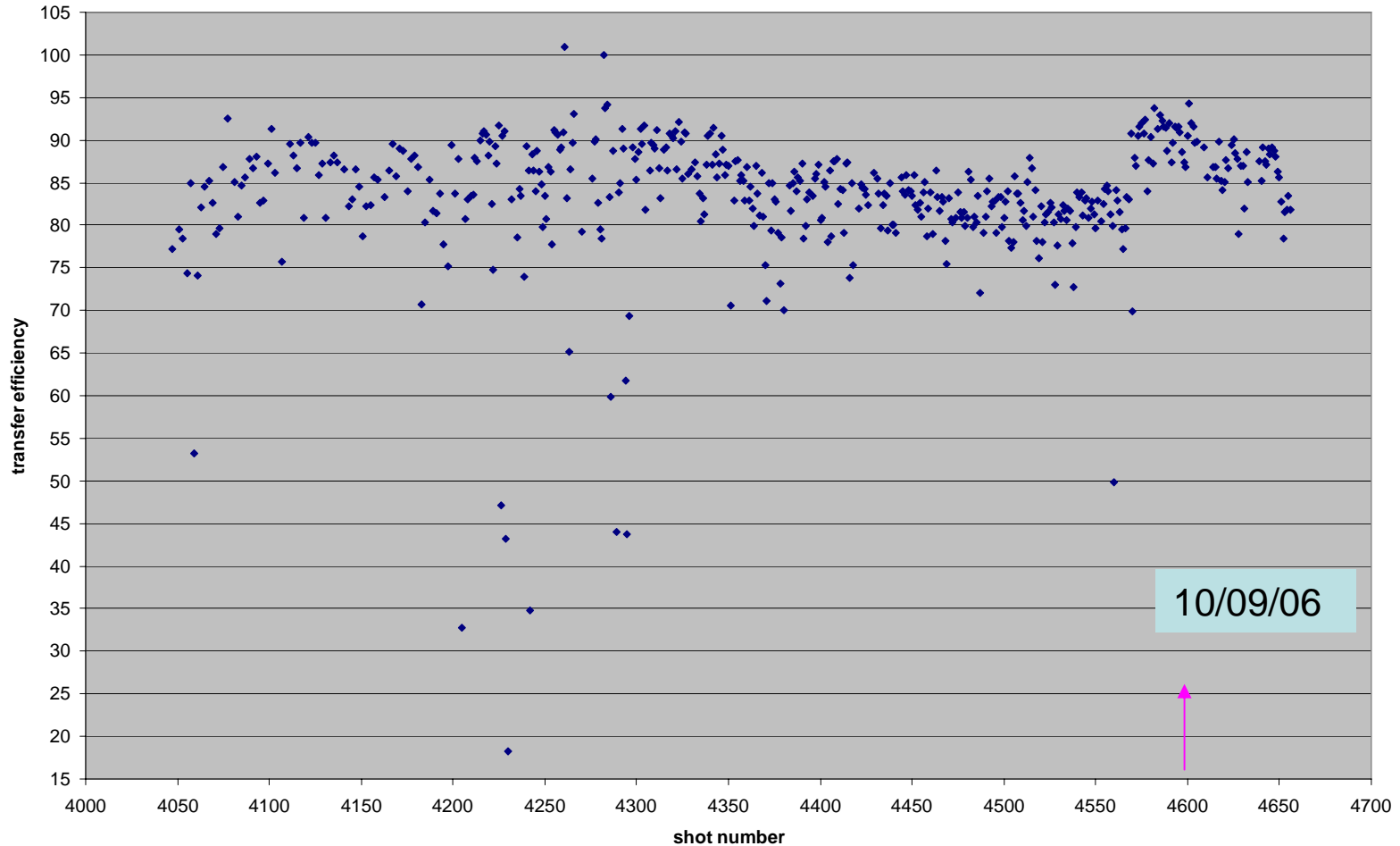


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# Transfer efficiency for RR shots shots 4047-4656

06/15/06-10/29/06

Column 35 Total transfer efficiency (beg-end)

