UNIVERSITY OF CALIFORNIA SANTA CRUZ

International Linear Collider

Simulation Studies at SCIPP

Momentum Resolution and Non-Prompt Track Reconstruction

ALCPG09
University of New Mexico
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CURVATURE RECONSTRUCTION PERFORMANCE

Many thanks to Alex Bogert (Undergraduate student)

One Question: ILD Higgs LOI recoil reconstruction appears somewhat better than SiD's. Could this be due to curvature reconstruction?

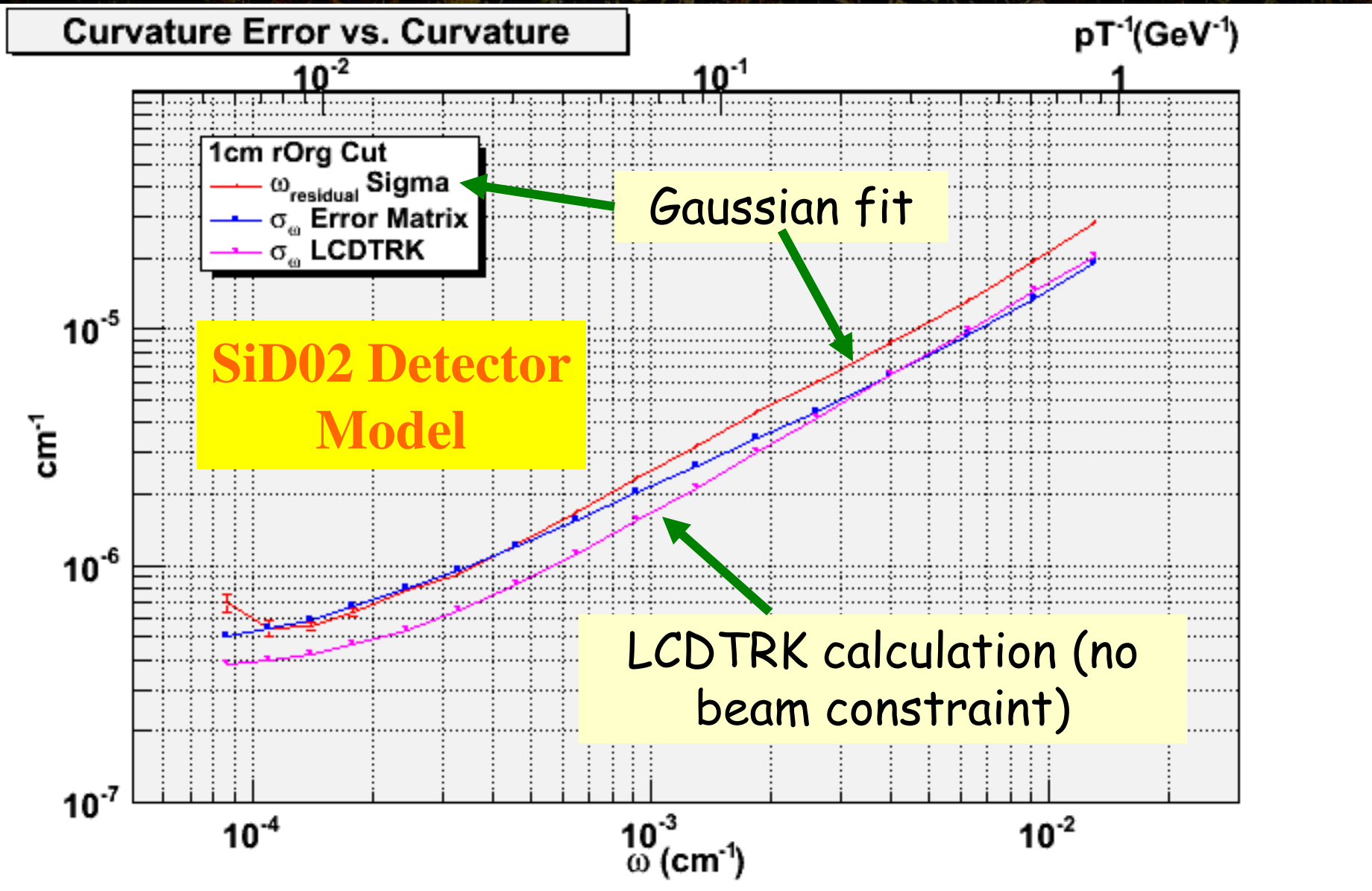
(9/30/09 UPDATE: Apparently not! But study still interesting)

