



Fermi National Accelerator Laboratory

ACCELERATOR DIVISION

# Booster Beam Notching Overview for 2012

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# Current Notching in 2011

- A 3 bucket gap is created using two kickers located at Long 5 and Long 12
  - Notcher – A High Voltage(55kV) Kicker at Long 5
  - Noker - Lower Voltage Kicker (20-40 kV) at Long 12
    - Used to clean out remnant Notched Beam in buckets
- At 700 MeV
- Beam is kicked vertically into collimator region at Long 6 and Long 13 with upstream gradient magnets seeing some deposited notched beam loss.
- The notch timing and synchronization is accomplished by modules in the Booster LLRF Room and local timing modules.
- Beam notch for non-cogged cycles occurs at 400 Mev
- Cogged notch occurs close to 700 MeV

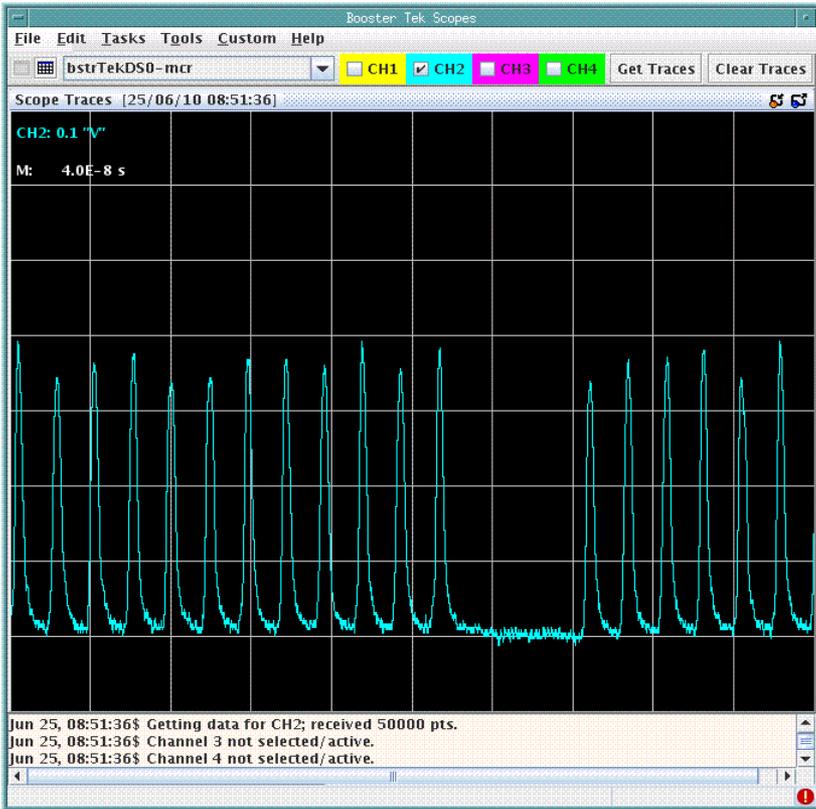
# Notching in 2012

## Phase 1

- A 3 bucket gap is created using three Long kickers located at Long 12
  - 3 Notcher – High Voltage(46kV) Kicker at Long 12
  - Notcher converted to Notch1
  - Noker converted to Notch2
  - Build/Commission new Notch3 mostly with parts on hand.
- Beam is kicked ~~vertically~~ Horizontally into new absorber at Long 13
- The notch timing and synchronization is accomplished by modules in Booster LLRF Room. (Same as before)
- Beam notch for non-cogged cycles occurs at 400 Mev. (Same as before)
- Cogged notch occurs close to 700 MeV. (Same as before)

