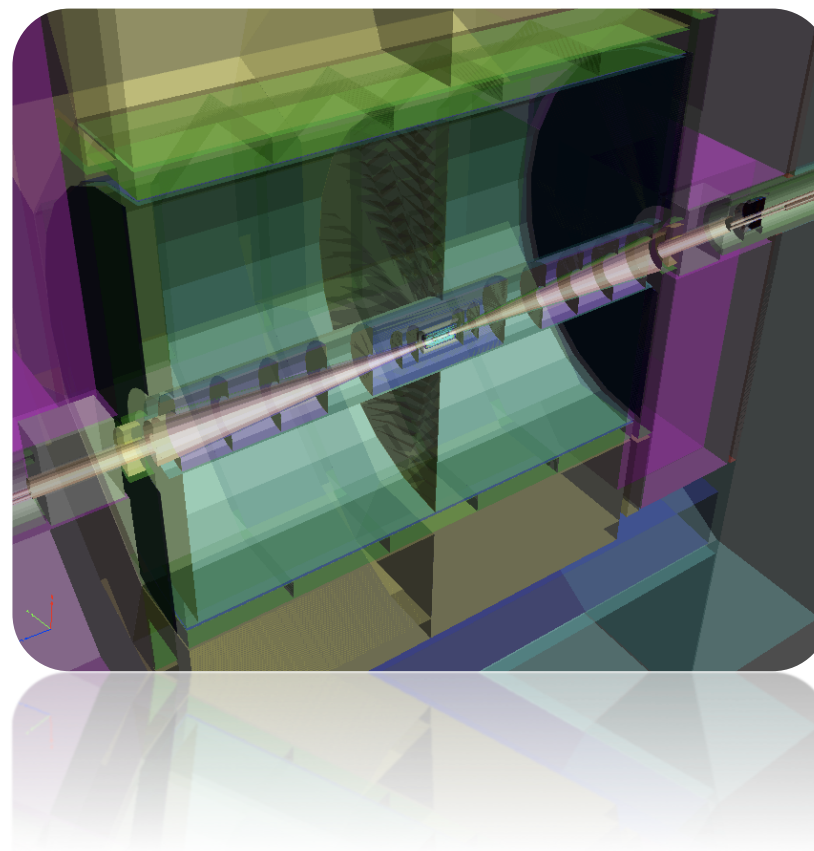# Tracking Software used for ILD Mass Simulation

Steve Aplin
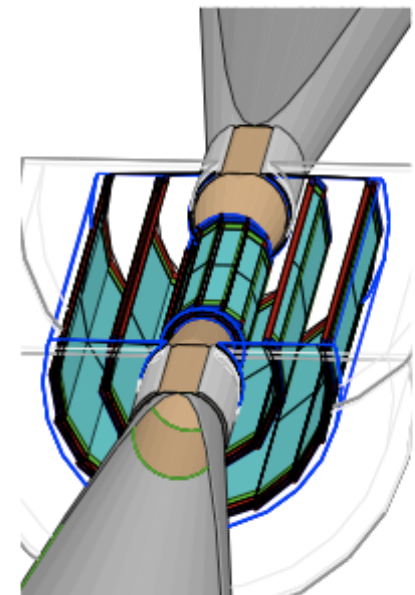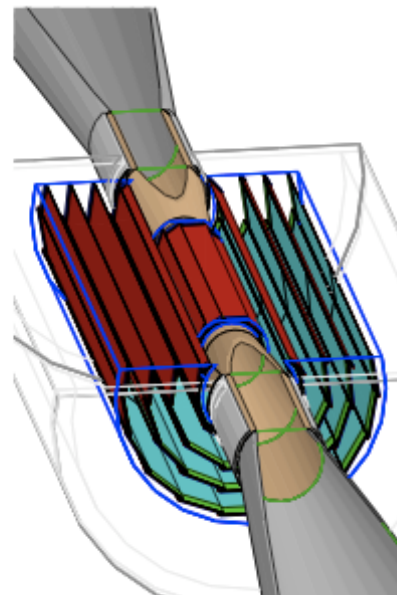
DESY

Tilc 2009 Tsukuba

18th April 2009

Overview

- Detector Simulation
- Reconstruction Software
- Performance
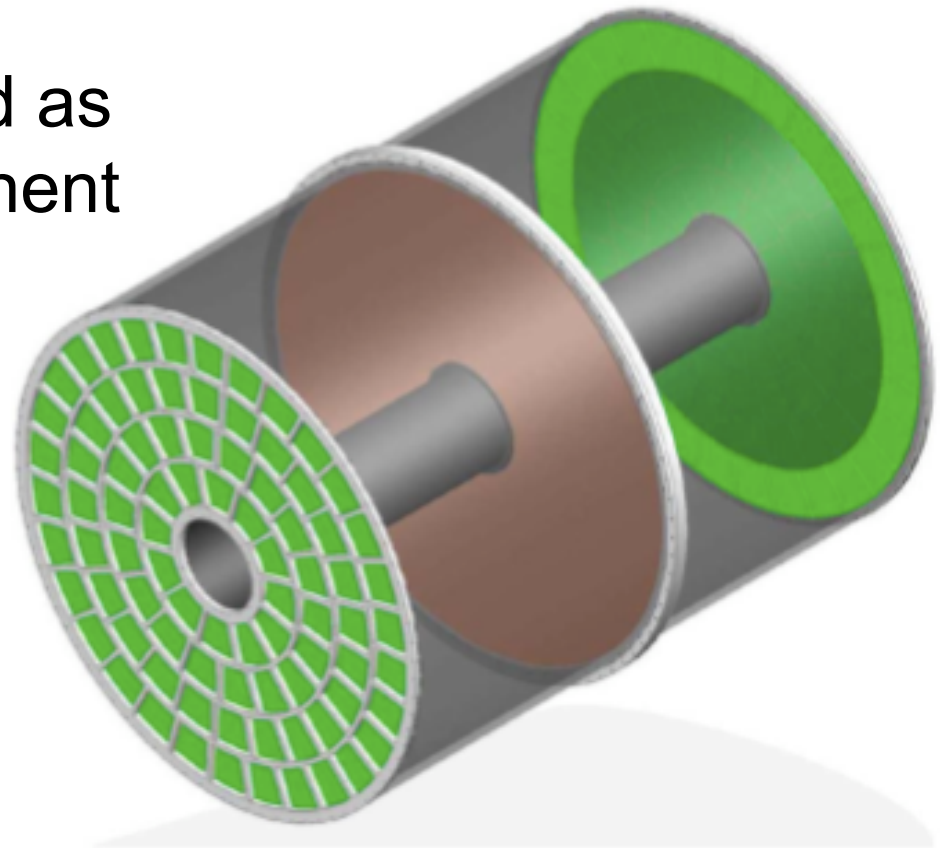- Current Issues
- Plans

