



ILC Detector R&D

Tracking Review - Introduction

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On behalf of the ILC Detector R&D Panel
(a Panel of the World-Wide Study Organising Committee)

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Committee membership

- **Panel members: Chris Damerell, Dean Karlen, Wolfgang Lohmann, Hwanbae Park, Harry Weerts**
- **External consultants: Peter Braun-Munzinger, Ioanis Giomataris, Hideki Hamagaki, Hartmut Sadrozinski, Fabio Sauli, Helmuth Spieler, Mike Tyndel, Yoshinobu Unno**
- **Regional representatives: Jim Brau, Junji Haba, Bing Zhou**
- **RDB chair: Bill Willis**
- **Local tracking experts: Chen Yuanbo, Ouyang Chun**
- **Admin support: Maura Barone, Maxine Hronek, Naomi Nagahashi, Xu Tongzhou**



Executive session - Introduction

- This is an historic occasion – the first international review of ILC detector R&D
- What has led up to this, and what is our purpose?
- LCWS has been under way since 1991, ILC-specific detector R&D since 1998 or earlier
- The WWS-OC created the ILC Detector R&D Panel in March 2005, at the same time as the GDE was formed
- Our first task was to gather information from all participating groups, and issue a report. This quantified the substantial activities, as well as the perceived need of the community to ramp up the R&D over the next 3-5 years, and identified several ‘missing topics’
- **Real needs or ‘unrestrained desires?’**
- *It is part of our purpose in this review to find out*

