Run IIb D-Zero Detector Project

- Overview of project
- Organization
- Cost, schedule tools
- Documentation provided to Committee
- Risk analysis
- Schedule, cost overview
- Project cost & funding
- Manpower profiles
- Procurement strategy
- Conclusions

Jon Kotcher

Department of Energy Review of the Run IIb Projects

September 24-26, 2002

Run IIb Design Guidelines

- Run IIb: increase in instantaneous, integrated luminosity relative to guidelines that drove Run IIa detector design

	Integrated Luminosity (fb^{-1})	Instantaneous Luminosity ($X10^{32}cm^{-2}sec^{-1}$)
Run IIa	2	1-2
Run IIb	10-15	2-5
Requirements for Run 2b	Silicon replacement, more rad-hard version	Trigger upgrades (dominated by Level 1)

- Silicon:
  - Current detector designed for ~ 2 fb^{-1}, evidence that it will survive to 4-5 fb^{-1}
    - The most appropriate rad-hard technology used at that time
  - After study of various options, have chosen to pursue full silicon replacement
    - Partial replacement not viable: unacceptable level of technical risk, more down-time for removal/installation, limited SVX2 chip availability, etc.
- Trigger:
  - Increase in luminosity results in unacceptable increase in rates - occupancies, pileup, combinatorial effects
  - Move rejection upstream in readout stream (contain dead time), maintain both downstream rejection, event selectivity
  - Address need for higher-bandwidth data logging

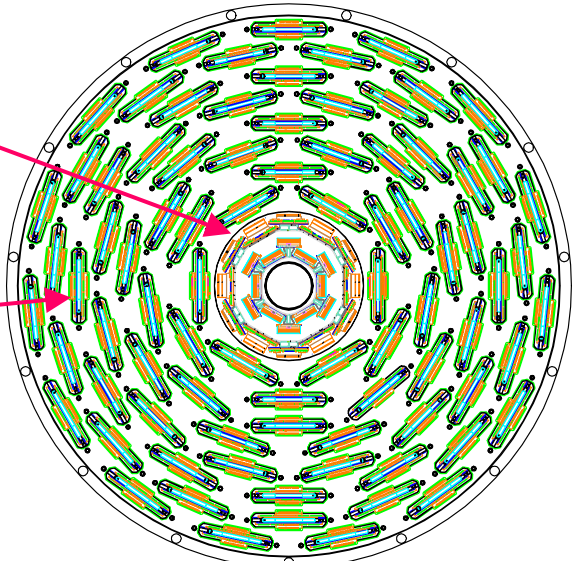
Subproject Overviews

- WBS 1.1: Silicon Detector
  - Replace with more radiation-hard version
- WBS 1.2: Trigger Systems
  - Level 1: Shift some trigger functionality upstream to hardware level trigger
    - WBS 1.2.1, L1 Calorimeter Trigger
    - WBS 1.2.2, L1 Calorimeter/Track Match
    - WBS 1.2.3, L1 Central Track Trigger
  - Level 2: Incremental upgrades to Run IIa systems
    - WBS 1.2.4, L2 Beta System
    - WBS 1.2.5, L2 Silicon Track Trigger
- WBS 1.3: DAQ/Online System
  - Address need for enhanced filtering capability, higher bandwidth data logging
- WBS 1.4: Project Administration
  - Project personnel, travel, miscellaneous supplies
- WBS 1.5: Installation
  - Integration of silicon, trigger installation & pre-beam commissioning

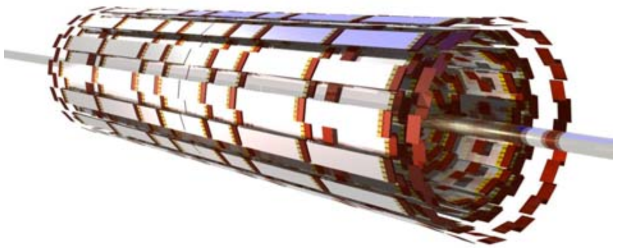
WBS 1.1: Basic Silicon Design Choices

See talks by Marcel Demarteau & Alice Bean

- Six layer silicon tracker, divided into two radial regions
  - Inner layers: Layers 0 and 1
    - Axial readout only
    - Mounted on integrated support
    - Assembled into one unit
    - Designed for V_{bias} up to 700 V
  - Outer layers: Layers 2-5
    - Axial and stereo readout
    - Stave support structure
    - Designed for V_{bias} up to 300 V



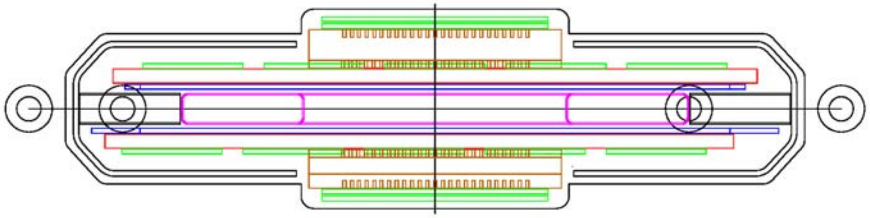
- Employ single sided silicon only, 3 sensor types
  - 2-chip wide for Layer 0
  - 3-chip wide for Layer 1
  - 5-chip wide for Layers 2-5



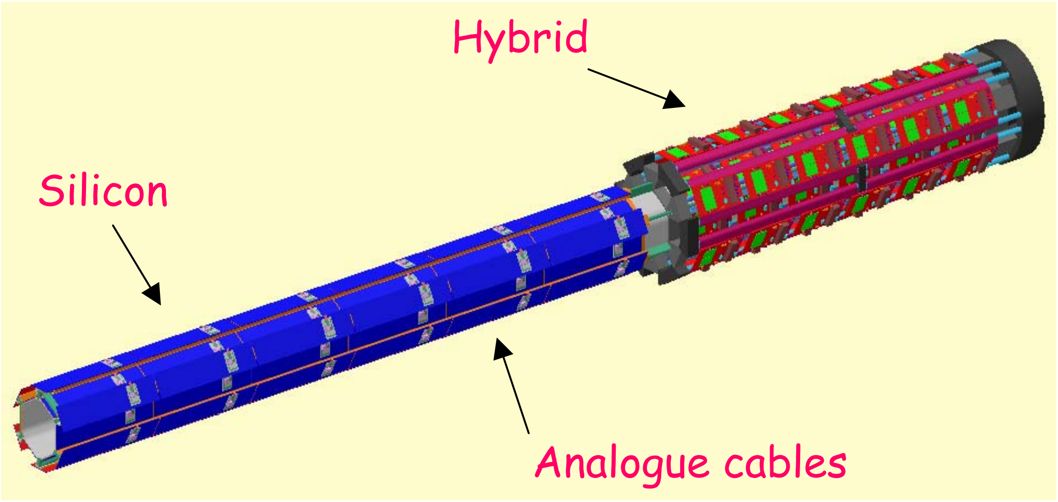
- No element supported from beampipe

Silicon Detector Elements

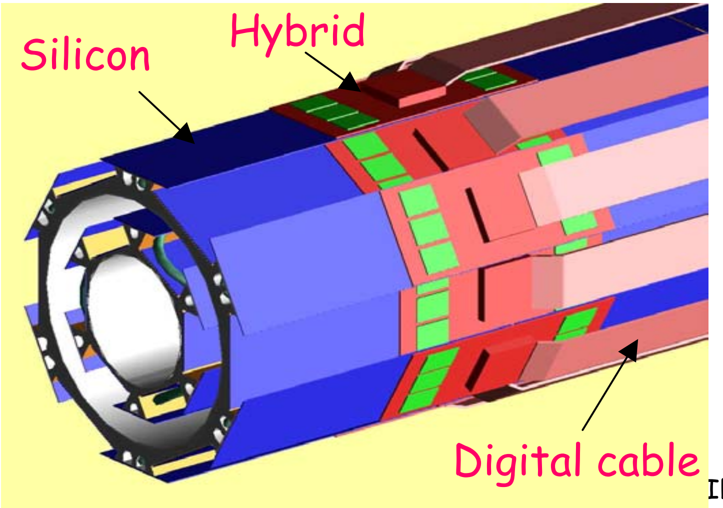
- 168 silicon staves: basic building block of outer layers
- Supported in positioning bulkheads at z=0, z=610 mm