CURVATURE RECONSTRUCTION PERFORMANCE

1. Compare width of Gaussian fit to residuals with two different estimates:
   - Error from square root of appropriate diagonal error matrix element
   - Error from Billior calculation (**LCDTRK** program)
2. Only tracks with all DOF (5 VTX and 5 CT layers) are considered.
3. Require $|\cos\theta| < 0.5$

Use q/qbar at 500 and 1000 GeV, tau samples at 500 GeV, all mixed together (shouldn't matter)

CURVATURE ERROR vs. CURVATURE



SAMPLE RESULTS AT P_T = 100 Gev

In terms of σ_p/p, at 100 GeV we have

LCDTRK	**0.28%**
Residuals	**0.39%**

The figure from the SiD LOI is about **0.33%** (obtained from fits to single muons)

➔ Somewhat contradictory? Need to explore (SCIPP should try single muons, etc.)

UPDATE: SINGLE MUONS AT 100 GeV

In terms of σ_p/p, comparing μ,π with p=100 GeV and $|\cos\theta| < 0.5$ we find

	μ	π
LCDTRK	0.28%	0.28%
Residuals	0.37%	0.39%
LOI Result	0.33%	----

➔ Think… (energy loss in material? I believe current fit is based on circular trajectory)

Separate Results for μ^+ μ^-

From distributions of $\omega_{meas} - \omega_{true}$ (units 10^{-7} cm^{-1}):

	μ^+	μ^-
N_μ	4538	4537
Gauss Mean	0.015	0.013
Gauss Sig	5.51	5.51
Error on Mean	0.083	0.083

➔ Means are very small with respect to error on the mean?

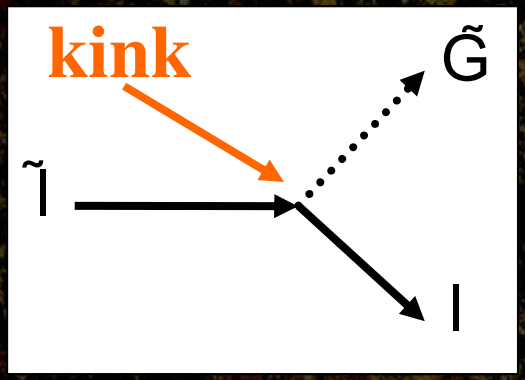
STUDIES OF NON-PROMPT TRACK RECONSTRUCTION AT SCIPP

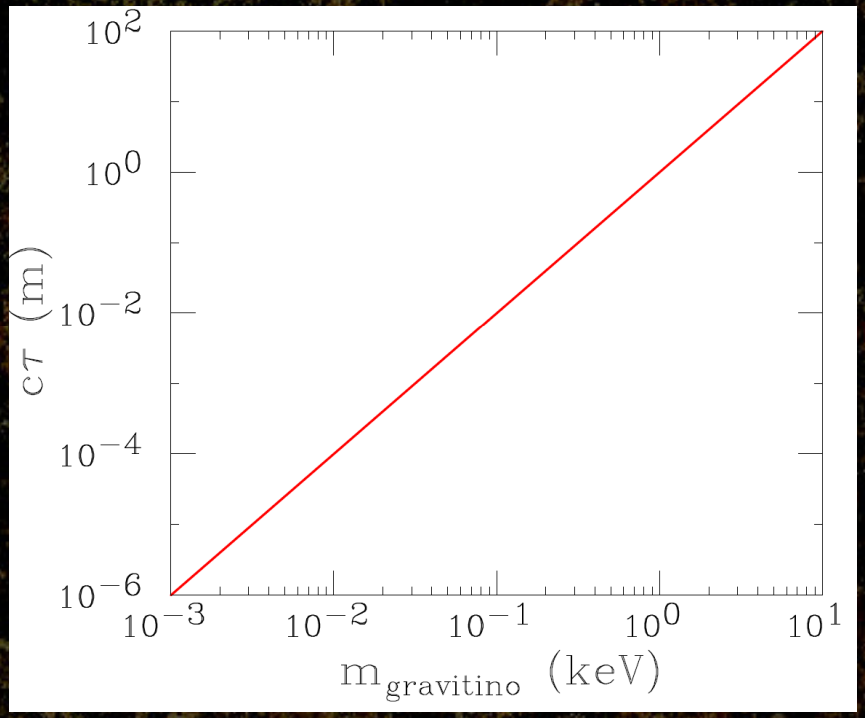
Exploring metastable Stau signatures

Thanks to undergraduates Chris Betancourt, Alex Bogert and Dustin Stolp (and former thesis students Chris Meyer and Tyler Rice)

