Rad Hard Detectors for Accelerator Instrumentation

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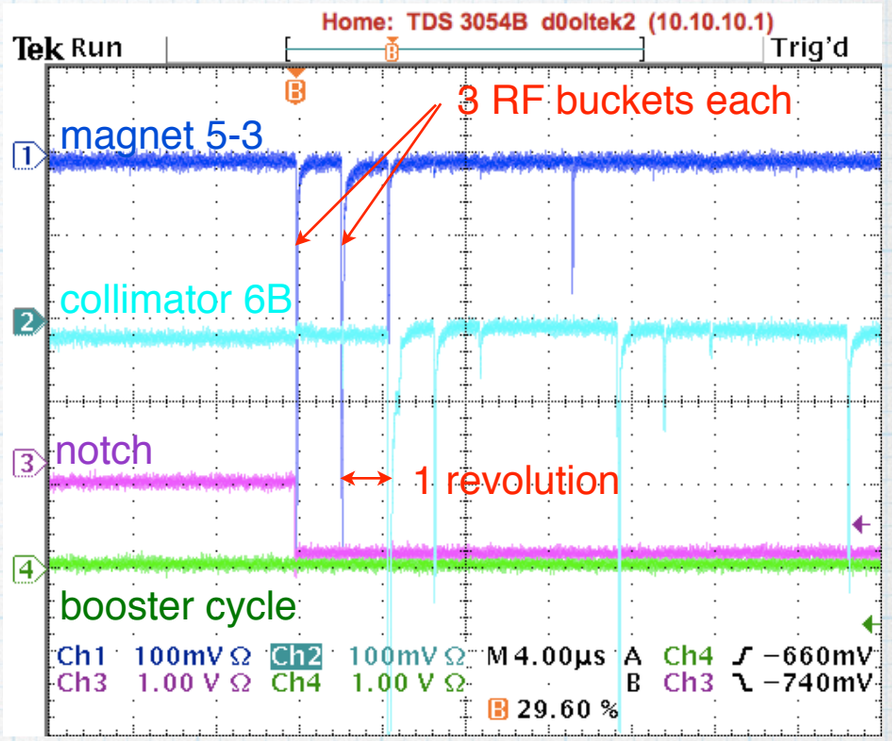
Booster Fast Loss Monitors (FLM)

Advanced design scintillation counters

- Single RF bucket resolution
- Desensitized to activation

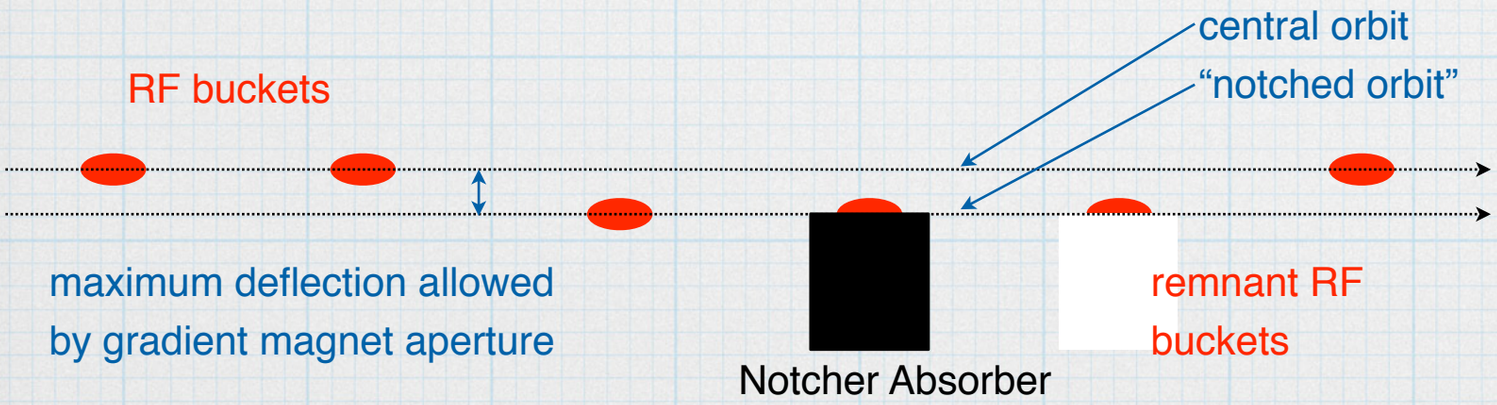
Uses:

