Run II PMG

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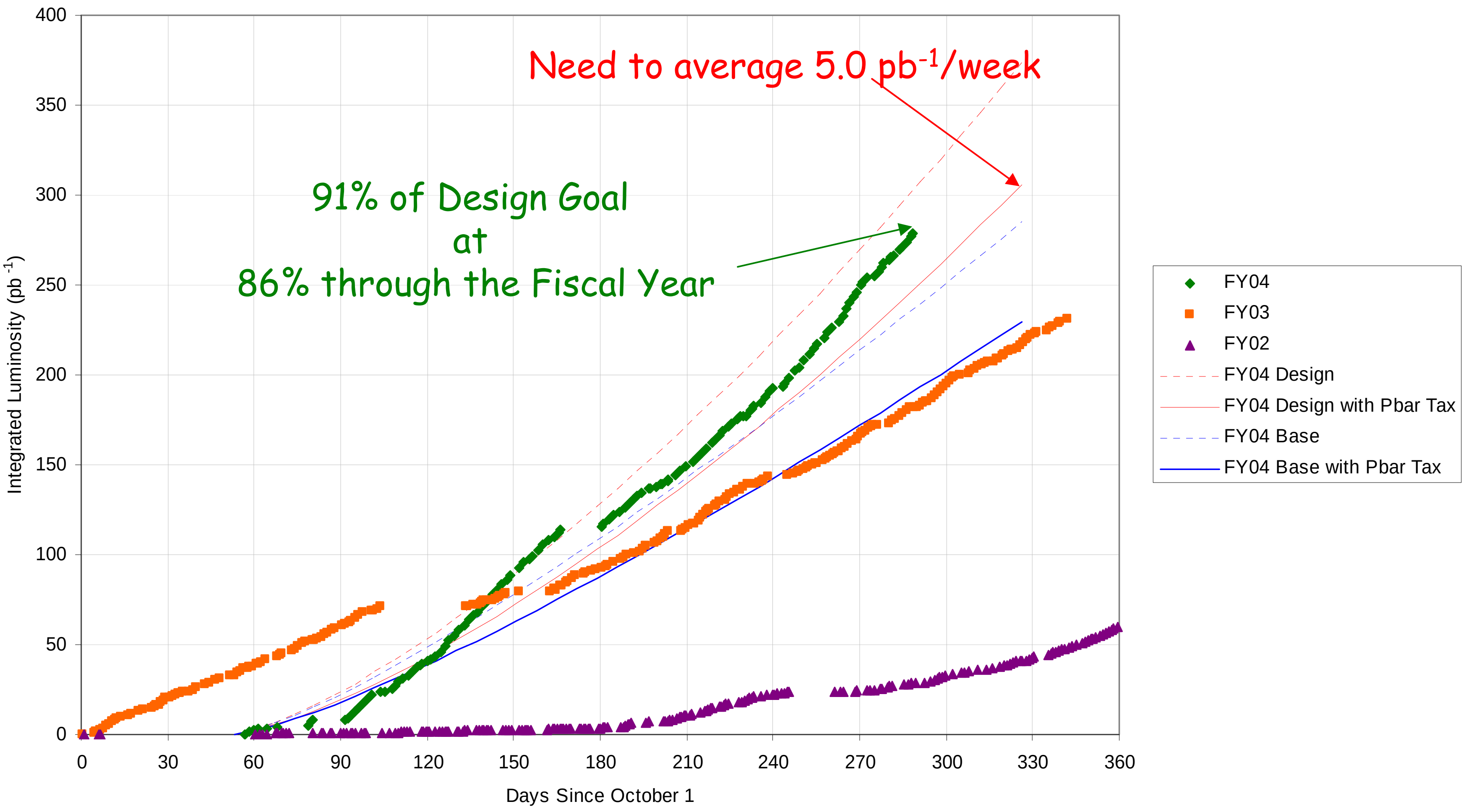
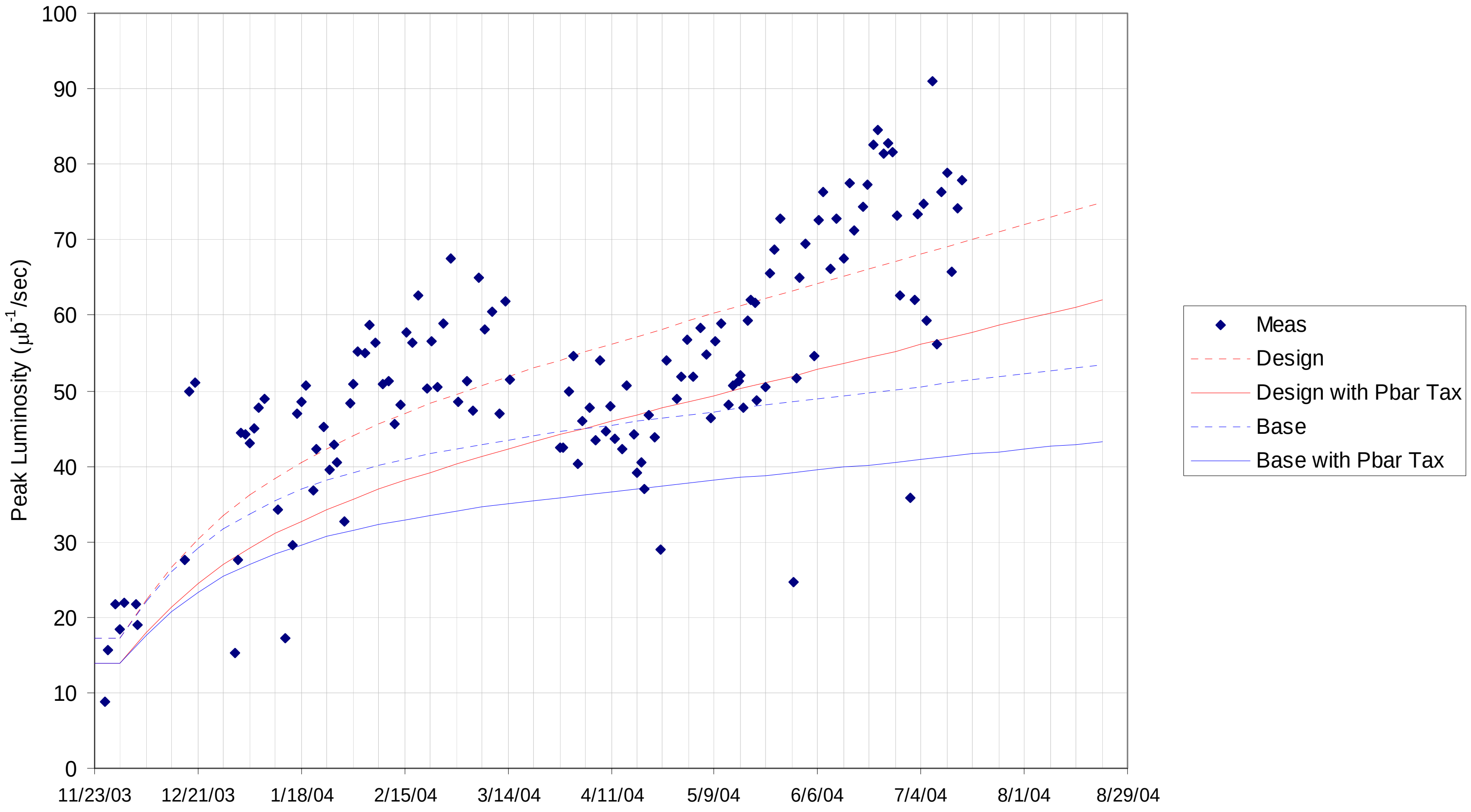
July 15, 2004

