Tracking Simulation Studies at UC Santa Cruz

- Tracking Validation Studies
- Non-prompt tracks with SiD

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I. Tracking Validation Pacakge

For now, demonstrate with Blanc/Wagner SODTracker, without proper fitter (Kalman Filter fitter ready but not yet tested)

SODTracker extends VXD stubs; “cheat” those for now

!!!!! Need legitimate full-service tracker !!!!

Tracking Validation Pacakge

Package is C++/ROOT written by Chris Meyer (UCSC physics major)

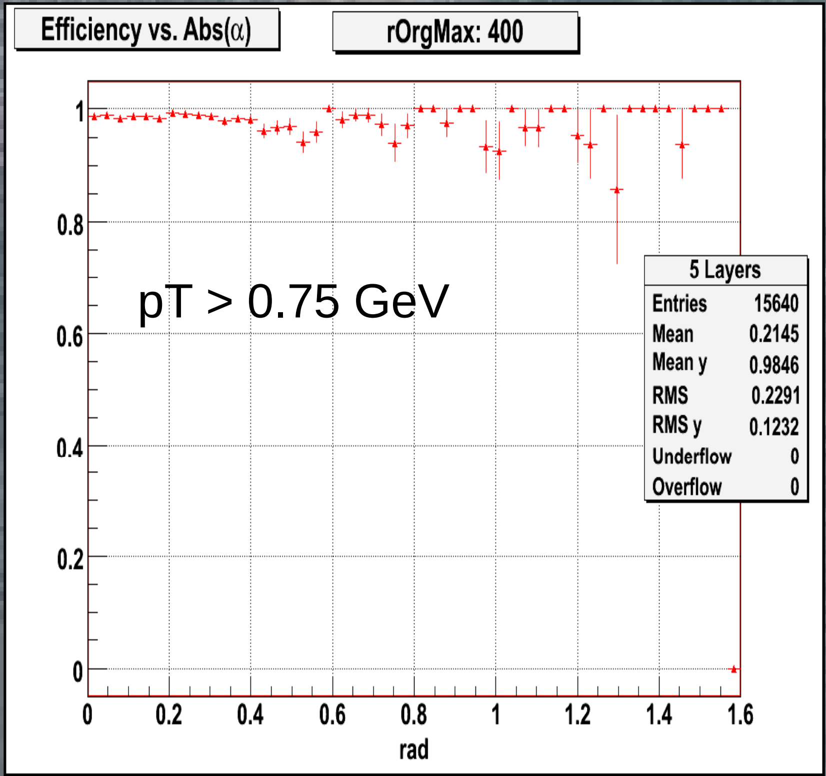
Reads in platform-independent flat file with specific format (output by JAS, …)

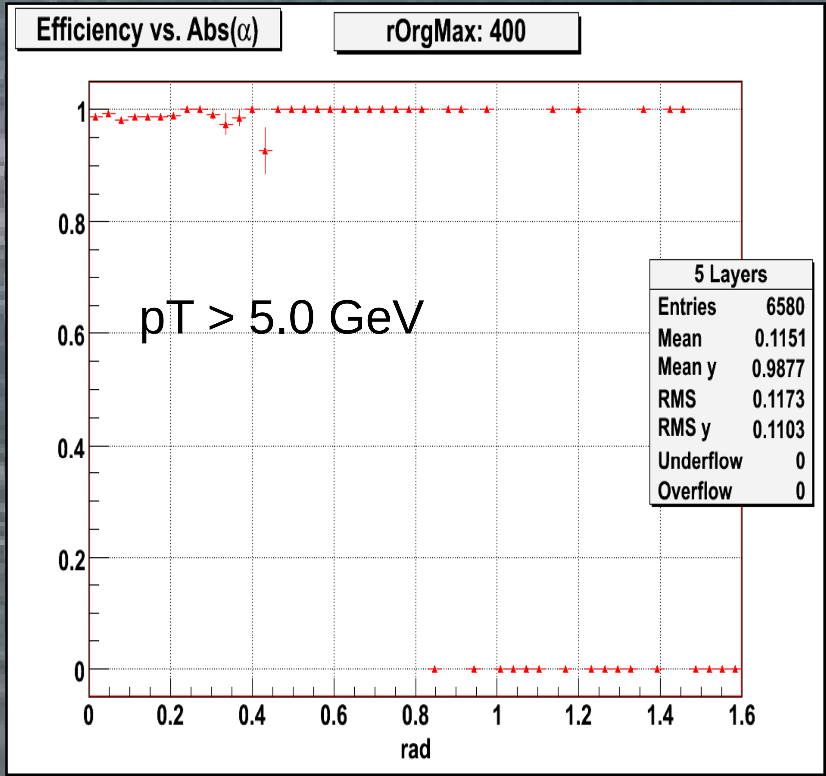
Flat file includes all relevant particles (MC) and tracks, with two-way MC Truth cross-referencing, and track/particle attributes

