Thoughts on SY120 Operation During FY'05

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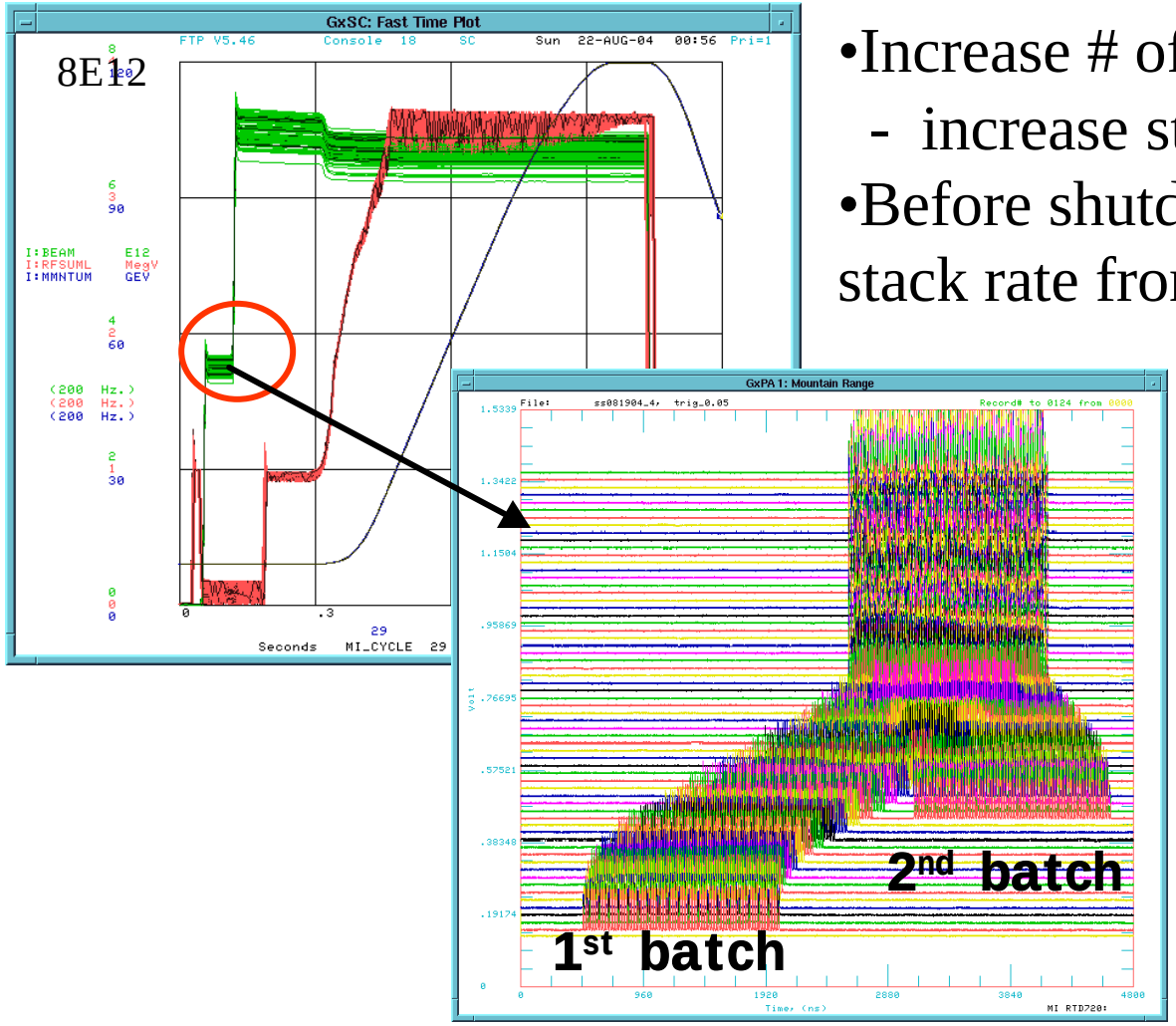
A Few Definitions

