The CDF Program for Run IIb

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The Run IIb Specifications

- The current detector was designed/built based on “Run IIa specifications:
  - Maximum instantaneous luminosity of $2\times10^{32}cm^{-2}s^{-1}$.
  - Integrated luminosity of 2 fb^{-1}.
- We now consider the detector to have a longer, harder life.
- For Run IIb:
  - Maximum instantaneous luminosity of $5\times10^{32}cm^{-2}s^{-1}$.
  - Integrated luminosity of 15 fb^{-1}.
  - Make the changes needed in a 6 month shutdown.

Implications of a 6 Month Installation

- In Jan-Feb. 2001, 6 weeks elapsed between silicon detector delivery and “ready for beam” condition.
  - Time was still needed to connect and commission the SVX/ISL system.
- This “roll in/out” operation cannot be significantly faster, in either direction
  - For scheduling, 7 weeks in each direction is reasonable to assume.
- Consequently, a 6 month shutdown gives CDF

  12 weeks of access to the detector.

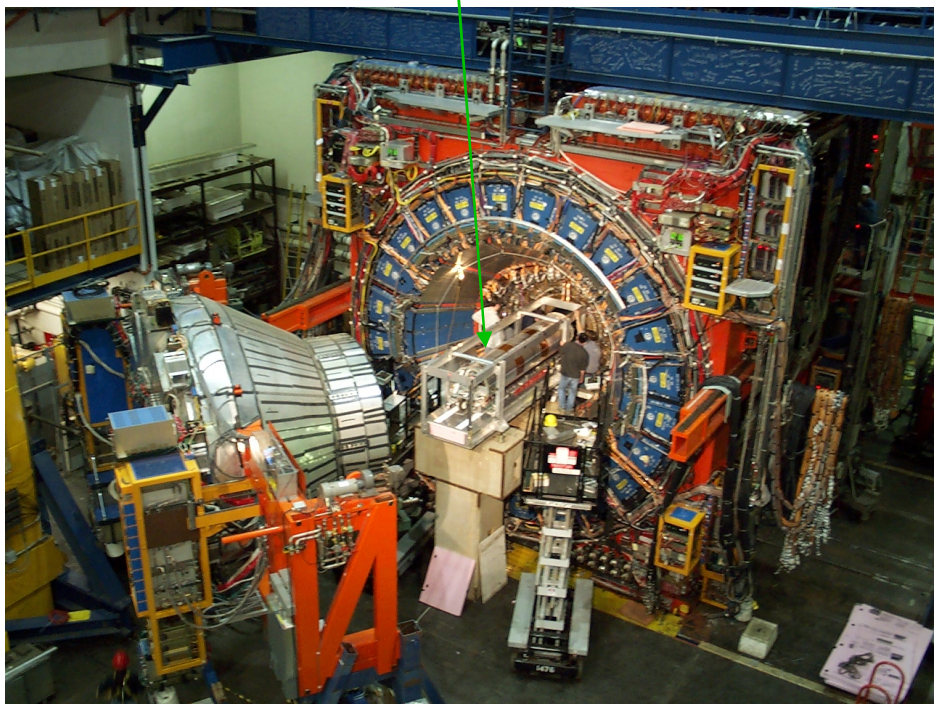
Implications of a 6 Month Installation

- The only way to replace a layer in the present silicon system with 12 weeks installation time is to replace mechanically discrete sections.
  - SVX II and the beampipe must be swapped with a replacement detector.
  - Any disassembly-reassembly approach would be time consuming and risky.
- Consequently, we propose a complete replacement of the beampipe, Layer 00 and SVX II.
  - Our model is 8 weeks for the detector swap, leaving 4 weeks for connecting/commissioning.

Run IIb Projects tied to detector access

- Silicon detector replacement
  - Space constraints require the central detector to leave the collision hall
  - The full silicon system (SVX II/ISL) must be removed and taken to the silicon facility
  - SVX, Layer 00 and the beampipe will be removed from the ISL
  - New replacement detector installed into the ISL
- Details will follow in the next talk.

