Data Taking

Achievements
Failures
Downtimes
Efficiency
Backgrounds

February − May 2002

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May 30, 2002

CDF Operations Summary

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- A typical week during the last 4 months:
  - ~6 stores, 12-15 hrs long
  - ~5 shifts of accelerator studies, Tuesday/Wednesday
  - ~80-90% of delivered luminosity to tape (if no major problems)
  - ~1 store: power supply dies during shot setup
  - ~10% of beam time devoted to special runs (new trigger tables and algorithms, Minimum Bias runs, Silicon D-mode calibrations, ...)
- Since Jan 27, "physics" runs, declared as "potentially good":
  - 8,310,997,985 Level 1 triggers
  - 437,361,298 Level 2 triggers
  - 61,453,640 Level 3 triggers

CDF Operations Summary

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Jan 27 to May 30:

Delivered luminosity	33.0 pb^{-1}
Live (to tape)	23.5 pb^{-1}
"Good" runs ("potentially good", physics trigger table)	22.3 pb^{-1}
"Good" runs (major components incl. SVX)	9.0 pb^{-1}

Why is the "good run" luminosity so low? Two main reasons:

- Radiation-induced power supply failures (typical failure during shot setup $\rightarrow$ whole store "bad")
- Silicon

Numerology

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- L1 / L2 / L3 rates: 6kHz / 240Hz / 30Hz
  at $1.5 \cdot 10^{31} cm^{-2} s^{-1}$ with the current trigger table PHYSICS_1_01 v8, in use since May 12
- Biggest run: $447 nb^{-1}$ (Run 145005)
  taken on May 17, 11hrs overnight (of course). Includes Silicon, all components marked "Good"
- Highest initial luminosity: $2.06 \cdot 10^{31} cm^{-2} s^{-1}$ (May 19)
- Best store CDF integrated luminosity: $602 nb^{-1}$ (May 17)
- Best "CDF-week": $2.97 pb^{-1}$ to tape (of $3.47 pb^{-1}$ delivered, week of May 16)
- Best store efficiency: 93.2% (May 16, 506 of $543 nb^{-1}$)

Integrated Luminosity

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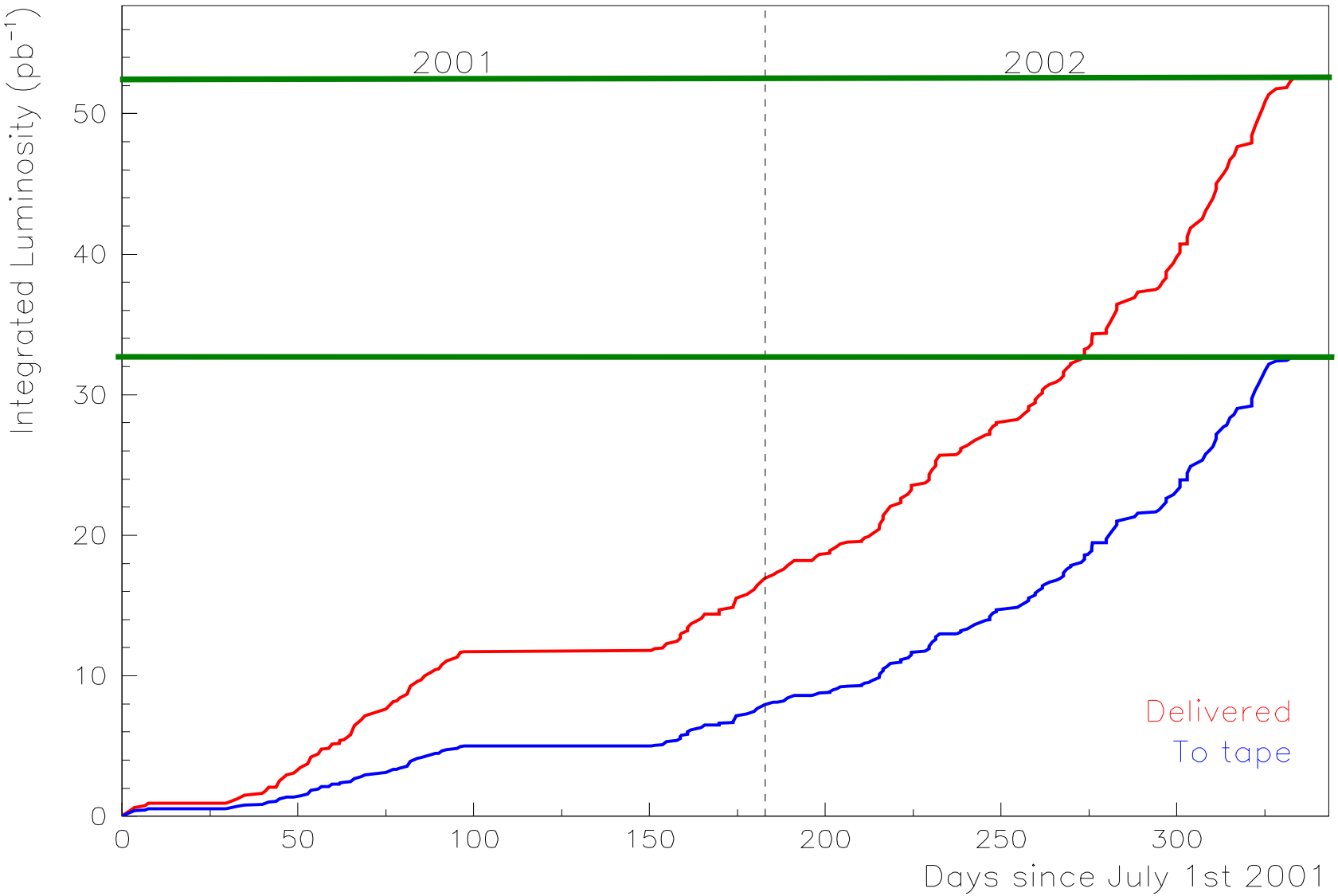

