Slip stacking Operation and Future Plan

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Fermilab

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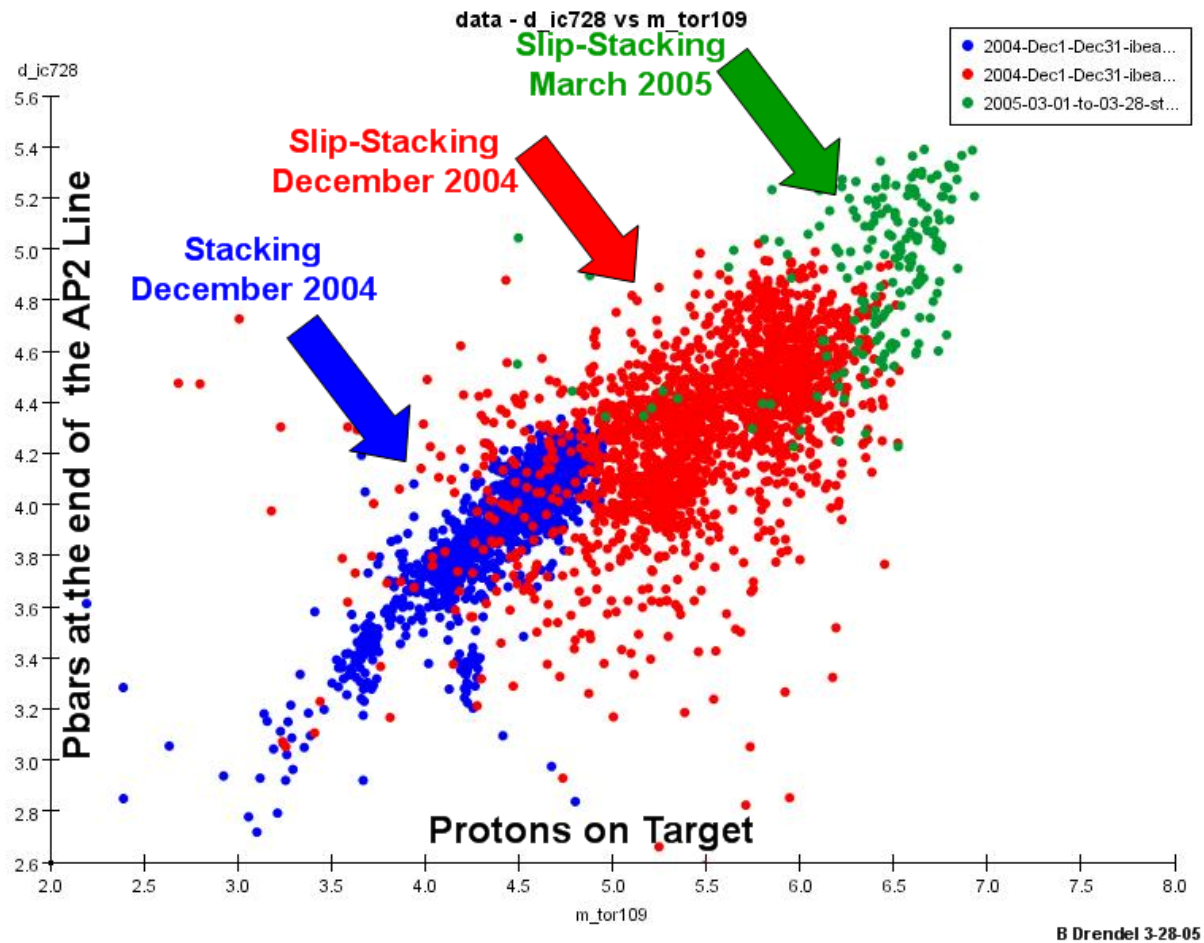
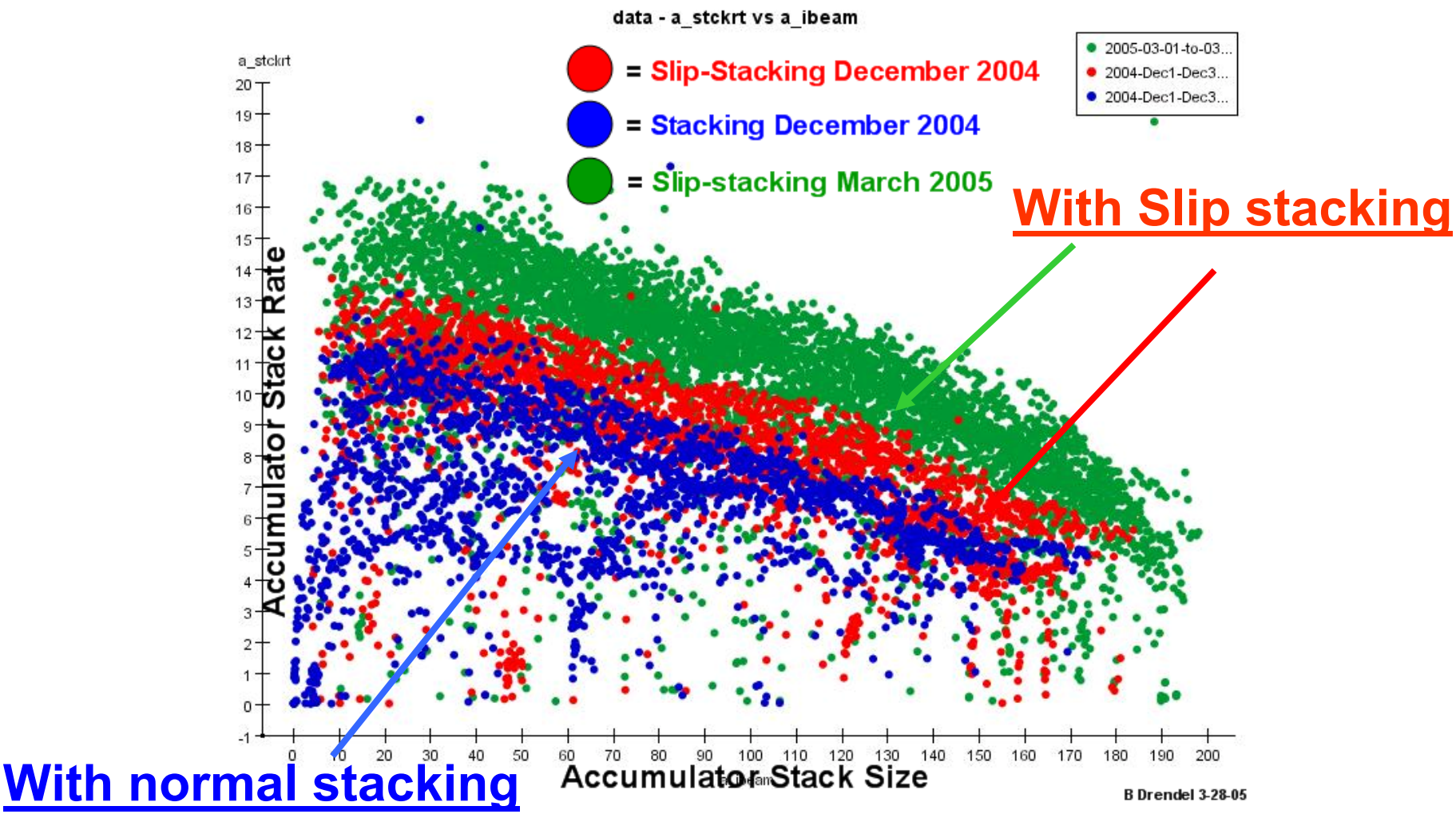
Effect of slip stacking on proton on target



