RHIC Abort System

a.k.a. Waste Management

C. Montag, A. Drees

The Team

L. Ahrens, P. Thieberger, K. Yip, H. Hahn, A. Zhang, J. Mi, J. Tuozzolo, M. Blaskiewicz, R. Hulsart, R. Michnoff, T. Shrey, S. Nayak,...

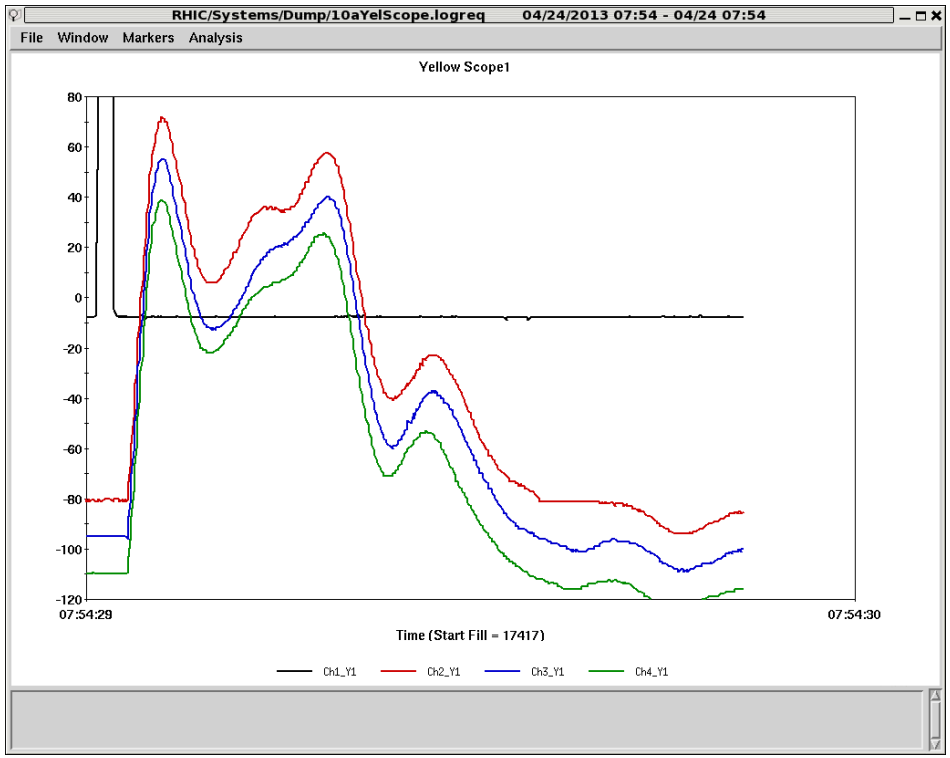
Problems and Challenges

- Many quenches with the increased proton intensity during Run-13, almost exclusively in Yellow

- Increasing Au intensity in conjunction with stochastic cooling exceeds the safety limit for thermal stress on the exit window - not covered here

The First "Mystery Quench"

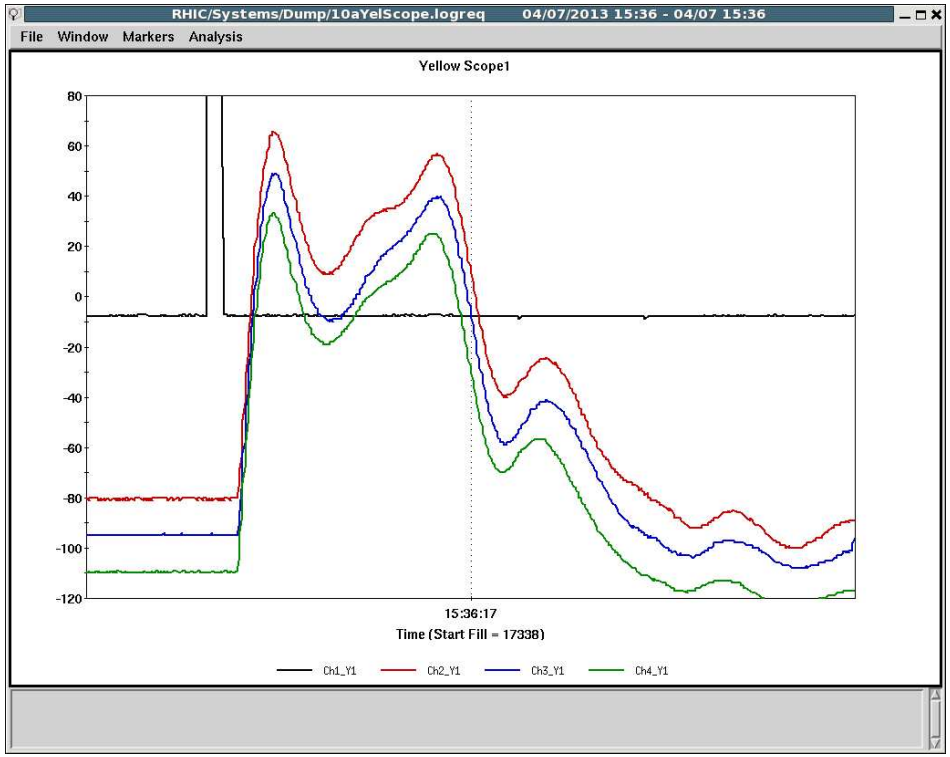
Measured abort kicker currents:



