# All Experimenter's Meeting

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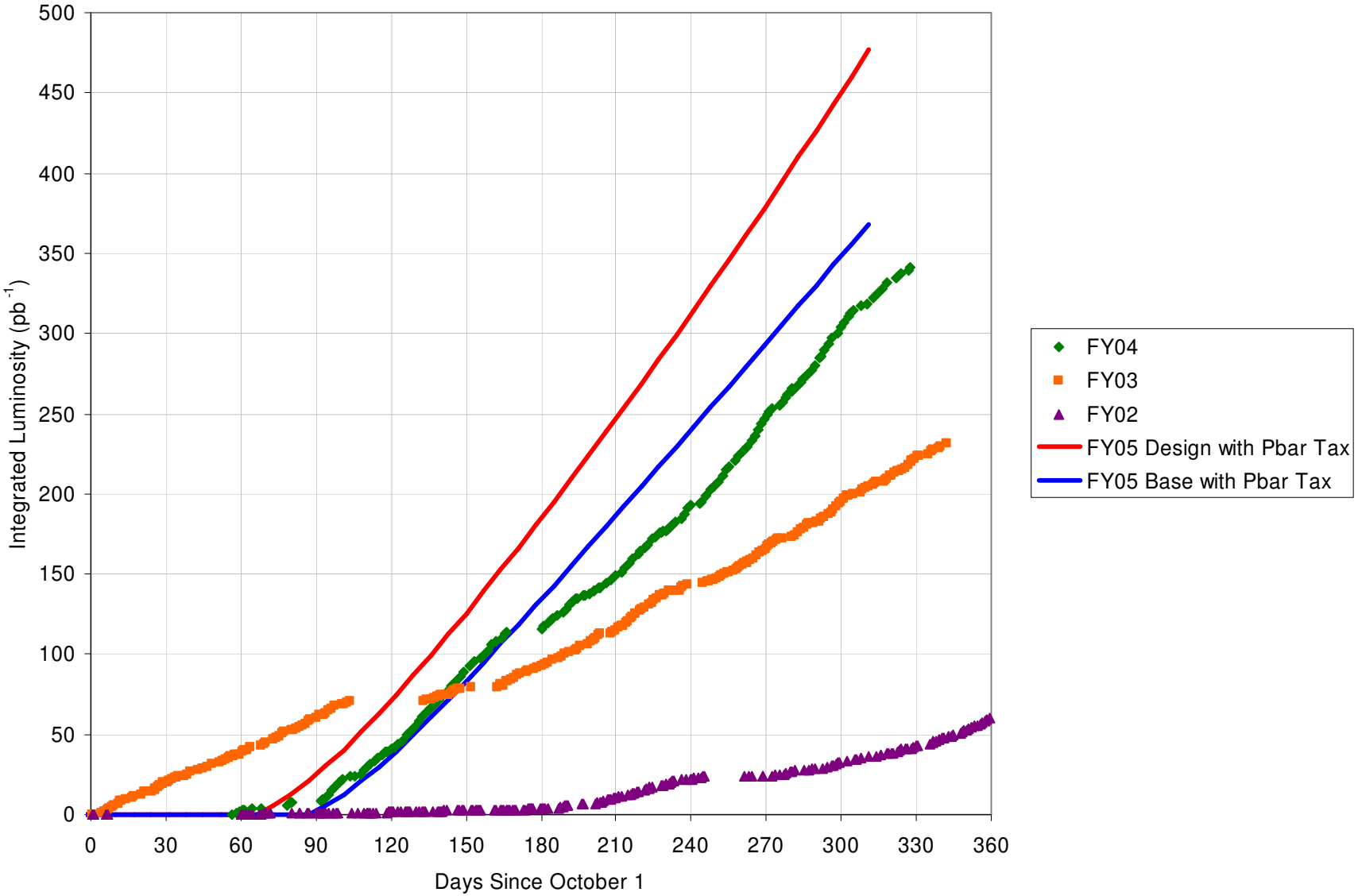
November 15, 2004

