The Vertex Tracker

- Sensor R&D
- Detector Design
- Physics Benchmarking

Marco Battaglia
UC Berkeley and LBNL
Sensor R&D

CCD Sensors

Reports from LCFI progress with successful tests of CPCCD clocked at 1 Mhz with low clock Voltage and development of new Readout Chip with correlated double sampling, data sparsification and time stamping capabilities.

CMOS Sensors

Start of R&D program on Monolithic CMOS sensors by Yale/Oregon U. with US vendor who has mature technology expertise to develop large (22x125 mm) devices, small pixels and high read-out capability.

Pick-up and Noise Suppression Capabilities

Need to carefully consider problems with reading 10^9 signals in an electrically hyperactive environment: being considered for different sensor technologies and cold/warm RF options.
Thin Hybrid Pixel Sensors

- R&D on Thin silicon sensors for SLHC / LCat Purdue U. in collaboration with Fermilab
- Production of thin strips and pixel detectors within common project with Micron
- Develop new HPS with interleaved pixels and 25x25 microns cell size for improved resolution
- Application in Fwd disks needs detail characterisation of environment

Pixel Mask Readout

D. Bortoletto/Purdue
Radiation Damage

- Systematic study to understand radiation damage of CCDs quantitatively and qualitatively
- CCDs irradiated with neutrons and electrons and results compared to sensors recovered from VXD3
- Observe that damage to VXD3 sensors was due to electrons
- Need to consider effects of pairs at the LC
- Measured long trap filling time will result in increased CTE at high readout speed

Neutron damage has clusters of trapping sites, while electron damage gives uniformly distributed single traps

O. Igonkina/Oregon
Thickness and Stability

Efforts to reduce layer thickness to minimise multiple scattering while ensuring required mechanical stability

Ultimate solution represented by thinned detectors supported at outer edges and stabilised under tension disfavoured by transverse bowing effects due to differential thermal contraction

Need light supporting substrate with good match to Si thermal properties (Be tested) or foam between layers

D. Jackson/LCFI
New STAR Vtx Detector provides interesting experience for both sensor technology and engineered detector design:
Constraints on Vtx Radius

- Vtx Inner Radius defines collimation requirements
- Small collimation apertures causes beam jitter amplification
- Since wakes effect scales as $1/E$, at low energies may need to trade aperture with luminosity
- Expect limitation to be similar for cold and warm RF technology.

A. Seryi
Physics Benchmarking

Study how tagging performance depends on layer thickness and/or innermost radius

Tau tagging in Higgs and SUSY decays is an interesting benchmark for the Vertex Tracker response with both ip and vtx tagging

B charge determination, requiring complete counting of decay tracks, offers stringent requirements and need to be matched to physics studies
The Vertex WG Activity in Perspective

The Vertex Tracker will require a sustained and coherent effort in Sensor R&D, Detector Design and Physics Benchmarking

New activities are starting in the US with alternative detector technologies being considered (CMOS, HPS)

Sustaining these activities in the present low-budget environment will require an effective synergy with relevant detector programs for HEP, Astrophysics, Medical Imaging in our Labs and efficient contacts with the R&D efforts in Europe and Asia

Need to involve new groups and more colleagues and help newcomers: plan SW tutorials, interim WG meetings and coordination of physics benchmark studies and development activities.