Experimenter Contributions to Booster Improvements

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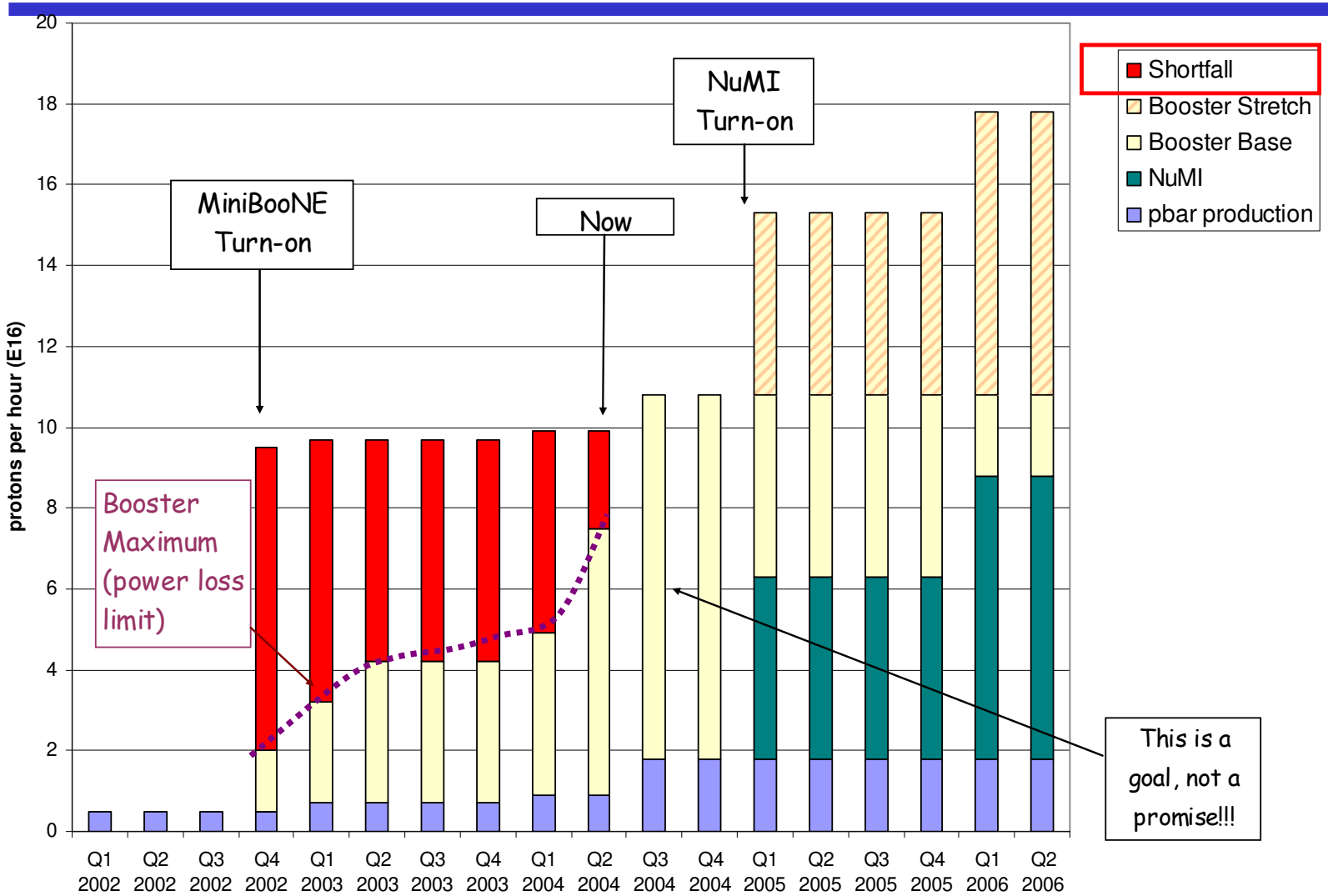
General

