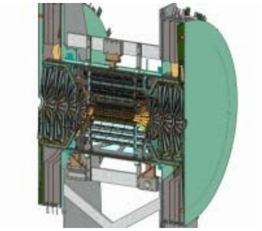
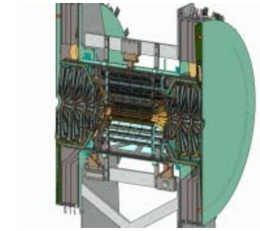


FVTX Project Overview
Cost & Schedule

Melynda Brooks

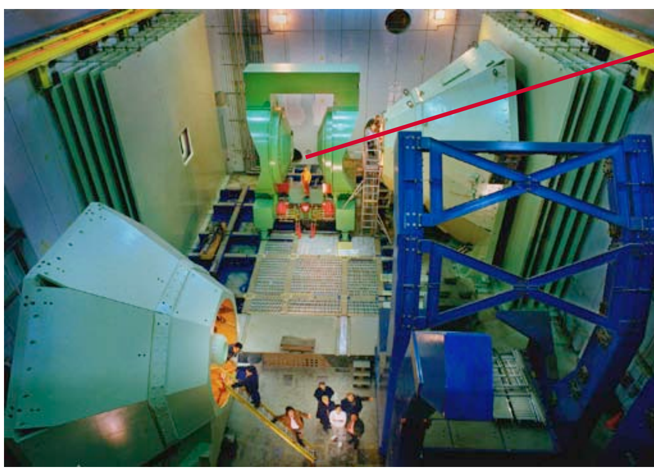
Los Alamos National Laboratory

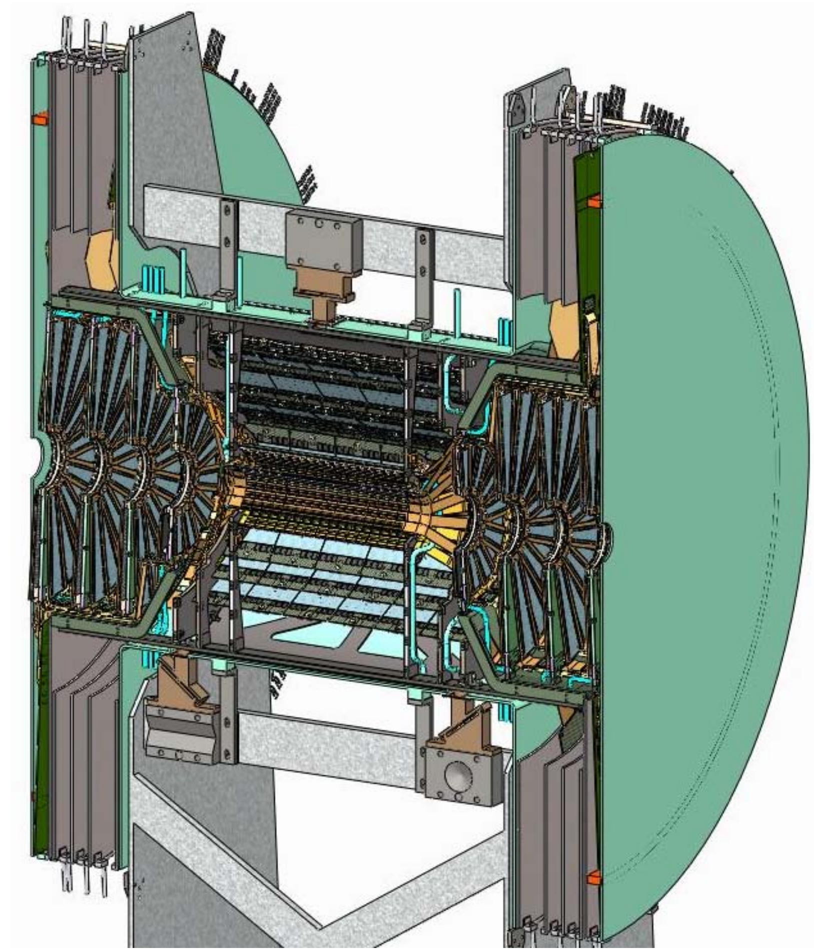
FVTX Project Manager

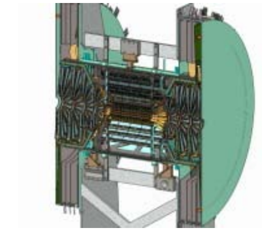


Talk Outline

- Project Overview
- Addressing past Review Questions
- Construction Progress
- FY10 Technical Plans
- Budget and Schedule Summary
- Day's agenda



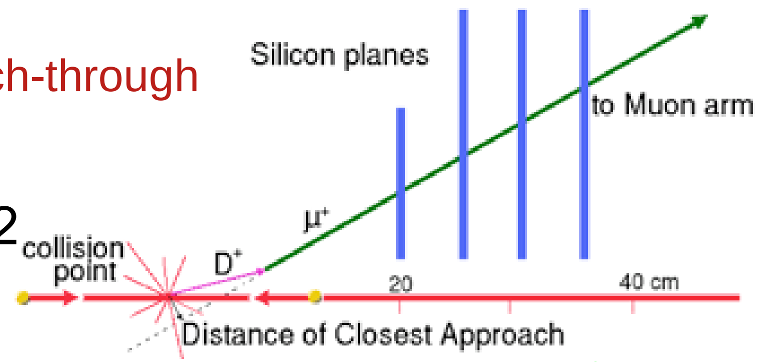


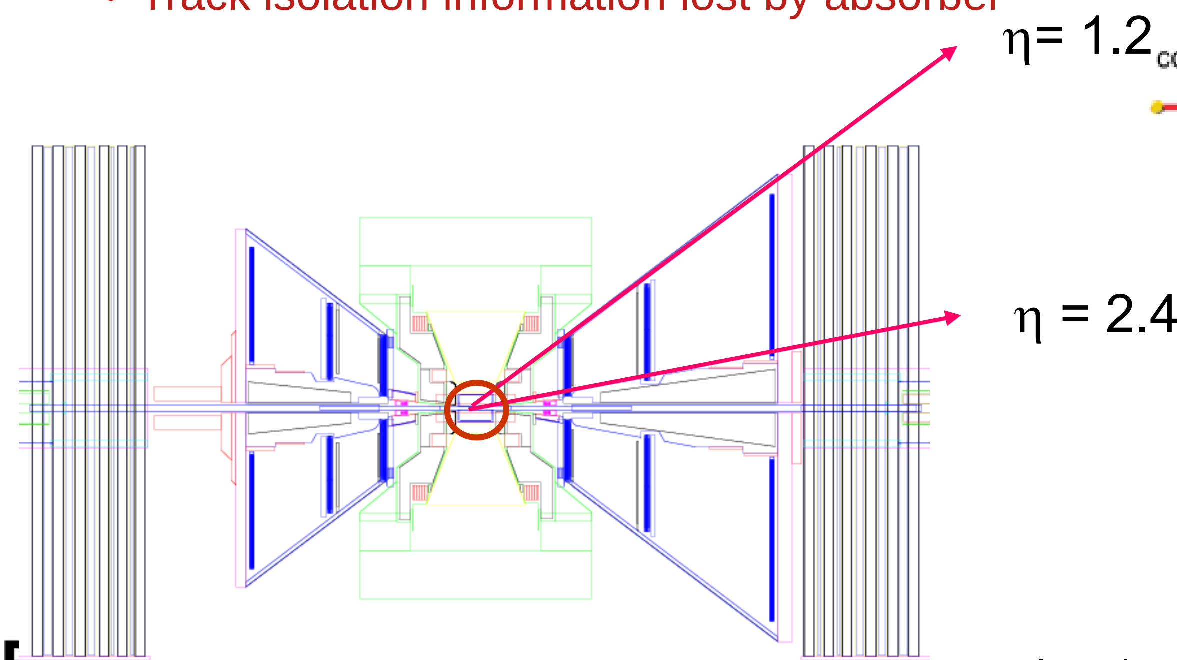


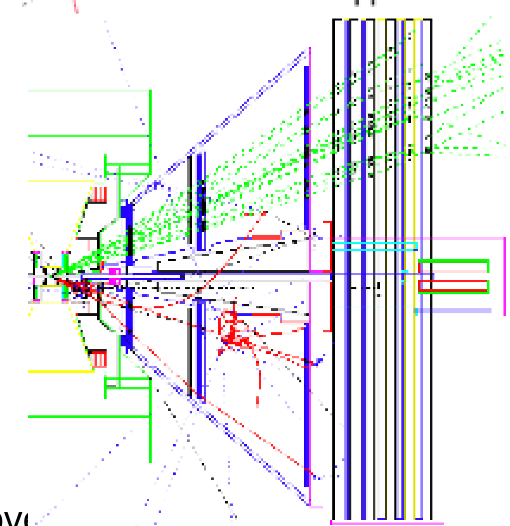
Why an FVTX Detector for Muons?

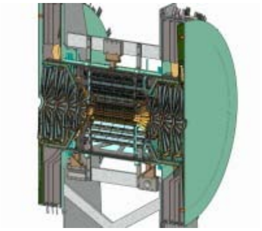
Enhance Muon performance to allow precision heavy flavor measurements

- Initial absorber to reduce hadrons that reach the active detectors
- Muon Tracking stations inside magnet to find tracks and measure momentum
- Muon Identifier for μ/π separation, Lvl-1 trigger
- ~1% "punch through", ~1% decay into muon before absorber, ~1%*15% decay after the absorber
- No way to discriminate $\pi/K \text{-->} \mu$, $D/B \rightarrow \mu$, π/K punch-through
- Mass resolution limited by absorber
- Track isolation information lost by absorber









Physics Programs Accessible With FVTX

Single Muons:

- Precision heavy flavor and hadron measurements at forward rapidity
- Separation of charm and beauty
- W background rejection improved

Dimuons:

- First direct bottom measurement via $B \to J/\psi$
- Separation of J/ψ from ψ' with improved resolution and S:B
- First Drell-Yan measurements from RHIC
- Direct measurement of c-cbar events via $\mu^+\mu^-$ becomes possible

Physics:

- Advance understanding of energy loss, by adding precise heavy flavor measurements of R_{AA} and flow.
- First detection of ψ' plus heavy quark allow detailed understanding of vector meson production and modification
- Separation/Understanding of Cold Nuclear Matter and QGP effects with rapidity coverage
- Precise gluon polarization and sea quark measurements over large x range, fundamental tests of Sivers functions possible

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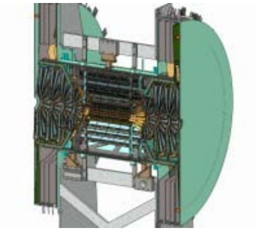
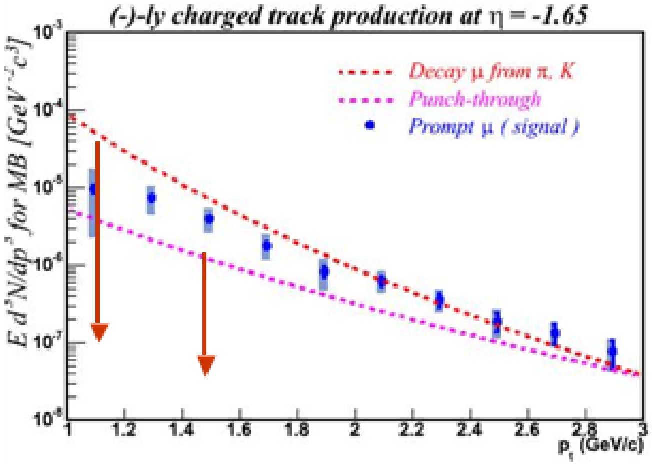
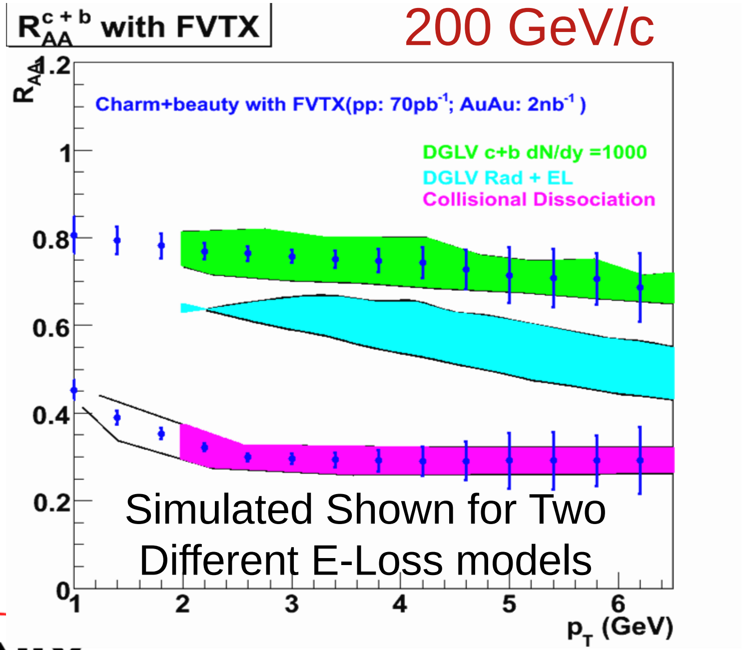


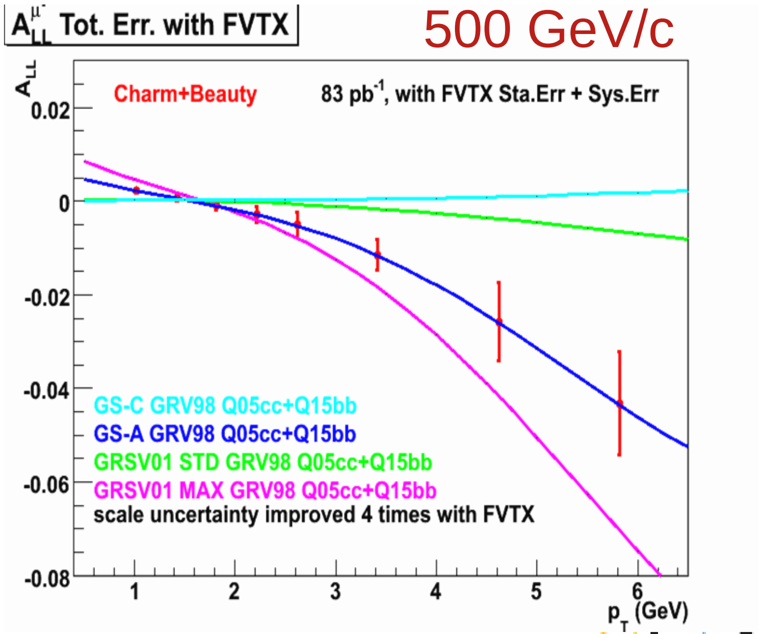
Reminder of Simulated Performance

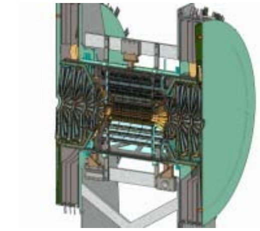
Improved S:B in heavy flavor via single muons allows precision heavy flavor R_{AA}, A_{LL} measurements

(Updated Information in Simulation Talk)