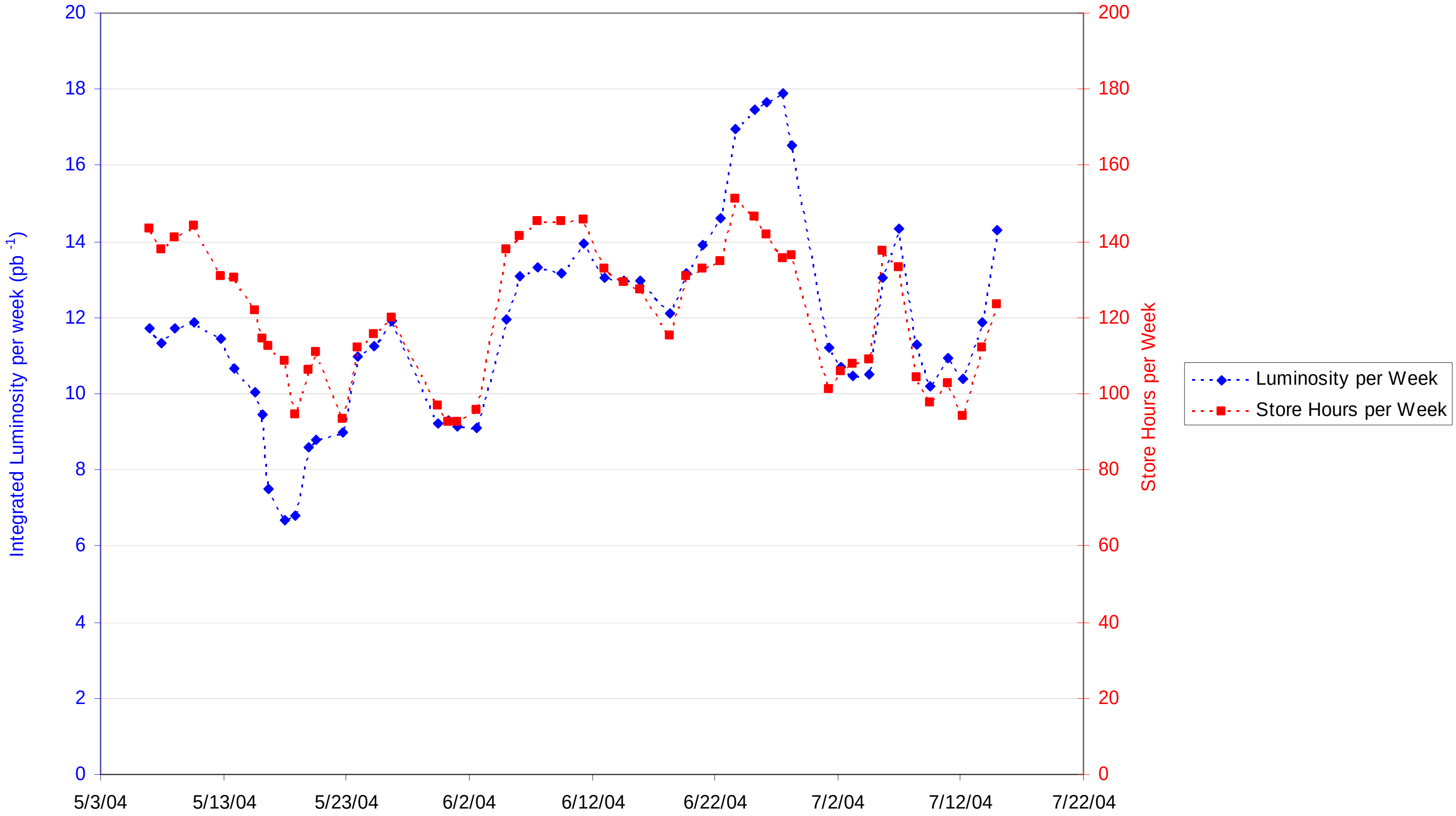
Integrated Luminosity



FY04 Peak Luminosity

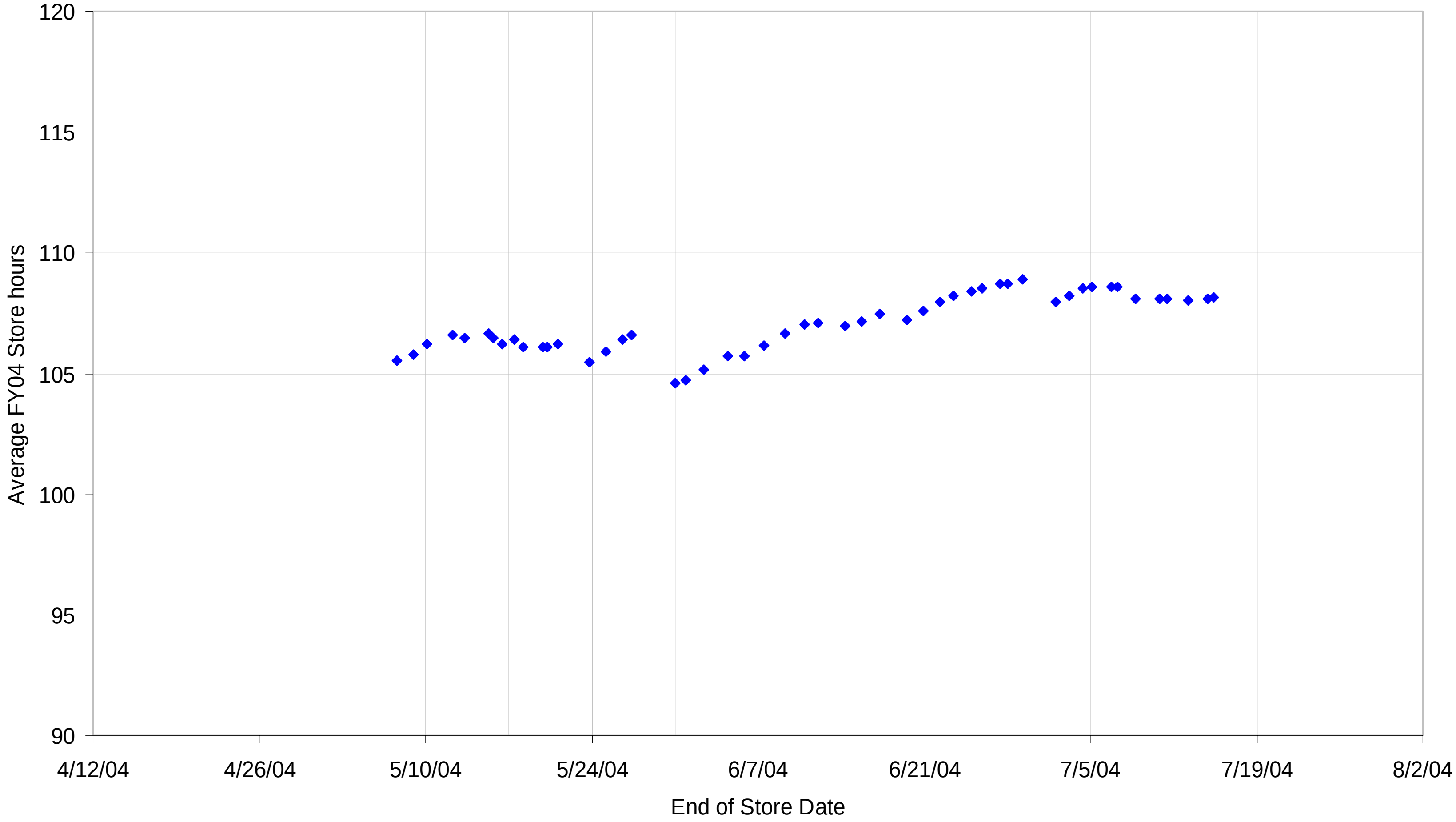


Integrated Luminosity and Store Hours per Week

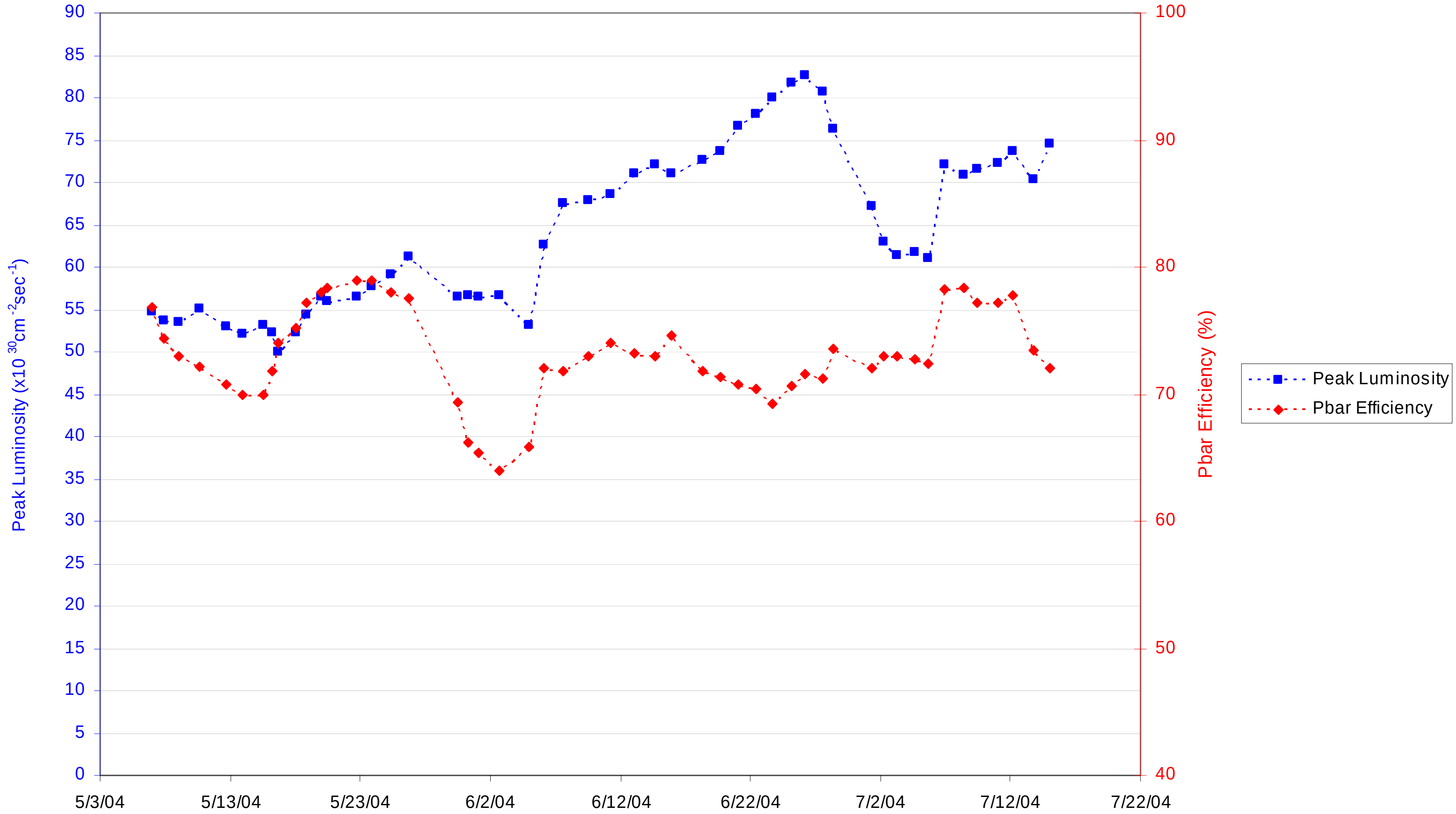


5 Store Running Average

FY04 Average Store Hours per Week