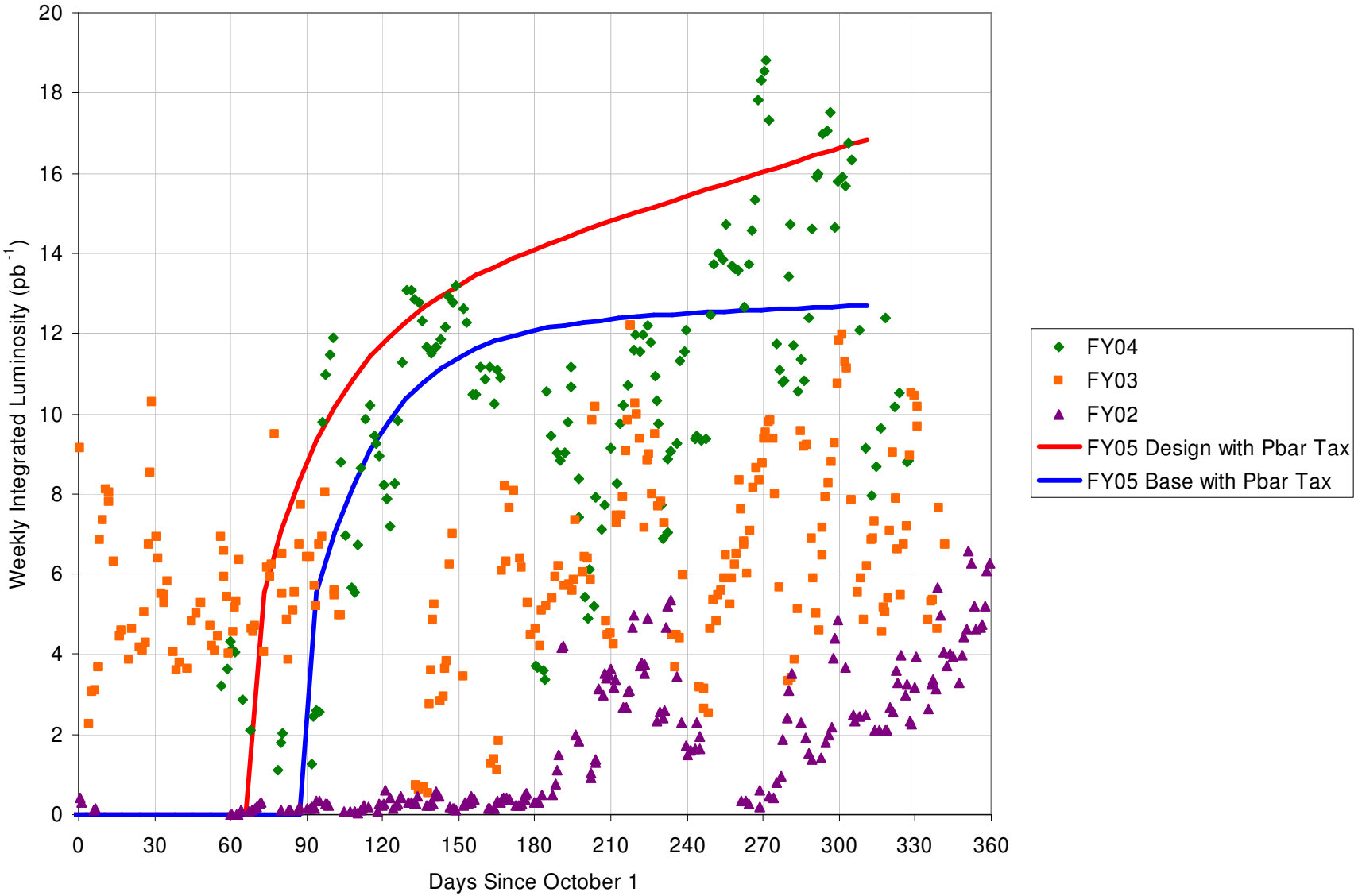
# Plans for FY05

- Install electron cooling in the Recycler in Fall '04 shutdown
- Run Slip Stacking at $8x10^{12}$ protons/pulse every 2 secs
- Increase the pbar production aperture by 25%
- Stack at small stacks with a rate of $24x10^{10}$ pbars/hr
- Run the complex in Mixed Pbar operations
  - Assume the gain from Mixed Pbar operations is "break-even" (pessimistic?)
- Demonstrate electron cooling of antiprotons by the end of FY05
  - 25% Pbar Tax is still in effect
- Integrate $470pb^{-1}$ in 34 weeks (average ~$14pb^{-1}$/week)
- Run NUMI at a 2 sec. cycle time with $2.5x10^{13}$ protons/cycle by Spring
  - Keep activation levels in Booster at the April 29, 2004 level.
  - Will need guidance from Program Planning on the priorities of NUMI, MiniBoone, SY120