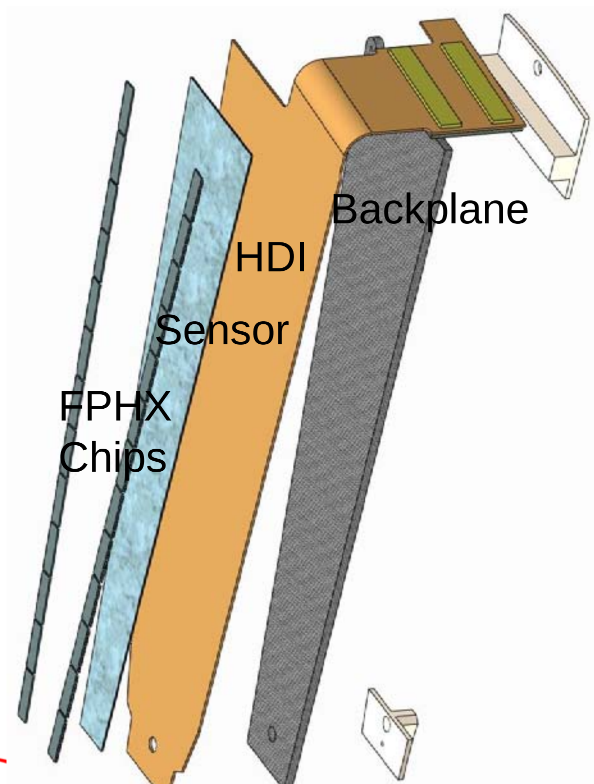


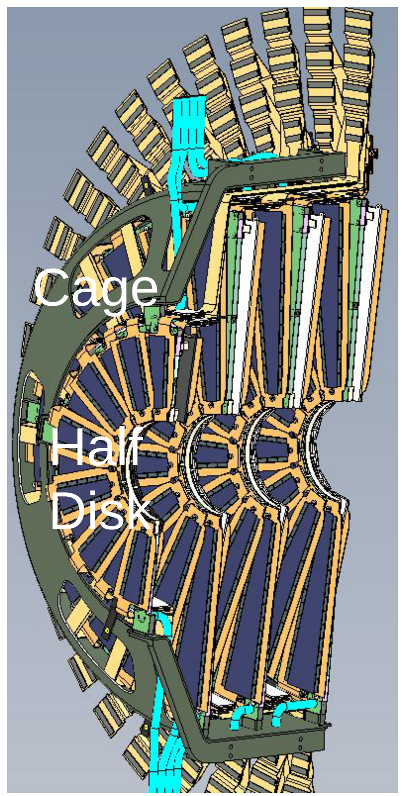


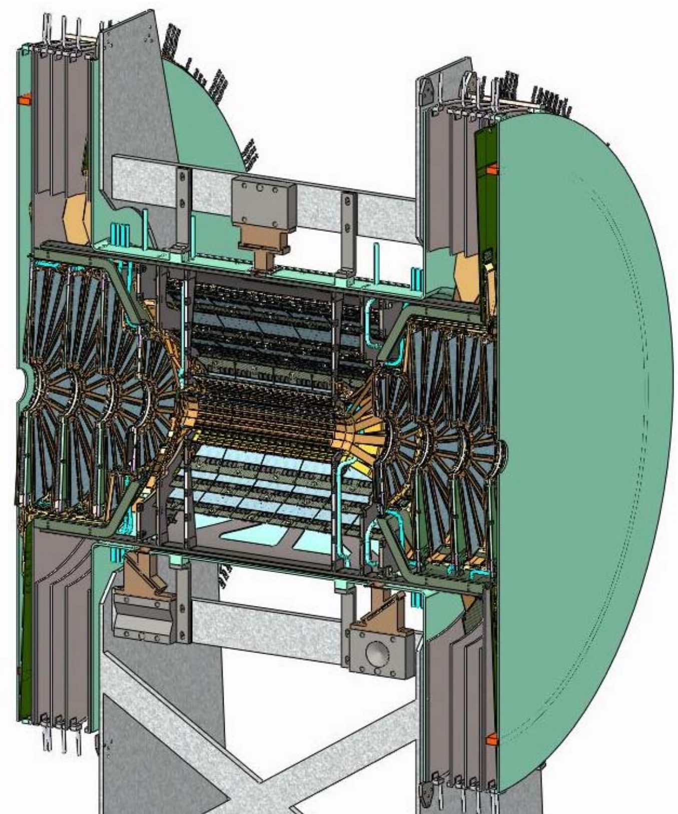
FVTX Geometrical Design

Four tracking stations with full azimuthal coverage

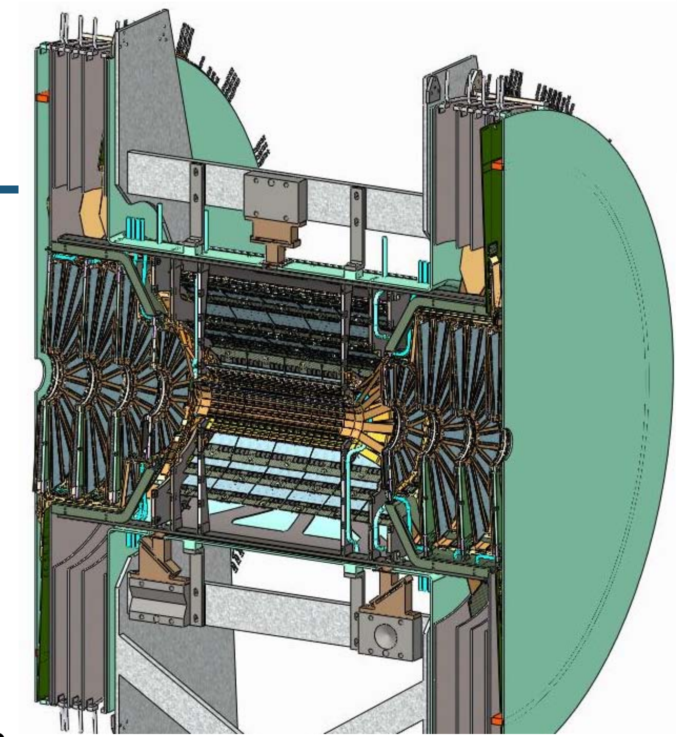
- 75 μm pitch strips in radial direction, 3.75° staggered phi strips
- Radiation length < 2.4%/wedge to minimize multiple scattering
- Outer Support and Cooling outside active area
- Kapton cable plant primarily outside active area



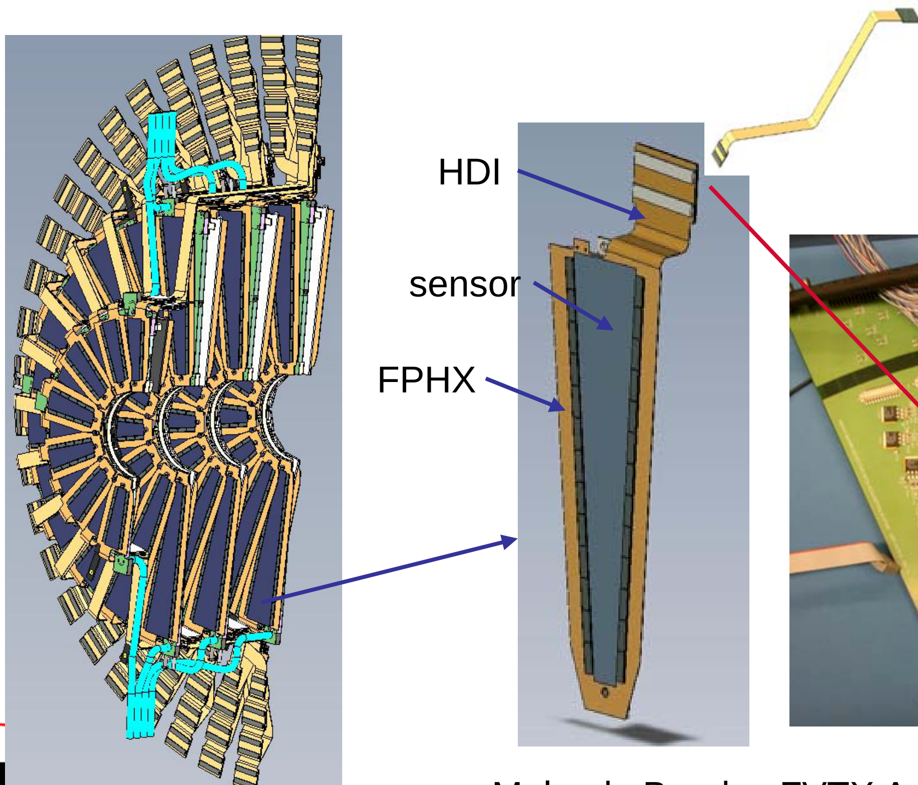




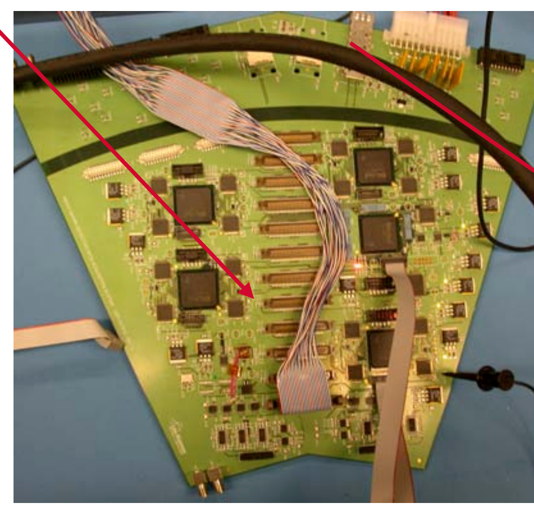
FVTX Electrical Design



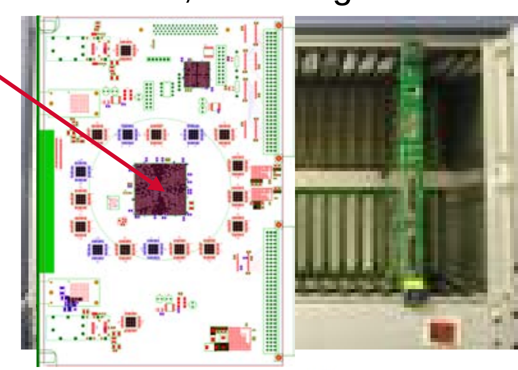
- p on n ministrip sensor, 75 μm x 3.75º →
- Data push FPHX readout chip →
- High density interconnect cable →
- ROC (big wheel area in IR) →
- FEM (VME crate in CH) →
- PHENIX DCMs

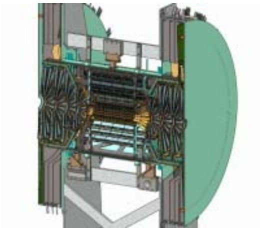


ROC, IR

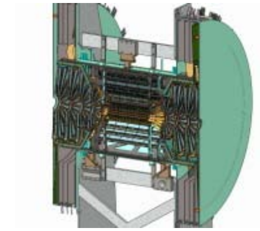


FEM, Counting House





FY08 Recommendations



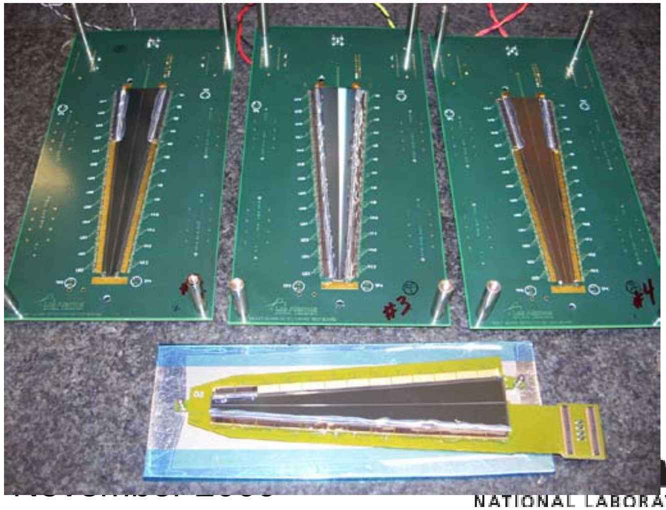
2008 Annual Review Recommendations

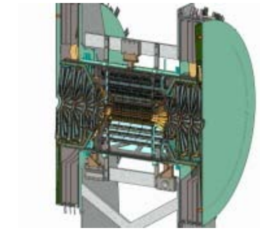
Reminder of November 2008 Status (last year's review):

- Prototype sensors procured and delivery expected Oct. 30
- 1st round FPHX chip delivered in August and testing in progress
- HDI layout completed, prototype not in hand yet
- FPHX was critical path and could not go to next stage until wedge system test

"The collaboration should design a normal printed circuit board as the first multi-chip module to test the FPHX prototype run. This should be done as soon as possible to remove the HDI as a potential schedule risk associated with the FPHX submission."

- Response:
  - PCBs made and procured
  - Delivery ~same time as kapton HDIs
  - However, simple interconnect allowed us to comprehensively test much faster than with kapton HDI



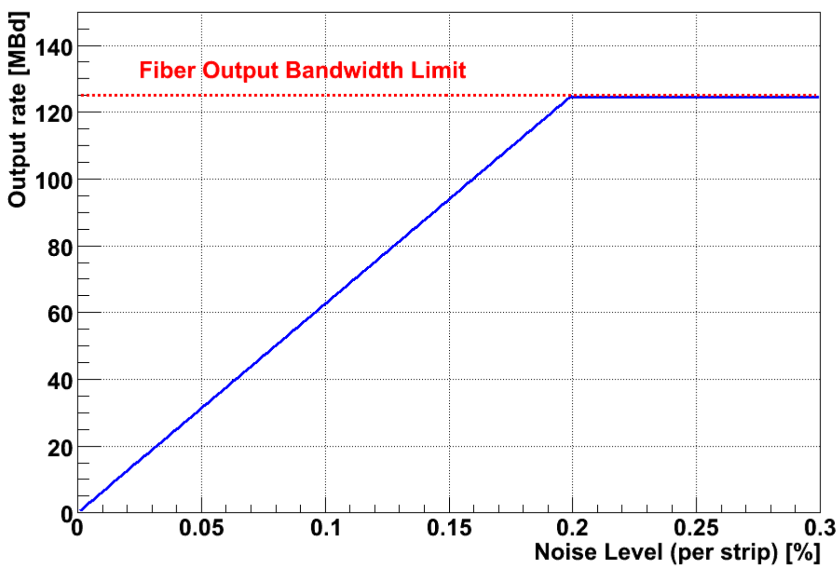


DAQ Bandwidth and Thresholds

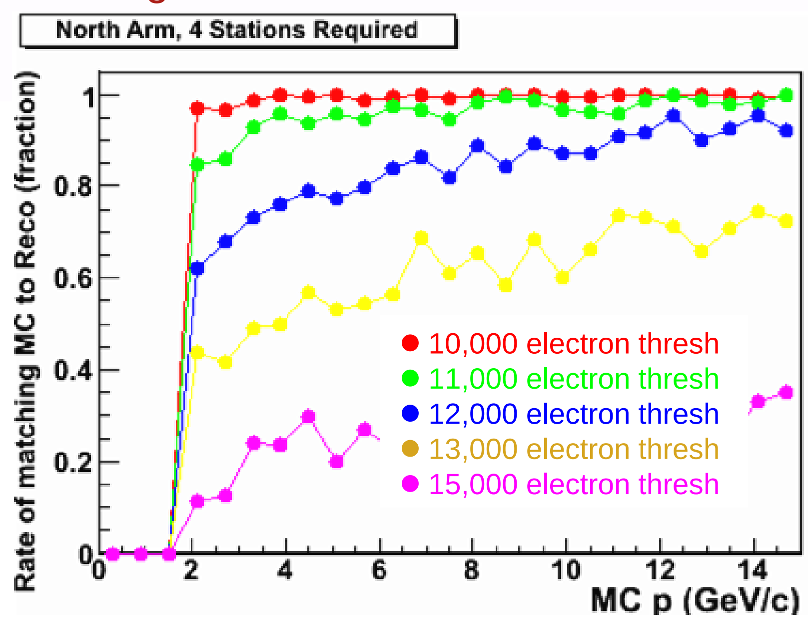
Bandwidth limitations alone → Noise hits should be <0.1% of detector to not saturate DAQ bandwidth (some options to increase this number with more fibers)

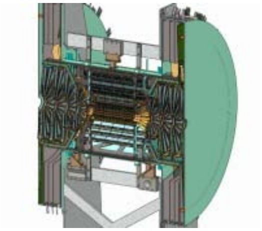
Thresholds can be ~5x nominal and still maintain good efficiency (Nominal threshold = 2000 electrons)

Bandwidth Limitations



Single Tracks Embedded in Au+Au

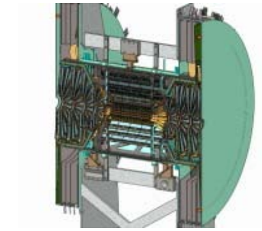




2008 Annual Review Recommendations

"The simulation package for the readout chain should be enlarged to include capability to determine where the high data rate bottlenecks occur, and whether DAQ data loss occurs gracefully or in "brick wall" fashion. The effect of threshold dispersion on track finding efficiency should be considered for all gain settings of the FPHX chip."