- MI Filling: Length of MI = 7 X Booster: Booster has 84-53 Mhz RF buckets (called a batch)
- Injections
  - Full batch(s): up to 6 batches with abort gap
  - Partial batch: < 84 bunches used for Collider and SY120
  - Slip stacking: merging 2 batches -> single high intensity batch (see next slide)
- Extraction
  - Single Turn:
    - MI52 kicker (t_{rise} ~ t_{fall} ~ 700 ns) -> to P1 beamline (stacking)
    - MI60 kicker (t_{rise} ~ 1.6 us t_{fall}~7 us) -> to NuMI beamline
  - Resonant: (slow spill) ½ integer extraction : MI52 septa
- Intensities
  - Pbar production: 5.5E12 single batch -> <8E12 slip stack
  - NuMI: 2.5E13 (in 5 batches)
  - Collider protons: 2.7 to 3E11 coalesced into single bench
  - SY120: has been 2 to 6E11 (in 30 to 84 bunches)

Slip Stacking for Pbar Production



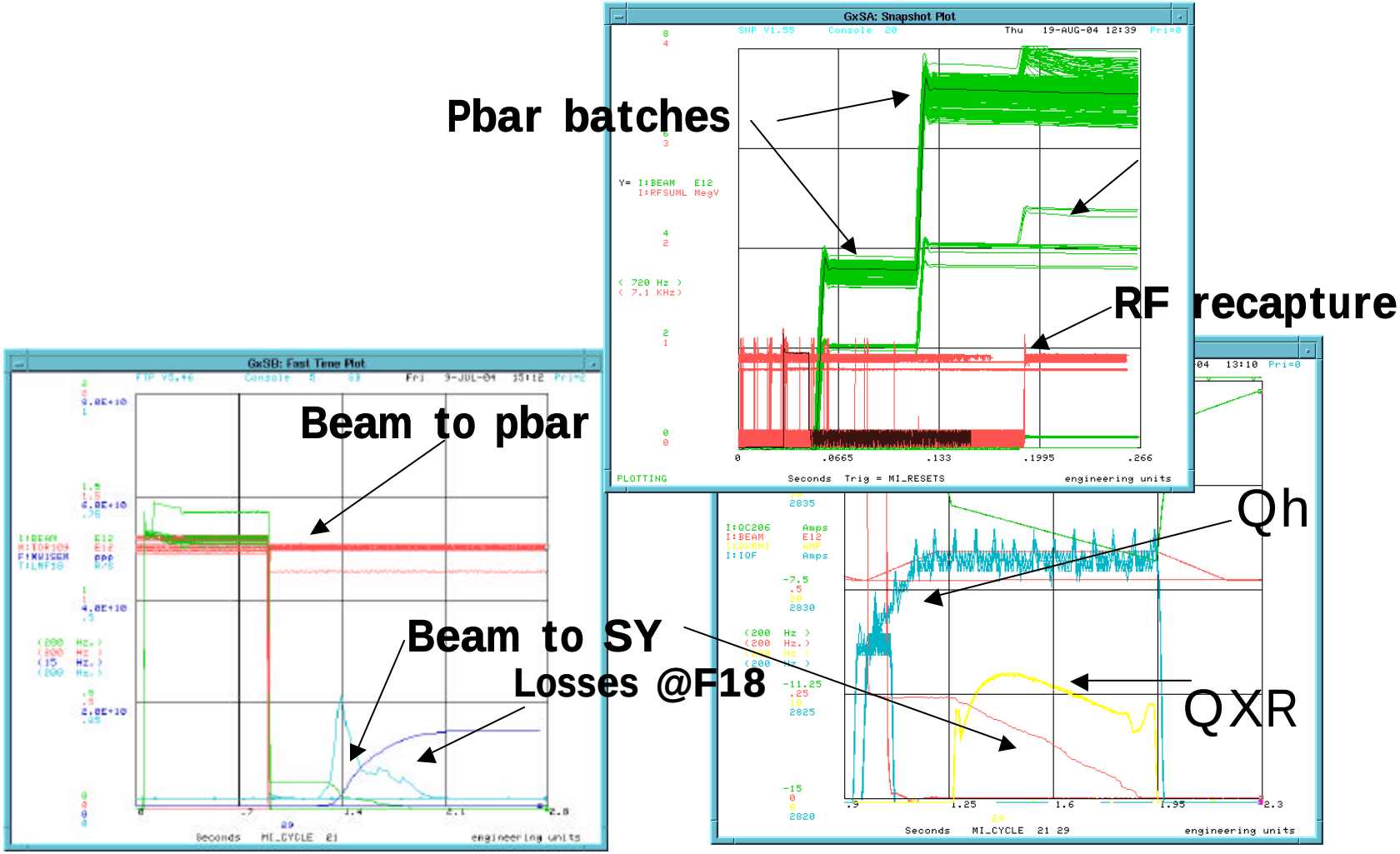
- Increase # of protons on target
  - increase stacking rate
- Before shutdown increase initial stack rate from 12 to 14 mA/hr

