Run II PMG Meeting

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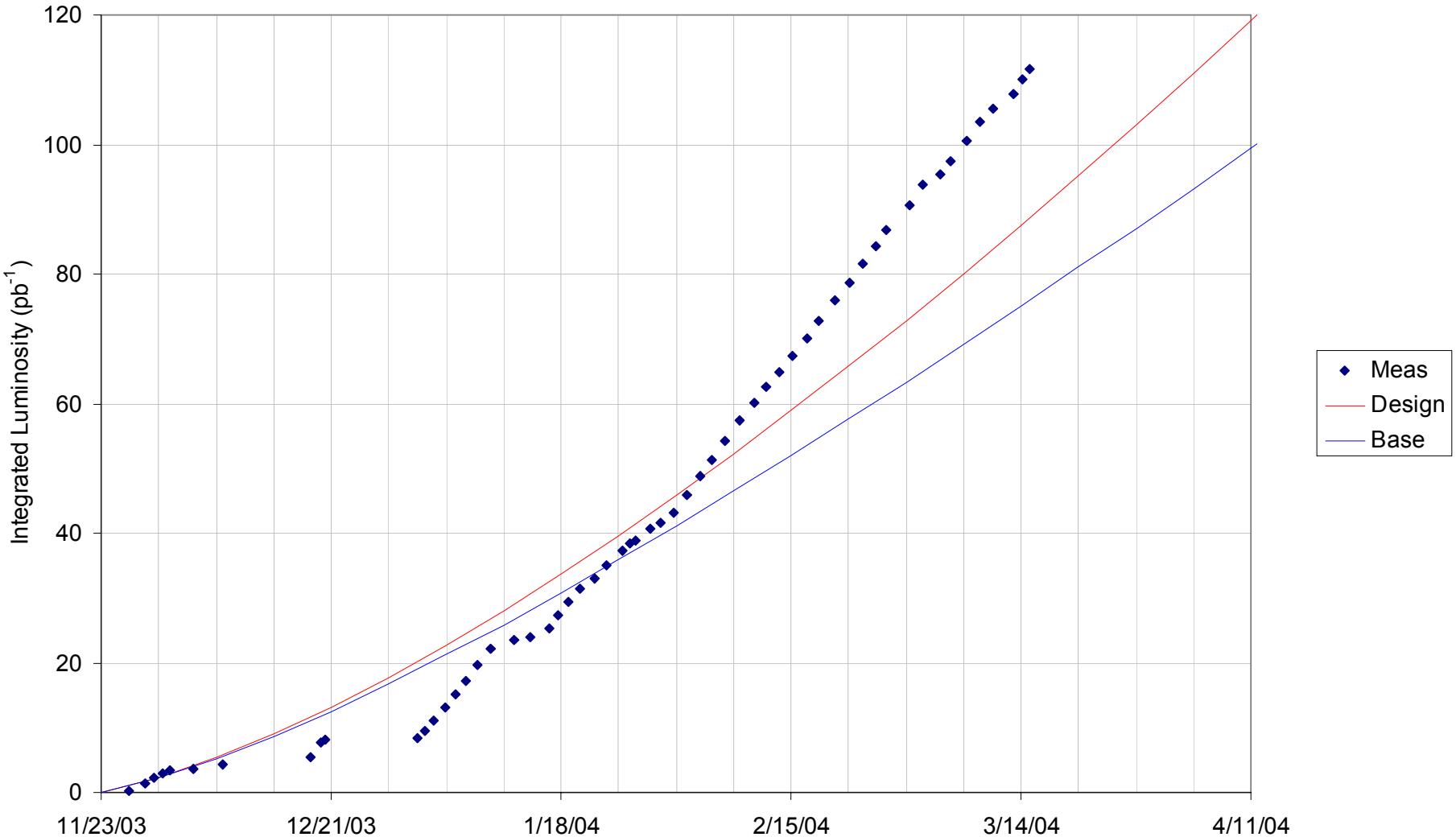
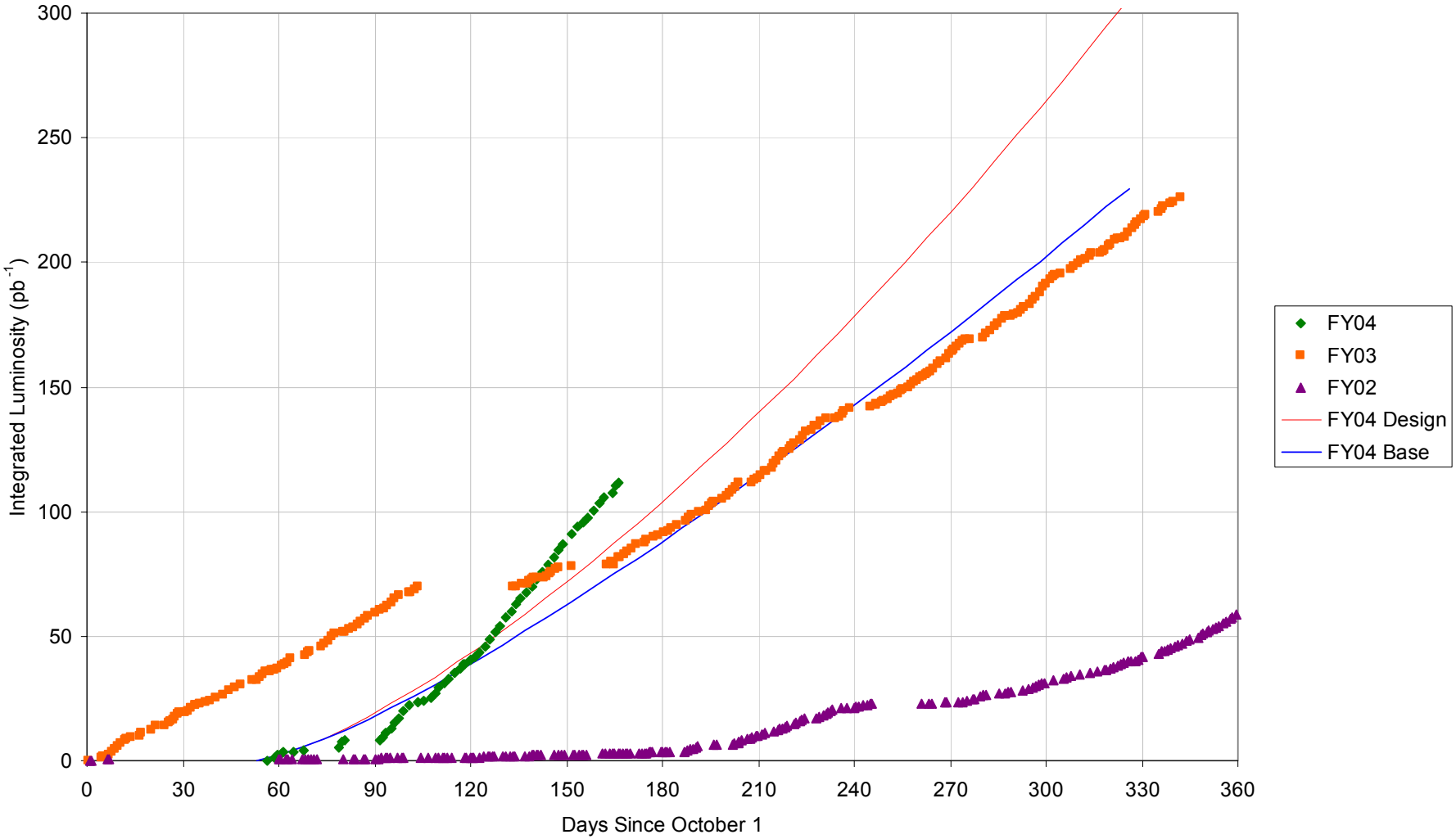
March 18, 2004