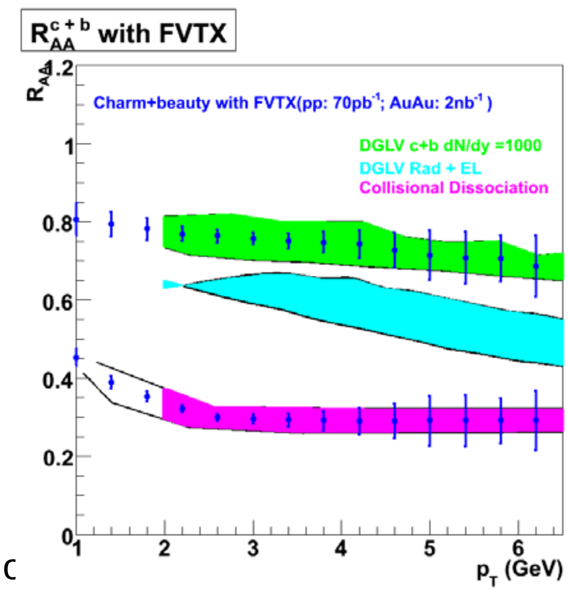
- Simulations include detector performance expectations
- VHDL simulations of ROC/FEM designs performed - details in ROC/FEM presentation by Sergey Butsyk

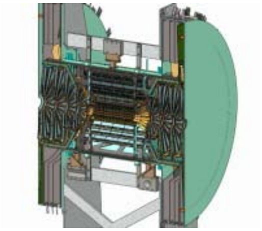


2008 Annual Review Recommendations

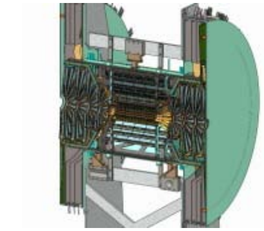
"*A complete heavy flavor R_{AA} analysis chain with realistic DCA errors should be demonstrated as soon as possible, and presented with one of the quarterly reports prior to the next annual review. A list of people who are actually doing the offline software and analysis, their FTE level of support, and their time schedule, should be presented as well.*"

- Heavy flavor R_{AA} produced in unblind analysis previously
- Blind analysis work with updated code underway
- Full reconstruction and analysis chain developed
- Detector performance maintained
- Working on updating physics plots
- Sofware workers:





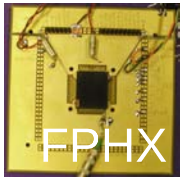
Technical Progress

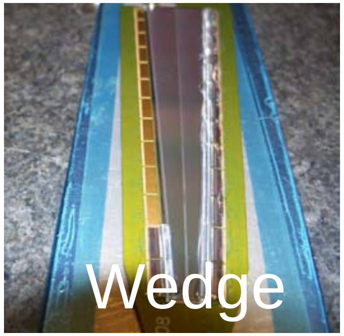


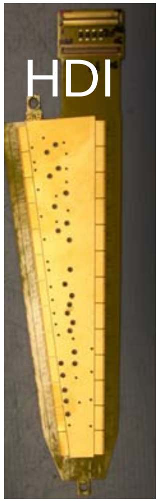
FY09 Progress - Technical

Wedge Components

- Prototype sensors procured, tested, and production order placed
- 1st and 2nd round FPHX chips tested and production order placed
- HDI prototype tested, 2nd prototype order in progress
- Backplane production order placed





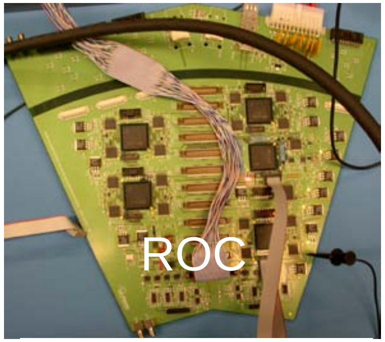


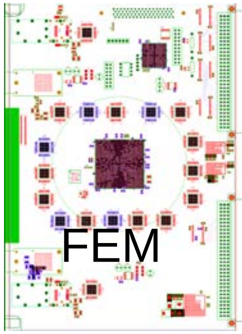
Detector Assembly

- SOW, schedule in place for wedge assembly at FNAL Silicon Fabrication Facility (SiDet). Several prototypes assembled
- Final design for wedge assembly fixtures completed, fab at UNM
- Assembly areas being prepared at BNL

DAQ

- 2nd round ROC in progress, first round used extensively in wedge testing
- FEM prototype ready for procurement





Mechanics

- Cage, backplane and disk designs completed, fab in progress

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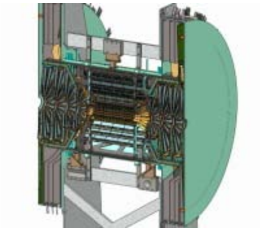


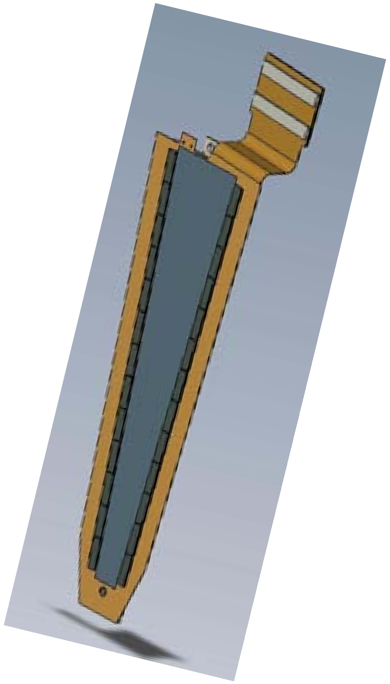
FY10 Technical Work

Wedge Components and Assembly

- All wedge components should arrive within the next few months
- Production fixtures produced
- Wedge assembly and testing for ~10 months in Project (SiDet estimate = 30 weeks)
- Disk assembly follows beginning of wedge assembly

DAQ

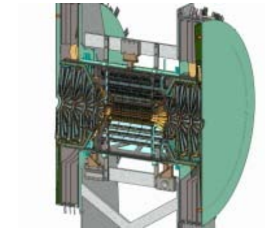
- Receive and test 2nd round ROC
- Receive and test FEM
- Production procurement in 2010



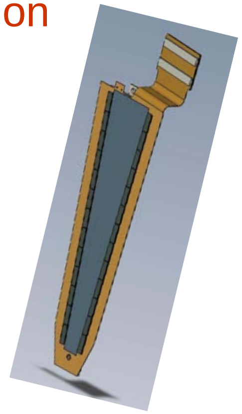
Mechanics

- Procure cages and disks in 2010
- Finalize disk and cage assembly procedures and procure fixtures

- Disks should be fully assembled in 2010



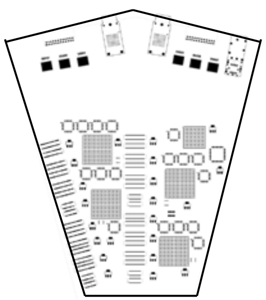
Project Reviews



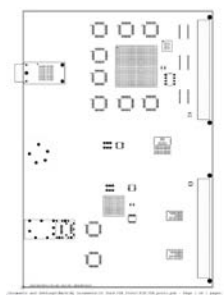
Feb-April 2008	FPHX Design Reviews before prototype submission
August 2008	Overall Electronics Design Review
August 2008	Informal Mechanics Review of Components
May 2009	FPHX review prior to FPHX-2 prototype
June 2009	1st RHIC Safety Review
Sep 2009	FPHX review prior to production
Oct 2009	HDI review prior to 2nd prototype
Dec 2009	Final HDI and Interconnect Cable review
Jan 2010	ROC + FEM review
Jan 2010	Final disk review

2010PHENIX Readiness Review

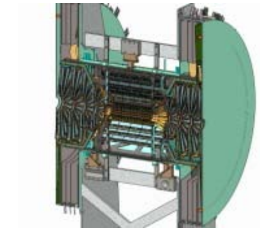
Note: each FPHX review was presented as a “system” review already



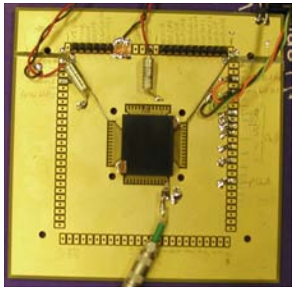
ROC

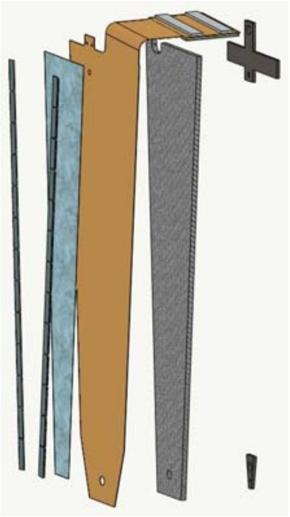


FEM



Issues/Concerns



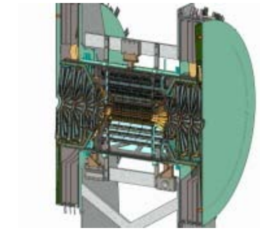


Schedule:

- We have~19 weeks float (23%) in the schedule and are starting assembly earlier than Management Plan, but:
- All wedge components on or very close to critical path
- Backplane, cage, disk, all on or near critical path, LBNL delivery times all longer than Management Plan
- Wedge assembly schedule determined from prototype experience, but can schedule be maintained?
- ROC very close to critical path

Assembly

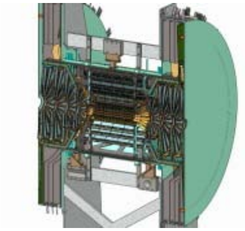
- Assembly of disks with full cable assemblies into cages, and cages with full disk assemblies into enclosure may be challenging
- Will we maintain performance as the system increases in size and becomes coupled to the VTX system?



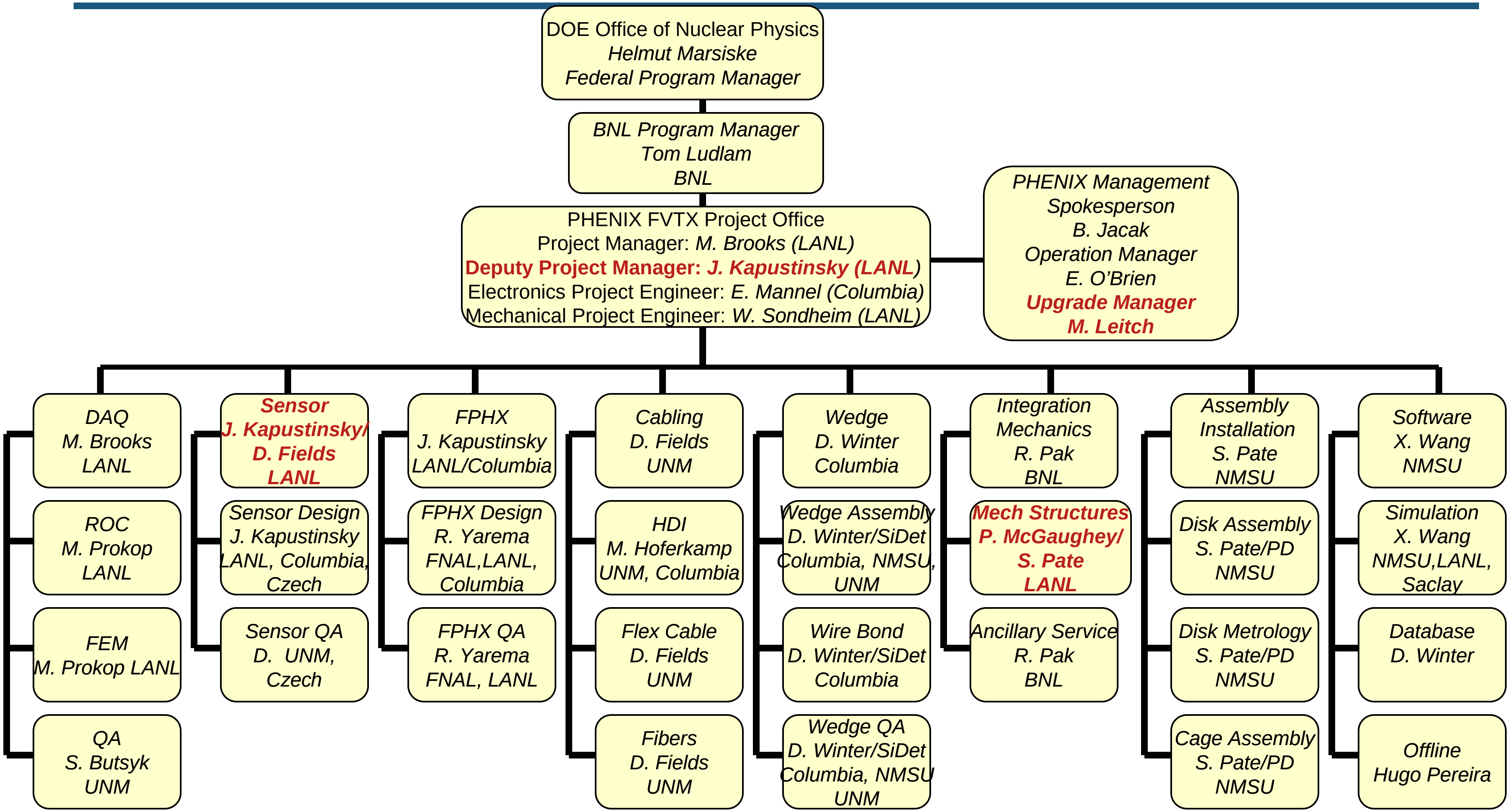
Proposed Project Deliverable Change

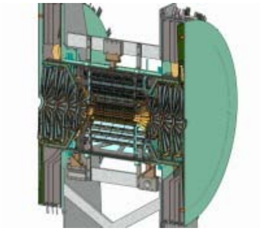
- Propose to meet “working wedge spares” but not “working sensor spares”
- 343 working large sensor and 120 small sensors being ordered