Data from Kiyomi

Current SY120 Modes of operation

- Modes of operation for slow spill to SY
  - Dedicated slow spill (initial mode)
  - Mixed-mode (single batch to pbar, 7/9)
  - Mixed-mode (2 batch slip-stacking to pbar, 8/19)
- Mixed-mode development required significant time and modifications
- Mixed-mode operation uses:
  - The same optics in P1 and P2 beamline for stacking and SY120
  - The same major dipole settings in P1/P2
  - Different dipole trim settings
- All three modes use same MI ramp and timing, but different TLG modules (<u>easy to switch modes</u>)
- All three modes have been commissioned
- The minimum cycle time 2.8 sec
- The spill length is 655 ms
- <u>Can provide up to ~14 sec of spill/min</u>

Two flavors of mixed-mode



Simple mixed-mode

Slip-stacking mixed-mode

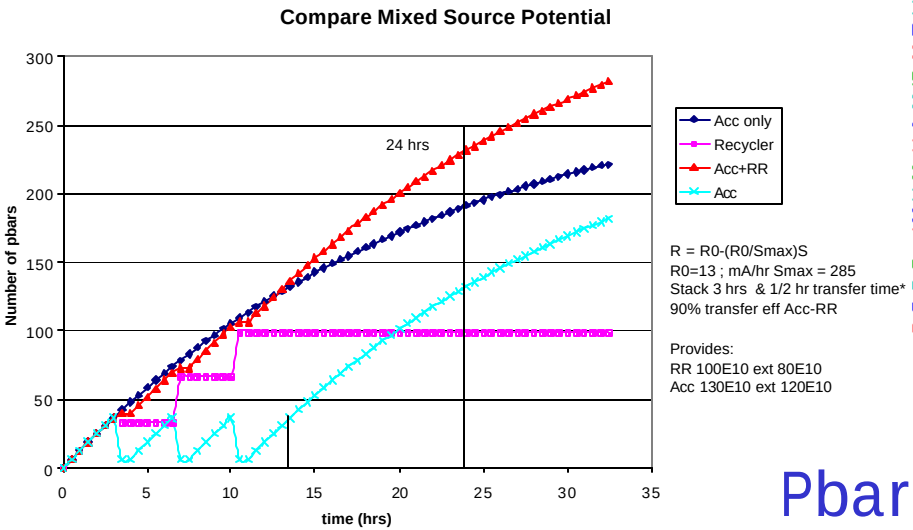
MI Cycle Rate for Pbar Stacking

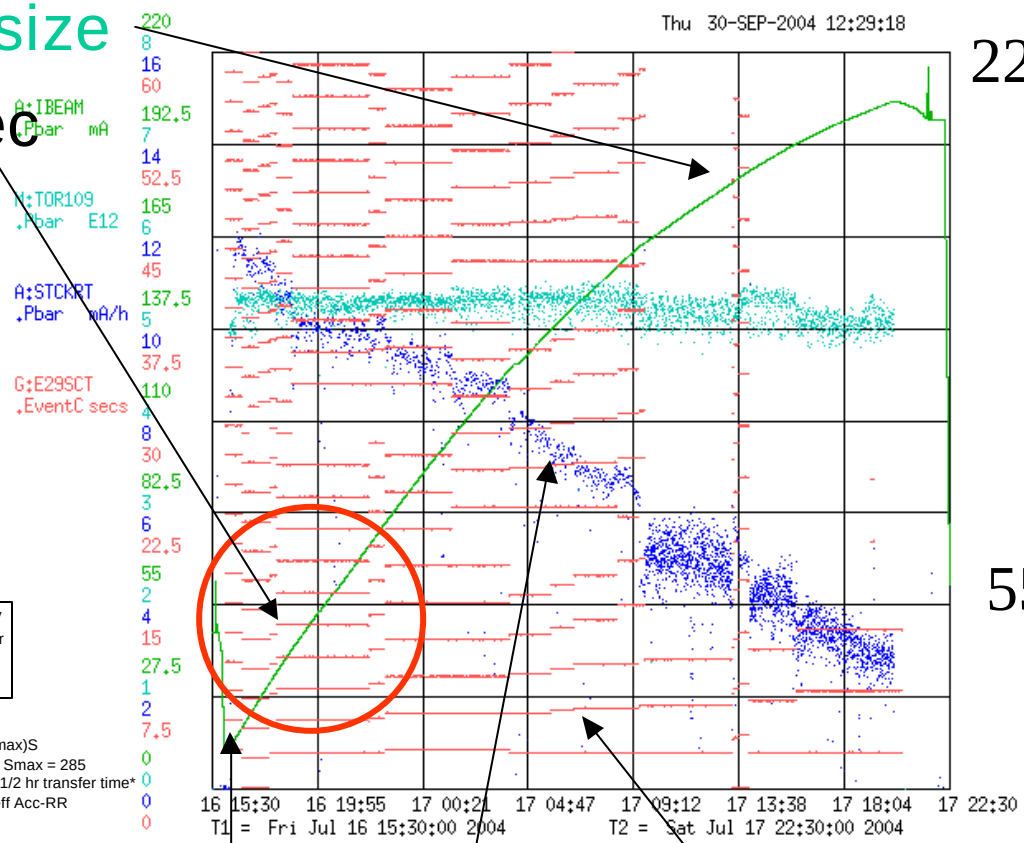
Pbar stack size

SY120 cycle time 2.8 sec

~2.7 sec

#hrs/day spent stacking at over 35 mA/hr depends on how the RR is integrated into Collider Operation