Also reads in error-matrix information in cosθ/p grid (e.g. from LCDTRK)

Some examples…

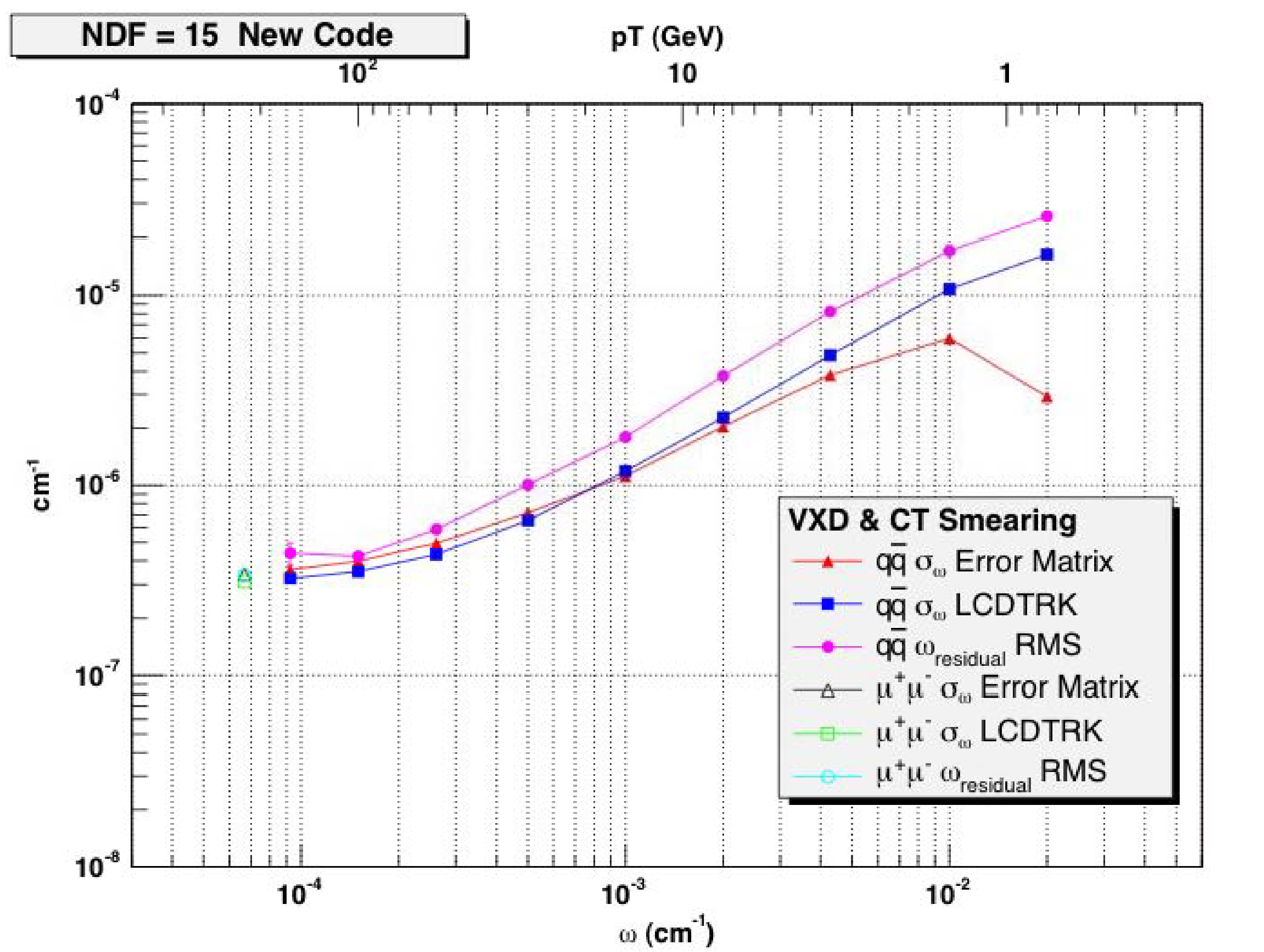
Efficiency vs. α 500 GeV uds