# The Notch

3 Bucket Notch Width



non-cogged Cycle  
Notch @ 400MeV

Cogged Cycle  
Notch @ ~700MeV

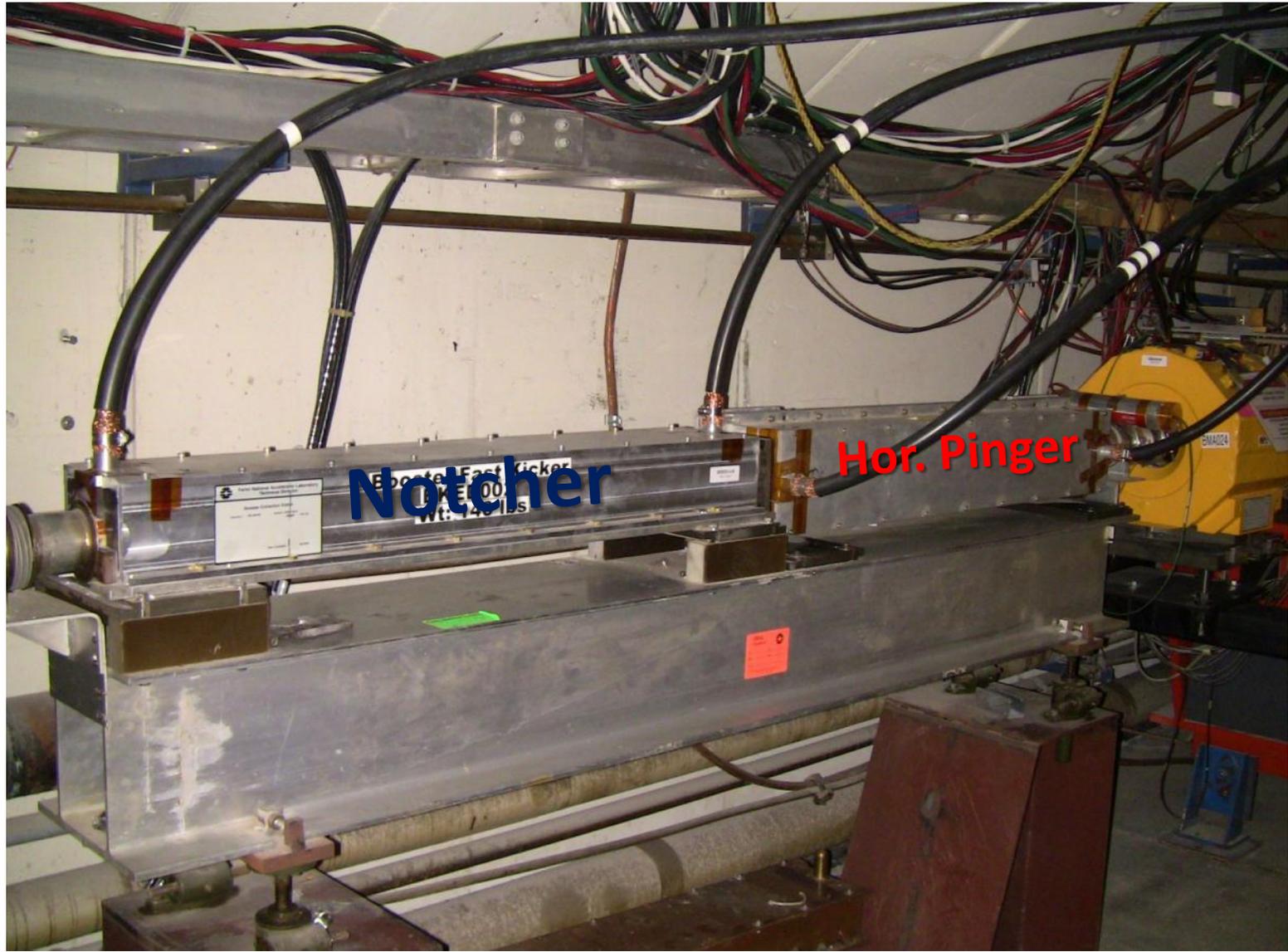


Extraction Loss

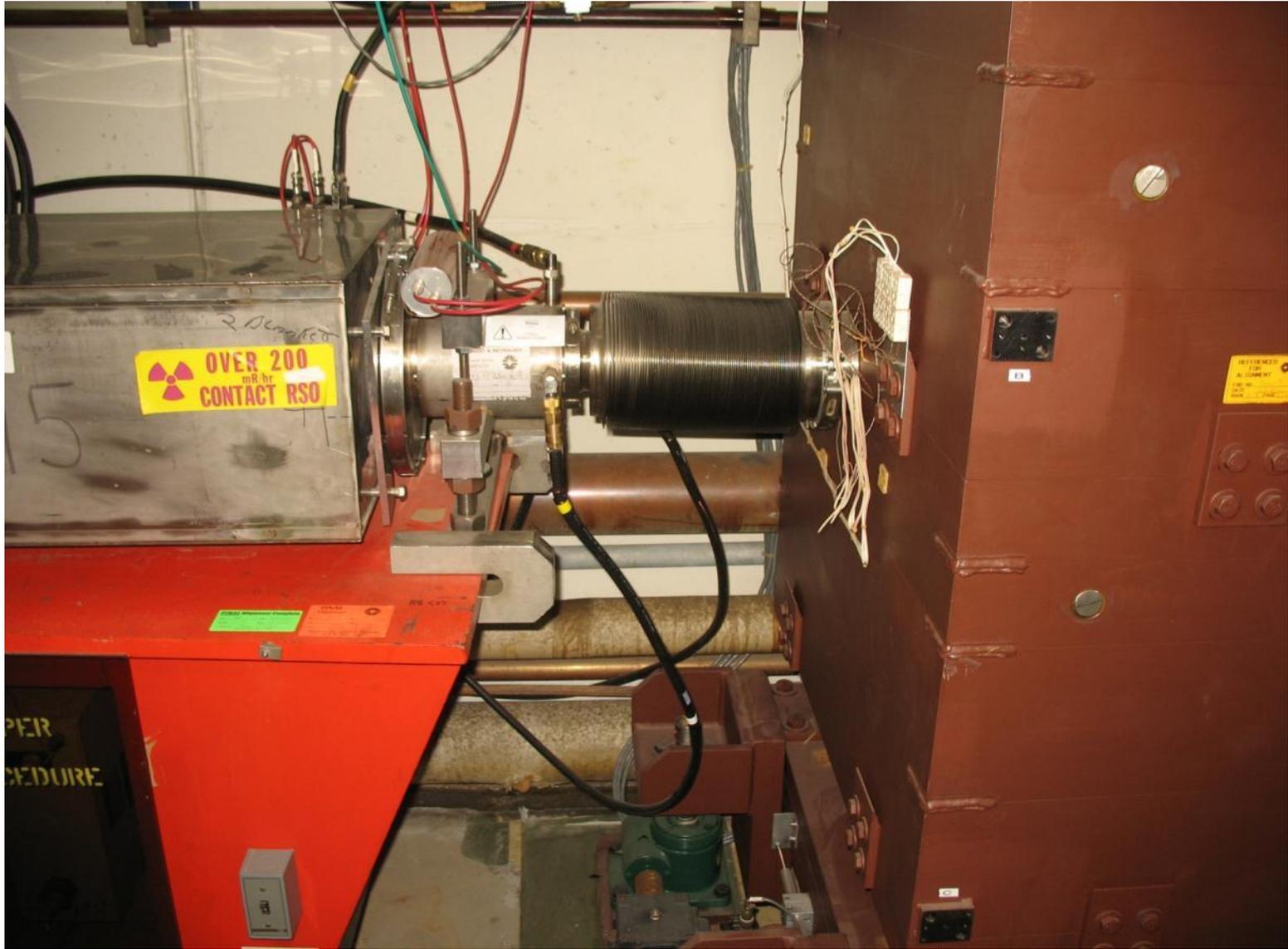
# L5 Notcher Current Location

Notcher magnet will be moved to L12