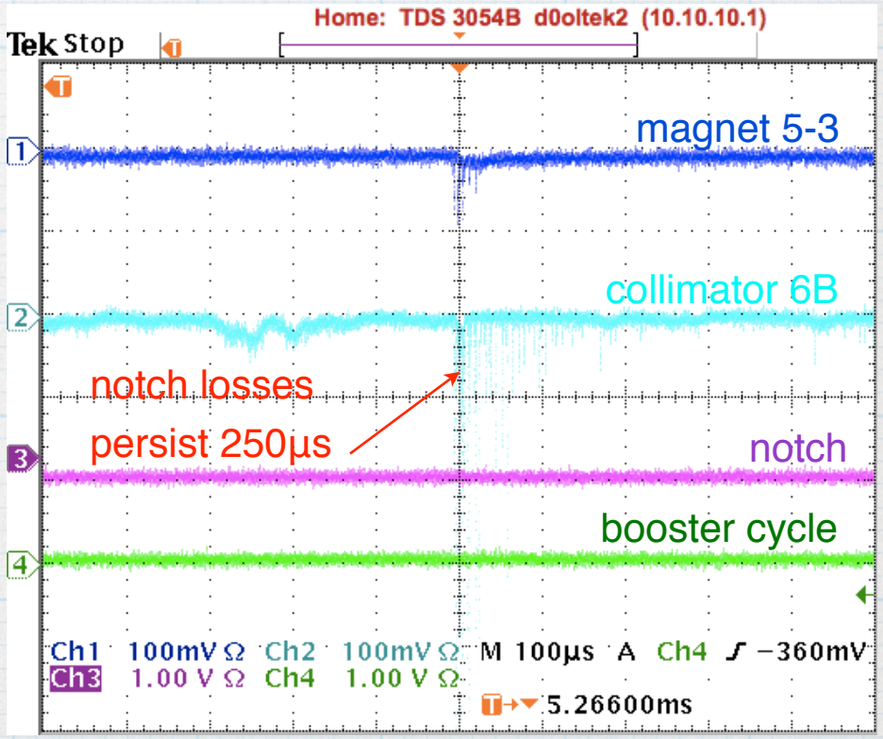
- Tune notch formation kicker parameters (oscilloscope)
- Monitor loss rates continuously for critical booster events: injection, notch formation, transition, extraction, etc. (ACNET)