- The Booster has exceeded the Run II handbook specification for protons to the pBar target
  - Slip-stacking the only thing left for Run II
  - Challenges come from neutrino program
- The present MiniBooNE and near future NuMI experiments depend critically on the performance of the Booster.
- When these experiments were initially approved, there was *no evidence whatsoever* that the Booster could meet the need.
- Luckily, the experiments came to understand this, and have provided and continue to provide valuable help:
  - People (studies, calculations, general help)
  - Fabrication (hardware, machine shop time)
  - Money (well, yeah)
  - "Advocacy" (very important)

Challenges in the Booster

- Repetition Rate
  - Injection system
  - Extraction septum
  - RF system
- Peak Intensity (batch size):
  - RF
  - Tuning
  - Transition
  - damping
- Beam loss
  - Tuning
  - Lattice Improvements
  - Beam control
  - Collimation
- Above-ground radiation
  - Calculation
  - Shielding
  - Work area re-classification
- Multi-batch issues
  - Beam cogging
- Reliability and Basic Understanding
  - Monitoring
  - Analysis

Proton Demand



Early Contributions from MiniBooNE

- Shielding and Loss Calculations:
  - Eric Zimmerman (Colorado U)
  - Randy Johnson (U. Cincinnati)
  - Goeff Mills (LANL)
- Dipole Corrector Studies:
  - Jocelyn Monroe (Columbia)
  - Morgan Wascoe (LSU)
  - Linda Coney (Columbia)
- General Booster Studies
  - Adam Malik (LSU)
  - Linday Coney (Columbia)
  - Jocelyn Monroe (Columbia)
- Total loss monitors
  - Yan Liu (U. Michigan)

RF Prototype Cavities – it takes a village

- Originally planned to build one large-aperture RF cavity based on a proton driver R&D proposal
- With the help of university machine shops, we were able to build *two* at a much lower price that one would have cost:
  - Princeton (MiniBooNE)
  - CalTech (NuMI)
  - Columbia (MiniBooNE)
  - Tufts (NuMI)
  - Indiana (MiniBooNE)
  - U. Texas, Austin (NuMI)
- University Coordination:
  - Doug Michael (CalTech)
  - Chris Smith (CalTech)
  - Bill Sands (Princeton)
- Construction an unmitigated success
  - All parts delivered on time
  - NO mistakes.
- One cavity will go in this fall and another in 2005 (as 19th and 20th cavities)