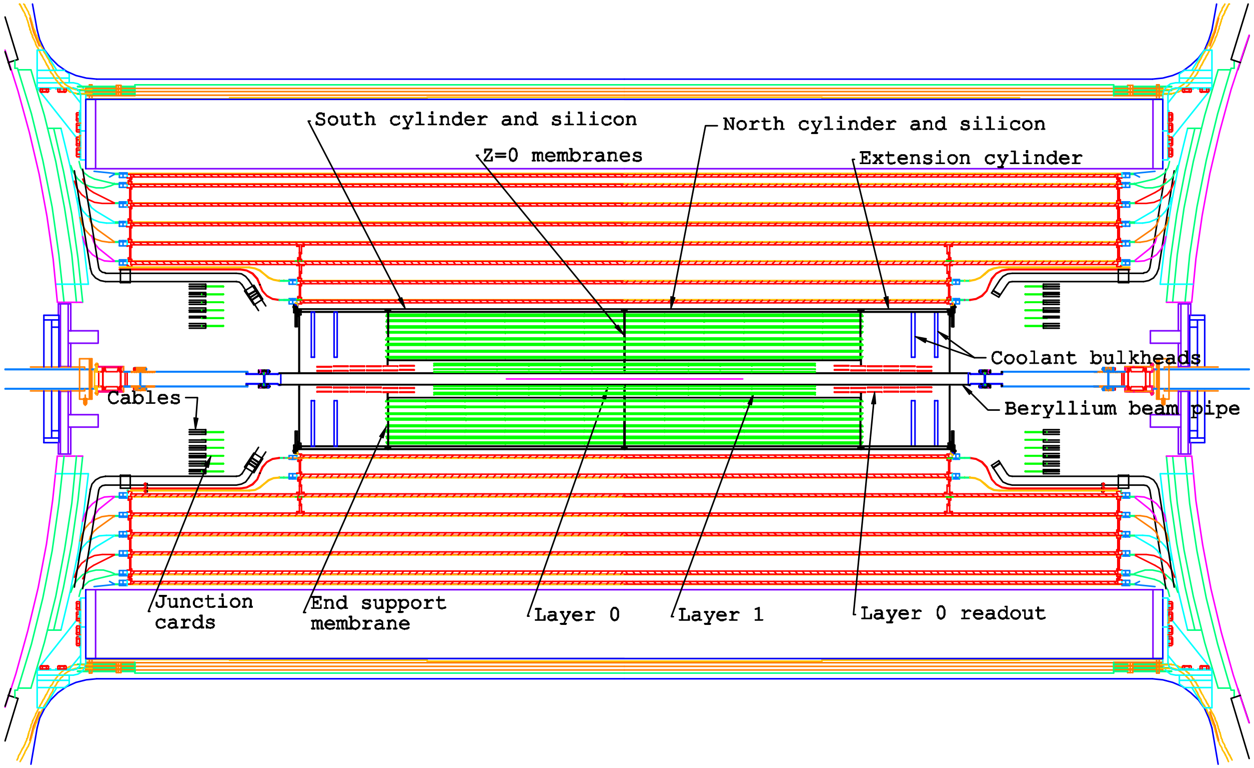
- Layer 0
  Support structure: University of Washington



- Layer 0/Layer 1 mated



Plan View of Run IIb Barrel Region



- 18.542 mm IR beam tube
- L0 and L1: 12 sensors long, each 79 mm in length
- L2 – L5: 12 sensors long, each 100 mm in length
- 1220 mm long barrel region
- Support from "bulkheads" at z = 0 and z = ±610 mm

WBS 1.2: Run IIb Trigger Upgrade

See talk by Darien Wood

System	Problems	Solutions
Cal	1) Trigger on $\Delta\eta\times\Delta\phi$=0.2×0.2 TTs ⇒ slow turn-on curve 2) Slow signal rise ⇒ trigger on wrong crossing	• Clustering • Digital Filter
Track	1) Rates sensitive to occupancy 2) Limited match to calorimeter	• Narrower Track Roads • Improve Cal-Track Match
Muon	No Additional Changes Needed!	• Requires Track Trigger

Trigger	Example Physics Channels	L1 Rate (kHz) (no upgrade)	L1 Rate (kHz) (with upgrade)
EM (1 EM TT > 10 GeV)	$W \to e\nu$ $WH \to e\nu jj$	1.3	0.7
Di-EM (1 EM TT > 7 GeV, 2 EM TT > 5 GeV)	$Z \to ee$ $ZH \to eejj$	0.5	0.1
Muon (muon p_T > 11 GeV + CFT Track)	$W \to \mu\nu$ $WH \to \mu\nu jj$	6	0.4
Di-Muons (2 muons p_T > 3 GeV + CFT Tracks)	$Z \to \mu\mu$, $J/\Psi \to \mu\mu$ $ZH \to \mu\mu jj$	0.4	< 0.1
Electron + Jets (1 EM TT > 7 GeV, 2 Had TT > 5 GeV)	$WH \to e\nu$+jets $tt \to e\nu$+jets	0.8	0.2
Muon + Jet (muon p_T > 3 GeV, 1 Had TT > 5 GeV)	$WH \to \mu\nu$+jets $tt \to \mu\nu$+jets	< 0.1	< 0.1
Jet+MET (2 TT > 5 GeV, Missing E_T> 10 GeV)	$ZH \to \nu\bar{\nu}b\bar{b}$	2.1	0.8
Muon + EM (muons p_T > 3 GeV+ CFT track + 1 EM TT > 5 GeV)	$H \to WW, ZZ$	< 0.1	< 0.1
Single Isolated Track (1 Isolated CFT track, p_T > 10 GeV)	$H \to \tau\tau$, $W \to \mu\nu$	17	1.0
Di-Track (1 isolated tracks p_T > 10 GeV, 2 tracks p_T > 5 GeV, 1 matched with EM energy)	$H \to \tau\tau$	0.6	<0.1

Level 1 systems

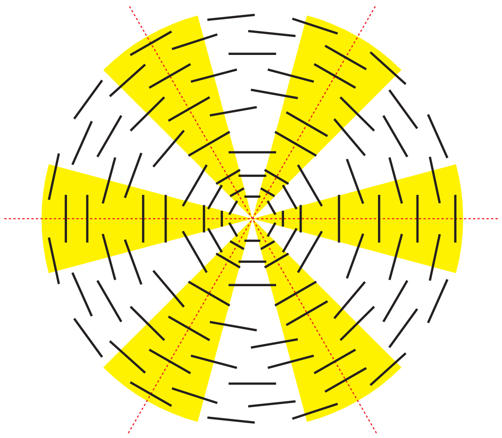
Core Run IIb trigger menu, simulated at 2E32, 396 ns ←

Total output rate with (without) L1 trigger upgrade = 3.2 (~30) kHz

Available L1 bandwidth budget: 5 kHz

Run IIb Level 2 Trigger Upgrade

- Modest upgrades to two components:
  - Silicon Track Trigger
    - Vital for triggering on b-quarks
      - $ZH \rightarrow \nu\nu bb$
      - $Z \rightarrow bb$ (top mass jet energy scale)
    - Improves track trigger
      - Sharper p_T turn-on
      - Reduced fake rate
    - Upgrade needed to accommodate design of new silicon detector
      - Instrumenting 5 of 6 Run IIb silicon layers
        - See report submitted to June PAC
  - Level 2β processors
    - More processing power required to retain same Level 2 rejection
    - Add 12 additional processors



Trigger upgrades centered at collaborating universities & laboratories, US and foreign

See talk by Stu Fuess

WBS 1.3: DAQ/Online

System	Items	Need
Level 3 filter nodes	96 more L3 Farm nodes	Match to rates and processing requirements
DAQ HOST system	Linux data logging nodes and buffer disk arrays	Replace existing systems with higher performance nodes
ORACLE systems	Database nodes, disk arrays, and backup systems	Adopt lab standard ORACLE platform
File Server systems	Linux server nodes, disk arrays, and backup systems	Provide increased storage capacity
Slow Control system	VME processors for control and monitoring of detector	Improve monitoring performance for extended run

Upgrades to DAQ/Online systems required for long-term, high rate running during Run IIb

