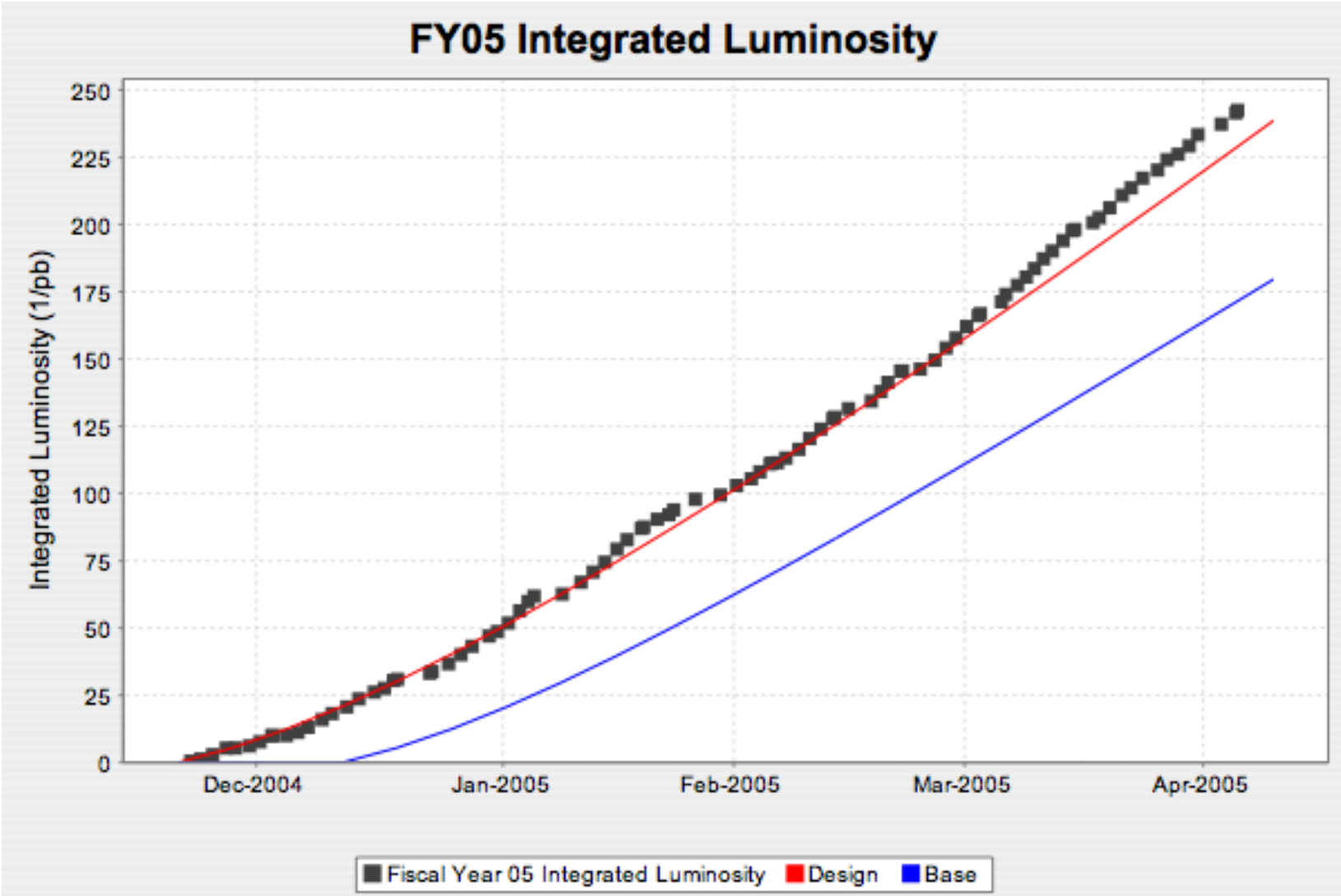
Run 2 PMG

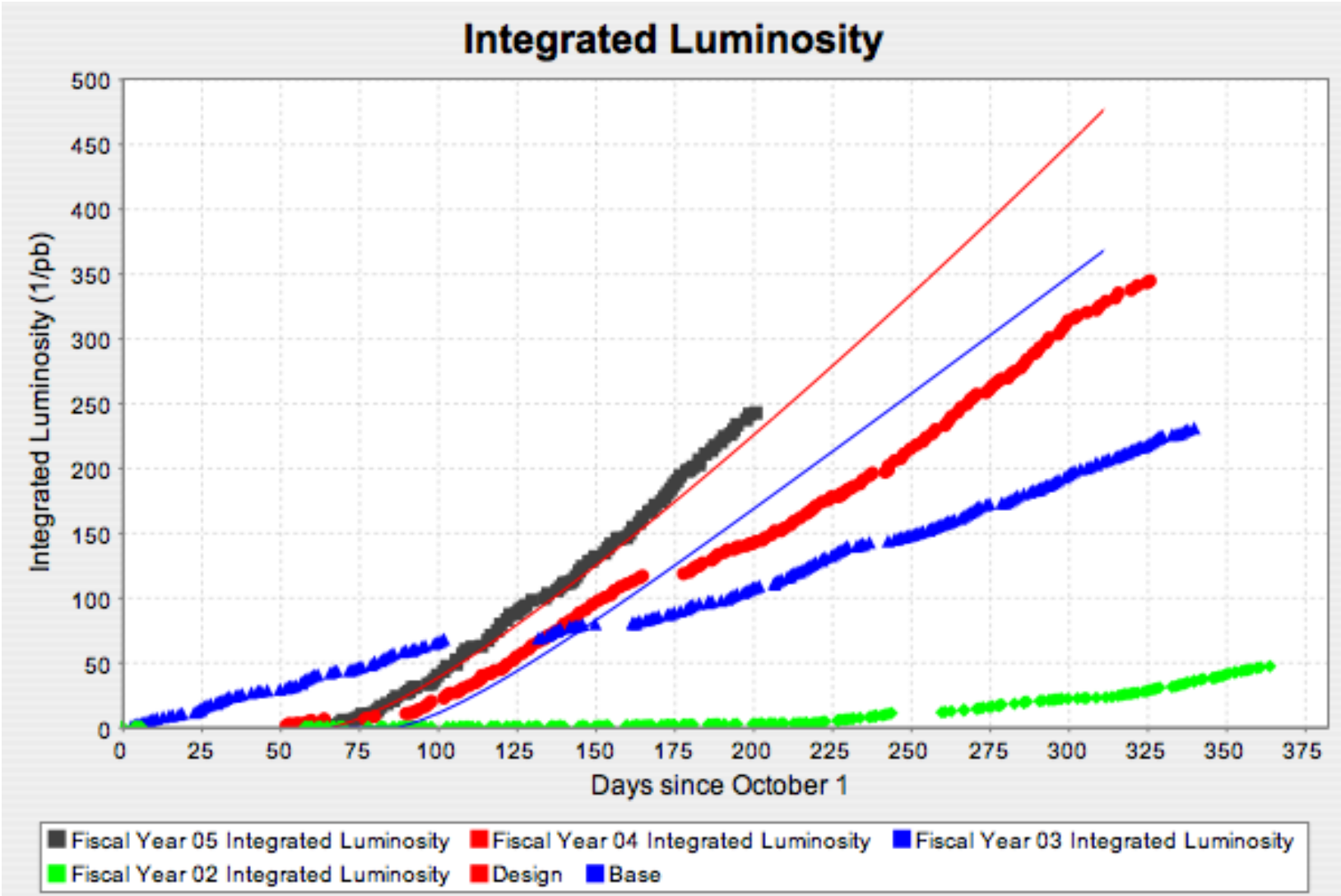
Dave McGinnis

April 21, 2005

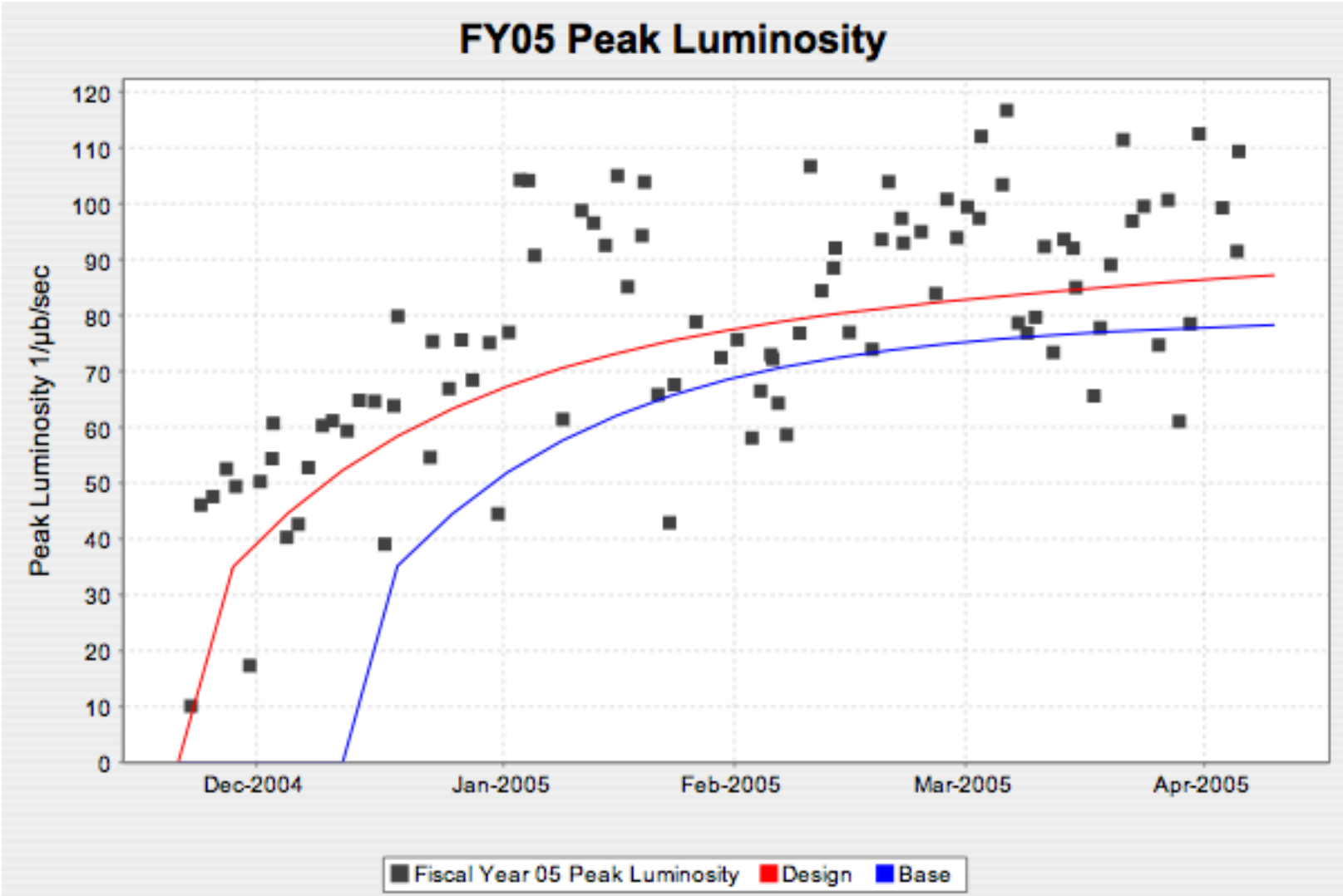
FY05 Integrated Luminosity



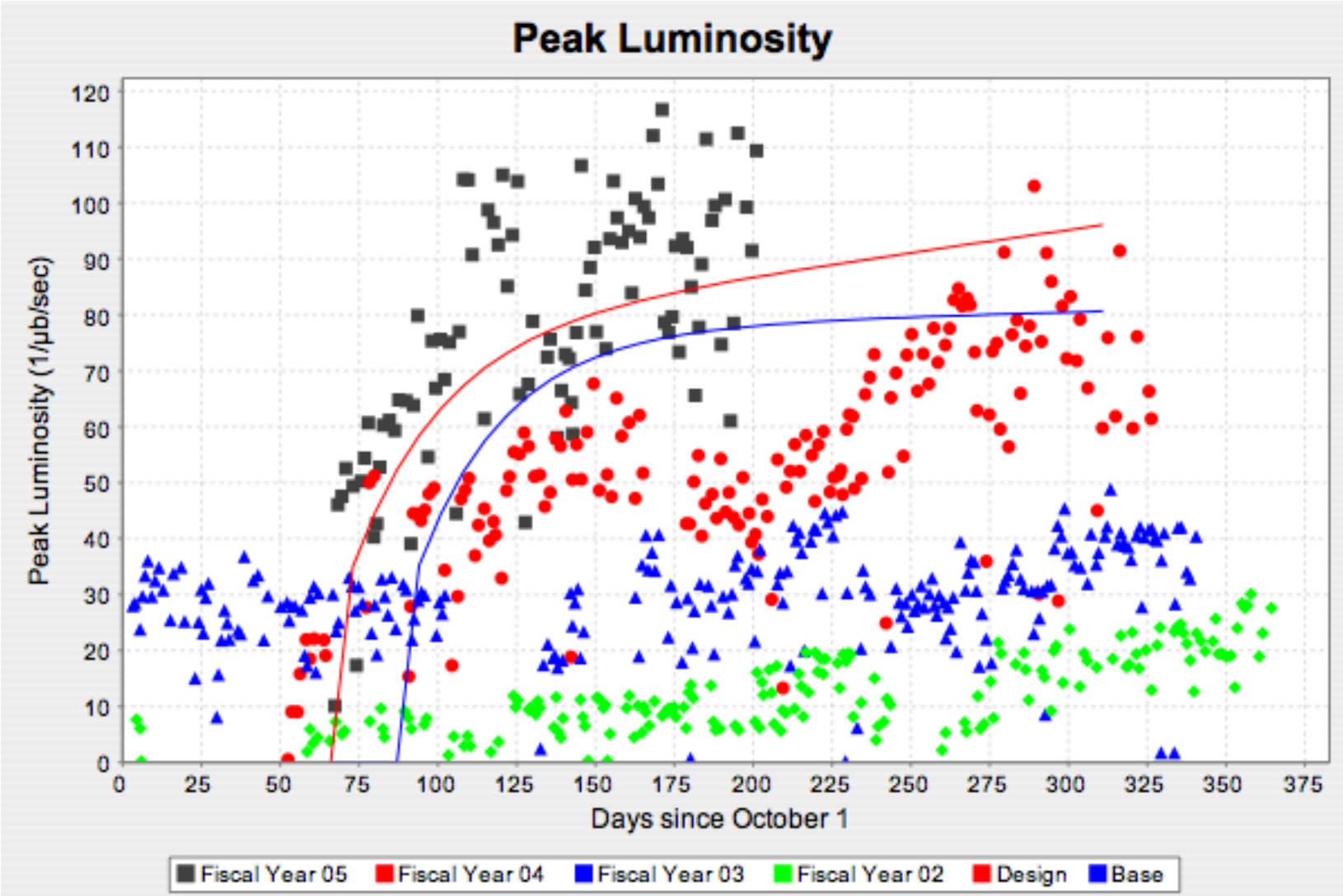
Integrated Luminosity



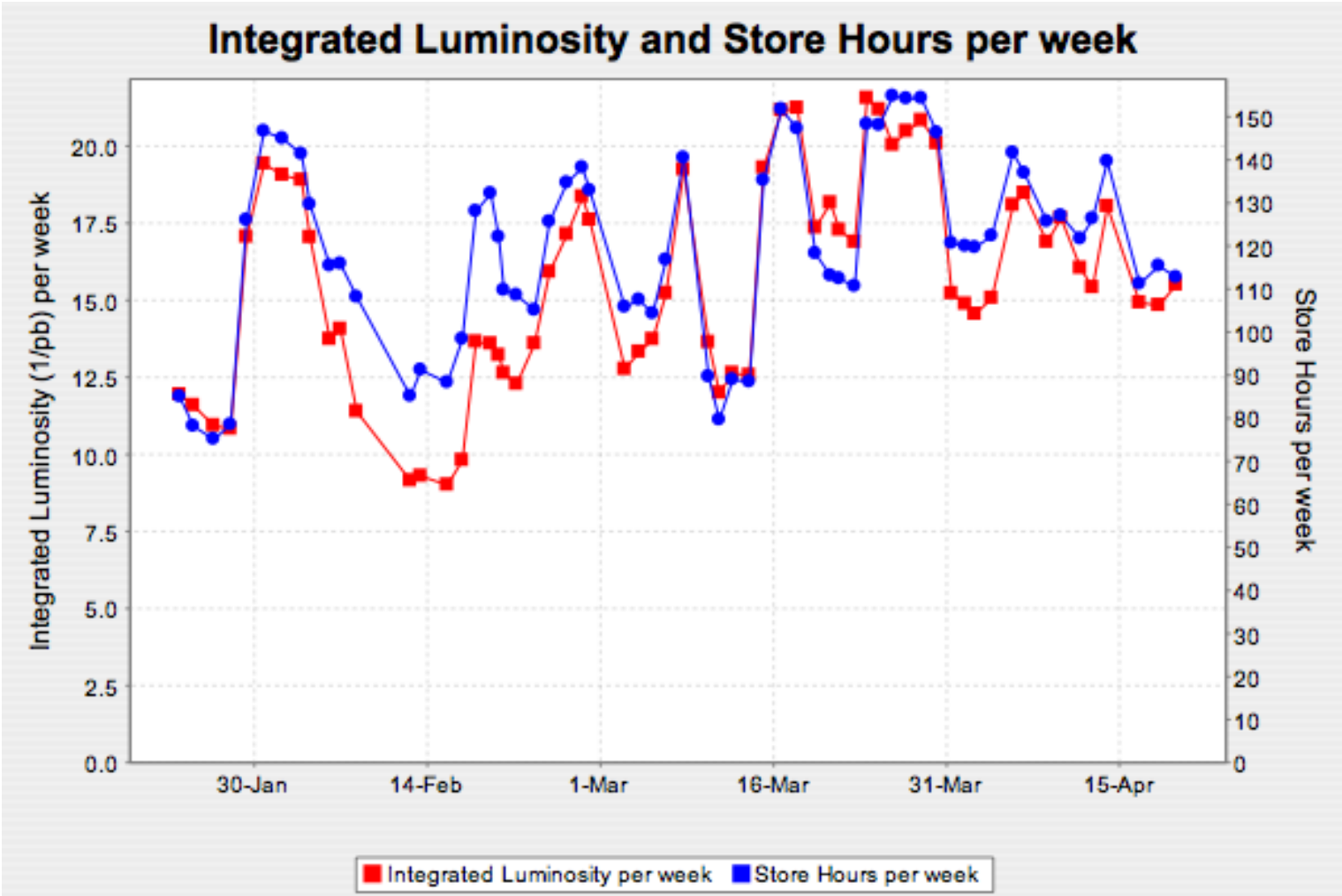
FY05 Peak Luminosity



FY05 Goals Peak Luminosity

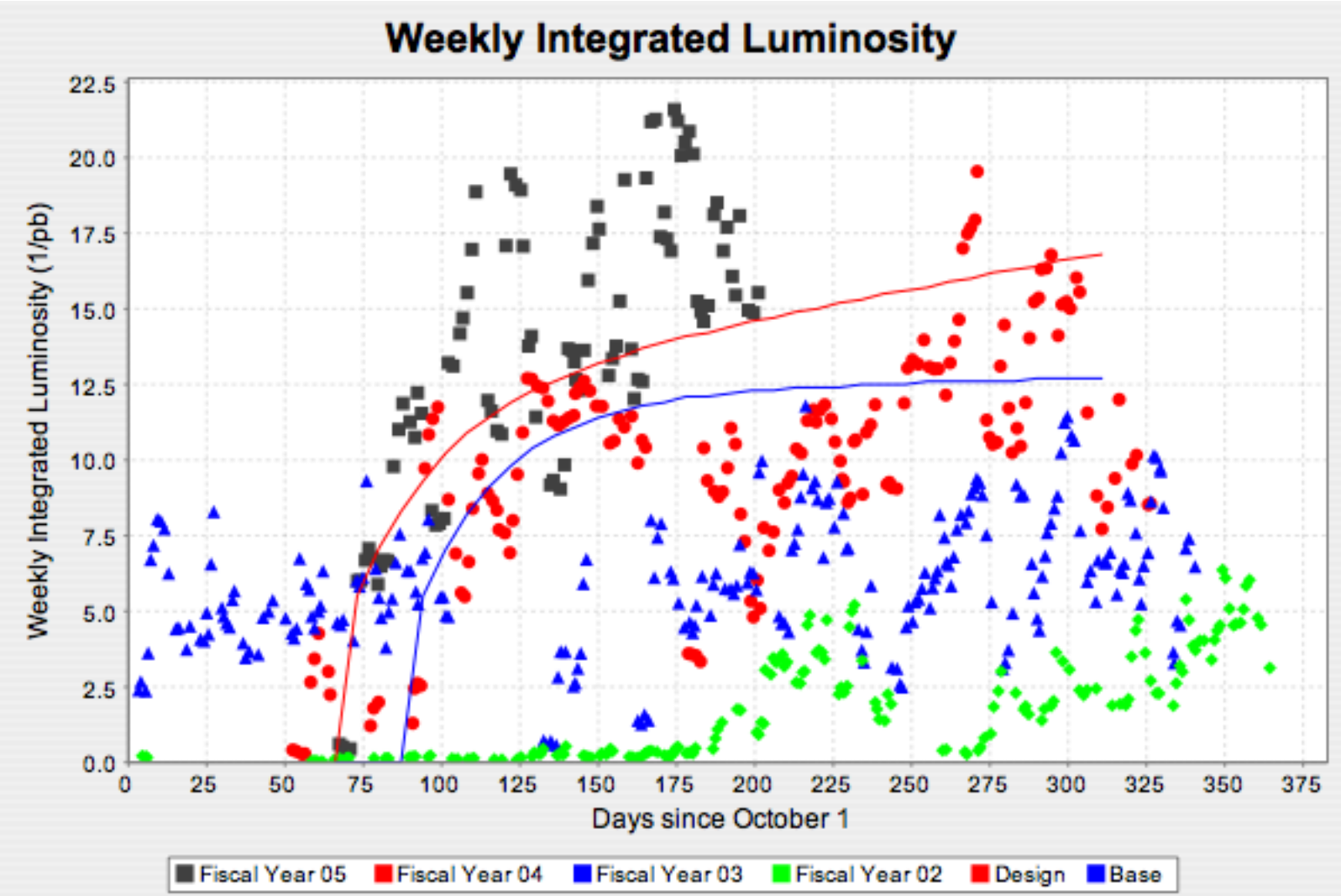


Integrated Luminosity and Store Hours per Week



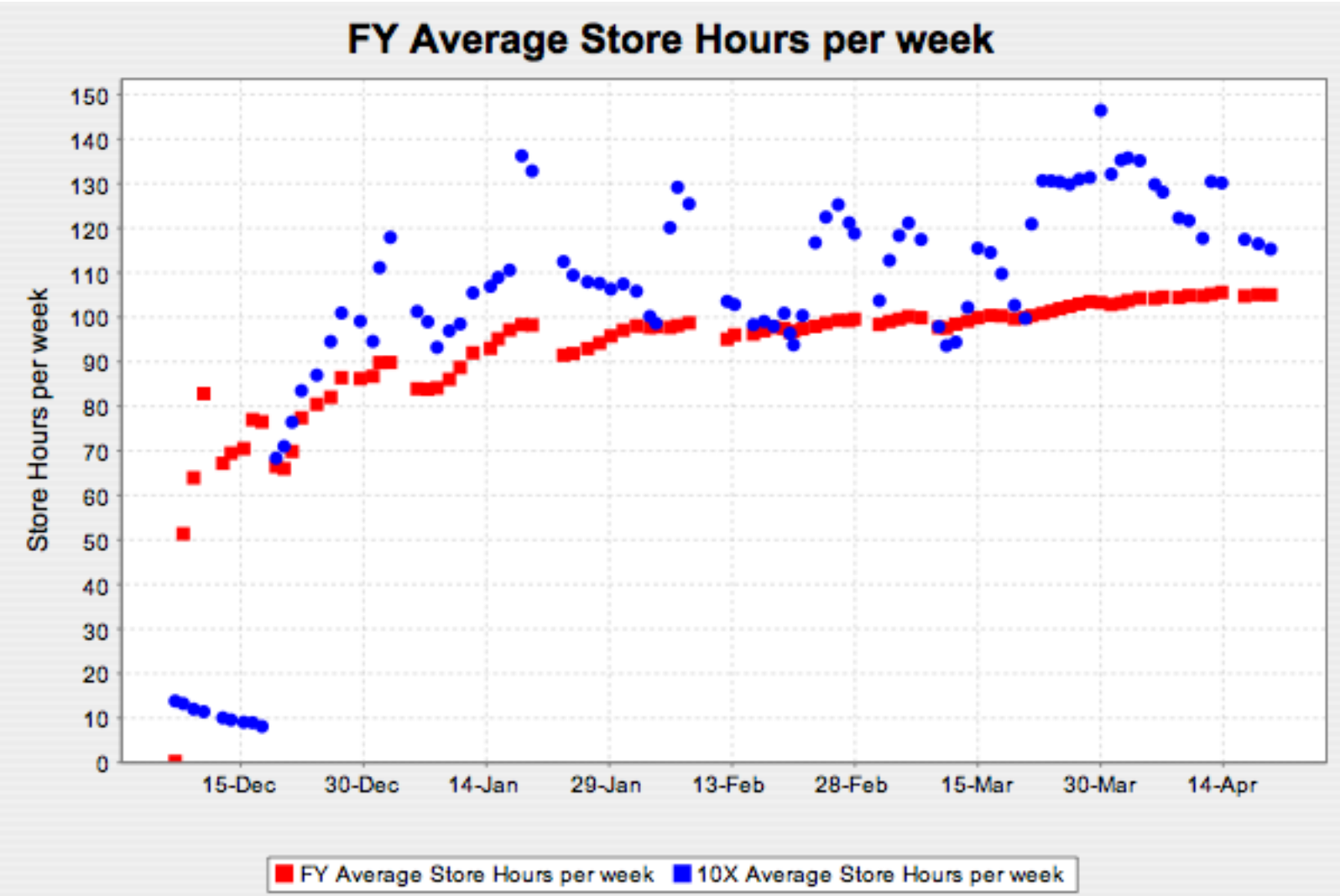
5 Store Running Average

FY05 Goals Weekly Integrated Luminosity

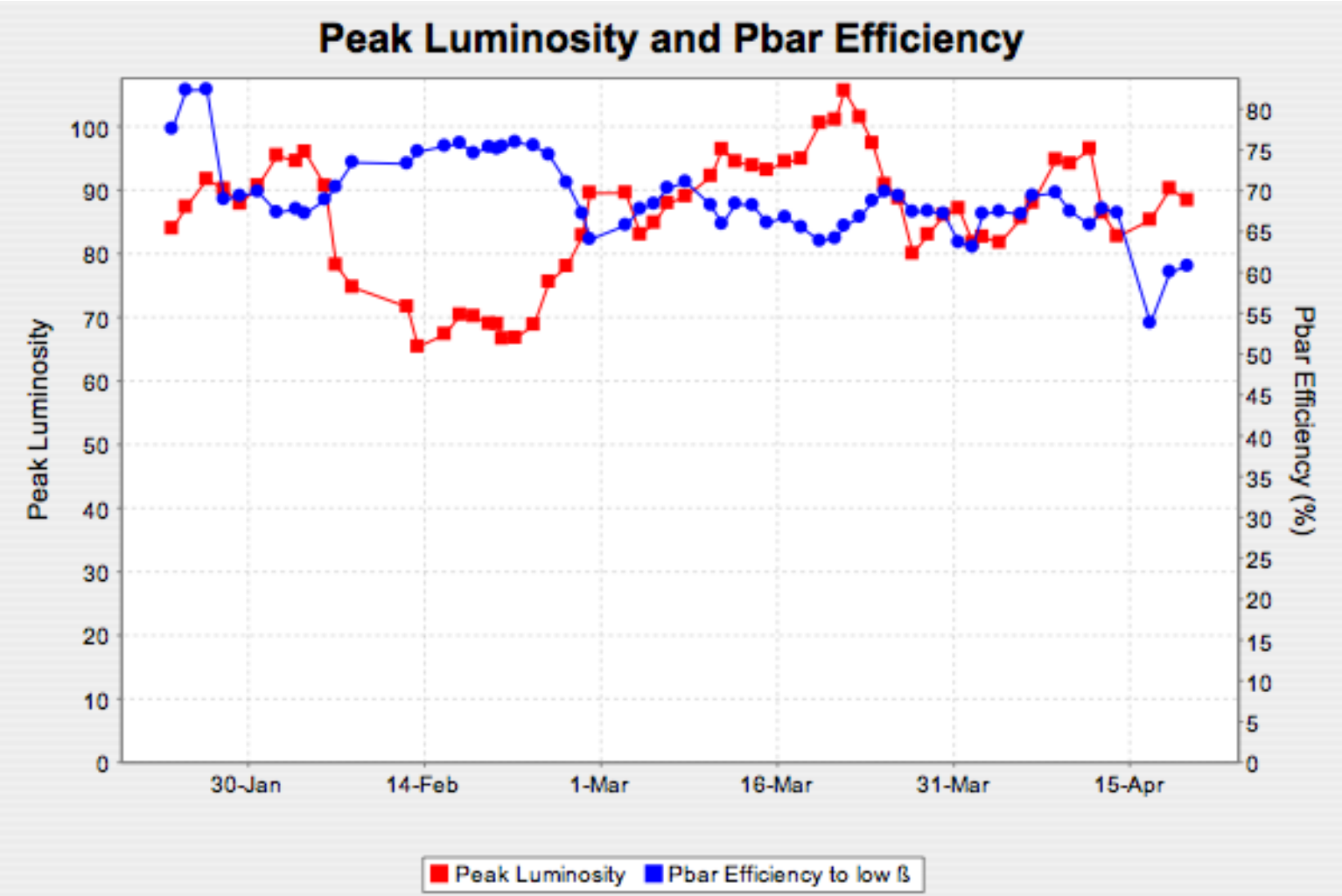


5 Store Running Average

FY05 Average Store Hours per Week



Peak Luminosity and Pbar Efficiency

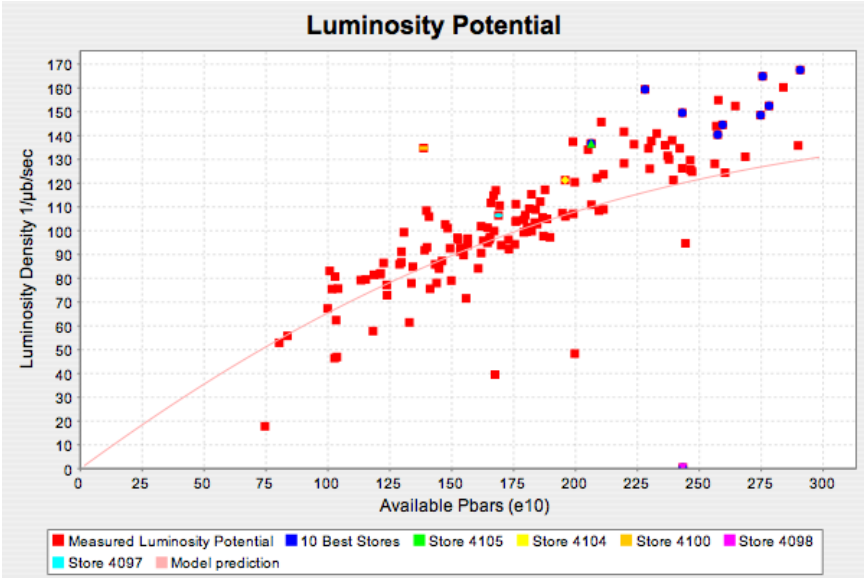


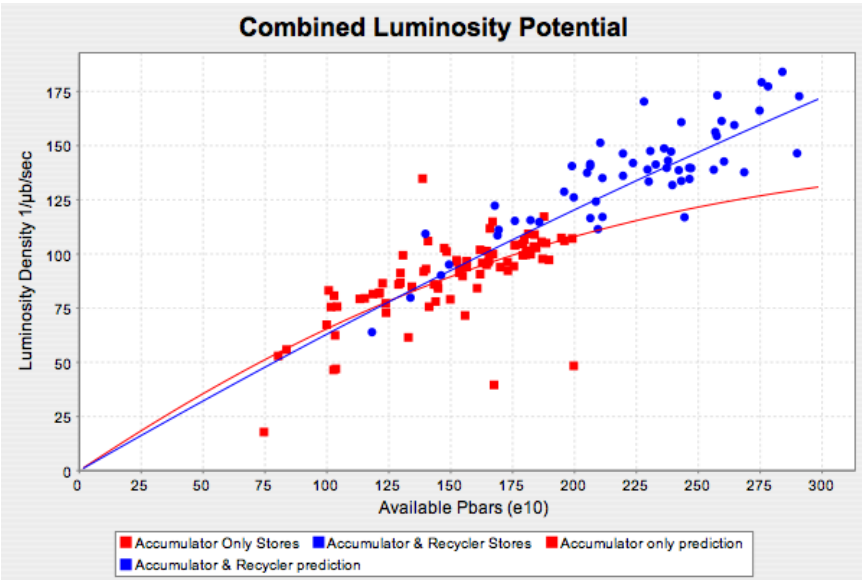
5 Store Running Average

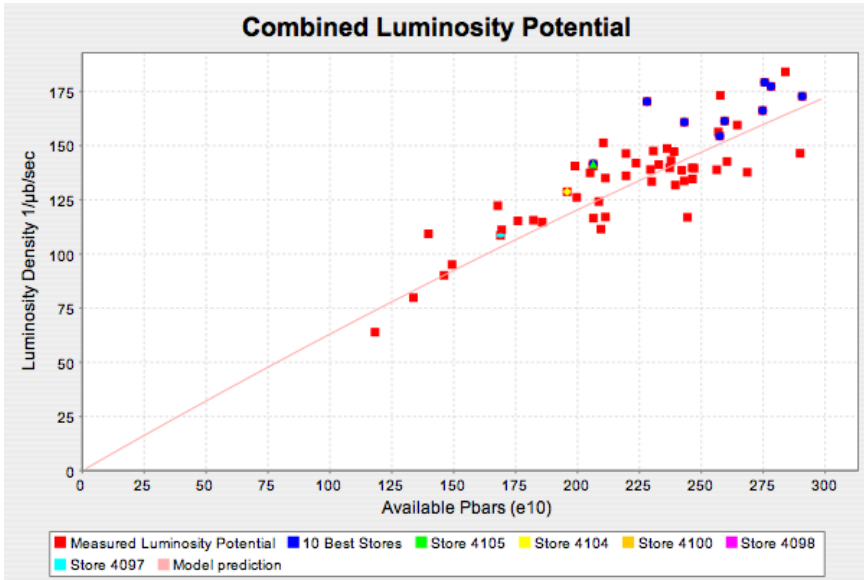
Data Summary Table

