

Review of LCFI programme at Fermilab

- Review of all ILC vertex detector R&D will take place from 23rd to 27th October at Fermilab.
- Report needed by 24th September.
- Should contain overview of R&D until construction with frozen design, proven manufacturers.
- Include topics such as:
 - ◆ Physics-driven performance goals.
 - ◆ Track-finding efficiency as function of angle and momentum.
 - ◆ Special case: tracks originating from B and D decays within or beyond the vertex detector.
 - ◆ Forward tracking.
 - ◆ Impact parameter resolution versus momentum and polar angle.
 - ◆ Design of sensors, modules, and support structures.
 - ◆ Readout electronics and DAQ system.
 - ◆ System power dissipation.
 - ◆ Cooling system.
 - ◆ Cabling and fibre optics.
 - ◆ Other infrastructure, e.g. monitoring and control systems.
 - ◆ Overall mechanical stability - implications of push-pull on calibration needs.
 - ◆ Tolerance of backgrounds.
 - ◆ Radiation resistance.
 - ◆ Tolerance of EMI.
 - ◆ Material budget; implications of secondary interactions and photon conversions on system performance.
 - ◆ Other topics that lie in the cracks between vertexing and other subsystems

LCFI report: programme until 2012

- Lots to do, but represents opportunity to collect material needed for next proposal to STFC.
- Objective, LCFI construct vertex detector for and lead studies of flavour physics in one of ILC collaborations.
- Physics studies:
 - ◆ Continue development of Vertex Package (2012).
 - ◆ Investigate different geometries, e.g. long and short barrels, but also implications of foam and shell supports, effects of material in bulkheads...(2010, earlier if possible!)
 - ◆ Benchmark studies for LoIs of GLDC and SiD concepts (2008).
- Sensors, CPC:
 - ◆ Manufacture CPC3, 120 x 20 mm² chips, i.e. 6" wafers: yield issues mean 100+ wafers needed? (2008, £450k+).
 - ◆ Back thinning needed.
 - ◆ Shorter (higher yield) CPC3-S for tests.
- Sensors, ISIS:
 - ◆ ISIS2 (2008).
 - ◆ ISIS3 120 x 20 mm² chips, i.e. 6" (8"?) wafers (2009, £450k+).
 - ◆ ISIS3-S.
 - ◆ Will we manage full size with ISIS3?
- Readout:
 - ◆ CPR3A (narrow) and CPR3B (full width) needed, both on 0.13 μm process.
 - ◆ Budget for further chip?
 - ◆ Non-sparsified readout?

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■ Drive:

- ◆ CPD2 needed?
- ◆ Transformers now only as back-up.

■ External electronics:

- ◆ Support electronics for CPC3, ISIS2 and ISIS3 needed.
- ◆ Develop capability for GHz readout (LVDS to optical fibre, memory and power requirements...).
- ◆ DAQ developments in collaboration with concepts.
- ◆ Testbeam electronics.
- ◆ Slow control and monitoring.
- ◆ Costs £100k+ and needs more manpower.

■ Integration:

- ◆ Bump-bond CPR3, CPD to CPC3.
- ◆ Attach handle wafer (wax).
- ◆ Grind/etch to 20...50 μm , backside implant, laser anneal if needed...
- ◆ Dice assemblies.
- ◆ Attach to support and melt wax.
- ◆ Clean, attach kapton cables to support.
- ◆ Wire bond.
- ◆ Similar procedures will have to be developed for ISIS, use same companies for both if possible.
- ◆ Two year programme at least.

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■ Testing:

- ◆ Radiation hardness studies of CPC1.
- ◆ Tests of CPC2/CPD1/CPR2A performance.
- ◆ Tests of CPC3.
- ◆ Full ladder tests in test beam with magnetic field, resolution, electrical and thermal performance (2010)
- ◆ Quarter VXD test?

■ Mechanical:

- ◆ Test support technologies, develop FEA models.
- ◆ Develop handling techniques.
- ◆ Build ladders etc. using failed chips.
- ◆ Design VXDs, long and short barrel, ladder and shell based supports.
- ◆ Study power distribution, cooling...

■ Topics for discussion:

- ◆ Pursue other sensors?
- ◆ Redesign work packages?

■ Summary

- ◆ Excellent progress made so far (have CPC, CPD, CPR functioning together!)
- ◆ Lots of work still to do before we have achieved the required performance for the CPC and the ISIS and have built a VXD...
- ◆ ...and lots of work to do before we have the report ready for Fermilab and our next proposal.