WBS 1.5: Installation

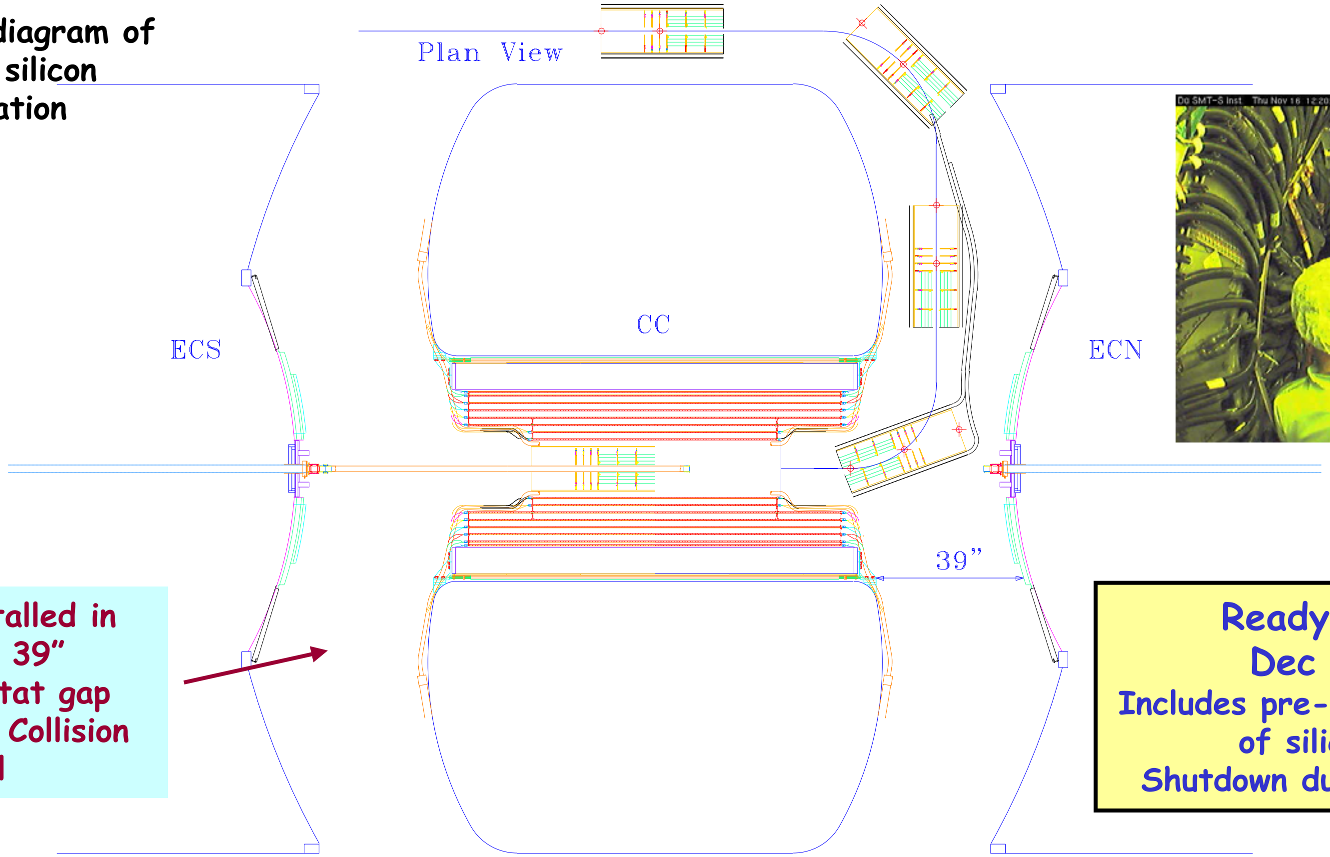
Installation sub-project contains integrated plan for silicon, trigger installation and commissioning

Activity in Collision Hall dominated by silicon installation, hookup

Split-silicon design allows installation in Collision Hall

Detector platform not rolled out - much reduces time, effort, risk

Conceptual diagram of Run IIa silicon installation



Silicon installed in nominal 39" intercryostat gap available in Collision Hall

Ready for Beam: Dec 22, 2005

Includes pre-beam commissioning of silicon, trigger

Shutdown duration: 7 months

D0 Experiment Organization

- **Spokespersons**: G. Blazey, J. Womersley
  - **Advisory Council** – Chair: V. Büscher
  - **Institutional Board** – Chair: T. Wyatt
  - **Speakers Bureau** – Chair: D. Hedin
  - **Run IIb Project** – J. Kotcher
    - Silicon
    - Trigger
    - DAQ/Online
    - Administration
    - Installation
  - **Run Coordinator** – D. Denisov
    - Subdetectors
    - Online
    - DAQ
    - Trigger
  - **Software and Computing** – A. Boehnlein, J. Qian
    - Algorithms
    - Simulation
    - Infrastructure
    - Global Systems and Production
    - Data Access and Databases
    - Online
  - **Physics Coordinator** – B. Klima
    - Physics Groups
    - ID Groups
    - Trigger Board
    - Offline Resources Board

Run IIb Project Organization

D0 Run IIb Project
J. Kotcher, Project Manager
R. Partridge, Deputy; V. O'Dell, Associate; W. Freeman, Assistant
M. Johnson, Technical Coordinator
C. Yoshikawa, Budget Officer; T. Erickson, Administration

WBS 1.1 Silicon
M. Demarteau
A. Bean, Deputy

- 1.1.1 Sensors — R. Demina, F. Lehner
- 1.1.2 Readout System — A. Nomerotski
- 1.1.3, 1.1.5 Mechanics & Assembly — W. Cooper, K. Krempetz
- 1.1.4 Production — J. Fast, H. Haggerty
- 1.1.4 QA, Testing, & Burn-in — C. Gerber
- 1.1.6 Monitoring — M. Corcoran, S. de Jong
- 1.1.7 Software & Simulation — F. Rizatdinova, L Shabalina
- 1.1.8 Administration — (M. Demarteau)

WBS 1.2 Trigger
H. Evans
D. Wood

- 1.2.1 L1 Cal Upgrade — M. Abolins, (H. Evans), P. LeDu
- 1.2.2 L1 Cal/Track Match — K. Johns
- 1.2.3 L1 Track Trigger — M. Narain
- 1.2.4 L2β Upgrade — R. Hirosky
- 1.2.5 Silicon Track Trigger — U. Heintz
- 1.2.6 Simulation — M. Hildreth, E. Perez
- 1.2.7 Administration — (D. Wood)

WBS 1.3 DAQ/Online
S. Fuess
P. Slattery

- 1.3.1 Level 3 Systems — D. Chapin, G. Watts
- 1.3.2 Network & Host Systems — J. Fitzmaurice, S. Krzywdzinski
- 1.3.3 Control Systems — F. Bartlett, G. Savage, V. Sirotenko
- 1.3.4 DAQ/Online Management — (P. Slattery)

