



# Status of the Run IIb CDF Detector Upgrade Project

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# 2b or not 2b

→ this is no longer the question

Goal is now for:  $3 \times 10^{32} \text{cm}^{-2} \text{s}^{-1}$

- RunIIb spec was for  $4 \times 10^{32} \text{cm}^{-2} \text{s}^{-1}$
- All non-silicon upgrades will NOT change, the scope is still right
- a portion of silicon tasks remain  
→ to take care of current detector

New baseline accepted by DOE,  
endorsed by CDF internal review



Strong commitment to see all the projects through...



# Project Scope (I)

- 1.1 - Silicon
  - Contains closeout activities, some tasks needed to preserve the current detector (DAQ maintenance, radiation monitoring, safety maintenance)
- 1.2 Calorimeter
  - 1.2.1 – Preshower Upgrade
    - No scope change needed
    - Significant impact on the installation plans due to silicon cancellation
  - 1.2.2 – EM Timing
    - No scope change needed



# Project Scope (II)

- 1.3 Data Acquisition and Trigger
  - 1.3.1 – TDC upgrade
  - 1.3.2 – Level 2 Decision crate upgrade
  - 1.3.3 – Level 1 Fast track trigger (XFT II) upgrade
  - 1.3.4 – Event Builder upgrade
  - 1.3.5 – Level 3 computer upgrade (buy new PCs)
  - 1.3.6 – Silicon Vertex Trigger upgrade (details changed)
- All are still needed to operate at  $3 \times 10^{32} \text{cm}^{-2}\text{s}^{-1}$  (design goal from the Summer 2003 DOE review).

**No scope changes**



## 1.2.1: Preshower Status

- Phototube status
  - Used to be the critical path item, ending in Oct 04
  - Japan has accelerated orders, now delivery is March 04
  - All phototubes will be ready for a Summer 04 installation
- Detector status
  - All time-critical production parts ordered
  - Ready to start production in February 04
  - 6-month production expected based on prototype
  - Should be ready for installation by Fall 2004



# Preshower Installation

- Cancellation of the silicon installation and its long shutdown has implications for other projects
- Preshower installation is most affected
- We have concluded that installation in the collision hall is possible.
- Current installation schedule for both EM Timing and Preshower requires 10 weeks
  - Realistic manpower availability (40 hour weeks, 1 shift/day)
  - If cannot be completed in summer 04, will be completed during 2005 summer shutdown



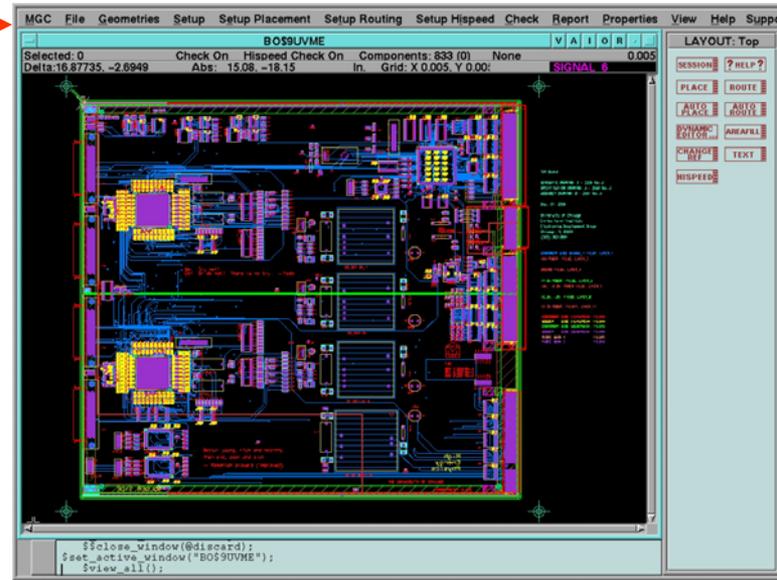
## 1.2.2: EM Timing Status

- Hardware is ready for installation
  - Hardware is 4 months ahead of schedule
  - All hardware finished & tested, ready for installation
  - All cables, splitters, ASDs and TDCs in hand
  - End-Plug installation completed, fully operational
  - 4 Central Wedges completed, fully operational
  - DAQ/online monitoring software fully working
  - Performance excellent, < 2 ns timing resolution
  - Installation procedures reviewed by experts
  - Installation to be completed in the next shutdown (2004)



