

Project name

Investigation of new technologies for the silicon vertex tracker

Classification (accelerator/detector:subsystem)

Detector: Vertex Detector

Institution(s) and personnel

Northwestern University, Department of Physics and Astronomy:

David Buchholz (professor), Harald Fox (postdoc)

Fermi National Accelerator Laboratory:

Ron Lipton (staff scientist), William Wester (staff scientist), Simon Kwan (staff scientist)

Contact person

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Project Overview

The detector for the linear collider needs to have a high resolution in order to achieve the goals of the proposed physics program. The present design of the vertex detector is based on pixelated silicon detectors. These detectors achieve an excellent position resolution. Three main areas where R&D is necessary have been identified:

- The neutron flux from accelerator background is expected to be greater than $10^9/\text{cm}^2/\text{year}$. The silicon detectors must survive this flux for many years.
- The intrinsically high number of channels poses a challenge to the readout. A readout cycle of the inner detectors must be completed within $50\mu\text{s}$.
- The detector thickness should be as thin as possible to avoid degradation of the momentum resolution by multiple scattering.

The proximity to Fermilab offers the possibility to address those problems. The members of this proposal have experience with building the DØ (Lipton, Buchholz, Fox) and the CDF (Wester) vertex detectors. Some of us (Wester and Kwan) are also involved in R&D for the BTeV vertex detector.

In the past the Fermilab booster facility has been used to irradiate silicon detectors for DØ and CDF. Additional radiation tests are planned for the run IIB upgrade of both detectors. We have also experience with irradiation of silicon detectors with Cobalt-60 and neutron sources. In addition some of us worked on the readout of silicon detectors (Wester, Buchholz, Fox) and on thinning silicon detectors for the BTeV experiment (Kwan).

Description of first year project activities

We propose to use the opportunities that the R&D for DØ, CDF and BTeV detectors offers for silicon detectors for the linear collider experiment. Prototype detectors can be irradiated at one or more of the facilities mentioned above. Thinning procedures that are being developed for BTeV can be applied to linear collider detectors as well.

For most of the proposed studies it is necessary to read the silicon detector out in order to estimate the effect of radiation or thinning. Fermilab has developed a generic readout system for the BTeV experiment. We want to adapt this tool at Northwestern for linear collider silicon detectors. The readout utilizes the commercial PCI bus. A PCI Test Adapter Card (PTA) can be used together with a PC. This setup together with another Fermilab development, the Programmable Mezzanine Card (PMC), provides a flexible and powerful readout for silicon detectors.

After readout from the detector has been established we plan to irradiate linear collider prototype detectors together with detectors of the DØ or CDF experiment. This project is ideal for participation of a student. We are therefore requesting funding for one undergraduate student majoring in physics.

Budget

Institution	Item	Cost
Northwestern	PC based readout system	\$ 6,000
Northwestern	Silicon fixture	\$ 5,000
Northwestern	Summer + academic year salary for one undergraduate student	\$ 4,400
Northwestern	Fringe benefits for above	\$ 836
Northwestern	Travel costs	\$ 2,000
Northwestern	Indirect cost at 49%	\$ 3,545
Northwestern	Indirect cost if 26% off campus	(\$1,881)
	Grand total	\$21,781