WBS 1.4 Project Administration

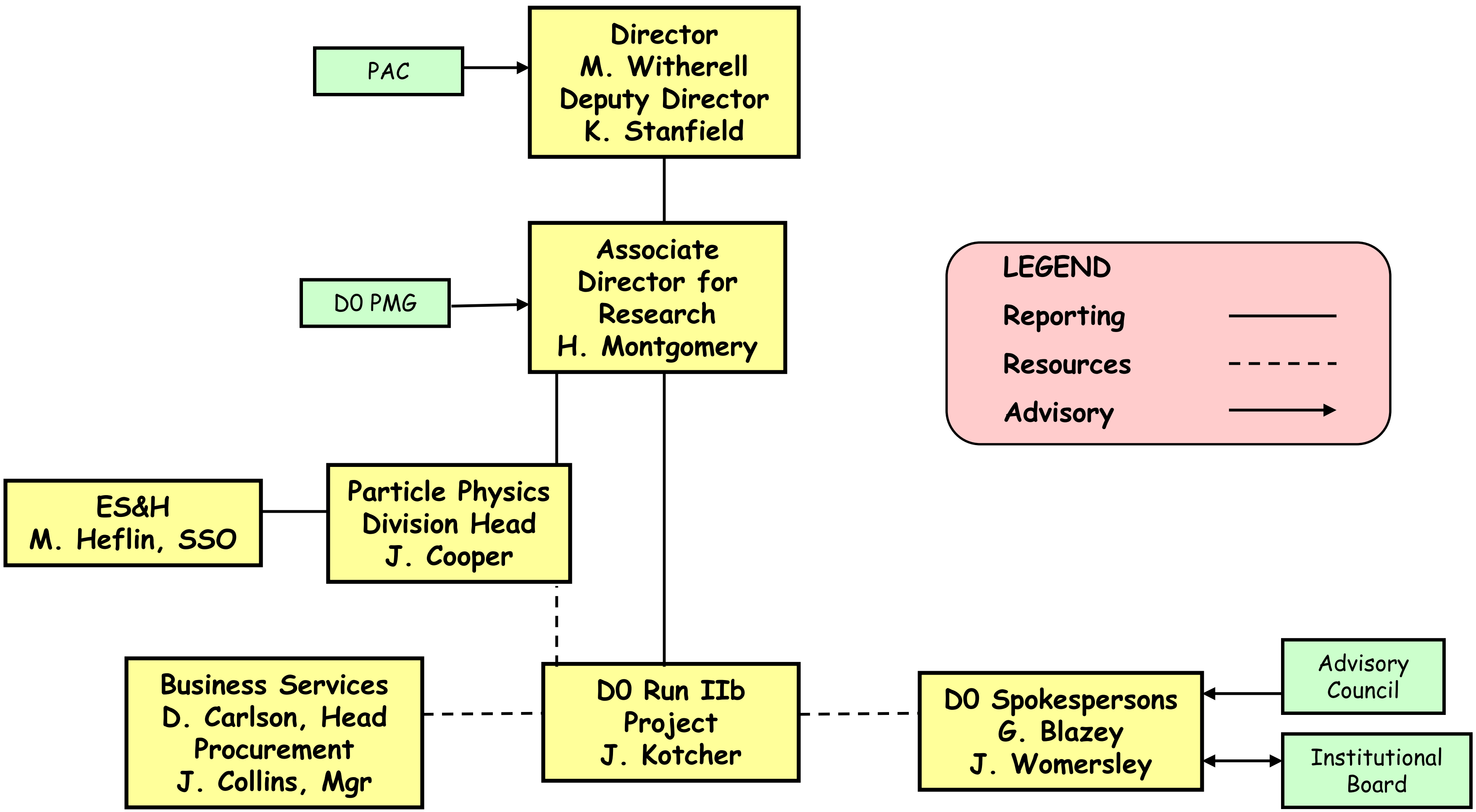
WBS 1.5 Installation
R. Smith

- 1.5.1 Silicon Installation — Mechanical: H. Lubatti; Electronics: L. Bagby, R. Sidwell
- 1.5.2 Trigger Installation — D. Edmunds

Installation is integral part of project plan, but removed from formal Run IIb baselining

Experienced group, key positions in place for more than 1 year. All managers in place through WBS Level 3.

Project Reporting Structure



Past Run IIb Milestones, Reviews

- April/Nov 00: Initial presentations of Run IIb plans to PAC
- June 01: D-Zero Trigger Task Force put in place to clarify Run IIb trigger needs
  - Co-chairs: M. Hildreth, R. Partridge
- Nov 01: Silicon TDR and Trigger/Online CDR presented to PAC
- Dec 01: Director's Technical Review of CDF and D-Zero Run IIb Upgrades
  - Chair: J. Pilcher
- April 02: Director's Review of Run IIb Upgrade Projects
  - Chair: E. Temple
- June 02: Aspen PAC recommends Stage I approval
- Aug 12-15 '02: Director's Review of Run IIb Upgrade Projects
  - Co-chairs: E. Temple, J. Pilcher
  - Silicon sub-project "well developed", design "clearly mature"
  - All five trigger sub-projects deemed "ready for baselining"
  - Project preparedness, quality & depth of staffing noted
- Sep 24-26 '02: DOE (Lehman) Review

Cost, Schedule Tools

- Work from resource-loaded schedule in MS Project 2000. To set scale:
  - Silicon (1.1) – 1000 lines
  - Trigger (1.2) – 340 lines
  - Online (1.3) – 150 lines
  - Project Administration (1.4) – 20 lines
  - Installation (1.5) – 180 lines

Total: 1690 lines

- MS Project schedule is primary project tool used for cost, schedule development
  - All M&S, labor, contingency estimates, & risk factors loaded directly into schedule
- Project costs reflect technical manpower only
  - Physicists are not costed, but are fully loaded & used for project planning
- Burdening, escalation introduced external to schedule for this review
  - COBRA, primary project cost tracking tool, in final stages of preparation
    - Introduces these factors - calculates earned value
  - Full D-Zero Run IIb schedule has been uploaded into COBRA

COBRA Output from Run IIb Schedule

Program: D0MASTER	Description: D0 MASTER PROGRAM	Approval:
Run Date: 9/21/2002	Status Date: 9/30/2001	Program Manager Functional Manager Cost Account Manager

WBS[2]	Funding-CA		FY 01	FY 02	FY03	FY 04	FY 05	FY 06	Cumulative
1.1 Run IIb Silicon									
	EQU	BCWS	0	0	4,206,885	4,585,514	748,262	0	9,540,661
	INK-MRI1	BCWS	15,021	977,981	985,572	443,384	4,945	0	2,426,903
	INK-OTHER	BCWS	0	0	0	14,000	0	0	14,000
WBS[2] Totals:		BCWS	15,021	977,981	5,192,456	5,042,898	753,207	0	11,981,564
1.2 Run IIb Trigger Upgrade									
	EQU	BCWS	0	0	424,572	892,671	205,036	0	1,522,278
	INK-FOREIGN	BCWS	0	226,680	249,753	108,923	2,016	0	587,372
	INK-MRI2	BCWS	0	0	110,802	403,395	47,790	0	561,986
	INK-OTHER	BCWS	0	149,179	194,790	17,037	40,531	0	401,539
WBS[2] Totals:		BCWS	0	375,859	979,917	1,422,027	295,372	0	3,073,175
1.3 Online Systems									
	EQU	BCWS	0	0	61,793	317,741	599,928	0	979,463
WBS[2] Totals:		BCWS	0	0	61,793	317,741	599,928	0	979,463
1.4 Run IIb Project Administration									
	EQU	BCWS	0	0	283,695	293,070	303,295	0	880,059
WBS[2] Totals:		BCWS	0	0	283,695	293,070	303,295	0	880,059
Grand Totals:									
		BCWS	15,021	1,353,841	6,517,861	7,075,735	1,951,803	0	16,914,261

All sub-projects

Funding sources

Budgeted Cost of Work Scheduled

Escalated, burdened project cost (no contingency)

Final cross checks in process

Documentation Provided to Committee

- Technical Design Report
  - Detailed technical descriptions of all systems: Silicon (WBS 1.1), Trigger (WBS 1.2), DAQ/Online (WBS 1.3), Installation (WBS 1.5)
- Black book:
  - Plenary talks
  - GANTT charts of project schedule, milestones, critical path
  - Risk analysis summary
  - D-Zero/CDF Silicon Comparison Document
  - Silicon Run IIb Manpower Requirements, Run IIa Comparison (PPD)
  - Committee Report from August '02 Director's Review
- Blue book:
  - Selected 15' presentations prepared for breakouts by Level 3 Subproject Managers
- Red book:
  - Preliminary project planning documents:
    - Acquisition Execution Plan
    - Project Execution Plan
    - Project Management Plan
  - Multi-Year Run IIb Memorandum of Understanding, Statement of Work
  - Run II General Collaboration MoU

Documentation Provided to Committee

- Purple book:
  - WBS Dictionary, Basis of Estimate for all subsystems
- Five green cost books:
  - Book 1: Silicon Sensors (1.1.1), Readout (1.1.2)
  - Book 2: Mechanical Design (1.1.3), Production & Testing (1.1.4)
  - Book 3: Barrel Assembly (1.1.5), Monitoring (1.1.6), Software & Simulation (1.1.7), Administration (1.1.8)
  - Book 4: Trigger (1.2)
  - Book 5: DAQ/Online (1.3)
  - Contain supporting BoE documentation: past POs/reqs, vendor quotes, labor estimates, etc.

Silicon (Books 1–3)

- Project charts (posted on walls in breakout rooms):
  - Flow chart of D-Zero silicon module production
  - GANTT chart of full project schedule
- Links to previous review web pages
  - June '02 PAC, Director's Reviews, responses to past reports, etc.