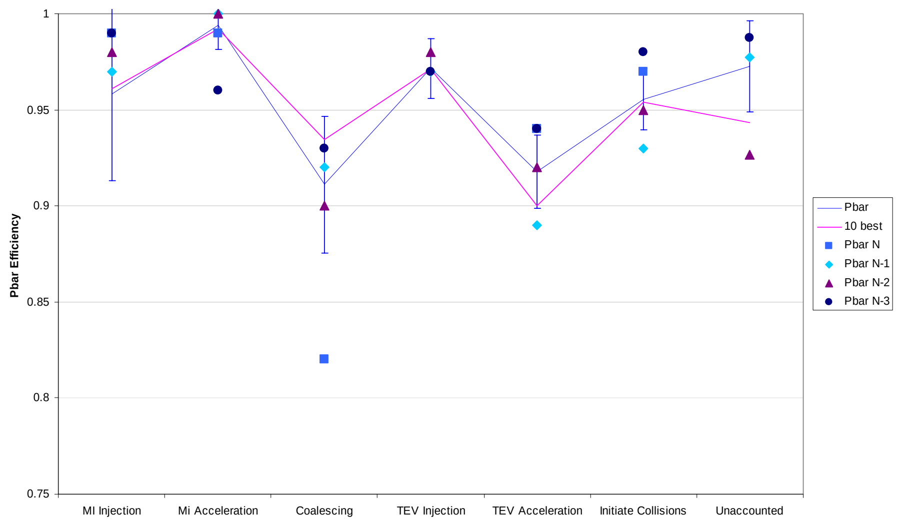
Peak Luminosity and Pbar Efficiency

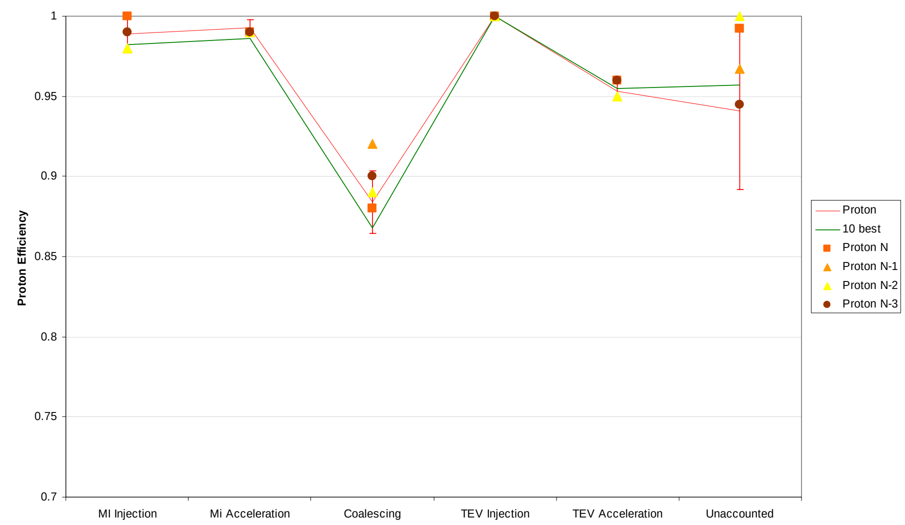


5 Store Running Average

Collider Transmission Efficiency*

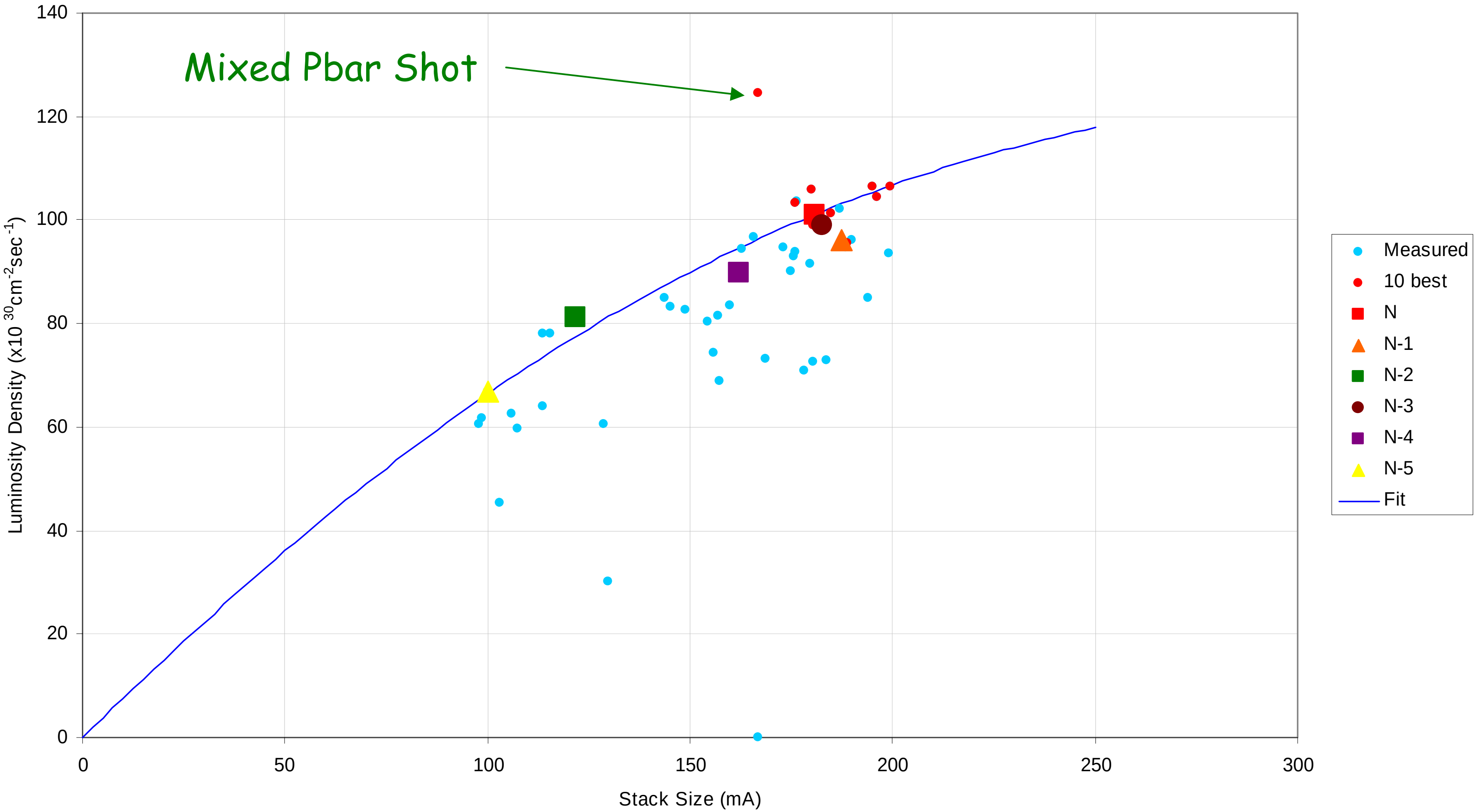
- Peak Luminosity up by 18%
  - Unstacked Pbars up by 2%
    - Store Length up by 32%
  - Pbar Transfer efficiency down by 6%
  - Protons per bunch is down by 5%
  - Effective Emittance down by 19%
  - Stacking Rate is down 36%
- Integrated Luminosity/week is up 9%
  - Store hours per week is up 30%