Vertical Pinger magnet will be removed from L12 and put here in its place

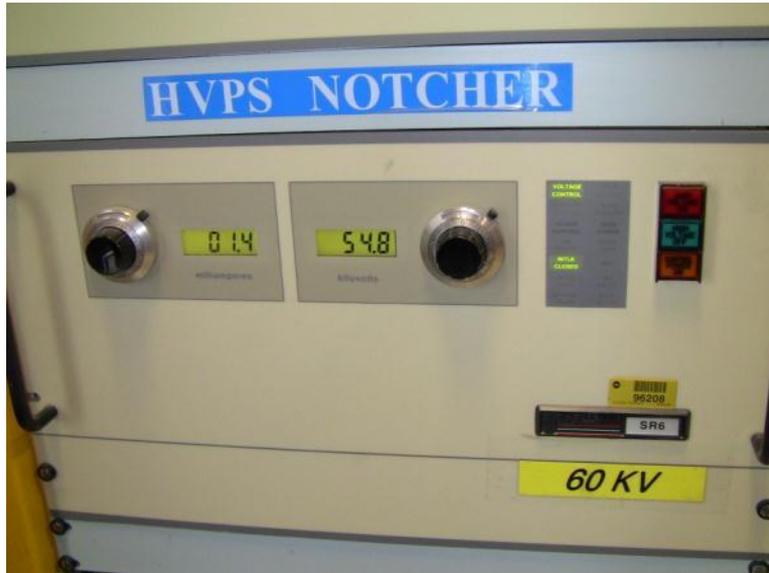


# L6a Absorber/Collimator



# L5 Notcher

Power supply components such as these  
Will need to be moved to support Long 12 region

