



Layer 0 Silicon Detector

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July 15, 2004

- **Overview of Detector**
- **Status**



Motivation

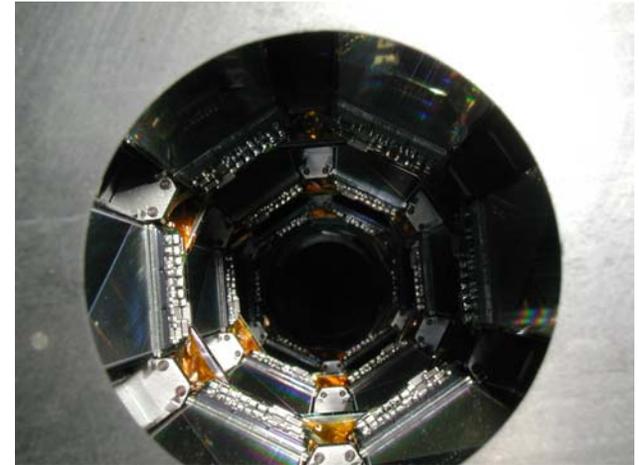


Install inside of current silicon detector

- ◆ Mitigate tracking losses due to radiation damage and detector failure

We expect layer 1 Micron sensors to begin to fail at exposures of $\sim 3-4 \text{ fb}^{-1}$

- ◆ Provide more robust tracking and pattern recognition for higher luminosities
- ◆ Improve impact parameter resolution
 - ▲ Relative increase of b-tagging efficiency is 15%





Institutions



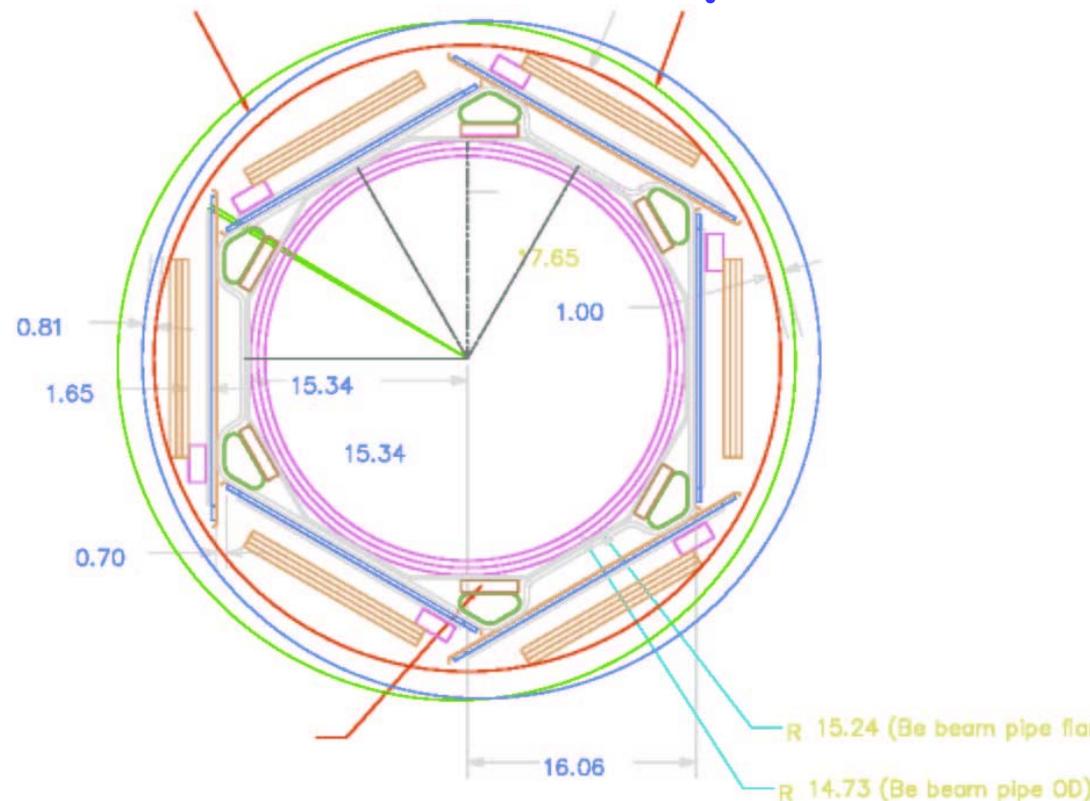
- **FNAL** - most assembly and a lot of engineering
- **MRI Institutes**
 - ◆ **Univ. of Kansas** - Electronics and procurement
 - ◆ **Kansas State Univ.** - Electronics
 - ◆ **Univ of Washington** - Mechanical support structure
 - ◆ **SUNY Stony Brook** - Sensor procurement and testing
 - ◆ **Cal State Fresno** - hybrid testing
 - ◆ **Brown** - procurement
 - ◆ **Michigan State** - machining
- **Louisiana Tech** - cable testing
- **Zurich** - analog cable testing
- **Rice** - temperature monitoring