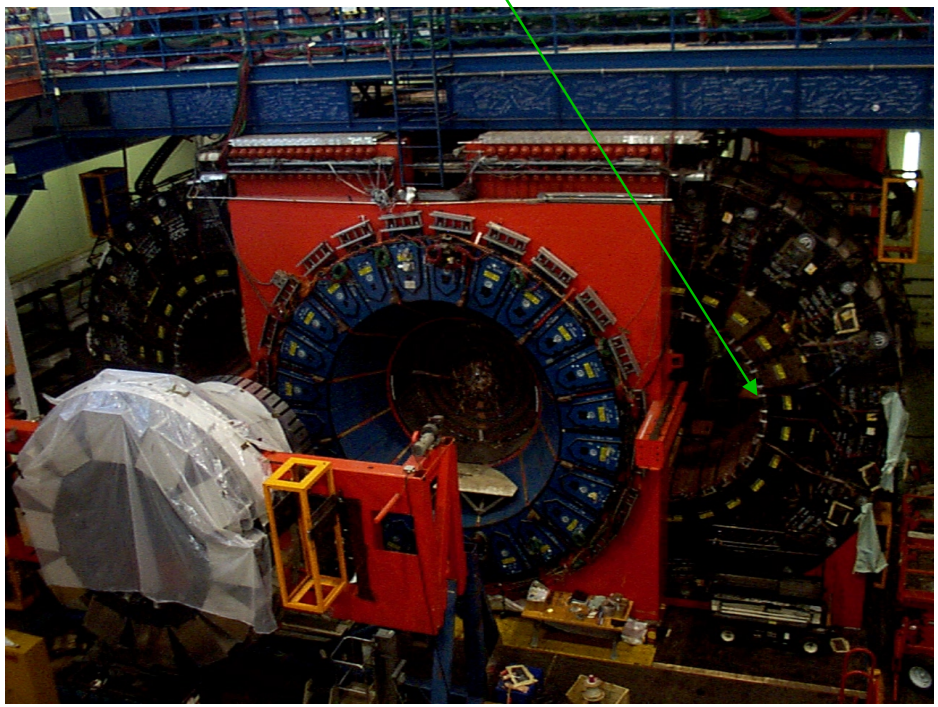
ISL positioned for installation



Run IIb Projects tied to detector access

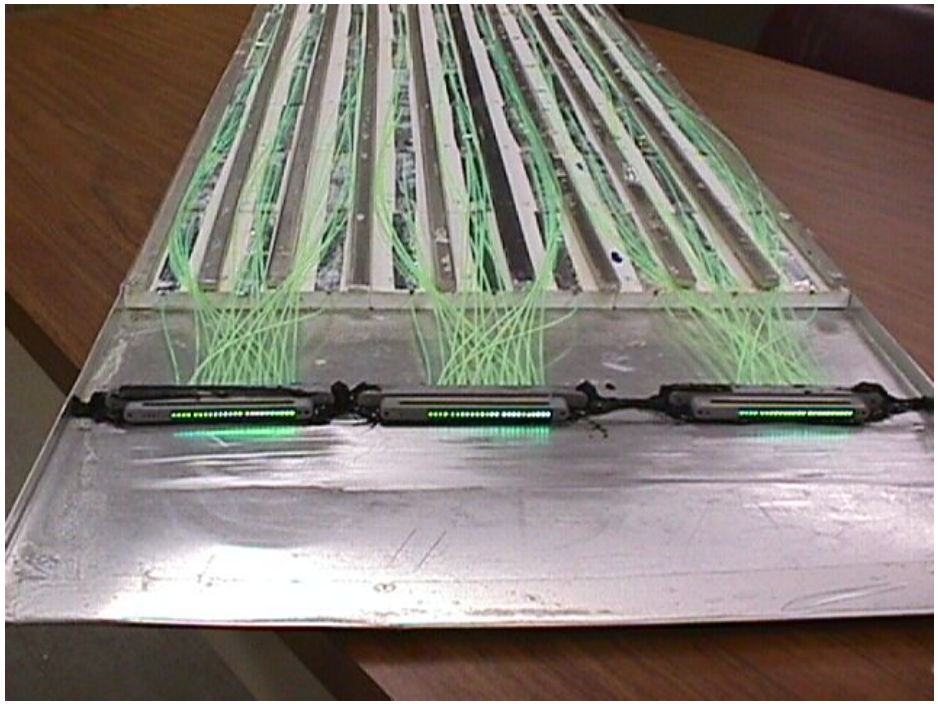
- Central Preradiator replacement
  - Existing gas chambers will be removed
  - New replacement scintillator chambers installed
  - Installation requires the calorimeter arches to be extracted
    - Only partial extraction is possible in the collision hall