VXD

- both 5 and 6 layer options well described in Mokka
- ladder structure
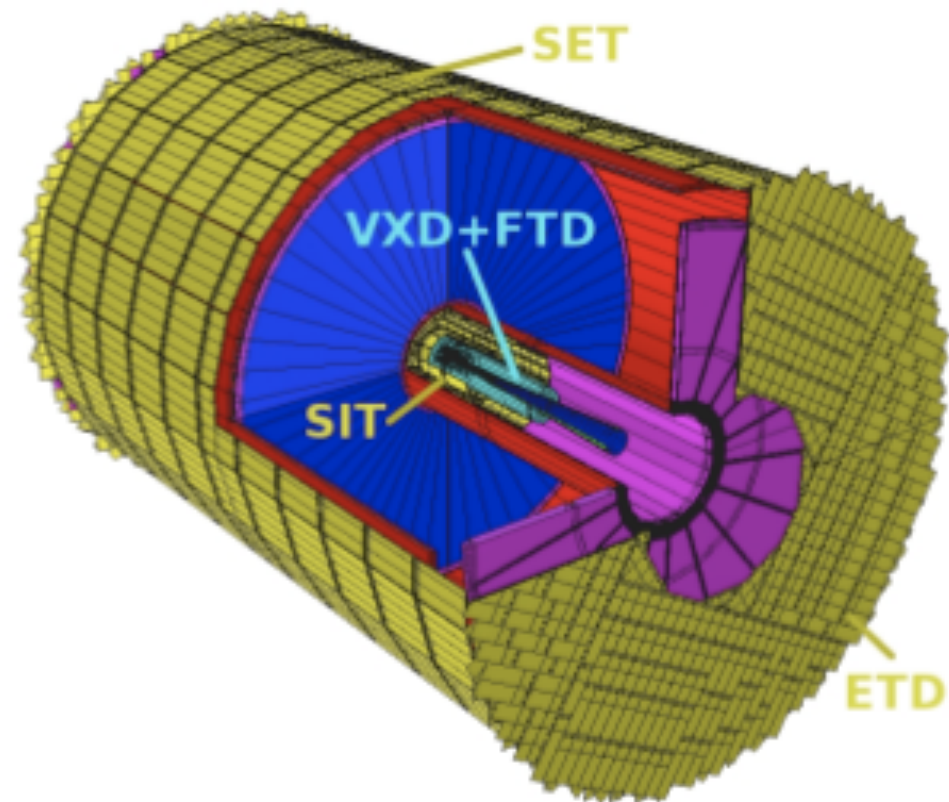- electronics
- support
- cryostat
- faraday cage

TPC

- TPC end plate described as uniform slices of component materials

- field cage uniform distribution of material
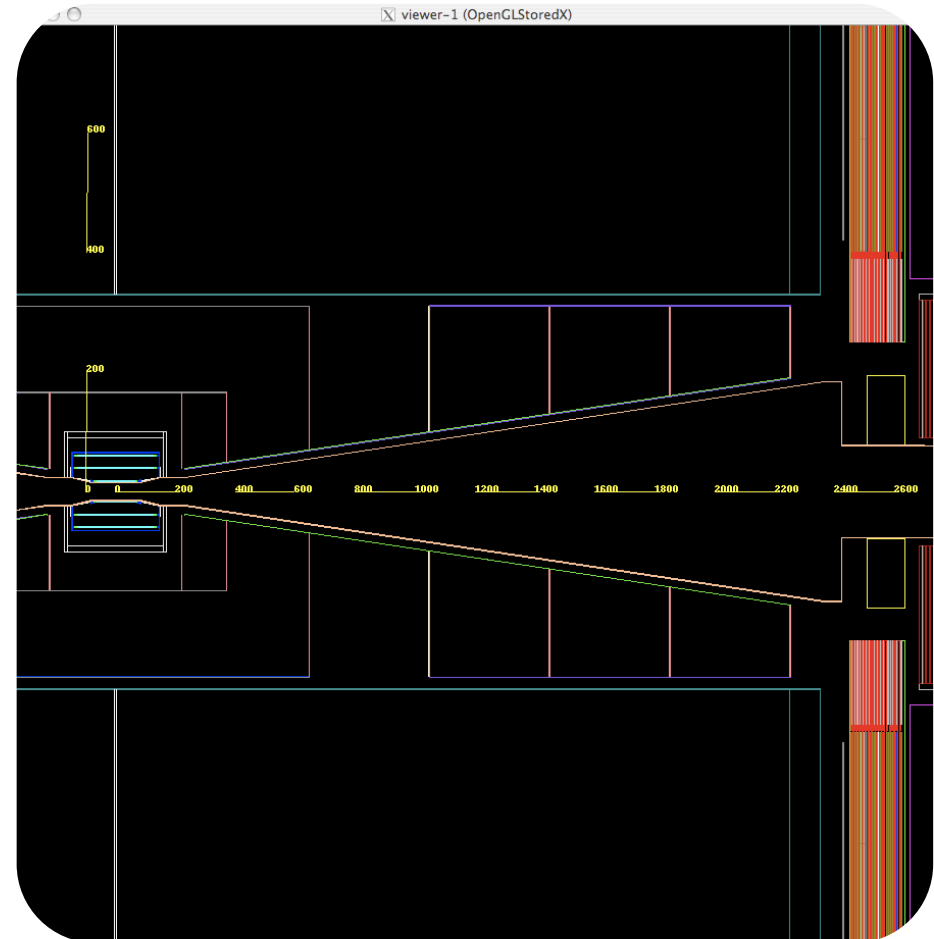
- cathode included