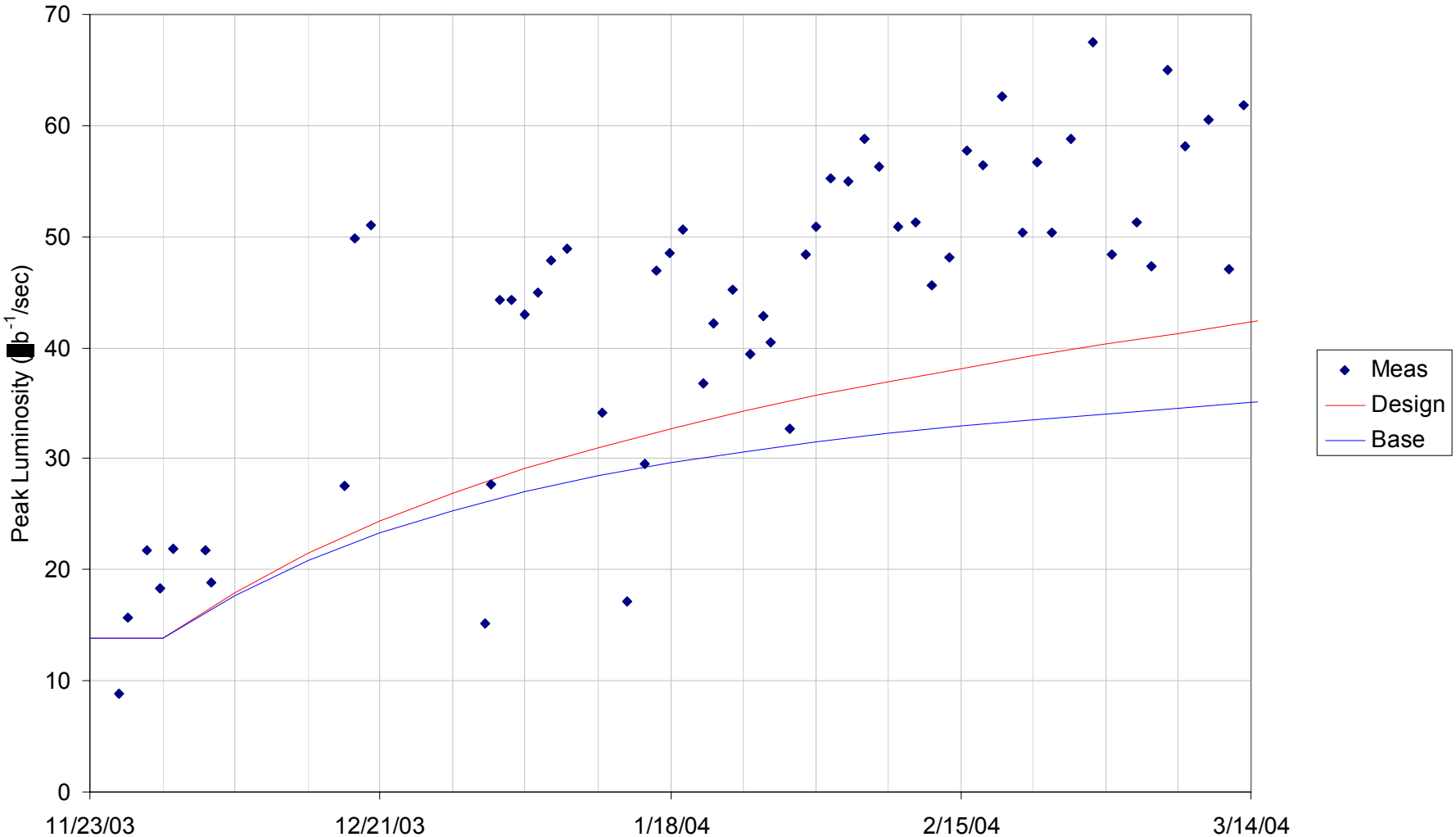
FY04 Integrated Luminosity



Fiscal Year Integrated Luminosity



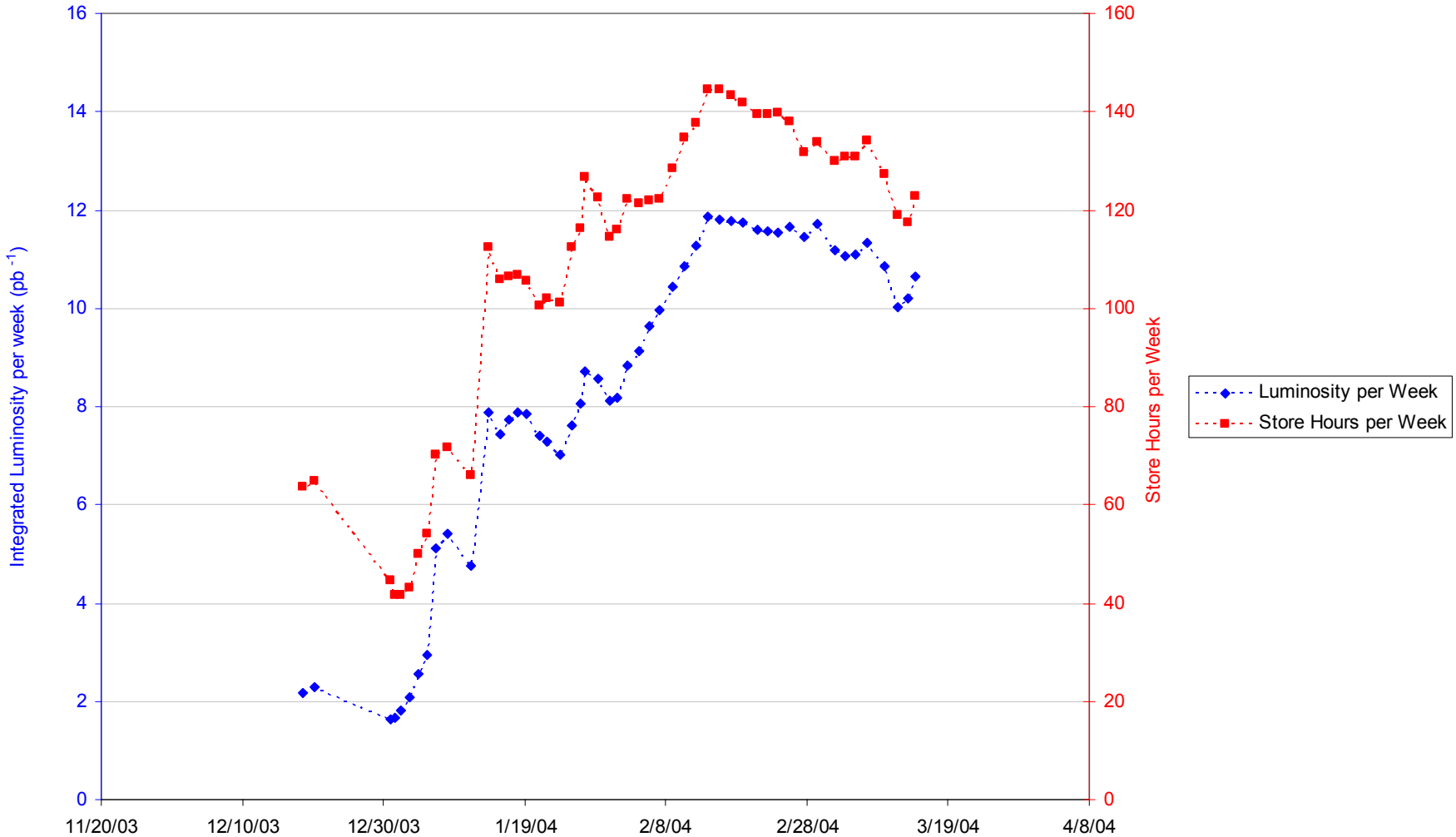
FY04 Peak Luminosity



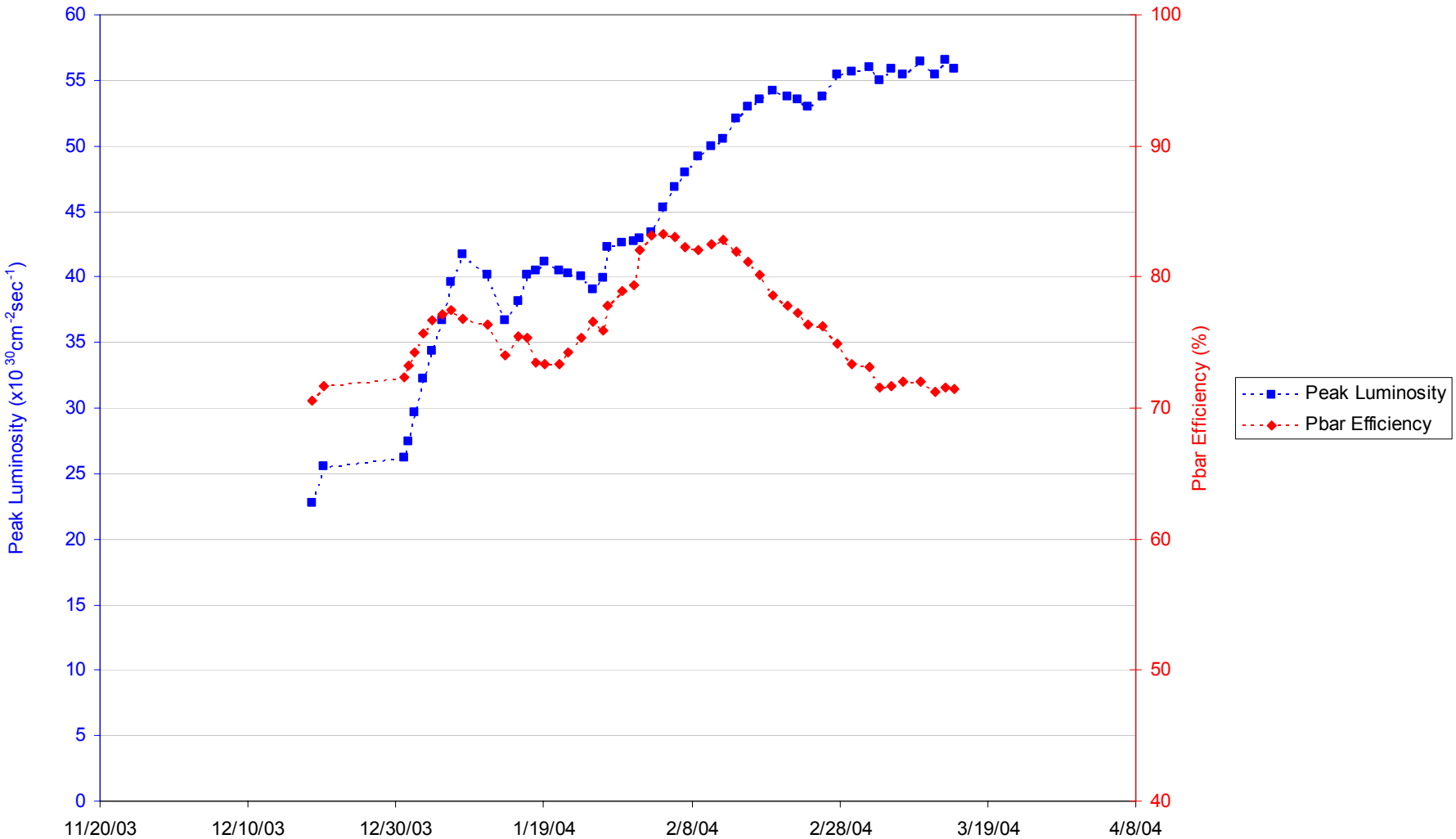
Store Performance

Store Parameters							
Parameter	Last Store	Last 10 stores Average	FY04 Average	End of FY03	FY04 (End) Design	FY04 (End) Base	
Initial Luminosity (Average)	51.5	55.9	47.9	36.1	61.9	43.3	$x10^{30}cm^{-2}sec^{-1}$
Integrated Luminosity per Store (Averaged)	1478	2571	2135	1089	2000	1300	nb^{-1}
Luminosity per week (Averaged)	-	10.4	8.5	6.4	11.3	7.4	pb^{-1}
Store Length	14.5	29.6	26.8	14.9	15.0	15.0	Hours
Store Hours per week	-	118	106	88	85	84	Hours
