Recent AD Attempts to Undertstand CDF/D0 Luminosity Ratio

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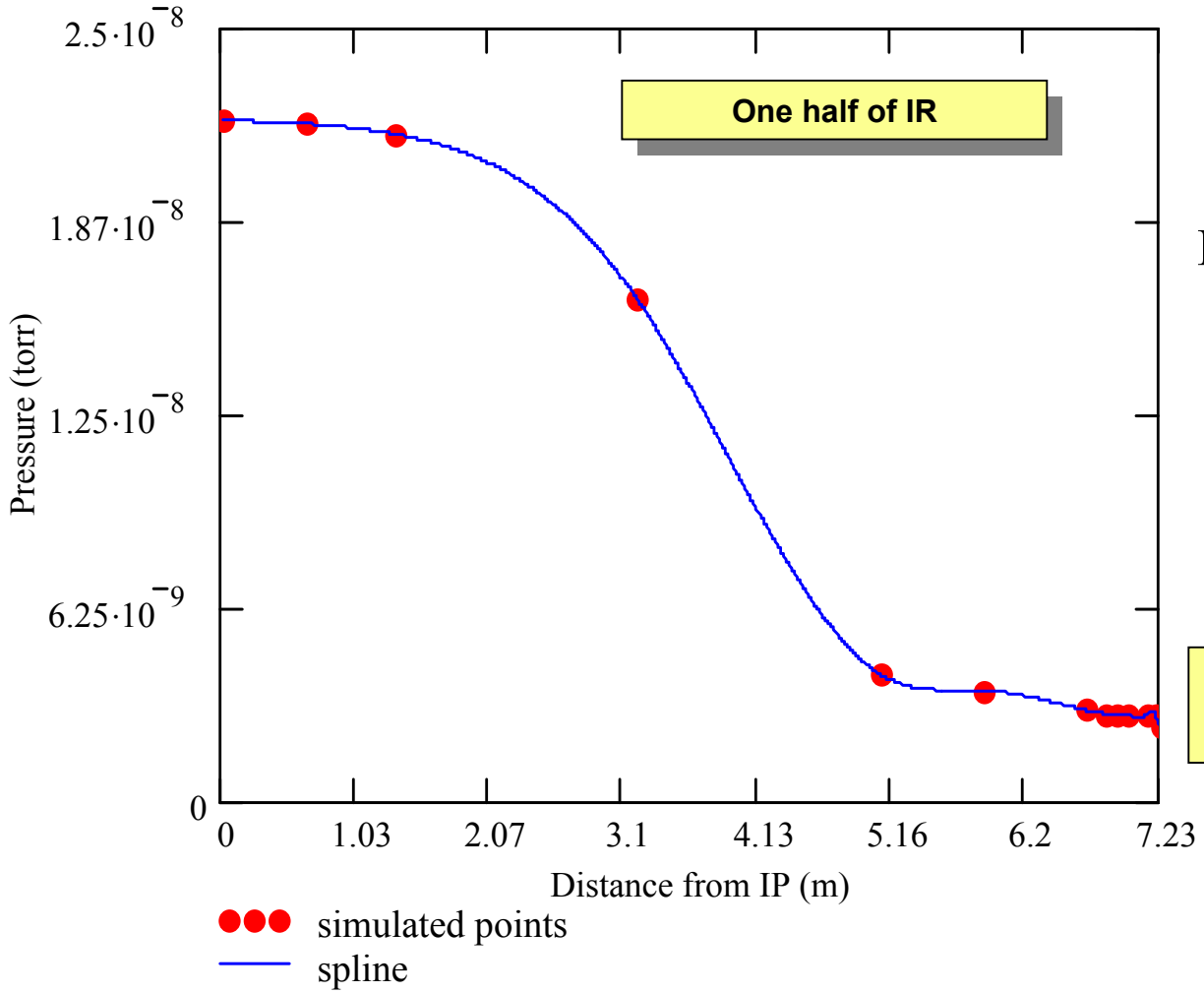
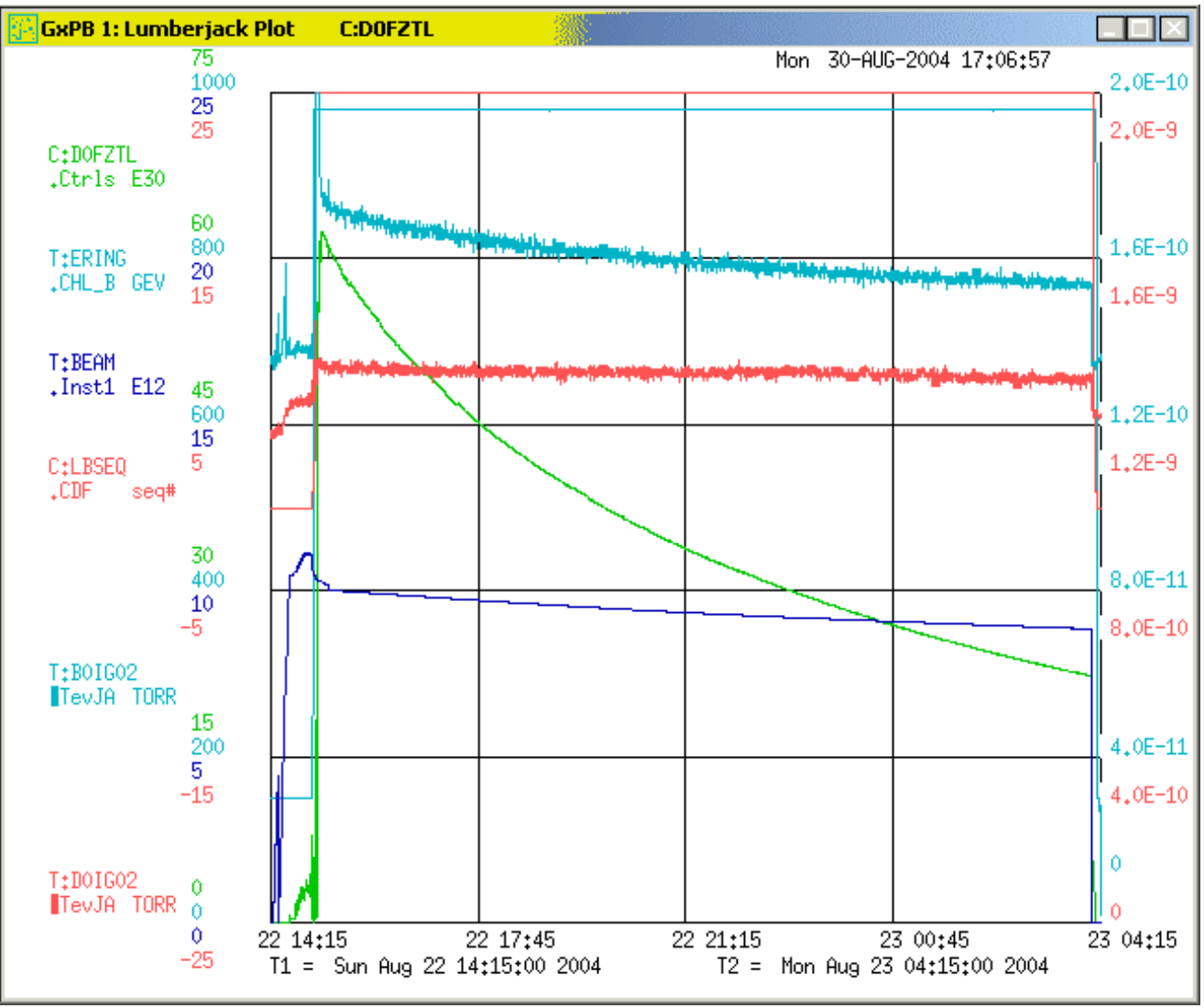
Introduction: vacuum at IPs