Gauge-Mediated Supersymmetry Breaking

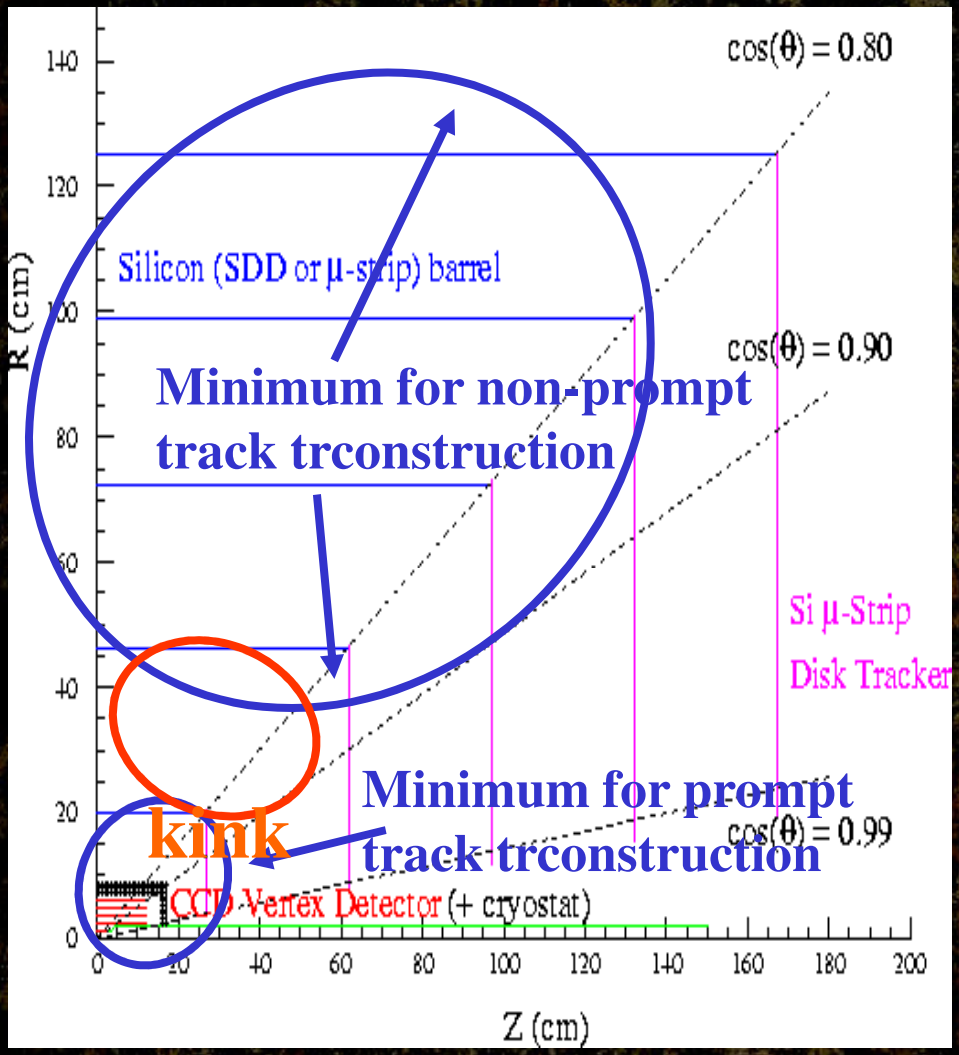
Scenarios with in-flight decay not disfavored by cosmological constraints





For a reasonable range of, e.g., gravitino mass, signature would be kinked track (possibly with change in rate of ionization loss)

Gauge-Mediated Supersymmetry Breaking II



Well-motivated, tractable signal.

This will challenge SiD, and perhaps provide constraints on layout and z segmentation.