Integrated Luminosity

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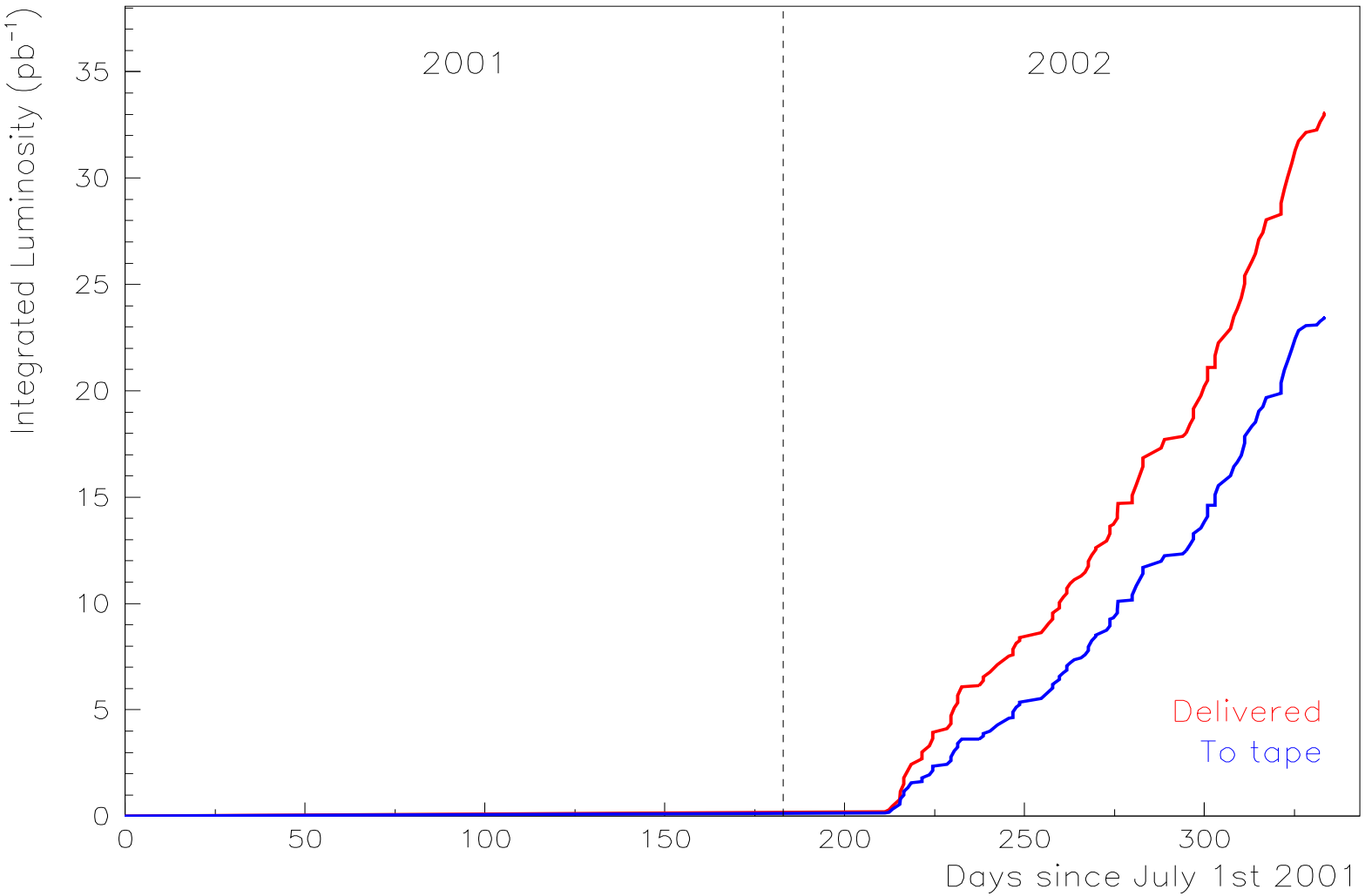
January 27 – May 29