Item	Number	Working Spares
Wedge assemblies		
Large Sensors	288	50 (25 in spare wedges)
Small Sensors	96	15 (8 in spare wedges)
Large Wedges	288	25
Small Wedges	96	8
ROC boards	24	4
FEM boards	48	6
Mechanical		
Large ½ Disks	12	2
Small ½ Disks	4	1
Suspension system	1 (VTX funded)	0
Dry gas enclosure	1 (VTX funded)	0
Cooling system	1 (VTX funded)	0
Power supply system	1	Spare components available
DCM channels	48	4

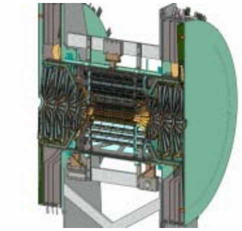


Organizational Chart Changes – October 2009





Cost & Schedule



Cost & Schedule Summary

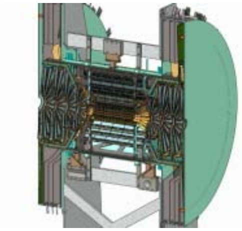
FVTX Costs:

- Management Plan Cost = $4880k, Contingency = $927k
- $1962k costs and commitments to date and remaining
- Cost to Complete = $2108k with Contingency = $810k (38%)

Current Schedule Expectations – Project Deliverables June 2011

• Backplanes, HDIs, FPHX available	Jan/Feb 2010
• Wedge Assembly	Feb 2010 – Nov 2010
• Wedge Assembly Float	4/1/10 – 5/26/10
• Disk Assembly	Apr (Jun) 2010 – Nov (Jan) 2010
• Disks into Cages	Jun (Aug) 2010 – Feb (Apr) 2011
• Test Functional Requirements	Nov (Jan) 2010 – Feb (Apr) 2011
• Additional Schedule Float	4/14/11 – 6/30/11

“Additional Schedule Float”, can be used to allow testing of functional requirements to properly mate up with RHIC Run schedule, availability of VTX enclosure.



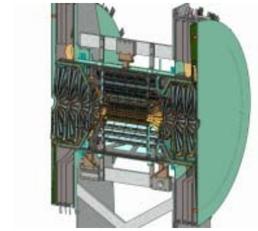
FVTX Component Delivery Dates

HDI	1/27/10	0.8 weeks float
Backplane	2/2/10	0.0 float
FPHX	1/21/10	2.4 weeks float
Sensor	2/19/10	0.4 weeks float
ROC	5/11/10	12 days float
Disk	4/6/10	2.2 weeks float
Cage	4/20/10	18.3 weeks float

But, we have:

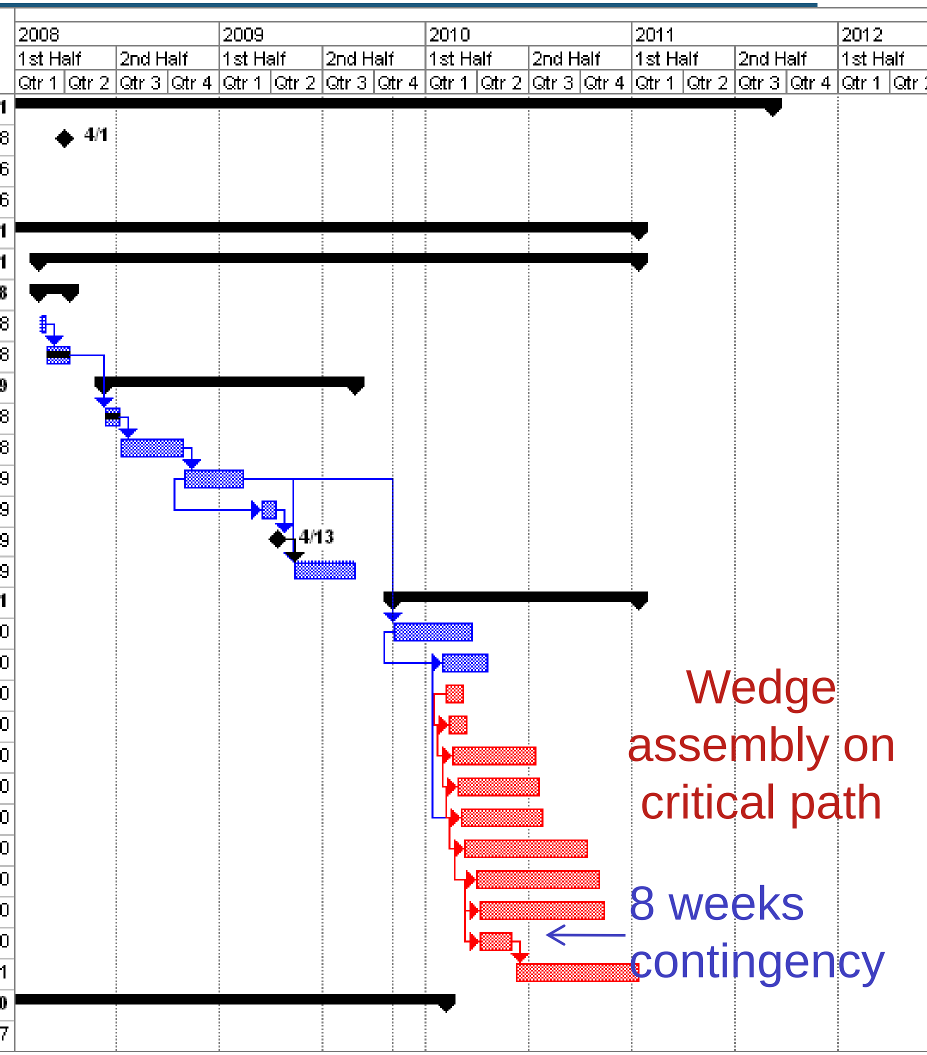
- 8 weeks contingency in assembly schedule
- 11 weeks contingency at end-of-project.

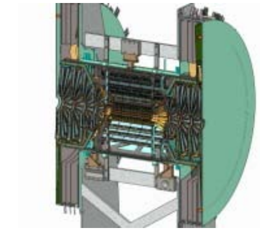
19 weeks/83 weeks = 23% schedule float



FVTX Project File

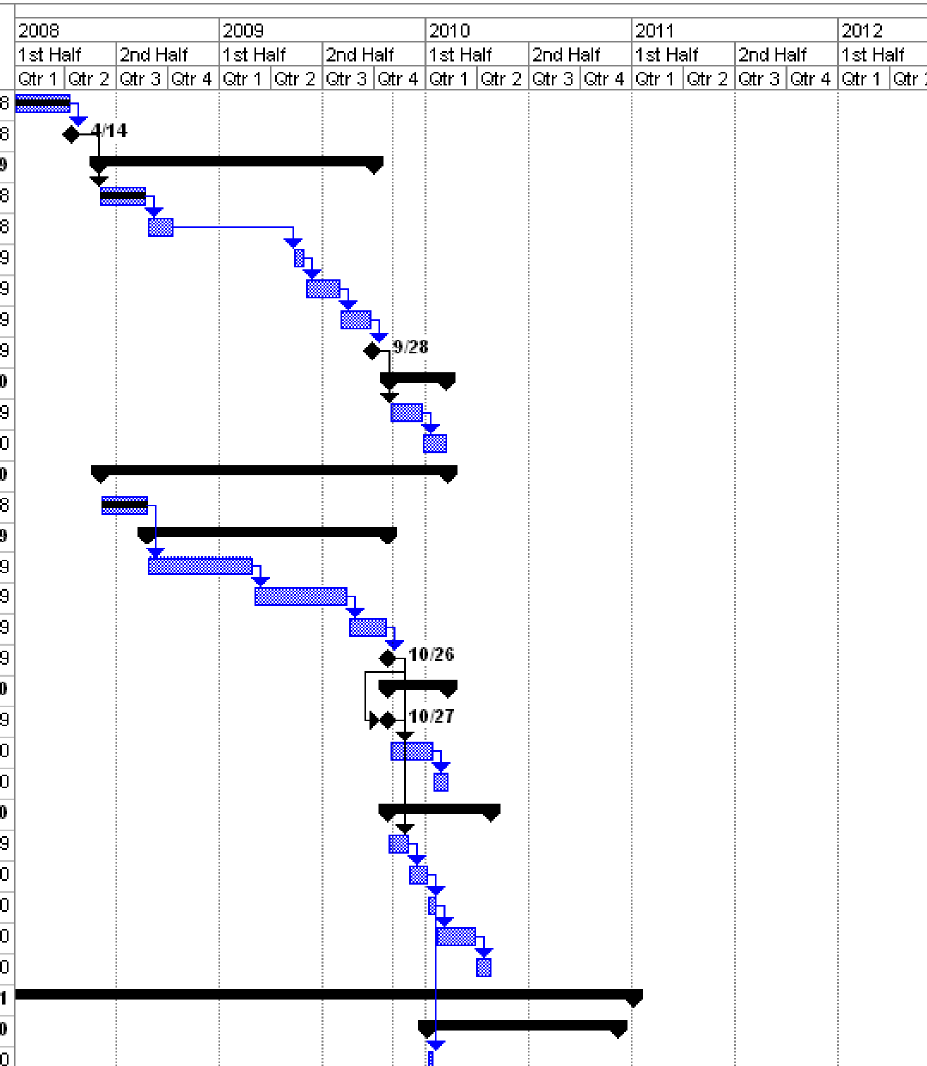
ID	WBS	Task Name	Start	Finish
1	1	**FVTX Project**	**Fri 10/21/05**	**Thu 9/8/11**
2	1.1	**Start Construction**	Tue 4/1/08	Tue 4/1/08
3	1.2	**Start R&D BNL**	Mon 1/2/06	Mon 1/2/06
4	1.3	**Start R&D LANL**	Mon 1/2/06	Mon 1/2/06
5	**1.4**	**Wedge Components**	**Thu 3/15/07**	**Thu 1/13/11**
6	**1.4.1**	**Wedge sensors**	**Fri 2/15/08**	**Thu 1/13/11**
7	**1.4.1.1**	**Vendor selection**	**Fri 2/15/08**	**Thu 4/10/08**
8	1.4.1.1.1	develop criteria	Fri 2/15/08	Thu 2/28/08
9	1.4.1.1.2	Vendor quotes	Fri 2/29/08	Thu 4/10/08
10	**1.4.1.2**	**procure prototype sensor**	**Wed 6/11/08**	**Fri 8/28/09**
11	1.4.1.2.1	mask set	Wed 6/11/08	Tue 7/8/08
12	1.4.1.2.2	sensor manufacture	Wed 7/9/08	Tue 10/28/08
13	1.4.1.2.3	test prototype sensor	Wed 10/29/08	Tue 2/10/09
14	1.4.1.2.4	wire bond FPHX	Mon 3/16/09	Fri 4/10/09
15	1.4.1.2.5	1st prototype wedge assembly	Mon 4/13/09	Fri 5/8/09
16	1.4.1.2.6	test wedge assembly(system test)	Mon 5/11/09	Fri 8/28/09
17	**1.4.1.3**	**procure sensors**	**Wed 11/4/09**	**Thu 1/13/11**
18	1.4.1.3.1	procure sensor(fully tested)	Wed 11/4/09	Tue 3/23/10
19	1.4.1.3.2	Sensor Q/A	Wed 1/27/10	Tue 4/20/10
20	1.4.1.3.3	Attach HDI to Backplane	Tue 2/2/10	Mon 3/8/10
21	1.4.1.3.7	Glue chips to HDI	Tue 2/9/10	Mon 3/15/10
22	1.4.1.3.12	Wire bond chips to HDI	Tue 2/16/10	Mon 7/12/10
23	1.4.1.3.8	Test chips and HDI	Tue 2/23/10	Mon 7/19/10
24	1.4.1.3.4	Attach sensor	Tue 3/2/10	Mon 7/26/10
25	1.4.1.3.5	Wire bond sensor to chips + HDI	Tue 3/9/10	Thu 10/14/10
26	1.4.1.3.6	Test chip,sensor + cable assemblies	Tue 3/30/10	Thu 11/4/10
27	1.4.1.3.9	Wire bond encapsulation	Tue 4/6/10	Thu 11/11/10
28	1.4.1.3.10	Assembly Contingency	Tue 4/6/10	Mon 5/31/10
29	1.4.1.3.11	Attach backplane mounts	Tue 6/8/10	Thu 1/13/11
30	**1.4.2**	**FPHX Chip**	**Thu 3/15/07**	**Thu 2/4/10**
31	1.4.2.1	design(FNAL)	Thu 3/15/07	Wed 6/20/07