Overview



- Layer 0 has 6-fold symmetry
- Fits inside present silicon layers at $r \sim 1.6\text{cm}$
- 4 sensor types provide 98.4% ϕ acceptance
- 4 sensors/z half
- 48 hybrids
- Use SVX4 chip

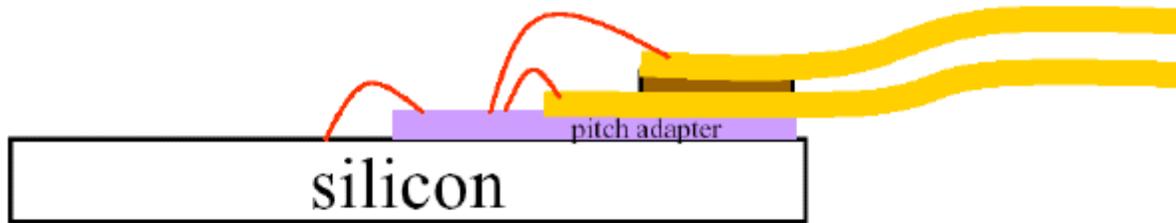




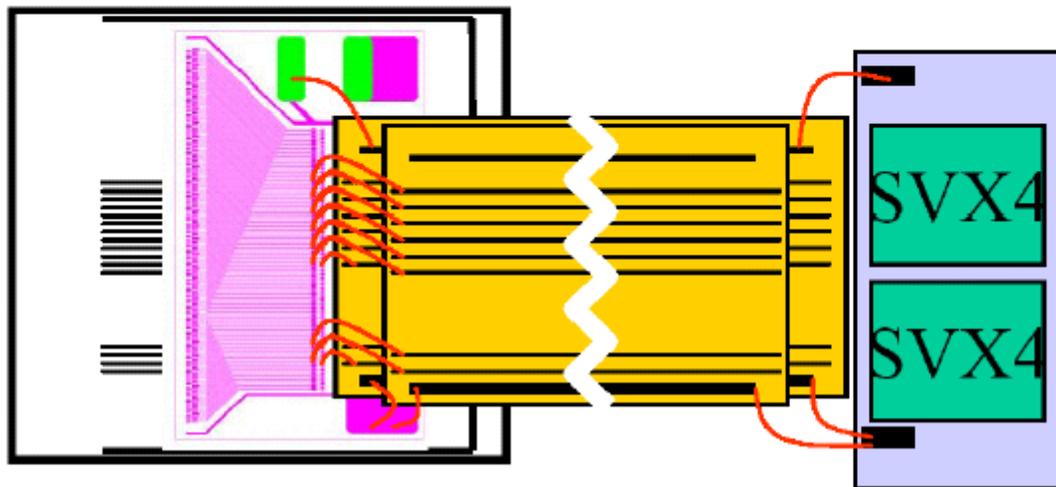
Readout channel



Sensors have intermediate strips with 2 different pitches (71 and 81 μm) and two different lengths (4 types total). 120 ordered from Hamamatsu.



Pitch adapter is put onto silicon to each wirebonding of analog cables.

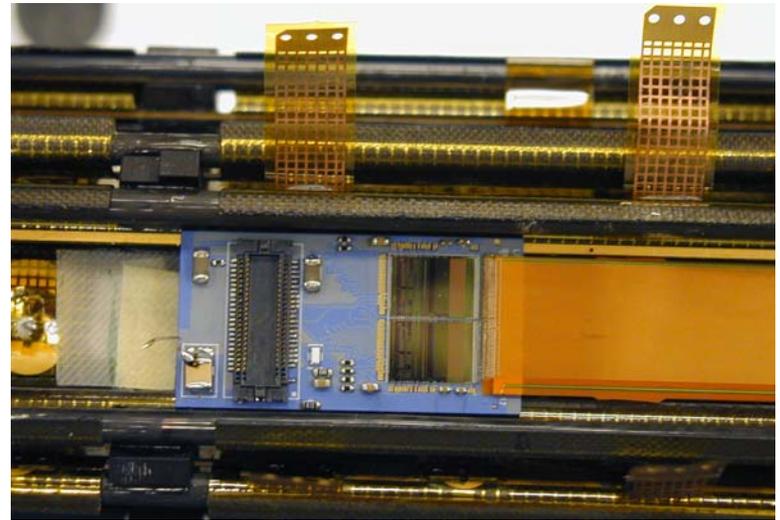




Readout channel (2)



