SiD Global Issues

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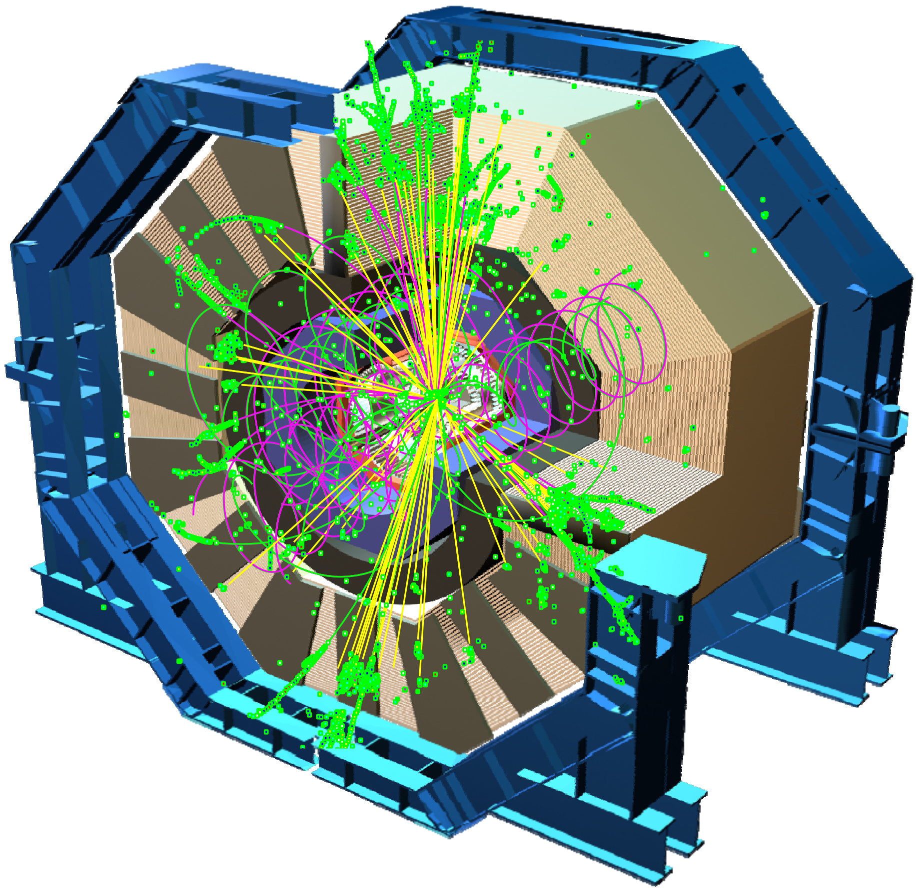


Topics

- Push Pull
- Platforms
- Assembly
- Costs

Push Pull Background and Assumptions

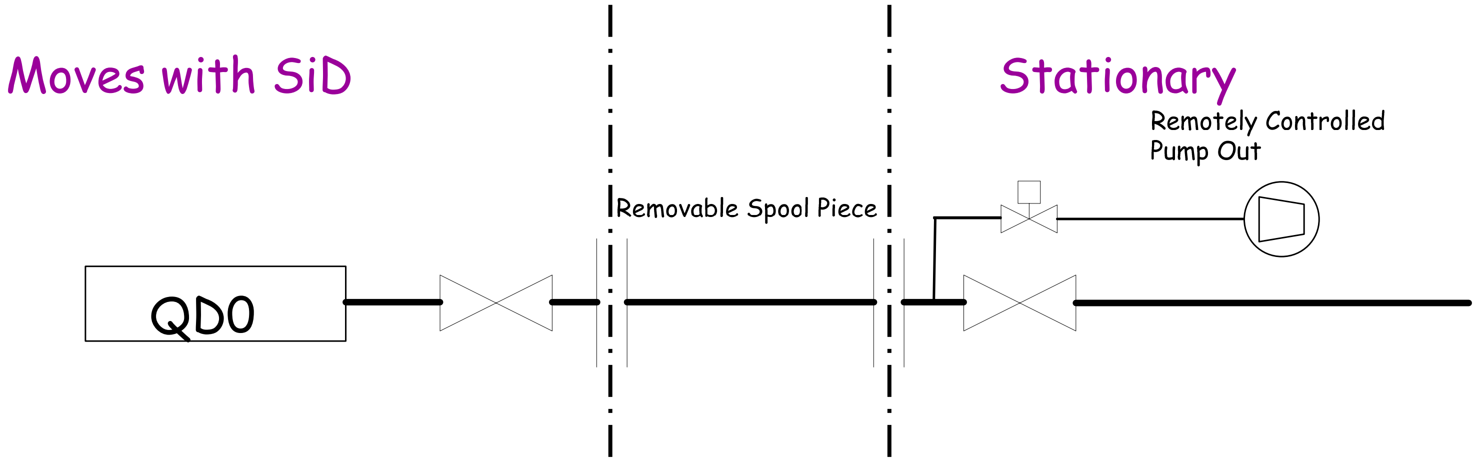
- It is still assumed that ILC will have two detectors, and that costs can be significantly lowered by sharing one Beam Delivery System.
- The alternative of two BDS's, alternating between them perhaps 1/month, is thought to be more conservative. This is likely so for the detectors, but unlikely for the machine. SLC experience indicates that luminosity recovery time scales with the downtime, and the two BDS scenario might involve continuously recomissioning beamlines that have been off for a month.
- We contend that with a reasonably engineered approach, the elapsed time from the beginning of a swap to the beginning of beam based alignment should be less than one day.