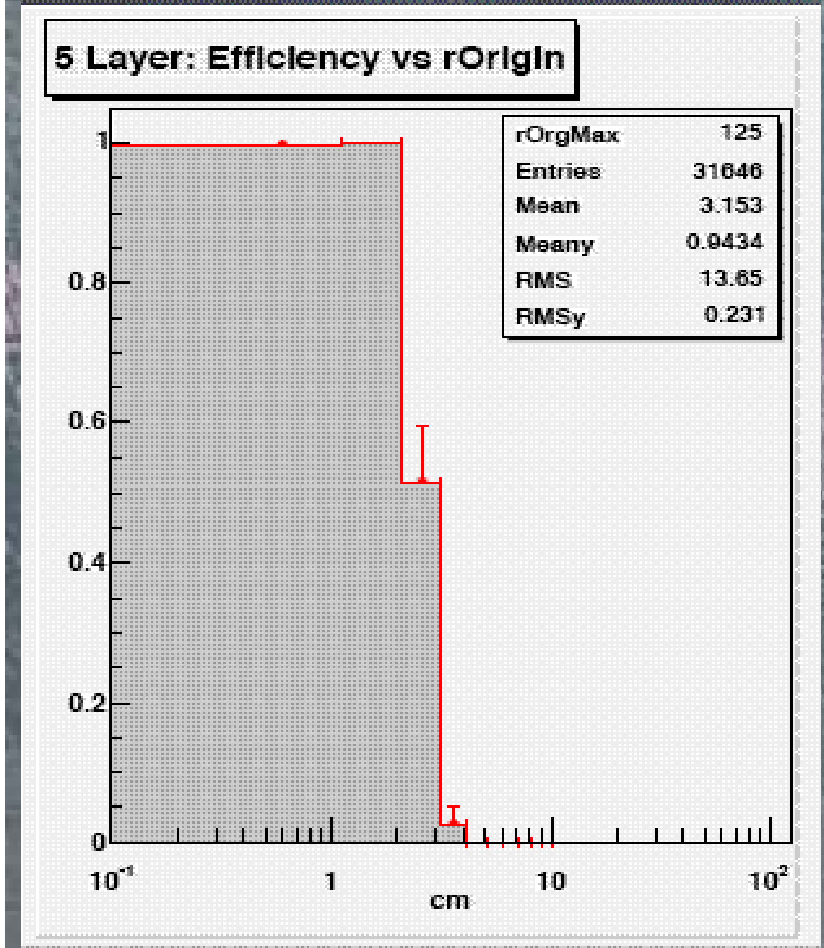


α = angle between jet axis and track

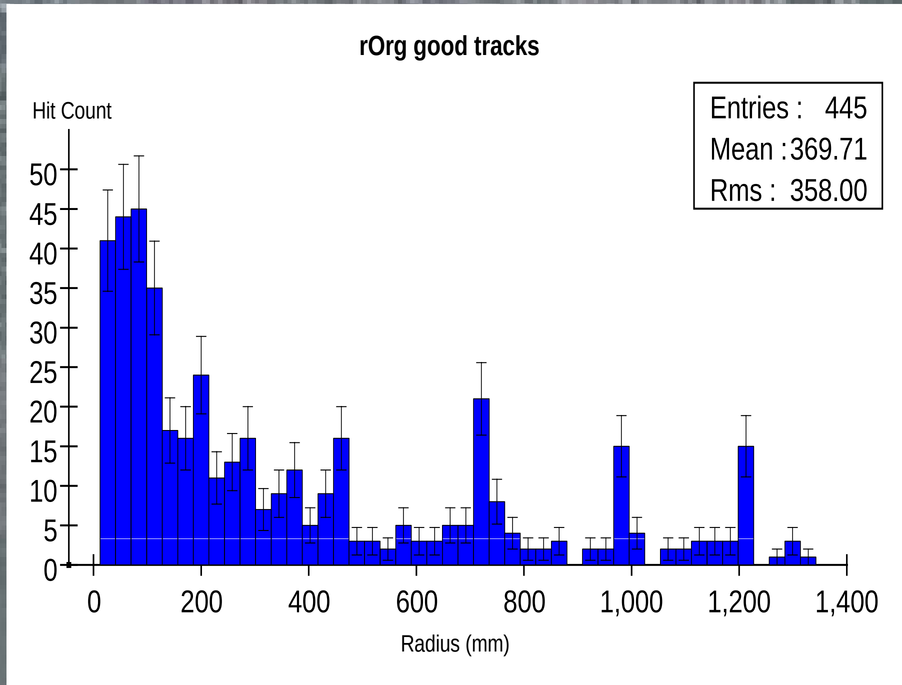
“Tri-Plots” (fitting validation)