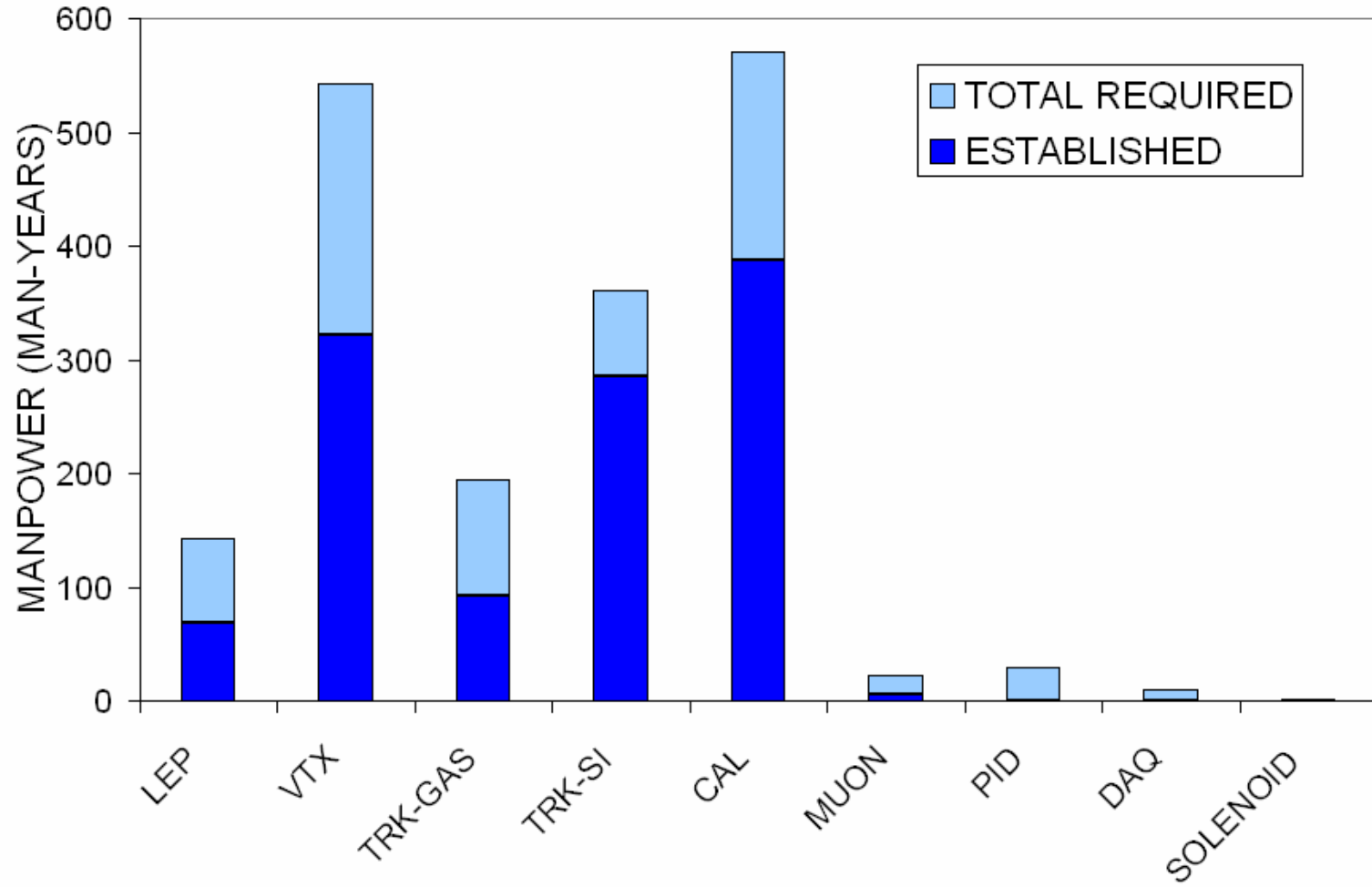


- Panel report available from <https://wiki.lepp.cornell.edu/ilc/bin/view/Public/WWS/>
- Resources are expressed in manpower and equipment budgets. Simplifying manpower to \$100k per person-year, resources are 85% manpower, with \$33M p.a. established, and \$55M p.a. required
- Tracking amounts to \$10.3M p.a. established, and \$15.4M p.a. required, so we are concerned in this review with about 30% of the total
- Even if the needs perceived by the detector community are fully justified, it is far from guaranteed that they will be realised.
- *Advice and support from this committee could be crucial*