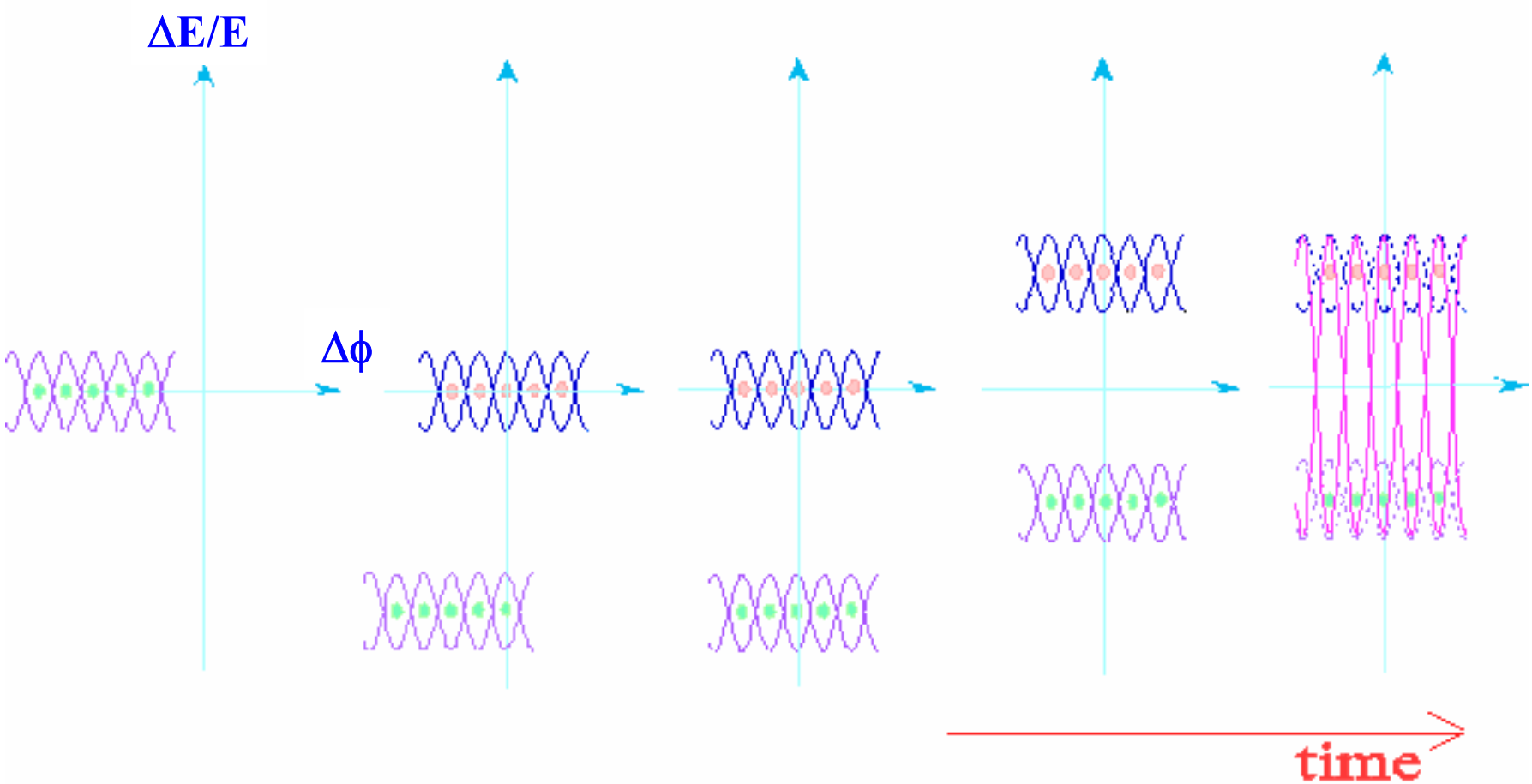
Effect of slip stacking on stack rate



Outline

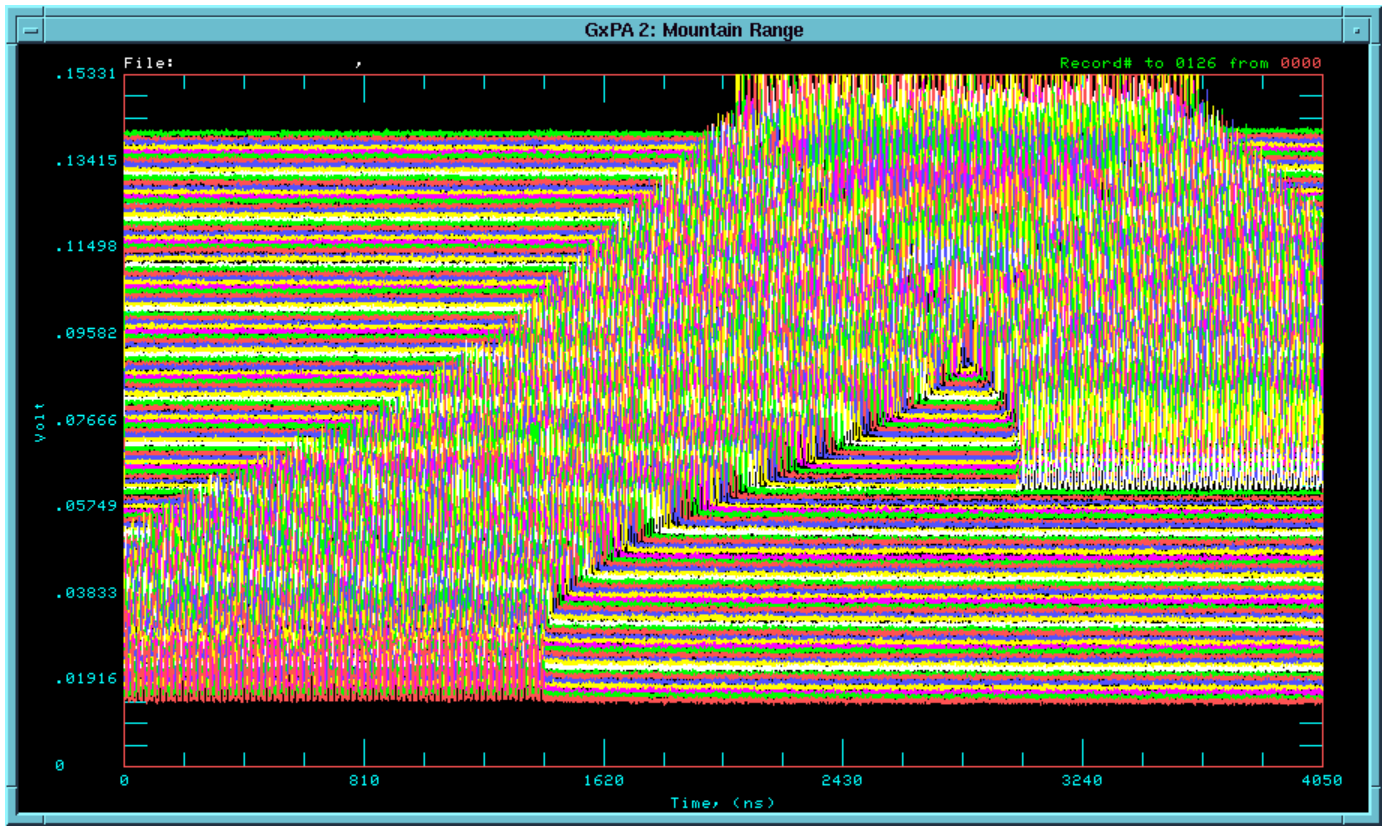
- Status of slip stacking operation
- Issues
  - Emittance from Booster
  - Balancer circuit for bunch rotation
- Future plans