Scheduling

- Propose that time be allocated in equal blocks to each detector, perhaps 35 days.
- The time required for the first detector to clear the area is deducted from their next run.
- The incoming detector can take whatever time they want to set up, but this time is part of their allocation.
- Everyone takes their chances with the machine.

Machine Assumptions

- There is a warm section of beamline upstream of QD0 that consists of a valve pair and pumping system



•There is an alignment system relating the detector beamline to the machine beamline with an accuracy of 1 mm or better.

Detector Assumptions

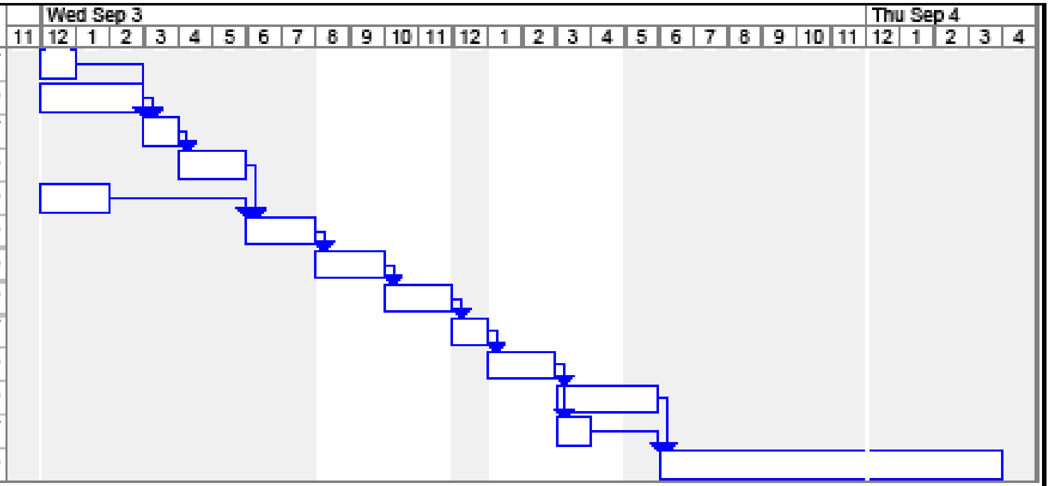
- The detectors are self-shielded.
  - The early SiD design was checked by the Radiation Safety people working with the Beam Delivery Group. The combination of calorimeters and steel was satisfactory.
  - This needs to be re-checked, but the Radiation group no longer exists.
  - Accident criteria may be different in different countries.
- The beamline has portable shielding (Pacmen) that have a section meeting the tunnel mouth that is common with the other detector.
- Liquid He (4K) is delivered by a permanently connected flex line to the detector. 2K He is made by a system that moves with the detector, and all the QD0 plumbing moves with the detector.
- All detector power and data cables are permanently connected to the detector.
- The detector is designed so that small distortions of the steel do not change stresses on the cryostat, which in turn isolates the support of the calorimeters and tracker.
- The wavelength scanning interferometer system checks alignment for the barrel and relates the endcap positions.
- The full detector position is adjustable in X and Y to 1 mm. The Y range will need to be determined to accommodate floor motion.

X Motion

- The preferred transport approach is Hillman Rollers on hardened steel rails. There is no problem with Hillman capacity. Airpads are not preferred.
- Stiction may be 5% of the static load (~4 Ktonne)
- Perhaps drive the detector with rack and pinion system.
- Design for a velocity of 1-5 mm/sec.