Totals over 3-5 yrs, to completion of R&D

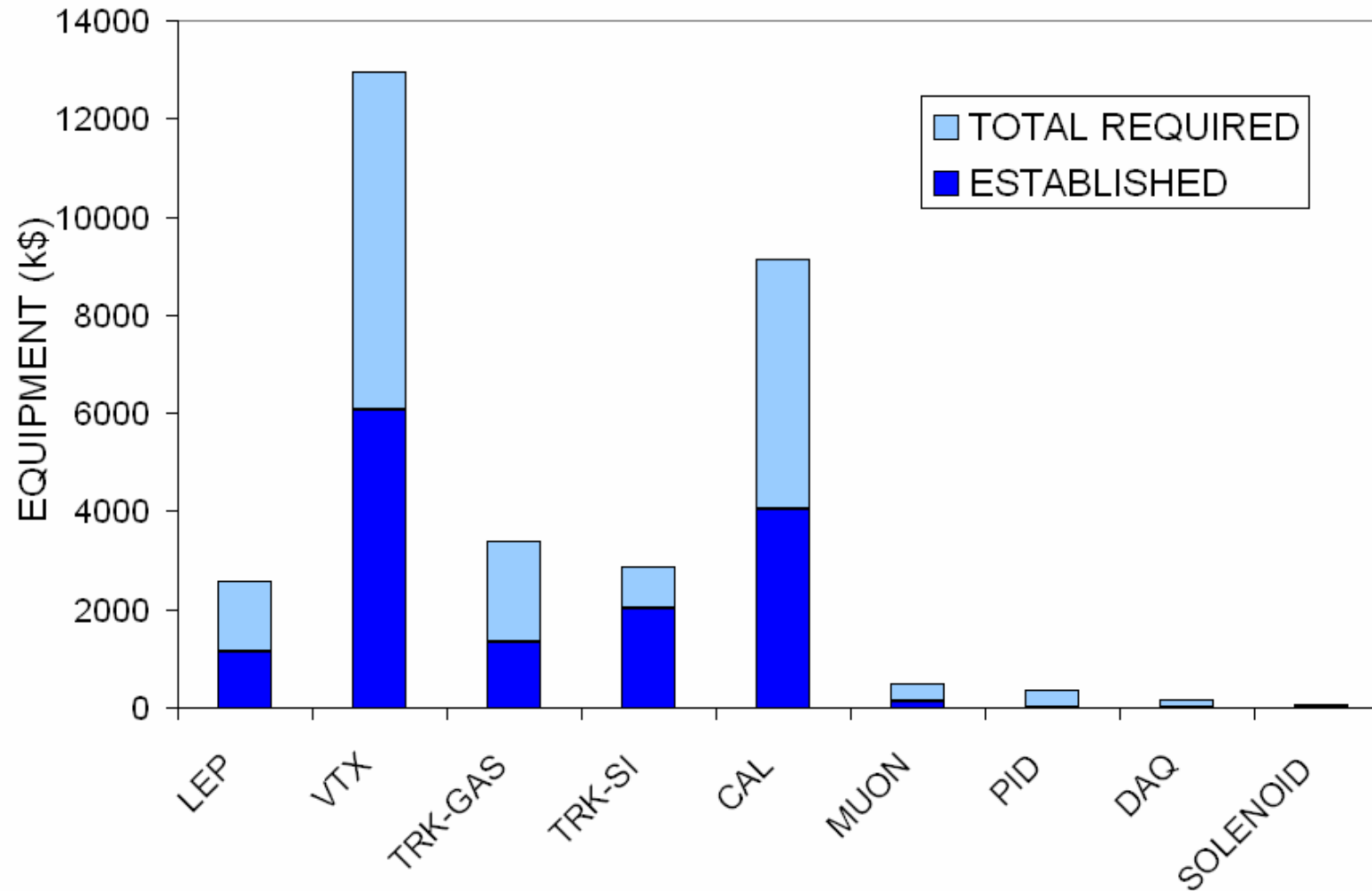
2006 to collaboration formation





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2006 to collaboration formation





Overview of these reviews

- To be included in every regional workshop from now on:
 - Beijing (Feb '07) **Tracking**
 - DESY (LCWS June '07) **Calorimetry**
 - Fermilab (Oct '07) **Vertexing**
 - Asia (tbd 2008) **PID, muon trkg, solenoid, beam diagnostics, DAQ**
- Cycle through R&D topics every 16 mo, **but each committee can reconvene by phone on request**, for example to review a new proposal
- Plans for the reviews were endorsed by the FALC (Funding Agencies for Large Colliders) last November, where they agreed to provide financial support for them
- Detector R&D Panel will transfer responsibility for reviewing R&D (mostly 'D'), at the time when the groups become absorbed in detector collaborations (as happened at LHC)



Purpose of the reviews

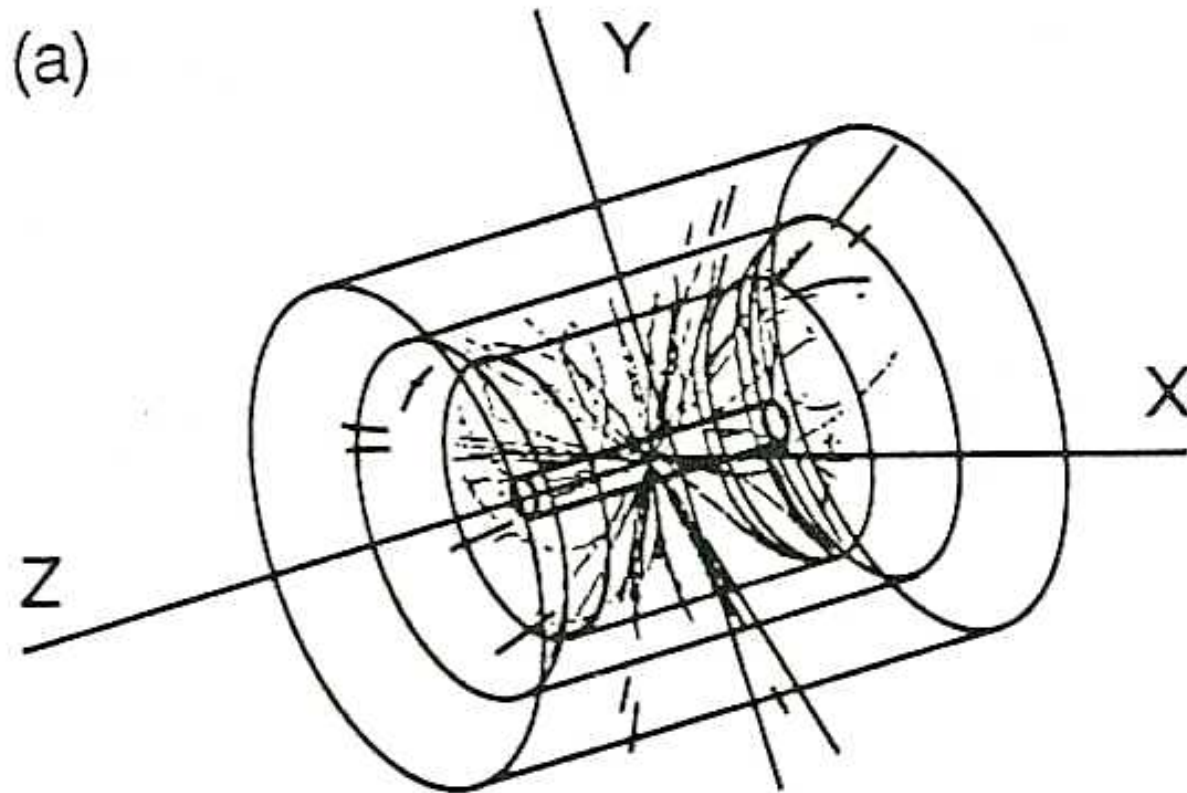
- **Improved communication leading to enhanced R&D programmes**
- **Get representatives of all R&D groups together for face-to-face discussions**
- **Engage expert consultants from outside the ILC community, who will surely provide new insights**
- **Ideally, the collaborations and the committee will converge on *mutually agreed* refinements**
- ***“If you don’t have buy-in, you can’t effect change.”***