## 1.3.1: TDC Status

- New high speed TDC with Altera Stratix FPGAs
  - Excellent Chicago engineer team (built many CDF boards)
  - Design work started on Dec 2002
  - Core firmware design finished on June 2003
  - Firmware design reviewed by experts on July 2003
  - Layout of board close to final →
  - Backward compatible
- Lots experience with TDC testing & commissioning within CDF





## 1.3.2: L2 Upgrade Status (I)

→ Pulsar production started

- Hardware 10 months ahead of original schedule
  - One motherboard, four mezzanine and one AUX design
  - All custom board prototypes designed&built last year
  - Board design extensively simulated + trace analysis
  - Have tested ALL interfaces in self-test mode (Tx →Rx)
  - Core firmware fully developed (in CVS) and tested in beam
  - Has been used as RunIIa L2 muon interface board for data taking (interface with legacy Alpha processor)
  - Muon online DAQ/monitoring/offline software working
  - Production Readiness Review done (Nov. 07, 2003)
  - **No blue wires on ALL prototypes, no revision needed**

**Web page: <http://hep.uchicago.edu/~thliu/projects/Pulsar>**



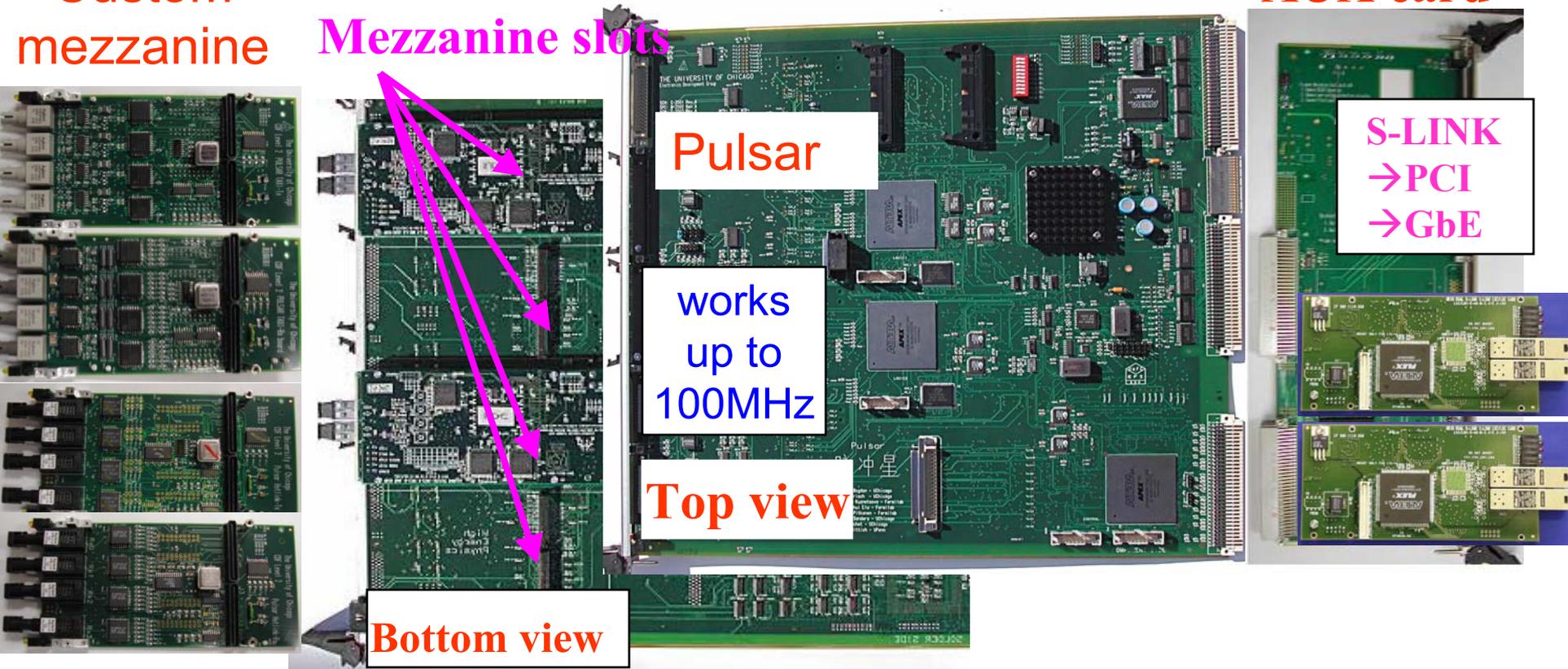
# Pulsar Design

→ modular/universal/self-testable

Custom  
mezzanine

Mezzanine slots

AUX card



*Pulsar design philosophy: able to interface with any user data with any link format (e.g. S-LINK or GbE) via mezzanine*  
*Many applications within & outside CDF (compatible with Atlas)*