- First pitch adapter prototypes had bonding problems
 - ◆ We are ordering more prototypes through 2 different vendors
- Analog cables ordered from Dyconex, delivered June 25 and being tested now
- Hybrids are essentially the same as RunIIb and ordered from Amitron March 10. Delivery expected July 31

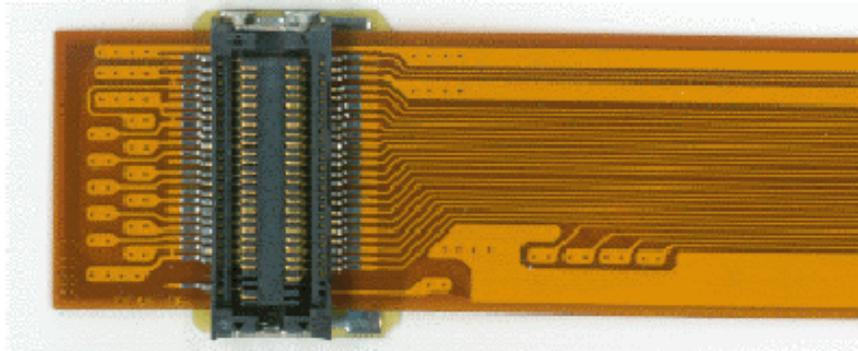




Downstream Electronics



- Digital Jumper cables are last of full chain to be settled on - we have just gone out for quote, design is the same as RunIIb



- Junction cards have initial design and layout and are waiting on final OK



Downstream Electronics (2)

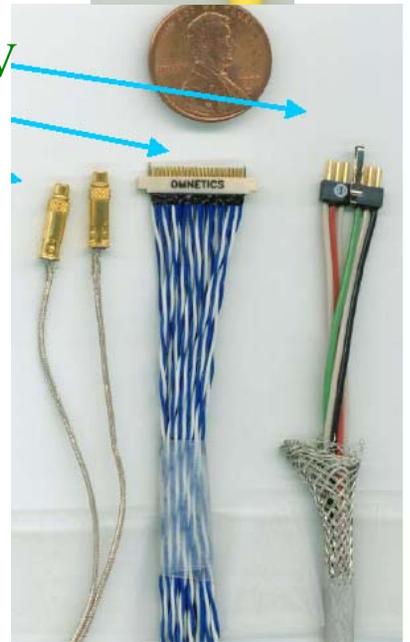


- Twisted pair cables connect Junction cards to Adapter cards
- Twisted pair cable bundle contains 3 sets of cables - signal twisted pair, clock cables, HV/LV cables
- Signal twisted pair is being built now, clock cable is ordered and HV/LV cable specifications are being completed
- Prototypes from RunIIb are available and being used for testing

Signal twisted pair bundle



HV/LV signal clock

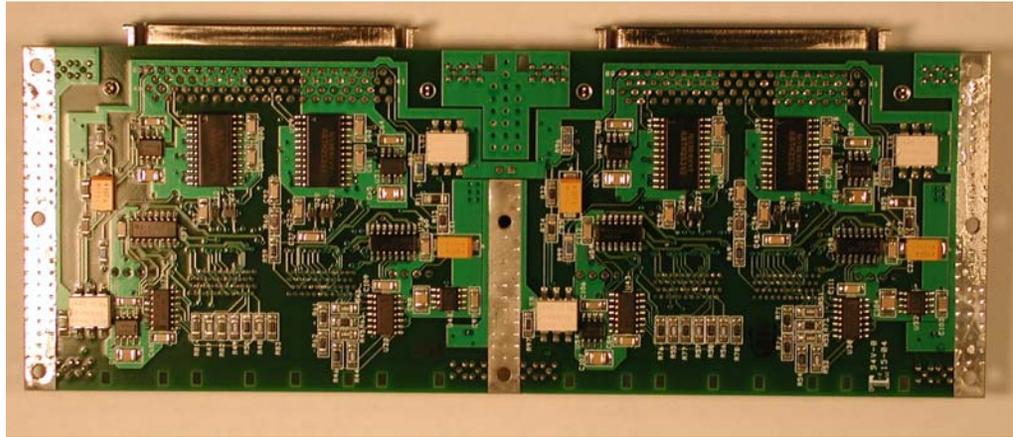




Adapter Card



- Adapter card has to electrically isolate (separate grounds for) North from South
- Adapter card design and testing is being done by KSU