FTD – SIT – ETD – SET

- cylinders used for scalability

- support structures needs improved detail

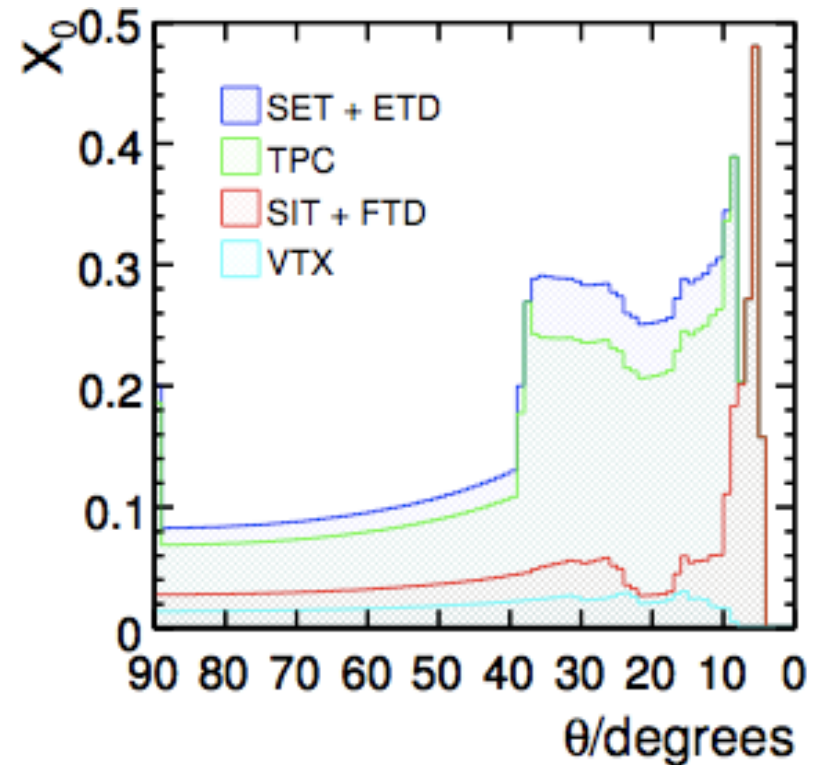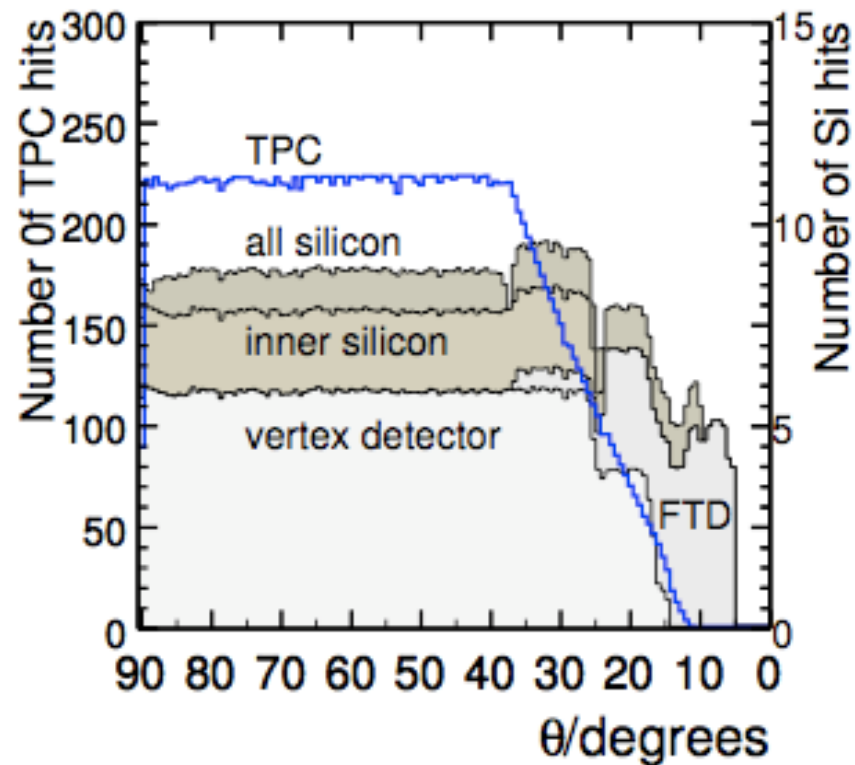- space points are used at present not strips
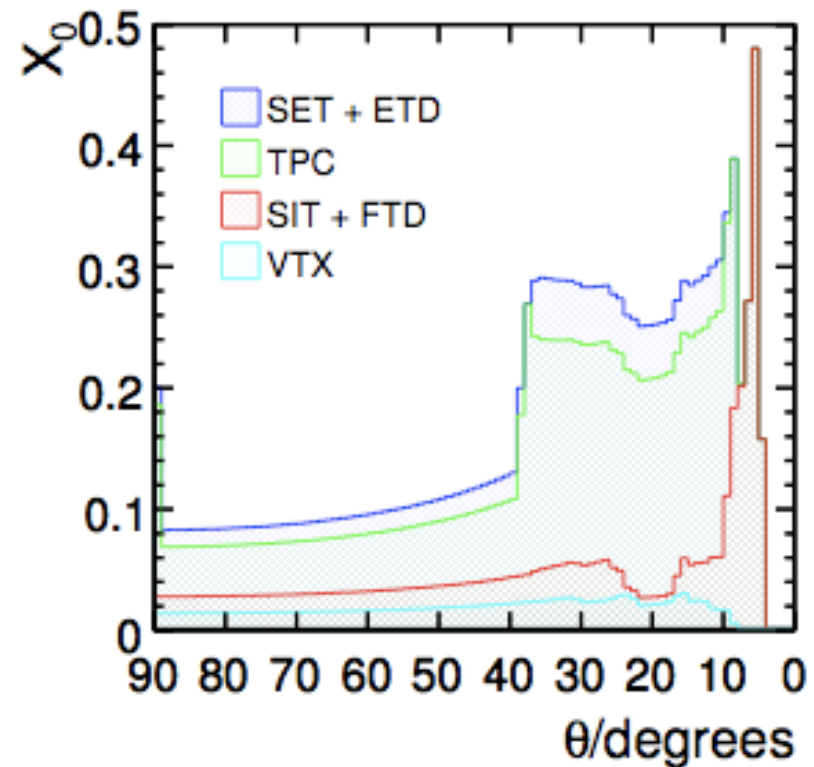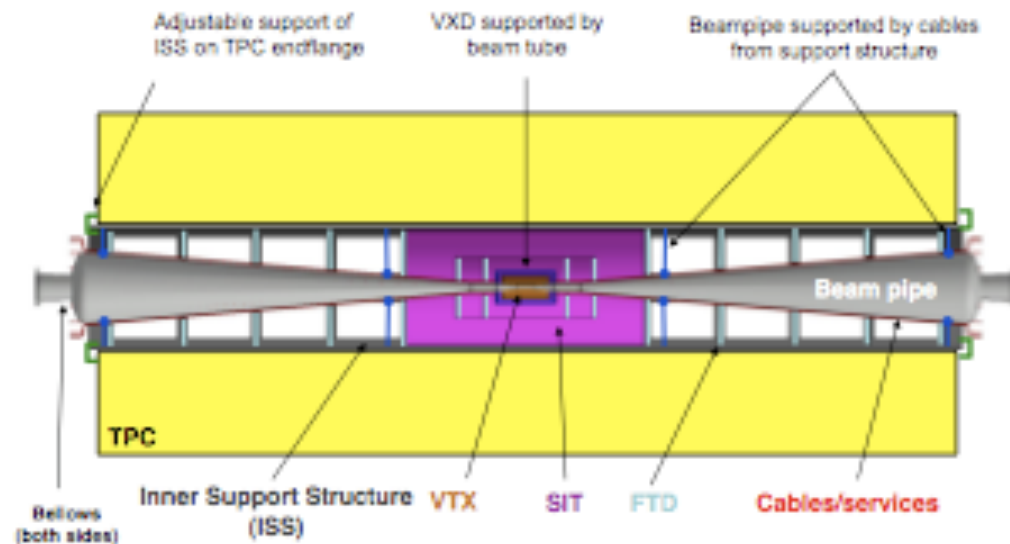
FTD – SIT – ETD – SET