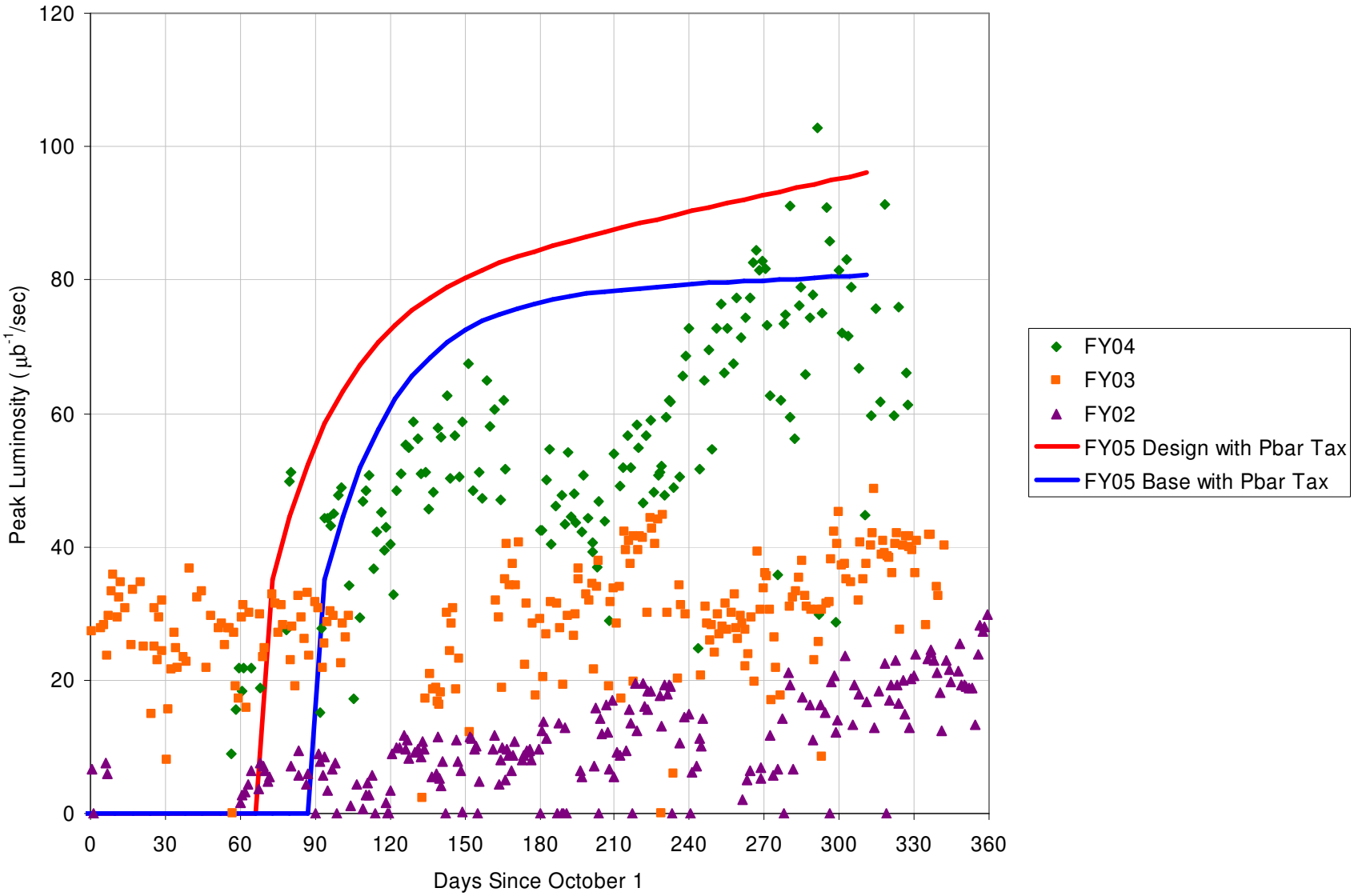
# FY05 Goals Integrated Luminosity



# FY05 Goals Weekly Integrated Luminosity



# FY05 Goals Peak Luminosity



# FY05 Goals

| | | Luminosity Parameters | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Parameter | Best Store | Best of FY04 | Best of FY03 | FY04 (End) Design | FY04 (End) Base | FY05 (End) Design | FY05 (End) Base | |
| Initial Luminosity (Average) | 102.8 | 87.6 | 43.7 | 61.9 | 43.3 | 96.1 | 80.7 | $x10^{30}cm^{-2}sec^{-1}$ |
| Integrated Luminosity per Store (Averaged) | 4241 | 3221 | 1518.5 | 2000 | 1300 | 3369 | 3190 | $nb^{-1}$ |
| Luminosity per week (Averaged) | - | - | - | 11.3 | 7.4 | 16.8 | 12.7 | $pb^{-1}$ |
| Store Length | 32.4 | 26.7 | 17.8 | 15.0 | 15.0 | 20.0 | 25.0 | Hours |
| Store Hours per week | - | - | - | 85 | 84 | 100 | 100 | Hours |
| Shot Setup Time | 2.4 | 2.6 | 2.1 | 2.2 | 2.2 | 2.6 | 2.6 | Hours |
| | | | | | | | | |
| | | TEVATRON Parameters | | | | | | |
| Parameter | Best Store | Best 10 stores Average | Best of FY03 | FY04 (End) Design | FY04 (End) Base | FY05 (End) Design | FY05 (End) Base | |
| Protons per bunch | 246 | 249 | 241.2 | 260 | 260 | 260 | 250 | $x10^{9}$ |
| Antiprotons per bunch | 43 | 36 | 25.6 | 31 | 25 | 42 | 34 | $x10^{9}$ |
| Proton Efficiency to Low Beta | 85 | 77 | 54.8 | - | - | - | - | % |
| Pbar Transfer efficiency to Low Beta | 86 | 81 | 63.5 | 80 | 77 | 76 | 74 | % |
| HourGlass Factor | 0.66 | 0.67 | 0.6 | 0.65 | 0.65 | 0.65 | 0.65 | |
| Initial Luminosity Lifetime | 5.2 | 6.0 | 8.9 | 8.3 | 7.0 | 6.4 | 6.4 | hours |
| Asymptotic Luminosity Lifetime | 17.7 | 19.3 | 23.7 | 25.0 | 25.0 | 25.0 | 25.0 | hours |
| Effective Emittance | 16.9 | 17.0 | 22.4 | 21.0 | 23.0 | 18.5 | 17.0 | $\pi$-mm-mrad |
| | | | | | | | | |
| | | Antiproton Parameters | | | | | | |