Shot Setup Time	2.6	2.5	2.6	2.3	2.2	2.2	Hours
TEVATRON Parameters							
Parameter	Last Store	Last 10 stores Average	FY04 Average	End of FY03	FY04 (End) Design	FY04 (End) Base	
Protons per bunch	231	241	229	237	260	260	$x10^{9}$
Antiprotons per bunch	25	30	28	22	31	25	$x10^{9}$
Proton Efficiency to Low Beta	82	81	78	58	-	-	%
Pbar Transfer efficiency to Low Beta	76	73	76	63	80	77	%
HourGlass Factor	0.72	0.70	0.70	0.70	0.65	0.65	
Initial Luminosity Lifetime	5.9	7.9	8.4	9.5	8.3	7.0	hours
Asymptotic Luminosity Lifetime	24.0	24.6	25.4	25.1	25.0	25.0	hours
Effective Emittance	17.0	20.0	20.2	21.6	21.0	23.0	π-mm-mrad
Antiproton Parameters							
Parameter	Last Store	Last 10 stores Average	FY04 Average	End of FY03	FY04 (End) Design	FY04 (End) Base	
Zero Stack Stack Rate	11.2	11.6	11.0	11.5	18.0	13.7	$x10^{10}$/hour
Normalized Zero Stack Stack Rate	2.2	2.3	2.2	2.3	3.6	2.7	$x10^{-2}$/hour
Average Stacking Rate	7.6	6.0	5.7	7.1	9.3	7.6	$x10^{10}$/hour
Stacking Time Line Factor	93	82	82	88	75	75	%
Stack Size at Zero Stack Rate	277	284	292	300	300	300	$x10^{10}$
Protons on Target	5.1	5.1	5.0	5.0	5.0	5.0	$x10^{12}$
Start Stack	129	169	157	144	155	130	$x10^{10}$
End Stack	12	17	25	16	15	15	$x10^{10}$
Unstacked Pbars	116	151	132	128	140	115	$x10^{10}$

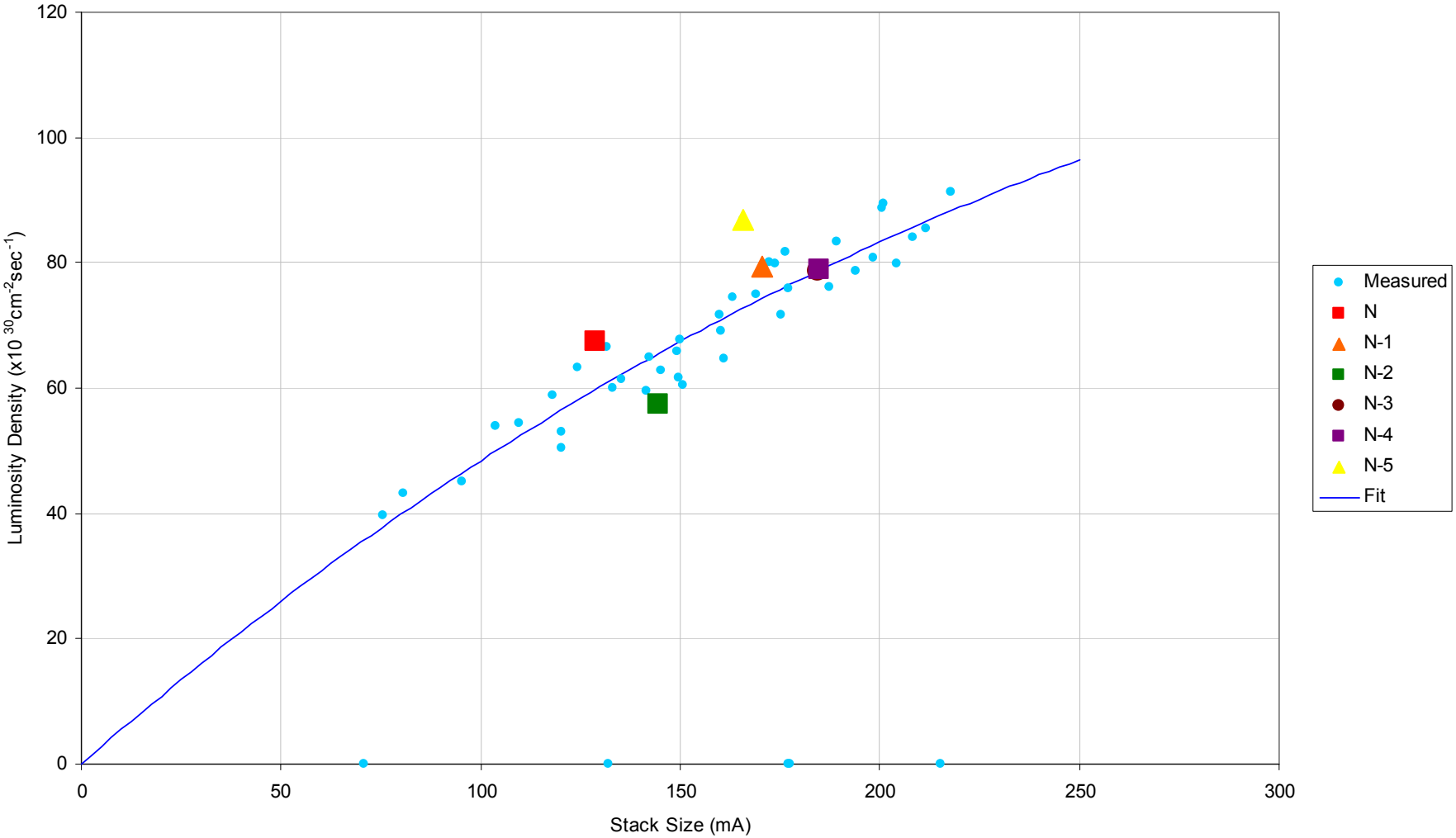
Integrated Luminosity Per Week (10 store running average)



