Full-Simulation Studies of the SI Tracker for LC

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Today, I'll show

- 1. Tracker Hit Occupancy
- 2. Two-track separation
- 3. Track reconstruction efficiency
- 4. Momentum resolution
- 5. Higgs mass resolution

In this study, we use **GEANT4** Full detector simulation + tracker hit position smearing **Assuming SDMar01 detector parameters:** 5 layer Si tracker: R = 20.05, 46.30, 72.55, 98.80, 125.05 cm B = 5.0 Tesla Track finding ... cheater (makes one track from one particle) Track fitting Here we only use Barrel region ( $|\cos\theta| < 0.8$ )

### **Tracker Hit Occupancy**



 $10^{-3} \sim 10^{-2}$  at inner most

## **Tracker Hit Occupancy**

 $e^+e^- \rightarrow tt \rightarrow 6$  Jets,  $\sqrt{s}=500$  GeV, nol SR, no beamstrahlung



### Minimum hit-hit distance

 $e^+e^- \rightarrow qq$  (q=udscb),  $\sqrt{s}=500$  GeV, nol SR, no beamstrahlung



## Hit merging rate

 $e^+e^- \rightarrow qq$  (q=udscb),  $\sqrt{s}=500$  GeV, noI SR, no beamstrahlung

#### Hit merging rate



Additional Hit in a strip ... ~10<sup>-2</sup> at pitch size < 200  $\mu$ m

# Track Reconstruction efficiency vs. pitch size For E>0.5 GeV, |cosθ|<0.8



# **Track Reconstruction Efficiency**



|cosθ|<0.8

## Momentum resolution

Generate single particle at  $|\cos\theta| = 0$ 



Resolution at low momentum region is worse than expected

### Momentum resolution SD vs LD



#### Higgs recoil mass resolution

 $e^+e^- \rightarrow Z^0H^0$  Events,  $\sqrt{s}=500$  GeV,  $M_h=140$  GeV, no I SR, no beamstrahlung Mass\_Z0\_mm2 Mass\_H0\_mm Nent = 1470 Nent = 857 Mean Mean 140 70 254 / 115 60 Constant = 42.85 Constant = Mean = 91.28Mean 139.9 = 1.716 Sigma Sigma = 4.615100 110 120 130 140 150 160 170 180 90 95 100 105 110 75 85 70 Recoil Mass (GeV) Z<sup>0</sup> Mass (GeV) Reconstructed Z<sup>0</sup> mass Recoil H<sup>0</sup> mass  $Z^0 \rightarrow \mu^+\mu^-$  mode 139.9 ± 4.63 GeV (FASTMC) 91.3 ± 1.27 GeV  $139.9 \pm 4.61 \text{ GeV}$  (GEANT4) 91.3 + 1.72 GeV  $Z^{0} \rightarrow e^{+}e^{-}$  mode 91.2 ± 1.45 GeV 139.9 ± 4.63 GeV (FASTMC) 141.3 ± 5.56 GeV (GEANT4) 90.8 ± 1.94 GeV

FASTMC/GEANT4 difference ... ~30%

#### Summary:

Using the GEANT4 simulation+Kalman filter, We start Si tracker Full simulation study

 \* Tracker Hit Occupancy level ... 10<sup>-2</sup> ~10<sup>-3</sup> at inner most Comparable to the estimated BG level from I R simulations ... We just started the I R/beam-delivery system simulation using GEANT4 at Tokyo

→ useful for the detail BG study in Si tracker

\* At low-P region: Track reconstruction efficiency is very low Momentum resolution is worse than expected Linking the Vertex detector hits may help

#### GEANT4 Beam Delivery System simulation study at Tokyo