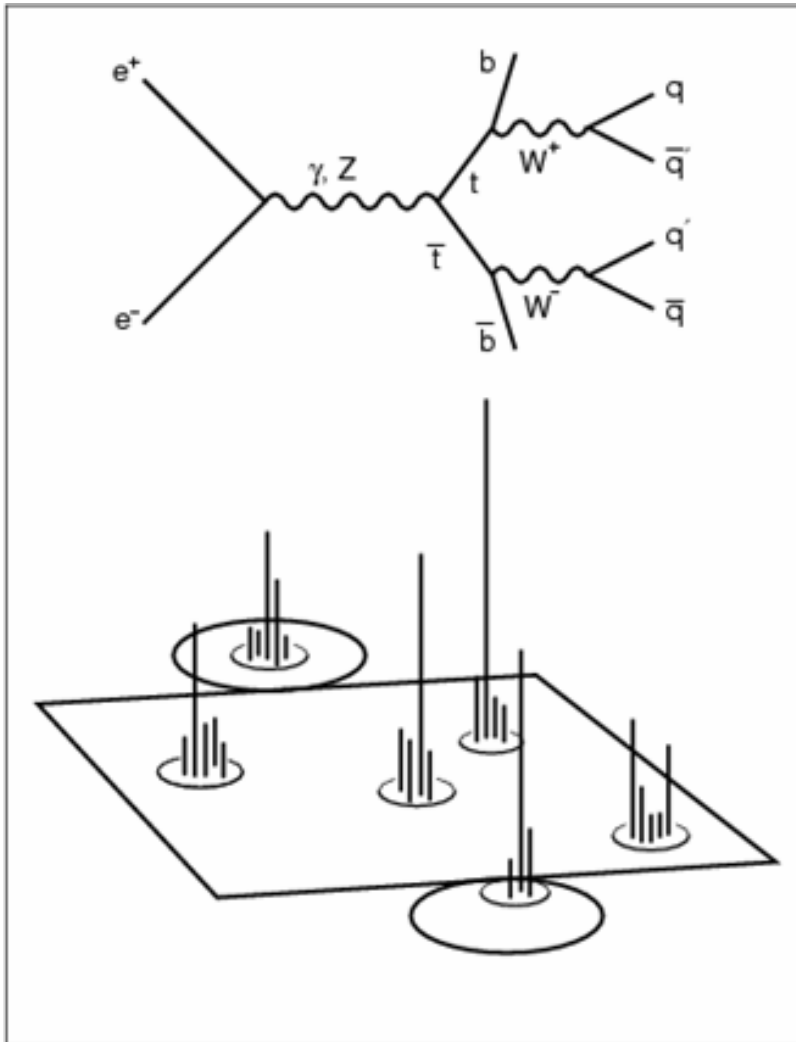
Structure of this review

- Originally (Valencia, last November) we had 7 disconnected groups to deal with, as well as the tracking collaborations
- One positive aspect already is that these groups have ‘taken shelter’ within the collaborations – an example of ‘spontaneous self-organisation’
- **Collaboration reports** should provide an overview of the projects through to ‘completion’, meaning ‘ready for construction’. Hence there is an overlap with the period after they may become incorporated into experiment collaborations
- **Open session presentations** should cover the technical aspects, and questions in these sessions should be restricted to these aspects
- **Closed session** gives the opportunity to understand the associated resources, including prospects for future expansion (if required), and other confidential matters
- **Closeout session:** Committee will inform collaborations of their draft recommendations, and seek agreement with these or some compromise plans

Forward tracking: a 'missing topic'?