D0 Pressure Profile From Ron Moore & Mike McGee's Measurements/Simulation *beams-doc-1325*

D0IG01 pressure $2.4*10^{-9}$ torr

Introduction: vacuum at IPs in store #3745



Ion Gauge Readings,e-10

150 LB EOS Ab

B0U 4.5→5.2→4.8→4.5

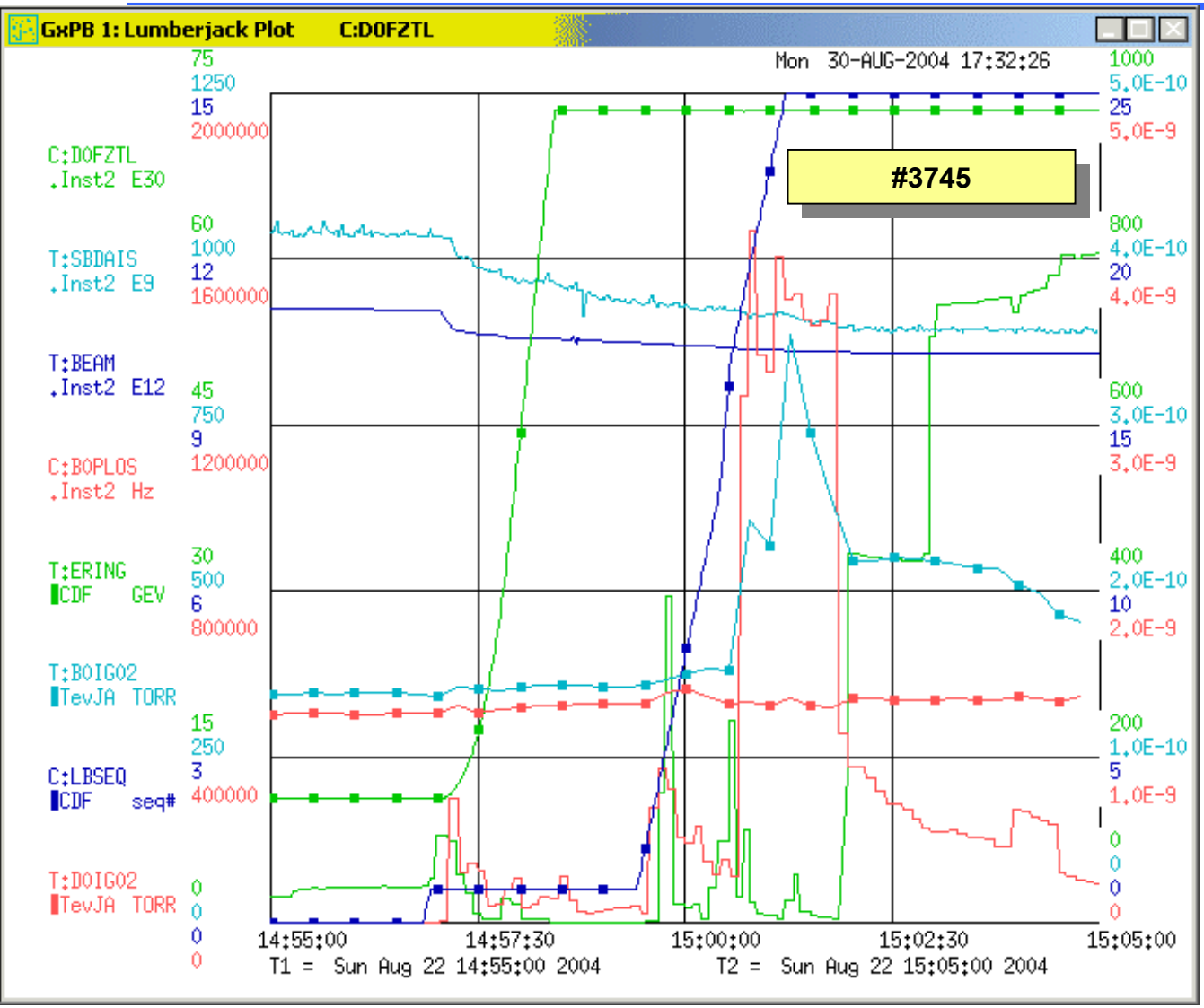
B0D 1.4→1.8→1.5→1.3

D0U 26→27→27→26

D0D 13→14→13→12

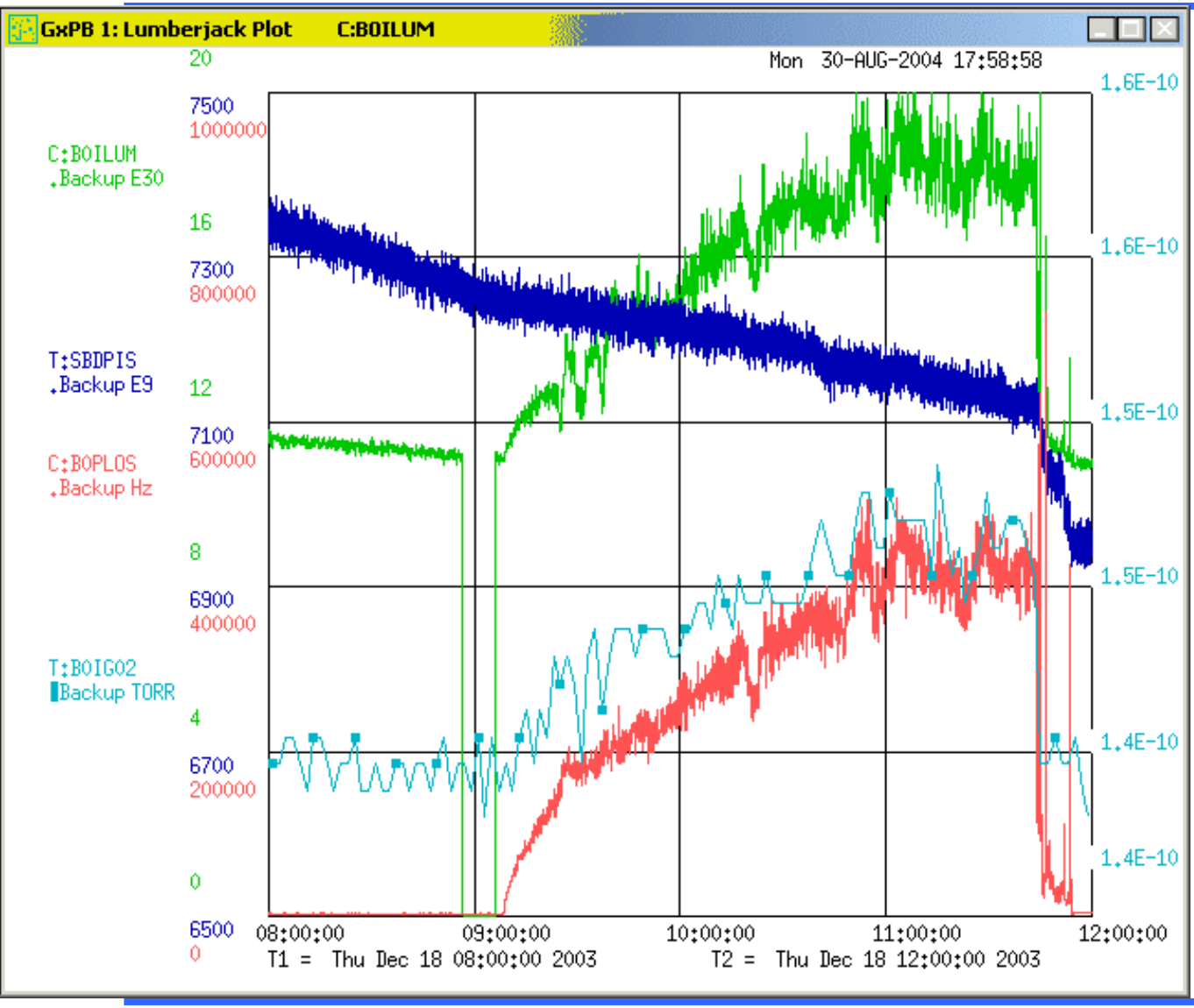
B0 gauges closer to pumps

Introduction: vacuum at IPs in squeeze