L(delivered) ~ 33pb−1 L(to tape) ~ 23.5pb−1 Efficiency ~71%



Store Efficiency

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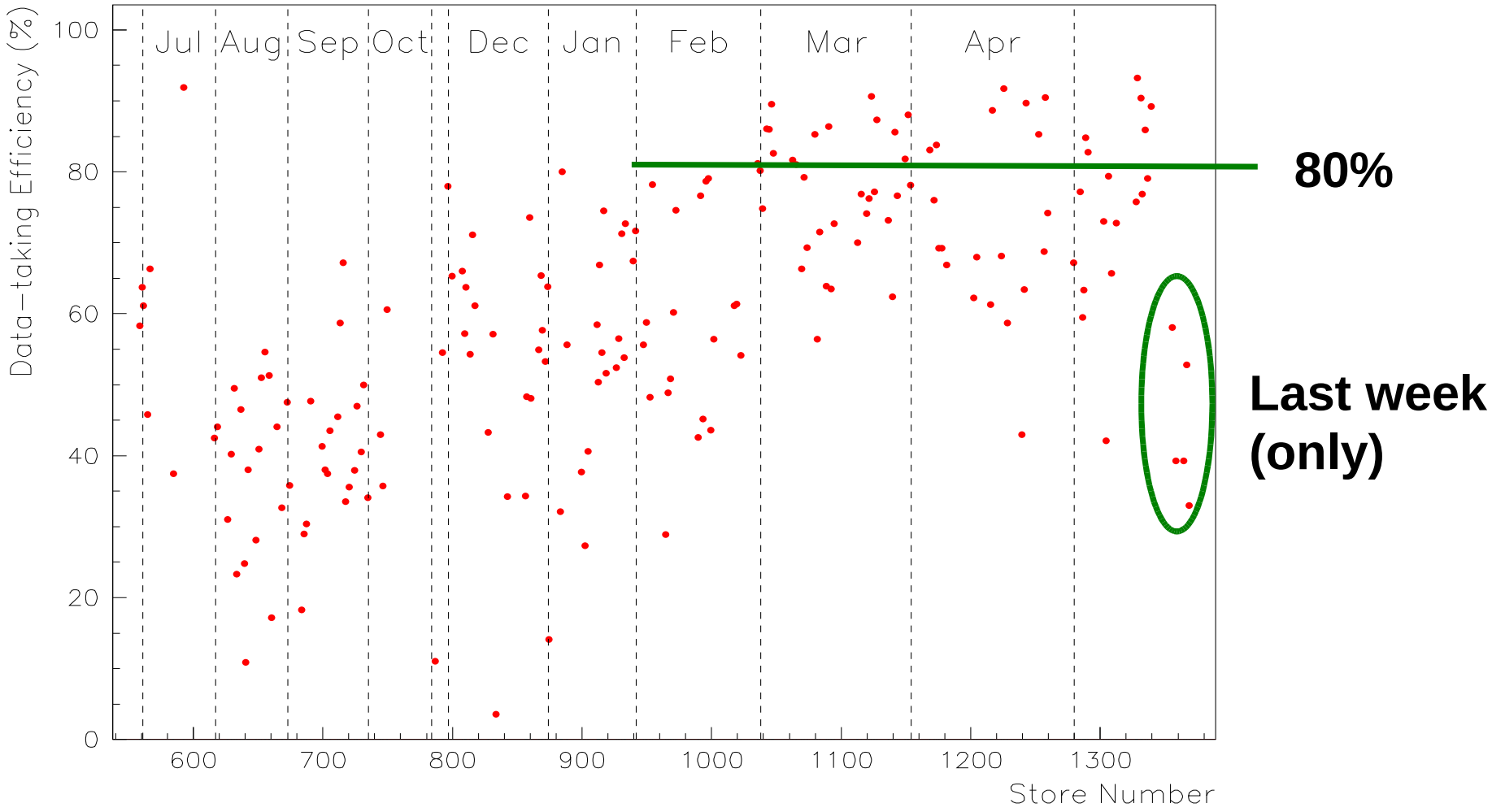

Store Luminosity

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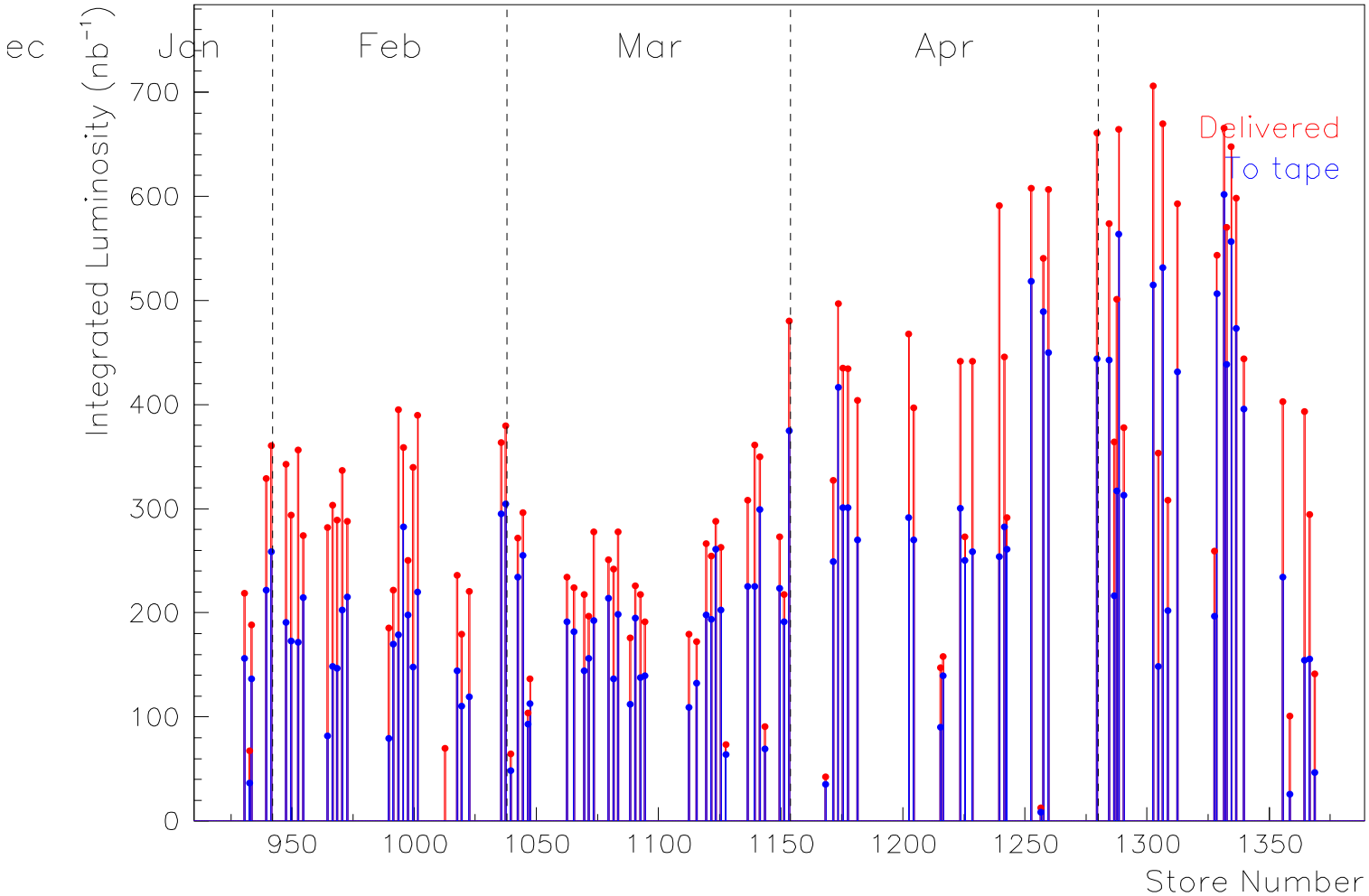
- Good running for ~5 weeks, before the pre-shutdown meltdown started