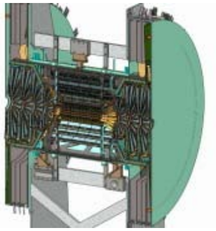




FVTX Project File

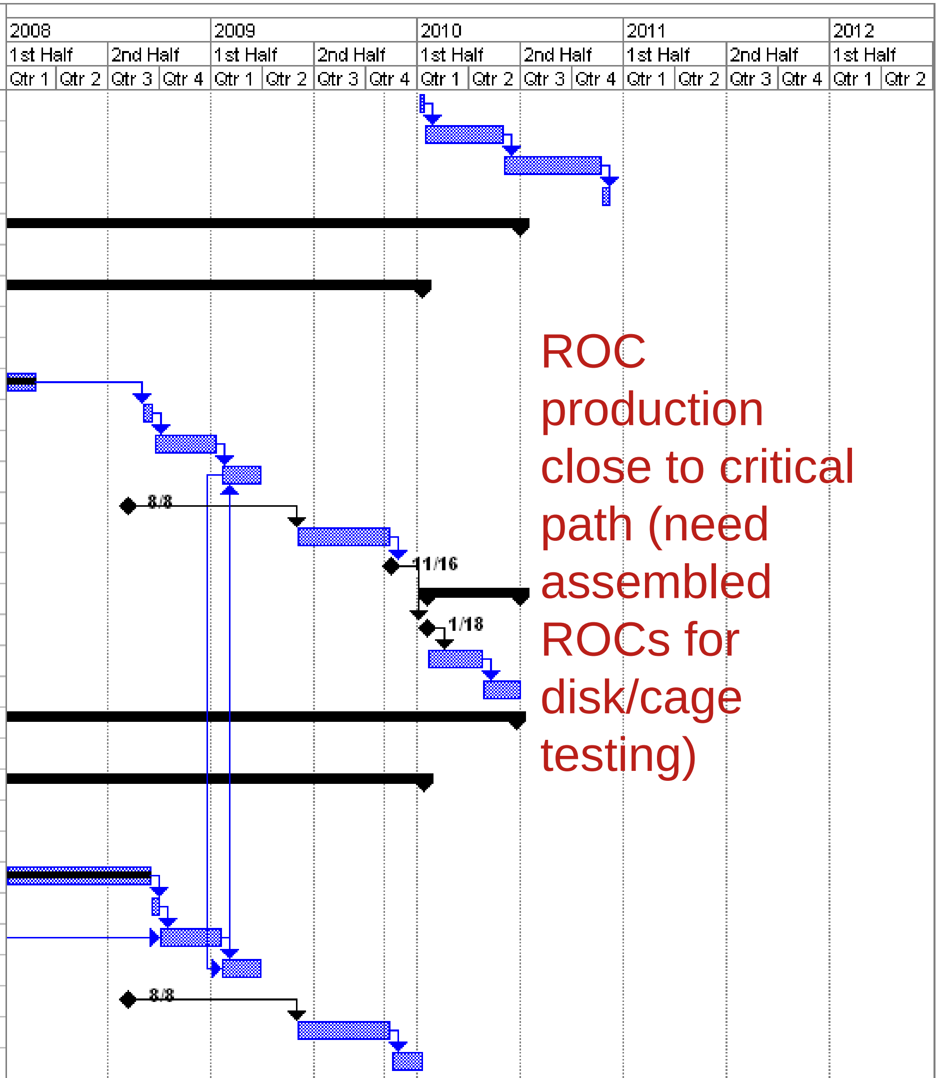
ID	WBS	Task Name	Start	Finish
32	1.4.2.3	layout	Fri 10/26/07	Thu 4/10/08
33	1.4.2.6	Review design	Mon 4/14/08	Mon 4/14/08
34	**1.4.2.4**	**procure prototype chip**	**Mon 6/2/08**	**Thu 10/1/09**
35	1.4.2.4.1	First MOSIS run	Mon 6/2/08	Fri 8/22/08
36	1.4.2.4.2	test prototype(FNAL)	Mon 8/25/08	Fri 10/10/08
37	1.4.2.4.3	redesign	Mon 5/11/09	Fri 5/29/09
38	1.4.2.4.4	submit 2nd MOSIS run	Mon 6/1/09	Fri 7/31/09
39	1.4.2.4.5	test 2nd proto	Mon 8/3/09	Fri 9/25/09
40	1.4.2.4.9	review and approve	Mon 9/28/09	Thu 10/1/09
41	**1.4.2.5**	**procure production chips**	**Fri 10/30/09**	**Thu 2/4/10**
42	1.4.2.5.1	engineering run	Fri 10/30/09	Thu 12/24/09
43	1.4.2.5.2	test chips(FNAL)	Fri 12/25/09	Thu 2/4/10
44	**1.4.3**	**Kapton flex cables HDI**	**Wed 6/4/08**	**Tue 2/9/10**
45	1.4.3.1	design	Wed 6/4/08	Tue 8/26/08
46	**1.4.3.2**	**procure prototype HDI**	**Wed 8/27/08**	**Mon 10/26/09**
47	1.4.3.2.1	prototype	Wed 8/27/08	Fri 2/27/09
48	1.4.3.2.2	test	Mon 3/2/09	Fri 8/14/09
49	1.4.3.2.3	redesign	Mon 8/17/09	Fri 10/23/09
50	1.4.3.2.6	review and approve HDI prototype	Mon 10/26/09	Mon 10/26/09
51	**1.4.3.3**	**procure production HDI**	**Tue 10/27/09**	**Tue 2/9/10**
52	1.4.3.3.3	final design review	Tue 10/27/09	Tue 10/27/09
53	1.4.3.3.1	procure	Wed 10/28/09	Tue 1/12/10
54	1.4.3.3.2	test cable	Wed 1/13/10	Tue 2/9/10
55	**1.4.4**	**Kapton HDI to ROC interconnect**	**Tue 10/27/09**	**Mon 4/26/10**
56	1.4.4.1	design	Tue 10/27/09	Mon 11/30/09
57	1.4.4.2	prototype	Tue 12/1/09	Mon 1/4/10
58	1.4.4.3	test prototype	Tue 1/5/10	Mon 1/18/10
59	1.4.4.4	procure	Tue 1/19/10	Mon 3/29/10
60	1.4.4.5	test cable	Tue 3/30/10	Mon 4/26/10
61	**1.5**	**DAQ**	**Mon 10/23/06**	**Mon 1/3/11**
62	**1.5.1**	**Fiber output ROC-FEM**	**Tue 1/5/10**	**Mon 12/6/10**
63	1.5.1.1	design	Tue 1/5/10	Mon 1/11/10



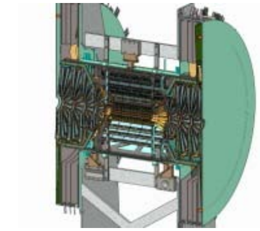


FVTX Project File

ID	WBS	Task Name	Start	Finish
63	1.5.1.1	design	Tue 1/5/10	Mon 1/11/10
64	1.5.1.2	prototype	Tue 1/12/10	Mon 5/31/10
65	1.5.1.3	procure	Tue 6/1/10	Mon 11/22/10
66	1.5.1.4	test cable	Tue 11/23/10	Mon 12/6/10
67	**1.5.2**	**ROC Electronics**	**Tue 1/30/07**	**Thu 7/1/10**
68	1.5.2.1	design	Tue 1/30/07	Mon 3/19/07
69	**1.5.2.2**	**procure prototype**	**Tue 3/20/07**	**Fri 1/8/10**
70	1.5.2.2.1	prototype	Tue 3/20/07	Mon 5/21/07
71	1.5.2.2.2	test prototype	Tue 5/22/07	Mon 7/30/07
72	1.5.2.2.3	redesign	Tue 7/31/07	Mon 2/25/08
73	1.5.2.2.4	2nd prototype ldrd version	Mon 9/1/08	Fri 9/19/08
74	1.5.2.2.5	test second proto	Mon 9/22/08	Fri 1/9/09
75	1.5.2.2.6	PHENIX system test	Tue 1/20/09	Mon 3/30/09
76	1.5.2.2.9	internal design review	Fri 8/8/08	Fri 8/8/08
77	1.5.2.2.7	preproduction prototype FVTX version	Mon 6/1/09	Fri 11/13/09
78	1.5.2.2.8	test ROC	Mon 11/16/09	Fri 1/8/10
79	**1.5.2.3**	**procure production ROC**	**Mon 1/18/10**	**Thu 7/1/10**
80	1.5.2.3.3	final design review	Mon 1/18/10	Mon 1/18/10
81	1.5.2.3.1	production	Tue 1/19/10	Mon 4/26/10
82	1.5.2.3.2	Q/A - 28 units	Tue 4/27/10	Thu 7/1/10
83	**1.5.3**	**FEM Electronics**	**Tue 1/30/07**	**Thu 6/24/10**
84	1.5.3.1	design	Tue 1/30/07	Mon 3/19/07
85	**1.5.3.2**	**procure prototype FEM**	**Tue 3/20/07**	**Mon 1/11/10**
86	1.5.3.2.1	prototype	Tue 3/20/07	Mon 6/4/07
87	1.5.3.2.2	test prototype	Tue 6/5/07	Mon 8/13/07
88	1.5.3.2.3	redesign	Tue 8/14/07	Mon 9/15/08
89	1.5.3.2.4	2nd prototype	Tue 9/16/08	Mon 9/29/08
90	1.5.3.2.5	test second proto	Tue 9/30/08	Mon 1/19/09
91	1.5.3.2.6	PHENIX system test	Tue 1/20/09	Mon 3/30/09
92	1.5.3.2.9	internal design review	Fri 8/8/08	Fri 8/8/08
93	1.5.3.2.7	preproduction prototype FVTX version	Mon 6/1/09	Fri 11/13/09
94	1.5.3.2.10	Test FEM	Mon 11/16/09	Fri 1/8/10



ROC production close to critical path (need assembled ROCs for disk/cage testing)



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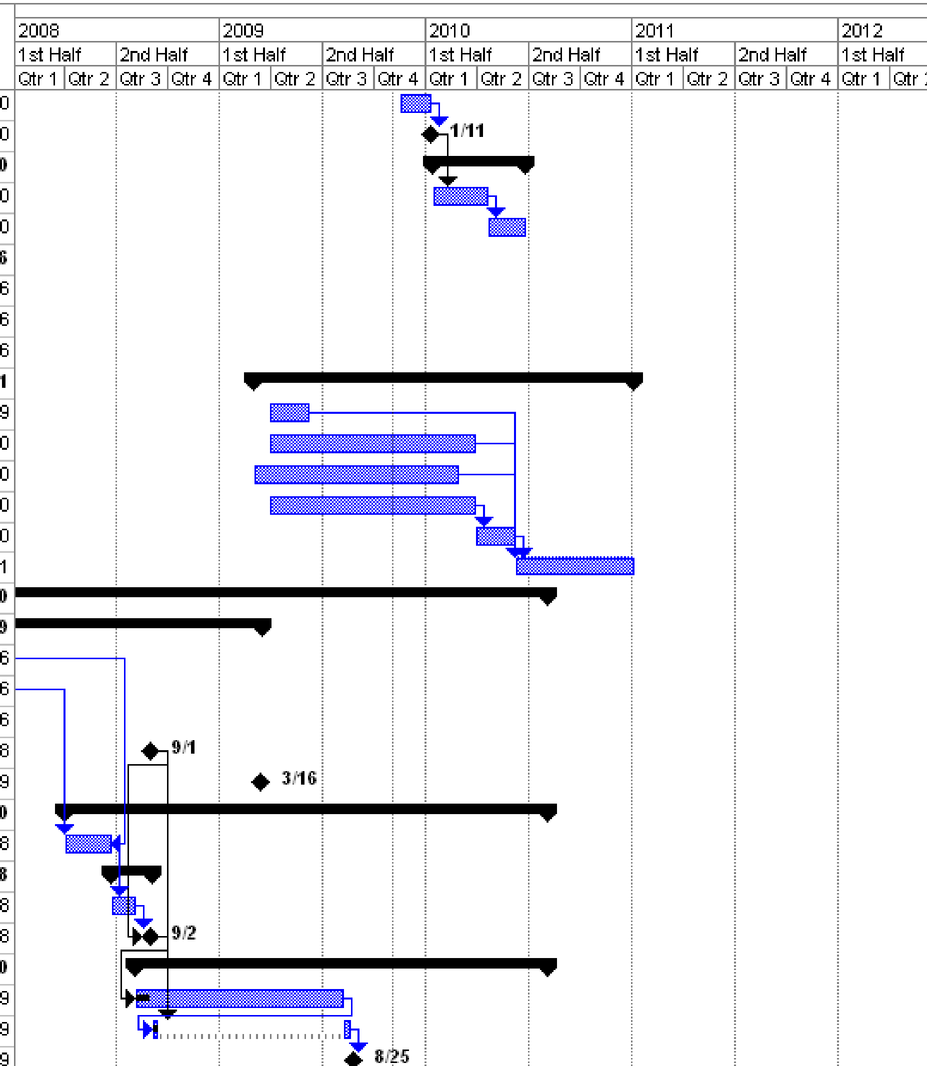
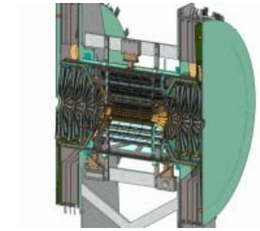
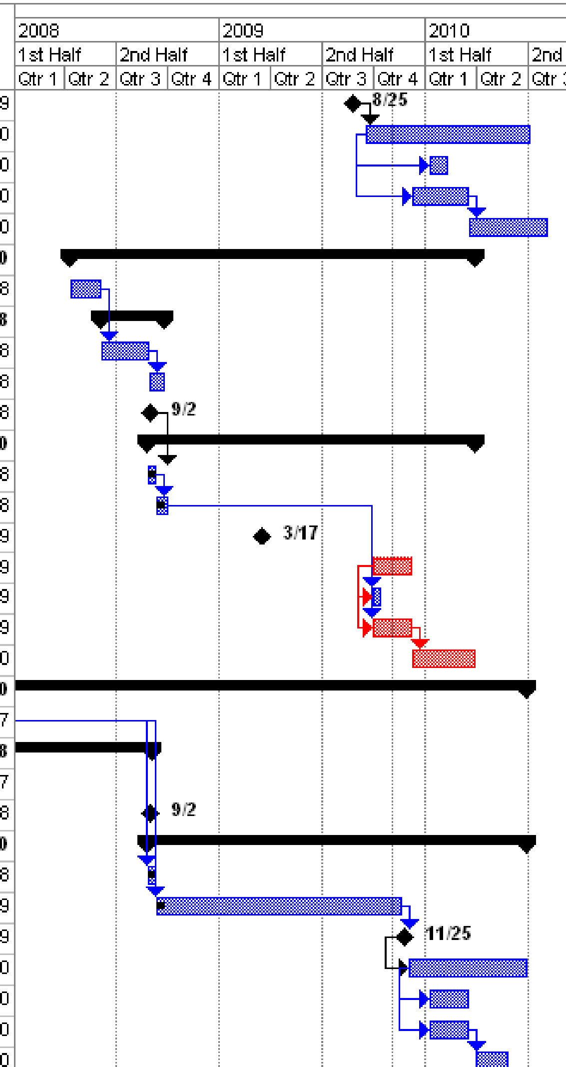
ID	WBS	Task Name	Start	Finish
94	1.5.3.2.10	Test FEM	Mon 11/16/09	Fri 1/8/10
95	1.5.3.2.8	review and approve FEM	Mon 1/11/10	Mon 1/11/10
96	**1.5.3.3**	**procure production FEM**	**Tue 1/12/10**	**Thu 6/24/10**
97	1.5.3.3.1	production	Tue 1/12/10	Mon 4/19/10
98	1.5.3.3.2	Q/A - 28	Tue 4/20/10	Thu 6/24/10
99	**1.5.4**	**Calibration**	**Mon 10/23/06**	**Fri 12/29/06**
100	1.5.4.1	Design Pulse injection	Mon 10/23/06	Fri 11/17/06
101	1.5.4.2	prototype	Mon 11/20/06	Fri 12/15/06
102	1.5.4.3	test prototype	Mon 12/18/06	Fri 12/29/06
103	**1.5.5**	**Ancillary**	**Mon 3/2/09**	**Mon 1/3/11**
104	1.5.5.1	Racks	Tue 3/31/09	Mon 6/8/09
105	1.5.5.2	LV,HV,crates,etc	Tue 3/31/09	Mon 3/29/10
106	1.5.5.3	DCM-24	Mon 3/2/09	Fri 2/26/10
107	1.5.5.4	Slow controls	Tue 3/31/09	Mon 3/29/10
108	1.5.5.5	Misc lab equip	Tue 3/30/10	Mon 6/7/10
109	1.5.5.6	install	Tue 6/8/10	Mon 1/3/11
110	**1.6**	**Mechanics**	**Fri 10/21/05**	**Tue 8/3/10**
111	**1.6.1**	**specifications**	**Fri 10/21/05**	**Mon 3/16/09**
112	1.6.1.1	endcaps - specify heat load	Tue 11/15/05	Mon 2/6/06
113	1.6.1.2	specify mechanical tolerances/distortions	Fri 10/21/05	Thu 2/9/06
114	1.6.1.3	specify disassembly/configuration options	Fri 10/21/05	Thu 2/9/06
115	1.6.1.4	Internall review	Mon 9/1/08	Mon 9/1/08
116	1.6.1.5	final design review	Mon 3/16/09	Mon 3/16/09
117	**1.6.2**	**Support structure cage**	**Tue 4/1/08**	**Tue 8/3/10**
118	1.6.2.1	design	Tue 4/1/08	Mon 6/23/08
119	**1.6.2.2**	**procure prototype cage**	**Tue 6/24/08**	**Tue 9/2/08**
120	1.6.2.2.1	prototype	Tue 6/24/08	Mon 8/4/08
121	1.6.2.2.2	Review and approve cage design	Tue 9/2/08	Tue 9/2/08
122	**1.6.2.3**	**procure**	**Wed 8/6/08**	**Tue 8/3/10**
123	1.6.2.3.1	final design	Wed 8/6/08	Thu 8/6/09
124	1.6.2.3.2	detail drawings	Wed 9/3/08	Tue 8/18/09
125	1.6.2.3.7	Cage Final design review	Tue 8/25/09	Wed 8/26/09





