

DBD Benchmarking

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Outline

- ▶ DBD Benchmarks with Baseline Detector
- ▶ Benchmarking for Detector Optimization
- ▶ DBD Benchmark Event Generation

Ron Cassell 2011 Study Using Full Simulation and Reconstruction (slicPandora) of sidloi3:

$$e^+e^- \rightarrow u\bar{u}d\bar{d} \text{ at } \sqrt{s} = 1 \text{ TeV}$$

Full energy W^+W^- / ZZ (no ISR)

■ W^+W^- ■ ZZ

$$e^+e^- \rightarrow W^+W^-, \sqrt{s}=1 \text{ TeV}$$

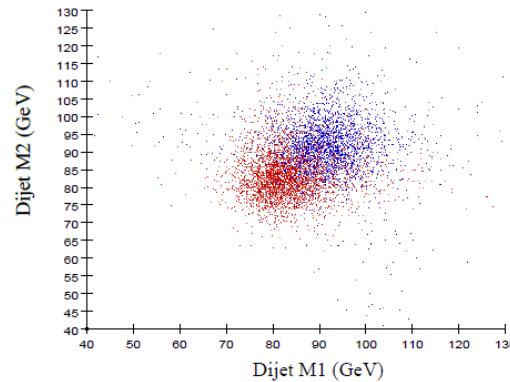
Four Jet Topology

Two Jets Plus Lepton Topology

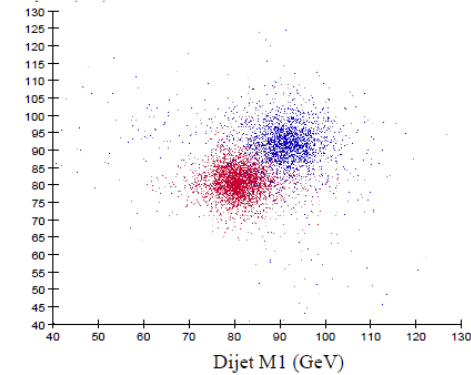
Beam Polarization Measurement

Triple Gauge Couplings

Original Reconstruction



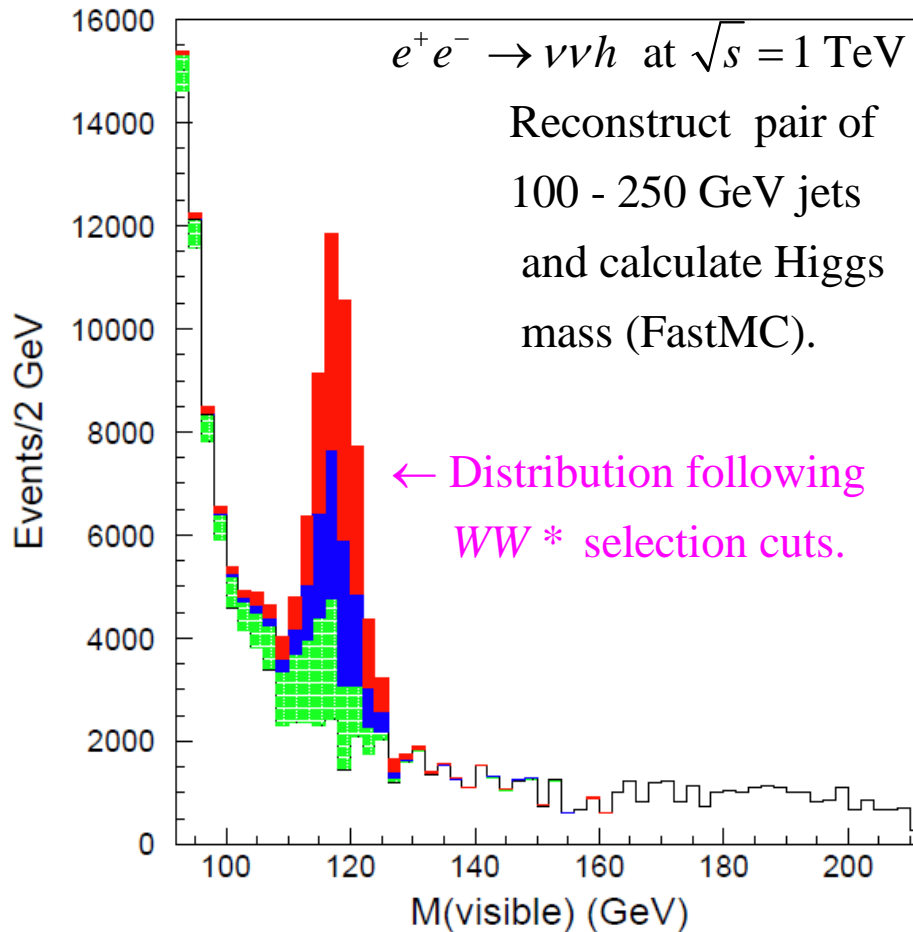
4C Fit + Neutral Hadron E Cut



$E_{\text{cm}}=500 \text{ GeV}$ ILD Study Will Serve as Guide for Beam Pol and WWV Coupling Analysis