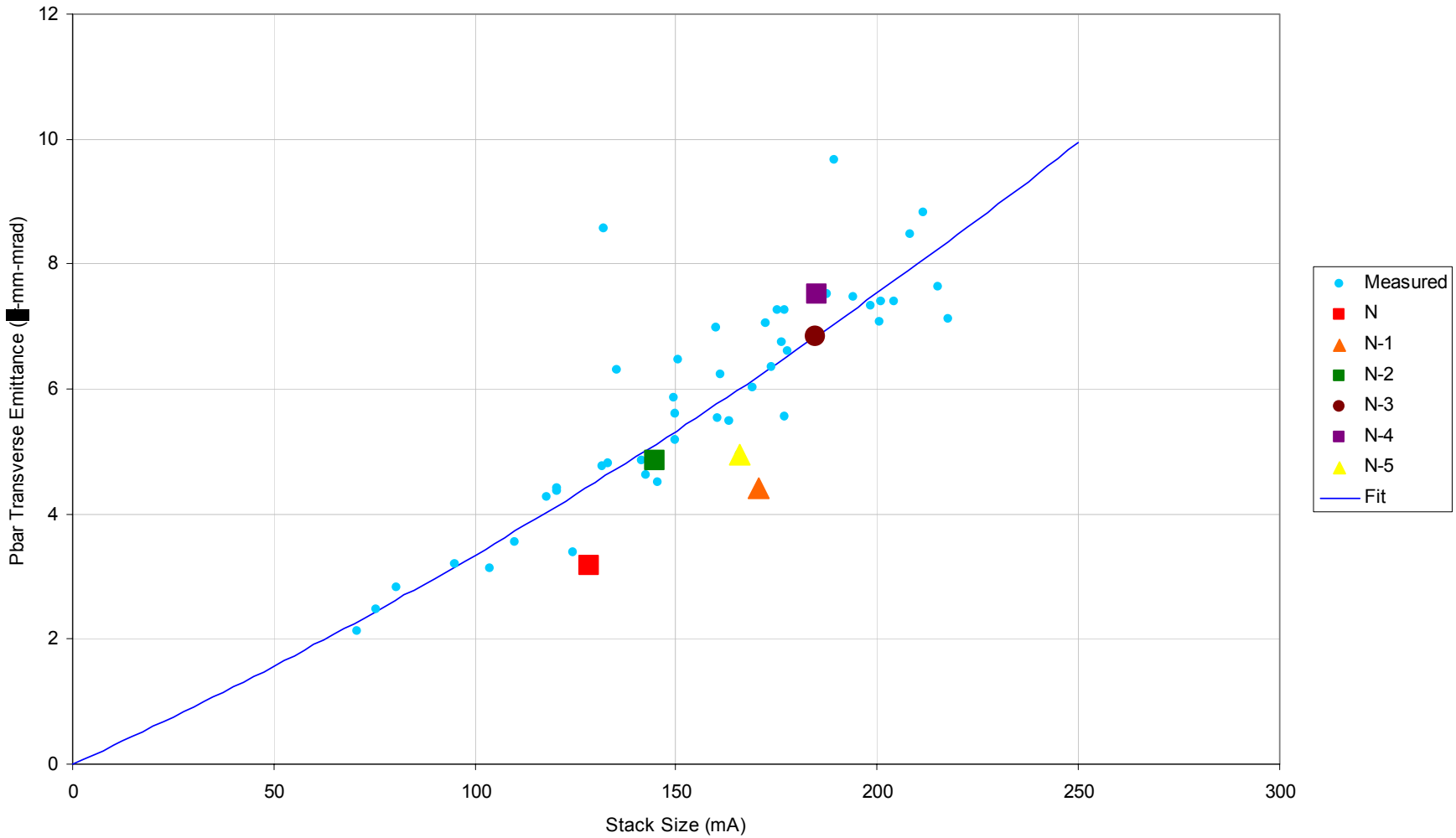
Pbar Efficiency and Peak Luminosity (10 store running average)



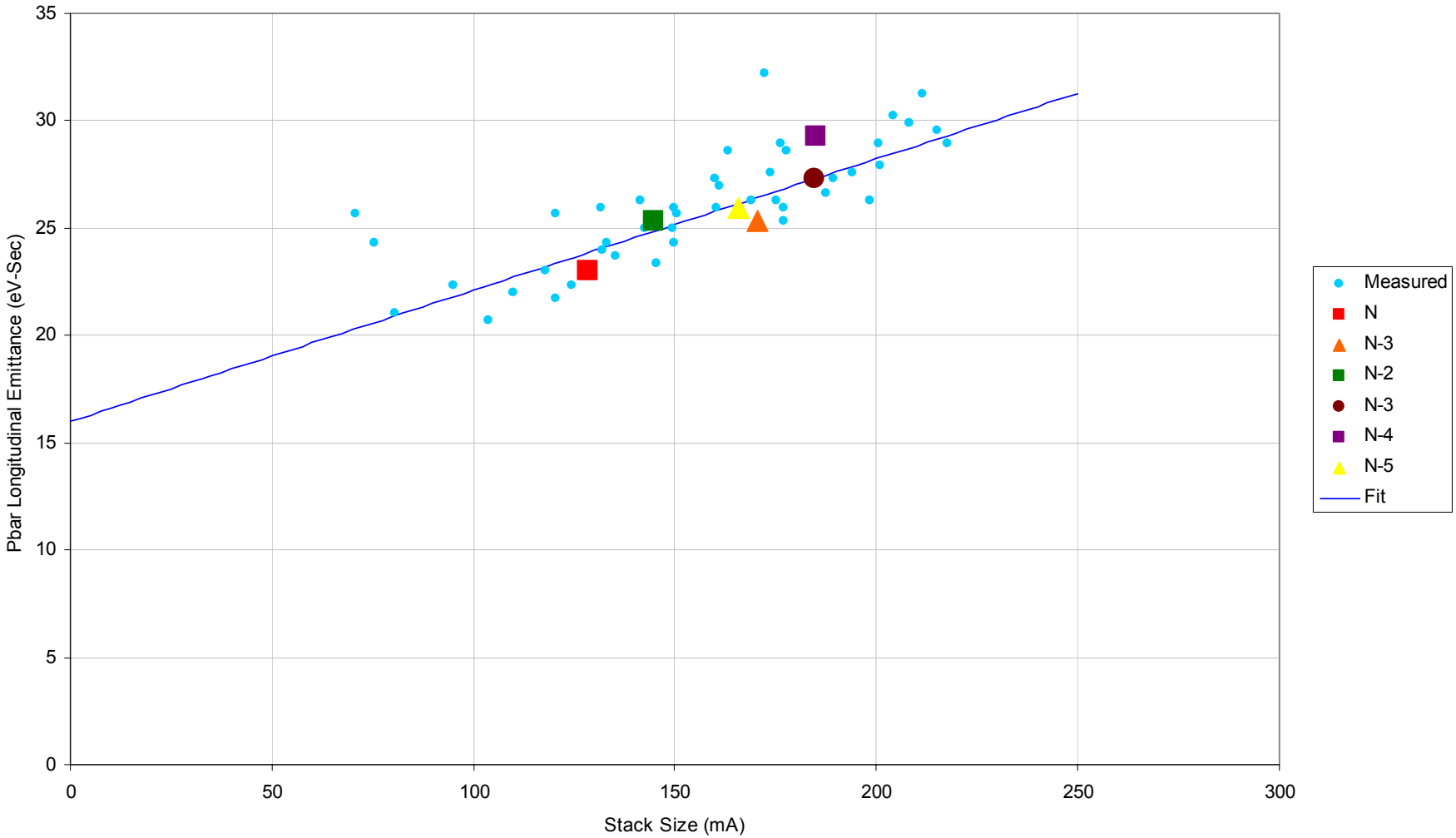
Predicting Luminosity - Luminosity Potential