Last Week

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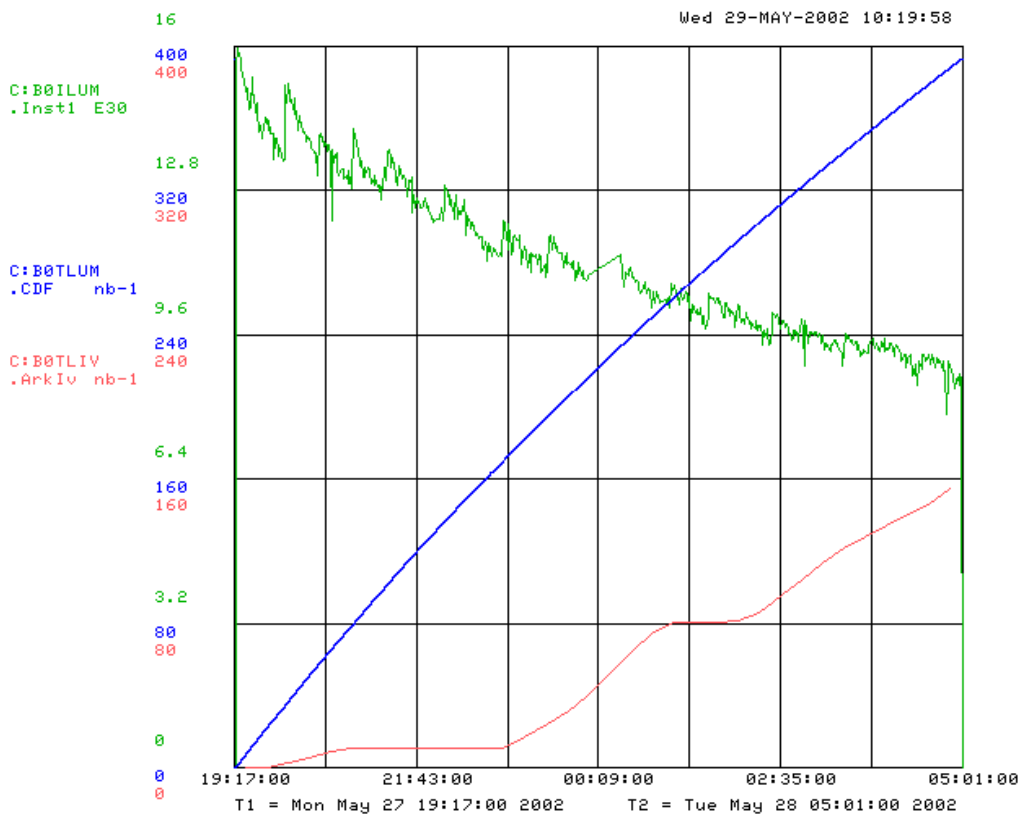
- In short: not worth mentioning
- Quite bad for the accelerator: replaced a P1 line dipole, recovery from power outage Sunday night (site-wide)
- For 2 stores, "sawtooth" behavior of luminosity, caused by spikes in the output of the B0 vertical separator
  - Silicon stayed out
- For the last store, lost many pbars during transfer into Tevatron
- Many Level 2 problems, temporarily had to switch back to "old" L2 crate to run at all
- On the positive side, many trigger tests (and other special runs) got done, in preparation for higher luminosity