April 24: All kicker traces appear normal, no pre-fire

What's going on???

Three Weeks Earlier



April 3: All kicker traces appear normal, no quench, but kicker amplitude in the minimum is significantly higher

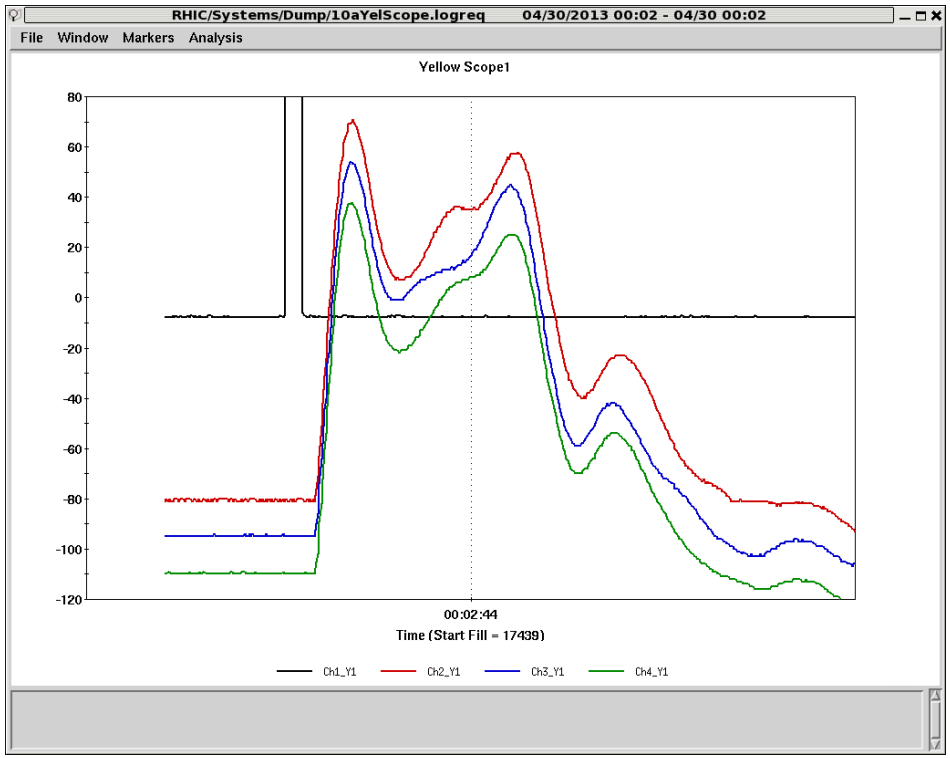
Some History

- Several abort-induced quenches when RHIC first ran at 250 GeV in 2009

- Simulations showed that protons that do not get buried deep enough in the dump get scattered back into the beam pipe and end up in downstream Q4, where they cause a quench