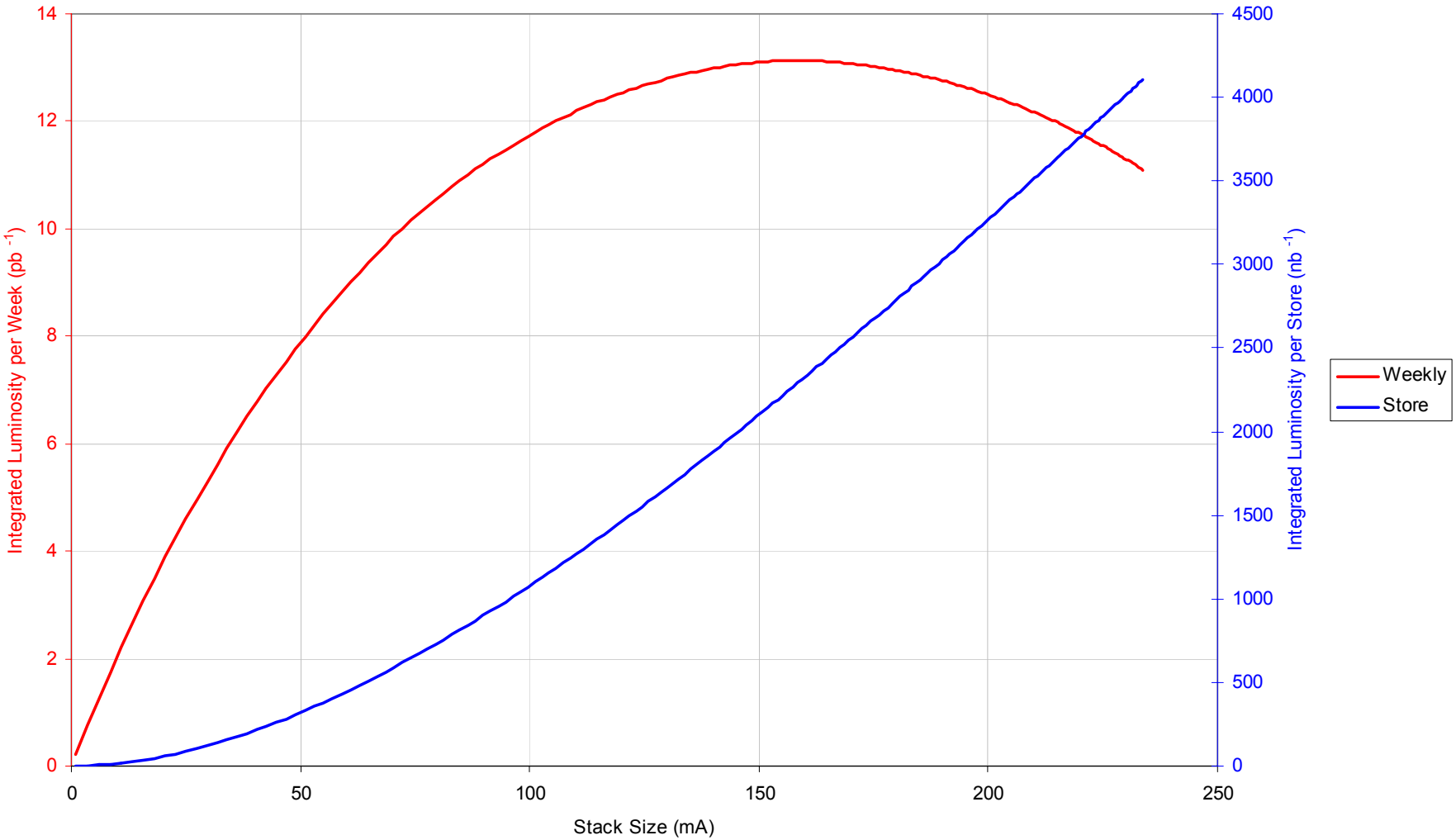
Accumulator Transverse Emittance vs Stack Size