Initial Luminosity

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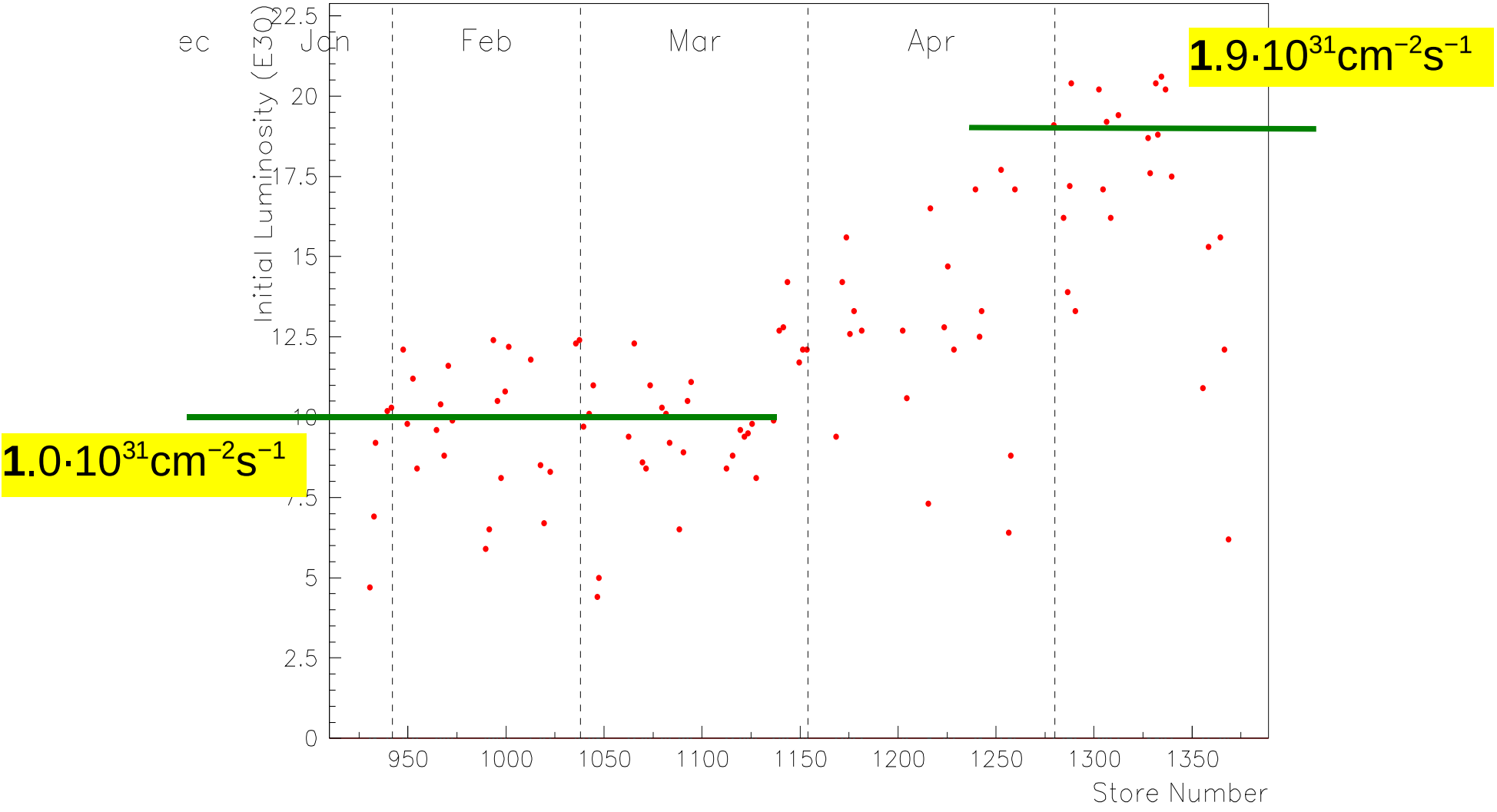

Major Achievements

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- In the perception of many, we made the transition from "commissioning" to "physics data taking" beginning of February; around February 8:
  - routinely turned on CMP (increasing current limits)
  - added SVT triggers at L2
- Quite stable set of SVX ladders integrated
- Significantly reduced data corruption
- We have a "good run" definition that actually tells something about the quality of the data
- Much better understanding of losses and backgrounds
- Rad hard(er) power supplies will be installed in June shutdown. Silicon West and 9/20 COT supplies have been installed recently
- Continued commissioning of Silicon and Level 2 - the only major systems in commissioning

"goodrun"