II. Non-Prompt Tracks with the SiD



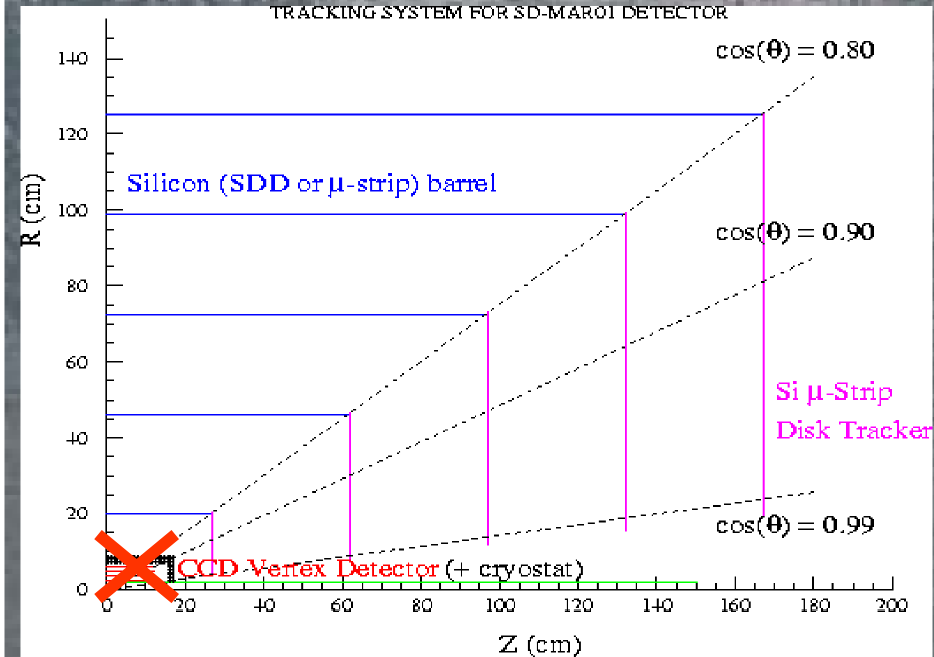
About 5% of tracks originate outside the 2nd layer of the VXD. Is the SiD able to reconstruct these?