		Luminosity Parameters							
Parameter	Last Store	Best Store	Last 10 Stores (Ave)	Best 10 Stores (Ave)	FY Average	Previous FY	FY End Goal (Design)	FY End Goal (Base)	
Initial Luminosity (Average)	91.3	116.5	92.2	107.9	76.9	71.1	96.1	80.7	$x10^{30} cm^{-2} sec^{-1}$
Integrated Luminosity per Store (Avera	824.3	2746	3191.8	3300.6	2610.9	2660	3369	3190	nb^{-1}
Luminosity per week (Averaged)	-	-	15.3	-	12.7	11.8	16.8	12.7	pb^{-1}
Store Length	3	11.2	23.3	20.3	21.7	24.5	20	25	Hours
Store Hours per week	-	-	111.6	-	105	108.3	100	100	Hours
Shot Setup Time	2	2.2	2.7	2.7	2.9	2.6	2.6	2.6	Hours
		TEVATRON Parameters							
Parameter	Last Store	Best Store	Last 10 Stores (Ave)	Best 10 Stores (Ave)	FY Average	Previous FY	FY End Goal (Design)	FY End Goal (Base)	
Protons per bunch	240.5	237.7	240.2	232.6	224.9	247.3	260	260	$x10^{9}$
Antiprotons per bunch	34.1	42.3	31.1	41.4	31.5	29.9	42	34	$x10^{9}$