Time Estimate

ID		Task Name	Duration
1		Secure ILC Beams	1 hr
2		De-energize magnets	3 hrs
3		Open Beamline Shielding	1 hr
4		Disconnect Beamlines	2 hrs
5		Checkout Detetctor Transport system	2 hrs
6		Transport Detector 20 m	2 hrs
7		Transport other detector on beamline	2 hrs
8		Connect beamline	2 hrs
9		Close Beamline shielding	1 hr
10		Check gross detector alignment & adjust if nece	2 hrs
11		Energize magnets	3 hrs
12		Safety Checks before beams	1 hr
13		Begin Beam Based alignment	10 hrs



With careful engineering and an experienced, well rehearsed crew, it seems plausible to make the push-pull cycle, not including the beam based alignment and re-tuning of the machine, in less than a day.

The converse is also true!

Platforms

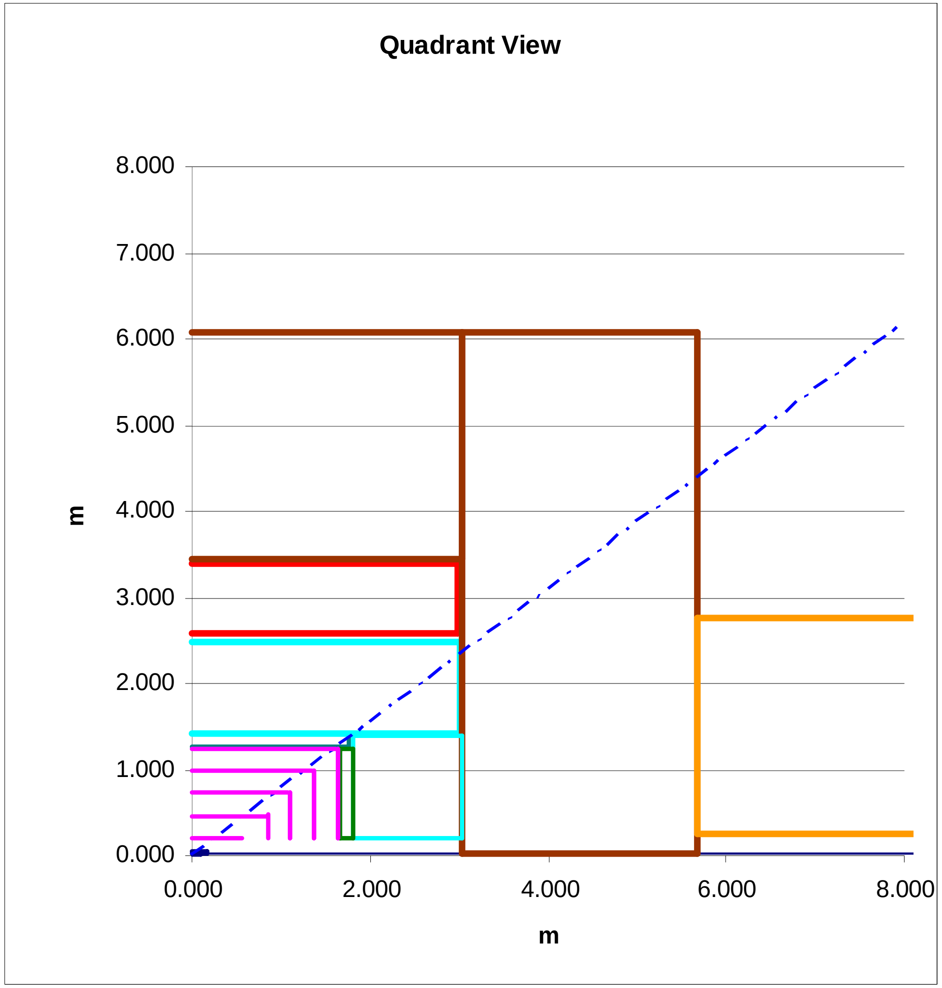
- Building the detector on a platform seems to have significant risks and costs with incommensurate benefits.
  - The major issue is vibration isolation to ensure luminosity.
  - The platform requires excavating the hall further below beamline, with roughly the same requirements on the "floor".
  - It appears rather expensive to make a platform stiff enough if it is supported discretely.
  - SiD can adjust its elevation to match the beamline with its proposed undercarriage.

Assembly Scenarios

- There appears to be a debate between surface and below ground assembly.
- However:
  - The major detector modules will be assembled elsewhere. This obviously includes the VXD, Tracker, EMCal, and HCal.
  - The muon detectors can be loaded into the iron elsewhere.
  - The solenoid will be wound elsewhere.
  - The amount of cabling and services on SiD is tiny compared to the LHC detectors.
- Therefore, we can choose among:
  - Assemble the barrel and doors above ground and lower the ~4Ktonne barrel and two ~2Ktonne doors.
  - Final assembly of the major steel components below ground. Depending on steel design, components might weigh 100-500 tonnes. The solenoid with calorimeters weighs ~700 tonnes, but calorimeters could be inserted later.
- Actual strategy depends on details of site and schedules

