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ILC Detector R&D

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Need for detector R&D

Good detectors are absolutely essential for making the ILC a success (!) Detector R&D and design are currently de-emphasized in the political discussion while the accelerator design and costing occupy center stage.

Designing and building detectors will take as long (or longer) as the machine (DØ and SLD were ~ 8 years; ATLAS/CMS letters of intent in 1992; subsystem TDRs in 1996 – 98.

Current planning is for decisions to proceed on ILC in ~2010, construction start in 2012 (need time for site acquisition, formal agreements, preparing contracts). Fastest construction duration is 7 years (political and funding reality will likely stretch this).

IT'S LATER THAN YOU THINK !

Need for detector R&D

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Important detector R&D and simulation effort remains

- How well does PFA work in practice?
- What is the optimum solution for Si VTX readout?
- Is PID really needed? etc.

Incisive estimates of physics performance are still needed

- Higgs BRs to heavy quarks
- W/Z (to quarks) separation and effect on physics
- Measuring $\not{C}P$ in neutralino sector, etc.

Developing detector concepts and moving toward experiment proposals

Optimizing ILC choices

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Study of global tradeoffs

GDE may need to consider scope changes to reduce cost:

- defer e^+ polarization
- decrease luminosity (through elimination of second e^+ DR, elimination of second tunnel & lower availability)
- eliminate/defer second IR, no second detector initially
- lower gradient, reduced energy
- funding limits that restrict detector complexity (e.g. no SiW + TPC)

Detector community needs to develop a way to compare and prioritize these from point of view of physics. For some small set of bellwethers (Higgs BR, Z′ reach …), estimate the loss of precision (or increase of Lumi for fixed precision) from such changes. Do a cost-performance optimization.

US Detector R&D

Since 2002, DOE and NSF have conducted a program for university-based ILC detector R&D. For FY05 – FY07 these funds are distributed as subcontracts from an umbrella grant to Univ. of Oregon.

FY05 grants totaled $700K (DOE) and $117K (NSF).

The FY06 funding is $1048K (DOE) and $300K (NSF), supporting 34 projects at 27 universities and 2 labs (ANL and LBNL). Funding distribution: 13% LEP, 14% vertex det., 24% tracking, 42% calorimetry, 7% PID/μ

It is DOE's hope to expand this program in future years.

- The detector R&D program has some elements that are more generically applicable. It is important to identify these, as in principle they can be supported on non-ILC budget lines.

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US University effort in ILC R&D

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"Both DOE and NSF recognize the high priority placed by HEPAP and the recent NRC EPP2010 report on conducting a vigorous R&D program that could lead to the ILC project. Both agencies currently fund university grants for both detector and accelerator research with applicability to the ILC. These programs have been modest but have grown over the past several years.

"Both agencies respond to grants through the peer review process. They welcome proposals for which ILC detector or accelerator R&D is the whole or a component of the effort, as well as for generic research that may have some bearing on ILC issues. In addition, there is often some latitude within existing grant funds to consider new directions. The use of existing grant funds for ILC-related research depends upon the details of each proposal and grant holders are encouraged to speak with their program monitors on the appropriate extent of such activities."

Detector R&D at Labs

The Laboratory effort on detector R&D in FY06 was reported by the labs early this year. About 80% is SWF. FY06 detector funds were from Lab core research; in FY07 the ILC-specific detector effort (not including physicists) should be on ILC budget. Generic R&D useful for ILC and other experiments could continue on core research budgets if available.

	FTE	SWF($K)	M&S($K)	Total($K)
SLAC	11.1	$2007	$460	$2467
FNAL	11.2	$1635	$420	$2055
LBNL	2.8	$335	$145	$480
ANL	3.3	$355	$100	$505
BNL	~1	$100	$0	$100
TOTAL	29.3	$4432	$1175	$5607

Actual FY06 expenditures may differ somewhat.