| Parameter | Best Store | Best 10 stores Average | Best of FY03 | FY04 (End) Design | FY04 (End) Base | FY05 (End) Design | FY05 (End) Base | |
| Zero Stack Stack Rate | 13.2 | 12.7 | 12.0 | 18.0 | 13.7 | 24.5 | 14.0 | $x10^{10}$/hour |
| Normalized Zero Stack Stack Rate | 2.5 | 2.4 | 2.4 | 3.6 | 2.7 | 3.1 | 2.3 | $x10^{-2}$/hour |
| Average Stacking Rate | 6.8 | 6.4 | 7.8 | 9.3 | 7.6 | 10.1 | 6.6 | $x10^{10}$/hour |
| Stacking Time Line Factor | 86 | 78 | 94.8 | 75 | 75 | 75 | 75 | % |
| Stack Size at Zero Stack Rate | 309 | 321 | 299.7 | 300 | 300 | 300 | 300 | $x10^{10}$ |
| Protons on Target | 5.3 | 5.2 | 5.1 | 5.0 | 5.0 | 8.0 | 6.2 | $x10^{12}$ |
| Start Stack | 198 | 179 | 158.8 | 155 | 130 | 216 | 181 | $x10^{10}$ |
| End Stack | 17 | 18 | 12.9 | 15 | 15 | 15 | 15 | $x10^{10}$ |
| Unstacked Pbars | 181 | 161 | 145.9 | 140 | 115 | 201 | 166 | $x10^{10}$ |

# Startup Planning

- Weekly startup meetings every Wednesday at 9am
  - Have had two already
  - First meeting
    - Overall Schedule
    - Startup goals
  - Second Meeting
    - Shift Planning
- Notes can be found at:

http://www-bdnew.fnal.gov/hq-integration/FY05Startup/index.htm

# FY05 Startup Guidelines

- Assume that it will take a maximum of 2 weeks from the day the TEV first sees beam to produce useable luminosity.
- Goal of commissioning plans should be to bring the machines to pre-shutdown level of performance
  - Proton source
    - 4.5 – 5.0x$10^{12}$ protons/pulse for stacking
    - 4.0x$10^{16}$ protons/hour for MiniBoone
  - Main Injector
    - 4.5 – 5.0x$10^{12}$ protons/pulse for stacking
    - 2.4 sec. cycle time at small stacks
  - Pbar Source
    - 10-12 mA/hr at zero stacks
  - Recycler
    - Be ready for Mixed Source operations within 1 month after startup
  - Tevatron
    - Commission orbits, tunes, etc. with new alignment
    - Commission new helix at low-beta