Slip stacking process in phase space



Mountain range plot at injection

time



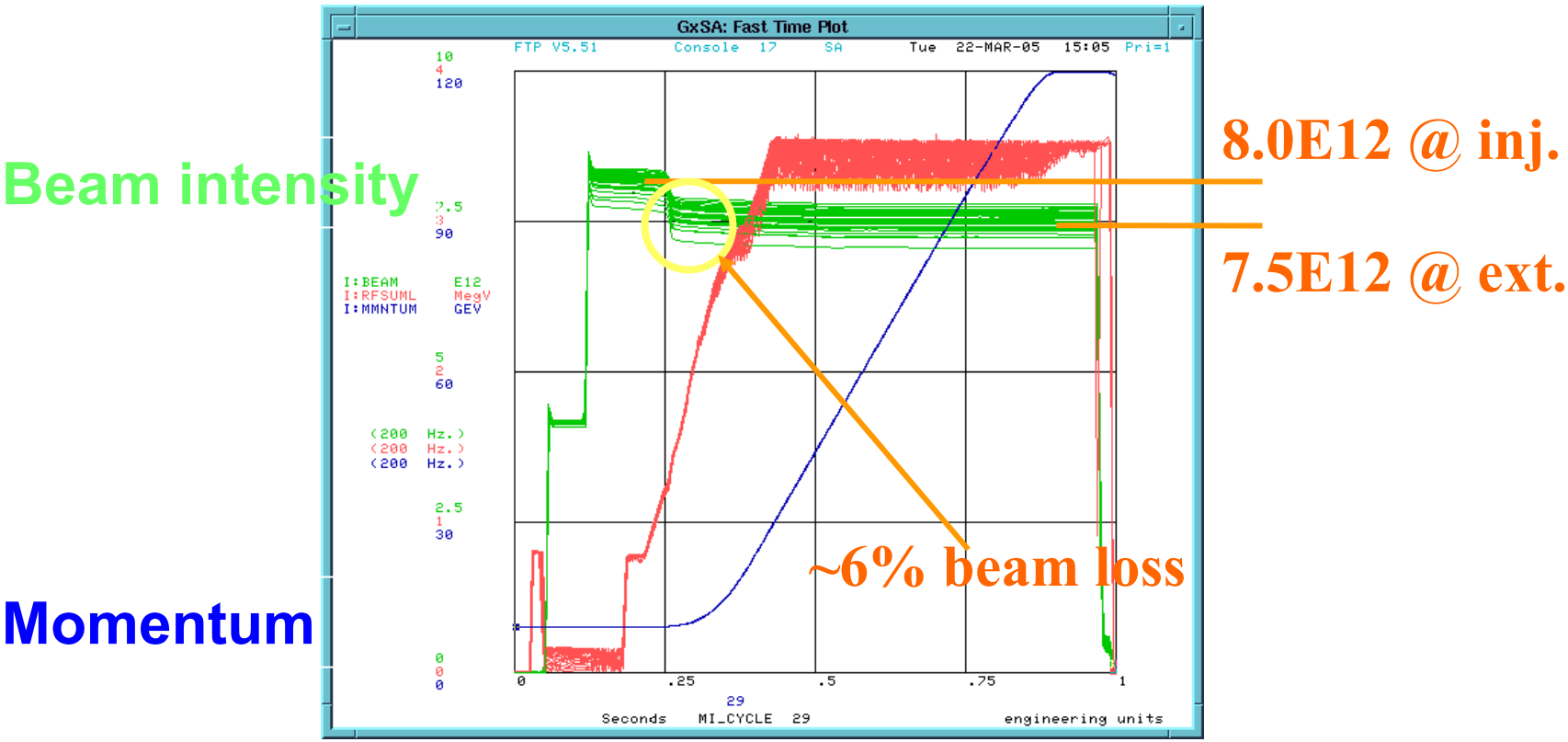
phase

Our goal for pbar stacking

- Intensity: 8E12 [ppp] (particle per pulse)
- Bunch length at extraction: < 1.5 nsec
- Time of slip stacking process: 200msec
  (<3 Booster cycles)