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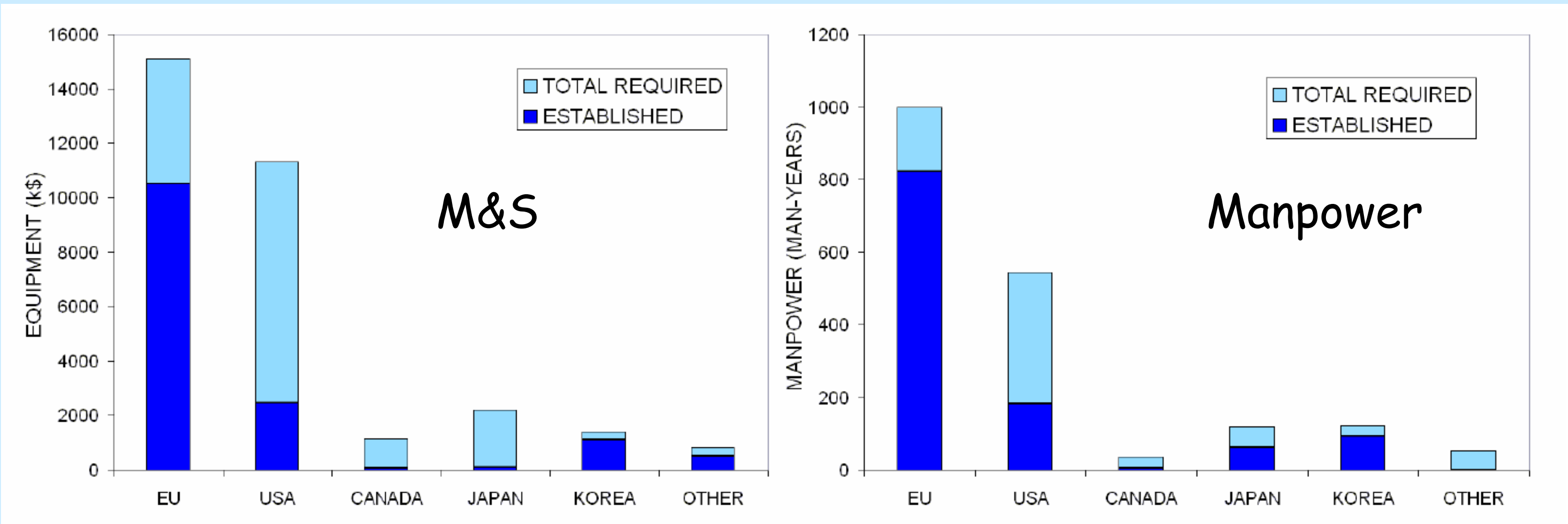
Detector R&D worldwide

A 2005 WWS panel chaired by C. Damerell compared currently funded and self-estimated needs for detector R&D in the three regions. The US and Japan lag behind Europe significantly. The US effort was about 4 times less than Europe, and was funded at about 35% of the estimated need.



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Future US Program

Informal and preliminary request by ALCPG for the scope of the ILC detector university program in FY07 is about $3M, with about $1M coming as a supplement early in the year.

Present detector R&D is matrixed: detector concepts and subsystem R&D. Need to plan the transition from generic to detector collaborations & proposals.

Informal coordination of detector R&D at universities and labs has been reasonably good, but a more integrated approach by ALCPG is needed to bring universities and laboratories into a common plan.

R&D Plan

DOE and NSF have asked the ALCPG for a multi-year resource-loaded schedule that identifies the prioritized goals of the US R&D in the world context, the milestones and requested budgets. Enunciate the needs and desired plan so that we can work toward evaluating and meeting it. Identify the components of the plan – generic and ILC specific, SWF vs. M&S, Lab and university so that we may use the full range of funding possibilities.

We expect to have the first draft this summer, prior to any actions on FY07 requests. Substantial increase in detector R&D funding will require this plan.

The detector R&D program will be subject to program reviews by the Agencies.

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Subsystem R&D vs. Detector Proposals

Planning the transition from generic detector R&D to experiment design.

- Many of the key issues now are demonstration of subsystem capabilities (pixel readout, PFA, HCal options …)
- Detector concepts and costs are needed for RDR, … but
- Experiment concepts will evolve in response to generic R&D
- Present concepts align to regions more than we might like. How can the detector collaborations be better internationalized?
- GDE has not yet taken ownership of the experimental program
- Key decisions remain for the machine which can affect detectors

It would be useful to consider here whether the ILC detector effort should re-emphasize R&D on sub-systems for the next ~ year or more, and set the stage for more international detector collaborations once the RDR is completed and detectors come under GDE control.

1 vs. 2 IRs

Specifying only 1 IR in the initial ILC design (perhaps with tunnel stubs for a 2nd IR) could become the GDE baseline. (I know nothing about a GDE decision on this.) The cost pressure will be severe, and savings are likely to be sought throughout the design.

A second unused (at any given time) IR may have some of the same political disadvantages that an unused tunnel for the 1 TeV upgrade would have.

The experimental community needs to confront the 1 IR possibility. How would one formulate an optimum detector strategy in the case ILC starts with just 1 IR?

(Big switch in raw data stream at exit of detector going to two completely independent collaborations?? Addresses competition, cross-checks, sociology arguments from Snowmass.)

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Balance of Detector and Accelerator R&D

There is at present no constituted body that is ideally suited to advise on the relative priority between accelerator R&D and detector R&D – in the Americas or world-wide – although LCSGA can provide some useful perspective in the Americas.

For making FY07 allocations, we will seek advice on this relative priority from LCSGA, augmented by some individuals who span the boundary between accelerators and detectors.

Detector R&D in the Americas must be coordinated with work elsewhere – we cannot afford duplication. WWS can play a role in this for detectors but to coordinate detector and accelerator R&D we should move to expanded GDE oversight of both sectors.

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Summary

- The need to expand detector R&D activity in the Americas is clearly recognized. Achieving the physics goals at the ILC depends on it.
- Moving toward more integrated planning of detector R&D worldwide is needed.
- Articulating a plan for the R&D phase is necessary.
- Balancing and managing the investment in accelerator and detector R&D is an important issue that needs more attention.

Snowmass rationale for 2 detectors

- Scientific redundancy
- Complementarity and collider options
- Competetion between collaborations
- Efficiency, reliability, insurance
- Sociology, scientific opportunity
- Historical examples