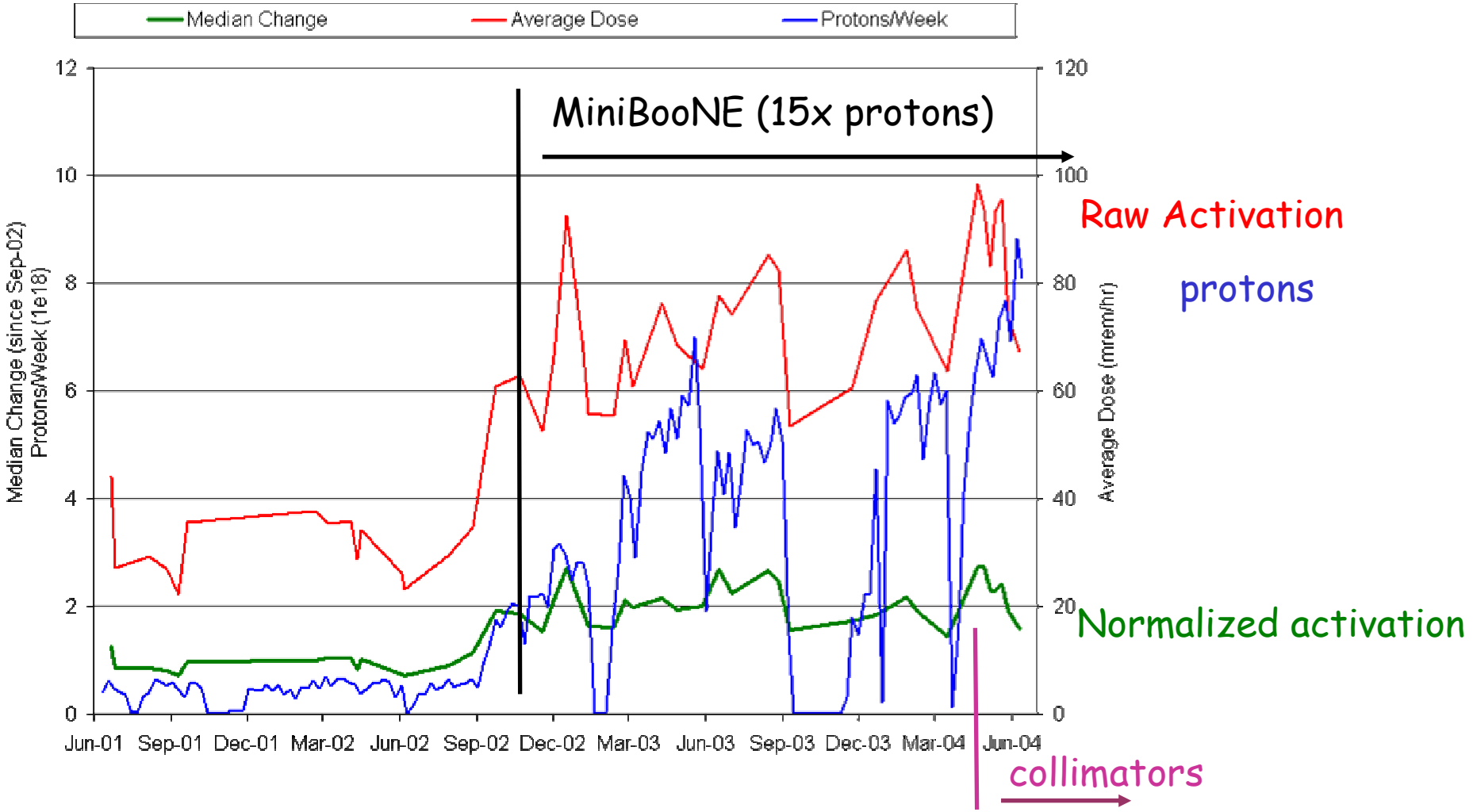
Fall 2003 Shutdown Work

- Collimator System
  - Initial collimator design abandoned as unworkable in late 2002
  - Aggressive new design in 2003
    - Larry Bartoszek, chief mechanical engineer (MiniBooNE)
  - Installation originally cancelled for 2003 shutdown
    - Columbia rescued it with a $300K loan.
- Dogleg modifications
  - Indiana provided a $100K loan to complete some of the miscellaneous installation and magnet work.