People and Contributions I

Tim Nelson (SLAC)

AxialBarrelTracker (Snowmass '05) finds tracks using only the five central tracking layers



Begins with three track "seed" from outer layers and works inwards

Designed to find prompt tracks if VXD disabled

People and Contributions II

Tyler Rice (UCSC Physics Major)

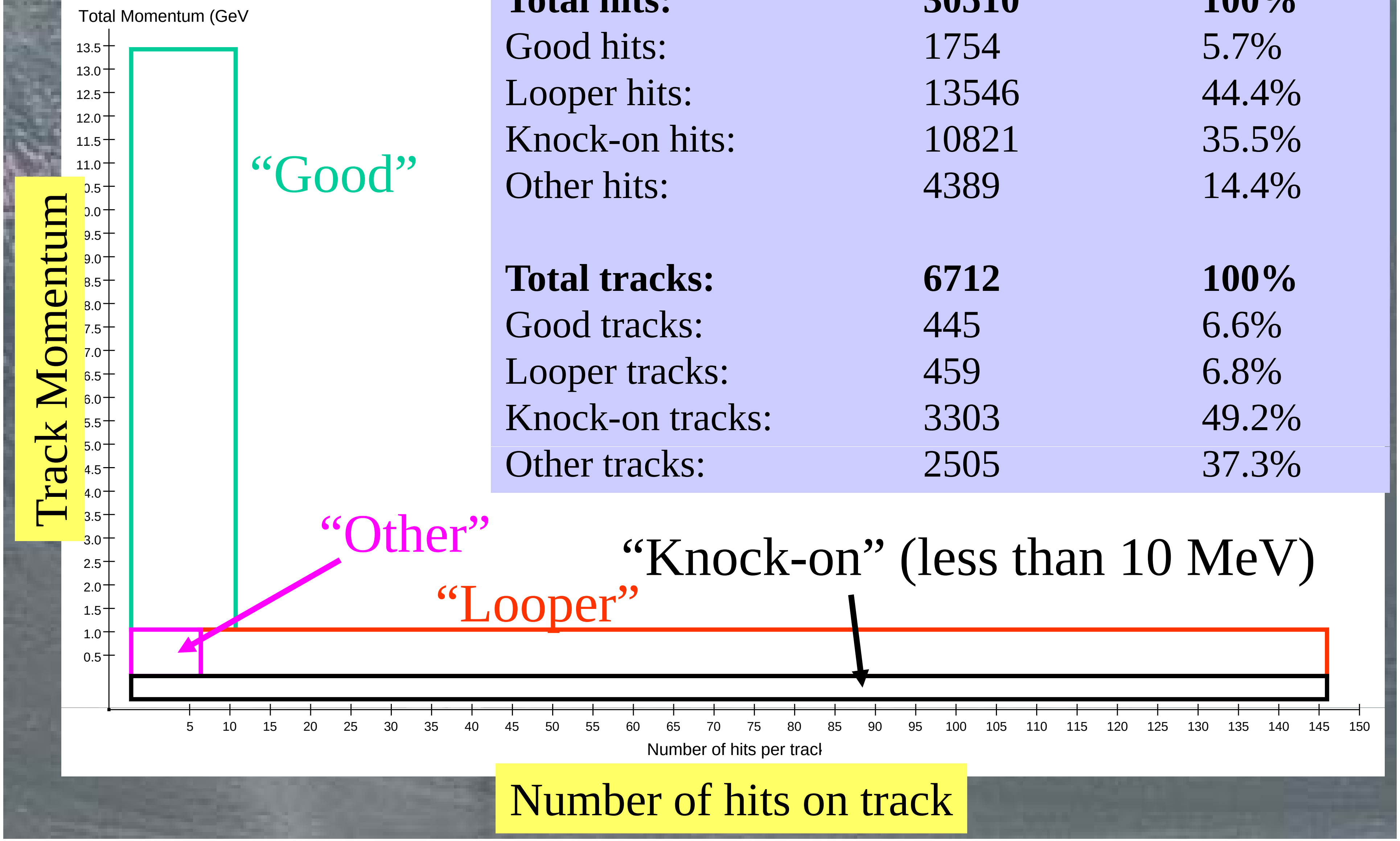
- Optimize AxialBarrelTracker for non-prompt tracks
- Benchmark and enhance performance