Need to Identify a Replacement for Ron to Complete this Study

$$e^+e^- \rightarrow \nu\bar{\nu}H, H \rightarrow \mu^+\mu^-, b\bar{b}, c\bar{c}, gg, WW^*, \sqrt{s}=1 \text{ TeV}$$



- $h \rightarrow WW^*$
- $h \rightarrow gg$
- $h \rightarrow b\bar{b}, c\bar{c}$
- non Higgs bgnd*

Barklow, hep-ph/0312268

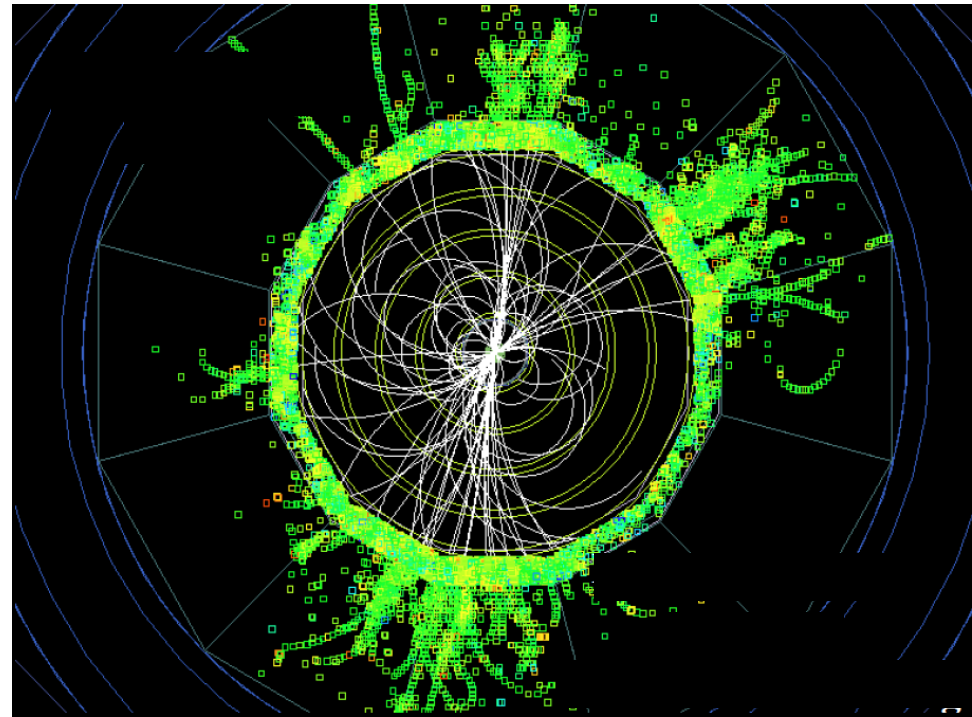
- Marcel Stanitzki has experience with gg and WW^* modes
- Jan Strube and Marcel Stanitzki did the LOI analysis of $\mu^+\mu^-$
- LCFIvertexPlus very important for $c\bar{c}$ & $b\bar{b}$
- Hope to use gg and WW^* modes for Detector Optimization

$$e^+e^- \rightarrow t\bar{t}H, \sqrt{s}=1 \text{ TeV}$$

Eight Jet Topology

Six Jets Plus Lepton Topology

Top Yukawa Coupling Measurement



- This is nearly uncharted water for ILC analyses
- Personnel-wise we are in the best shape with this benchmark since Jan Strube and Philipp Roloff will be doing this analysis
- LCFIvertexPlus very important for this analysis

$$e^+e^- \rightarrow \tau^+\tau^-, \sqrt{s}=500 \text{ GeV}$$

Cross Section and A_{FB} Precision

Tau Decay Mode Efficiencies and Purities

Tau Polarization

We must redo one LOI analysis using the DBD detector. Until recently we said we would redo the tau analysis. With Ron's departure it might make more sense to do the ttbar analysis or even the Higgs recoil.

A ttbar analysis would enable a comparison of ILD, CLIC-ILD and SiD since CLIC-ILD has recently done a ttbar analysis at $\sqrt{s} = 500 \text{ GeV}$ and ILD plans to do ttbar for the DBD. We might be able to pull it off since Andrei Nomerotski has expressed a desire to participate in the DBD benchmarking exercise. However, he is not in a position at this time to make a commitment.

Benchmarking for Detector Optimization

Goal is to measure BR errors for $H \rightarrow gg, WW^*$ using $e^+e^- \rightarrow \nu\nu H$ at $\sqrt{s} = 1 \text{ TeV}$ for several different detector configurations such as sidloi3 and sidloi3 $\pm 1\lambda$

Ron and I had been developing this analysis using fully simulated and reconstructed signal and background. FastMC studies had indicated that the dominant backgrounds were $H \rightarrow bb$, $e^+e^- \rightarrow e\nu qq$, $e^- \gamma \rightarrow \nu qq$. We had done full simulation and reconstruction with sidloi3 on 100,000 $e^+e^- \rightarrow \nu\nu H$ events and several million $e^+e^- \rightarrow e\nu qq$, $e^- \gamma \rightarrow \nu qq$ events. We were in the process of determining whether or not a generator level filter could be used to reduce the number of background events we had to process since even several million $e^+e^- \rightarrow e\nu qq$, $e^- \gamma \rightarrow \nu qq$ events represent only a small fraction of the events at 1 ab^{-1}

Present plan is to proceed with full simulation and reconstruction of signal events with different detector configurations so that we can at least get Higgs mass reconstruction plots in the next couple of months. We will try to identify another person to work on the analysis.