- This led to thickening of the abort beam pipe with sleeves

The Band-Aid

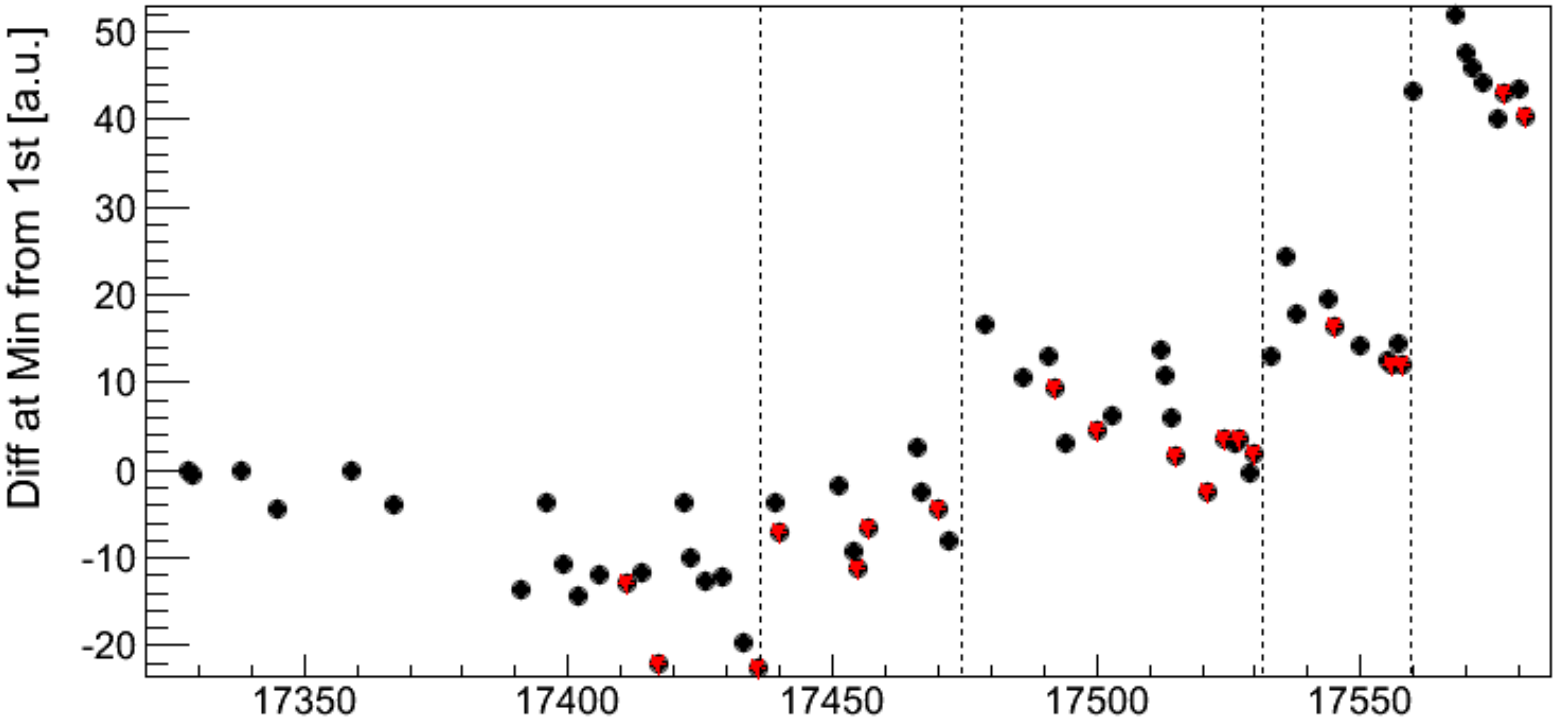


Re-tuned one module (blue trace) to raise the minimum

More modules were treated this way during the course of the run

Could eventually result in cracking the window

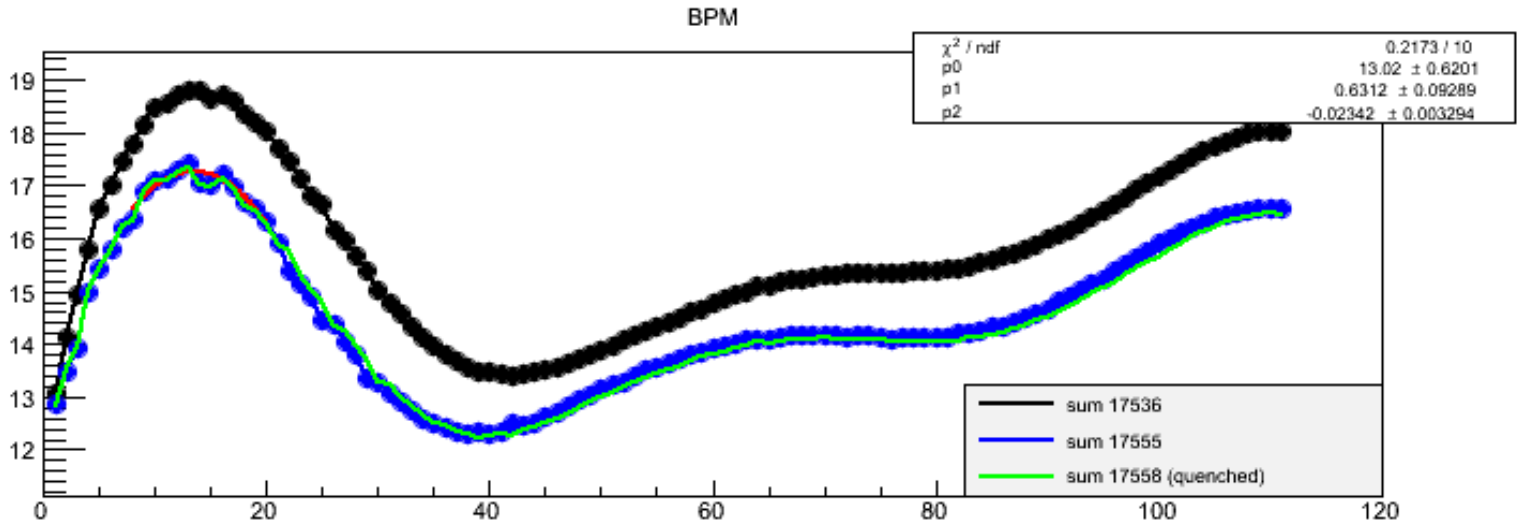
Minimum Kick vs. Time