Can we extend this by reconstructing tracks originating outside second tracking layer?

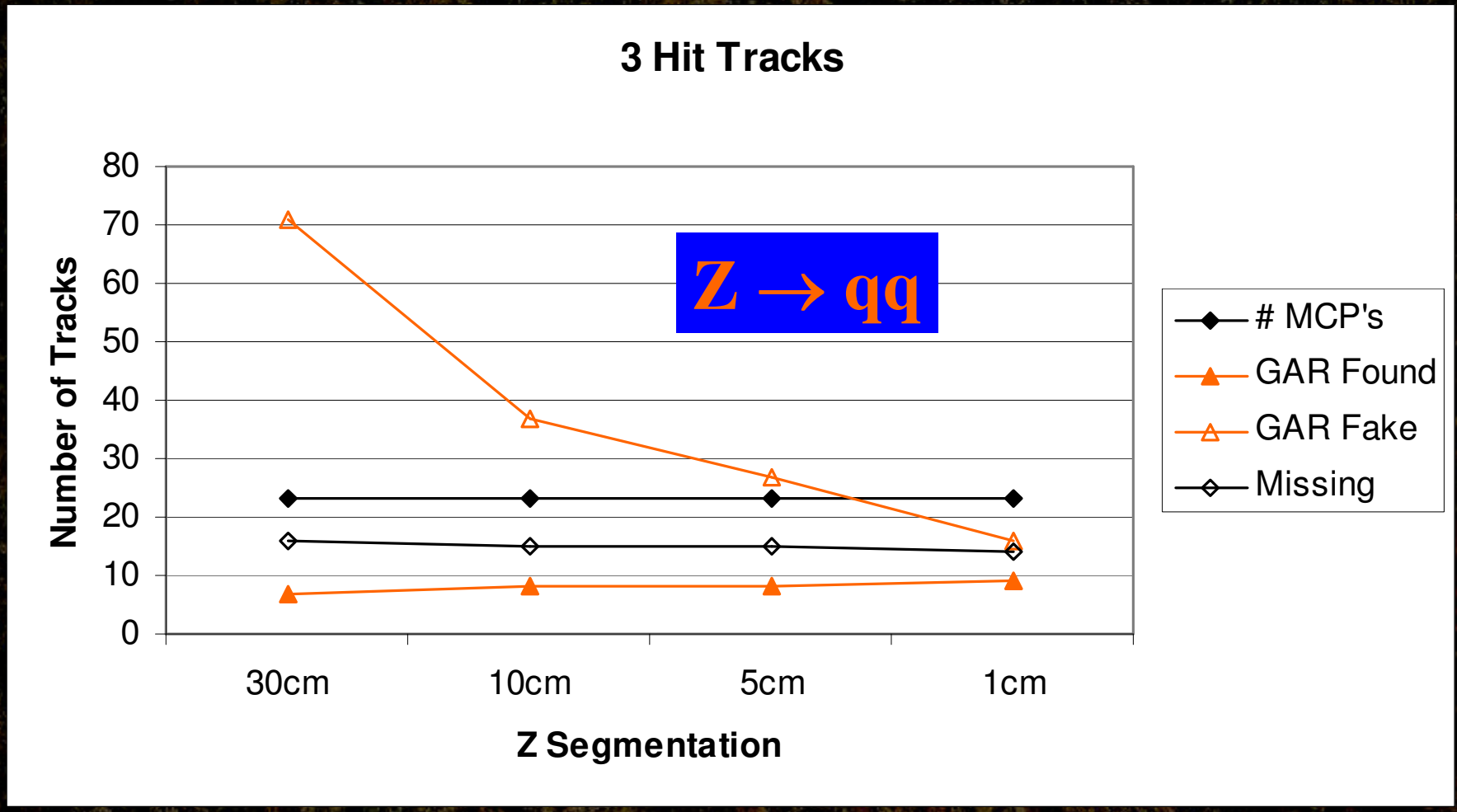
GARFIELD and SeedExtend

Two algorithms attempt to use minimum-ionizing track stubs in SiW Cal

GARFIELD (Onoprienko): Extend calorimeter stubs back into tracker; motivated by K^0_S reconstruction

SeedExtend (former UC students Meyer, Rice): Match three-hit tracker seeds with calorimeter tracking stubs. Geared toward Stau reconstruction.