- First two prototypes arrived in May and are being tested in Full chain test for isolation, etc
- Review of HV and LV power system is proceeding now



Testing



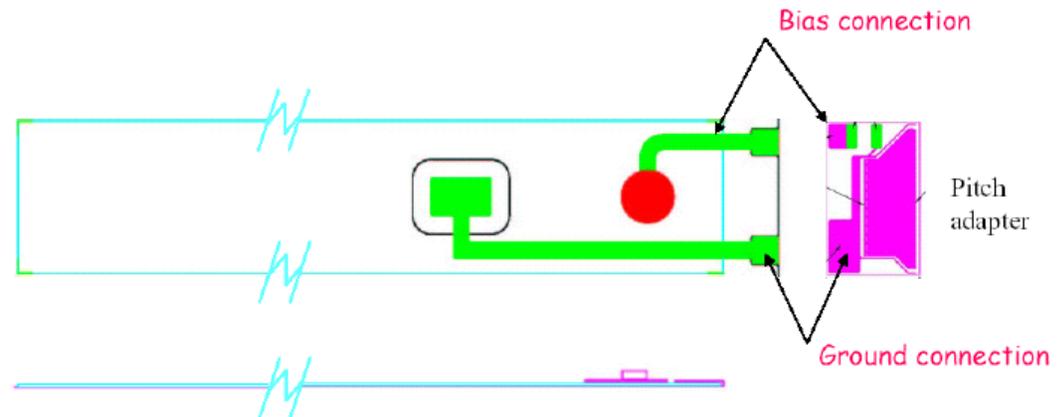
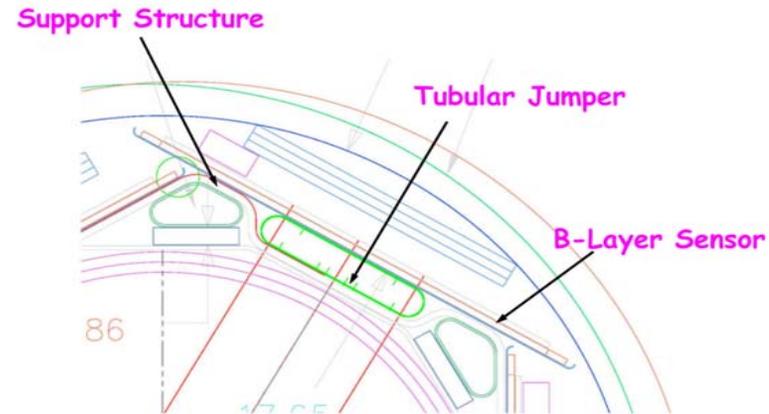
- Standalone teststands are ready as well as burn-in stands at FNAL as well as KU (hybrids) and CSUF
- Two L0 modules have been tested for weeks
 - ◆ One since March 04;
 - ◆ One since late April;
Currents have been steady
- Two L0 Hybrids - since June 1
- Full chain teststands being used to test new adapter card design and grounding
- SVX4/SVX2 hybrid operation already tested with full 1% teststand which includes full DAQ



Grounding Scheme



- Flex circuit glued to the back of the sensor provides: bias and ground connections
- Flex wraps around the sensor edge so bias and ground are brought to the top of the module
- Cylinder mesh to sensor wrap-around connections prototyped by UW, arrived mid-June