# Preliminary Schedule

| | | |
|---|---|---|
| Monday | November 22 | Daily 9:00 am meetings begin in the Huddle |
| Wednesday | November 24 | Shutdown ends |
| Thursday | November 25-26 | Power supply startup by the Operations Dept. |
| Saturday | November 27-28 | Main Injector beam startup |
| Monday | November 29 | 8 GeV beam to Pbar and the Recycler |
| Monday | November 29 | 150 GeV beam to TEV |
| Monday | November 29 | MiniBoone Beam line commissioning |
| Wednesday | December 1 | MI Slow Spill startup |
| Thursday | December 2 | 120 GeV beam to Pbar |
| Friday | December 3-4 | 120 GeV Beam to NUMI |
| Friday | December 3 | SY120 Comissioning |
| Monday | December 6 | Pbar transfers to MI |
| Tuesday | December 7 | Pbar Shot to the TEV |

# Tev Startup

- Before Beam
  - Check out QPM interface to new HTS leads.
  - Power and plot correction elements.
  - Power main bus and low betas to 1005 GeV.
  - Condition Separators.
- Establish Circulating beam (2 shifts)
  - Run beam down P1 line with ILAM off (may need D. Johnson)
  - Get first turn close while aborting on first turn
  - Let beam circulate and get tunes close to nominal (.575 and .585)
  - Check BPMs and smooth the orbit
  - Adjust tunes, coupling, and chromaticity to nominal
  - Aperture scan A0, B0, D0, D17, and E0
  - Take BPM data to verify separator polarities
- Accelerate (2 Shifts)
  - Copy DFGs up the ramp and accelerate.
  - Smooth first using only Horz correctors near C0.
  - Do more ramp cycles to finish correcting the orbit and setting tunes and coupling.

# Tev Startup

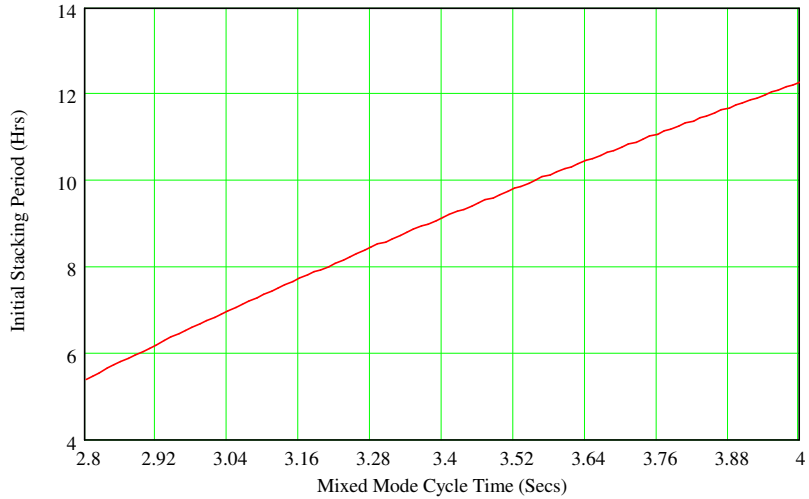
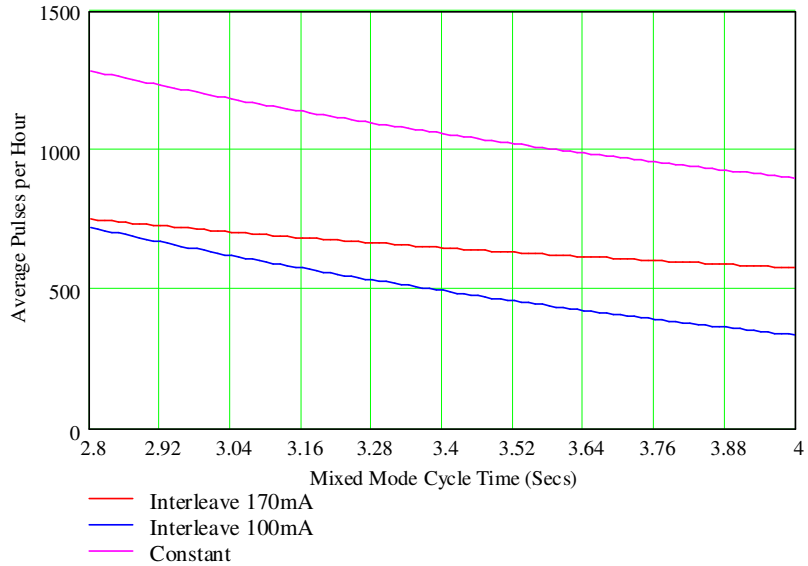
- Parse Squeeze (3 Shifts)
  - Parse through the squeeze with separators off correcting orbits, tunes, and coupling (.003 or better)
  - Go through the ramp and squeeze cycle to collect all orbits. If they are not good enough, smooth and repeat
  - Go through the ramp and squeeze cycle twice with different radial offsets to measure chromaticities
- Separators On – Tune Feed-downs (6 Shifts)
  - 150 GeV (1 shift)
  - Flattop (1 shift)
  - Squeeze-parse every 3rd step (2 shifts)
  - Ramp and squeeze on both helices to measure tunes on Proton and Pbar orbits. Make necessary adjustments (2 shifts)
- Misc. Activities (6 Shifts)
  - Do reverse injection tune up (1/2 shift)
  - Check abort timing (1/2 shift)
  - Check out instability dampers (1/2 shift)
  - Check out longitudinal dampers (1/2 shift)
  - Verify and calibrate instrumentation (1 shift )
  - Measure tune and chromaticity drifts after flattop of more than 1 hour (1 shift )
  - Verify TEL operation (1/2 shift)
  - Collision Helix closure using BPMs (1/2 shift)
  - Collimator Testing (1/2 shift)
  - 36X0 including Halo removal (1/2 shift)