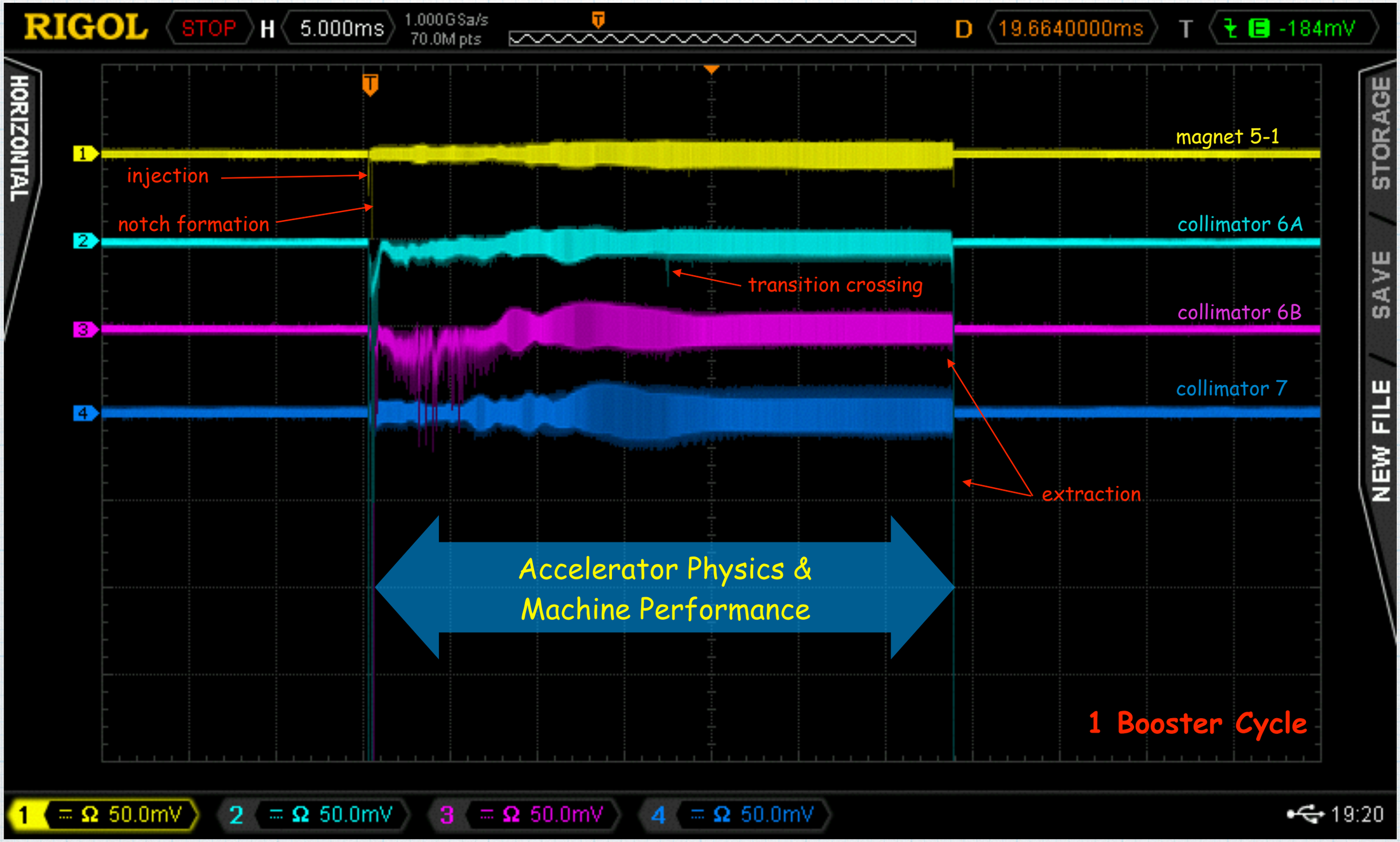
Example: Notch formation losses:

- Remnant RF buckets persist after notching





Booster Cycle Fast Losses 11/13/15



Detector R&D

Ideal detector:

- Fast (signal rise time 5ns or less)
- Local gain (non-electronic)
- Rad Hard ($\Phi > 10^{15}$ Particles/cm^2; 50 MRad)

PMT + plastic scintillator works well with caveats

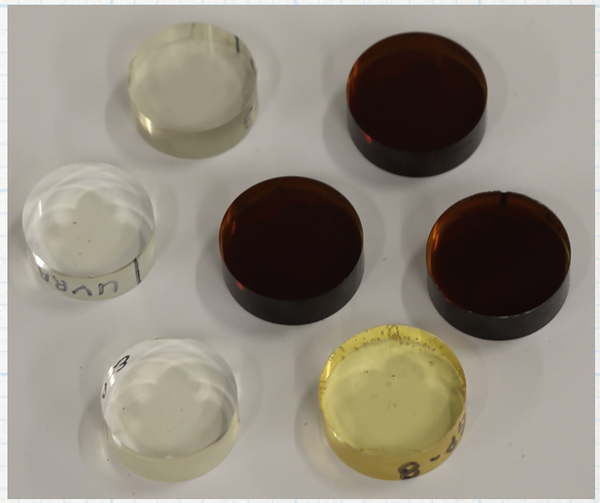
- borosilicate glass (rad soft)
- Most optical cements very rad soft (Below)

Pursue alternate detectors with above

- Micro-channel plate devices without optical windows show some promise (secondary emission)
- Red scintillators

Unirradiated

Irradiated



(3.6×10^{14} MIPS/cm^2)

Optical cements exhibit radiation damage earlier than other material in optical systems; weak link in optical systems.

- Samples are 9 mm thick
- Exposure to mixed radiation field
- Measure transmission spectra
- Quote wavelength for 50% transmission

Identified rad tolerant industrial epoxy

- Yellowing partially due to aging in the first 2-3 weeks after sample preparation.
- Cost ~ 10% of traditional optical cements
- Publication in preparation for submission to JINST