CPR location



Preradiator Replacement

- The preradiator replacement will take the place of CPR
  - CPR is a gas chamber which will see ~20 interactions in Run IIb.
  - Replacement uses extruded scintillator
    - Minos excess is possible, used for the prototype
  - Fiber readout, with 16 channel phototubes
    - Same tube used in the plug calorimeter shower maximum detector



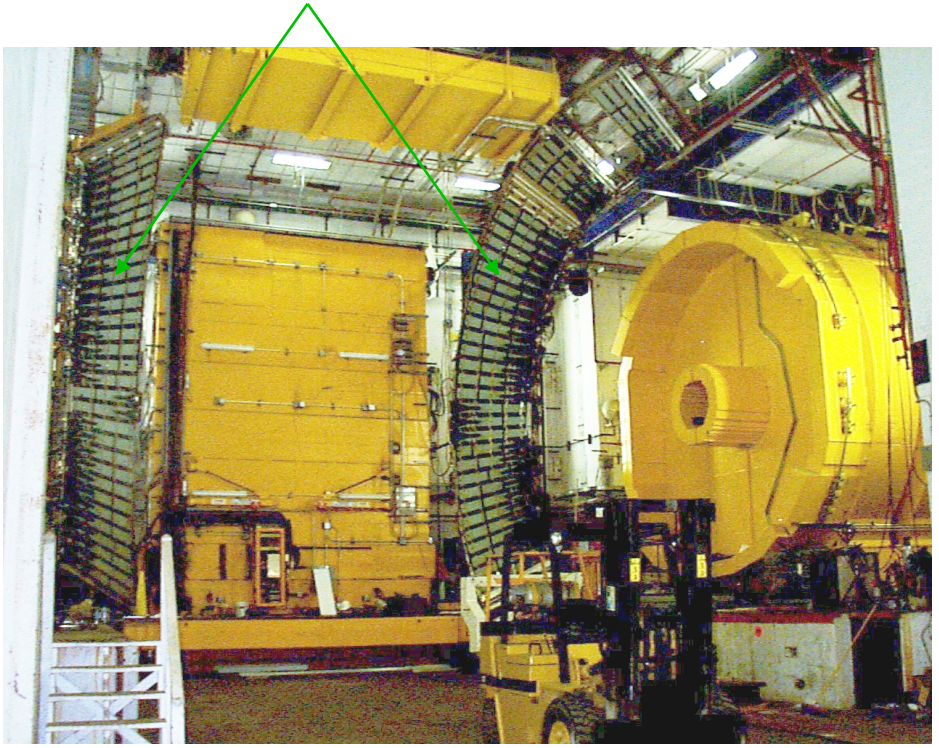
Preradiator Replacement

- CPR2 would be assembled at Argonne
  - Construction labor has been included in the cost estimate.
- A year to build is thought to be ample, so schedule is not yet critical for Run IIb
- Still some R&D to do, to settle on details
- Significant foreign contributions are expected
  - Phototubes and bases will be provided by Japan.
  - High voltage supplies provided by Italy.
- Installation can proceed within the ~8 weeks allowed
  - This does not compete with silicon detector installation for space.

