One of purposes of ILC is to measure Higgs coupling constant precisely, especially to b-quark and c-quark. ILC is a lepton collider, so precise measurement of Higgs boson coupling to b-quark and c-quark can be done.

FPCCD Vertex Detector will satisfy this!

**FPCCD Vertex Detector**

FPCCD (Fine Pixel CCD) Vertex Detector will enable precise flavor tagging.

- Space resolution: **Very Good**
- Pixel occupancy of background: **Good**
- Two-track separation capability: **Good**
- Background rejection by cluster shape: **Good**
- Readout per one train: **completely free** from beam-induced RF noise (EMI)

Performance Evaluation and Software Development for FPCCD

**Higgs Study in ILC**

The golden mode of Higgs generation process in ILC is $ee \rightarrow ZH$. One of these, $W^+ W^-$ production, is illustrated here. I.L.C. calculates the $W^+ W^-$ cross section per one train (1 ms).

**Before building FPCCD Vertex Detector, its performance should be evaluated and optimized.**

**Performance Evaluation and Software Development for FPCCD**

**Pixel Occupancy of Background**

Main background in VXD is caused by electron-positron beam.

- at 500 GeV: Occupancy is less than 1%, even in the outer 4 layers.
- at 1 TeV: Occupancy is less than 1%, even in the outer 4 layers.

**Pixel-size configuration has been optimized to reduce power consumption of readout.**

If pixel size in the outer 4 layers are 10$\mu$m x 10$\mu$m, then power consumption of readout is decreased by 70%. If both occupancy and I.P. resolution remain OK, this value is very attractive.

**Occupancy requirement cleared with 10$\mu$m x 10$\mu$m pixel configuration!**

- at 1 TeV:
  - layer No. 5 x 5 $\mu$m$^2$: 0.0
  - layer No. 10 x 10 $\mu$m$^2$: 0.2

**Summary and Plan**

- If FPCCD is used, Occupancy: OK (under $E_{CM} = 500$ GeV)
- Impact parameter resolution: **Very Good**
- Power consumption can be reduced with new configuration of pixel size.

**Problem about the efficiency:**
1. Why is the efficiency at 1GeV with 100 ~ 1000BX higher than that with 0BX?
2. Why is the efficiency at 1GeV with 100 ~ 1000BX higher than that with 0BX?

**I.L.C.**

- **Electron-positron beam.**
- **Total length:** 31 km
- **Peak luminosity:** $2 \times 10^{34}$ cm$^{-2}$s$^{-1}$
- **Energy range:** 250 ~ 500 GeV (upgrade: 1 TeV)
- **Vertex Detector:** Required to see measure 100 $\mu$m scale and below.

**FPCCD Vertex Detector**

FPCCD (Fine Pixel CCD) Vertex Detector will enable precise flavor tagging.

- **Basic Characteristics**
  - pixel size: 5$\mu$m x 5$\mu$m
  - sensor thickness: 50$\mu$m
  - number of pixels: $\sim 10^9$
  - fully depleted CCD
  - three doublet structure
  - background rejection by cluster shape: Good
  - readout per one train: completely free from beam-induced RF noise (EMI)

**Before building FPCCD Vertex Detector, its performance should be evaluated and optimized.**

**Summary and Plan**

- If FPCCD is used, Occupancy: OK (under $E_{CM} = 500$ GeV)
- Impact parameter resolution: **Very Good**
- Power consumption can be reduced with new configuration of pixel size.

**Beam Test:** June 2013.
I’ll prepare analysis code to derive FPCCD’s excellent spatial resolution.