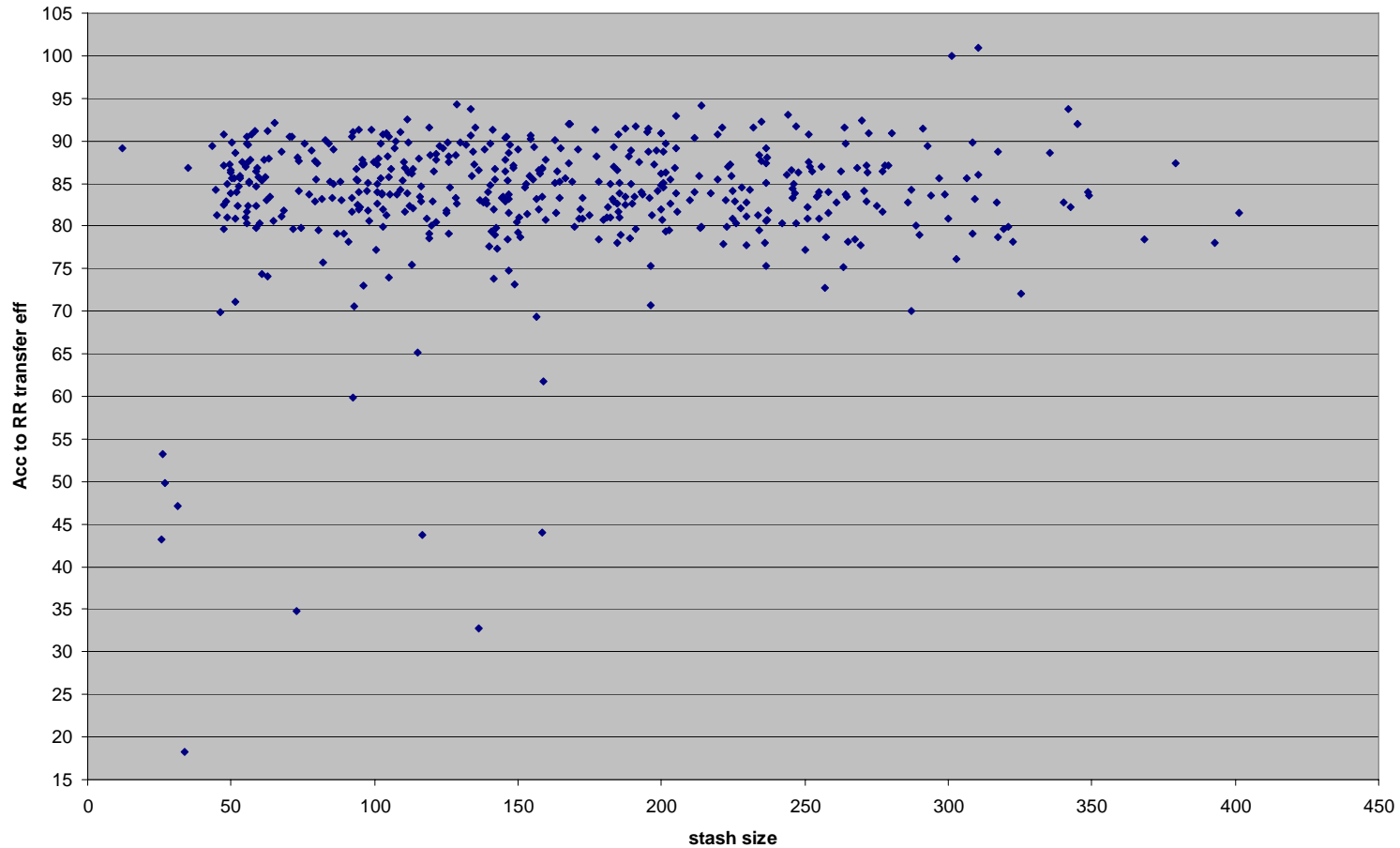




# Transfer efficiency for Acc-RR shots vs stash size,shots 4047-4656

06/15/06-10/29/06

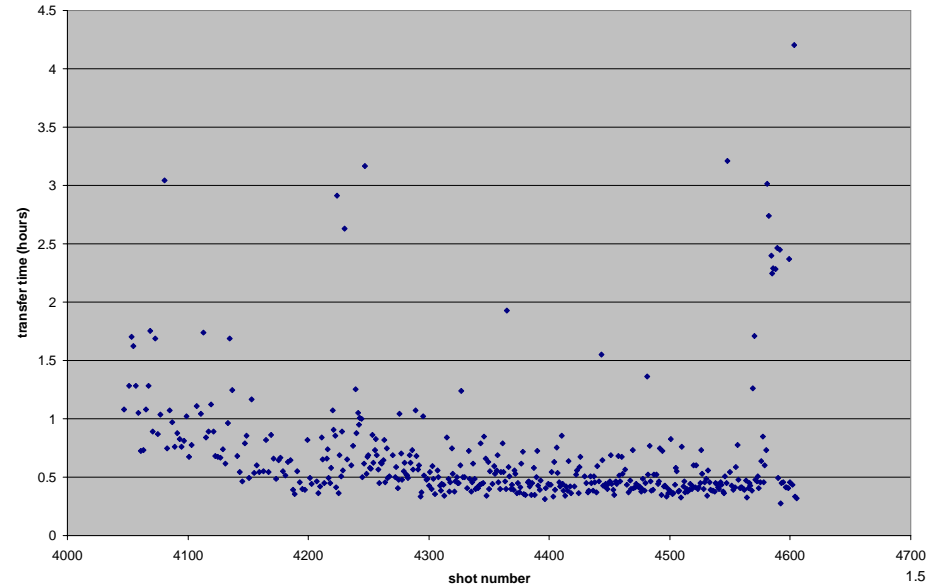
Column 35 Total transfer efficiency (beg-end)