Intensity on stacking cycle

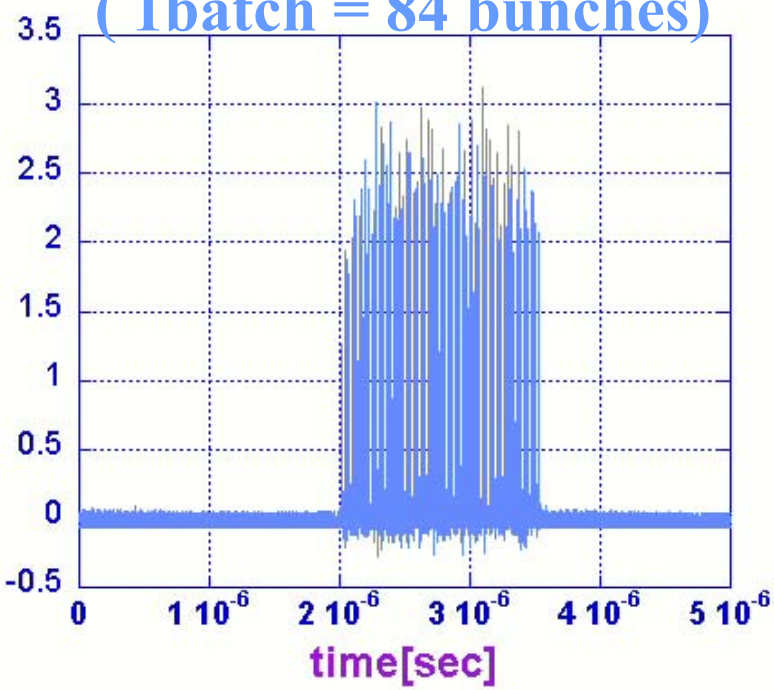
- Intensity @ ext.: 7.5E12



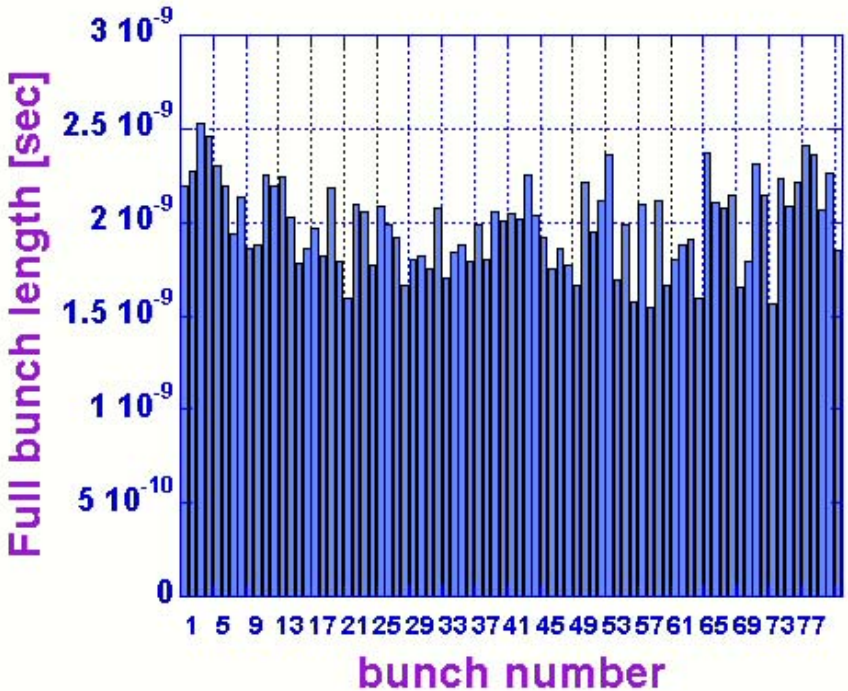
WCM signal and bunch length at extraction

- Bunch length @ ext.: ~1.8 nsec

WCM signal
(1batch = 84 bunches)



Bunch length

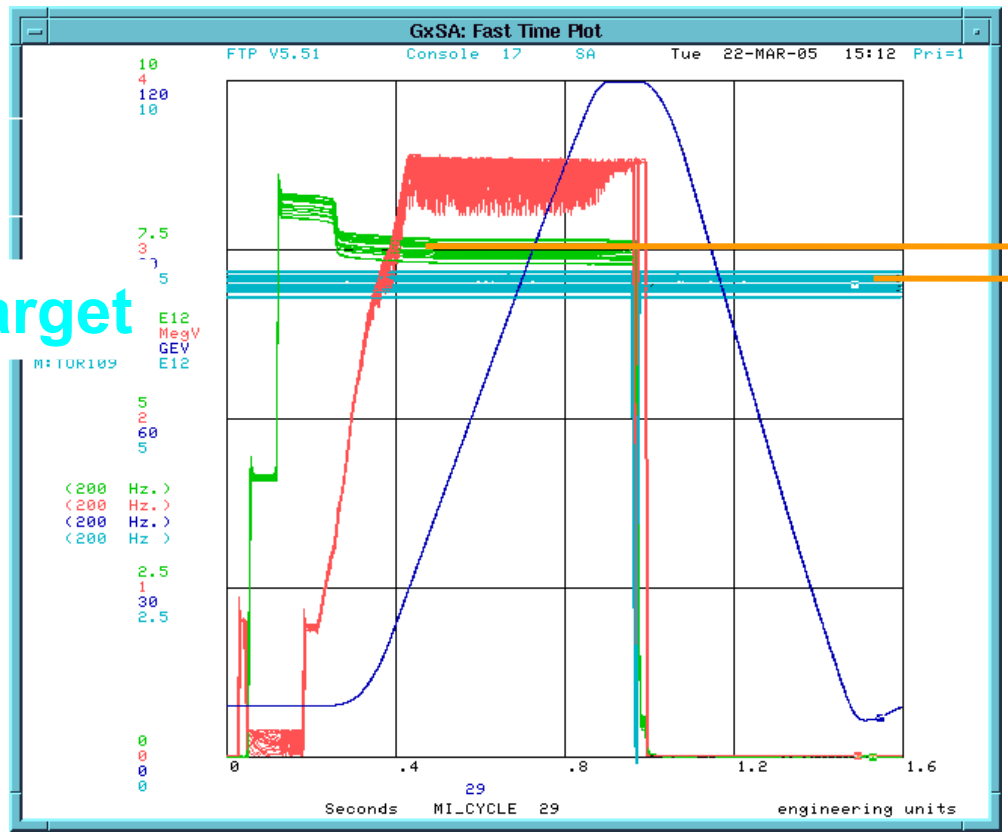


Intensity on Pbar target

- Intensity on Pbar target: 7.0E12

Beam in MI

Beam on target



7.5E12 @ MI ext.

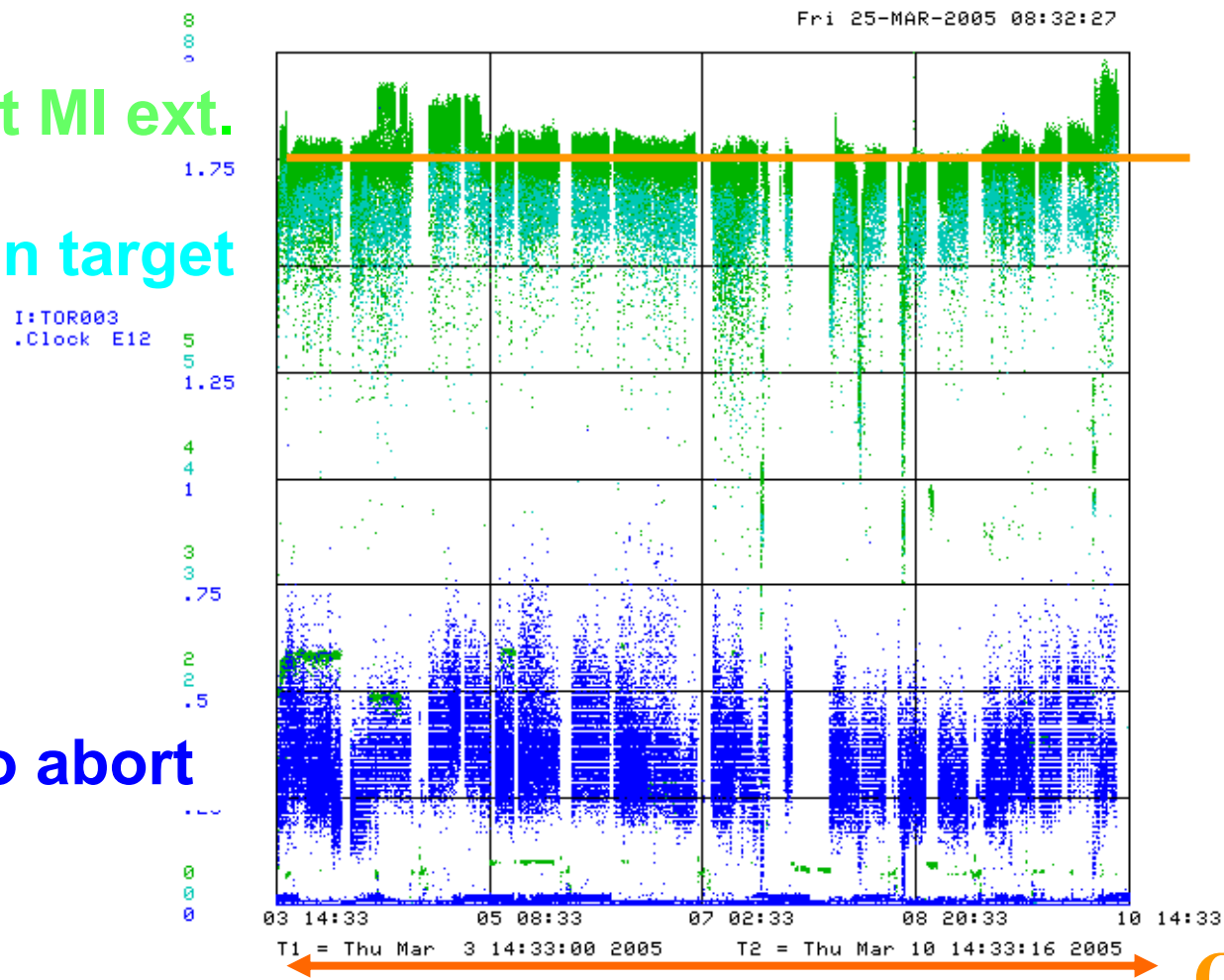
7.0E12 on target

Operation condition on stacking cycle

Beam at MI ext.