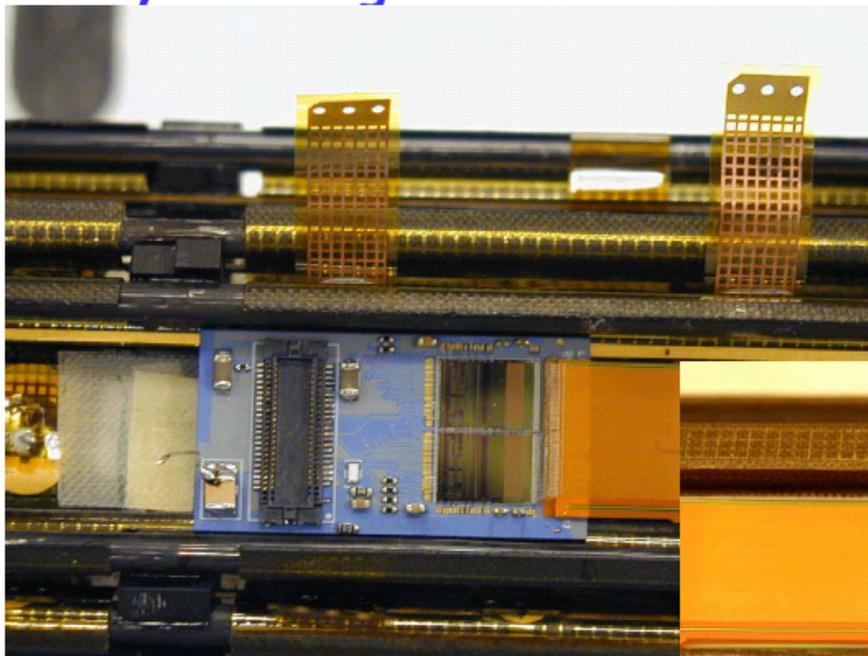




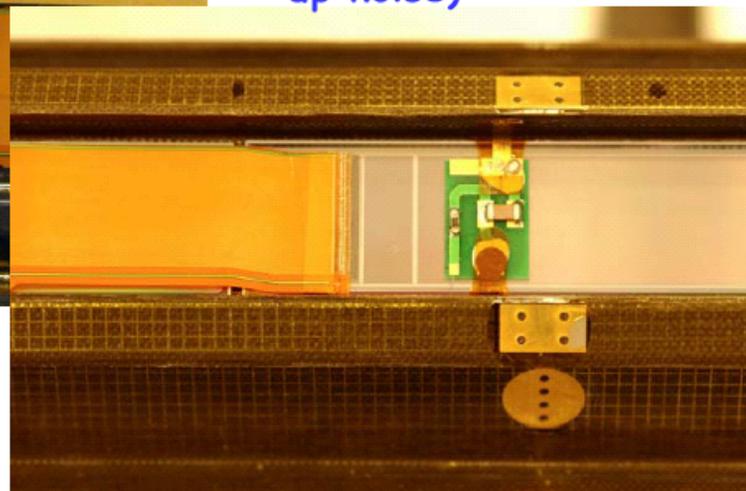
Layer 0 Grounding



- Hybrid region



- Implements new grounding approach : laminated ground mesh covering all CF surface
- Excellent noise performance without Faraday cage (no pick-up noise)



Sensor region

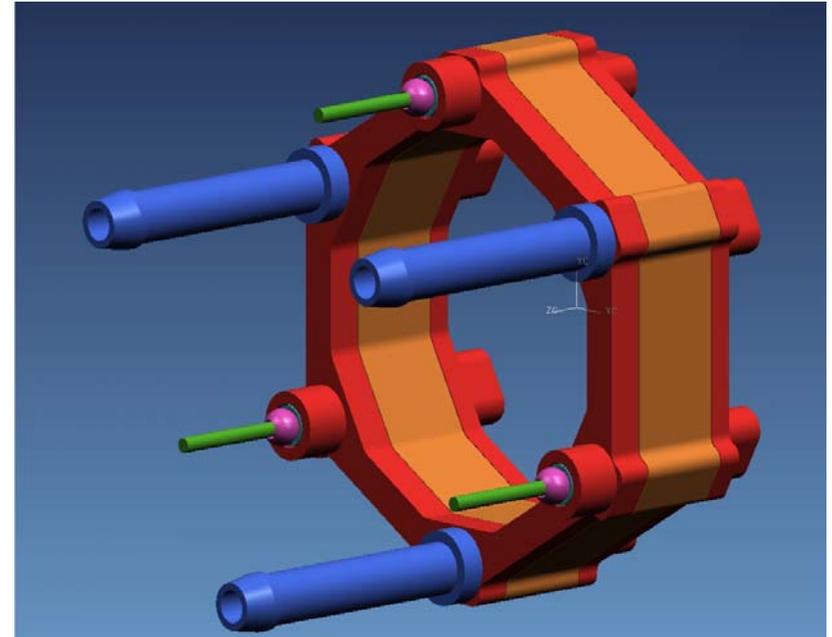




Support Structure



- Carbon Fiber structure designed and fabricated at UW
- Latest work has been on cooling tube design using PEEK tubes
- Prototype structures have been used already
- Fixtures for installing modules have been prototyped
- A dimensionally/electrically accurate support to arrive at FNAL end of July as well as an electrical prototype and we expect the final structure in October