After each re-tuning, the minimum slowly slides down

Quenches happen at higher and higher minima

Bunch-by-Bunch Dump BPM Signals

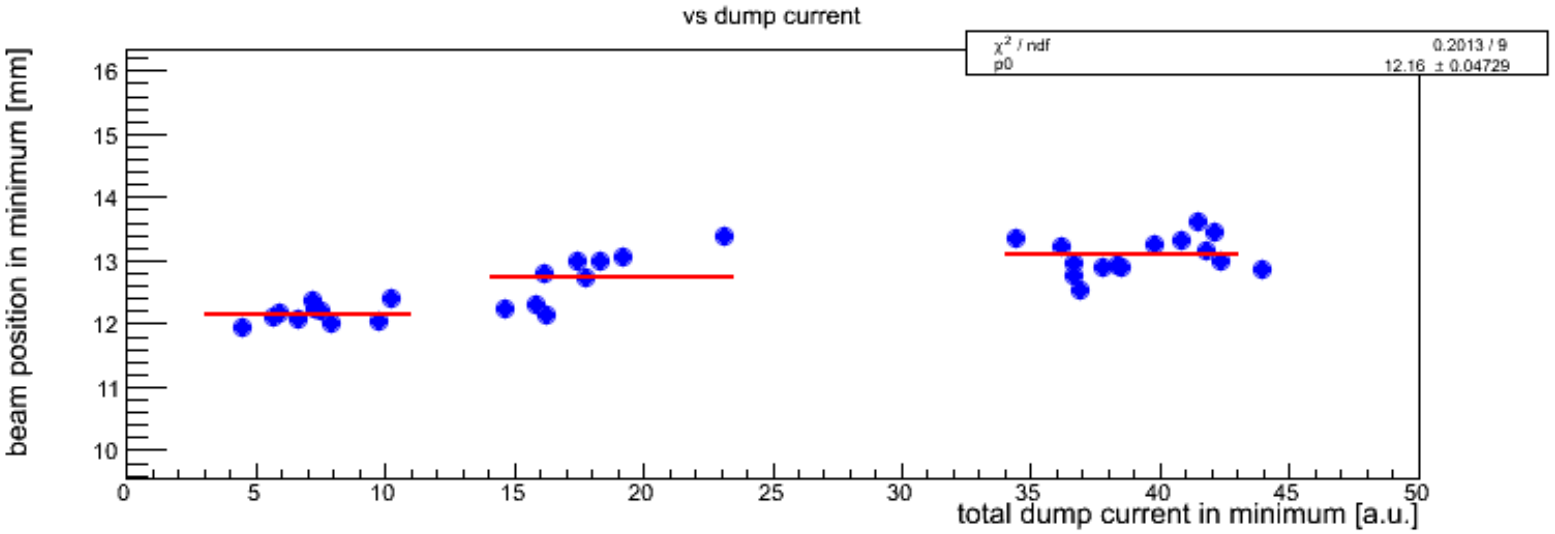


Black trace: Fill 17536

Blue trace: Fill 17555

In spite of tuning after Fill 17536, resulting in higher current in the minimum, the beam receives a smaller kick