Beam on target

Beam to abort



7.0E12

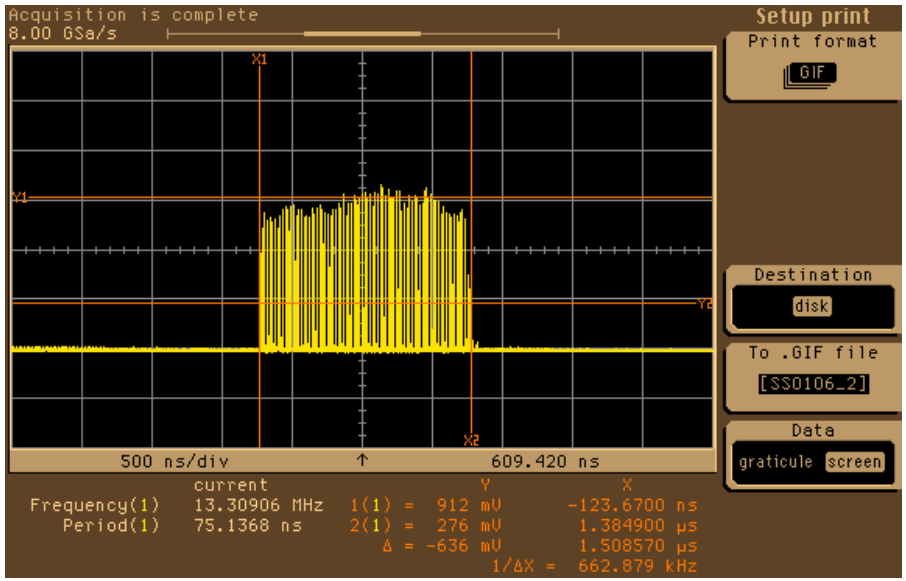
One week

Status

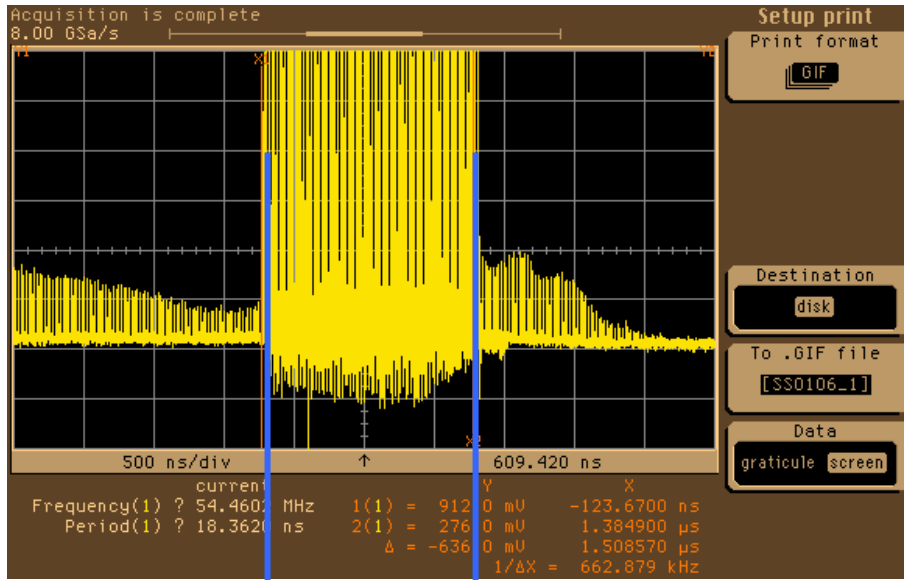
- Intensity: 7.5E12 (@ MI ext.)
  - Intensity @ inj.: 8.0E12
  - Intensity on Pbar target: 7.0E12
  - Intensity to abort line: 0.5E12
- Bunch length @ ext.: 1.8 nsec
- Time of slip stacking process: 184 msec