*Of the past 10 stores w.r.t the FY04 Goals

Stack Size Potential



Data Summary Table

				Store Parameters					
Parameter	Last Store	Best Store	Last 10 stores Average	Best 10 stores Average	FY04 Average	End of FY03	FY04 (End) Design	FY04 (End) Base	
Initial Luminosity (Average)	77.8	91.0	72.8	81.4	65.0	36.1	61.9	43.3	$x10^{30} cm^{-2} sec^{-1}$
Integrated Luminosity per Store (Averaged)	1896	1356	2123	3028	2250	1089	2000	1300	nb^{-1}
Luminosity per week (Averaged)	-	-	12.3	-	11.3	6.4	11.3	7.4	pb^{-1}
Store Length	10.4	7.4	19.9	26.5	22.7	14.9	15.0	15.0	Hours
Store Hours per week	-	-	111	-	113	88	85	84	Hours
Shot Setup Time	2.1	2.9	2.4	2.6	2.4	2.3	2.2	2.2	Hours
				TEVATRON Parameters					
Parameter	Last Store	Best Store	Last 10 stores Average	Best 10 stores Average	FY04 Average	End of FY03	FY04 (End) Design	FY04 (End) Base	
Protons per bunch	256	230	248	251	246	237	260	260	$x10^9$
Antiprotons per bunch	33	38	30	34	29	22	31	25	$x10^9$
Proton Efficiency to Low Beta	83	75	80	77	77	58	-	-	%
Pbar Transfer efficiency to Low Beta	71	90	75	73	73	63	80	77	%
HourGlass Factor	0.69	0.66	0.69	0.68	0.68	0.70	0.65	0.65	
Initial Luminosity Lifetime	6.9	7.0	6.2	6.2	6.4	9.5	8.3	7.0	hours
Asymptotic Luminosity Lifetime	18.7	24.0	19.4	20.9	21.7	25.1	25.0	25.0	hours
Effective Emittance	18.2	15.7	17.0	17.5	18.7	21.6	21.0	23.0	π-mm-mrad
				Antiproton Parameters					
Parameter	Last Store	Best Store	Last 10 stores Average	Best 10 stores Average	FY04 Average	End of FY03	FY04 (End) Design	FY04 (End) Base	
Zero Stack Stack Rate	13.2	11.9	11.4	12.9	12.5	11.5	18.0	13.7	$x10^{10}$/hour
Normalized Zero Stack Stack Rate	2.3	2.2	2.1	2.4	2.3	2.3	3.6	2.7	$x10^{-2}$/hour
Average Stacking Rate	7.6	6.8	6.1	6.5	6.2	7.1	9.3	7.6	$x10^{10}$/hour
Stacking Time Line Factor	88	87	76	82	77	88	75	75	%
Stack Size at Zero Stack Rate	341	312	348	300	314	300	300	300	$x10^{10}$
Protons on Target	5.4	5.1	5.3	5.4	5.3	5.0	5.0	5.0	$x10^{12}$
Start Stack	181	167	155	185	160	144	155	130	$x10^{10}$
End Stack	16	14	13	16	16	16	15	15	$x10^{10}$
Unstacked Pbars	165	153	143	169	144	128	140	115	$x10^{10}$

Luminosity Difference Between CDF and D0

- There has been a fair amount of controversy about the difference in luminosity between CDF and D0
  - Most of this controversy has centered on the fact that the ratio of peak luminosity measured at CDF to peak luminosity measured at D0 increases with peak luminosity
  - Also, the ratio of instantaneous luminosity measured at CDF to instantaneous luminosity measured at D0 changes during a store.
    - A simple analysis done by Valeri Lebedev shows that the hourglass effect can only explain a small portion of the luminosity ratio change through the store
  - Although the experiments are more concerned about the difference in peak luminosity from store to store, the two issues are closely related.

TEVATRON Focus

- Since the beginning of running in FY04, we have kept to a fairly focused plan for the Tevatron
- After starting up and recovering from the magnet failures early in FY04, the TEV department focused on fixing the injection optics which finished with the rolling of the quads in the P1 line in the March 04 shutdown.

TEVATRON Focus

- From the March 04 shutdown until late June, the TEV department has been working on correcting the collision optics. The goal of the adjusting the collision optics was to bring the beta* at BOTH IP's to the design of 35 cm.
  - This first step in this procedure was a series of optics measurements using differential orbits
  - The next step was to figure out a way of introducing the optics changes at collisions without disturbing the rest of the TEV ramp.
  - Next was implementing the optics changes, correcting the tunes and orbits.
    - What we found at this step was that the differential tunes (tune difference between protons and pbars) was much larger than expected and was difficult to compensate.
  - Next, we did alpha scans and separator scans to ensure that the beta* was at the center of the detectors and that the beams were colliding head on.
- We spent over a month struggling with extremely high proton losses at CDF.
  - The solution to this problem was to adjust the tune working point of the TEV and implementing a double scrape procedure. The double scrape procedure was the most effective of the solutions tried.

TEVATRON Plans

- Because we cannot explain the changing luminosity ratio with bunch length evolution and the measured difference in beta's between the two IP's, we are reluctant to embark on a program to make the luminosity detectors at both experiments read the same number at this time.
- Also, as seen previously, optics changes in the TEV can be extremely painful and time consuming

TEVATRON Plans

- We would prefer to focus increasing integrated luminosity at both experiments. The plan to do this is:
  - Implement the new B2 un-wind procedure in the TEV.
    - This should increase ramp efficiency and store-to-store reproducibility.
  - Commission the new octopole settings in the TEV.
    - This should increase beam stability which should allow us to put more protons into the TEV.
  - Mixed Pbar operation.
    - This should put more pbars into the TEV
  - Zero Stack Stacking rate.
    - This should put more pbars in the TEV and permit faster recovery from lost stores.
  - Slip-Stacking.
    - This should put more pbars in the TEV and permit faster recovery from lost stores