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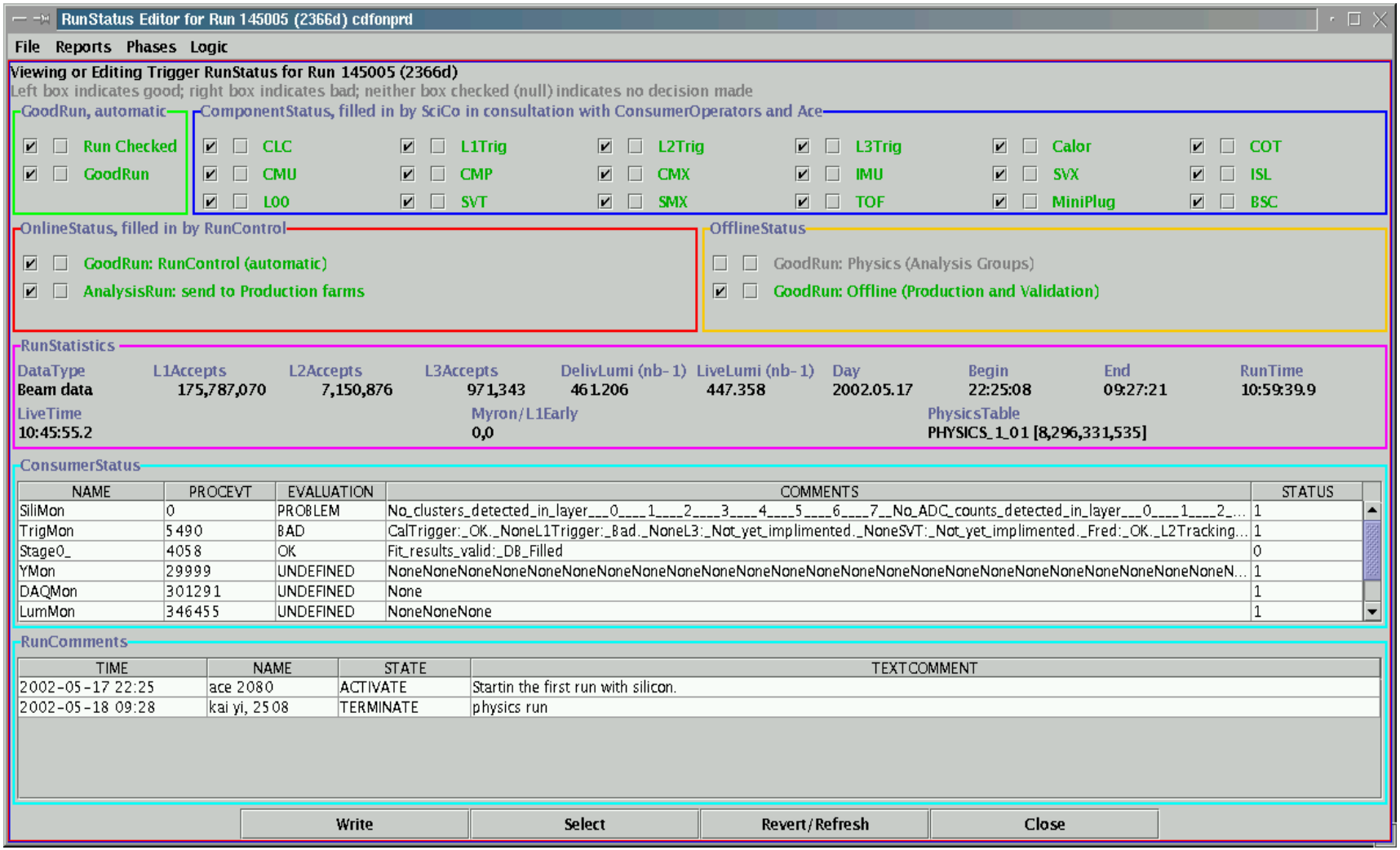
- Detailed checklist developed to determine the (online) quality of the data, filled out by SciCo with CO assistance



Silicon

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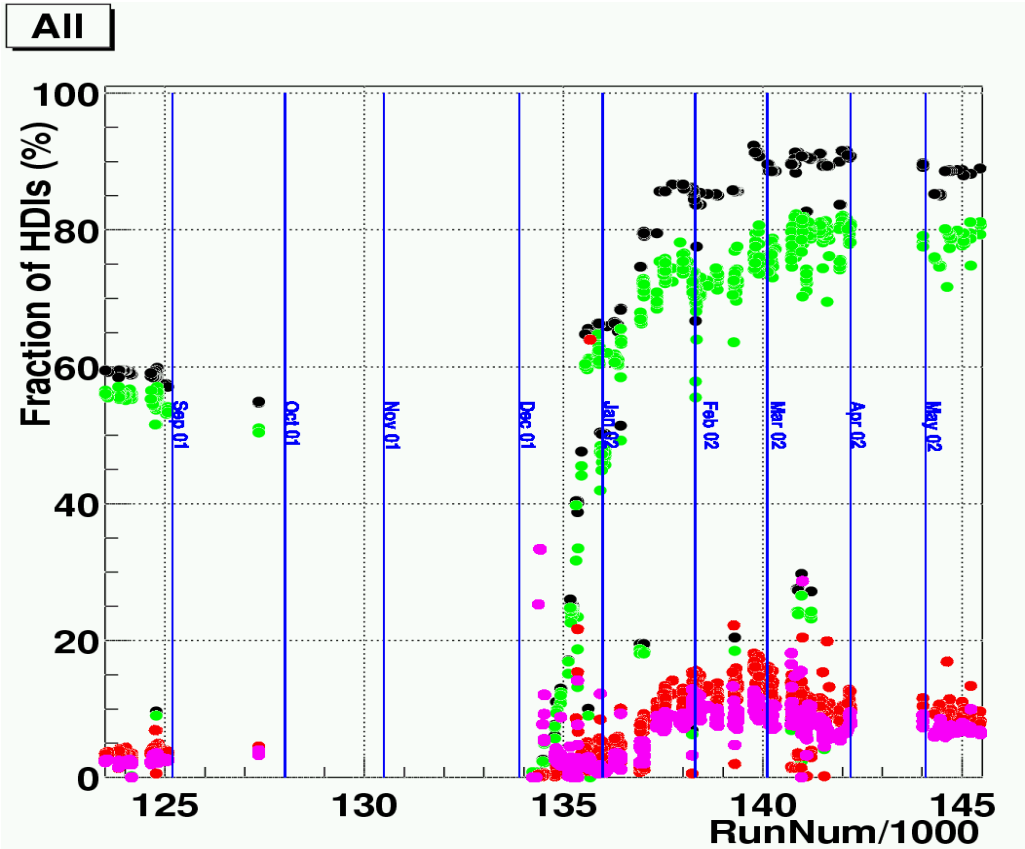
- March 30 incident: partially lost 6 SVXII ladders during a beam abort with debunched beam in the Tevatron (massive RF failure)
- Hypothesis was a rate dependent failure: small dose (few rads) in short time (~150ns), but this could not be confirmed unambiguously
- For about 3 weeks, no Silicon operation with beam. Two sets of radiation studies in the Booster during this time
- Added RF interlock, interlock for missing abort gap marker; some risks remain (kicker prefire)
- Integrating the Silicon detectors still requires expert approval, 30-60min observation of losses
  - For "good" stores, 90% with Silicon
  - 1-2 times per week whole stores w/o Silicon (accelerator irregularities)