Wall current monitor at extraction

300mV/div



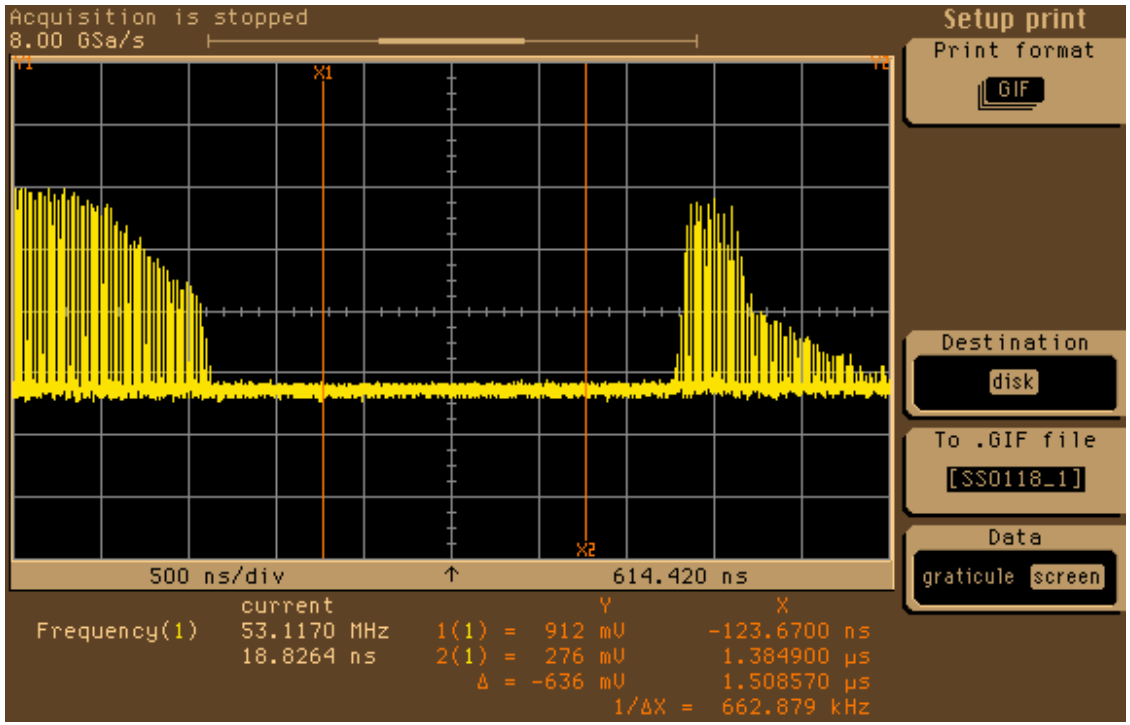
10mV/div



82 bunches to target

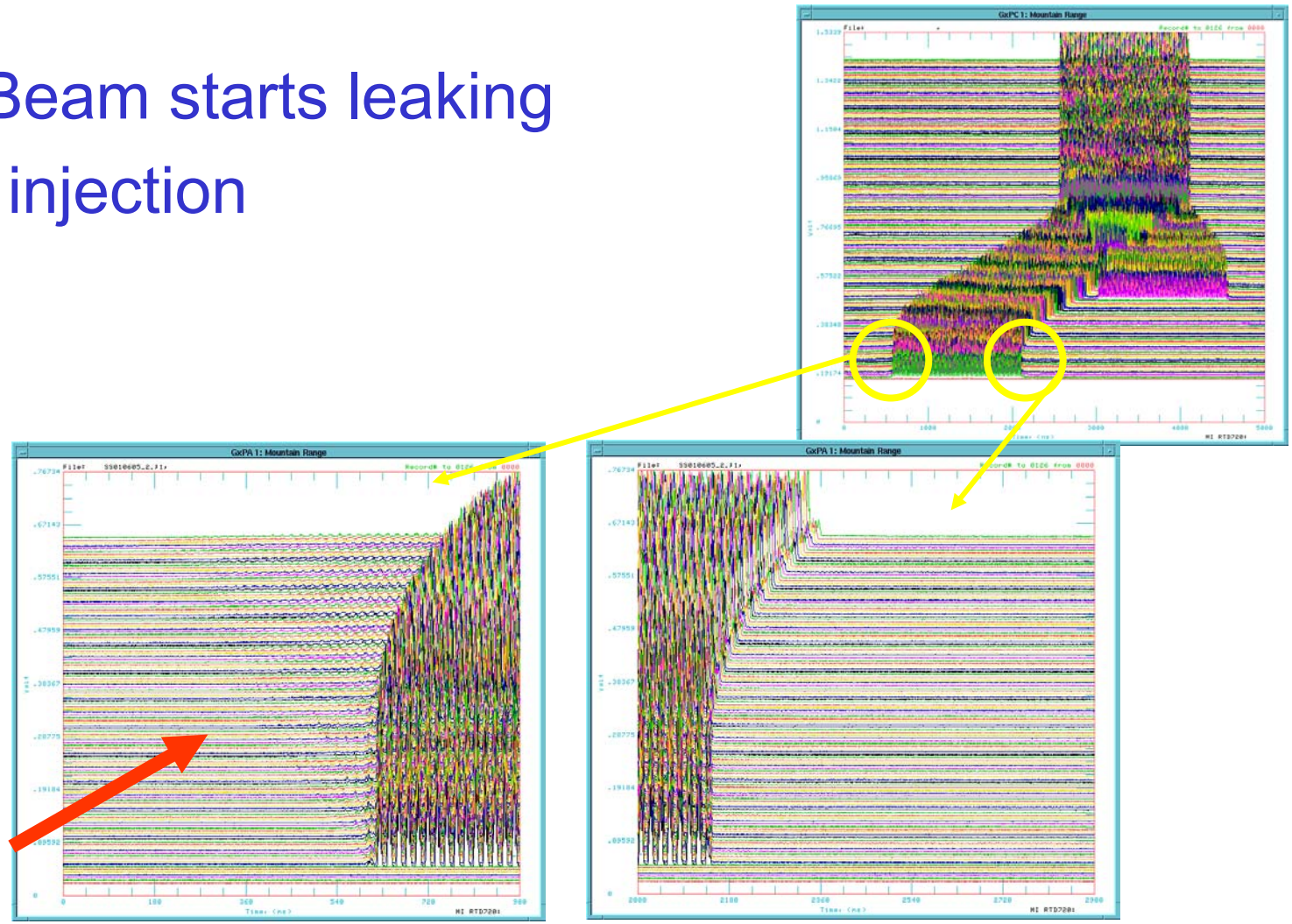
WCM signal After extraction kicker fired

- Beam to MI abort line



WCM signal at injection

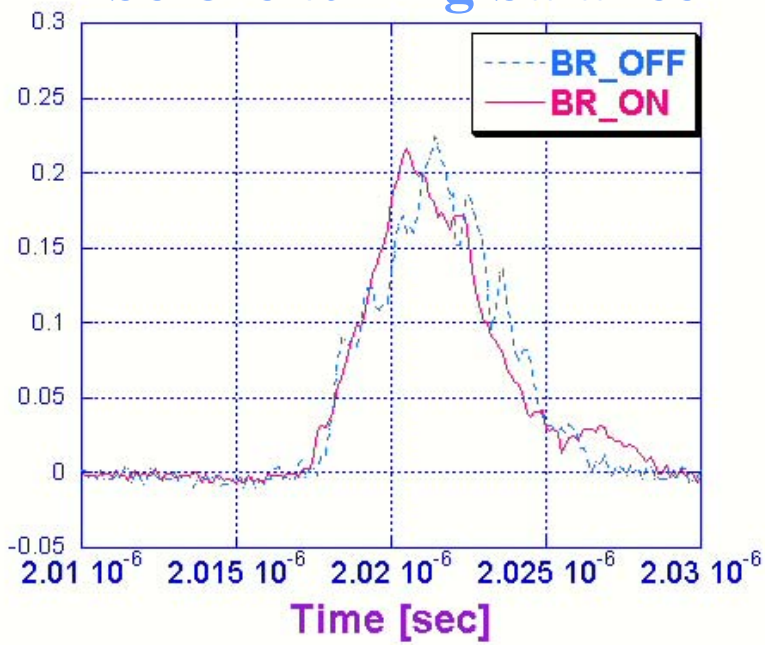
- Beam starts leaking at injection



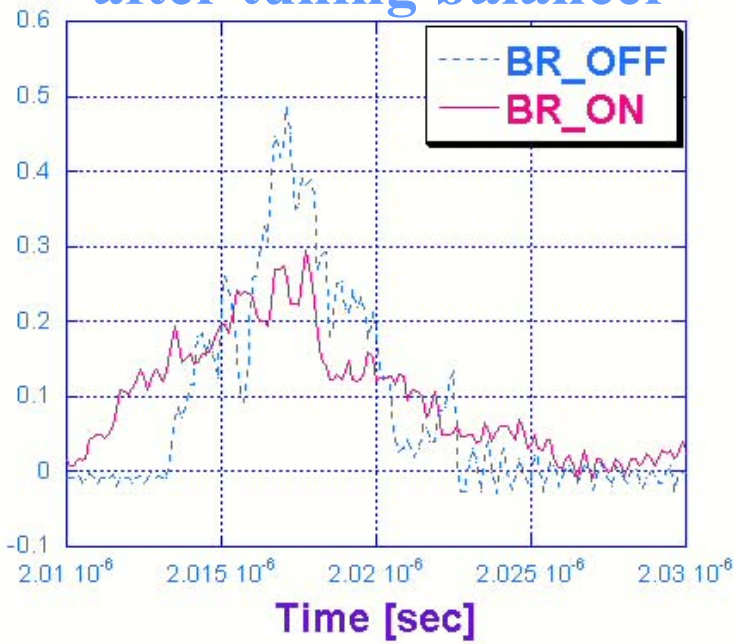
WCM signal at injection with and w/o bunch rotation