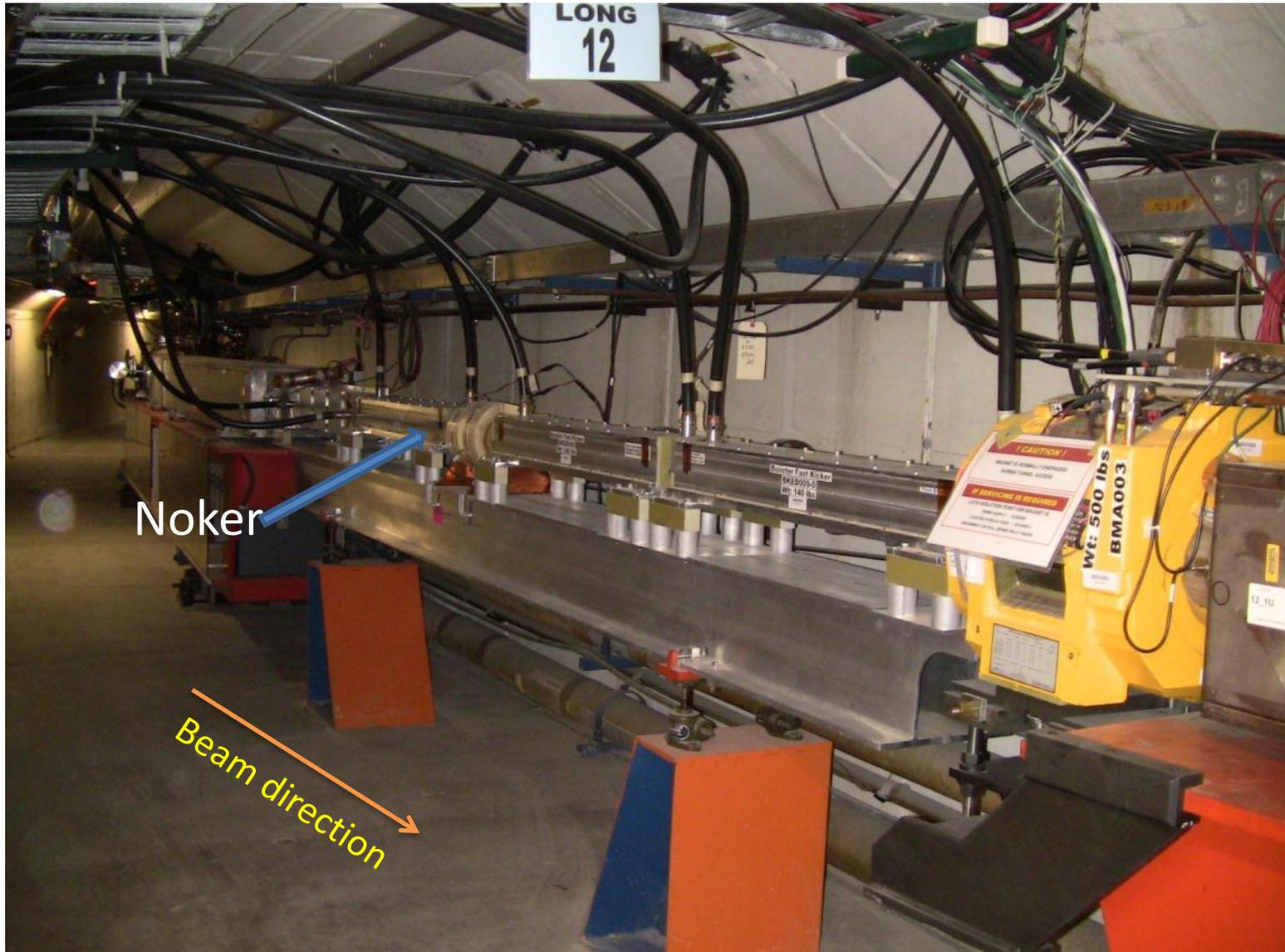


CX1168 tube  
Low Level  
equipment



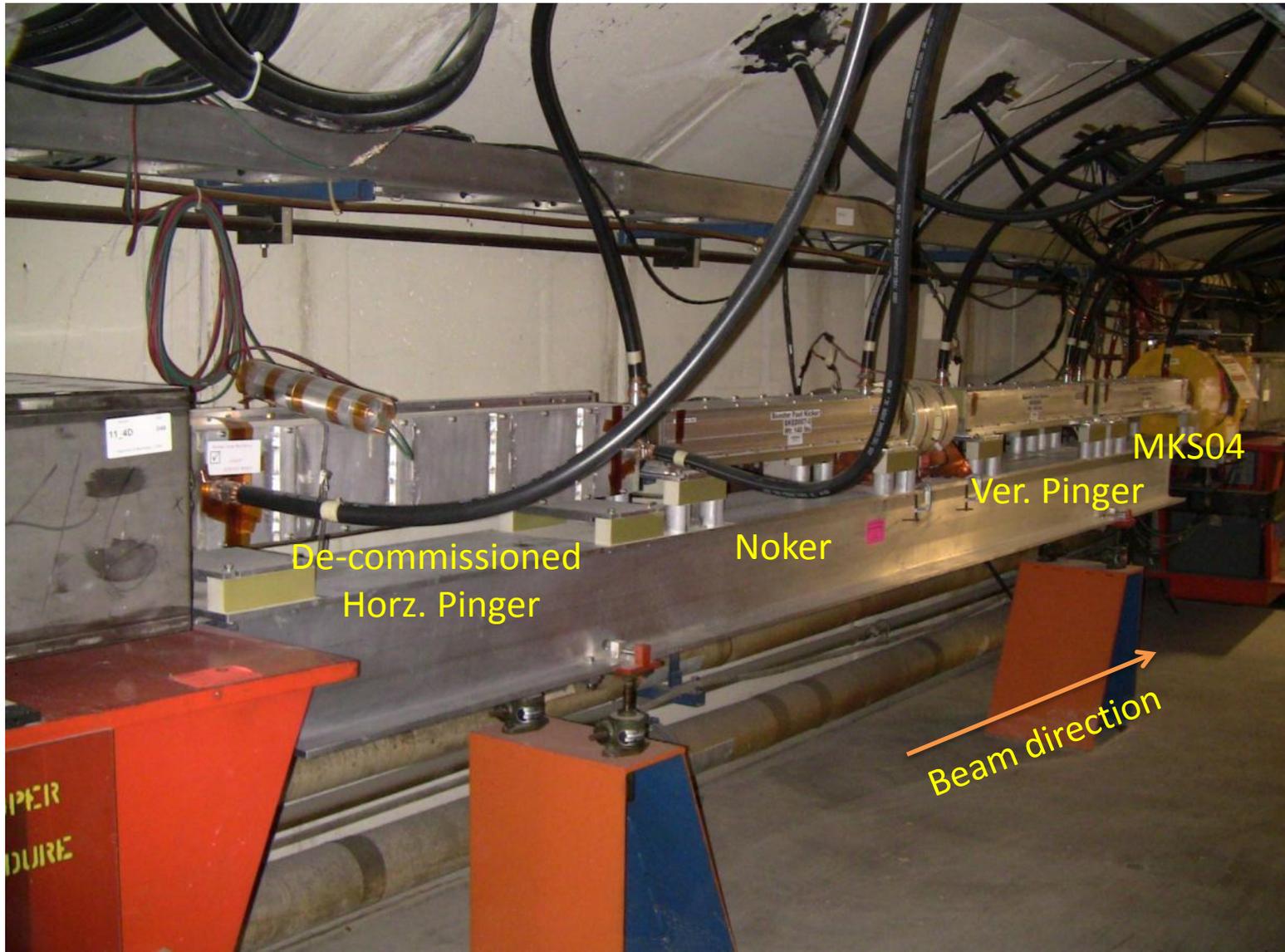
# L12

## Noker Current Location



# L12

## Noker