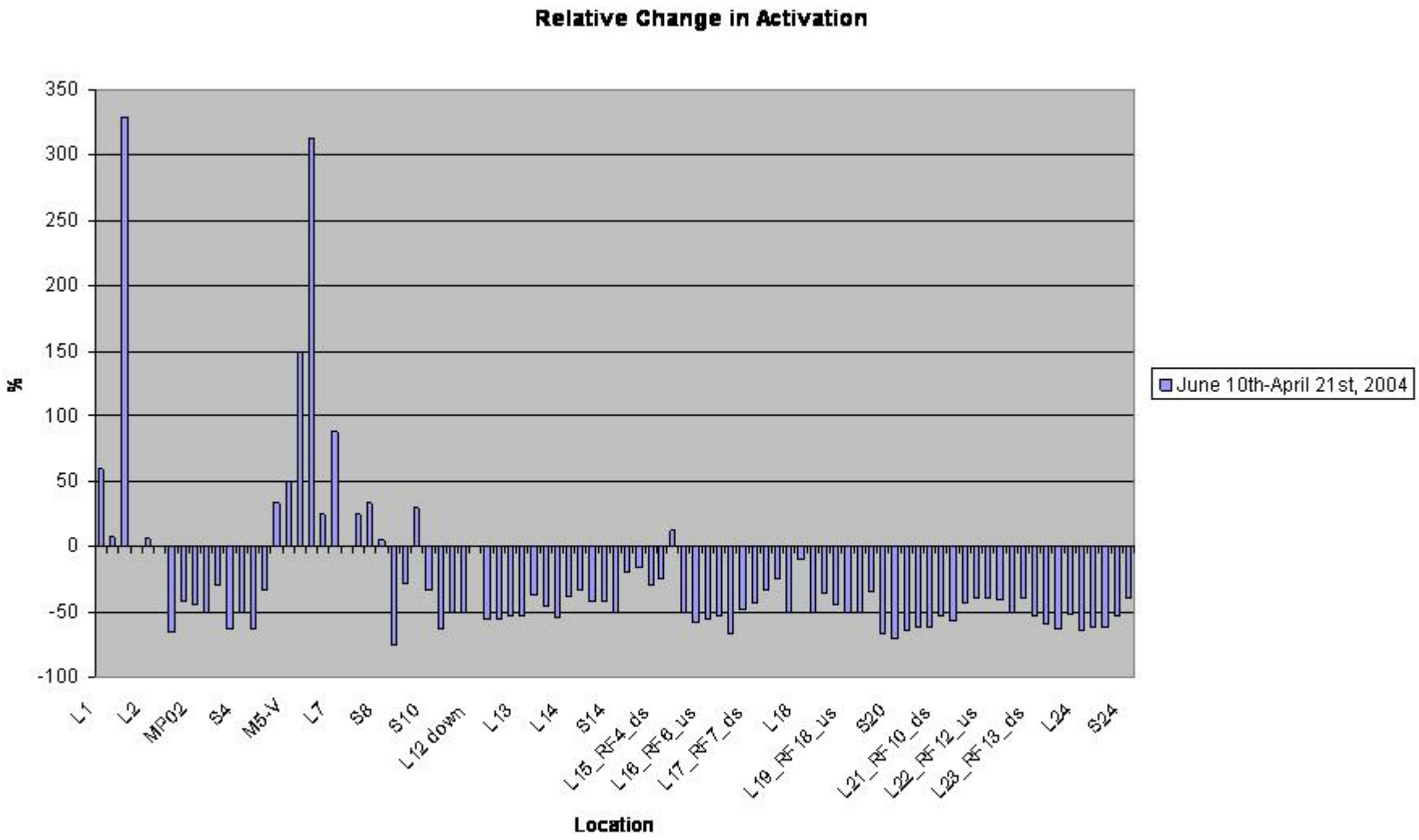
Current Projects

- Booster Cogging
  - Needed for both NuMI and pBar multi-batch operation
  - B. Zwaska (NuMI, U. Texas, Austin/FNAL Accel. PhD)
- Booster Ramp Monitoring
  - Monitor and alarm ramped devices
  - Ami Choi (MiniBooNE, Columbia)
- Booster Rad Robot
  - Use a robot to monitor both real time loss and activation in the Booster
  - $35K NSF grant through Columbia
  - Dave Schmidt (Columbia) working on software

Successes


Median Change
Average Dose
Protons/Week
MiniBooNE (15x protons)
Median Change (since Sep-02)
Protons/Week (1e18)
Average Dose (mrem/hr)
0
2
4
6
8
10
12
0
20
40
60
80
100
120
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
Dec-02
Mar-03
Jun-03
Sep-03
Dec-03
Mar-04
Jun-04
Raw Activation
protons
Normalized activation
collimators

Activation (since collimators)



Recent Records

- Protons per pulse: 6.06E12 (Run II=5E12)
- Protons per hr to MiniBooNE: 7.5E16 (80% MiniBooNE goal)

Some Comments

- If experiments depend critically on accelerator performance, it's vital that experimentors get involved.
- The contributions from MiniBooNE and NuMI have been very important to the Booster, but…
- Most of the work has come from the lab, both from the proton source department and other departments, who have not been thanked here.
- While on the topic of "outside help", I should mention Argonne (Jim Norem, Kathy Harkay, Jeff Dooling):
  - Transition work
  - $$ for dogleg modification.