Minimum Kick (Bunch Position) vs. Kicker Current

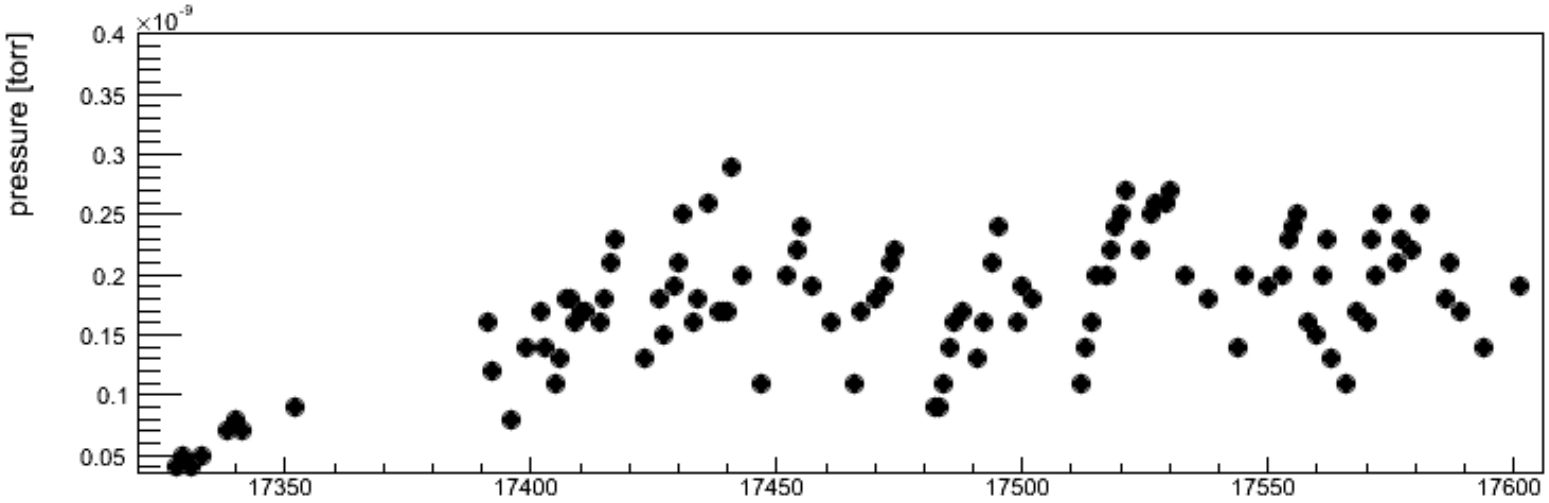


Modules were re-tuned two times - hence, three groups of data

The second tuning, which resuletd in twice as much current increase than the first, increased the minimum kick only marginally