Current Location

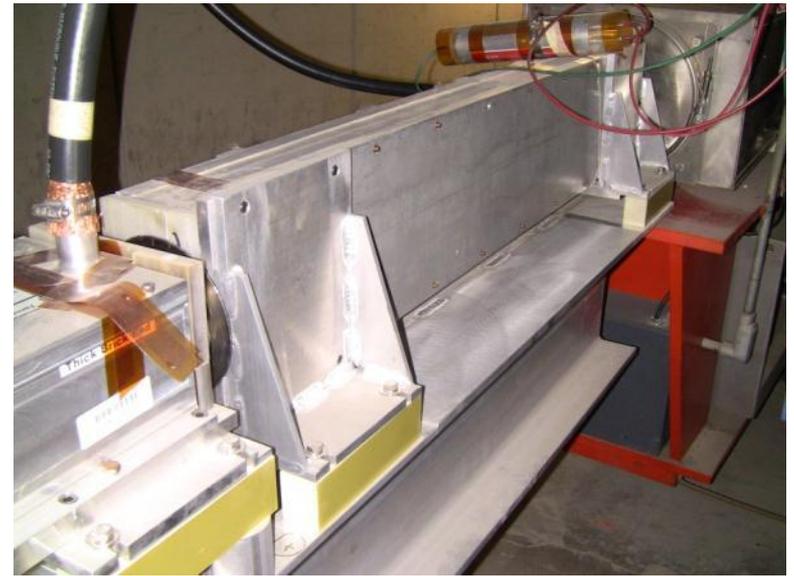


# L12

## Noker Current Location

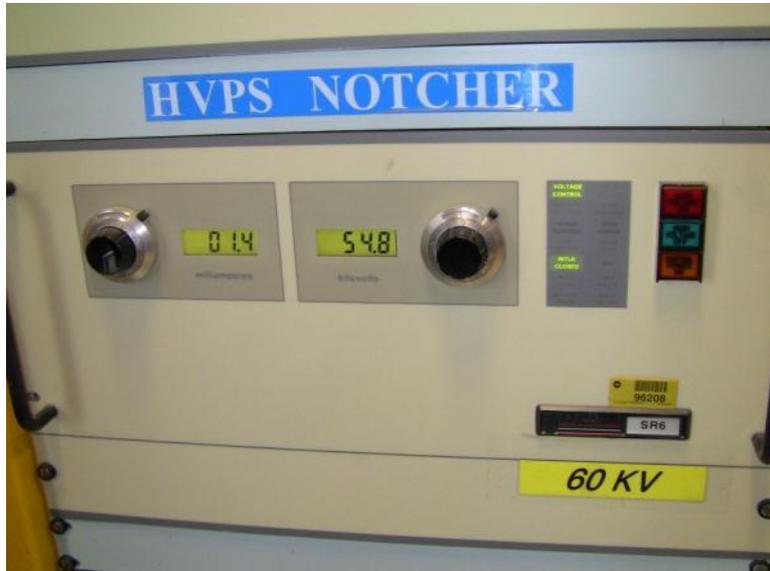


# Kicker magnets rotated to kick Horizontally



# L12 Noker & Extraction Kicker MKS04

Power supply components such as these will need to be installed/relocated to support notch2 & notch3 in east Booster Gallery