220

55

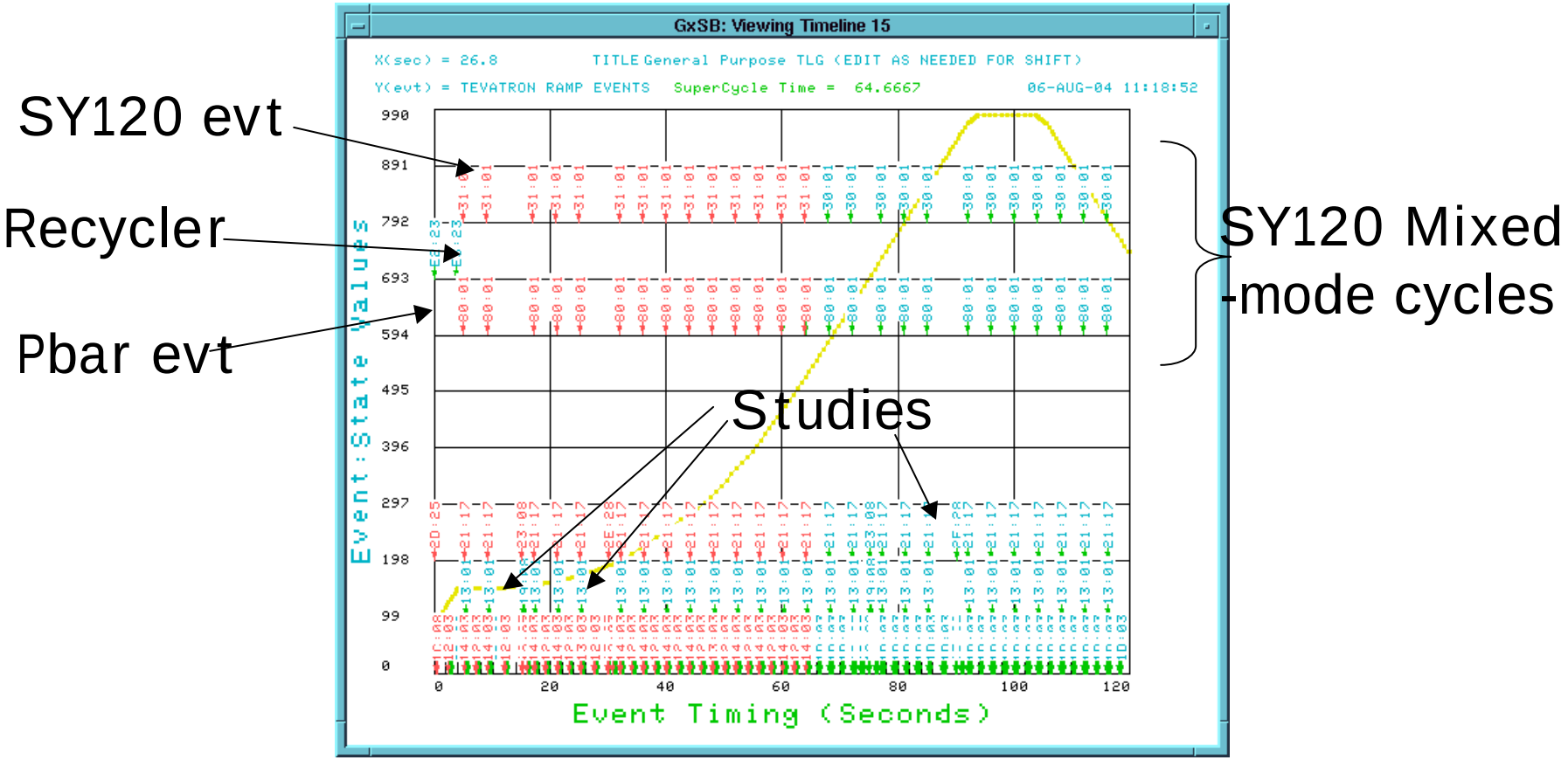
~2.2 sec

$29 cycles in 60 sec

Pbar stacking rate

Store 3657 L_0>1E32

Mixed-Mode Stacking Time Line



SY120 rep rate 4 sec -> 8.6 sec spill/min !!

MI Department Priorities

- Run II
  - Provide protons for Tevatron (coalescing, 2.5 Mhz acceleration, longitudinal dampers, etc…)
  - Providing protons for stacking (beamline support, slip stacking)
  - Supporting Recycler operation (rapid transfers)
  - Mixed-Source operation (pbars Acc & RR)
- NuMI
  - Support commissioning NuMI beamline
- SY120
  - Support SY120 program with <u>existing</u> dedicated and mixed mode operation
  - Commission Bucker system (Instrumentation, MI, EE Support)

How does SY120 fit into the Program, I

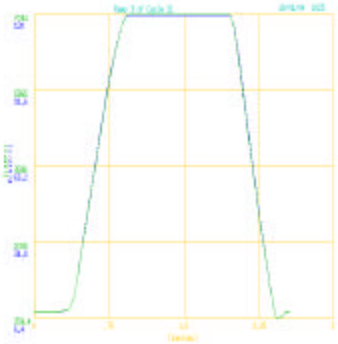
-Minimize impact on Run II and stacking and NuMI

-Maximize beam to users within Program Planning guidelines

- **It will be an optimization of:**
  - **number of cycles per min in the timeline**
  - **the spill length per cycle**

What determines the cycle time, flattop time, and repetition rate?

- The minimum cycle time is determined by a combination of
  - o MI feeder peak voltage-> ramp rate
  - o RF power -> ramp rate
  - o BL PS voltage and rms current limits ->HVF12/SY(?)