$\Rightarrow$ Something is wrong with the kicker magnets

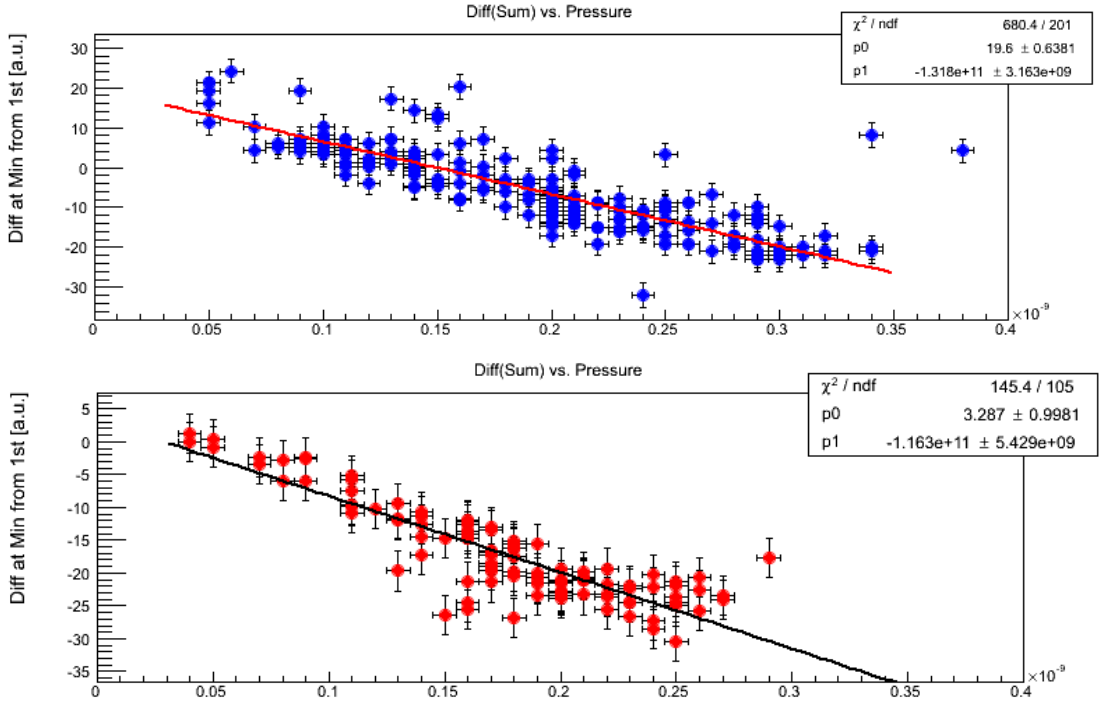
Vacuum Pressure in Kicker Area



Vacuum pressure in kicker area slowly creeps up during the run

$\Rightarrow$ Outgassing of the kicker magnets due to heating by the beam

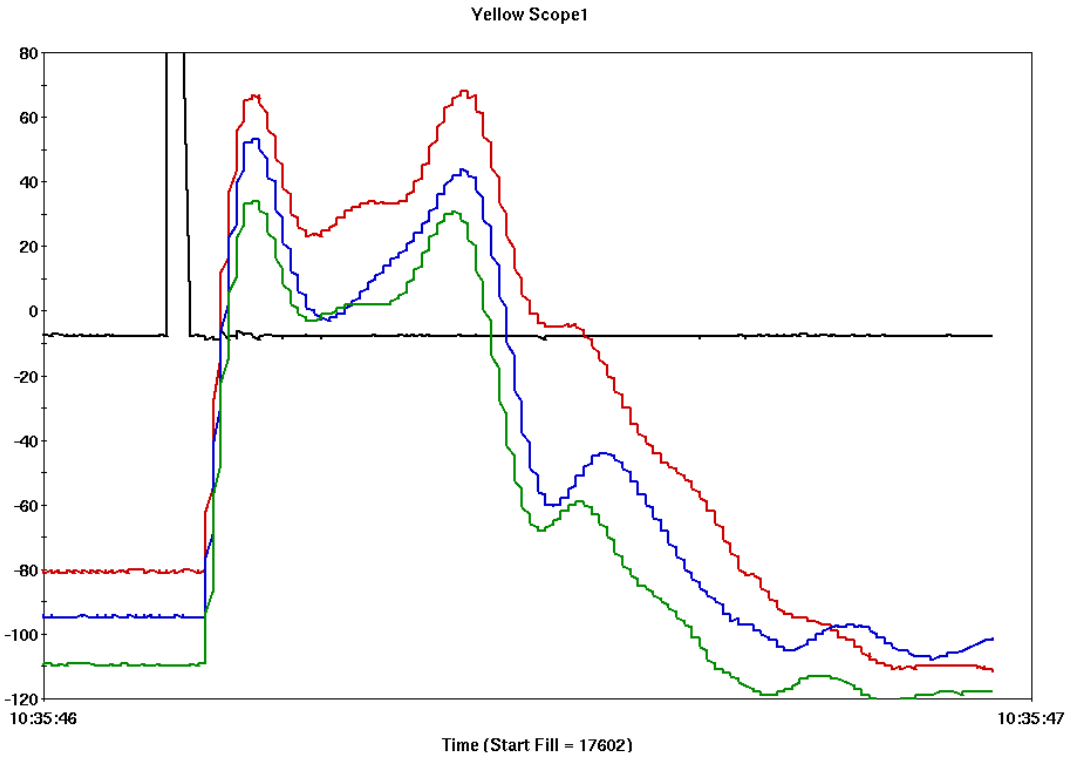
Kicker Currents vs. Vacuum Pressure



Outgassing indicates a temperature rise, which changes the kicker impedance and therefore the current waveform