Spike from seq16 to initiate collisions in B0Downstream gauge correlates with B0 proton loss

Old Puzzle: Lumi raise during IP scan, 12/18/03

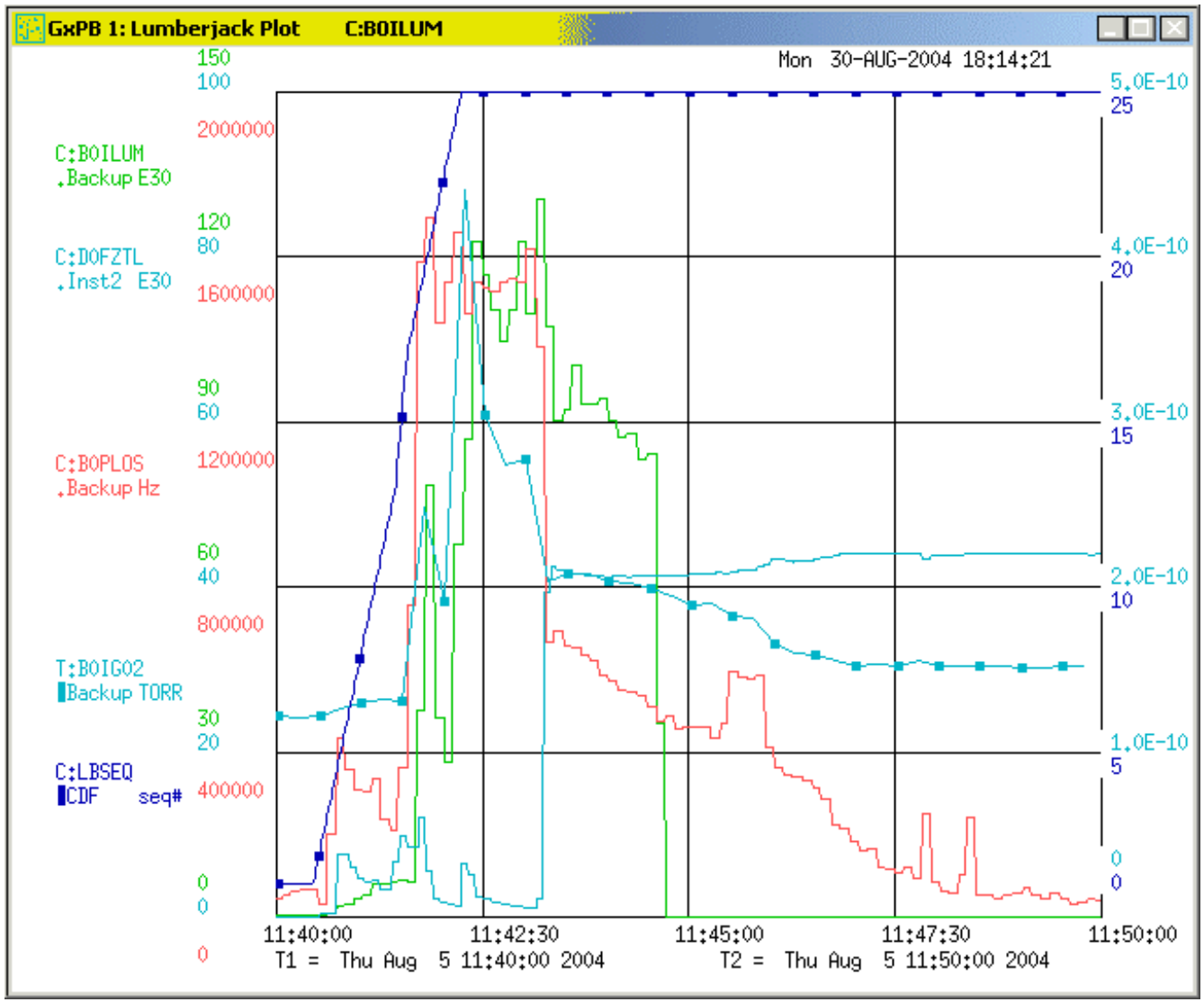


- Studiers reported high losses resulting in 80% increase in luminosity during separator scan
- The IP scan assumes moving helical orbits by about 1 sigma
- Correlation with B0 vacuum revealed in July'04
- Did not happen since than (3 scans)
- In one scan we had collimators IN

Why would IP vacuum readings change?