- ▶ DBD Benchmark Event Generation (ILC Common Generation)
 - Compared to LOI there are new event generation features such as flavor sums and off-diagonal CKM $W_{ff'}$ vertices. These have been successfully tested in CLIC event generation.
 - Guinea-Pig to WHIZARD interface files for B1b with TF have been completed
 - WW, $\nu\nu H$ and ttH signals: Trivial to generate, but DBD generation is currently held up by a few unresolved details involving a common file storage system and event generation data base for events generated at SLAC, KEK and DESY.
 - 2-4-6 fermion SM Background: a little bit of everything will be generated – just as was done for LOI. More SM background statistics can be generated with restricted phase space at the request of benchmarking groups. $ee \rightarrow 2f$ and $ee \rightarrow 4f$ will be done at DESY; high p_T $\gamma\gamma \rightarrow 2f$, $e\gamma \rightarrow e + 2f$ will be done at SLAC; $ee \rightarrow 6f$ will be done at SLAC and CERN
 - $ee \rightarrow ttbb$ & ttZ 8f background will be done at KEK
 - $\gamma\gamma$ mini-jet events (high p_T subprocesses involving quark & gluon constituents of photons) will be generated separately – they slipped through the cracks in LOI generation; to be generated at SLAC
 - Low p_T , high cross section $\gamma\gamma \rightarrow$ hadrons production for event overlay will be done at SLAC
 - Maximum stdhep file size has been reduced from 2GB to 0.5 GB.

▶ DBD Benchmark Event Simulation and Reconstruction

- We will overlay $\gamma\gamma \rightarrow$ hadrons background on all events, integrating over one bunch crossing
- Stdhep files with 100% beam polarization will be used as input to the event simulation and reconstruction. Physics analysis groups will then have to mix the fully reconstructed Lcio files to obtain the proper polarization. This is done in part so that systematic effects in the WW measurement of beam polarization can be studied.

SiD LOI Benchmarking

$\sqrt{s} = 500 \text{ GeV SM Bgnd}$

Process	$\sigma(\text{fb})$	Lumi (fb^{-1})	# Events
	$pol_{e^-/e^+} = \mp 80/\pm 30\%$		
$e^+e^- \rightarrow e^+e^-$	1.74×10^7	0.04	696435
$\gamma\gamma \rightarrow f\bar{f}$	5.55×10^6	0.10	554700
$e\gamma \rightarrow e\gamma$	1.74×10^6	0.10	172119
$e\gamma \rightarrow e f \bar{f}, \nu f \bar{f}$	2.59×10^5	4.00	1034034
$e^+e^- \rightarrow \gamma\gamma$	2.60×10^4	2.00	51974
$e^+e^- \rightarrow f\bar{f}f\bar{f}$	1.90×10^4	140.00	2665962
$e^+e^- \rightarrow \mu^+\mu^-, \tau^+\tau^-, q\bar{q}$	1.85×10^4	50.00	924384
$e^+e^- \rightarrow \nu\bar{\nu} + n\gamma$	1.31×10^4	40.00	522449
$e^+e^- \rightarrow \gamma\gamma, \gamma\gamma\gamma$	1.46×10^3	20.00	29166
$e^+e^- \rightarrow f\bar{f}f\bar{f}f\bar{f}$	7.32×10^2	500.00	366070
$\gamma\gamma \rightarrow f\bar{f}f\bar{f}$	2.32×10^2	500.00	115914
$e\gamma \rightarrow f\bar{f}f\bar{f}f\bar{f}$	1.14×10^2	500.00	56875
$\gamma\gamma \rightarrow t\bar{t}, e\gamma \rightarrow \nu b\bar{t}, e\bar{t}\bar{t}$	2.56×10^0	500.00	1282
Total			7191364

We must produce a similar table of cross sections and numbers of events to generate for $\sqrt{s} = 1 \text{ TeV}$ in the next few weeks.

Summary

- ▶ SiD is in good shape for DBD analysis of $v\bar{v}H$ and $t\bar{t}H$
- ▶ We must identify personnel to help with validation of reconstructed Lcio files and with electron, muon and photon identification.
- ▶ We must identify personnel for the DBD analysis of WW.
- ▶ We must quickly identify personnel for a detector optimization analysis of $h \rightarrow gg, WW$ if we want the detector optimization completed by spring 2012.
- ▶ SiD should push hard to make LCFIVertexPlus work with SiD events.
- ▶ ILC Common Data Sample group has a lot of work over the Christmas holiday to get the event generation machinery going, and to determine the exact number of SM background processes to generate.