Same behavior in both rings

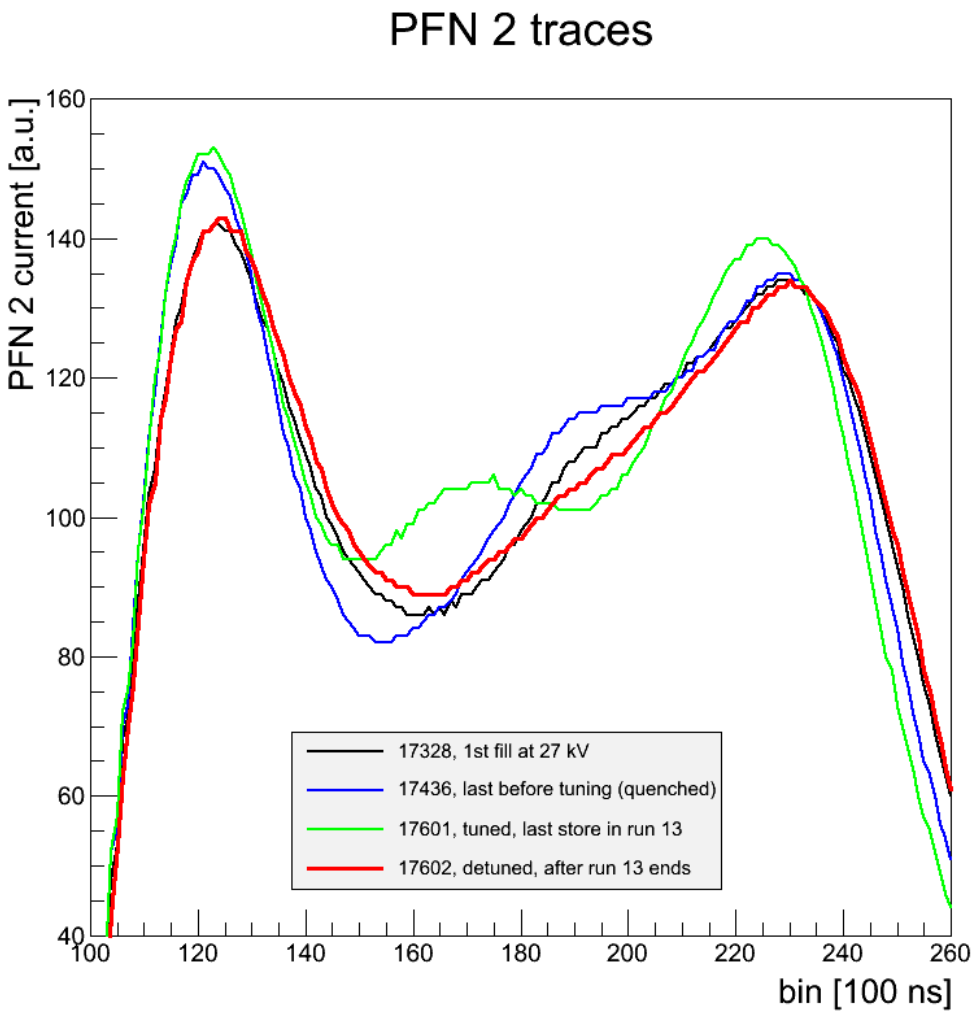
Kicker Waveforms Several Days After the End of the Run



After reverting the tuning modifications, kicker waveform (blue trace) has recovered

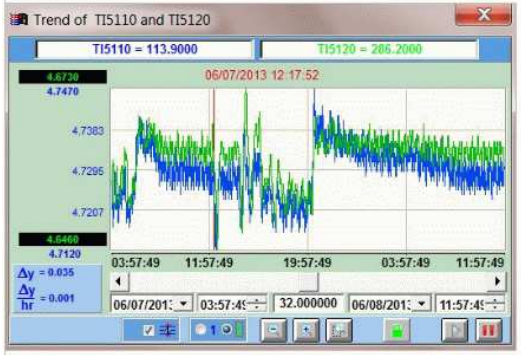
$\Rightarrow$ Kicker magnets have cooled down

Evolution of Yellow Module 2 During the Run

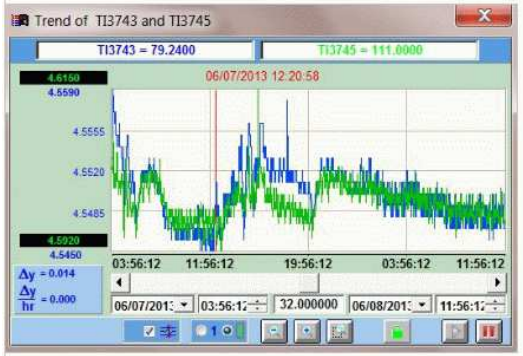


Why only Yellow?

Q4 magnet in yellow sector nine (9Q4) temperature profiles at inlet and outlet



Q4 magnet in blue sector ten (10Q4) temperature profiles at inlet and outlet



Blue sector 10 runs about 200 mK cooler than Yellow sector 9

However, these measurements are not calibrated

What Can We Do?