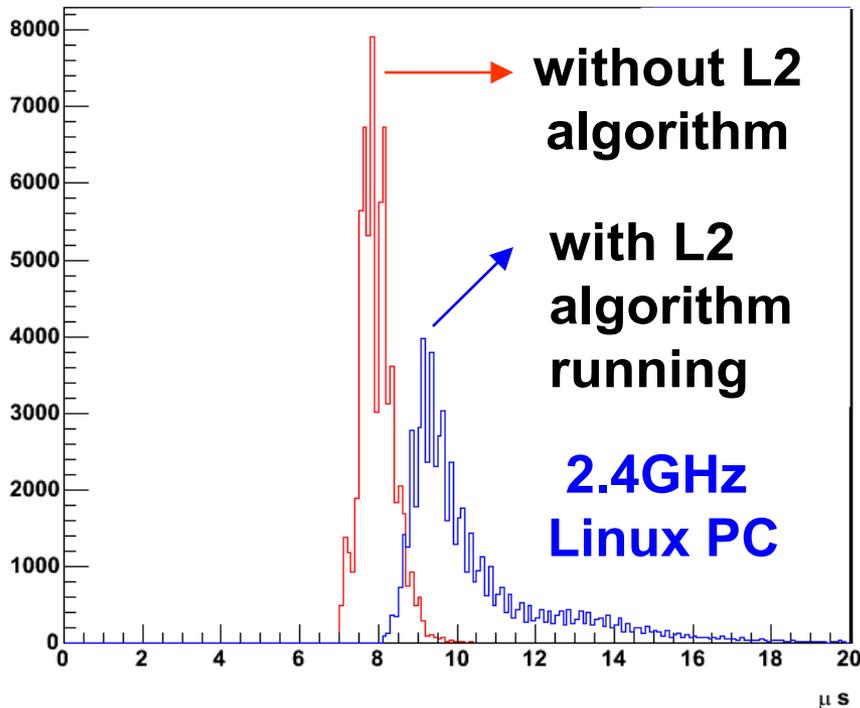


# 1.3.2: L2 Upgrade Status (II)

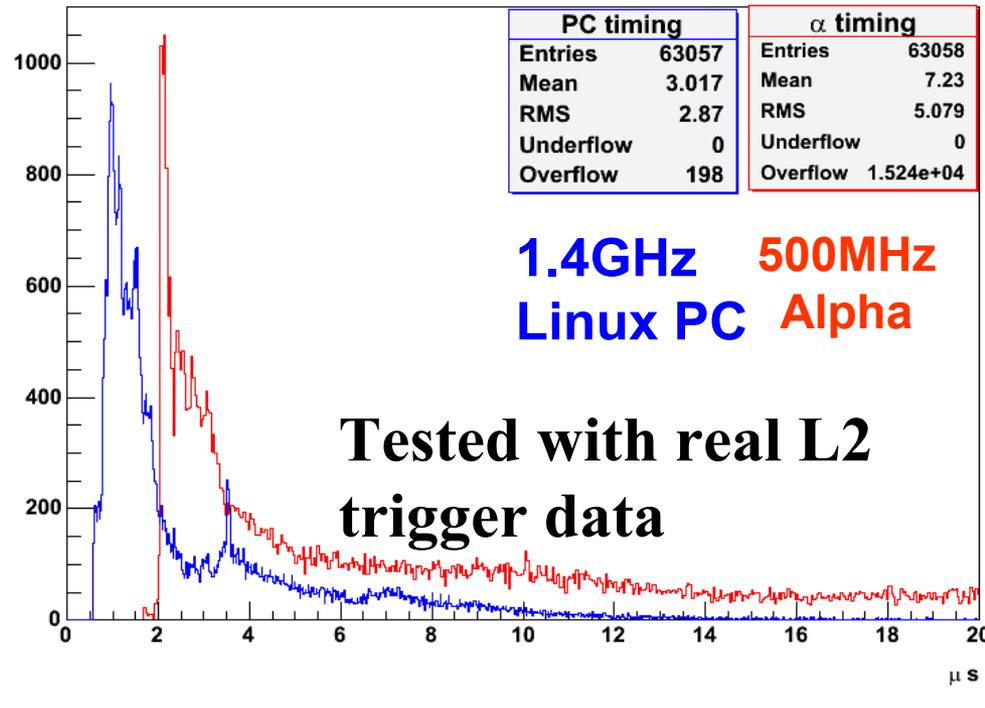
Pulsar ↔ PC timing

- Pulsar to PC round trip timing measured (w S-Link to PCI)
- With Alpha L2 algorithm code running in Linux PC
- Good performance (compare to that of old Alpha)

*Pulsar ↔ PC roundtrip timing*



*PC vs old Alpha algorithm timing*





## 1.3.3: Fast Track Trigger (XFT II) Status

- Lots simulation work done
  - Have working XFT upgrade simulation
- Hardware progress (in parallel with simulation)
  - Most interfaces design do not need to change, primary changes are in the firmware (algorithm)
  - All fully backward compatible
  - New Linker: firmware implemented & fully simulated
  - Finder&Linker board design begun
  - Start production by late 2004
  - XFT II ready by summer 05
  - Three new postdocs recently joined (Sept. 2003 -)



## 1.3.4: Event Builder Status

- Technology decision made (Gigabit Ethernet)
  - VME to switch readout: VMIVME-7805
  - GbE switch: Cisco 6509
- Well underway:
  - System design has been decided
  - Final system switch ordered
  - Readout test boards ordered
  - Expertise on board (from both CD and CDF)
  - Working prototype by Aug 2004
  - Plan to have new system ready by Summer 2005



## 1.3.6: SVT Upgrade (SVT II)

- Original plan was only to handle SVX IIb geometry
  - additional Merger boards + new Track Fitter boards
- Now main motivation is to improve SVT efficiency with good timing (critical for high Luminosity → L2 latency)
  - Redundant roads removal @ earlier stage → less fits
  - Finer roads (larger Associative Memory or AM) → less fits
  - Improve track fitting
  - Replace obsolete boards, add additional flexibility
  - Ensure good SVT performance all the way through 2009