Run IIb Projects tied to detector access

- CSX replacement
  - With the detector out of the collision hall, scintillator can be reached.
- Simple replacement of the interior counters would require new scintillator/ light guides.
- This project is not finalized
  - More Run IIa experience is needed.
  - We anticipate Italian funding of this, if we need it.

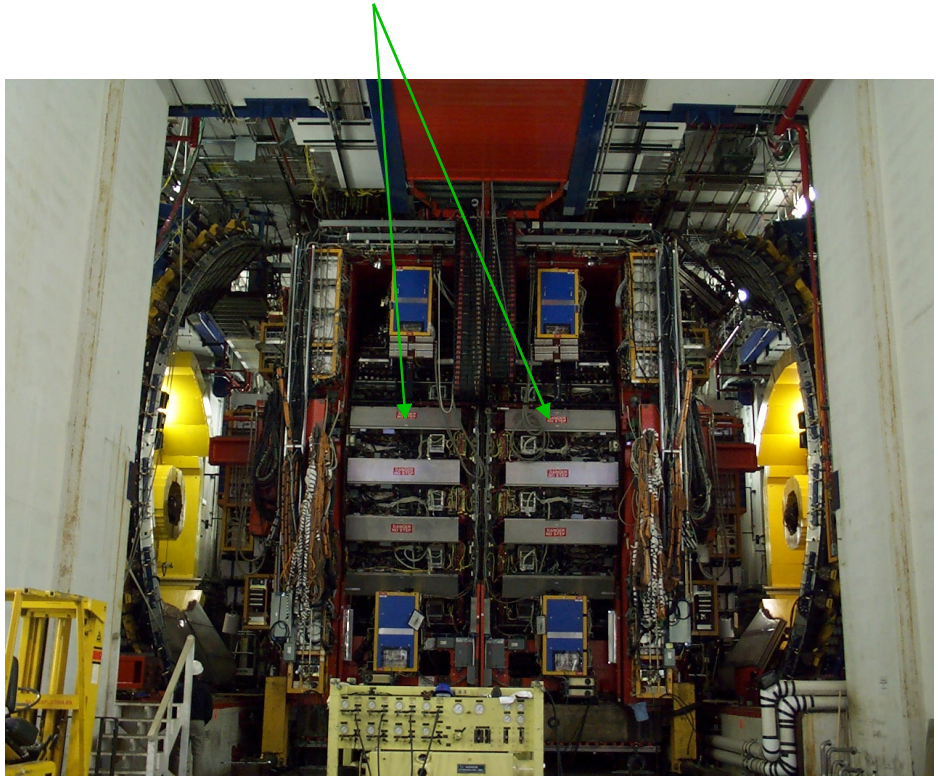
CSX counters



Run IIb Projects tied to detector access

- Electromagnetic calorimeter timing
- This proposal requires
  - Modification of each central EM Cal. phototube base
  - Cables installed to
    - new discriminators
    - TDCs in the counting room
- This plan still needs a technical review – not finalized
  - Impact on calorimeter and installation time uncertain

Central calorimeter



Run IIb Projects tied to detector access

- Cabling from counting rooms to the detector
  - Stereo track trigger cables
  - Calorimeter timing cables
  - These must be run with the detector out of the collision hall.
- Local cabling of the silicon system (detector to front end racks)
  - While possible in the collision hall, it would be quicker and safer outside.

Other installations

- 8 weeks is a reasonable amount of time for the other detector related installations. They are well removed from each other and independent.
  - Silicon cabling – owns the tracking volume
  - CPR2 – on the arches
  - CSX – in the collision hall
  - Counting room cabling – overhead, in the cable carrier
- Manpower estimates for these things make them look reasonable. Doing much more would be a challenge.