SiD Costs – Parametric Model

- Rtrkr = 1.25 m
- Cos(θtrkr) = 0.80
- Hcal λ = 4.5
- Hcal layers = 40



Base, Contingency, & Indirects

	M&S	Labor	Totals
Base	$220	$100	$320
Contingency	$83	$35	$118
Total	$303	$135	$438
Indirect rates	0.06	0.20	
Indirects	$18	$27	$45
Totals w indirects	$321	$162	$483

Labor Summary

WBS	Title	Engineer	Tech/Design	Admin	
1.1.1	Beam Pipe & Vertex	6.5	15	0	
1.1.2	Tracker	20	69.8	0	
1.1.3.1	EMCal	10	262	0	
1.1.3.2	Hcal	10	187	0	
1.1.3.3	Forward Calorimeters	4	10	0	
1.1.4	Muon Tracker	9	35.5	0	
1.1.5	Electronics	68	53	0	
1.1.6	Magnet	29.3	25	0	
1.1.7	Installation	5	27	0	
1.1.8	Management	37	5	25	
	Total Man-yrs	199	689	25	913
	Rates (K$/yr)	131	101	100	
	Totals (M$)	26	70	3	98

With Escalation

Total in FYXXXX M$	2007		**483.1**
Start Year	2016		
Construction Duration	6	years	
Inflation	1.035	per year.	
Factor	1.511		
Total Escalation			246.9
Total, TYM$			***730.0***

Work Breakdown Structure (WBS)

- A complementary cost document has been developed using Tony Johnson's WBS program.

WBS	Component	Number	Unit	Comment	Materials	MContingency	Labor	LContingency	Total
1	NLC Detectors	1 each			222,533,712	84,629,177	100,958,823	33,525,409	441,647,121
1.1	SiD	1 each			222,533,712	84,629,177	100,958,823	33,525,409	441,647,121
1.1.1	Beam Pipe & Vertex Detector	1 each		@CF=VXD	3,810,800	2,608,300	2,351,083	800,531	9,570,714
1.1.2	Tracker	1 each		@CF=Tracker	13,848,760	5,260,006	9,895,648	3,463,477	32,467,891
1.1.3	Calorimeters	1 each			73,248,752	31,976,256	52,959,757	18,510,555	176,695,320
1.1.4	Muon Tracker	1 each		@CF=Muons, update 6...	3,703,700	1,446,295	3,286,208	1,134,825	9,571,028
1.1.5	Electronics	1 each		@CF=Elecs	3,908,400	1,304,600	13,892,309	4,380,468	23,485,777
1.1.6	Magnet	1 each		@CF=Magnet	120,474,500	41,339,700	6,364,915	2,085,950	170,265,065
1.1.7	Installation	1 each		@CF=Install	2,617,800	522,320	5,428,202	1,654,308	10,222,630
1.1.8	Management	1 each		@CF=Management	921,000	171,700	6,780,700	1,495,295	9,368,695

WBS facilitates a detailed breakdown

1.1.2	Tracker	1 each
1.1.2.1	Tracker ED&I	1 each
1.1.2.1.1	Mechanical Engineer	20 man year
1.1.2.1.2	Mechanical Designer	10 man year
1.1.2.1.3	Mechanical Tech	40 man year
1.1.2.2	Tracker Mechanics	1 each
1.1.2.2.1	Tracker Space Frame, Barre	1 lot
1.1.2.2.2	Outer Endcap Frame	1 lot
1.1.2.2.3	Tracker Cooling	1 lot
1.1.2.2.4	Tracker Alignment System	1 each
1.1.2.3	Tracker Silicon Detectors	1 each
1.1.2.3.1	Barrel	1 each
1.1.2.3.1.1	Tracker Silicon	66.7 Sq.m.
1.1.2.3.1.2	Tracker Module	6,946 each
1.1.2.3.1.2.1	Tracker Module Fran	1 each
1.1.2.3.1.2.2	Tracker KPiX	2 each
1.1.2.3.1.2.3	Tracker Cable	1 each
1.1.2.3.1.3	Level 1 Concentrator, Ti	467 each
1.1.2.3.1.3.1	Level 1 Concentrato	1 each
1.1.2.3.1.4	Level 2 Concentrator	0 each
1.1.2.3.1.5	Electronics Tech	6 man year
1.1.2.3.1.6	Mechanical Tech	7.5 man year

Status

- A draft exists forSiD.
- It corresponds at the ~1% level to the parametric level, but that is largely by construction.
- There has been too little review to publish it in the LOI!

Conclusions

- Kurt will talk about actual detector engineering tomorrow.
- We need to decide what we are going to put in the LOI about the issues discussed here.