- cylinders used for scalability

- support structures needs improved detail

- space points are used at present not strips

Coverage and Material Cost

Coverage and Material Cost

Reconstruction Software

Structure of Tracking Package

Digitisation

more sophisticated digitisers for Silicon exist, though these are currently not used

	$\sigma_{r-\phi}/\mu m$	$\sigma_z/\mu m$		$\sigma_{r-\phi}/\mu m$	$\sigma_z/\mu m$
VTX	2.8	2.8	FTD	5.8	5.8
SIT/SET	7.0	50.0	ETD	7.0	7.0
TPC	$\sigma_{r\phi}^2 = 50^2 + 900^2 \sin^2\phi + ((25^2/22) \times (4/B)^2 \sin\theta)\, z\, \mu m^2$ $\sigma_z^2 = 40^2 + 8^2 \times z\, \mu m^2$				

LEPTracking

- Original Tracking Code in MarlinReco
  - C++ wrapping for the Aleph/Delphi F77 Tracking Code – taken from BrahmsReco
- Today only provides TPC pattern recognition
- Out–In search using fast fitting
- Final TPCTracks fitted using Kalman Filter

SiliconTracking

- Combined pattern recognition in all inner Si tracking devices VXD,FTD,SIT
- Searches for hit triplets in the outermost layers
- Inward extrapolation of triplets
- C++ Pattern Recognition
- Uses F77 Kalman Filter for Fitting

FullLDCTracking

- Final step in full track reconstruction
- Associates SiTracks and TPCTracks
- Merges split low pt loopers
- Adds Hits from SET and ETD
- Picks up unassigned hits
- C++ Pattern Recognition
- Uses F77 Kalman Filter for Fitting

Software Status

- Code base is very stable
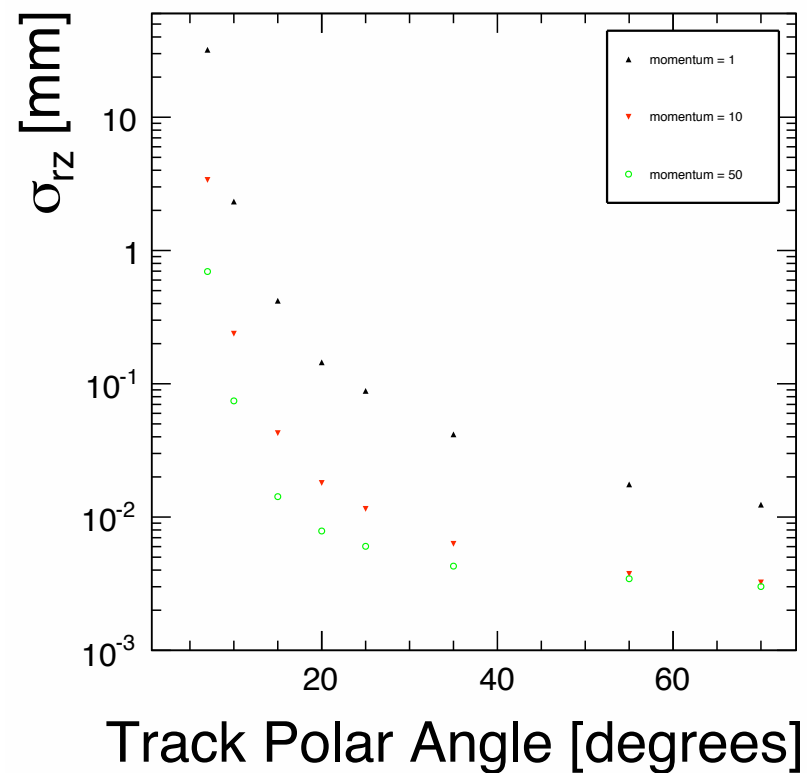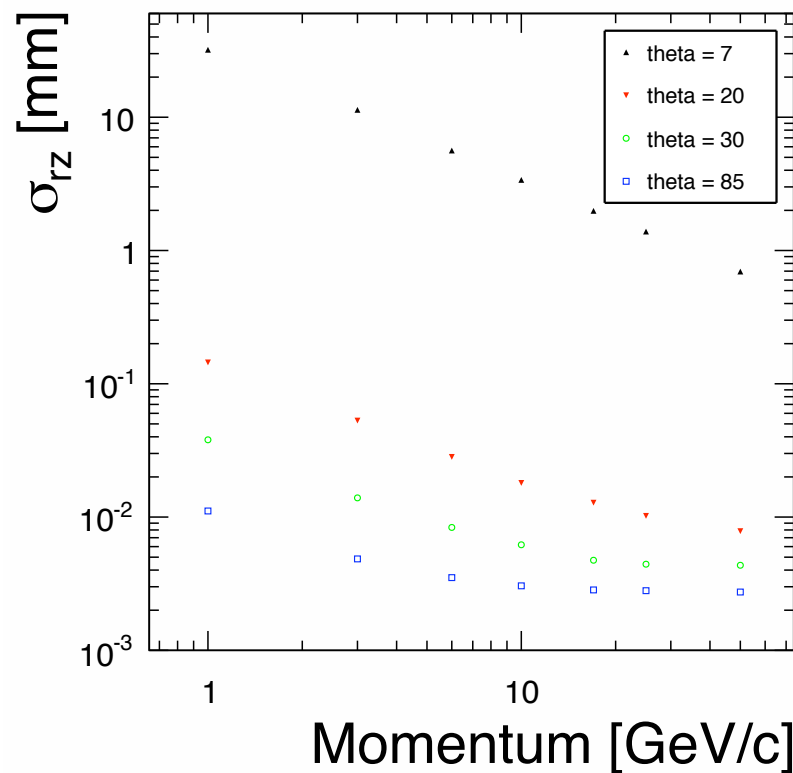- No real development since start of LOI mass production – LCWS08
- A few bug fixes here and there