Run IIb Projects in the counting rooms

- Projects that do not require detector access have different schedule constraints.
  - While they may imply interruption to operations, they don't require six months, or affect the detector
- Event builder upgrade
- Track trigger upgrade
- Other Level 2 or TDC upgrades
- These can all proceed on a different schedule.

Triggers

- Addition of stereo information to XFT
  - Is an extension of the existing XFT system
  - This permits mass based track triggers
  - Also allows rapidity correlations with muon/electron detectors at the trigger level.
- Upgrade of the two track trigger
  - Include 3D information
- These projects are needed to retain low P_t triggers in Run IIb.
- More experience with Run IIa is needed to quantify the rates.
- Only cable installation is tied to detector access
  - Cables are in hand.
- Costs are based on experience with the XFT system

Event Builder/Level 3

- The event builder will require expansion to accommodate Run IIb rates.
- An upgrade of the ATM switch will likely be needed
  - Described in the TDR, this is straightforward.
- Other issues involve maintenance
  - Parts or software becomes obsolete – not supported.
  - Though many spares are in hand, some pieces may need replacement
- Computing power/needs for Level 3 are difficult to predict.
- The system is easy to expand, easy to swap in faster CPU.
- More experience with operations are needed
  - Level 2 commissioning
  - High luminosity experience

Other possible projects

- Level 2
  - Based on Alpha processors, this will be obsolete, and we may need more processing power in Run IIb.
  - Bus used for transferring data in Level 2 may be too slow for Run IIb
- This is not fully commissioned for Run IIa
- More experience is needed before this can be specified.
- TDCs
  - Readout times of the current TDCs may be insufficient for Run IIb.
  - Higher luminosity, and higher occupancy, slow the readout
- Operation at high luminosity is needed to fully understand this.
- Presumably, the next couple of months will teach us a lot here.

Other possible projects

- Projective COT
  - Presented at the last meeting, experts have been busy with operations.
  - Currently, no working plan exists to make COT projective.
  - Installation would present several problems
    - Risk to the chamber
    - Incompatible with 6 month shutdown.
  - We simply don't know enough to pursue this right now.
- These are mentioned simply for information.
- Run IIa operation has not yet taught us everything we need to know about high luminosity operation.