Proton Efficiency to Low Beta	70	60.7	58	56.6	61.7	72.7	-	-	%
Pbar Transfer efficiency to Low Beta	69.1	66.4	63.7	67.7	70	74	76	74	%
HourGlass Factor	0.67	0.67	0.67	0.68	0.67	0.68	0.65	0.65	
Effective Emittance	14.9	14.2	13.6	15.2	15.5	18.1	18.5	17	π-mm-mrad
		Antiproton Parameters							
Parameter	Last Store	Best Store	Last 10 Stores (Ave)	Best 10 Stores (Ave)	FY Average	Previous FY	FY End Goal (Design)	FY End Goal (Base)	
Zero Stack Stack Rate	16	13.4	14.9	14.1	13.1	12.2	24.5	14	$x10^{10}$/hour
Normalized Zero Stack Stack Rate	2.6	2.3	2.3	2.4	2.3	2.3	3.1	2.3	$x10^{-2}$/hour
Average Stacking Rate	7.1	7.8	7.5	7.3	7.3	6.2	10.1	6.6	$x10^{10}$/hour
Stacking Time Line Factor	62.5	79.3	65.4	71.5	75.7	76.6	75	75	%
Stack Size at Zero Stack Rate	314.8	412.9	413.3	370.6	384.4	332.6	300	300	$x10^{10}$
Protons on Target	6.3	5.9	6.4	6	5.8	5.2	8	6.2	$x10^{12}$