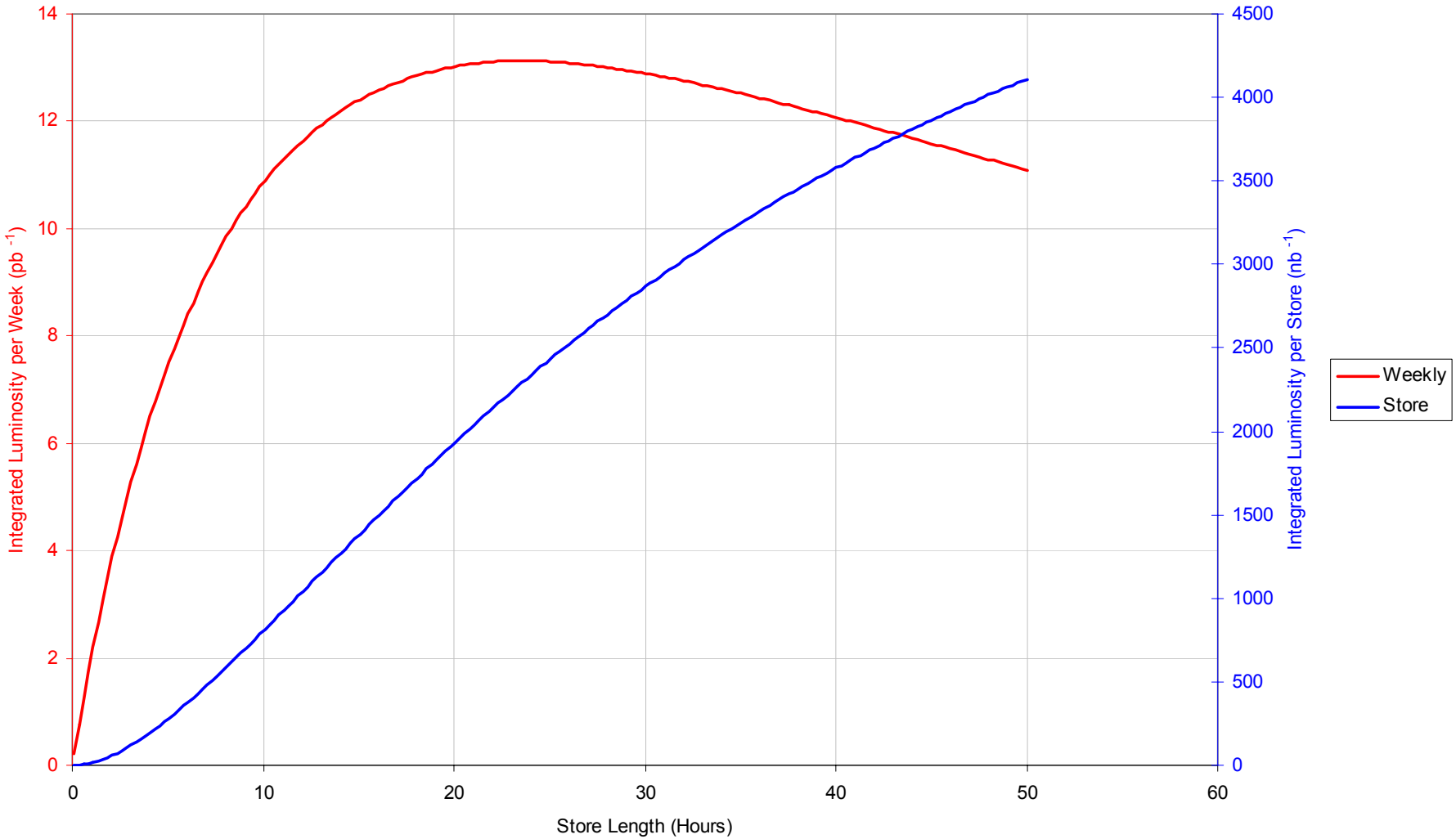
Accumulator Longitudinal Emittance vs Stack Size



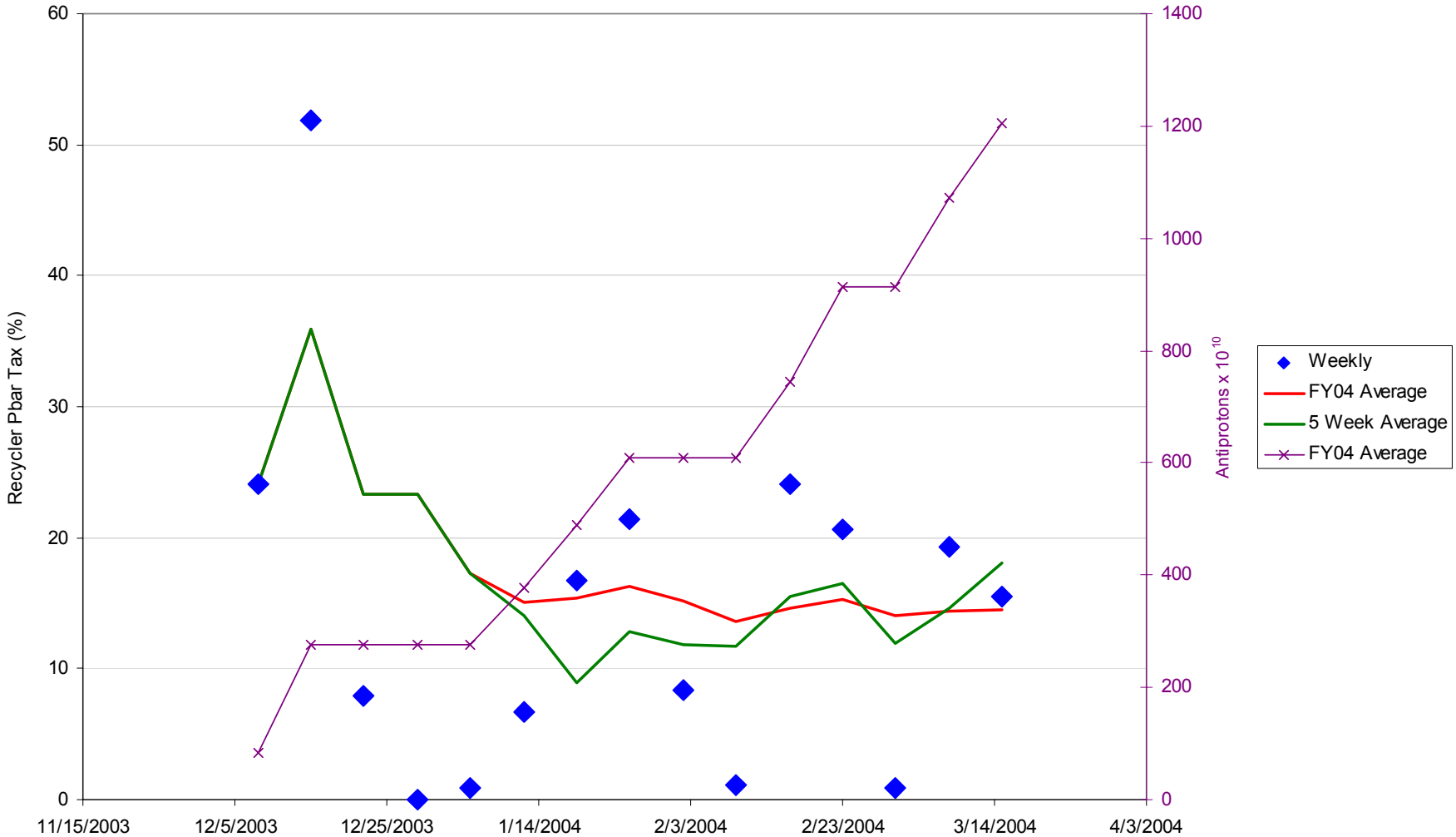
Predicted Integrated Luminosity vs Stack Size