TEVATRON Plans

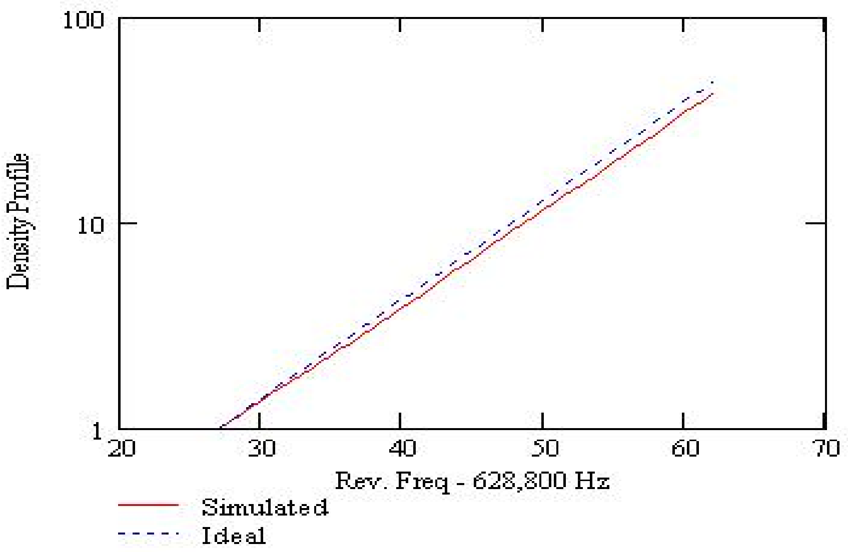
- The above 5 items compete for limited study time and will bring about much more integrated luminosity.
- We propose that when we understand the measured luminosity difference at both IP's we would undergo another round of optics corrections (and the pain that goes with it) after the above 5 items are completed.

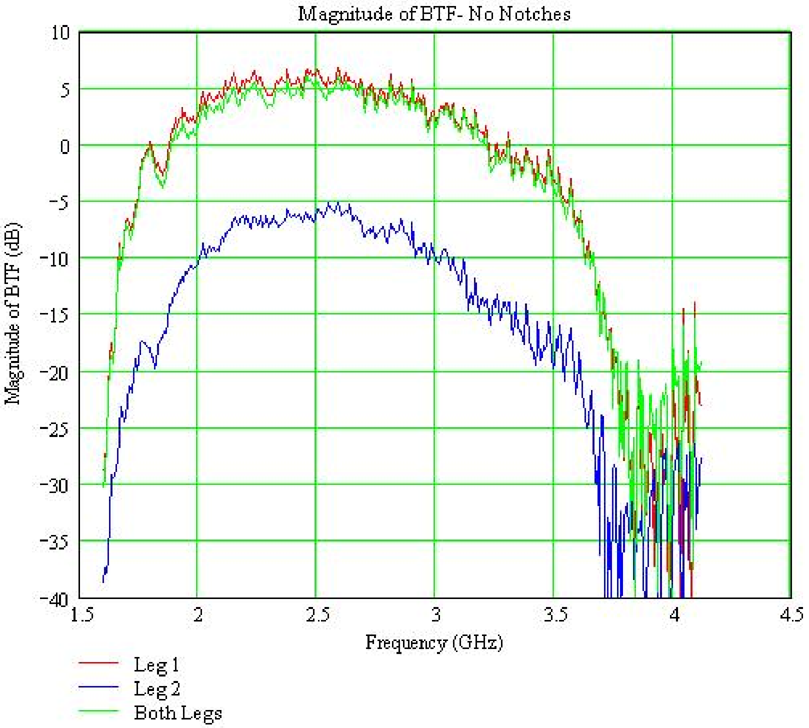
Pbar Cooling Plan Outside the Run II Upgrades

- Increase the bandwidth of the Debuncher Momentum cooling system (~20%) with equalizers
  - 1st band done ~ rest in about3 months
- Optimize gain and gain ramping in the Debuncher momentum cooling
  - in place – further optimization on hold while investigating zero stack studies
- Investigate a static change in gamma-t in the Debuncher
  - in place – γ_t went from 0.006 – 0.007 - further optimization on hold while investigating zero stack studies
- Investigate the feasibility of ramping gamma-t in the Debuncher
  - ~6 months
- Implement momentum selective ARF1 curves
  - Finished
- Increase bandwidth of the Stacktail system by about 10-20% by extending bandwidth of the Stacktail notch filters
  - Finished
- Install controllable phase shifters in both legs of the Accumulator Stacktail
  - Finished
- Implement a phase crossover in the Stacktail system using phase shifters
  - Finished
- Implement 4-8 GHz momentum core cooling during stacking
  - On hold while investigating zero stack studies

Pbar Zero Stack or Small Stack Studies

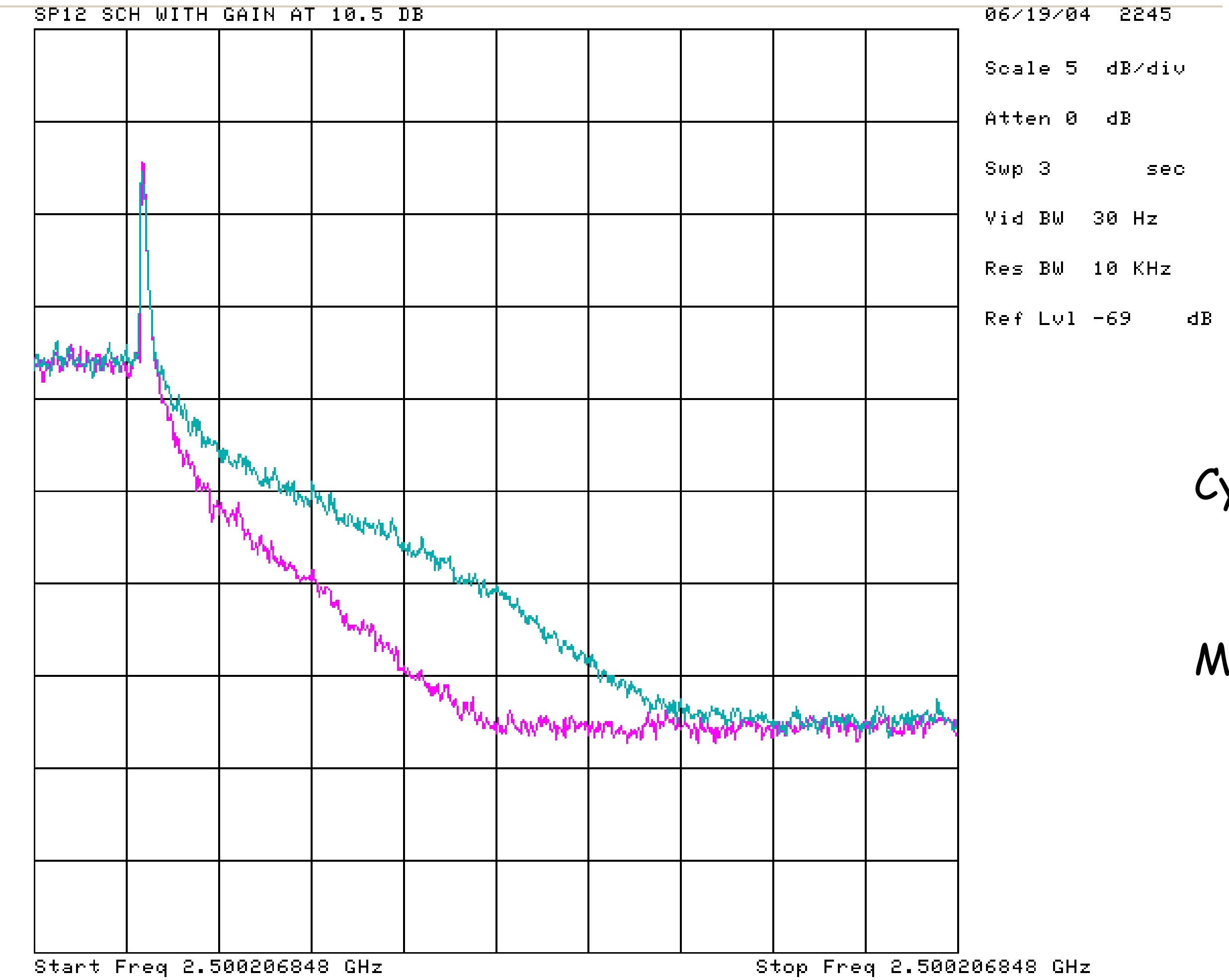
- Purpose: To understand the flux limitations of the Stacktail without the influence of a large core.
- Conclusions:
  - The present stacktail system with the bandwidth as measured should be capable of handling a static flux of 29mA/hr