Start Stack	196.1	275.9	192.2	261.8	186.4	170.7	216	181	$x10^{10}$
End Stack	18.7	46.9	25.3	41.5	21.3	15.8	15	15	$x10^{10}$
Unstacked Pbars	177.4	229	166.9	220.3	165.1	154.9	201	166	$x10^{10}$

Stack Size Potential







Last Month's Activities

- Proton Source
  - Upgraded Booster-MI transfer Synch system for cogging.
  - Achieved 5e20 protons for MiniBoone
  - Bunch Rotation studies
  - Linac collimator studies
- Main Injector
  - Upgraded Booster-MI transfer Synch system for cogging.
  - Solved the 10 GeV Pbar loss for TEV shots
  - Commissioned Slip Stacking on NUMI cycles
  - Ran NUMI operations
  - NUMI target Problems
  - Slip Stacking Studies
- Pbar
  - Debuncher Bumping
  - D/A Line Steering
  - ARF4 Curves Upgraded
  - Debuncher η change
- Recycler
  - NUMI compensation
  - IBS and stochastic cooling studies
  - Recycler-only store attempted
  - Electron Cooling commissioning
- Tevatron
  - Octupoles operational
  - Incremental changes for Step 24-25 loss
  - CDF IP move
  - Longitudinal damper gain protocol for longitudinal instability
  - Vary helix size store-to-store

Tevatron Studies

Date	Duration (Hr)	Description
3/2/2005	1.0	Wet squeeze to measure orbits
3/2/2005	2.8	Tune tracker
3/2/2005	3.2	RF modulation chromaticity measurements
3/3/2005	1.5	12x0 to check scraping procedure
3/3/2005	4.5	Tune tracker
3/8/2005	1.3	Wet squeeze for helix vs. tunes and check losses in steps 24/25
3/9/2005	0.7	Orbit adjustments to compensate for T:HA48 correction element
3/9/2005	3.7	O1/O2 octupole studies
3/9/2005	1.4	36x0 to check losses in abort kicker room
3/10/2005	2.0	12x0 stores to check collimator operation
3/15/2005	0.7	End of store, helix amplitude vs. tune
3/19/2005	2.0	Aperture measurements