# Machine Studies

- Over a year ago, we made the strong statement that we are leaving the commissioning phase of Run II behind and entering an operations phase in which we incorporate the Run II Upgrades.
- Although it has taken us awhile to come up with the right way to blend in studies with operations, we have achieved that balance during the second half of FY04.
- The success of this strategy comes from the following points (in order of importance)
  - Accelerator basics are the most important studies. The aperture, orbit, tune, and chromaticity must receive the highest attention.
  - The studies must be focused. That is, when possible, we do one study at a time and finish the studies to a conclusion.
  - Studies are embedded into operations. We follow the rhythm of the machine and use the machine performance as a reality check to the control and benefit of the studies. A natural result of this strategy is that study periods are often short. It is rare for us to schedule more than two study shifts in a row.
  - Injector chain studies have the highest priority (Recycler, MI slip stacking, AP2 aperture, Pbar production). To permit efficient coordination of injector chain studies, we run very long stores.

# Commissioning NuMI

- Next to restarting the Collider, commissioning NuMI is our next highest priority
- Commissioning will come in 3 phases
  - Commissioning the NUMI beam line
    - Low intensity shake-out in December
    - Moderate intensity commissioning at the end of January '05
  - Commissioning of high intensity Mixed Mode NUMI multi-batch cycles
    - Will start in mid-December and continue until the NuMI beamline requires production beam
    - Needs to accommodate slipped stacked pbar production batches
  - Commissioning the 2 second cycle time
    - In late January, we will do a radiation survey of the MI tunnel
    - We will decide on an acceptable level of activation in the tunnel.
    - We will initially tie the NUMI cycle time to the naturally lengthening cycle time of pbar production
      - For fast cycle times we will reduce the NuMI intensity
      - For slow cycle times we will increase the NuMI intensity
    - Once the loss issues of the NuMI cycles have been mitigated and full intensity NuMI can run faster than the initial natural cycle time of pbar production, we will hold the cycle time constant.
      - The slowdown in cooling for large stacks in Pbar will be accommodated by reducing the bucket area on ARF1 (yet to be successfully demonstrated)
      - Lithium Lens pulses issues

# Stacking and SY120 Operations

- The primary focus of the Accelerator division in the beginning of FY05 will be to maximize the stacking rate.
- The complexity of running the Collider in Mixed Pbar Source mode with the Recycler encourages keeping operational scenarios as simple as possible.
- Stacking and SY120 Mixed Mode operating Scenario (Before NUMI becomes "operational")
  - Interleave single pbar stacking cycles with Mixed Mode SY120 cycles for the first part of the stacking period.
  - During the second part of the stacking period, we would run Mixed Mode SY120 cycles every pulse.
    - During both periods, the cycle period will be adjusted to accommodate the natural slowdown of stacking as the pbar stack grows.
    - The boundary between these two periods is determined when the natural stacking cycle length equals the minimum Mixed Mode cycle length.
- Once NUMI becomes "operational", SY120 will get one pulse every 60 seconds