Predicted Integrated Luminosity vs Store Length



Recycler Pbar Tax



Pbar Studies

Date	Duration (Hr)	Description	Comments
1/6/2004	8.0	Accumulator ramp table repairs	
1/6/2004	3.0	Stacktail notch filter measurements	
1/10/2004	4.0	Accumulator ramp table repairs	
1/10/2004	2.0	Accumulator tunes across aperture program commissioning	
1/11/2004	4.0	Accumulator tunes across aperture program commissioning	
1/26/2004	5.0	Debuncher bump measurements	
1/28/2004	4.0	Debuncher bump measurements	103E10 lost from stack
1/30/2004	3.0	AP-2 aperture measurements while stacking	
2/5/2004	5.0	Debuncher bumps and aperture painting	
2/6/2004	5.0	Debuncher bumps and SEM profiles	
2/9/2004	5.0	Debuncher bumps	
2/10/2004	2.0	Debuncher Low level RF phase jump	
2/16/2004	8.5	AP-2 aperture, Debuncher bumps, Debuncher aperture painting	Poor stacking due to studies
2/23/2004	6.5	Debuncher momentum cooling characterization	
2/26/2004	5.0	Reverse protons up AP-2, beamline BPM measurements	
2/28/2004	5.0	Reverse protons, Debuncher orbit offset from quadrupole centers	
3/1/2004	9.5	Reverse protons, Debuncher aperture, quad centers, tank moves	
3/4/2004	4.0	Debuncher energy match/phase jump	
3/5/2004	7.0	Reverse protons, Debuncher quad centers	
3/14/2004	2.5	Accumulator and debuncher admittance measurements	
	2.5	Sum for Week	
	271.5	Sum for FY04	
	18.3	Average Per Week	

TEV Studies

1/9/2004	1.0	Separator scans	
1/9/2004	5.5	Orbit smoothing	
1/10/2004	9.0	Diagnosis and correcting cause of quench following orbit smooth	
1/11/2004	9.0	Diagnosis and correcting cause of quench following orbit smooth	
1/12/2004	8.0	Orbit bumps to reduce losses	
1/13/2004	16.5	Investigate cause of recent quenches	
1/14/2004	9.0	Investigate cause of recent quenches	
1/15/2004	12.0	Investigate cause of recent quenches	
1/15/2004	1.0	End of store collimator study	
1/16/2004	1.0	Check of tunes at low beta	
1/23/2004	2.0	End of store abort tune-up	
1/29/2004	12.0	Orbit smoothing	
2/2/2004	2.0	End of store, damper to remove beam in abort gap	
2/6/2004	1.0	End of store, tune vs. separation	
2/13/2004	1.5	End of store, tune vs. separation	
2/13/2004	6.0	Orbit smoothing, 1-bump measurements in Tev, P1 line measurements	
2/16/2004	2.5	B0 aperture scans	
2/18/2004	3.5	End of store, separator scans (including A17 with manually reversed polarity)	
2/20/2004	1.0	End of store, synchrotron light	
2/20/2004	4.0	Beginning of store, helix amplitude vs. lifetime	
2/22/2004	1.0	150 GeV optics measurements	
2/23/2004	0.5	Increase helix during middle of store	
2/25/2004	2.0	End of store, synchrotron light	
2/25/2004	0.5	Automated chromaticity measurements	
2/26/2004	0.5	Increase helix during middle of store	
2/27/2004	3.5	Orbit smoothing	
2/28/2004	0.5	Increase helix during middle of store	
3/1/2004	4.5	End of store, TEL for beam-beam compensation	
3/2/2004	3.0	RF checkout, lattice measurements, protons on pbar helix	
3/5/2004	0.5	End of store, A0 bumps	F48 quench due to studies
3/7/2004	1.0	End of store, vertical bump at TEL	
3/8/2004	1.5	End of store, synchrotron light	
3/10/2004	0.5	Collimator alignment	Quench caused by controls proble
3/10/2004	1.7	B0 and C0 aperture scans	
3/11/2004	5.5	Tevatron checkout after store lost when RF didn't change frequency	
3/13/2004	3	Lattice measurements plus quench recovery	Quench during abort after studies
	12.2	Sum for Week	
	267.7	Sum for Year	
	18.2	Average per Week	

Short Term Focus

- Recover the complex
  - Injector commissioning should be complete before TEV startup
    - Booster Alignment
    - Pbar Cooling changes
    - 8 GeV commissioning of the P1 line for Pbars
  - Tev Turn on
    - Orbits, Tunes, chromaticities to accommodate low-beta magnet alignment
    - Commissioning of the P1 line for 150 GeV injection
  - Get 3-4 stores on the "curve" before considering studies

Medium Term Focus - April

- Proton Source
  - Commission the collimators
  - Commission cogging for NUMI and slip-stacking
- Main Injector
  - Make 2.5 MHz transfers between the Accumulator and the Main Injector operational on shots
  - Commission multi-batch extraction for NUMI and pbar production
  - Push slip stacking
- Pbar
  - Optimize cooling cycle time because of the new cooling improvements
  - Make 2.5 MHz transfers between the Accumulator and the Main Injector operational on shots
  - Optimize cooling profiles during shot setup
- Tevatron (done in order)
  - Optimize low-beta optics
  - Implement new b2 compensation algorithm
  - Commission octupoles
- Recycler
  - Optimize transfer mechanics
  - Characterize phase space vs. stack size

Long Term Focus – Mid Summer

- Mixed-Mode Pbar Extraction (Brian Chase)
  - Extracting pbars from both the Accumulator and the Recycler for the same store i.e.
    - Twenty four bunches from the Accumulator
    - Twelve bunches from the Recycler
  - Ratio $I_{Recycler}/I_{Accumulator}$ is governed by:
    - Recycler phase space density (cooling)
    - Recycler transfer time (Rapid transfers)
  - Reasons
    - Push Recycler commissioning progress by plunging it into operations
    - Luminosity enhancement – larger amount of pbars for smaller emittances
      - Accumulator stack size limited to <200 mA
        - » Stacking Rate
        - » Transverse emittance vs Stack Size
    - Flexibility in the Run II Upgrade schedule
      - Natural merging of commissioning of electron cooling
  - Obstacles
    - Injector Complex 8 GeV energy alignment
    - Accumulator non-zero intercept of longitudinal emmittance vs stack size
    - Recycler longitudinal emmitance vs stack size with stochastic cooling

Long Term Focus – Mid Summer

- Constant Pbar Cycle Time vs Stack Size
  - Presently we keep production efficiency constant by slowing down the cycle time as the stack grows
    - Good for losses in the Main Injector
    - Bad for NUMI
  - The losses of the NUMI beam in the Main Injector will overshadow the losses due to pbar production
    - Keep cycle time constant
    - Trade off production efficiency vs stack size by grabbing only the pbars of the Accumulator extraction orbit that the Stacktail can cool.