- Install thermocouples in one kicker module to monitor temperature during next run

- Re-build the beam dump (replace carbon with steel in strategic locations) to be less sensitive to kicker amplitude. Simulations are underway

- Modify kickers to reduce beam-induced heating - under study

Summary and Outlook

- Beam induced heating of the kickers affects their impedance, resulting in a reduced kick

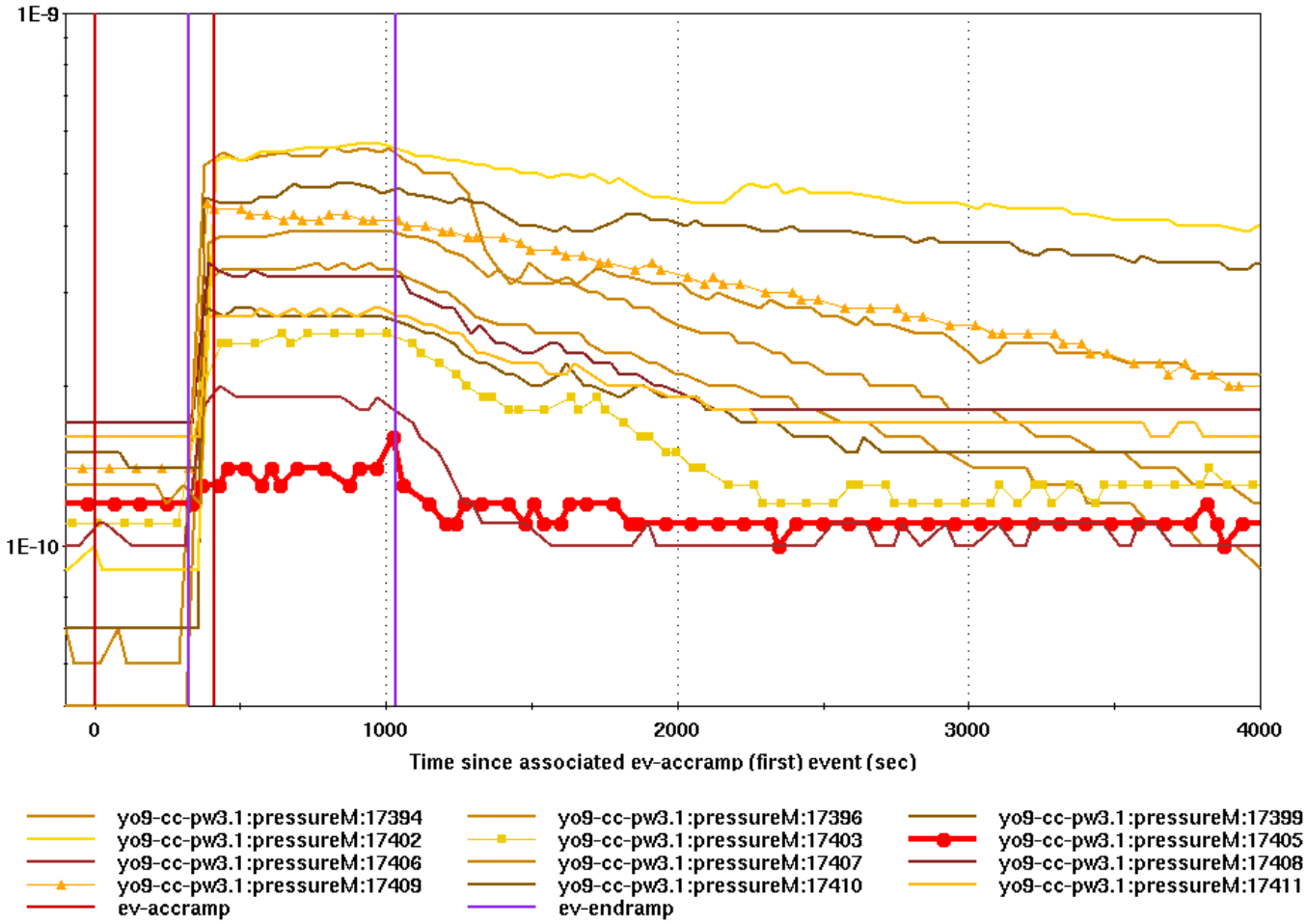
- Kickers have to be modified for the next proton run (Run-15)

- Beam dump will be modified during shutdown 2014 to be less sensitive to kick strength by replacing carbon with steel to prevent dumped particles from being scattered back into the beam pipe

- Stainless steel exit window will be replaced with titanium in 2014 to allow higher Au intensities.

Spare Slides

Vacuum Pressure in Dump Area During Stores



quenched fills	retuned after fill
17411	
17417	
17436	
	17436
17440	
17455	
17457	
17470	
	17474
17492	
17500	
17515	
17521	
17524	
17527	
17530	
	17531
17545	
17556	
17558	
	17559 (2 modules)
17577	
17581	
17587	