$e^+ e^- \rightarrow t \bar{t}$, LCWS 1991. At first sight, a confusing spray of particles ...



The miracle of PFA (or equivalent) reveals the flow of energy from the quarks of the primary process

But 2 out of 6 jets rely heavily on fwd trkg. How good is this? How valid is the frequently repeated claim that the resolution on charged trk energy is much better than can be obtained from calorimetry? Previous achievements with fwd trkg?

For vertex charge determination, *any* of the 6 jets may have important tracks curled into the fwd disks



Continue looking for missing topics

- Some critical questions could lie in the cracks between recognised R&D topics
- For example, what is the risk of ILC occasionally delivering the dreaded '**fliers**', seen when SLC was behaving badly
- Errant bunch, at maybe 0.001 Hz or 0.0001 Hz
- Characterised by a shower of off-axis particles (electrons and/or muons) (maybe 0.1% of the bunch) that traverse the tracking system
- Such a massive pulse of electric charge could effectively short out a gaseous tracking detector, causing the main high voltage to trip
- Such fliers are of little interest to the accelerator people, since the effect on delivered luminosity is negligible
- However, they would effectively disable a system that utilises gaseous tracking detectors
- This topic will be addressed by the S4 Task Force (having been raised during ILC MAC meeting earlier this month). It should be possible to do much better than at SLC in cleanup from DRs, but what about the undulator source and other novel ILC features?



Possible review outcomes (1)

- Maybe we should structure our thinking in three broad areas, technical, organizational and resource-related
- **TECHNICAL**
 - Suggestions will no doubt be prompted by the 15 presentations
 - Good opportunity to look for unnecessary duplication, or lessons to be learned from other projects
 - Particular attention to ‘missing topics’, including system aspects that risk being left too late
- **ORGANIZATIONAL**
 - The three main R&D collaborations clearly have effective organizational structures
 - **What about a level above – some form of global coordination of ILC tracking R&D?**
- **RESOURCES**
 - Are significant additional resources needed by some or all collaborations to achieve proof-of-principle demonstrations ‘in time’?
 - Are there ideas for pooling, or sharing resources with non-ILC projects, which could enable these requirements to be satisfied?



Possible review outcomes (2)

- Could imagine a **Tracking Task Force** in which work on common elements such as infrastructure could be planned and implemented, including
 - Test beam facility with ILC-specific features eg bunch timing – a significant investment
 - Appropriate high field magnet for testing large-scale prototypes, specially regarding complex issues such as mechanical disturbances due to pulsed power
 - Agreed test procedures for evaluating prototypes, with a view to providing experiment collaborations with objective data for decision-making
 - Even the true material budgets associated with different options may not be trivial to establish
- [The ILC vertexing community, encouraged by the WWS-OC, has recently decided to form a **Vertexing Infrastructure Task Force**, with similar aims]
- *This review provides an opportunity for the committee and collaborations to think about whether this, or some other link between the R&D collaborations, might be useful*



Possible review outcomes (3)

- Encourage groups to submit future R&D proposals to this committee, for advice from a fully international perspective, *before* submitting to national funding agencies
(by analogy with current practices by the accelerator people)
- **Aim to complete committee report within 2 weeks. Distribute this with collaboration reports to:
Collaborations, WWS-OC, GDE EC, relevant funding agencies and FALC**



Conclusions and Hopes

- This review will provide an excellent opportunity to optimise the world-wide R&D for ILC tracking detectors
- Progress can only be made by agreement - if people don't buy in to the committee recommendations, they won't happen
- Shortcomings in design of detectors and MDI systems at LEP and SLD did reduce the physics output – maybe dramatically ... Were any of these avoidable, other than with hindsight?
- Given our world-wide R&D community, we can aim for unprecedented detector performance at ILC, matched to the complex physics challenges
- ***This review can help us achieve our ambitious goals***



Backup