Lori Stevens (UCSC Physics Major)

- Introduce z-segmentation algorithm into AxialBarrelTracker
- Study performance vs. z segmentation

What's left after "finding" (cheating!) prompt tracks?

Total hits:	**30510**	**100%**
Good hits:	1754	5.7%
Looper hits:	13546	44.4%
Knock-on hits:	10821	35.5%
Other hits:	4389	14.4%
Total tracks:	**6712**	**100%**
Good tracks:	445	6.6%
Looper tracks:	459	6.8%
Knock-on tracks:	3303	49.2%
Other tracks:	2505	37.3%



AxialBarrelTracker Effieciency Studies

Out of 304 “findable” particles in $Z^0 \rightarrow bb$ events

“Found”: associated with a track, with at most one hit coming from a different particle.

“Fake”: Any non-associated track with $p_t > 0.75$ and DCA < 100mm.

	Particles		Fakes
Found 5 Hits	131	(43%)	1
Found 4 Hits	100	(33%)	270
Not Found	73	(24%)	-----

- Find 43% of particles
- Four-hit tracks seem difficult

Sources of Inefficiency

Restrict to particles that hit all five layers:

166 Findable MC Particles (304 before requirement)

113 Found with 5 hits (68% vs. 43%)
25 Found with 4 hits (15% vs. 33%)
28 Missed (17% vs. 24%)

Also require all three “seed” hits to be from same particle:

144 Found with 5 hits (87% vs. 43%)
15 Found with 4 hits (9% vs. 33%)
7 Missed (4% vs. 24%)

Improving AxialBarrelTracker Efficiency

For the vast majority of particles, all hits are within $\pi/2$ of one another in azimuth (ϕ). Make this restriction…