GARFIELD performance on three-hit tracks



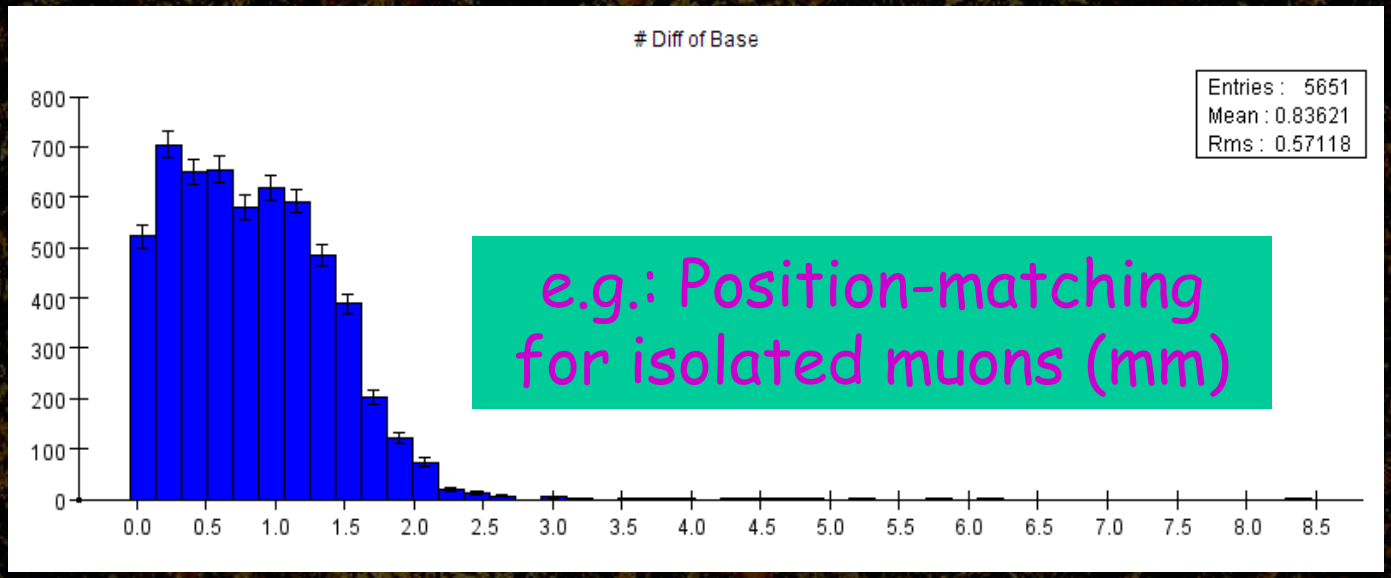
3-hit efficiency and purity not optimal ➔ SeedExtend alorithm developed at SCIPP

SeedExtend Approach

UCSC students proposed matching precise three-hit tracker seeds to Garfield stubs

Helix – Stub Matching (optimized for $Z \rightarrow qq$)

- **Base Difference < 2 mm**
- **Phi Difference < 100 milliradians**
- **Curvature Ratio ($(\kappa_{seed} - \kappa_{stub})/\kappa_{seed}$) < 10**



SeedExtend Performance; $Z \rightarrow qq$

Of a total of 20 3-hit particles:

- 12 were reconstructed as 3-hit tracks, with only 4 fakes
- Two additional 4-hit particles were found

Encouraging results; how will this do for reconstructing long-lived Stau decays?

GMSB Stau Reconstruction Study

SiDSeedTracker algorithm (Partridge) now available for tracker-only tracking:

- Optimize SiDSeedTracker strategy for prompt stub (Stau track)
- Run Garfield and SeedExtend sequentially, eliminating hits for found tracks
- Match inside-out (Stau) stubs with outside in (tau-decay) tracks with "Kinker" algorithm
- Work being done by UCSC undergrads Alex Bogert and Dustin Stolp

How wide a range in R_{dec} can we detect?

Summary

Have looked into accuracy of momentum SiD reconstruction simulation; some questions raised that require further exploration.

Full simulation study of non-prompt signature (GMSB Staus) underway for SiD to explore reach in R_{dec}.

ILD assumed to be robust, but similar study would be of interest.