- Tuned up balancer in Booster for bunch rotation

before tuning balancer



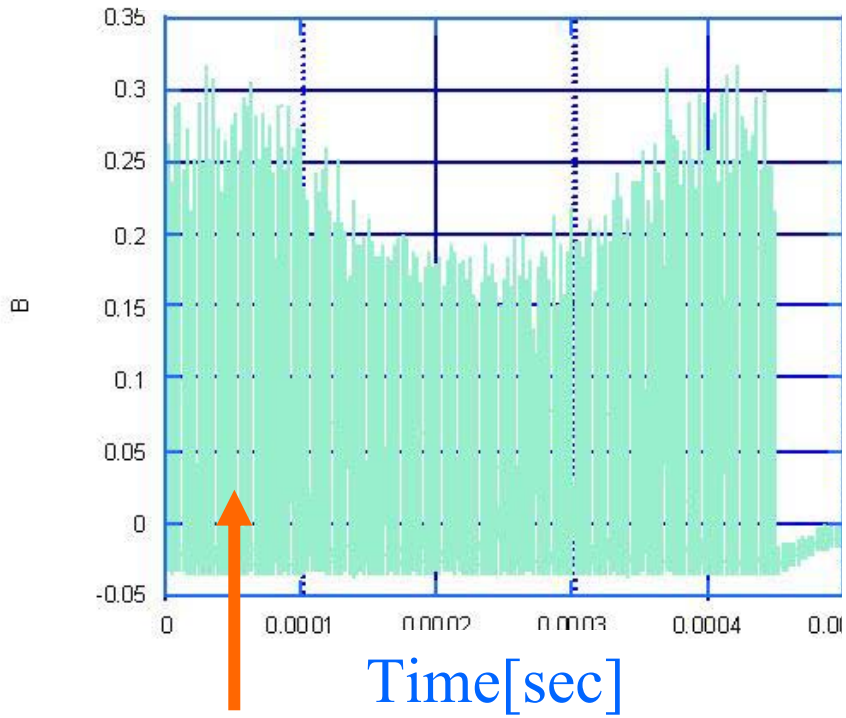
after tuning balancer



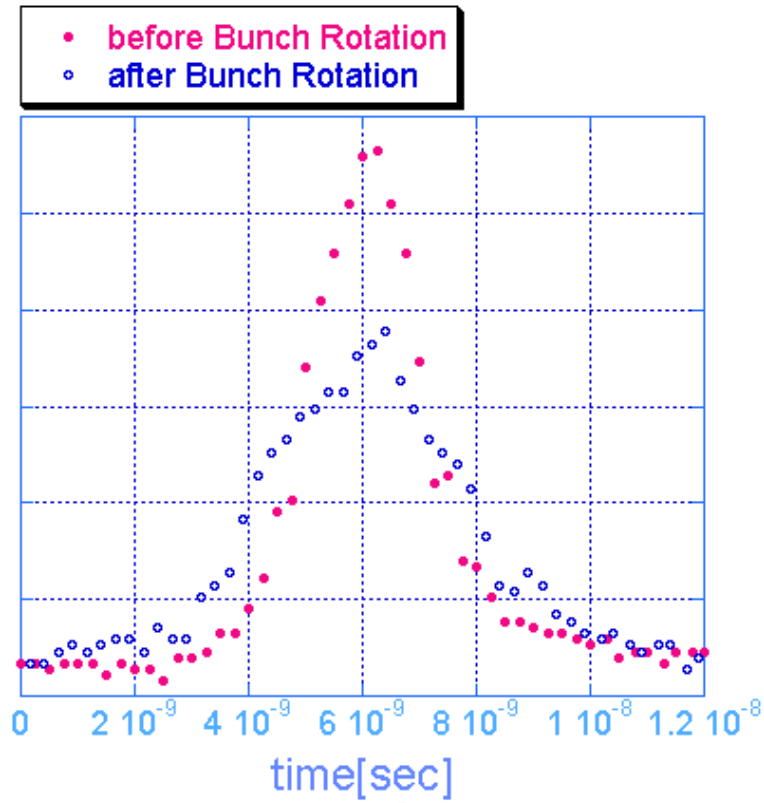
Bunch rotation at Booster extraction

- Vrf @ Booster ext. : 400kV ←→ Vrf @MI inj. : 90kV

Wall Current Monitor Signal

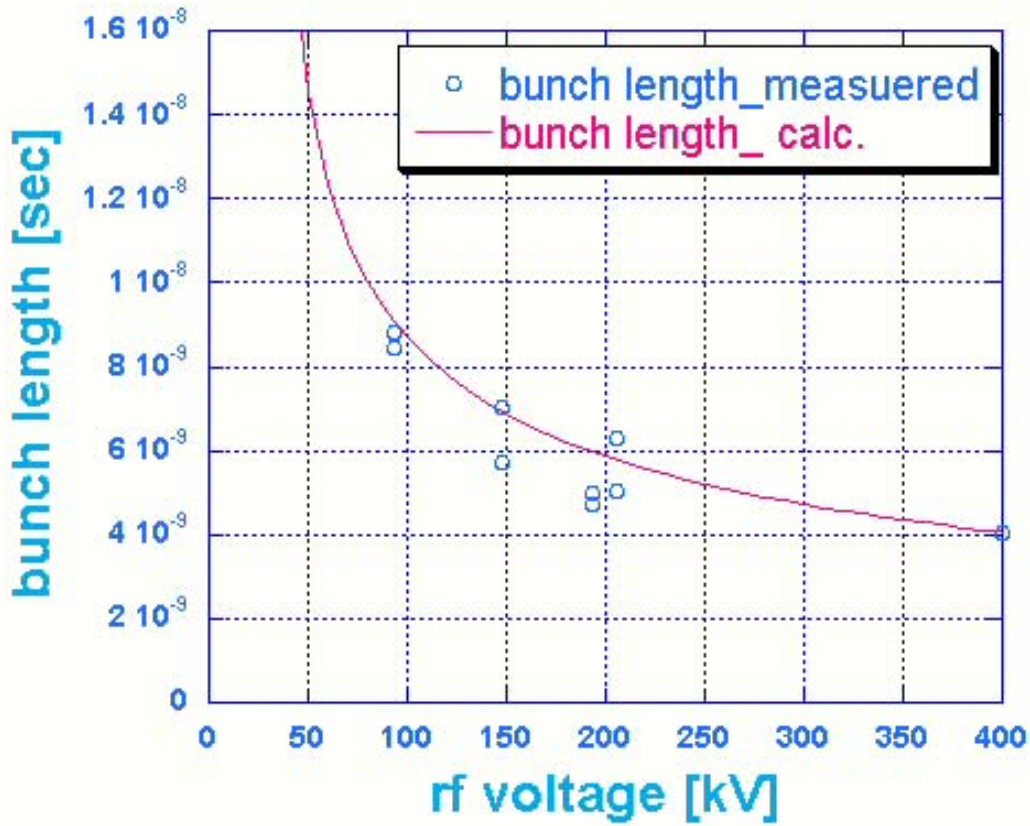


Bunch Rotation ON

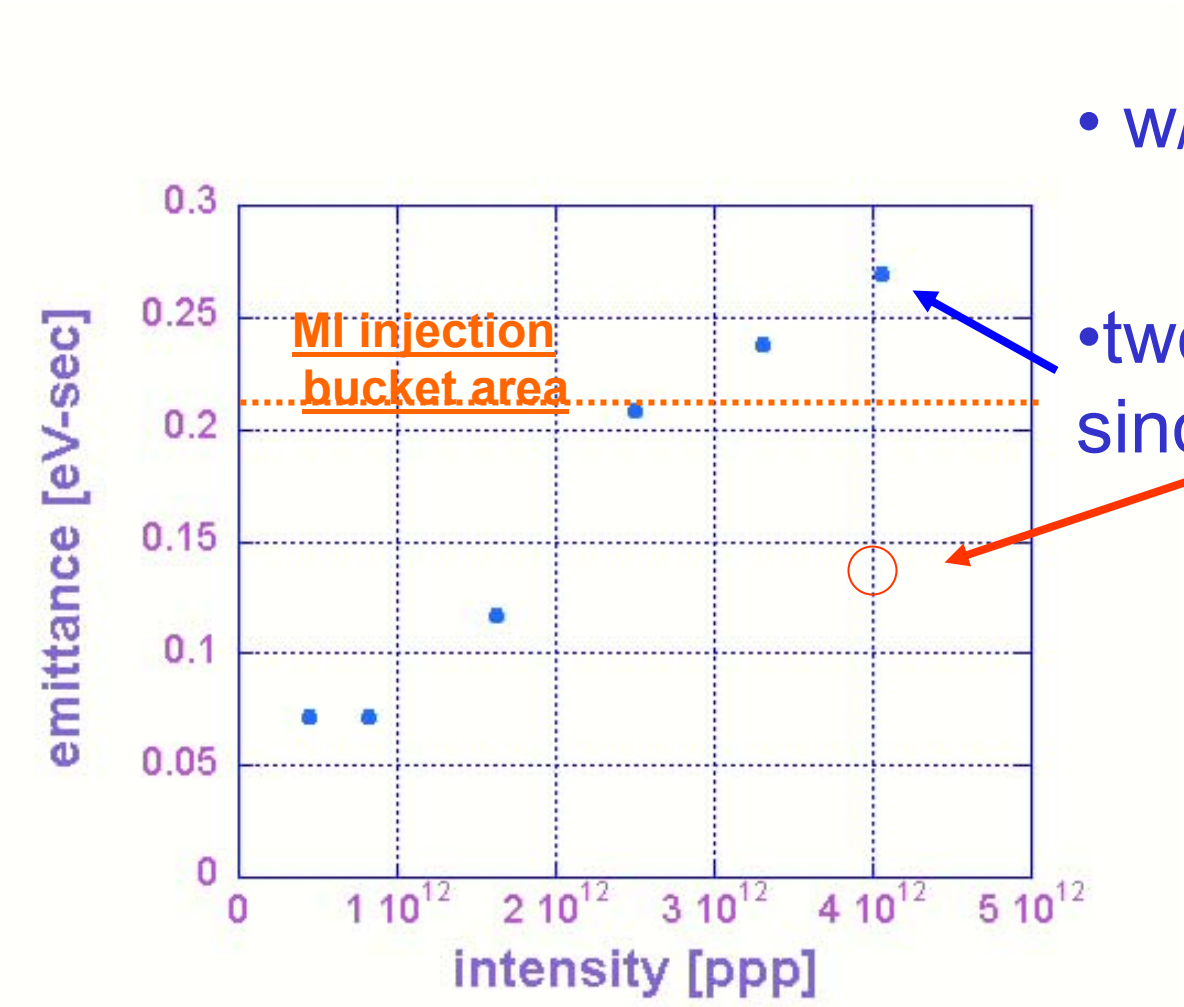


Δp/p: 0.0015 → 0.00082