Project Risk Assessment

Evaluating Impact of a Risk on Major Project Objectives

Project Objective	Very Low Impact .05	Low Impact .1	Moderate Impact .2	High Impact .4	Very High Impact .8	Comments
Cost	Insignificant cost increase	<5% cost increase	5-10% cost increase	10-20% cost increase	>20% cost increase	
Schedule	Insignificant schedule slippage	Schedule slippage <5%	Overall project slippage 5-10%	Overall project slippage 10-20%	Overall project schedule slips>20%	20% slippage ~ 8 months
Scope	Scope decrease barely noticeable	Minor areas of scope affected	Major areas of scope affected	Project scope reduction unacceptable for physics objectives	Scope of project effectively useless for physics objectives	
Technical	Technical degradation of project barely noticeable	Technical performance of final product minimally affected	Technical performance of final product moderately affected	Degradation of technical performance of final product unacceptable for physics objectives	Technical performance of project end item effectively useless for physics objectives	

Risk evaluated at WBS Level 4, project wide

Project Risk Assessment

Risk Matrix:
Product of risk impact and probability
green, yellow, red = low, moderate, high risk

Probability	Risk Score = Probability x Impact				
0.9	0.05	0.09	0.18	0.36	0.72
0.7	0.04	0.07	0.14	0.28	0.56
0.5	0.03	0.05	0.10	0.20	0.40
0.3	0.02	0.03	0.06	0.12	0.24
0.1	0.01	0.01	0.02	0.04	0.08
	0.05	0.10	0.20	0.40	0.80
	Impact on Objectives				

- Select high risk score elements, discuss means of mitigation
  - Mitigation procedure in notes field in Basis of Estimate
- Risk score used to aid assigning cost, labor, and schedule contingency

Example Risk Summary

Silicon Sensors (1.1.1) & Readout (1.1.2)

ID	WBS	Name	Cost Risk Score	Schedule Risk Score	Scope Risk Score	Technical Risk Score
1	1.1	Run IIb Silicon				
2	1.1.1	Sensors				
3	1.1.1.1	Probing Equipment Setup	Green	Green	Green	Green
16	1.1.1.2	L0 Sensors	Green	Green	Yellow	Yellow
43	1.1.1.3	L1 Sensors	Green	Green	Yellow	Yellow
73	1.1.1.4	L2-L5 Sensors	Yellow	Yellow	Green	Green
105	1.1.2	Readout System				
106	1.1.2.1	SVX4 Chips	Red	Red	Yellow	Yellow
139	1.1.2.2	L0 Hybrids	Green	Green	Yellow	Yellow
164	1.1.2.3	L1 Hybrids	Green	Green	Yellow	Yellow
196	1.1.2.4	L2-L5 Hybrids	Yellow	Yellow	Yellow	Yellow
227	1.1.2.5	L0 Analog Flex Cables	Yellow	Green	Red	Red
239	1.1.2.6	L0-L1 Digital Jumper Cables (KSU)	Green	Green	Green	Green
252	1.1.2.7	L2-L5 Digital Jumper Cables (KSU)	Green	Green	Green	Green
265	1.1.2.9	Testing of cables (LA Tech)	Green	Green	Green	Green
273	1.1.2.10	L0-L1 Junction Cards	Green	Green	Green	Green
283	1.1.2.11	L2-5 Junction Cards	Green	Green	Green	Green
293	1.1.2.12	Twisted-Pair Cables	Yellow	Green	Yellow	Yellow
311	1.1.2.13	Adapter Cards	Yellow	Green	Yellow	Yellow
326	1.1.2.14	SASEQ Test Stands	Green	Green	Green	Green
357	1.1.2.16	Interface Boards and backplanes	Green	Green	Green	Green
371	1.1.2.17	Low Voltage System	Green	Green	Green	Green
390	1.1.2.18	High-mass Cables	Green	Green	Green	Green
394	1.1.2.19	High Voltage System	Green	Green	Green	Green
410	1.1.2.21	Support of Downstream electronics at Fermilab	Green	Green	Green	Green

Risk assessed at WBS Level 4

(Green, Yellow, Red) = (Low, Medium, High) Risk Score

Performed for all subprojects

Schedule Management

- April '02 Director's Review of Run IIb Projects:
  - "…we do encourage the collaborations to manage aggressively to an optimistic schedule."
  - "…suggest a significant float be added to project completion, perhaps as much as a year beyond the Silicon ready to install date."
  - Approach endorsed by August Director's Review Committee
- Schedule being managed to contains no explicit slack
  - Task durations reflect nominal need for completion
- Three tiers of project milestones, with time offsets between them, will be used for project oversight:
  - Project Manager Milestones, extracted directly from schedule. These contain no explicit contingency.
  - Director/DOE Project Manager Milestones: modest amount of schedule contingency introduced, aided by integrating risk assessments.
  - DOE Level 1 Milestones, in which additional contingency has been added, based on above guidance.
- Project being managed to nominal dates represented by Project Manager Milestones. These reflect the schedule we intend to meet.

DOE Level 1 Milestones, CD-4

Milestone	Project Manager	Director/ DOE PMgr	DOE Level 1
All silicon sensors delivered and tested	07/28/04	10/26/04	7/05
Level 2 Trigger Production and Testing Complete	02/28/05	06/25/05	3/06
Level 1 Trigger Production and Testing Complete	03/16/05	07/13/05	4/06
Silicon stave production complete	03/25/05	07/24/05	4/06
Online System Production and Testing Complete	06/17/05	10/06/05	7/06
Silicon ready to move to DO Assembly Building	07/22/05	12/26/05	11/06 CD-4: Approve Project Closeout

Project being managed to Project Manager's Milestones

DOE Level 1 milestone dates guided by recommendations from April '02 Director's Review of Run IIb Projects

GANTT Chart of Director's Milestones for All Subprojects

ID	Task Name	Milestone (2003–2006)
1	**Silicon**	
2	Silicon Prototype Mechanical Stave Built	12/27
3	L2-L5 Silicon Sensors Released For Production	3/3
4	SVX4 Released For Production	6/27
5	Successful Readout Of Full Silicon Stave	11/23
6	Silicon Module Production Begun	3/22
7	All SVX4 Chips Produced And Tested	6/27
8	All Silicon Hybrids Produced And Tested	10/8
9	Silicon Stave Production Begun	10/20
10	All Silicon Sensors Delivered And Tested	10/26
11	Silicon Module Production And Testing Complete	2/20
12	Downstream Silicon Readout Ready for Installation On Platform	4/24
13	Silicon Stave Production Complete	7/24
14	South Silicon Complete	10/27
15	North Silicon Complete	12/6
16	Silicon Ready To Move To DAB	12/26
17	**Trigger**	
18	L1 Trigger Cal-Trk Match Production and Testing Completed	9/26
19	L2 Silicon Track Trigger Production and Testing Complete	3/8
20	L1 Calorimeter Trigger Production And Testing Complete	5/15
21	L2 Beta Trigger Production And Testing Complete	6/7
22	L2 Trigger Upgrade Production and Testing Complete	6/25
23	L1 Central Track Trigger Production And Testing Complete	7/13
24	L1 Trigger Upgrade Production and Testing Complete	7/13
25	**Online**	
26	Online System Production and Testing Complete	10/6

Cost, Labor Contingency Evaluation

- Base estimates for both labor and equipment contain no contingency
- Contingency for both estimated on task-by-task basis by Level 2 Subproject Managers
- Contingency guidelines provided by Project Manager in Project Management Plan
- Can be overridden by Subproject Managers if justified by risk factors
  - Example: 94% on silicon analog flex cables (WBS 1.1.2.5)
  - Moderate cost risk, high scope/technical
  - Large contingency helps mitigate potential risk
  - Same principle applies to labor contingency estimates
- Contingency estimates by Subproject Managers thought to be adequate, and have been used in cost estimates

Project Contingency Guidelines

- **Guidelines for M&S contingency from Project Management Plan:**

7.1.2 Contingency Estimation

The contingency is estimated by the WBS level 3 Sub-project Managers at the lowest available level. It is based on detailed estimates of designs where available, and on the experience of the Sub-project Managers and the engineering staff directly involved with the subsystem where a conceptual design exists. Guidelines for the estimation of the contingency have been provided, but may be overridden by the Sub-project Managers in exceptional cases. The general guidelines for the contingency estimation are:

- 0% on items that have been completed.
- about 10-15% on items that have been ordered, but not delivered (this accommodates change orders, delivery costs, etc.)
- about 30-50% on items that can be readily estimated based on quotes for a detailed design
- about 50-70% on items for which a detailed conceptual design exists
- about 70-100% on items for which there does not yet exist a detailed conceptual design, but which is an item required for the Project

- **For Labor, general guidance is 50% - exceptions can be made during life cycle of project (i.e., multiple shifts, overtime during production)**

US National Science Foundation MRIs for Run IIb

- Silicon MRI submitted Feb '01, awarded July '01
  - Brown, California State (Fresno), U Illinois (Chicago), Kansas, Kansas State, Michigan State, Stony Brook, Washington, (Moscow State, CINVESTAV)
    - Principal Investigator: A. Bean
    - Co-PIs: R. Demina, C. Gerber, R. Partridge, G. Watts
  - $1.7M + $0.7M matching = $2.4M total
- Level 1 Trigger MRI submitted Jan '02, partial award granted July '02
  - Arizona, Boston, Columbia, Florida State, Langston, Michigan State, Northeastern, Notre Dame, (Saclay)
    - Principal Investigator: M. Narain
    - Co-PIs: H. Evans, U. Heintz, M. Hildreth, D. Wood
  - $456k + $113k matching = $569k total
  - Funds will go toward Central Track Trigger upgrade
  - Level 1 Calorimeter, Track Match proposal will be re-submitted at end of year
- D0 universities playing major role throughout Run IIb Project