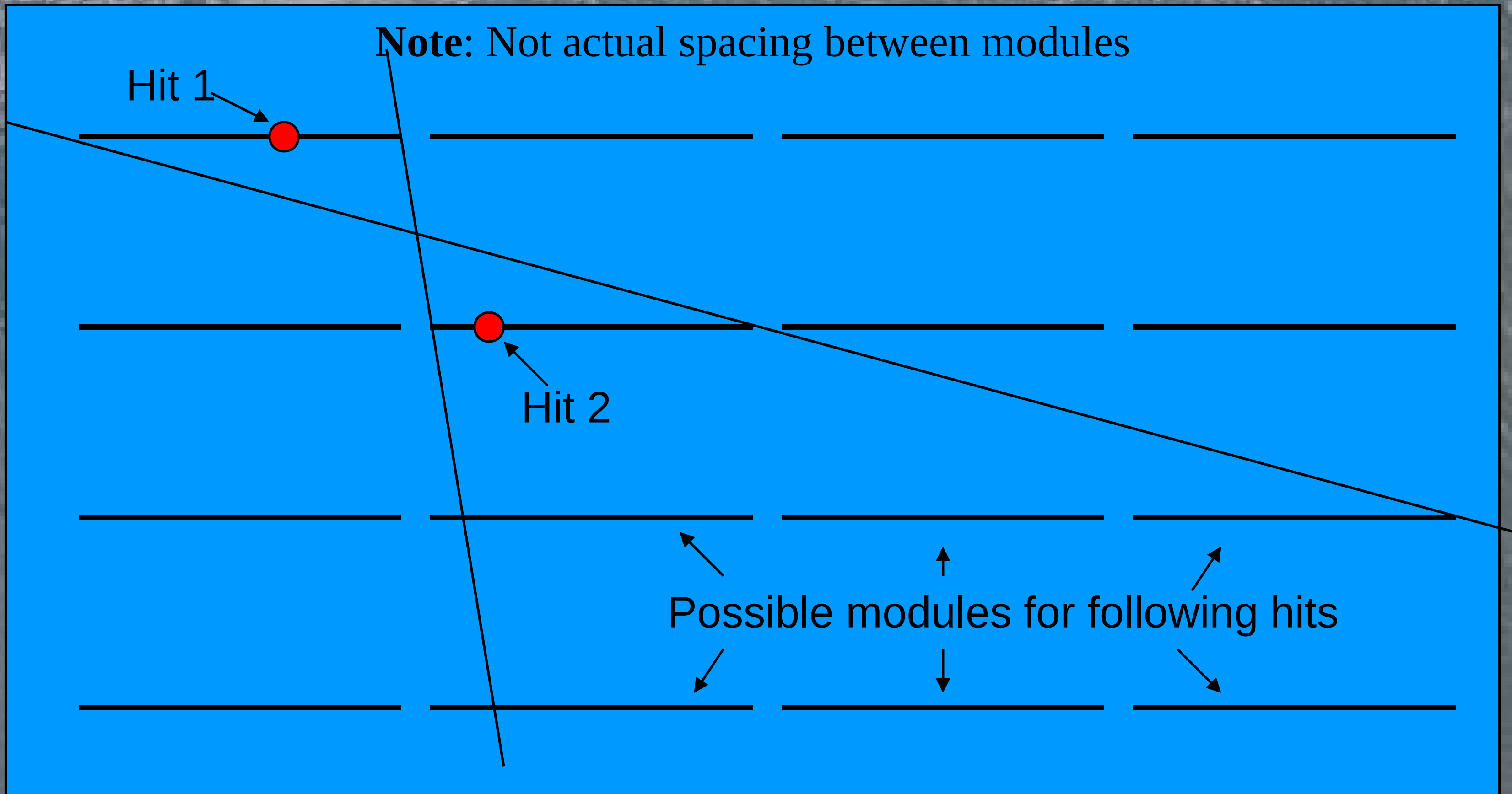
	With Azimuthal Restriction	% of MCPs	Without Azimuthal Restriction	% of MCPs
# of MCPs	304	100%	304	100%
Found with 5 hits	145	48%	131	43%
Found with 4 hits	112	37%	100	33%
Missed	47	15%	73	24%
Fake (4 hit / 5 hit)	157 / 1		270 /1	

Some improvements in efficiency and reduction of fakes…

Z Segmentation

Can we use z-segmentation to further clean up seeds and eliminate fake tracks? Can we make 4-hit tracks usable?