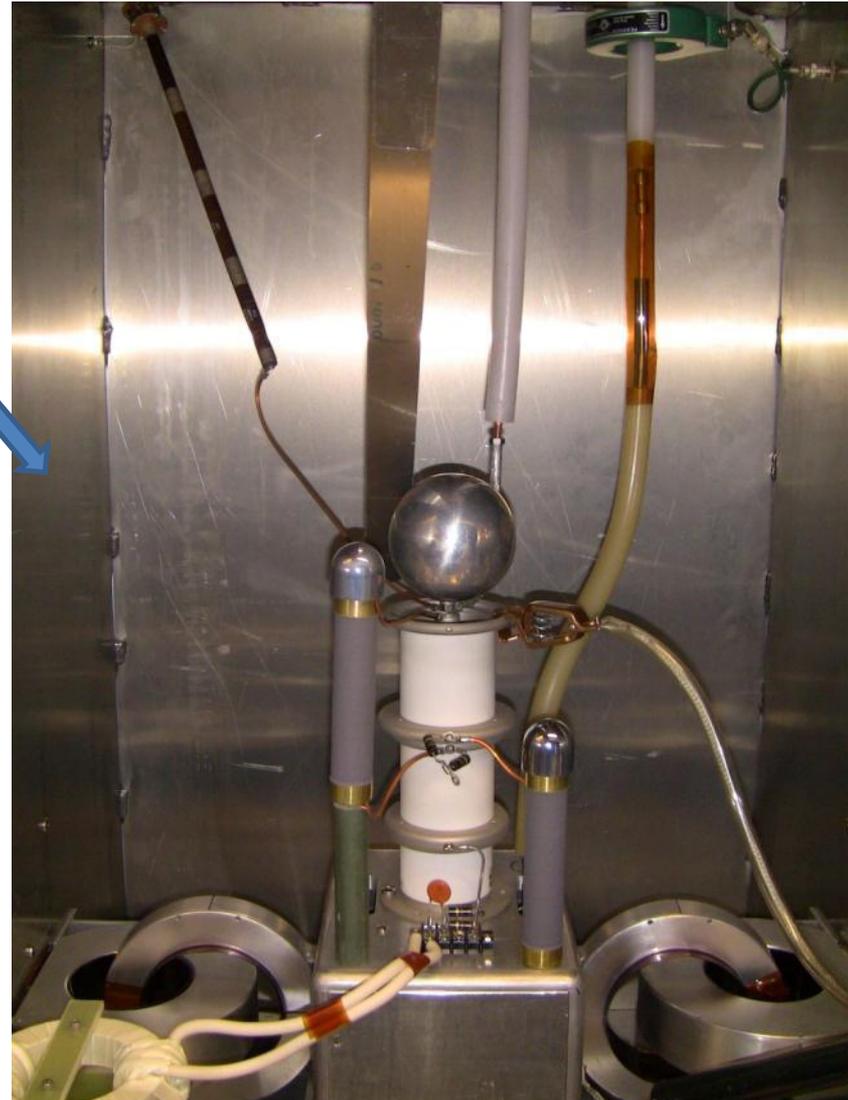
Beam sync  
Modules  
and other NIM crate  
Support modules.



# Make Room For 2 more systems In East Gallery



# Build another Thyatron Cabinet For Notch3



# Long 13

Current Naked beam absorber



# Long 13

Current Naked beam absorber



# Long 13

Very Crude example of possible new absorber



# Notching in later 2012-Beyond

## Phase 2

- Convert 3 Long kicker magnet notchers to short doublets magnets
- 6 short style kicker magnets would be driven by faster thyratrons to allow quicker fill times creating a cleaner notch
- 2 short magnets will mount in the foot print of one long magnet(current) kicker.