- available via cvs anonymous check-out or web-based tarball download

Impact Parameter Resolution
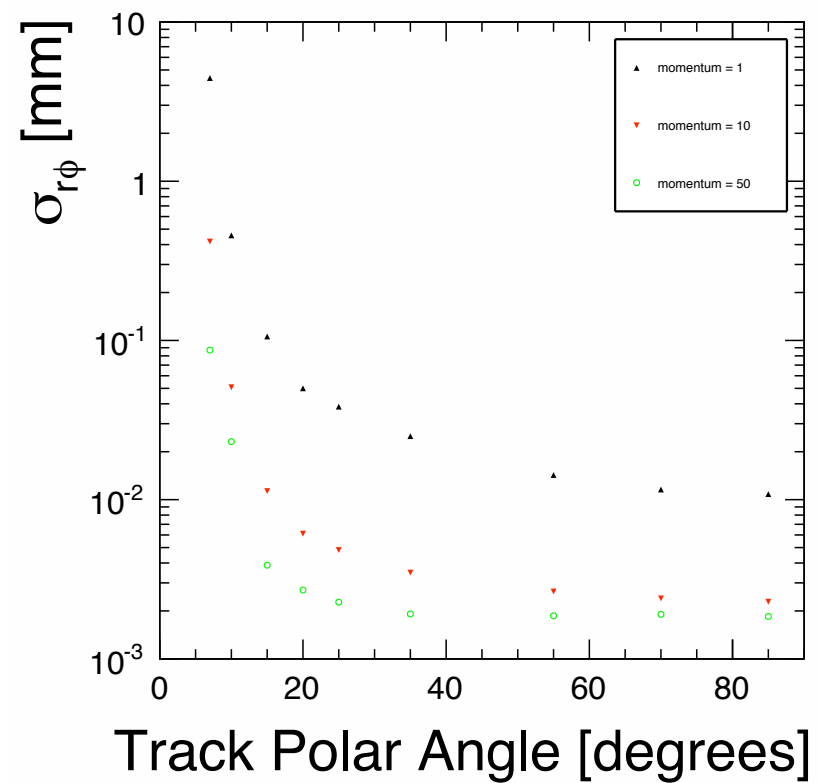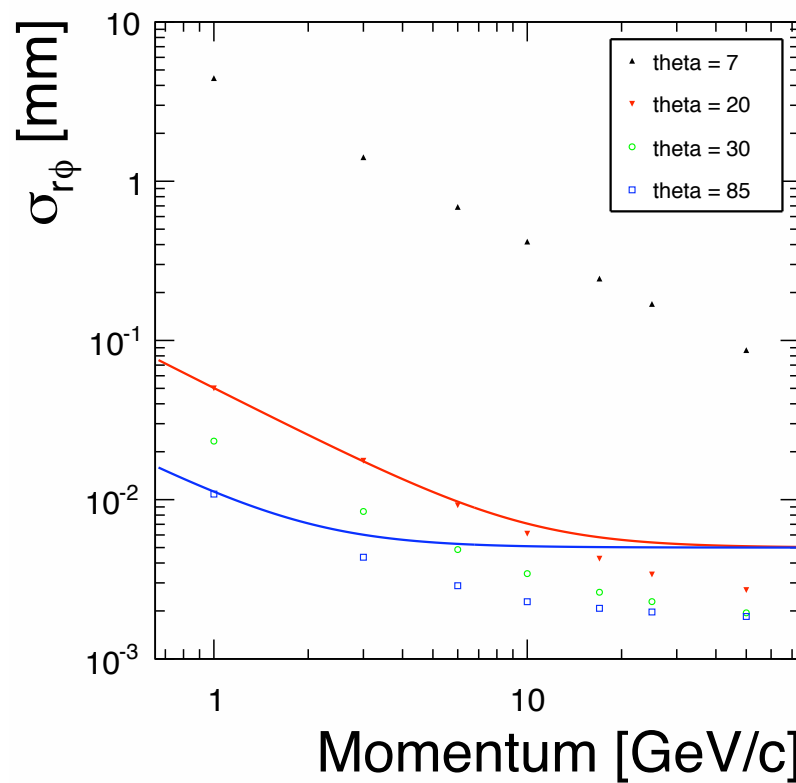
$$\sigma_{1/p} = 5 \oplus 10/(p\ sin^{3/2}\ \theta)$$