3/19/2005	3.0	Tune tracker and chomaticity measurements
3/19/2005	5.5	Longitudinal stability plus quench recovery
3/21/2005	0.0	Change helix amplitude from store to store for lifetime comparison
3/30/2005	6.9	Longitudinal instability
3/31/2005	7.0	O1/O2 octupole studies, plus recovery
4/9/2005	1.5	Tune and orbit check-out and adjustment following quench
4/11/2005	1.6	CDF vertical IP adjustment
4/11/2005	1.5	E44 aperture scans
4/14/2005	1.6	End of store, tune measurement using longitudinal damper pickups
	4.7	Sum for Week
	210.6	Sum for Year
	11.3	Average per week

Pbar Studies

Date	Duration (Hr)	Description
3/3/2005	0.5	Debuncher bumping while stacking
3/6/2005	1.0	Debuncher bumping while stacking
3/7/2005	6.5	Reverse protons, verify Debuncher bumps
3/8/2005	0.4	Commission A:H104 bump
3/10/2005	0.3	Debuncher bumping while stacking
3/13/2005	1.5	Debuncher bumping while stacking
3/14/2005	0.5	A:H104 bump commissioning
3/15/2005	0.8	AP-2/Debuncher aperture measurements while stacking
3/16/2005	7.5	Reverse protons, DEXbump and Debuncher orbit
3/17/2005	0.5	D/A studies while stacking
3/17/2005	0.3	ARF-4 studies
3/19/2005	2.0	D/A studies while stacking
3/20/2005	0.3	Debuncher bumping while stacking
3/21/2005	0.3	Debuncher bumping while stacking
3/23/2005	0.0	ARF-4 software changes and commissioning
3/24/2005	0.3	Debuncher cooling tank centering
3/25/2005	0.3	Debuncher intensity with DCCT
4/6/2006	0.2	Debuncher bumping while stacking
4/8/2005	1.0	Low intensity Debuncher momentum measurements
4/11/2005	1.3	Debuncher eta change to .006
4/12/2005	0.3	Debuncher orbits, reverse protons
4/13/2005	0.3	Debuncher orbit correction with reverse protons
4/14/2005	1.0	D/A steering while stacking
	2.9	Sum for week
	60.3	Sum for year
	3.2	Average per week