# New short kicker prototype faster rise/fill time



# Short Kicker/Long kicker (25 ohm setup) on CX1168 Thyatron tube test-setup.

MKS04 (Long Kicker)    ShortKick (Short Kicker)

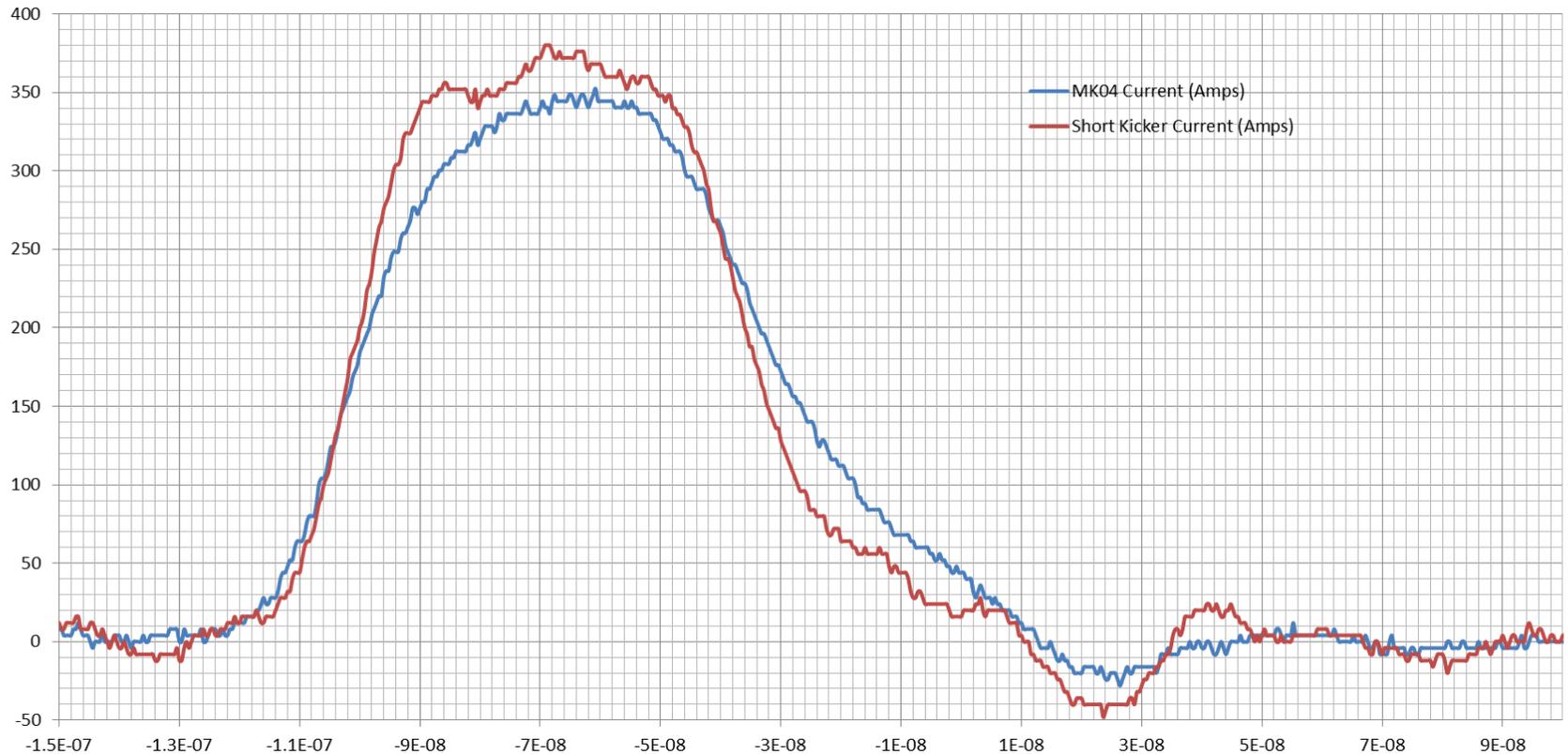
Rise = 30nS

Rise = 21nS

Fall = 50nS

Fall = 33nS

Typical Booster kicker rise time 40 ns



# Conclusion

- Phase 1 of new notching scheme should reduce extraction losses with a cleaner notch still using long kicker modules.
- Losses will be better directed to a more optimized absorber close to the notching kickers.
- Phase 2 will implement faster rise kicker modules to further reduce losses.
- With higher beam throughput in 2012 and beyond this new notch system configuration should help reduce losses and minimize activation of critical areas in the Booster enclosure.

More L13 tunnel Pictures







LONG  
13

CAUTION  
BMA013  
WE: 500 lbs

50-100  
1 HOUR MAX.