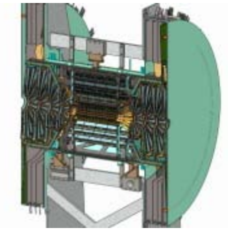
FVTX Project File

ID	WBS	Task Name	Start	Finish
125	1.6.2.3.7	Cage Final design review	Tue 8/25/09	Wed 8/26/09
126	1.6.2.3.3	Cage Laison	Tue 9/15/09	Tue 7/6/10
127	1.6.2.3.4	Cage Tooling	Tue 1/5/10	Tue 2/9/10
128	1.6.2.3.5	Cage Material	Tue 12/8/09	Tue 3/16/10
129	1.6.2.3.6	Cage Fabrication	Tue 3/16/10	Tue 8/3/10
130	**1.6.3**	**wedge backplane**	**Fri 4/11/08**	**Mon 3/29/10**
131	1.6.3.1	design	Fri 4/11/08	Thu 6/5/08
132	**1.6.3.2**	**procure prototype wedge backplane**	**Fri 6/6/08**	**Thu 9/25/08**
133	1.6.3.2.1	prototype	Fri 6/6/08	Thu 8/28/08
134	1.6.3.2.2	test	Fri 8/29/08	Thu 9/25/08
135	1.6.3.2.4	internal review	Tue 9/2/08	Tue 9/2/08
136	**1.6.3.3**	**procure**	**Tue 8/26/08**	**Mon 3/29/10**
137	1.6.3.3.1	final design	Tue 8/26/08	Mon 9/8/08
138	1.6.3.3.2	constr drawings	Wed 9/10/08	Tue 9/30/08
139	1.6.3.3.7	Backplane Final design review	Tue 3/17/09	Tue 3/17/09
140	1.6.3.3.3	Backplane Liason	Tue 9/29/09	Mon 12/7/09
141	1.6.3.3.4	Backplane Tooling	Tue 9/29/09	Mon 10/12/09
142	1.6.3.3.5	Backplane Material	Tue 9/29/09	Mon 12/7/09
143	1.6.3.3.6	Backplane Fabrication	Tue 12/8/09	Mon 3/29/10
144	**1.6.4**	**support disk**	**Thu 1/4/07**	**Tue 6/29/10**
145	1.6.4.1	R&D design	Thu 1/4/07	Wed 5/23/07
146	**1.6.4.2**	**procure prototype disk**	**Mon 10/22/07**	**Tue 9/2/08**
147	1.6.4.2.1	prototype	Mon 10/22/07	Fri 12/14/07
148	1.6.4.2.2	internal review	Tue 9/2/08	Tue 9/2/08
149	**1.6.4.3**	**Procure**	**Tue 8/26/08**	**Tue 6/29/10**
150	1.6.4.3.1	final design	Tue 8/26/08	Mon 9/8/08
151	1.6.4.3.3	construction drawings	Wed 9/10/08	Tue 11/17/09
152	1.6.4.3.9	Disk Final design review	Wed 11/25/09	Wed 11/25/09
153	1.6.4.3.4	Disk Liason	Wed 12/2/09	Tue 6/29/10
154	1.6.4.3.5	Disk Tooling	Wed 1/6/10	Tue 3/16/10
155	1.6.4.3.6	Disk Material	Wed 1/6/10	Tue 3/16/10
156	1.6.4.3.7	Disk Fabrication	Wed 3/31/10	Tue 5/25/10



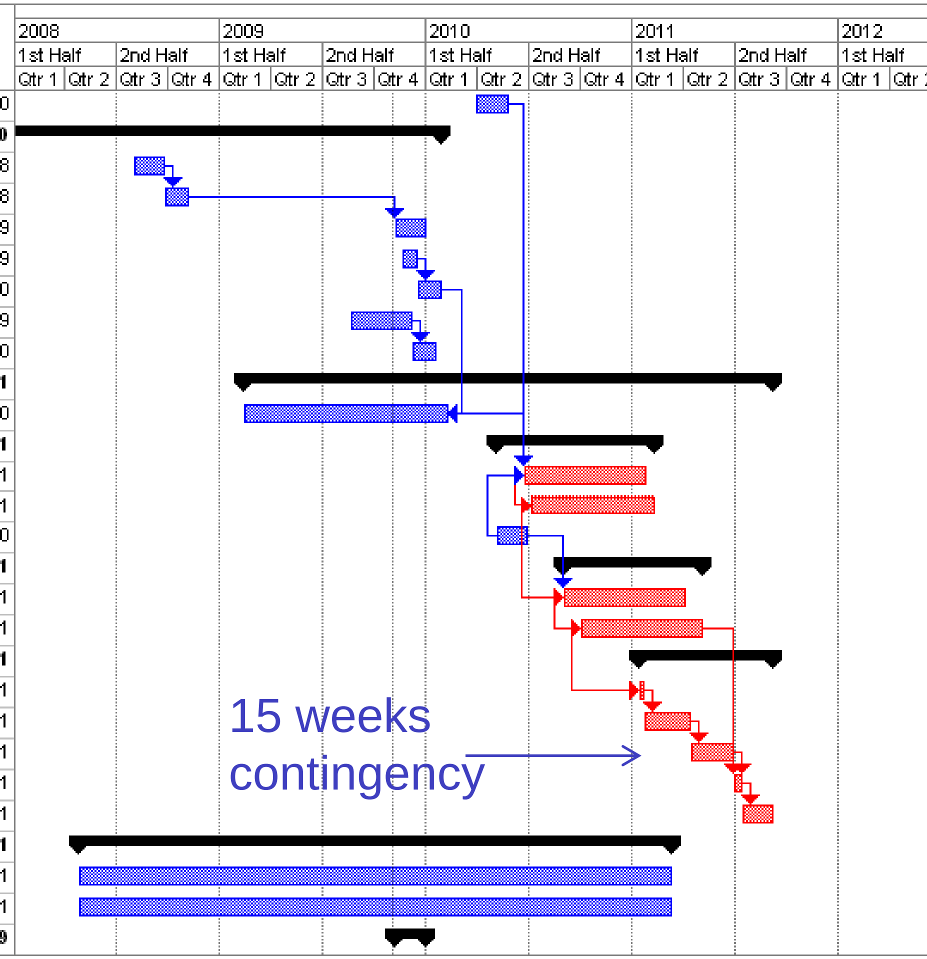
Backplane fabrication on critical path

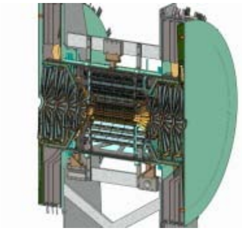
Cage and Disk fabrication very close to critical path



FVTX Project File

ID	WBS	Task Name	Start	Finish
156	1.6.4.3.7	Disk Fabrication	Wed 3/31/10	Tue 5/25/10
157	**1.6.5**	**Alignment and assembly jigs**	**Fri 10/21/05**	**Tue 1/26/10**
158	1.6.5.1	design wedge jig	Fri 8/1/08	Thu 9/25/08
159	1.6.5.2	procure prototype wedge jig	Fri 9/26/08	Thu 11/6/08
184	1.8.3.7	procure production wedge jigs	Fri 11/6/09	Thu 12/31/09
161	1.6.5.3	design cool plate jig	Wed 11/18/09	Tue 12/15/09
162	1.6.5.4	procure cool plate ass jig	Wed 12/16/09	Tue 1/26/10
163	1.6.5.5	design cage ass jig	Tue 8/18/09	Tue 12/8/09
164	1.6.5.6	procure cage ass jig	Tue 12/8/09	Tue 1/19/10
165	**1.7**	**Endcap Assembly**	**Wed 2/11/09**	**Thu 9/8/11**
166	1.7.8	assembly lab setup	Wed 2/11/09	Tue 2/9/10
167	**1.7.1**	**Assemble ladders onto cooling plate**	**Tue 5/4/10**	**Mon 2/7/11**
168	1.7.1.1	place wedges on cooling plate	Tue 6/22/10	Mon 1/24/11
169	1.7.1.2	optically survey wedges	Tue 7/6/10	Mon 2/7/11
170	1.7.1.3	Assemble ROC Big Wheel	Tue 5/4/10	Mon 6/28/10
171	**1.7.2**	**Install into cage enclosure**	**Tue 8/31/10**	**Thu 5/5/11**
172	1.7.2.1	place cooling plates in cage	Tue 8/31/10	Mon 4/4/11
173	1.7.2.2	optically survey	Thu 9/30/10	Thu 5/5/11
174	**1.7.3**	**Install cages into VTX enclosure**	**Thu 1/13/11**	**Thu 9/8/11**
175	1.7.3.4	Install 2 half cages in enclosure into IR	Thu 1/13/11	Thu 1/20/11
176	1.7.3.5	test and verify functional requirements	Thu 1/20/11	Thu 4/14/11
177	1.7.3.9	Schedule Contingency	Thu 4/14/11	Thu 6/30/11
178		Install remaining half cages into enclosure in IR	Thu 6/30/11	Thu 7/14/11
179		test and verify remaining half cages	Thu 7/14/11	Thu 9/8/11
180	**1.8**	**System Integration**	**Fri 4/25/08**	**Thu 3/10/11**
181	1.8.1	Mechanical egineer	Fri 4/25/08	Thu 3/10/11
182	1.8.2	Electrical Engineer	Fri 4/25/08	Thu 3/10/11
183	**1.8.3**	**FVTX Management**	**Fri 11/6/09**	**Thu 12/31/09**





Cost Updates Since Management Plan

Included In Current Costs:

FPHX prototyping costs less than MP	$166k savings
Electrical Integration costs less than MP	$ 61k savings
Mechanical Integration costs less than FY09 MP	$ 19k savings
Cage and backplane costs higher than MP	$177k additional cost
Extra mechanical design costs	$ 30k additional cost
ROC/FEM prototyping costs increased (we think)	$ 60k additional cost
Added PCB HDI task, testing fixtures, etc.	$ 40k additional cost
HDI quote fits within MP	
Sensor quote fits within MP	
FPHX quote fits within MP	
SiDet assembly quote fits within MP	

Management Plan Cost = $4880k, Contingency = $927k

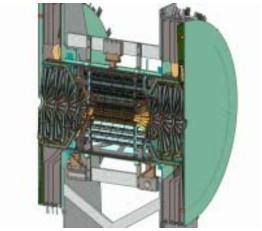
$1962k costs and commitments to date and remaining Contingency = $810k (38%)

Future Changes

Expect additional costs in power distribution

May reduce some backplane work costs if not done at LBNL (mounts)

DAQ boards need cost update – increase expected due to increased fibers



ARRA FVTX Funds

$2M in ARRA funds received in summer 2009. Milestones:

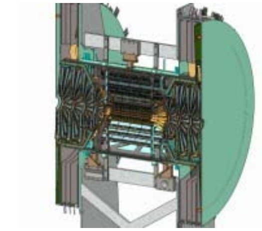
Initiate Backplane procurement process	6/2009
Initiate Cage procurement process	6/2009
Start Recovery Act FVTX Management and Integration by LANL	7/2009
Initiate Ancillary System procurement process	11/2009
Review and approve ROC/FEM design	12/2009
Initiate ROC/FEM production procurement process	1/2010
Begin testing ROC/FEM board	2/2010
Begin attaching HDIs to Backplane	3/2010
Begin testing production version of FPHX chips	4/2010
Begin attaching chips to HDIs	6/2010
Begin attaching sensors to HDIs	7/2010
Begin testing wedge assemblies	8/2010
Begin assembling wedges into disks	9/2010

FVTX Cost Estimate

2 endcaps		WBS	TPC 2007	Baseline Cost with contingency AY	Baseline Conting	Remaining contingency	Cost AY$
Mechanics		**1.6**					
Cage		1.6.2	352	174	35	-77	251
Backplane		1.6.3		188	38	41	147
Disk		1.6.4		114	23	28	86
Alignment and Assembly jigs		1.6.5.2	60	80	15	20	60
	1.6	**totals**	**412**	**555**	**110**	**11**	**544**
Sensor							
Silicon Sensor		1.4.1					
prototype sensor and test		1.4.1.2	85	107	19	-32	139
purchase		1.4.1.3	410	553	107	143	410
sensor Q/A and testing		1.4.1.3.2	50	62	8	3	59
attach HDI to backplane		1.4.1.3.3	30	39	7	35	4
attach sensor		1.4.1.3.4	30	39	7	35	4
wire bond assembly		1.4.1.3.5	188	263	49	55	208
test wedge assembly		1.4.1.3.6	40	54	9	9	45
Sidet prototype assembly		1.4.1.1		0		-19	19
	1.4.1	totals	**833**	**1118**	**206**	**230**	**888**
FPHX		1.4.2					
1 st Prototype		1.4.2.4.1	0	0	0	-90	90
2 nd + 3rd Mosis run and test		1.4.2.4.4	175	242	51	153	89
FNAL coding W.Wester		1.4.2.4.9	0	0	0	-20	20
FPHX test stands		1.4.2.4.9		0		-5	5
engineering run		1.4.2.5.1	240	385	115	131	254
testing		1.4.2.5.2	50	64	8	9	55
	1.4.2	totals	**465**	**692**	**174**	**179**	**513**