Bunch rotation study with low intensity

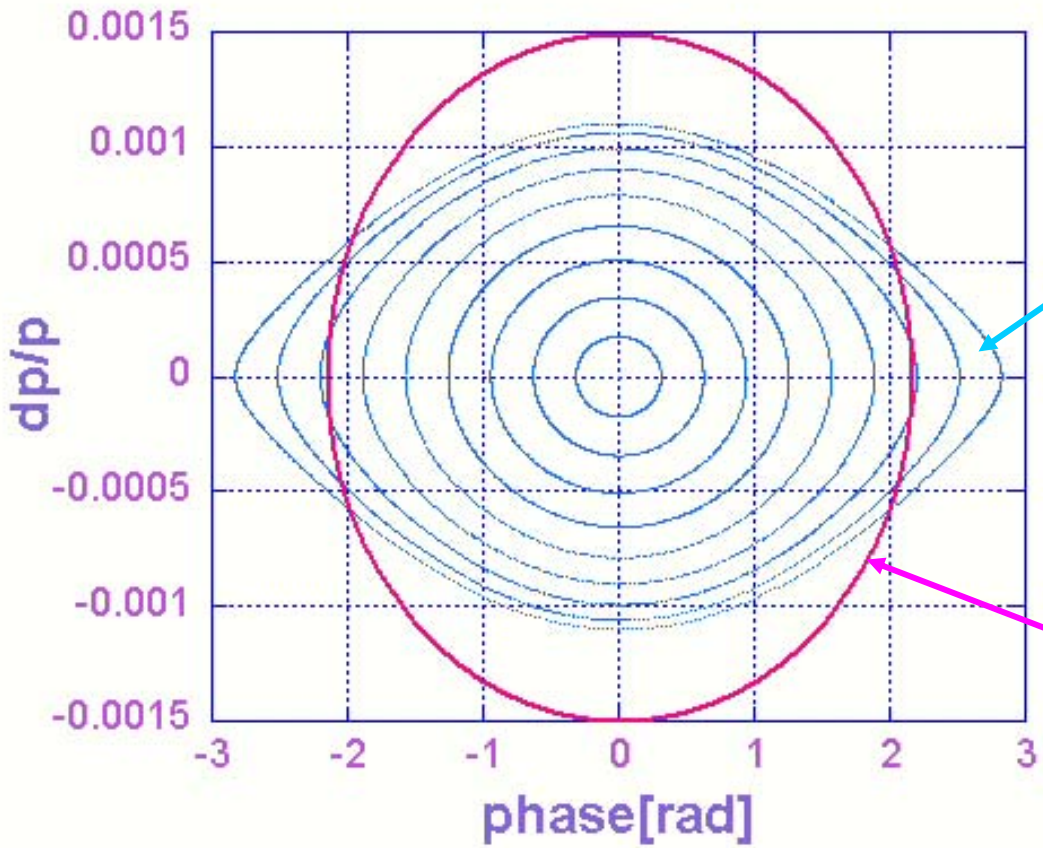


Beam emittance vs Intensity from Booster



- w/o bunch rotation
- two times bigger since shutdown

Beam emittance on MI rf bucket



MI rf bucket (90kV)

Beam emittance (Intensity @ 4E12)

Future plan

- To fix un-captured beam at injection
  - Emittance from Booster
  - Balancer circuit for bunch rotation

- Increase intensity to 8E12 on TARGET