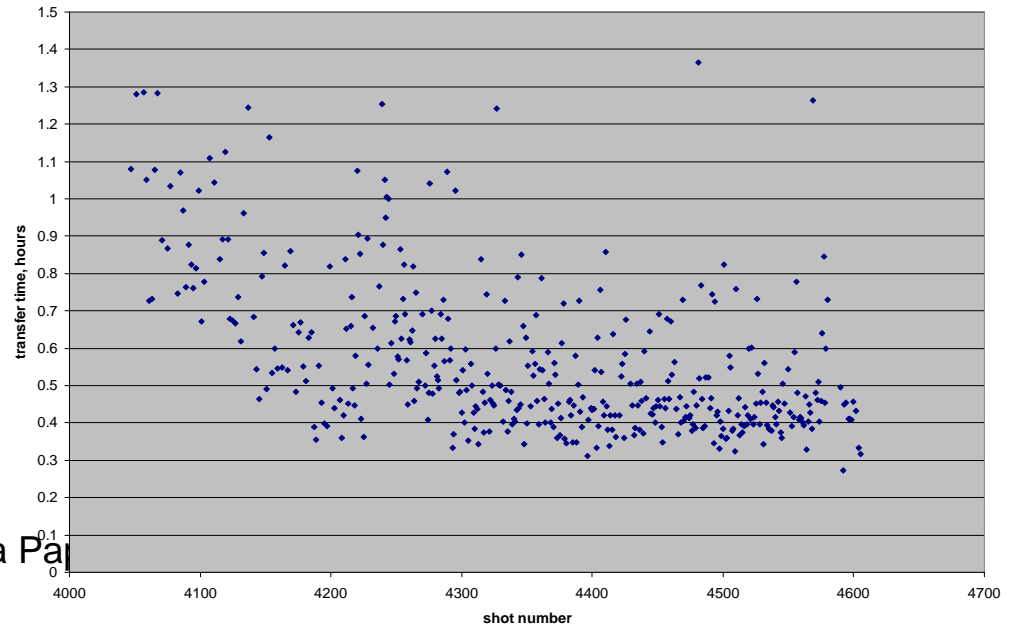
# Transfer time, shots 4047-4605

transfer time (hours), 4047-4605

Pbar Shots 4047-4605,  
06/15/06-10/09/06



transfer time, hours, vs shot



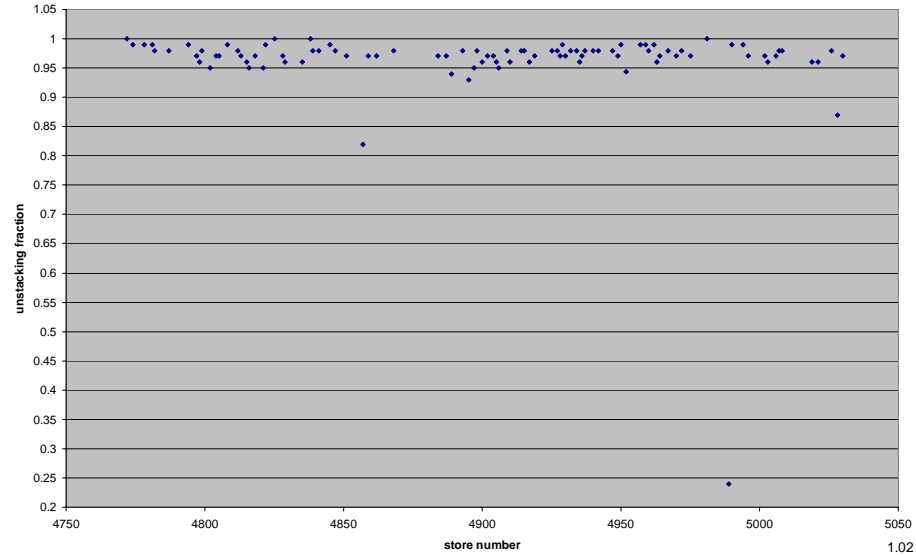
AVG: 0.66 h

STD DEV: 0.48 h

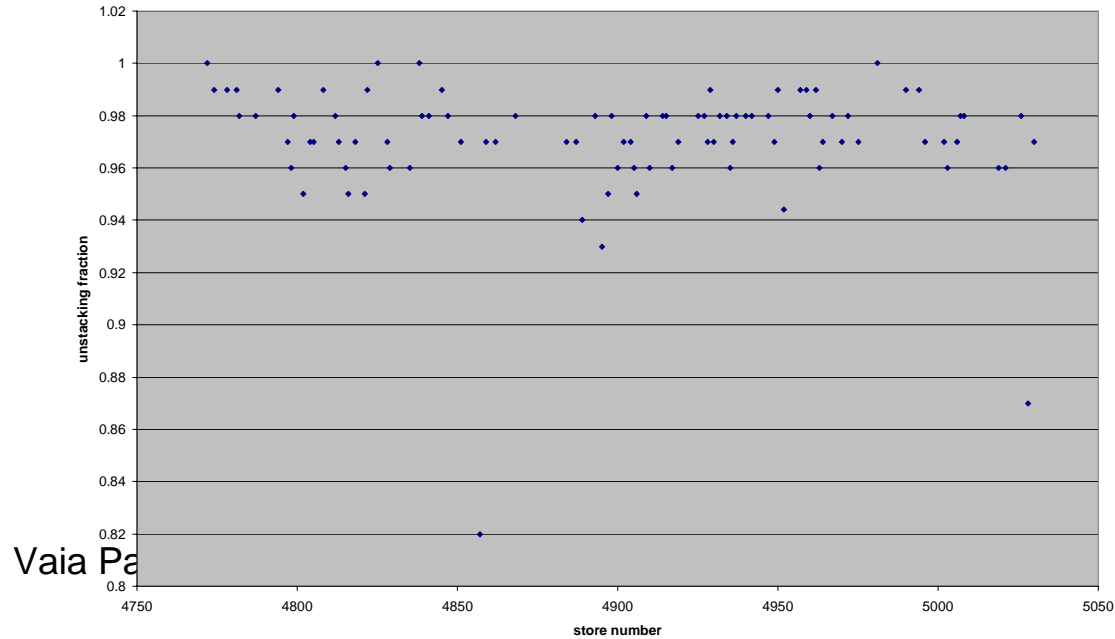
# Unstacking fraction, stores 4772-5030

06/15/06-10/26/06

# 31 RR unstacking fraction



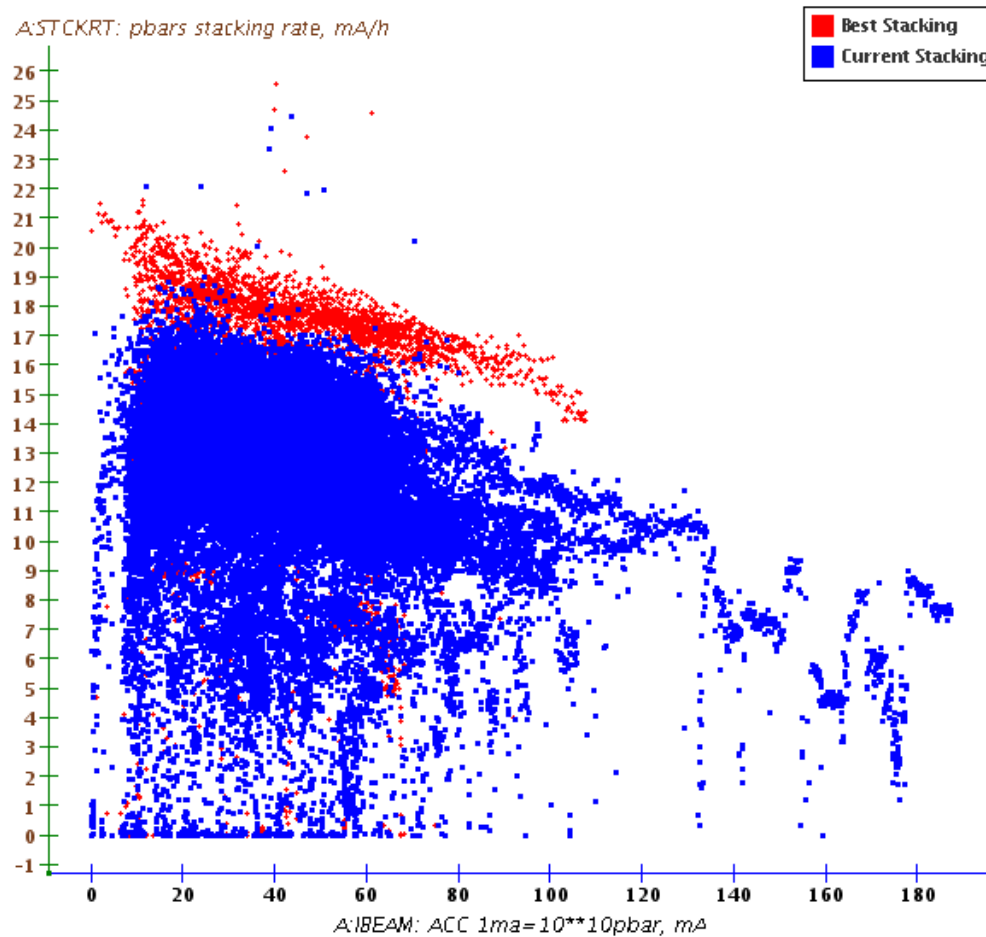