Cooling manifold design



Status



Parts Delivery

- Analog cables are at Zurich being inspected and tested - should be here in 7/15
- Hybrids due mid August? (was end of July)
- Sensors will be "on the plane" 7/31
- Pitch adapters from TFT should be done 7/15
 - ◆ Backup order to Seigert from Brown ~8 week delivery
- First pass support structure by end of July

All parts for modules will be in our hands in August - most ahead of schedule

We are planning now for starting module production this Fall



Status (2)



- We are tracking the schedule through Microsoft Project
- We are on schedule
- Funding for most parts coming from NSF MRI - We've just received an extension on funding through July 2005
- Presently, most parts are on or under budget - except: Twisted Pair cable termination, no quote yet for Digital Jumper Cables



Layer 0 Schedule



			Current Goal			Baseline Schedule		Δ days
			Start	Finish		Start	Finish	
1.6.1.8	Produce sensors	21 w	02/27/04	07/26/04	26 w	2/27/04	8/30/04	-35
1.6.1.9	Probe sensors (FNAL)	8 w	08/01/04	09/21/04	8 w	8/31/04	10/26/04	
1.6.1.10	Probe sensors (MRI)	8 w	08/02/04	09/21/04	8 w	8/31/04	10/26/04	
1.6.1.13	All Sensors Delivered and Tested	0 w	09/21/04	09/21/04	0 w	10/26/04	10/26/04	-35
1.6.2.3.6	Produce hybrids	17 w	03/26/04	07/26/04	14 w	3/26/04	7/5/04	21
1.6.2.3.10.4	Wipe hybrids	1 w	07/27/04	08/02/04	2 w	7/6/04	7/19/04	
1.6.2.3.10.5	Measure hybrids (mechanical)	3 w	08/03/04	08/23/04	3 w	7/20/04	8/9/04	
1.6.2.3.10.6	Probe bare hybrids	6 w	08/03/04	09/14/04	6 w	7/20/04	8/30/04	
1.6.2.3.10.7	Stuff and wirebond hybrids	6 w	08/17/04	09/28/04	8 w	8/31/04	10/26/04	
1.6.2.3.10.8	Perform initial functionality test	4 w	09/29/04	10/26/04	4 w	10/27/04	11/23/04	
1.6.2.3.10.9	Perform hybrid burn-in tests	8 w	10/06/04	12/02/04	8 w	11/10/04	1/18/05	
1.6.2.3.11	All L0 Hybrids Delivered, Stuffed, and Te	0 w	12/02/04	12/02/04	0 w	1/18/05	1/18/05	-47
1.6.2.4.6	Produce analog cables	14.6 w	03/22/04	07/01/04	16 w	3/22/04	7/13/04	-12
1.6.2.4.7	Test analog cables	0 w	07/07/04	07/07/04	10 w	7/14/04	9/22/04	-77
1.6.2.4.8	All Analog Cables Delivered and Tested	0 w	07/15/04	07/15/04	0 w	9/22/04	9/22/04	-69
								0
1.6.4.4.1	Qualify fixtures and procedures	4 w	08/24/04	09/21/04	8 w	9/8/04	11/2/04	-42
1.6.4.4.2	Produce preproduction modules	2 w	09/29/04	10/12/04	2 w	11/24/04	12/9/04	-58
1.6.4.4.3	Test preproduction modules	2 w	10/13/04	10/26/04	2 w	12/10/04	12/23/04	-58
1.6.4.5	Conduct L0 module production readines	0 w	10/26/04	10/26/04	1 w	1/4/05	1/10/05	-76
1.6.4.6.1	Silicon L0 Module Production Begun	0 w	11/01/04	11/01/04	0 w	1/14/05	1/14/05	-74

Several of the probing/testing times were conservative
 We are aiming to start module production mid-October