Impact Parameter Resolution

Momentum Resolution
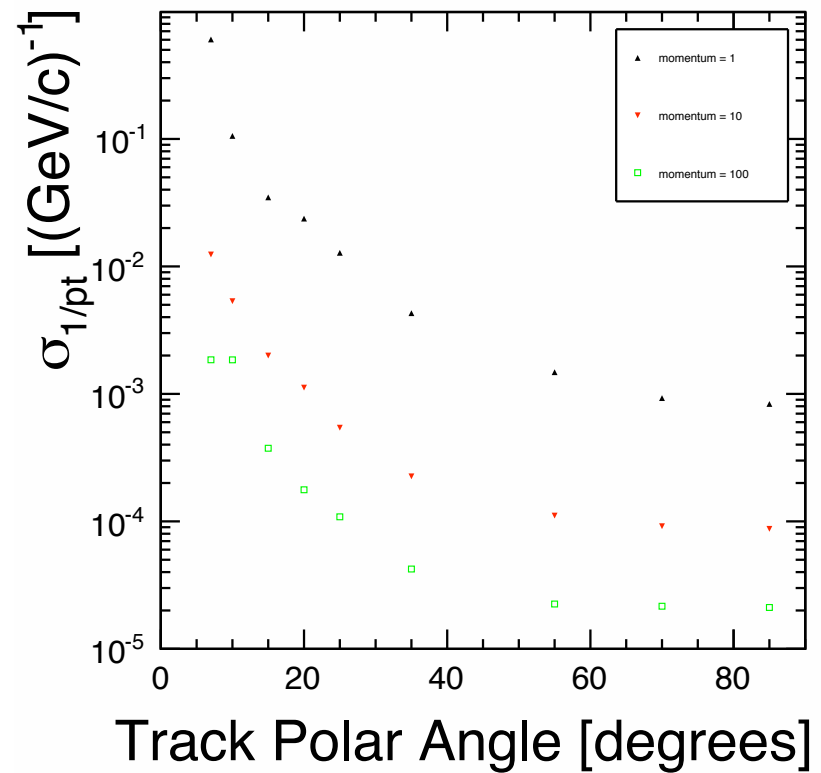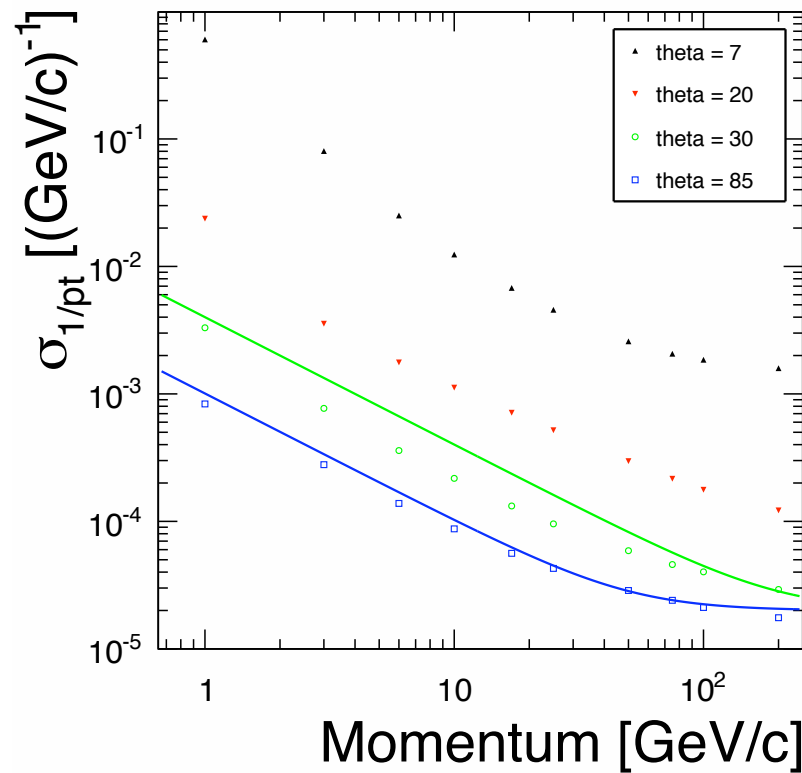
$$\sigma_{1/pt} = 2 \times 10^{-5} \oplus 1 \times 10^{-3} / (pt\ sin\ \theta)$$

Momentum Resolution
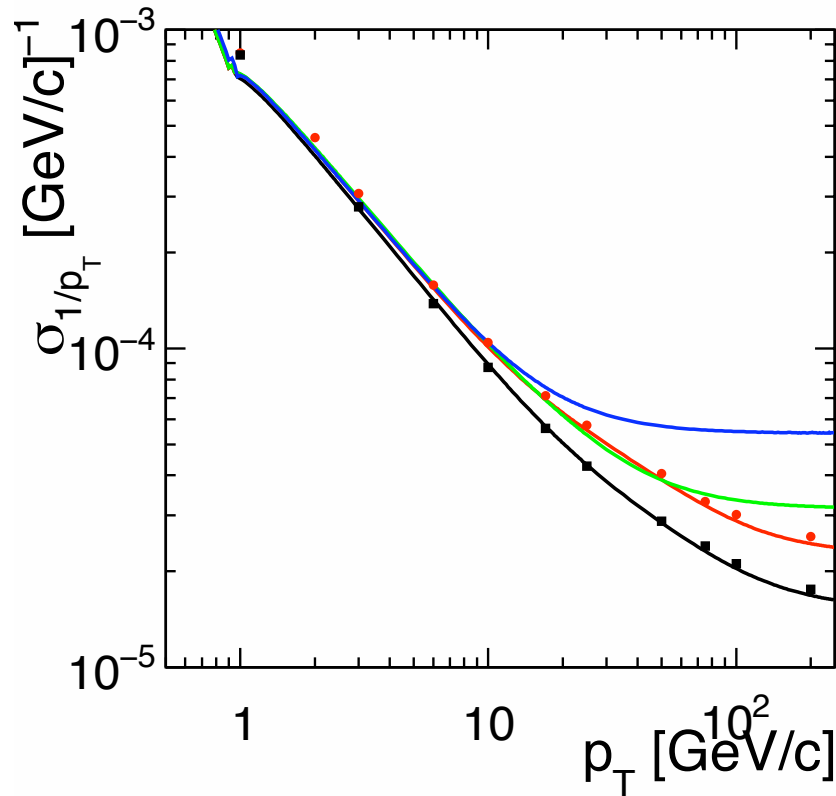
- Comparison of Fast Simulation SVG (M. Berggren) and Full Reconstruction