Total Project Cost in FY02 k$

Includes G&A, contingency

FY02 k$	Base	Cont %	Cont	Total
Silicon	14208	54	7712	21920
Trigger	3076	47	1459	4535
Online	942	48	453	1395
Administrative	1109	50	554	1663
TOTAL PROJECT COST	19335	53	10178	29513

Cost by subsystem

FY02 k$	M&S + R&D Cost	G&A	Cont %	Cont	Cost+ Cont Total	Total M&S + R&D	Labor FNAL	G&A	Cont %	Cont	Cost+ Cont Total	Total Labor	Total
Silicon	8188	992	55	5048	13237	14228	3909	1119	53	2663	6572	7691	21920
Trigger	2739	211	48	1415	4153	4364	98	28	35	44	142	171	4535
Online	605	107	51	363	968	1075	179	51	39	90	269	320	1395
Administrative	89	15.8	50	52	141	157	781	223	50	502	1283	1506	1663
TOTAL PROJECT COST	11621	1326	53	6878	18499	19825	4967	1422	52	3300	8267	9688	29513

Cost broken out into M&S + R&D, FNAL labor

Fermilab G&A rates applied

	EQUIPMENT	LABOR
G&A	17.72%	28.62%

Total Project Cost in AY k$

Includes G&A, contingency, & escalation

AY k$	Base	Cont %	Cont	Total
Silicon	14757	55	8178	22935
Trigger	3189	48	1540	4728
Online	1014	48	489	1503
Administrative	1197	51	607	1803
TOTAL PROJECT COST	20156	54	10814	30970

Cost by subsystem

AY k$	M&S + R&D Cost	G&A	Cont %	Cont	Cost+ Cont Total	Total M&S + R&D	Labor FNAL	G&A	Cont %	Cont	Cost+ Cont Total	Total Labor	Total
Silicon	8386	1047	56	5286	13672	14719	4139	1185	54	2892	7031	8215	22935
Trigger	2831	220	49	1491	4322	4542	107	31	35	49	156	186	4728
Online	646	114	51	389	1035	1150	197	56	39	100	297	353	1503
Administrative	94	16.6	51	56	149	166	845	242	51	551	1396	1638	1803
TOTAL PROJECT COST	11956	1398	54	7223	19179	20577	5288	1513	53	3591	8879	10392	30970

Cost broken out into M&S + R&D, FNAL labor

FNAL ESCALATION RATES		FY01	FY02	FY03	FY04	FY05	FY06
EQUIPMENT	BY YEAR	-2.9%	N/A	2.3%	2.8%	2.7%	2.6%
	CUMULATIVE	0.971	1	1.023	1.052	1.080	1.108
LABOR	BY YEAR	-4.0%	N/A	4.0%	4.0%	4.0%	4.0%
	CUMULATIVE	0.960	1	1.040	1.082	1.125	1.170

Total Project Cost = $30,970k
Includes 54% contingency ($10,814k)
Contingency consistent with April '02 Dir Rev guidance (57%)

Obligation Profiles in AY k$

Obligation Profile AY k$ (by subsystem)	FY01	FY02	FY03	FY04	FY05	FY06	TOTAL
Silicon (incl. G&A and FNAL labor)	17	1326	6171	4034	709	354	12611
Trigger (incl. G&A and FNAL labor)	0	453	1040	1561	109	0	3163
Online (incl. G&A and FNAL labor)	0	0	64	331	619	0	1014
Administration (incl. G&A and FNAL labor)	0	0	385	399	413	0	1197
Sub Total	17	1778	7660	6325	1850	354	17985
R&D (incl. G&A and FNAL labor)	0	1376	795	0	0	0	2171
Contingency	0	0	3645	3143	4026	0	10814
Total Project Cost	17	3154	12100	9468	5876	354	30970
Percentage by FY	0	10	39	31	19	1	

Obligations by subsystem w/R&D and contingency broken out

Obligation Profile AY k$ (by funding type)	FY01	FY02	FY03	FY04	FY05	FY06	TOTAL
M&S (incl. cont and In-Kind contr.)	17	1778	7960	5413	3102	0	18270
R&D (incl.cont. on R&D)	0	662	247	0	0	0	909
FNAL Labor (M&S and R&D, incl. Cont)	0	464	2941	3048	2426	0	8879
G&A (on M&S and R&D)	0	250	951	1007	349	354	2912
TOTAL	17	3154	12100	9468	5876	354	30970

Obligations broken out by funding type

Tables include G&A, contingency, & escalation

Funding Need in AY k$

Includes G&A, contingency, & escalation

Funding need broken out by source

TPC, Funding Need In AY k$	FY01	FY02	FY03	FY04	FY05	FY06	TOTAL
Silicon (incl. Cont + G&A)	17	1326	8963	6382	3428	354	20470
Trigger (incl. Cont + G&A)	0	453	1423	2142	676	0	4693
Online (incl. Cont + G&A)	0	0	84	418	1002	0	1503
Administration (incl. Cont + G&A)	0	0	507	527	770	0	1803
Total Project	17	1778	10977	9468	5876	354	28470
R&D (incl. Cont + G&A)	0	1376	1123	0	0	0	2499
Total Project Cost	17	3154	12100	9468	5876	354	30970
DOE M&S	0	0	4615	4533	3057	2000	14205
DOE SWF	0	0	2229	3048	2426	0	7702
DOE G&A	0	0	788	1007	349	354	2498
TOTAL DOE EQ	0	0	7631	8588	5832	2354	24406
DOE M&S R&D	0	662	247	0	0	0	909
DOE SWF R&D	0	464	713	0	0	0	1177
DOE G&A R&D	0	250	163	0	0	0	413
TOTAL DOE R&D	0	1376	1123	0	0	0	2499
In Kind - Foreign	0	258	267	70	1	0	597
In Kind - MRI silicon	17	1326	811	306	0	0	2460
In Kind - MRI trigger	0	0	114	474	0	0	588
In Kind - US base	0	194	153	30	43	0	420
Total In-Kind contributions	17	1778	1345	880	44	0	4065
Forward Funding			2000			-2000	
Total Project Cost	17	3154	12100	9468	5876	354	30970