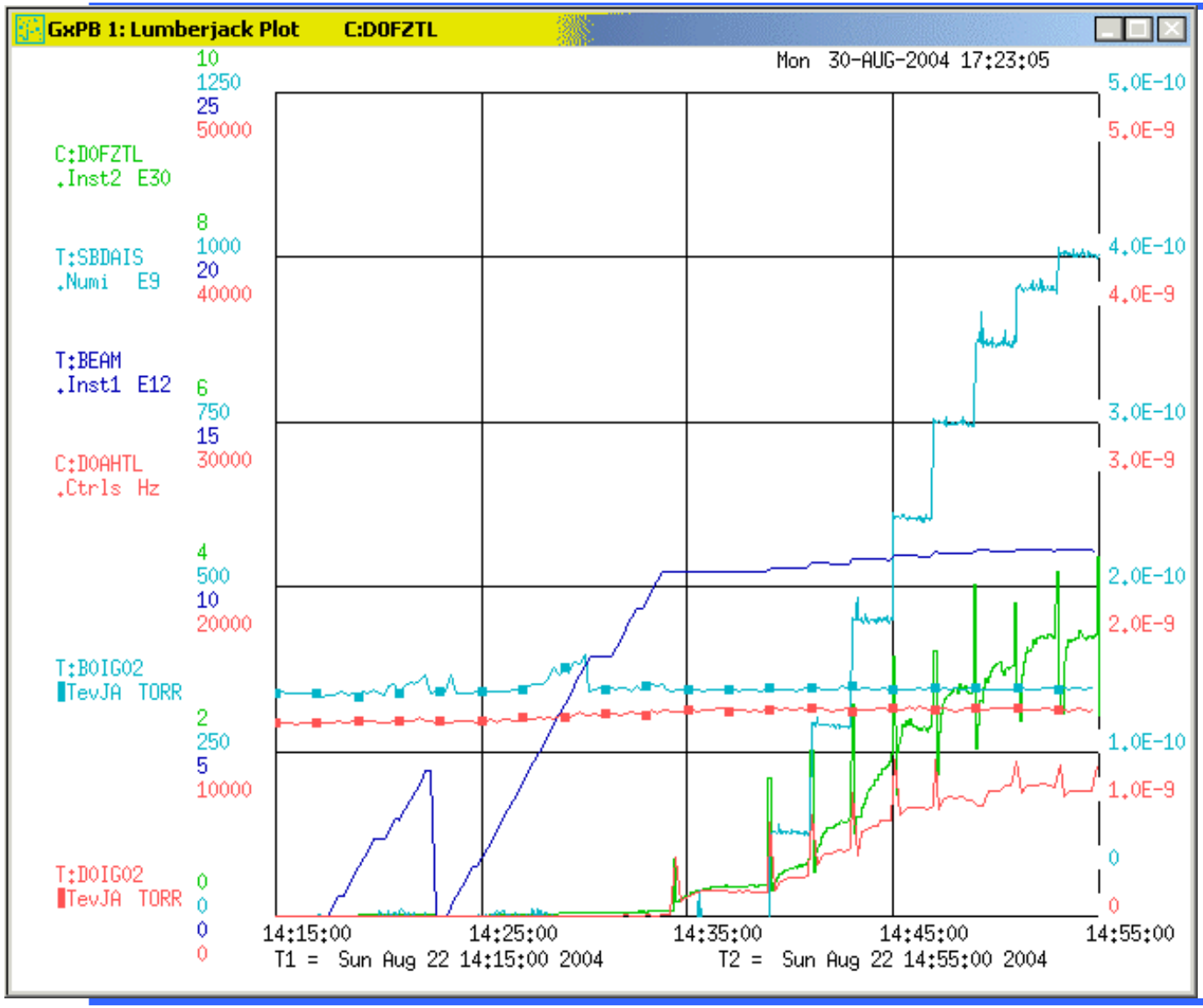
- Stray magnetic field of few to dozen(s) of G effects ion gauges ← not real pressure bump
- Scrubbing = beam losses induce pressure rise, can be local, may be dependent on beam orbit ← *seems to be most probable*
- Heating = image currents led to small temperature rise… SS is preferred (vs Be), should depend mostly on total beam current
- Vacuum instability, multipactor = p,pbars ionize molecules and accelerate electron, e- hit the wall and desorb more molecules, etc.