lines: SGV * 1.1

markers: Full Reconstruction

- ■ — : ILD_00
- ■ — : SET removed
- — : also SIT removed
- — : VXD points not used (ie. TPC alone, with VXD material included)

Track Efficiency vs momentum

ttbar events @ 500 GeV – MCParticles with > 3 tracker hits

log p (GeV)

log pt (GeV)
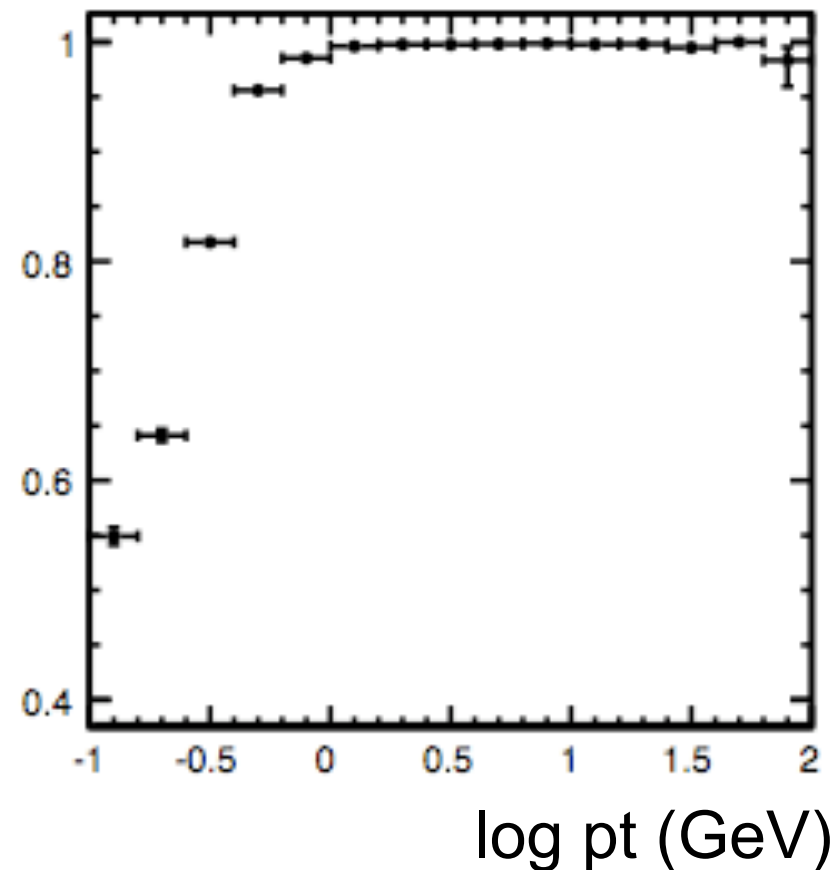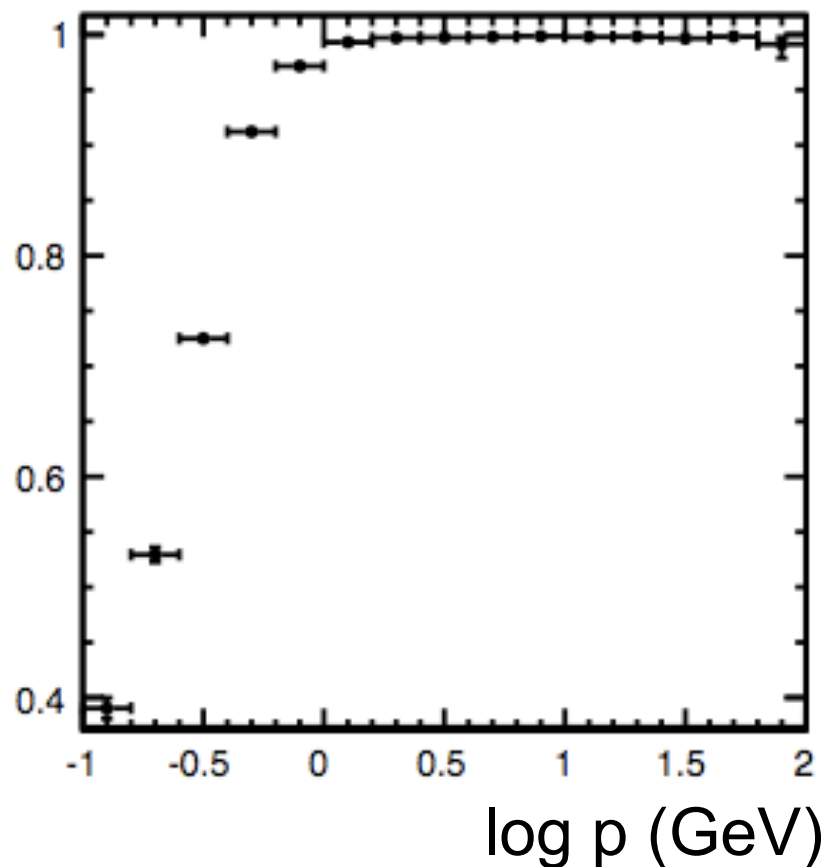
Track Efficiency vs angle