$2M in forward funding introduced to alleviate FY03 need

$1M forward funding in hand, additional ~ $2.1M in process

FY06 contains only FF payback

Project Funding in AY k$

Includes G&A, contingency, & escalation

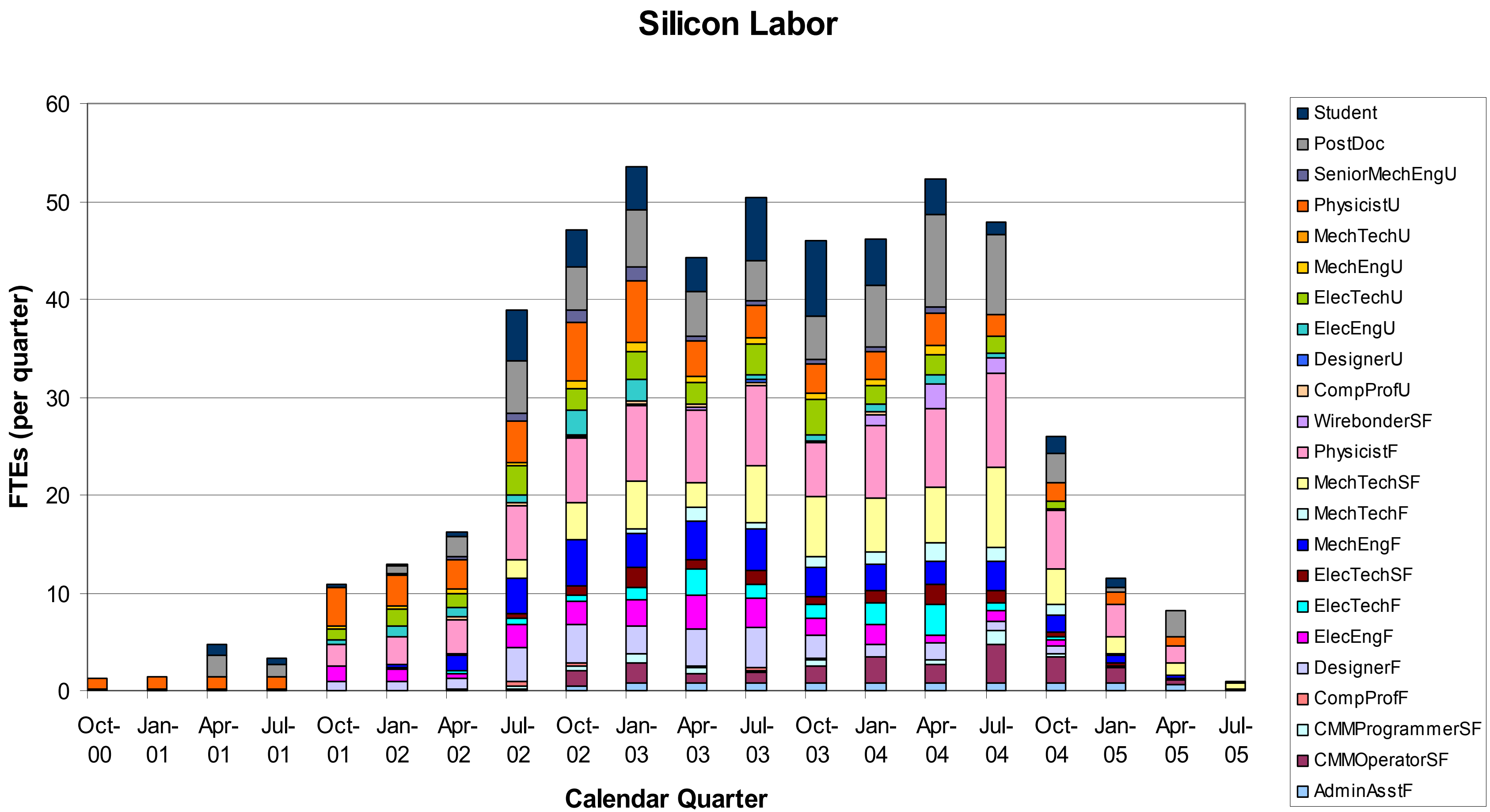
Laboratory guidance:

- 7,632k EQ in FY03 (includes FY02 carry-over)
- 2,499k total R&D for FY02+FY03 (excess carried over)

Total Project Cost In AY k$	FY01	FY02	FY03	FY04	FY05	FY06	TOTAL
Silicon (incl. Cont + G&A)	17	1326	8963	6382	3428	354	20470
Trigger (incl. Cont + G&A)	0	453	1423	2142	676	0	4693
Online (incl. Cont + G&A)	0	0	84	418	1002	0	1503
Administration (incl. Cont + G&A)	0	0	507	527	770	0	1803
Total Project	17	1778	10977	9468	5876	354	28470
R&D (incl. Cont + G&A)	0	1376	1123	0	0	0	2499
Total Project Cost	17	3154	12100	9468	5876	354	30970
Project Funding in AY k$	FY01	FY02	FY03	FY04	FY05	FY06	TOTAL
DOE EQ	0	3500	4131	8588	5832	2354	24406
DOE R&D	0	1499	1000	0	0	0	2499
In Kind - Foreign	0	258	267	70	1	0	597
In Kind - MRI silicon	17	1326	811	306	0	0	2460
In Kind - MRI trigger	0	0	114	474	0	0	588
In Kind - US base	0	194	153	30	43	0	420
Total In-Kind contributions	17	1778	1345	880	44	0	4065
Forward Funding	0	0	2000	0	0	-2000	0
Total Funding	17	6777	8477	9468	5876	354	30970

Project meets FY03 Laboratory guidance
Contingency profile adjusted to reflect anticipated project need

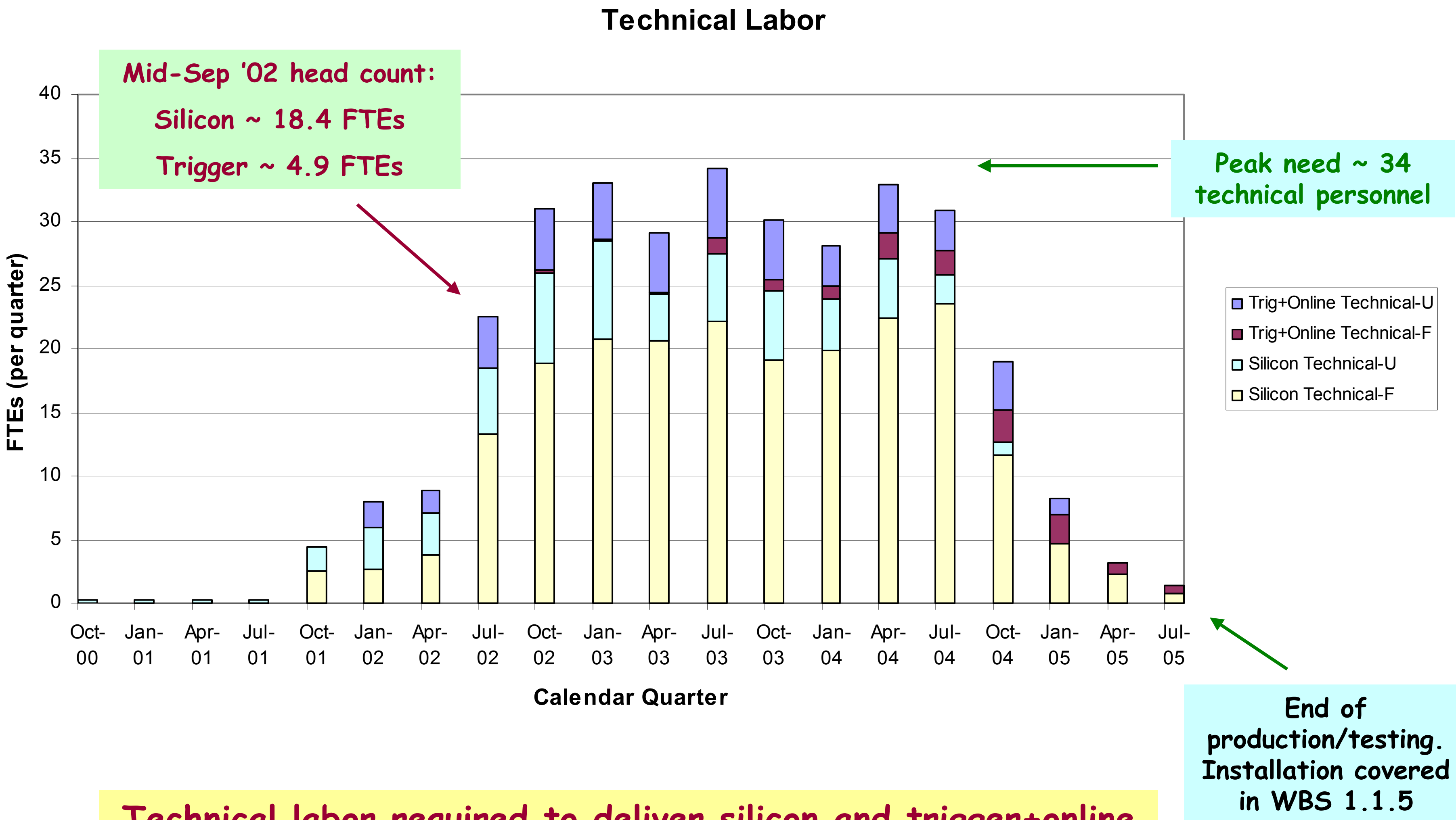
Total Silicon Labor



Includes all personnel, all categories – physicists, technical, and administrative – required to deliver silicon detector