Pbar Zero Stack or Small Stack Studies

- Conclusions
  - At small stacks, the present stacktail system can clear the deposition orbit as fast as 1.2 seconds

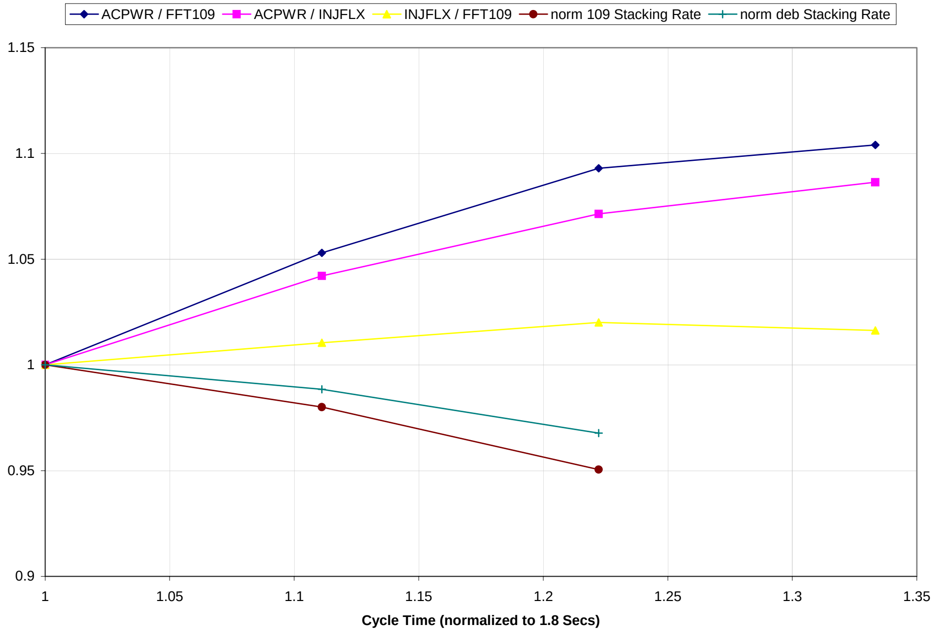


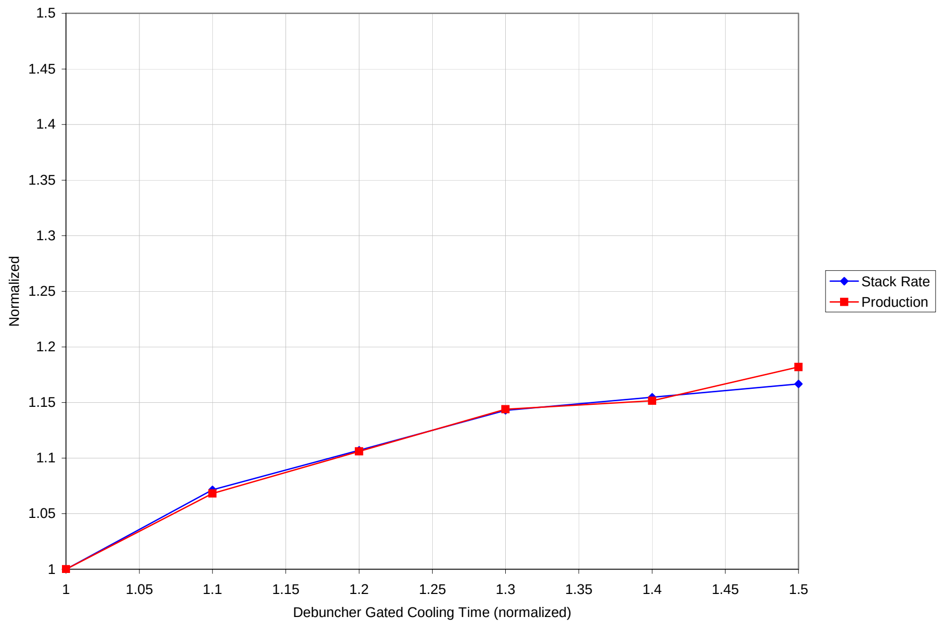
Cyan Trace with attenuator at 10.5 dB clears in 1.8 secs

Magenta Trace with attenuator at 4.5 dB clears in 1.2 secs

Pbar Zero Stack or Small Stack Studies

- Conclusions
  - At small stacks, increasing the stacktail gain or power does not affect stacking
    - It also does not seem to affect the emittances in the stacktail
  - We can account for about 2/3 of the stack rate vs. cycle time by observing that the amount of beam received by the Accumulator decreases as the cycle time decreases.
  - Initial measurements of Debuncher cooling gating can account for most of this observed decrease.