  - o Available magnet cooling



in the MI, P1, P2, P3, Switchyard, and Meson beamlines

- Want to maximize spill time /cycle, & be compatible with stacking at low stacks

- The repetition rate -> Operational Considerations (stacking,studies, Store length,RR utilization,NuMI comm/oper * current limit MI Corr RMS -> quad alignment

How does SY120 fit into the Program, II

During NuMI Commissioning

- NuMI / stacking cycles will not be at 2 sec rep rate (my opinion)
- Best option to utilize Mixed-mode (with/without SS)
  - Max rep rate is 2.8 sec (goal) – run all the time
- Number of cycles depend on utilization of RR/Operational Issues

During NuMI running (when will this be? Spring ?)

- Division indicated stacking/NuMI will be at 2 sec rep rate
- How does SY120 fit in? Mixed-mode stacking or dedicated SY cycle?
  - Dedicated options: Beams-doc 880 (preliminary analysis for 6 sec FT)
    - Increase FT length of 120 GeV cycle (3 sec ->6 sec->longer?) for dedicated cycle only (precludes further mixed mode oper)
      - FT length determined mainly by MI corrector rms and
      - Beamline power supply rms /SY cooling
    - ~~Reduce energy of SY120 cycle to 100 GeV (last resort-much work)~~
    - ~~Mixed-mode stacking-NuMI-SY120 (not possible)~~