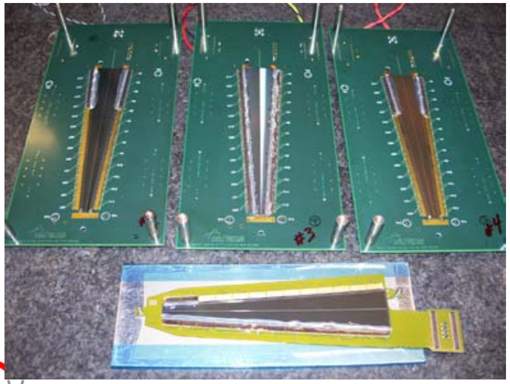
FVTX Cost Estimate

2 endcaps		WBS	TPC 2007	Baseline Cost with contingency	Baseline Conting	Remaining contingency	Cost AY$
	1.4.2	totals	**465**	**692**	**174**	**179**	**513**
HDI bus		1.4.3	143	194	39	-64	259
flex cables, sensor to ROC		1.4.4	56	70	9	7	62
		totals	**1497**	**2074**	**428**	**352**	**1722**
Readout Electronics							
ROC electronics		1.5.2					
preproduction proto		1.5.5.2	71	100	26	-43	144
Clock and Interface			0	0	0	-40	40
production		1.5.5.3.1	337	497	111	123	374
Q/A		1.5.5.3.2	14	18	2	2	16
		totals	**422**	**615**	**139**	**42**	**574**
FEM electronics		1.5.3					
preproduction		1.5.3.2	80	116	29	1	115
production		1.5.3.3.1	301	444	99	110	334
Q/A		1.5.3.3.2	14	18	2	2	16
fibercables, ROC-FEM		1.5.1	17	21	3	2	19
lab equipment		1.5.5.5	100	117	10	101	16
		totals	**512**	**716**	**143**	**217**	**500**
Ancillary Systems		1.5.5					
Racks,LV,HV,DCM,crates,install		1.5.5.1-1.5.5.6	99	123	12	13	110
slow controls		1.5.5.4	5	7	1	1	6
calibration system		1.5.4					0
		totals	**104**	**130**	**13**	**14**	**116**
Assemble endcap		1.7	**30**	**42**	**8**	**9**	**33**
Electronics Integration		1.8.2	165	189	23	71	118
Mechanical Integration		1.8.1	250	311	35	61	250
	totals		**415**	**500**	**58**	**132**	**368**
Management		1.9	**200**	**249**	**28**	**34**	**215**
	total		3593	4881	927	810	4071

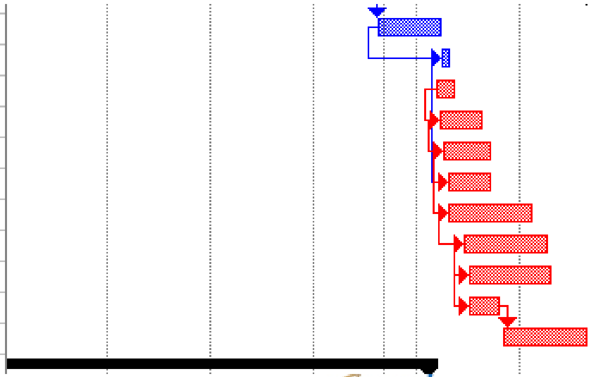


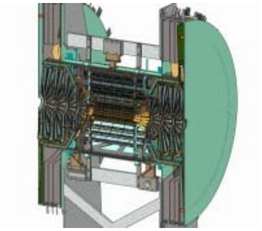
Summary

- Significant technical progress in the last year – prototyped almost all components, tested, reviewed and moving into production. No significant issues uncovered
- Critical path FPHX development went very well
- However, all other wedge components basically on critical path (good news/bad news)
- Currently have ~19 weeks contingency in schedule (23%)
- Project Costs reasonably maintained with $810k (38%) remaining contingency



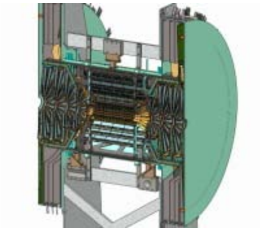
procure sensor(fully tested)	Fri 10/23/09	Thu 2/11/10
Sensor Q/A	Fri 2/12/10	Thu 2/25/10
Attach HDI to Backplane	Tue 2/2/10	Mon 3/8/10
glue chips to HDI	Tue 2/9/10	Mon 4/26/10
test chips and HDI	Tue 2/16/10	Mon 5/10/10
Attach sensor	Tue 2/23/10	Mon 5/10/10
wire bond assembly	Thu 2/25/10	Wed 7/21/10
test chip,sensor + cable assemblies	Thu 3/25/10	Wed 8/18/10
wire bond encapsulation	Thu 4/1/10	Wed 8/25/10
Assembly Contingency	Thu 4/1/10	Wed 5/26/10
attach backplane mounts	Thu 6/3/10	Wed 10/27/10
X Chip	**Thu 3/15/07**	**Thu 1/21/10**



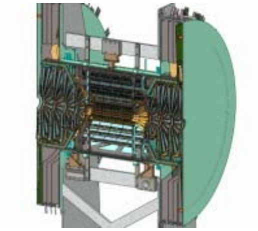


Day’s Agenda

10:00 – 10:30	Simulations – Xiaorong Wang
Break	
10:50 – 11:30	WBS 1.4.1, 1.4.2, Sensors/FPHX Readout Chip – Jon Kapustinsky
11:30 – 12:00	WBS 1.4.3 HDI – Doug Fields
lunch	
1:00 – 2:00	WBS 1.5.2, 1.5.3 DAQ Overview – Sergey Butsyk
2:00 – 2:30	WBS 1.4 Wedge Assembly – Dave Winter
2:30 – 2:50	WBS 1.7 Detector Assembly – Steve Pate
break	
3:00 – 3:20	WBS 1.6 Mechanics -- Walt Sondheim
3:20 – 3:40	WBS 1.8.1 Mechanical Integration -- Robert Pak
3:40 – 4:00	WBS 1.8.2 Electrical Integration – Eric Mannel



Backups



Participating and Interested Institutions

Los Alamos National Laboratory

LANL coordinate work to procure the silicon sensors, work with FNAL on the development of the PHX chip, on development of the interface to PHENIX DAQ, and on the simulation effort with NMSU. Los Alamos is currently leading the mechanical engineering and the integration effort for the barrel detector, VTX, and will continue those efforts for the FVTX.

Bhabha Atomic Research Centre

Involvment still under discussion

Brookhaven National Laboratory

Brookhaven manages the integration and ancillary systems for the VTX and will do the same for the FVTX. They might also participate in software and the assembly of the disks and cages.

Charles University, Czech Technical University, Institute of Physics, Academy of Sciences, Prague

The Czech groups have been active in the development, testing, assembly, and commissioning of the ATLAS pixel sensors. They will do the same for the FVTX effort and additionally participate in software development.

Columbia University

Columbia University has major responsibility with the complete wedge assembly and testing. They are also have co-responsibility for the FPHX chip and are active in the software simulations.

Iowa State University

Iowa State University is currently working on management details with the barrel detector and working on an (funded) SBIR effort for the level one trigger capabilities of the FVTX.

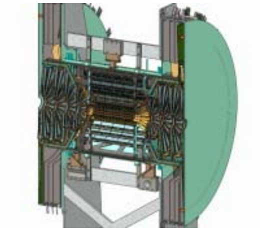
New Mexico State University

NMSU will be responsible for the FVTX detector assembly, as well as managing and working on comprehensive simulations for the FVTX effort and working on the sensor testing.

Saclay

Saclay will work on software

.



Participating and Interested Institutions

University of Jyvaskyla

Involvment still under discussion. Have indicated that they will contribute students in the assembly and

testing

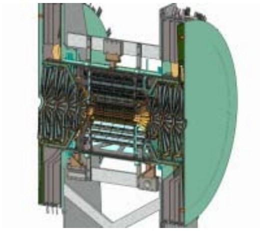
University of New Mexico

UNM has experience in testing, Q/A and a laboratory for characterization of sensors. They are currently working on the barrel strip sensors and will do the same for the FVTX effort. They may also work on the flex cables.

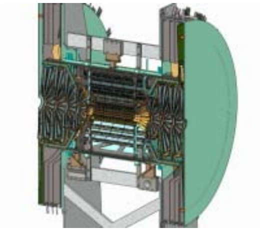
Yonsei University, Seoul, Korea

Involvment still under discussion

FVTX Milestones



WBS Number	Control Milestone Name	Baseline Date	Actual/ Forecast Date
WBS 1.1	**DOE construction funds received**	**Q3 FY08**	**Q3 FY08**
Accounts open	**Accounts open**	**Q3 FY08**	**Q3 FY08**
WBS 1.6.2.2.2	**Review and Approve wedge, disk, cage design**	**Q3 FY08**	**Q3 FY08**
WBS 1.4.3.2.5	**HDI tested**	**Q3 FY08**	**Q2 FY09**
WBS 1.4.1.2.3	**Sensor prototype tested**	**Q1 FY09**	**Q1 FY09**
WBS 1.4.1.2.5	**First prototype wedge assembly**	**Q1 FY09**	**Q2 FY09**
WBS 1.5.2.2.6	**PHENIX system test complete**	**Q1 FY09**	**Q3 FY09**
WBS 1.5.2.2.8	**Review and Approve FEM and ROC**	**Q2 FY09**	**Q1 FY10**
WBS 1.4.1.3.1	**Sensor Procurement complete**	**Q3 FY09**	**Q1 FY10**
WBS 1.4.1.2.6	**Wedge assembly test complete**	**Q4 FY09**	**Q4 FY09**
WBS 1.4.2.5.1	**FPHX engineering run complete**	**Q1 FY10**	**Q1 FY10**
WBS 1. 5.3	**ROC and FEM production Complete**	**Q2 FY10**	**Q2 FY10**
WBS 1.7.1.1	**Disk Assembly begins**	**Q3 FY10**	**Q3 FY10**
WBS 1.5.5.6	**Install ancillary Equipment**	**Q4 FY10**	**Q4 FY10**
WBS 1.7.1.1	**Disk Assembly complete**	**Q1 FY11**	**Q1 FY11**
WBS 1.7.2.1 ½	**Cage Assembly finished**	**Q2 FY11**	**Q2 FY11**
WBS 1.7.3	**Install into VTX enclosure**	**Q2 FY11**	**Q2 FY11**
WBS 1.7.3	**Project Complete**	**Q3 FY11**	**Q3 FY11**



Schedule Changes in FY09

Reminder: Construction Start

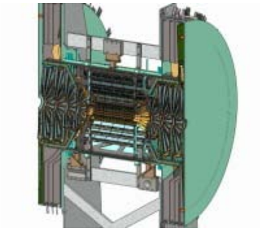
- Management Plan sign-off March 2008
- Construction Funds April 2008 - $500k in FY08

FPHX chip (FY08 Critical Path driver) prototyping and testing went reasonably smoothly. Float in schedule, for 3rd round, not needed

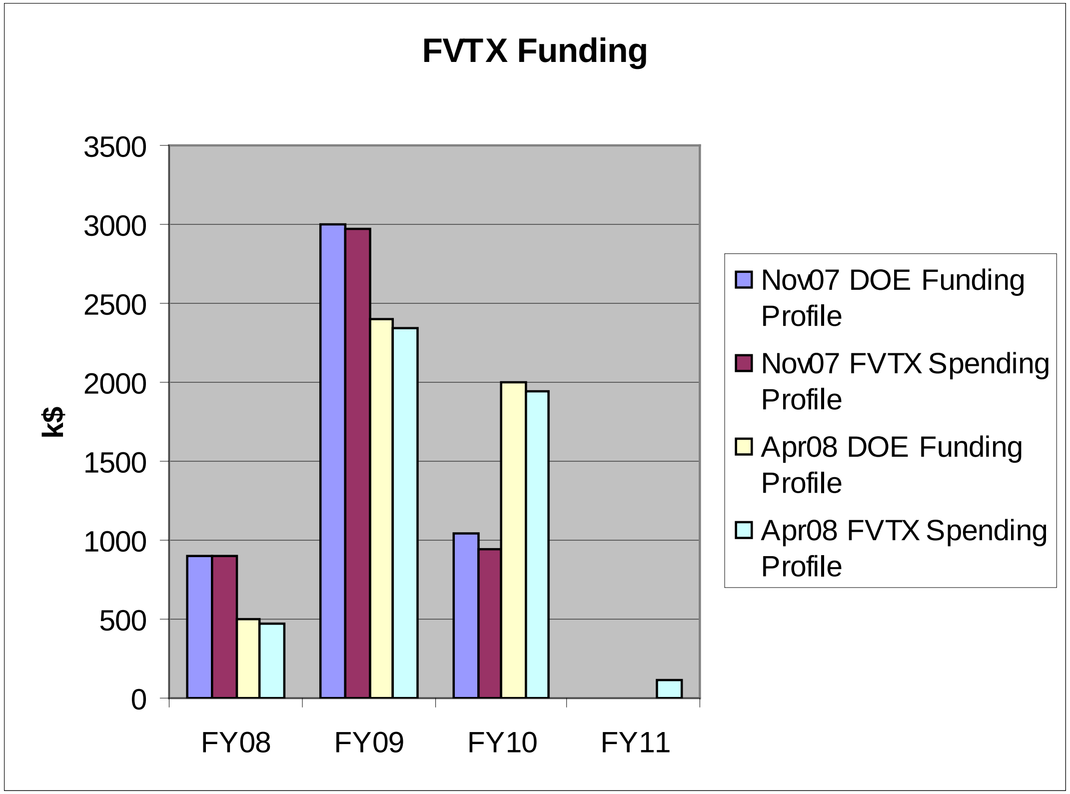
Other non-critical items moved to critical path: HDI, backplane, sensor, cage, disk, ROC+FEM moving closer

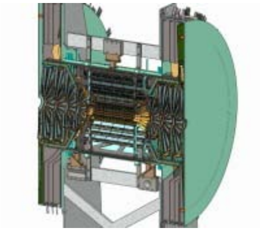
- We wanted all components to wait for system test before production→wedge components "caught up" with FPHX schedule
- Sensor purchase took longer than expected to place
- ROC/FEM design work much slower than anticipated (sharing of resources, more complexity in design)
- Mechanical estimates for fabrication in MP much less than current estimates from LBNL, taking 6+ months to place order (mostly waiting for quotes)