# 31 RR unstacking fraction



# Stacking vs ibeam

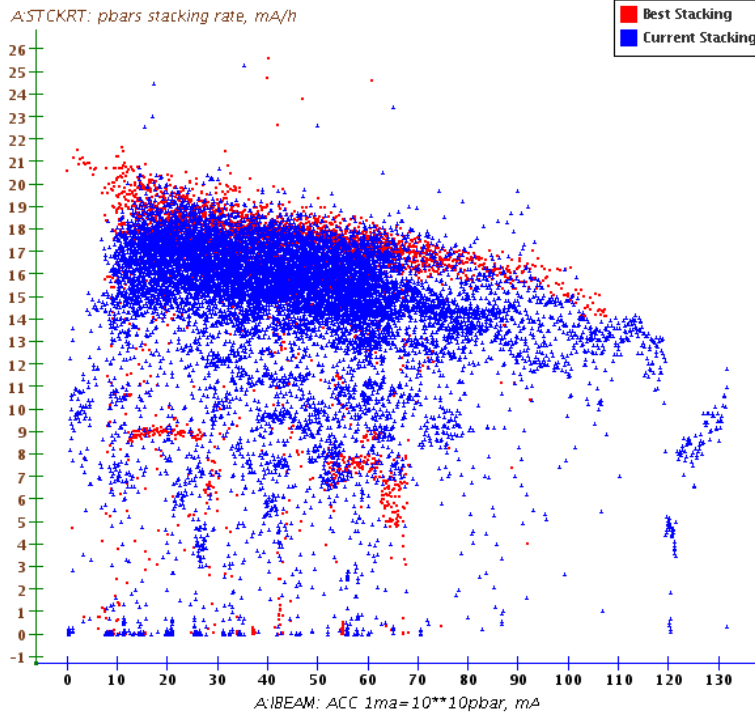
July 2006

month 7 2006 stck vs ibeam



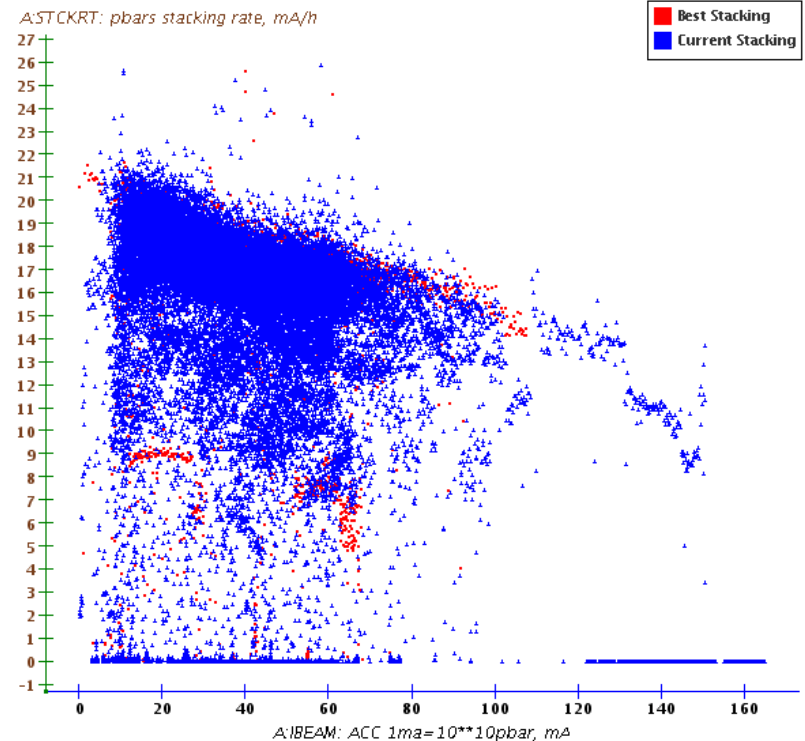
# Stacking vs ibeam

month 8 2006 stck vs ibeam



August, September 2006

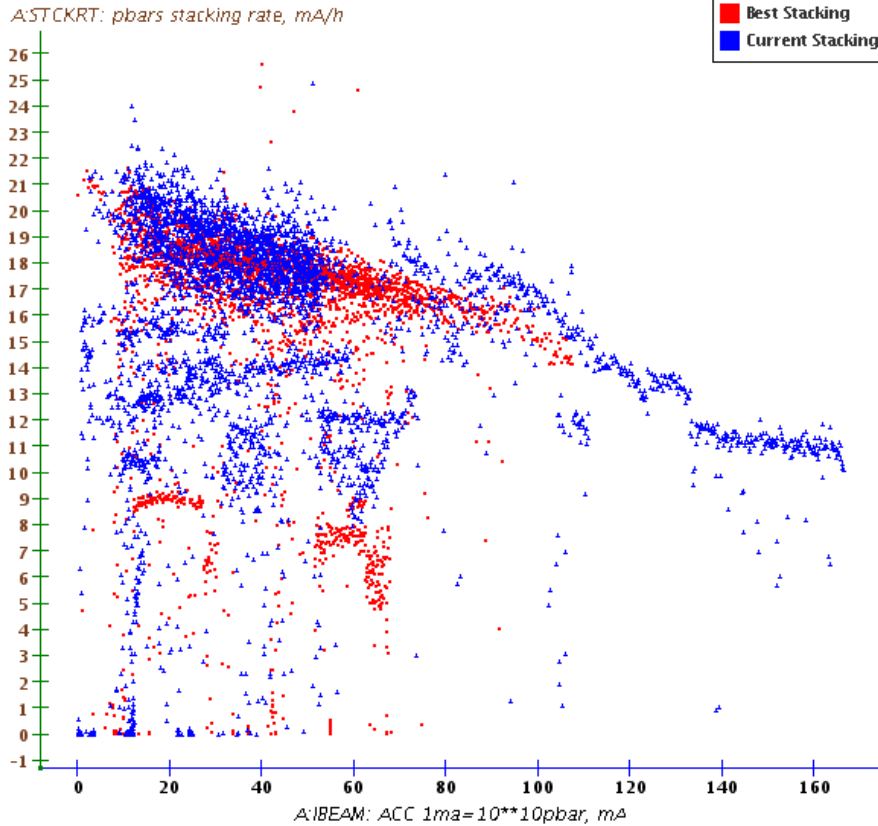
month 9 2006 stck vs ibeam



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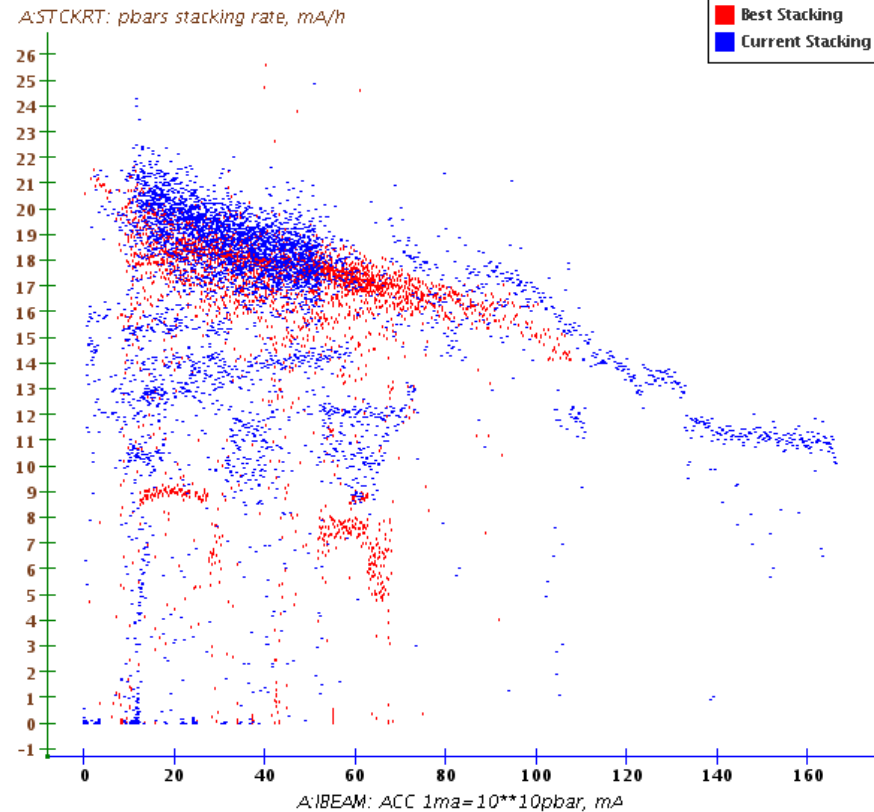