## 1.3.6: SVT Upgrade (SVT II)

- Phase One: (funded by operation money)
  - Use Pulsar as Road Warrior to remove redundant roads
  - RW firmware successfully tested on Pulsar last month
  - Ready for commissioning early 2004 (Pulsar production)
- Phase Two: (AM++ funded by INFN R&D)
  - Replace old AM boards with new AM++ developed for LHC
  - Use Road Warrior to replace Hit Buffer & AM Sequencer (mostly firmware changes, replace obsolete boards, which also provides additional flexibility)
  - Replace Track Fitter (RunIIb money)
  - All backward compatible, can develop&tune standalone



# Conclusions

- Our baseline schedule will not change
  - We will work towards earlier completion
  - Our target is to install as much as possible in the summer 2004 and 2005 shutdowns.
- We proposed a new baseline cost for the DOE MIE of \$10.4M, accepted by the DOE on 8 December.

**By Fall 2005,  
CDF will be ready for operation at  $3 \times 10^{32} \text{cm}^{-2} \text{s}^{-1}$**



# Rebaselined Cost Estimate

|             | Baseline (\$K) |          | New Scope (\$K) |          |
|-------------|----------------|----------|-----------------|----------|
|             | Cost           | Cont.*   | Cost            | Cont.    |
| Silicon     | \$ 12,008      | \$ 5,145 | \$ 2,527        | \$ 396   |
| Calorimeter | \$ 342         | \$ 335   | \$ 342          | \$ 335   |
| DAQ         | \$ 3,788       | \$ 1,678 | \$ 3,788        | \$ 1,678 |
| Admin.      | \$ 1,285       | \$ 407   | \$ 1,006        | \$ 302   |
| Total       | \$ 17,422      | \$ 7,565 | \$ 7,663        | \$ 2,711 |

- Contingency per subproject is from 2002 low level estimate – \*scaled by use to date
- New DOE MIE total cost drops - \$24,987K → \$10,374K
  - All costs shown are total (M&S/Labor/Overhead), in current year \$K