Schedule and Manpower



- The project is on schedule - we are turning our attention to building fixtures and making prototype assemblies in preparation for module production
- We are working on securing necessary support personnel at SiDet. In the near future we will:
 - ◆ Mock up end supports and cables
 - ◆ Study module assembly and fold-over techniques
 - ◆ Assemble prototype cylinder and supports and install test modules
 - ◆ Understand bondability of analog cables and pitch adapters
 - ◆ Develop encapsulation techniquePlus any work for the Fall shutdown



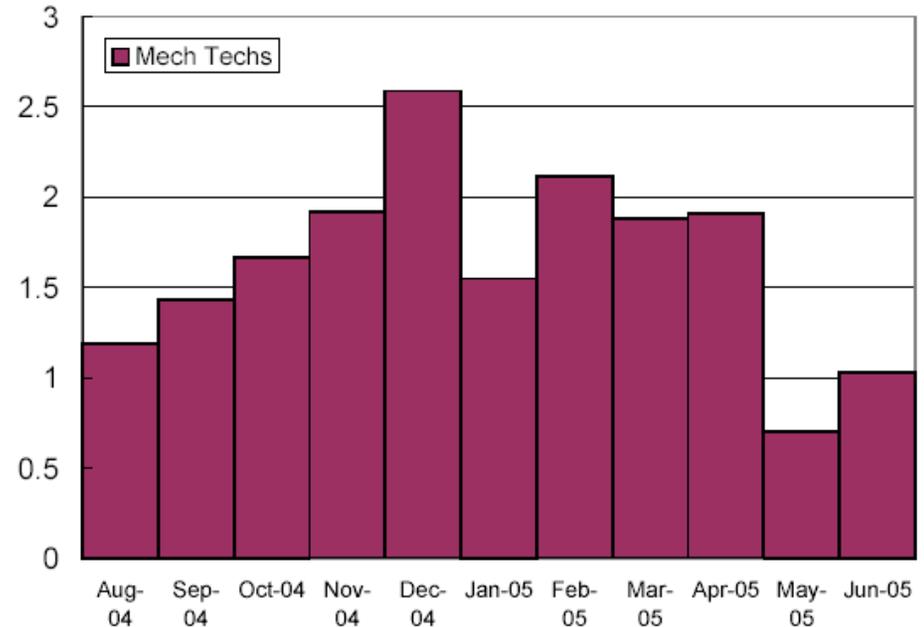
FNAL Manpower Requests



Labor profile for mechanical techs

We need support from PPD/SiDet for:

Burt Gonzalez, Tim Griffin, CMM operators and wirebonders as well as a continued commitment of Mike Hrycyk. We have not received assurances that technical support will be available given accelerator demands





Cost



M&S costs for parts so far are under budget by \$48K

We still don't know how much some of the downstream electronics will cost but are getting close

WBS	Type	sched \$	spent \$	sched date	real date	Amount sa
1.6.1.8	Sensors	\$161,000	\$96,000	8/30/04	7/31/04	\$65,000
1.6.2.3.6	Hybrids - bare production	\$34,860	\$26,897	7/5/04	7/31/04	\$7,963
1.6.2.4.6	Analog cables	\$103,400	\$76,309	7/13/04	6/28/04	\$27,091
-	Pitch adapters	\$0	\$19,287			-\$19,287
1.6.2.5.3	Grounding circuits	\$15,580	\$19,694	4/8/04	4/15/04	-\$4,114
1.6.2.7.6/7	Twisted Pair cables	\$26,753	\$55,206	9/14/04	on time	-\$28,453



Costs (2)



Schedule cost versus MRI expended costs so far

	MRI costs	Schedule	Scheduled amount	Spent or en
		r total		i total
1.6.1	Sensors	187600		120800
1.6.2	Electronics	362076		257431
1.6.3	Mechanical	137548		84036
1.6.4	Modules	17300		3275
1.6.5	Final assembly	17000		0
1.6.6	Admin	11000		858
	TOTAL	732524	514438	466400
	INST TOTALS	732524		466400
	KU	125736		125545
	KSU	123300		36463
	BROWN	104200		89372
	CSUF	33440		8709
	UW	140548		84036
	MSU	17800		3275
	SUNY SB	187500		119000



Summary



- Design "Complete"
- Most components ordered and on schedule
- Module production to tool up this summer to begin this Fall which is earlier than schedule predicts
- Module testing underway to understand readout, grounding, other issues