CDF Luminosity in #3711



- CDF luminosity counters were On till early in scraping
- Eventually luminosity was about 50e30
- In the squeeze and before collisions initiated, L=130.2
- B0 vacuum and proton loses were high, too

Typical D0 luminosity at injection



- D0 luminosity follows pbar injections, reaches 3.5e30
- As well as D0 pbar and proton loss rates D0PHTL and D0AHTL
- Luminosity is much smaller before pbar injection, with protons only on the helix

Idea Behind Studies: Vacuum Collisions → Luminosity

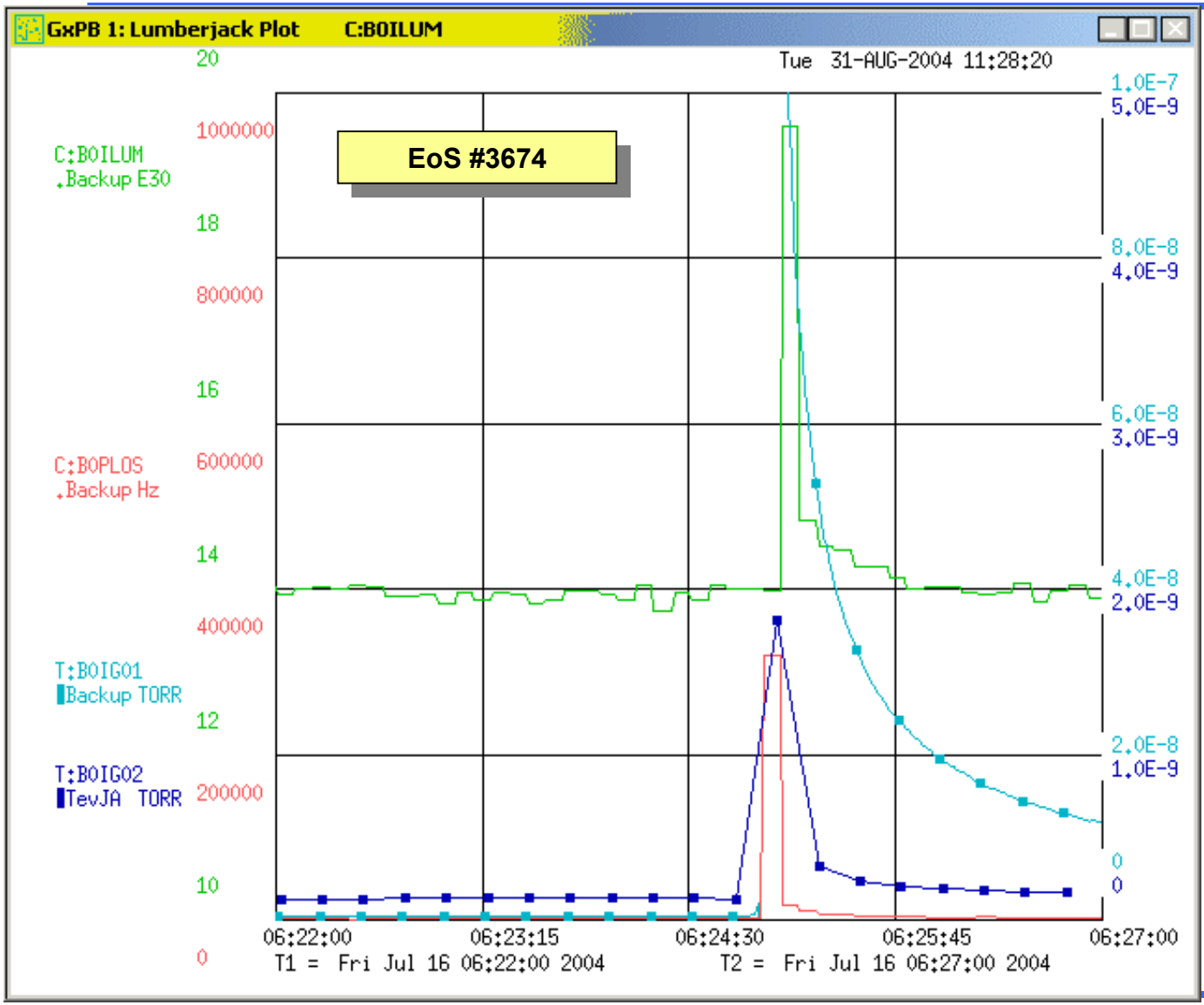
- Counting rate has a term proportional to Luminosity, cross-terms (Vacuum-Luminosity) and purely Vacuum term

$$dN/dt = \varepsilon_1 \cdot \varepsilon_2 \cdot L + (1-\varepsilon_1) L \varepsilon_2 N_p \rho +$$

$$(1-\varepsilon_2) L \varepsilon_1 N_{pbar} \rho + \varepsilon_1 \varepsilon_2 N_p \rho N_{pbar} \rho$$