Future Work for Zero Stack Studies

- Dis-entangle the effects of Debuncher momentum and transverse cooling on beam received on the Accumulator Injection orbit
- Thoroughly investigate Debuncher transverse cooling.
- Investigate D/A line aperture

DRAFT FY05 Goals

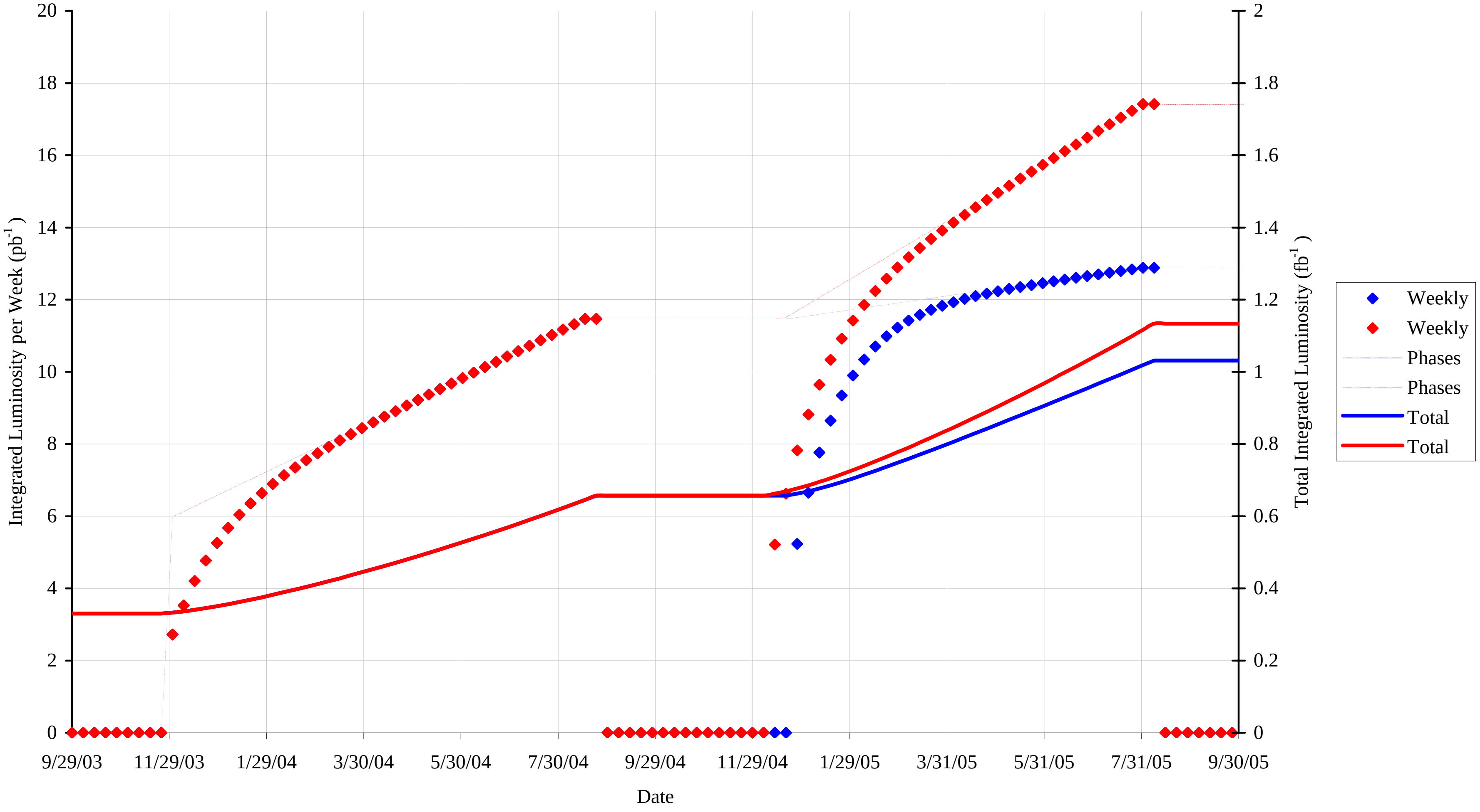
Luminosity Parameters				
Phase	1	Design	Base	
Initial Luminosity	72.8	99.3	77.6	$x10^{30}cm^{-2}$
Average Luminosity	32.0	48.4	37.8	$x10^{30}cm^{-2}$
Integrated Luminosity per week	11.5	17.4	12.9	pb^{-1}
Integrated Luminosity per store	2.9	3.5	2.7	pb^{-1}
Number of stores per week	4.0	5.0	4.7	
Average Store Hours per Week	100	100	95	Hours
Store Length	25	20	20	Hours
Initial Lifetime	6.4	6.4	6.4	Hours
Average Lifetime	12.8	12.0	12.0	Hours
HEP Up Time per Week	110	113	107	Hours
Shot Setup Time	2.6	2.6	2.6	Hours
	FY04 Plan	**Slip Stacking**	**Slip Stacking**	

TEVATRON Parameters				
Phase	1	Design	Base	
Number of Protons per bunch	250	260	260	$x10^{9}$
Number of Pbars per bunch	31.6	43.9	34.3	$x10^{9}$
Proton Emittance	24	25	25	π-mm-mra
Pbar Emittance	11	12	12	π-mm-mra
σ_{proton}	0.500	0.500	0.500	cm
σ_{pbar}	0.500	0.500	0.500	cm
BetaIP	35	35	35	cm
Transfer Eff. To Low Beta	0.72	0.76	0.75	
	FY04 Plan	**Slip Stacking**	**Slip Stacking**	

Antiproton Parameters				
Phase	1	Design	Base	
Zero Stack Stacking Rate	13.0	26.2	17.2	$x10^{10}$/hou
Average Stacking Rate	6.3	10.4	8.2	$x10^{10}$/hou
Stack Size transferred	158.2	208.0	164.7	$x10^{10}$
Stack to Low Beta	113.9	158.1	123.5	$x10^{10}$
Pbar Production	16.0	20.0	17.0	$x10^{-6}$
Protons on Target	5.4	8	6.2	$x10^{12}$
Pbar cycle time	2.4	2.2	2.2	Secs.
Pbar up time fraction	0.75	0.75	0.75	
Initial Stack Size	15	15	15	$x10^{10}$
Stack Size at 1/2 Stacking Rate	150	150	150	$x10^{10}$

Fiscal Year	Accumulated	Accumulated	per Year	per Year
	fb^{-1}	fb^{-1}	fb^{-1}	fb^{-1}
FY03	0.33	0.33	0.33	0.33
FY04	0.66	0.66	0.33	0.33
FY05	1.13	1.03	0.48	0.37

DRAFT FY05 Goals Integrated Luminosity



DRAFT FY05 Goals Peak Luminosity