For now, apply only to three-hit seeds…

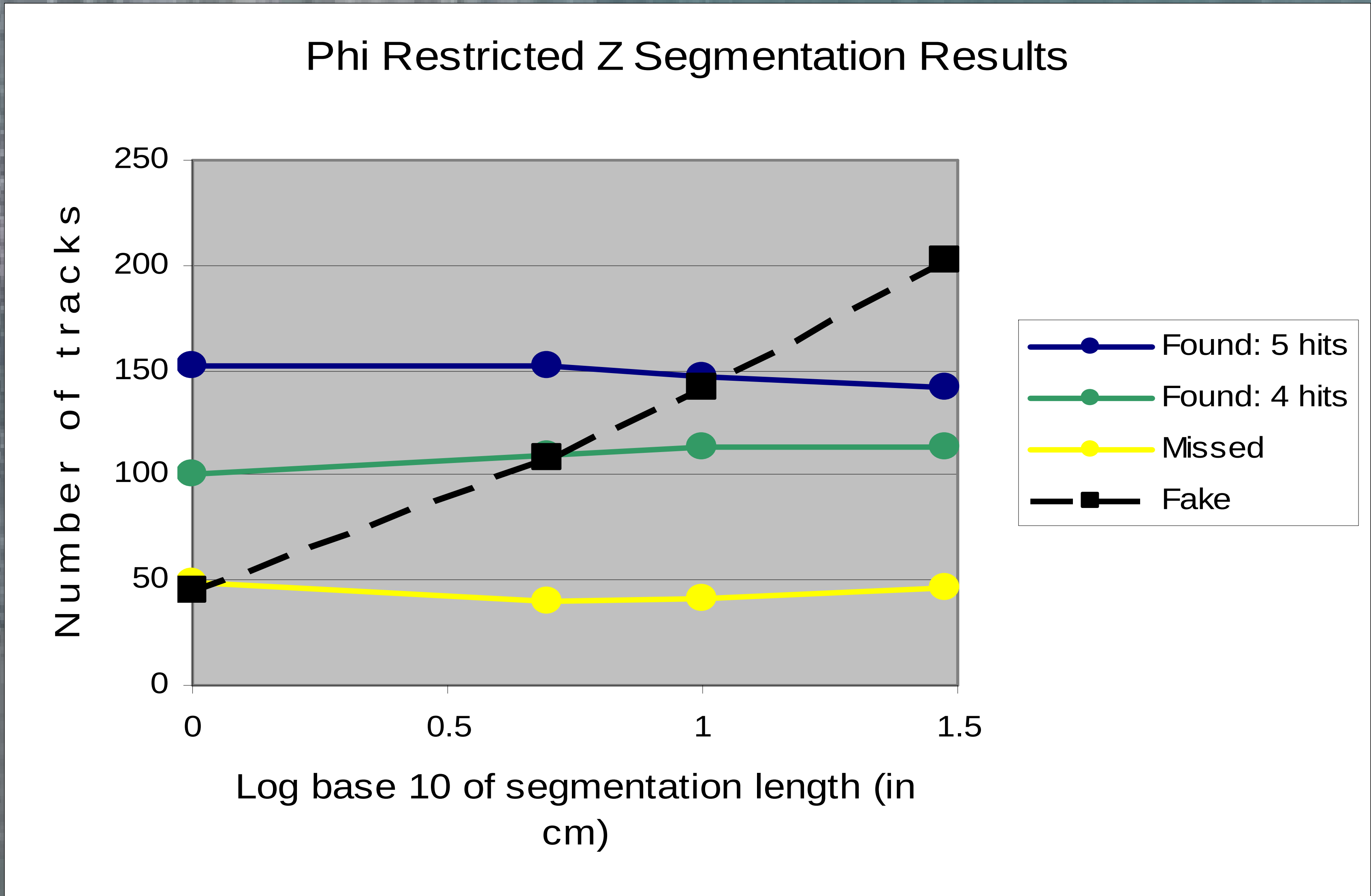


AxialBarrelTracker Effieciency

	Two halves (original)	30cm segments	10cm segments	5cm segments	1cm segments
# MCPs	304	302	302	302	302
Found with 5 hits	145	142	147	152	152
Found with 4 hits	112	113	114	110	101
Missed	47	47	41	40	49
4-hit fake	157	201	141	108	45

Application of segment consistency to seeds provides improvement, but only for lengths less than 10cm

AxialBarrelTracker Effieciency



Conclusions/Outlook

Preliminarily, need z-segmentation substantially finer than 10cm to clean up "seeds" for stand-alone central tracking

Still need to explore segmentation constraint for additional hits (soon!… but probably only 4th hit matters)

Platform-independent tracking validation package available

Next up: include CAL information…

> Look for extension of 4-hit (and 3-hit?) tracks

> Use Kansas State "Garfield" algorithm as 3rd-pass (after VXD-based algorithm and AxialBarrelTracker)

Questions addressed:

How few hits do we need in central tracker to reliably reconstruct tracks?

How fine does z segmentation need to be to help?

AxialBarrelTrackFinder Performance

Define “findable” particle as

- $P_t > 0.75$
- Radius of origin < 400 mm (require four layers)
- Path Length > 500 mm
- $|\cos\theta| < 0.8$