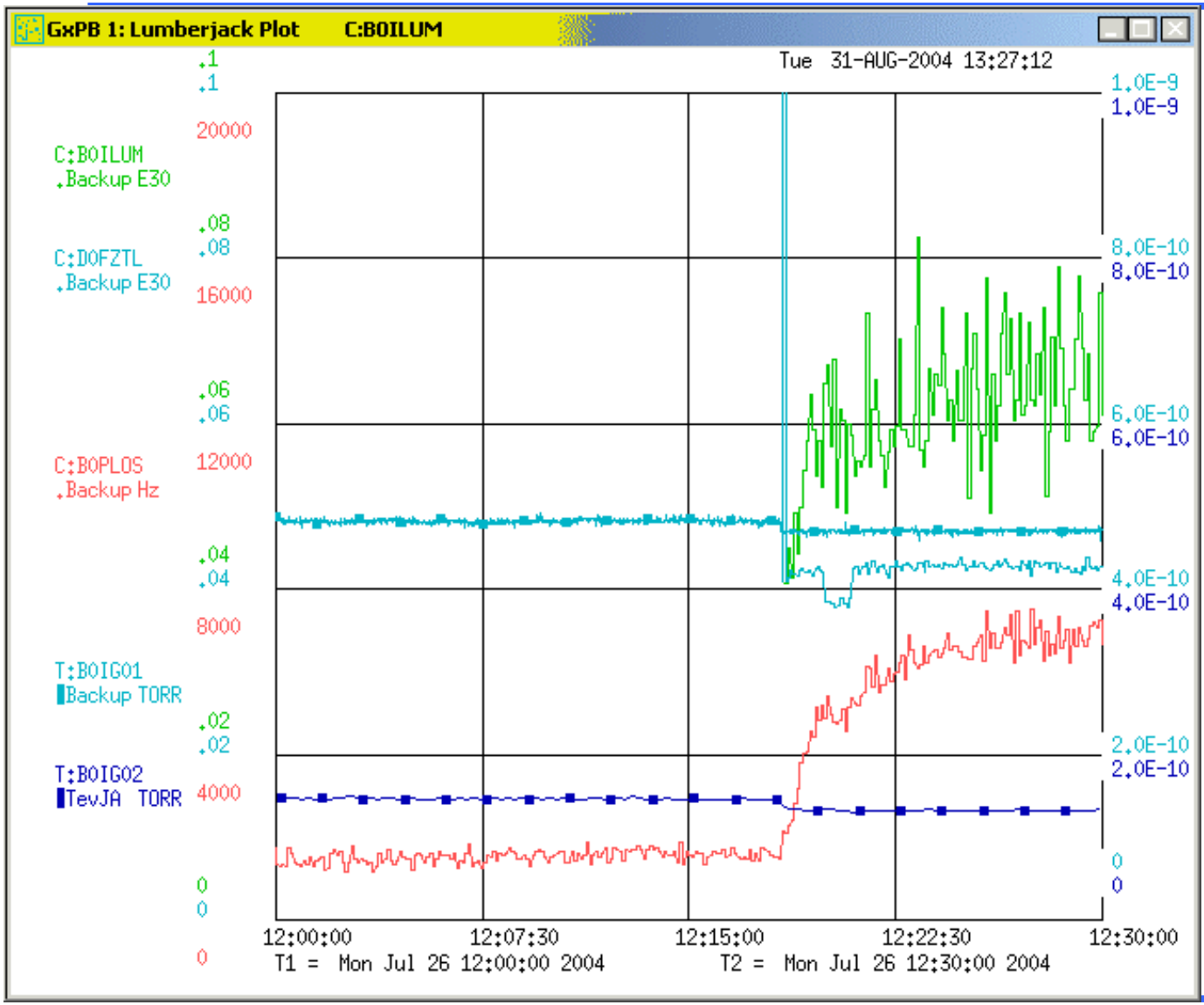
- Study #1: change vacuum pressure ρ at the IP(s) and detect change in apparent luminosity (terms 2 and 3 and 4, CDF should not depend on background, D0 should)
- Study #2: separate the beams at IPs and leave only term 4

Study #1: change vacuum at IP



- Not easy – as pumps are to far from IP and pressure determined mostly by outgassing INSIDE
- Luckily, B0 Upstrem pump was OFF for several days before, and when we turned it ON there was a burst of pressure (1e-7 at B0IG01)
- CDF Luminosity jumped from 14 to 19
- D0 luminosity unaffected
- Similar attempt with D0 was not successful – all pumps were ON all the time