Cost and Schedule

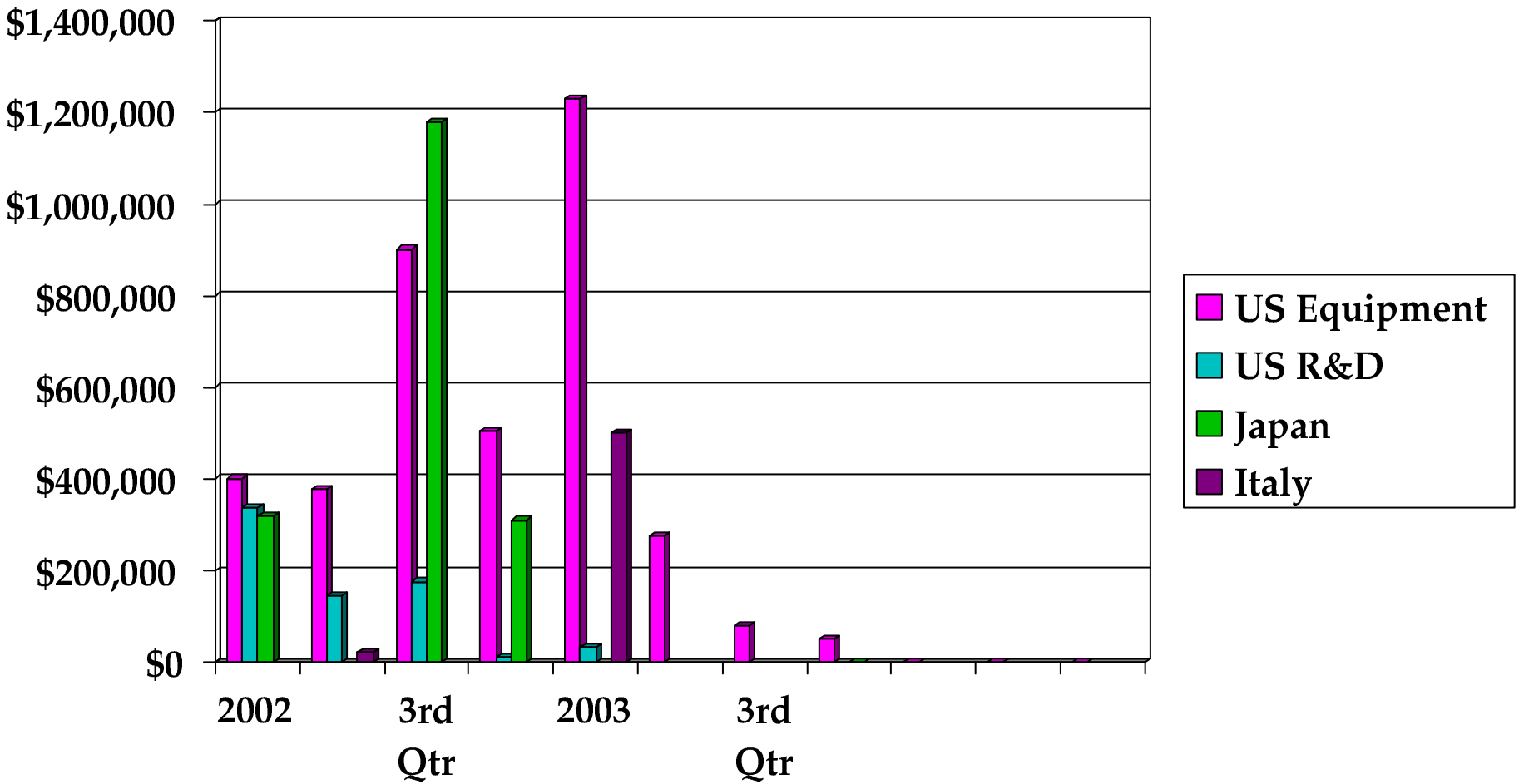
- Resource loaded schedules are in progress for silicon and preradiator projects.
- Only the silicon project has a schedule that looks tight.
  - R&D efforts on others are needed next year, however.
- Other projects have cost estimates, generally based on quotes and experience (Run IIa).
- Significant contributions are expected from Italy and Japan.

Estimated Cost of Run IIb

Project	Cost	Cost with Contingency	Foreign Contributions
Silicon Tracker	$7,515,300	$9,769,890	$3,154,000
Trigger Electronics	$484,880	$622,850	
Central Preradiator replacement	$603,084	$757,009	$445,664
Electromagnetic timing	$267,800	$398,500	$134,400
CSX Replacement	$113,000	$169,500	$113,000
Data Acquisition	$1,375,000	$2,062,500	
Total	$10,359,064	$13,780,249	$3,847,064

Foreign contributions are included within the Cost.

Funding profile for Run IIb Silicon detector (M&S)



Funding profile

- There are no surprises to the funding profile needed for the silicon detector
  - All the prototypes must be ordered now
  - All the quantity parts must be ordered in ~6 months
  - Production follows the acquisition of the parts
- To be ready for a July 2004 installation, we must start now, and be able to move quickly.

CDF's requests for Run IIb

- We request approval for
  - The silicon detector to replace SVX/L00. Next talk describes this.
  - The central preradiator replacement detector.
  - The stereo XFT and 3d track trigger boards.
  - The upgrade to the event builder and level 3 systems.
- Pending the results of more data and internal review
  - CSX replacement – aging needs to be demonstrated
  - Calorimeter timing – installation issues

Next steps

- Schedules will be further developed.
  - Labor profiles for the projects will be included.
- Cost review is scheduled for Early Dec.
- Baseline (Lehman) review scheduled for late January.
- Memoranda of Understanding will be written, to establish responsibilities amongst the institutions.