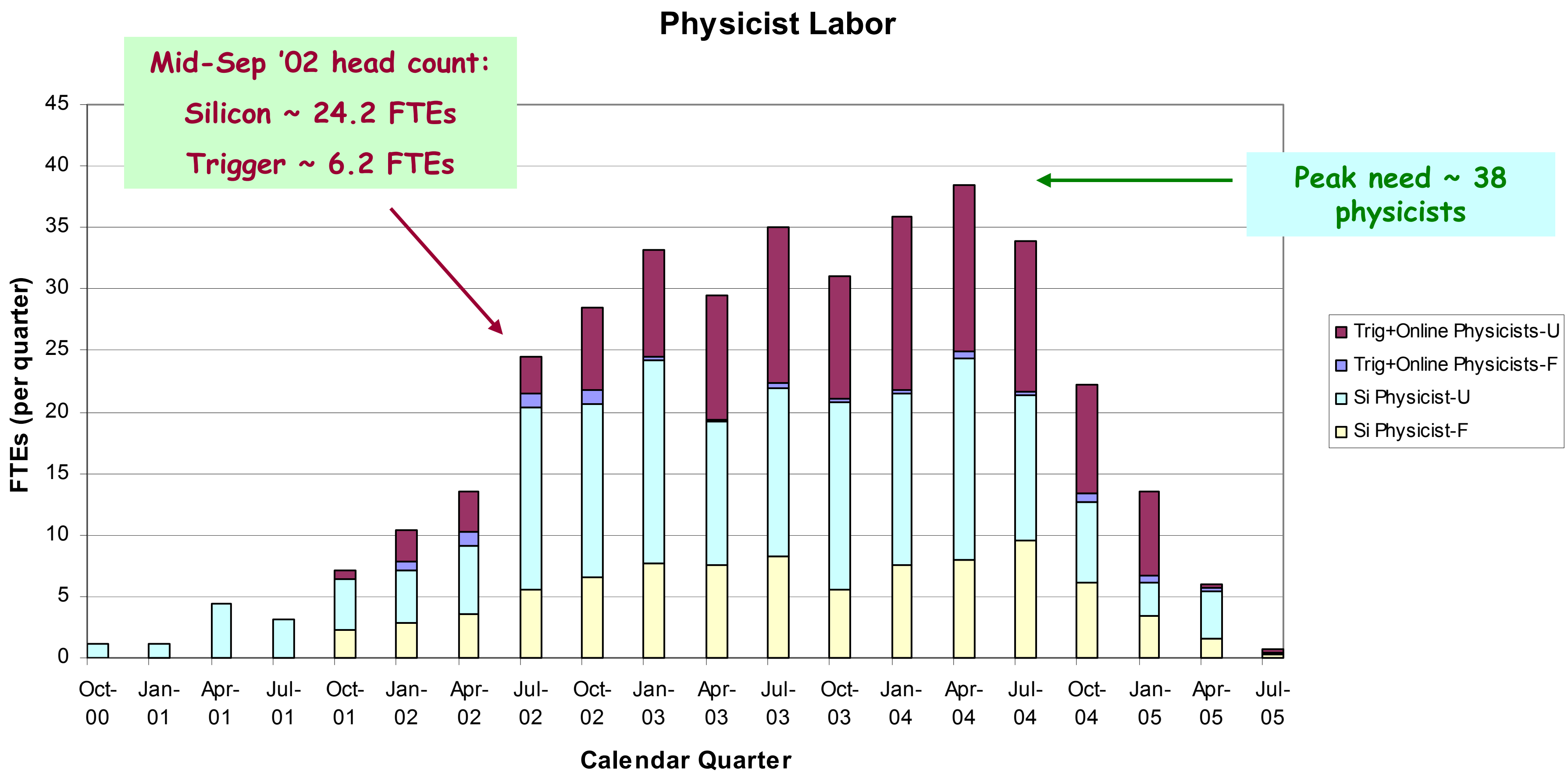
Base need only – contingency not included

Total Technical Labor



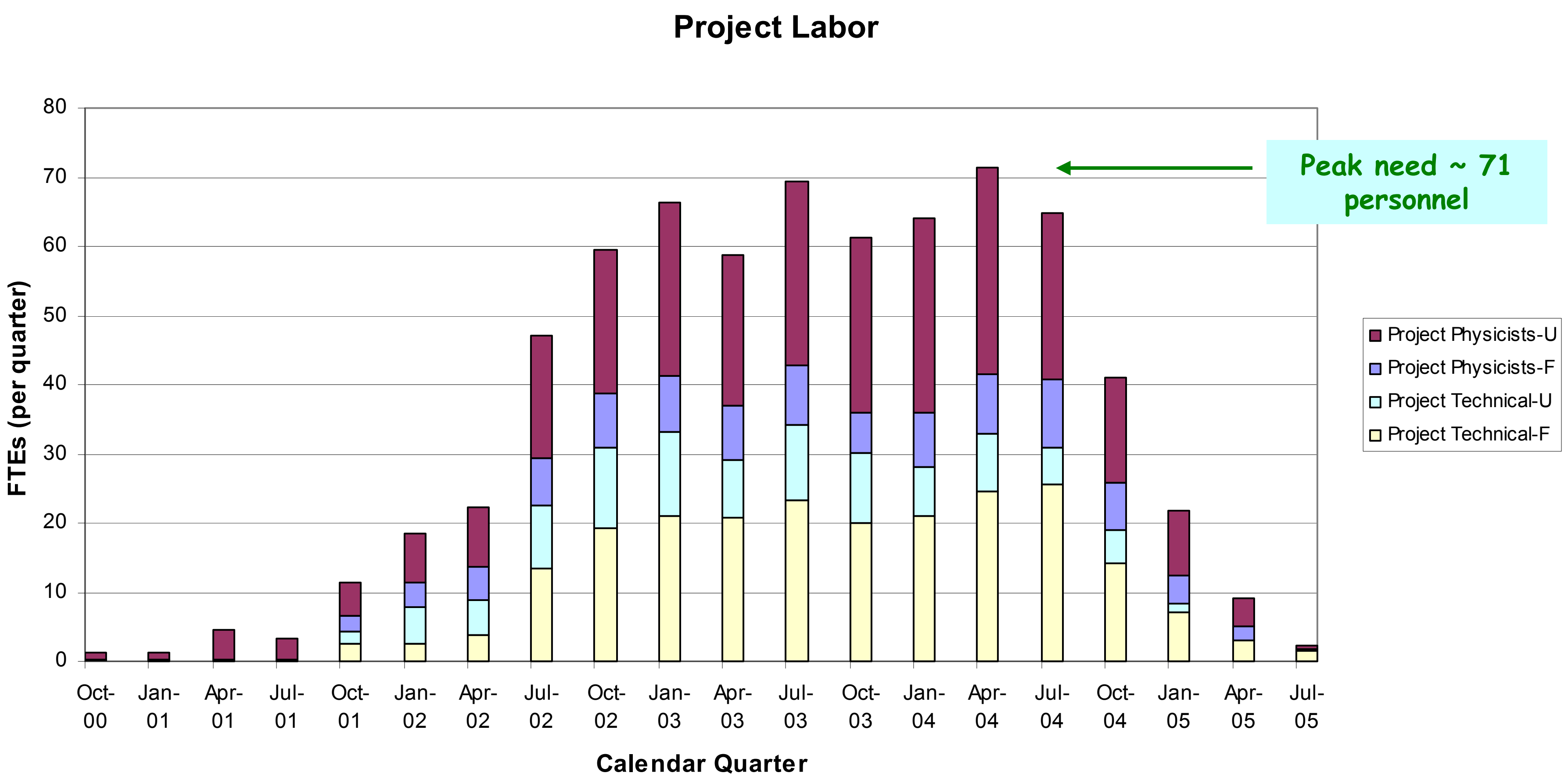
Technical labor required to deliver silicon and trigger+online projects, divided into Fermilab and university components

Total Physicist Labor



Physicists required to deliver silicon and trigger+online projects, divided into Fermilab and university components

Total Project Labor



Total required to deliver silicon and trigger+online projects, divided into Fermilab and university components

Near Term Procurements, Strategy

Silicon Procurements Over $100k

Item	Cost (FY02 k$)	Production Start Date
SVX4 Pre-production Chip	158	11/18/02
L2-L5 Sensors	1,453	2/12/03
L2-L5 Digital Jumper Cables	263	4/3/03
L0 Sensors	161	4/17/03
L1 Sensors	155	4/17/03
SVX4 Production Chips	475	5/21/03
Analog Cables	167	7/3/03
L2-L5 Production Hybrids	382	7/16/03
Twisted Pair Cables	256	4/26/04

Total silicon procurements through FY03: $3.2M

- Project & FNAL Procurement have been developing collaborative approach to facilitate procurements
  - Series of meetings between Project and FNAL Procurement, Business Services, & Project Management Offices
  - Quantify cycle times, procurement steps
  - Post-mortems of early prototype orders, identify and ameliorate potential bottlenecks
  - Expedite convergence of specifications, etc. with vendors
  - Specific needs of Run IIb projects discussed
- Example: L2-5 sensor order
  - Pre-production order out 8/02
  - Experience being applied to expedite 2/03 production order
- Project, Laboratory, & FNAL DOE Office working together to develop efficient acquisition strategy

Conclusions

- Run IIb has matured into a solid, well-defined project
- Full project plan in place, based on detailed technical designs and fully resource loaded schedule
- Experienced, dedicated project team poised to move through & beyond prototyping phase
- We are seeking approval to begin construction on all Run IIb subsystems – silicon, trigger, & DAQ/online