Study #2: p and pbars separated at IP ~10 sigma



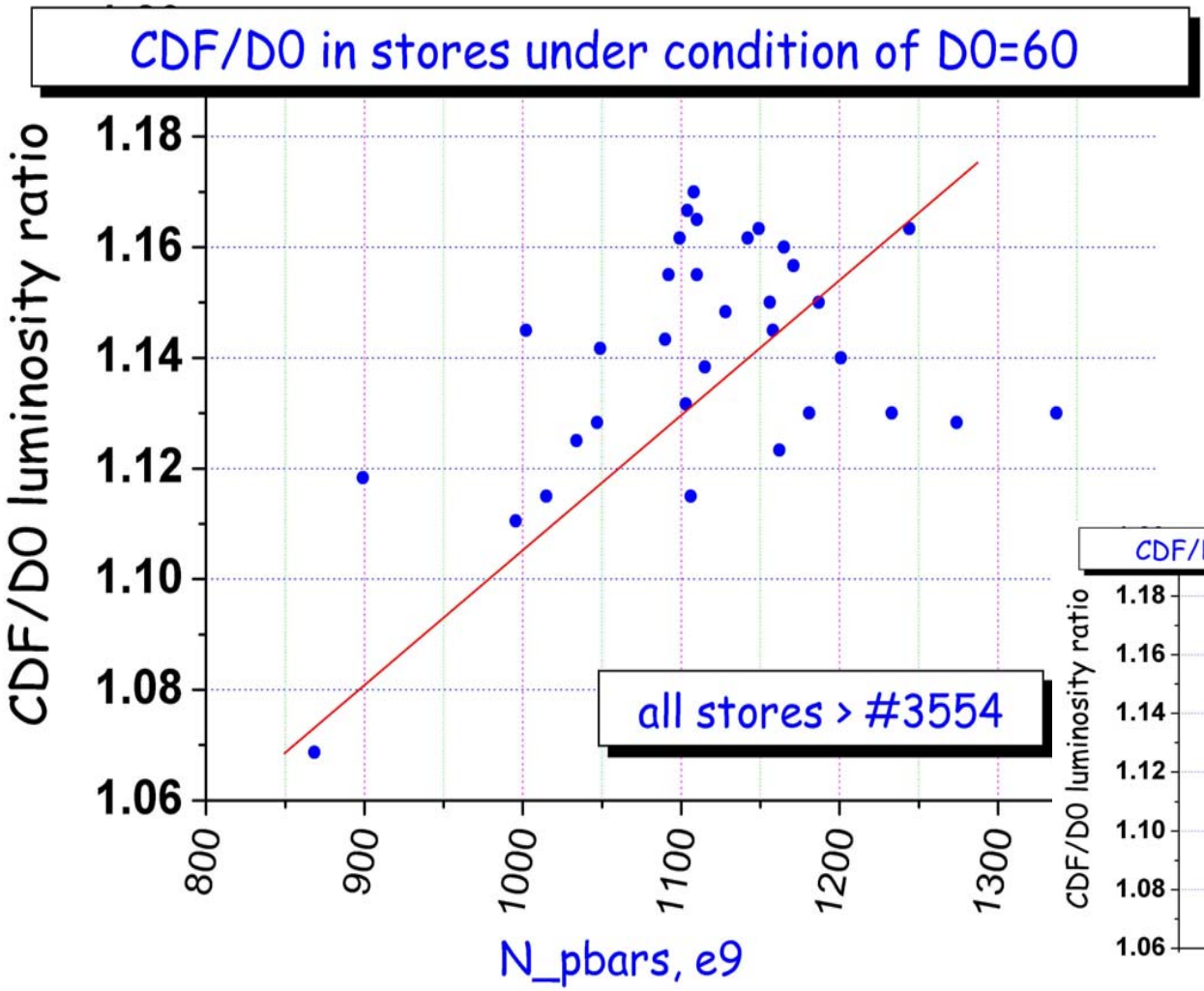
- Reversed "initiate collisions" command in sequencer
- Vacuum pressures did not change
- N_p=7845e9
  N_a=585e9
- Luminosities

	CDF	D0
before	17.0	15.9
after	0.042	0.042
15 min	0.064	0.042

…so, the "term 4" effect is 0.25%

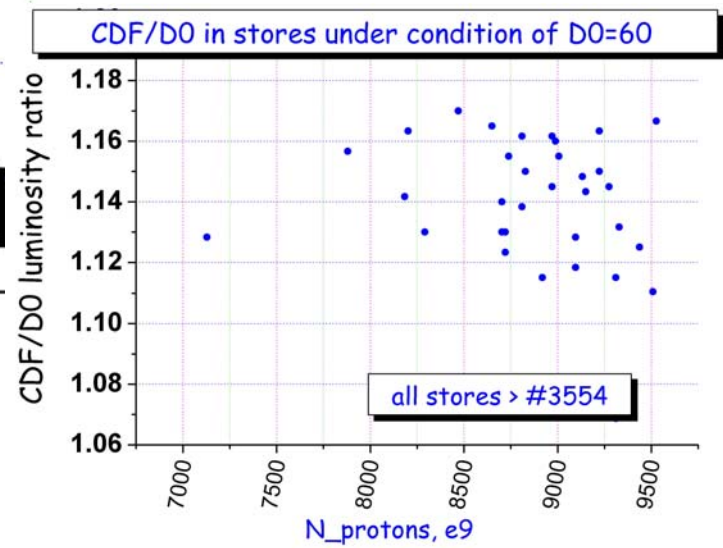
- CDF luminosity tracks B0PLOS after separation

A Clue? (Does CDF/D0 ratio depend on Pbars?)



A.Xiao

- No dependence on Nprotons



Summary:

- Vacuum pressure at IPs varies during the store, more at CDF, sometimes clearly correlated with halo rates
- CDF luminosity shows dependence on losses/vacuum
  - In squeeze →130e30
  - During luminosity scan 11→19
  - When vacuum spoiled 14→19
  - When beams separated 0.042→0.064

  In all cases B0PLOS is 100-1000 times usual rates
- D0 counters regularly report luminosity at 150 GeV proportional to number of pbars/losses
- When beams separated, luminosity drops 400 times in the end of store conditions
- Open questions:
  - Are “cross-terms” important?
  - Does CDF/D0 ratio depend on number of antiprotons?