LCFI Collaboration Overview

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> for the Linear Collider Flavour Identification (LCFI) Collaboration



Outline

- People, capabilities, etc.
 - Proposal (at right) outlines our goals for 2006-8
 - 9 institutes and growing
 - ~50 people involved
 - Permanent academic staff (~15), postdocs (~6), graduate students (~9), ASIC designers, engineers, techs etc...
 - Funding from Science and Technology Facilities Council (UK), also by academic groups and EU
- LCFI work packages
 - WP1: Vertex physics studies
 - WP2: Sensor design and production
 - WP3: Readout and drive electronics
 - WP4: External electronics
 - WP5: Integration and testing
 - WP6: Mechanical studies





Vertex Detector Performance Goals

- Physics environment:
 - Average impact parameter, d_0 , of B decay products ~ 300 μ m, of charmed particles less than 100 μ m.
 - d₀ resolution given by convolution of point precision, multiple scattering, lever arm, and mechanical stability.
 - Multiple scattering significant despite large \sqrt{s} , as charged track momenta extend down to ~1 GeV.
 - Resolve all tracks in dense jets.
 - Cover largest possible solid angle: forward/backward events are important.
 - Stand-alone reconstruction desirable.

 In terms of impact parameter, require resolution in rφ and rz:

$$\sigma = \sqrt{a^2 + \left(\frac{b}{p\sin^{\frac{3}{2}}\theta}\right)^2}$$

a < 5μm (point precision)b < 10μm (multiple scattering).

- Implies typically:
 - Pixels ~ 20 x 20 μm^2 .
 - First measurement at r ~ 15 mm.
 - Five layers out to radius of about 60 mm, i.e. total ~ 10⁹ pixels
 - Material ~ 0.1% X_0 per layer.
 - Detector covers $|\cos \theta| < 0.96$.

Physics Studies

- LCFI studies have had a big impact
 - Beampipe radius studies
 - Studies vs. layer geometry, polar angle
- Vertexing software package
 - Vertex finder, flavour tagger, quark charge
 - Code released in use for ILD, SiD
 - New version soon; improved performance
- Next tasks
 - Realistic simulation; full/cheated tracking, hadronic interactions, photon conversions
 - Code improvements
 - Benchmarking, detector optimisation





Vertex detector mechanical design

- Sensor support prototyping
 - Investigating low density foams, carbon fiber support
 - Well developed construction, gluing techniques
 - High-precision laser measure of deflection vs. temp
- Cooling studies
 - Low-rate flow of dry gas
 - Cooling studies on test stand and in simulation
- Detector conceptual designs
 - Detector layouts to check compatibility, investigate novel designs
 - Connection to detector concept groups



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Sensors, readout and testing

- Sensors, readout
 - Column-parallel CCD working at 45 MHz
 - ISIS sensors in testbeam now
 - Readout ASICs CPR2 bump-bonded to sensor, CPR2A nearing submission
- Testing and Electronics
 - Many interesting studies on CCDs, clock drive, etc.
 - Radiation studies, ladder design
 - Full package of CPC2+CPR2+CPD1 working to 9 MHz









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Summary

LCFI active in developing all components for the vertex detector

- Talks:
 - Simulation and Physics Studies (25') Sonja Hillert
 - Mechanical Studies (25') Joel Goldstein
 - Sensor and Readout (35') Konstantin Stefanov
 - Testing and Electronics (25') Andrei Nomerotski