ttbar events @ 500 GeV – MCParticles with > 3 tracker hits
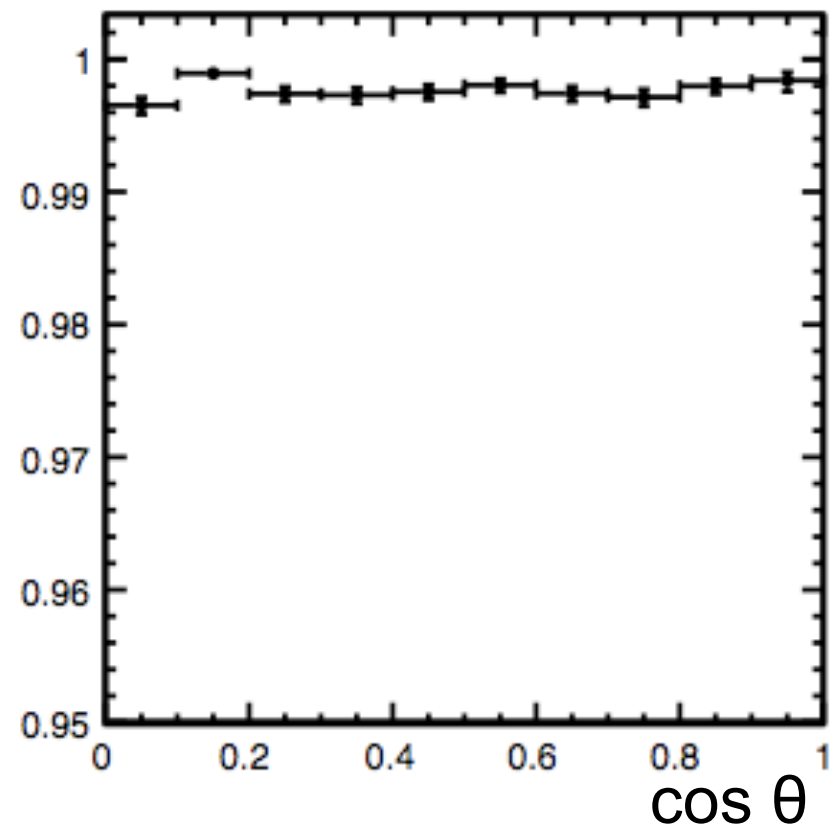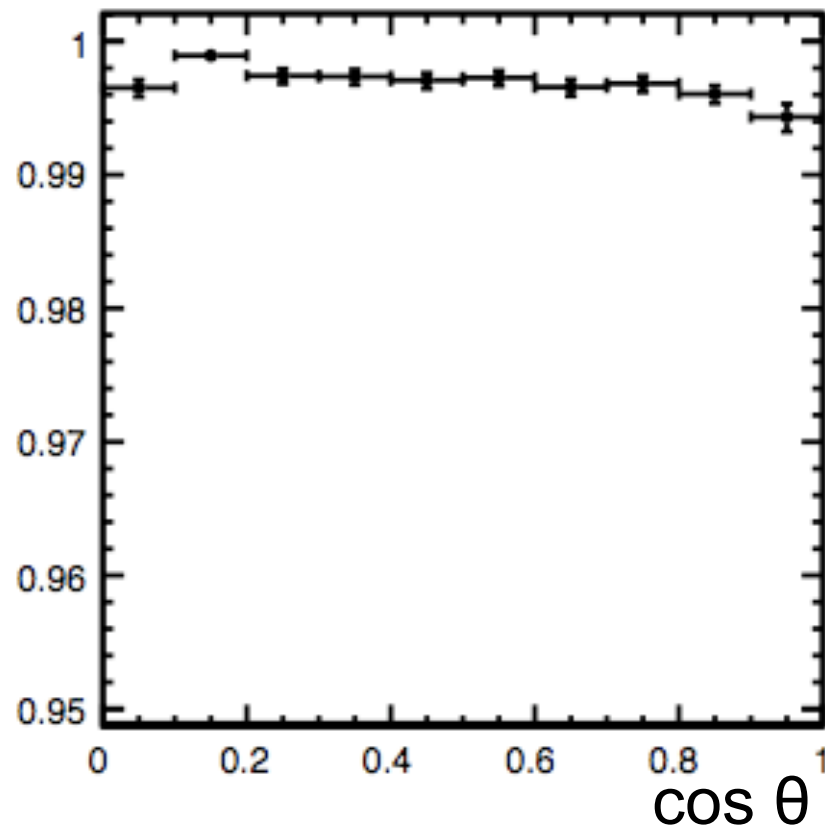
Outstanding Issues

- Background needs to be addressed
- Error Description – impact parameters only determined by the SiTracks due to problems with error determination for FullLDCTracks
- Efficiency at low momentum < 0.5 GeV
- Difficult to manage mixed language code base

Plans

- Background Studies
- Track Model
- MarlinTPC <=> MarlinReco

Plans

- Background Studies
- Track Model
- MarlinTPC <=> MarlinReco

Backup

Model Name		GLD	GLD$'$	GLD4LDC	LDC4GLD	LDC$'$	LDC	ILD
Simulator		Jupiter			Mokka			Mokka
B field (T)		3.0	3.5	4.0	3.0	3.5	4.0	3.5
Beampipe R_{min}		15.0	14.0	13.0	15.5	14.0	13.0	14.5
Vertex	Geometry	cylindrical			ladders			ladders
Detector	Layers	3 doublets			5			3 doublets
	R_{min}	17.5	16.0	15.0	16.5	15.0	14.0	16.0
Barrel	Layers	4 cylinders			2 cylinders			2 cylinders
SIT	Radii	90, 160, 230, 300			161.4, 270.1			165, 309
TPC	R_{min}	437	435	371	371			395
drift	R_{max}	1978	1740	1520	1931	1733	1511	1739
region	z_{max}	2600	2350	2160	2498	2248	2186	2247.5
TPC pad rows		256	217	196	260	227	190	224
ECAL	R_{min}	2100	1850	1600	2020	1825	1610	1847.4
barrel	Layers	33			20(thin)+9(thick)			20+9
	Total X_0	28.4			22.9			23.6
ECAL endcap z_{min}		2800	2250	2100	2700	2300	2550	2450
HCAL	Layers	46	42	37	48			48
barrel	R_{max}	3617	3260	2857	3554	3359	3144	3330
λ_I (ECAL+HCAL)		6.79	6.29	5.67	6.86			6.86