Plan for the Month

- Proton Source
  - Slip Stacking
    - Bunch Rotation at Extraction
- Main Injector
  - Slip Stacking Studies
    - Beam loss outside RF bucketes
  - 2.5 MHz Acceleration in concert with electron cooling commissioning
- Pbar
  - Slip Stacking Studies
    - Production vs Beam on Target
  - Accumulator to Recycler Transfers
  - Beam Based Alignment
  - Debuncher η change
    - Need to correct orbits in Debuncher
- Recycler
  - Accumulator to Recycler Transfers
  - Recycler Only Store
  - Electron Cooling commissioning
- Tevatron
  - Step 24-25 loss
    - Incremental changes each store
  - Vary helix size store-to-store
  - Longitudinal instability and RF cavity tuning
  - Store-Store orbit smoothing with the new Tev BPMs
  - Octupole & transverse stability at low beta

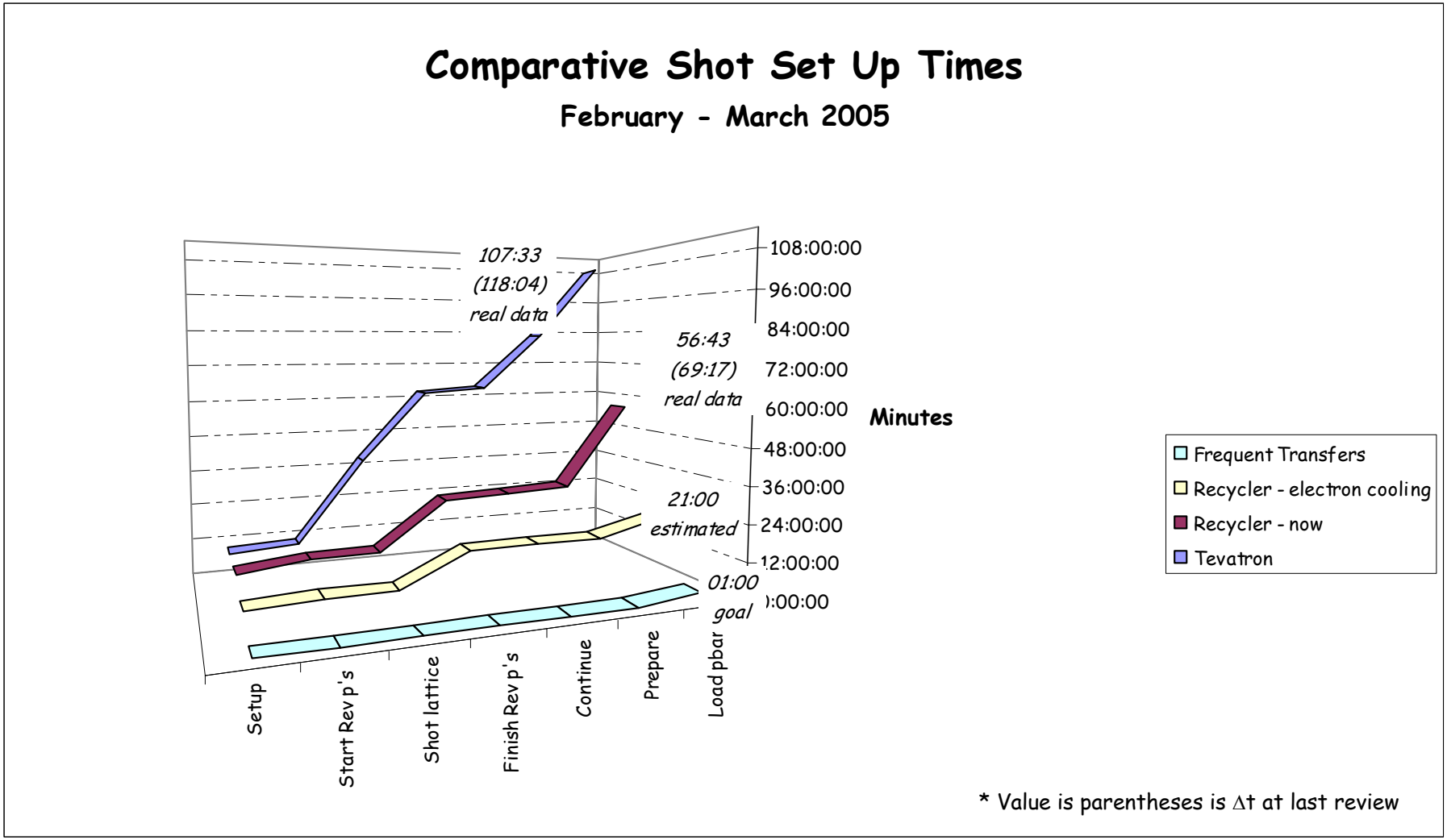
Accumulator to Recycler Rapid Transfers

- Motivation – Recycler-only stores
  - Long term – Electron cooling
  - Near term – Low transverse emittances

$$L = \frac{3\gamma f_0}{\beta^*}\left(BN_{\bar{p}}\right)\left(\frac{N_p}{\varepsilon_p}\right)\frac{F\left(\beta^*, \theta_{x,y}, \varepsilon_{p,\bar{p}}, \sigma^L_{p,\bar{p}}\right)}{\left(1+\varepsilon_{\bar{p}}/\varepsilon_p\right)}$$

- Goal
  - 90% efficient, 15 minute turn around by June 1
- Short Term Plan – Eliminate reverse proton tune-up

Shot Setup times



Eliminate Reverse Proton Tune-up

- Adopt a philosophy of being willing to lose a pbar transfer occasionally
- Build procedure for doing Main Injector tune-up on stacking cycles
  - Document position and kicker settings at 8 Gev for present cycles
  - Determine algorithm for setting kicker based on positions
- Commission Main Injector 2.5 MHz Transverse Dampers
  - Determine volts needed for MI dampers
    - Determine tolerance on Accumulator closure
      - Track changes on closure trims
      - Calc from lattice what closure is needed
    - Measure tune spread or decoherence time in Main Injector
- Implement 4-8 GHz momentum cooling during stacking prior to transfers
  - Smaller longitudinal emittance of the core -> fewer transfers
- Cleanup sequencer