Level 2 Commissioning

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- Slow (sometimes painful) transition to new MagicBus backplane with TTL arbitration
- Benefit is greatly improved rate capability, and a path to design rates
- All interface boards except muon interface are read out with "final" delays
- L2 latency is still of the order of 100 μs (x5 goal), corresponding to ~10kHz L1A
  - L2 executable / Alpha infrastructure not optimized
  - Long tails in SVT loading/processing time vastly improved, but still ways to go (mean ~25 μs now)
- L2 tagsets introduced: know what L2 code was running for each run
- See separate talk for details

DAQ / Trigger Limitations

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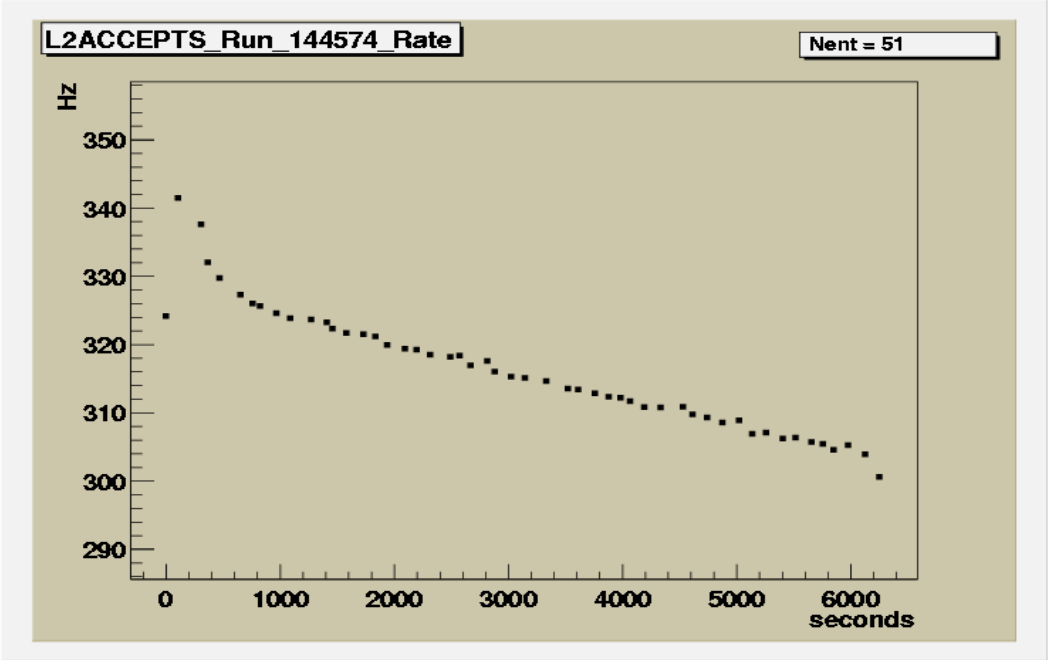
- DAQ deadtime becomes noticable with current trigger table above ~$1.8 \cdot 10^{31} cm^{-2} s^{-1}$
- E.g. store 1303 (previous trigger table):
  - Without Silicon, $L = 2.0 \cdot 10^{31} cm^{-2} s^{-1}$:

L1A / L2A / L3A = 8.4kHz / 325Hz / 30Hz
5-6% deadtime (50% L2, 50% readout)
average event size at logging 190kB

  - Integrate Silicon at 1.7E31 (adds SVT triggers at L2): deadtime 11-12%, evenly split between L2/readout/EVB+L3, event size ~290kB
- Improvements to reduce L2A rate being developed (current table already 20% improved)



Downtimes I: Procedures

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- In February, while pushing hard to get the data taking efficiency consistently above 80%, we determined that
  - about half of the inefficiency is caused by our procedures (calibrations during store, beginning and end of store, tests of new triggers, ...)
  - the other half is due to actual failures
- This split is still about the same (both improved)
- Integrating Silicon
  - 10-30min each store
  - Sometimes complete stores without Silicon; approximately 50-70% of data taking includes Silicon, during the last few weeks
- Recovery after power outage (~14 hrs last Sunday)
  - Develop procedures
- First generations of aces were mostly "detector experts" - this is changing
  - Need improved documentation in many areas
  - Better training