Wedge assembly more clearly defined, somewhat shorter than MP

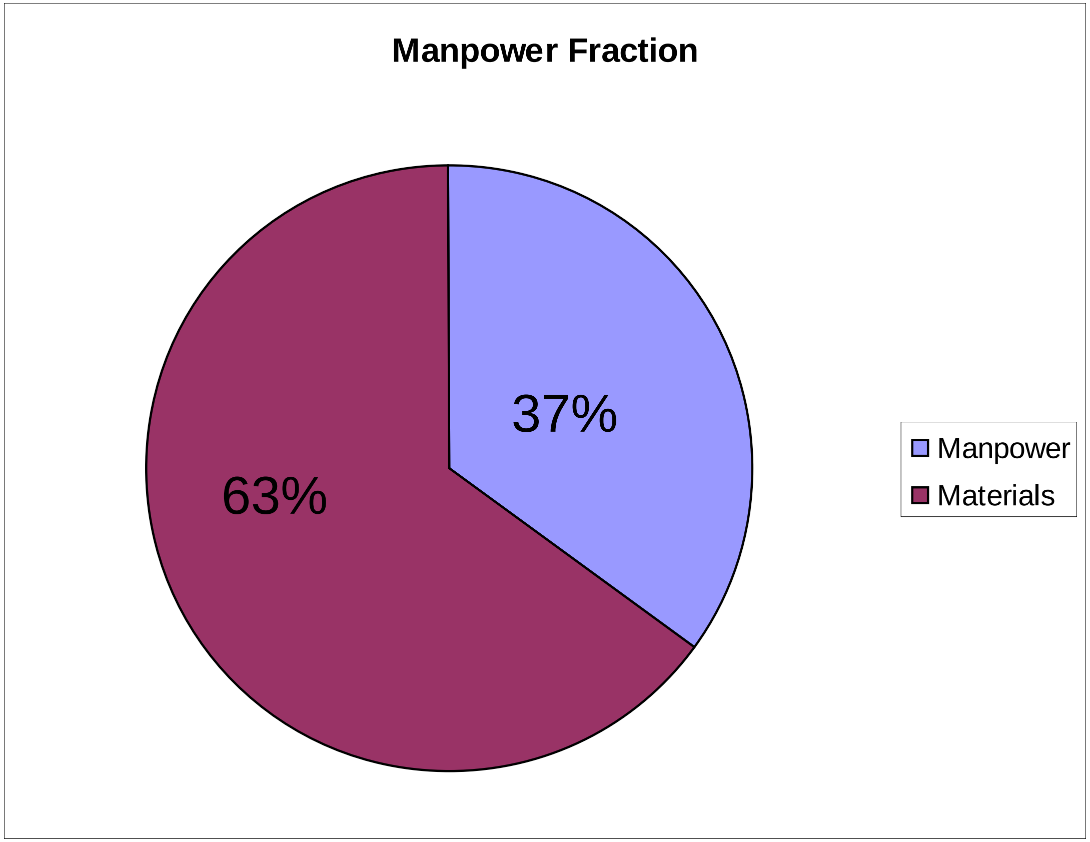


Funding and Spending Profiles

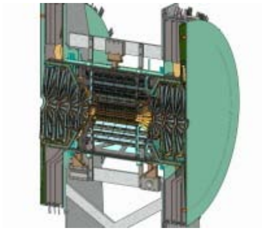


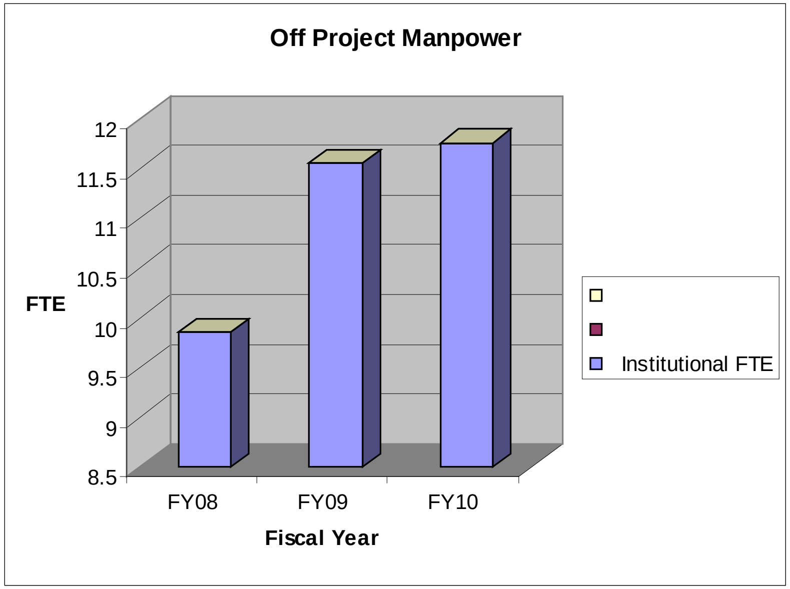


Project Manpower Fraction



Estimated Manpower

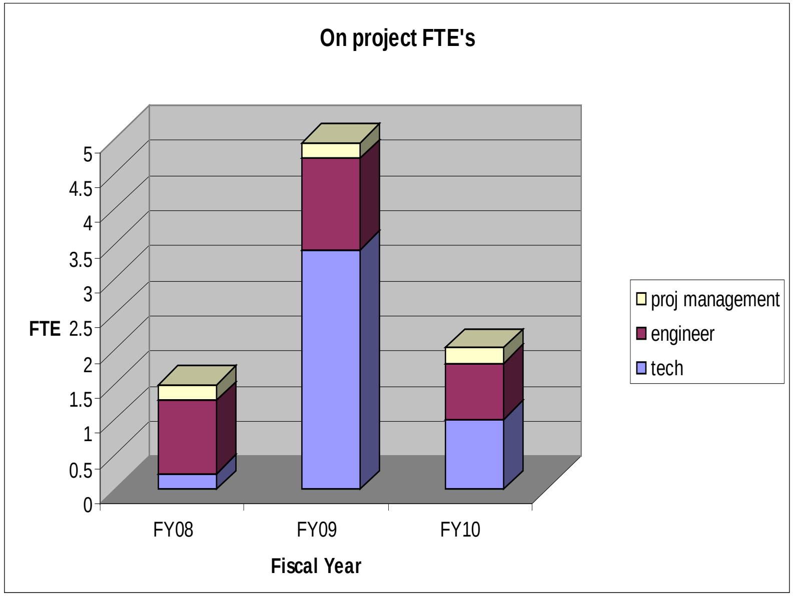




From Workforce Spreadsheets- covers all scientists, and training for postdocs and students.

Ave Tech = $100k

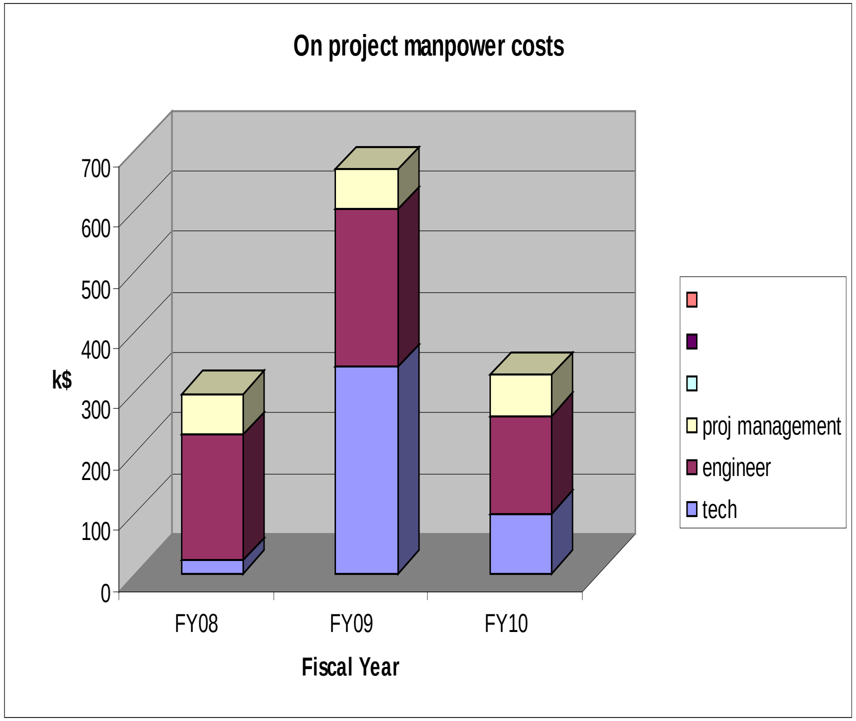
Ave Engineer = $200k



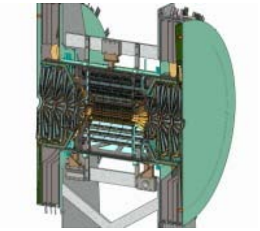
From FVTX Project File

On Project Workforce

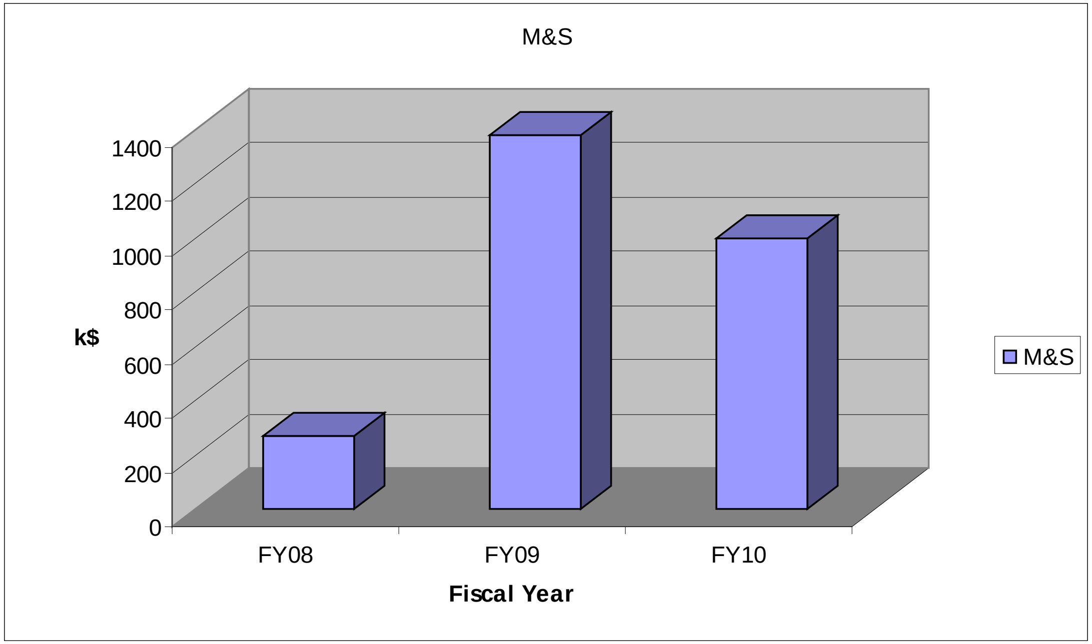
WBS		tech $	Eng $	tech08	tech09	tech10	eng08	eng09	eng10
1.4.1.3.2	unm	50			50				
1.4.1.3.3	cu	30			26	4			
1.4.1.3.4	cu	30			26	4			
1.4.1.3.6	cu	40			15.4	24.6			
1.4.2.4.3	fnal		30				30		
1.4.2.4.5	fnal		15					15	
1.4.2.5.2	fnal	50			50				
1.4.3.3.2	unm	18.2			18.2				
1.4.4.5	unm	18.2			18.2				
1.5.1.4	unm	6			6				
1.5.2.2.7	lanl	26.6	30.7		26.6			30.7	
1.5.2.3.1	lanl	26.6	30.7		26.6			30.7	
1.5.2.3.2	lanl	14			14				
1.5.3.2.7	lanl	24.8	30.7		24.8			30.7	
1.5.3.3.1	lanl	17.9	23.7			17.9			23.7
1.5.3.3.2	lanl	14				14			
1.5.5.2	bnl	5			5				
1.5.5.4	bnl	5			5				
1.5.5.6	bnl	5				5			
1.6.2.3.1	hytec		20				20		
1.6.2.3.2	hytec	10		10					
1.6.2.3.3	hytec		5					5	
1.6.3.2.2	hytec	5		5					
1.6.3.3.1	hytec		10				10		
1.6.3.3.2	hytec	2		2					
1.6.3.3.3	hytec		5					5	
1.6.4.3.1	hytec		10				10		
1.6.4.3.3	hytec	5		5					
1.6.4.3.4	hytec		5					5	
1.6.5.1	hytec	10			10				
1.6.5.3	hytec	10			10				
1.6.5.5	hytec	10			10				
1.7.1.1	bnl	10				10			
1.7.1.2	bnl	5				5			
1.7.2.1	bnl	5				5			
1.7.2.2	bnl	5				5			
1.7.3	bnl	5				5			
1.8.1	lanl		250				83.3	83.3	83.3
1.8.2	cu		165				55	55	55
1.8.3	lanl	200					66.6	66.6	66.6
		663.3	630.8	22	341.8	99.5	274.9	327	228.6

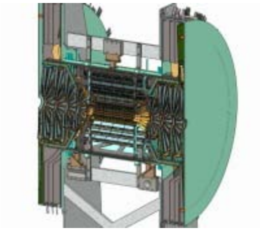


On Project M&S Costs



FVTX M&S Costs				
WBS #	Task	FY08	FY09	FY10
1.4.1.2.1	Mask Set	67		
1.4.1.2.2	sensor pro	36.9		
1.4.1.2.3	test prototy	5		
1.4.1.2.4	wire bond I	5		
1.4.1.3.1	procure sensor		381.5	
1.4.1.3.5	wire bond sensor			208
1.4.2.4.4	ChipProto	144.8	188	
1.4.2.5.1	production run		161	100
1.4.3.2.1	prototype H	5		
1.4.3.3.1	procure HDI		123	
1.4.4.2	prototype i		5	
1.4.4.4	procure		35.4	
1.5.1.3	procure fiber		11.8	
1.5.2.2.7	preproduct		76	
1.5.2.3.1	production ROC			312
1.5.3.2.7	preproduct		85.7	
1.5.3.3.1	production FEM			288.3
1.5.5.2	LV,HV,crates,etc			44.3
1.5.5.3	DCM			48.7
1.5.5.6	Misc. Lab		100	
1.6.2.3.4	tooling cage		7.8	
1.6.2.3.5	material		10	
1.6.2.3.6	fabrication		50	
1.6.3.2.1	prototype v	5		
1.6.3.3.4	tooling wedge		15	
1.6.3.3.5	material		33.6	
1.6.3.3.6	fabrication wedge		9	
1.6.4.3.5	toolig disk		10	
1.6.4.3.6	material		20	
1.6.4.3.7	fabrication		30	
1.6.5.2	procure wedge jig		9.1	
1.6.5.4	procure disk jig		10	
1.6.5.6	procure cage jig		10	
		268.7	1381.9	1001.3





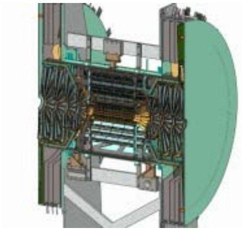
Performance Requirements

Silicon Sensors - good efficiency and resolution, low noise, minimize radiation length

DAQ - keep up with expected data rates, ability to participate in Lvl-1

Integration into PHENIX - seamless integration into PHENIX data-taking

	Minimum Acceptable	Expected Performance
Mini strips active	>90%	>95%
hit efficiency	>95%	99%
Radiation length per wedge	< 2.4 %	1.5%
Detector hit resolution	< 25 μm	~15 μm
Noise hits/chip	<1%	<<1% (thresh:noise=5)
LVL1 latency	4 μs	
LVL1 Multi-Event buffer depth	4 events	
Read-out time	< 40 μs	
Read-out rate	> 10 kHz	



Physics Performance Requirements

- Noise levels can be higher than nominal, but need to maintain approximately nominal threshold:noise ratio.

	Minimum Acceptable	Expected Performance
Mini strips active	>90%	>95%
hit efficiency	>95%	99%
Radiation length per wedge	< 2.4 %	1.5%
Detector hit resolution	< 25 μm	~15 μm
Noise hits/chip	<1% → **<2000 e noise, thresh:noise >= 4**	400 e noise, thresh:noise = 5
LVL1 latency	4 μs	
LVL1 Multi-Event buffer depth	4 events	
Read-out time	< 40 μs	
Read-out rate	> 10 kHz	