# Stacking vs ibeam

week 43 2006 stck vs ibeam



the last two weeks in Oct 2006

week 44 2006 stck vs ibeam



Vaia Papadin

## Selected Inputs for Second model with the goal to compare expected and delivered luminosity in FY06

- ❖ Number of protons per bunch  $250 \times 10^9$
- ❖ Luminosity Density @  $100 \times 10^{10}$   $62.5 \mu\text{b}^{-1} / \text{sec}$
- ❖ Luminosity Density @  $300 \times 10^{10}$   $180.4 \mu\text{b}^{-1} / \text{sec}$
- ❖ Init Tevatron Lifetime @  $80 \mu\text{b}^{-1}/\text{sec}$   $7.7$  hours
- ❖ Init Tevatron Lifetime @  $160 \mu\text{b}^{-1}/\text{sec}$   $6.9$  hours
- ❖ HEP store hours per week  $98$  hours
- ❖ Acc-Rec Transfer Efficiency @  $0 \times 10^{10}$   $86\%$
- ❖ Acc-Rec Transfer Efficiency @  $300 \times 10^{10}$   $86\%$
- ❖ Acc-Rec transfer time  $0.5$  hours
- ❖ Recycler lifetime  $500$  hours
- ❖ Zero stack stack rate  $17.5 \times 10^{10}/\text{hour}$
- ❖ Half rate stack size  $150 \times 10^{10}$
- ❖ Maximum stack size  $320 \times 10^{10}$
- ❖ Timeline Utilization Factor  $75\%$
- ❖ Accumulator leftover factor  $15\%$

Here we have no luminosity ramp up implemented after shutdowns

With above inputs we should have expected  $\sim 19 \text{ pb}^{-1}/\text{week}$  in FY06 for a total of  $\sim 680 \text{ pb}^{-1}$