Downtimes II: Failures

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- Event Builder failures
  - Known instability (a certain VRB in two crates), but rate has been creeping up recently: up to once per store
  - Recovery takes 30-40min
- Level 2
  - Typically several hours of downtime over the week, some scheduled tests for improvements
  - Still some way to go to the final system (1 vs. 4 Alpha boards, no Muon interface, optimization)
  - See detailed talk later
- COT broken wire repair, week of April 15
  - Caused 3.5 days shutdown, one week without COT

Backgrounds and Losses

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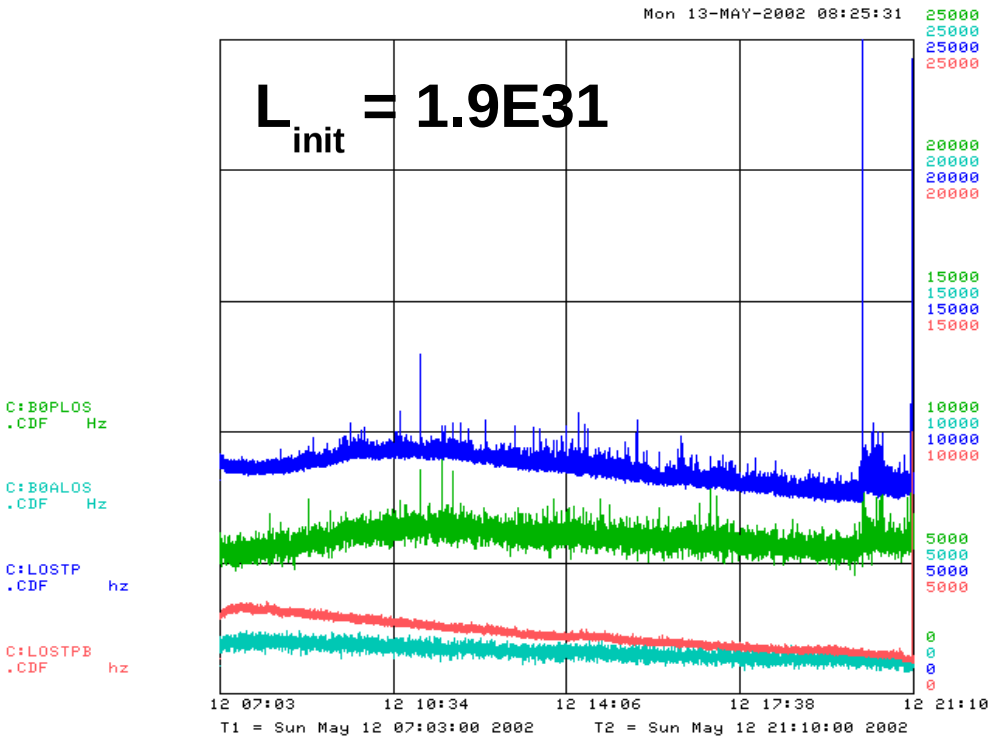
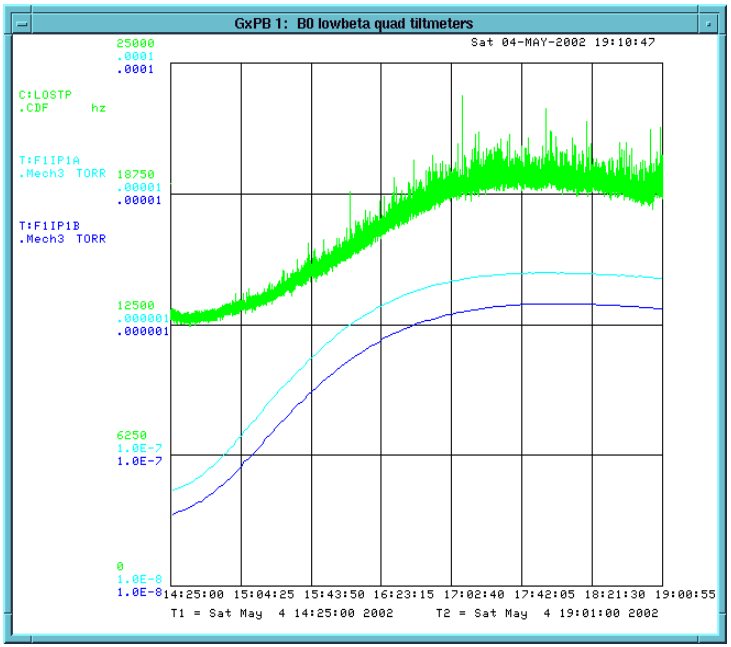
- In general losses are within operating limits
- Peculiar structure caused by bad vacuum in F-sector, will be improved in June shutdown
- Occasional TEL problems





- Losses rarely generate problems, with the exception of Silicon integration

Summary

- The quality of the data improved to a level where it is useful for many physics studies and analyses
- Collected 23.5pb^{-1} of data over the last 4 months, an average data taking efficiency of 71%
- Only 9pb^{-1} have been classified as "good" for all major components
  - Mostly due to missing Silicon and power supply failures
- Typical data taking efficiency is now of the order of 80%, thanks to improved procedures, fewer test runs, and better reliability
- Major disruptions: the Silicon incident on March 30, and the COT broken wire (April 14)
- Much progress in Silicon and Level 2 commissioning, with direct impact on daily operations
- Running the experiment continues to be a very people-intensive effort