Future SiD Benchmarking Studies

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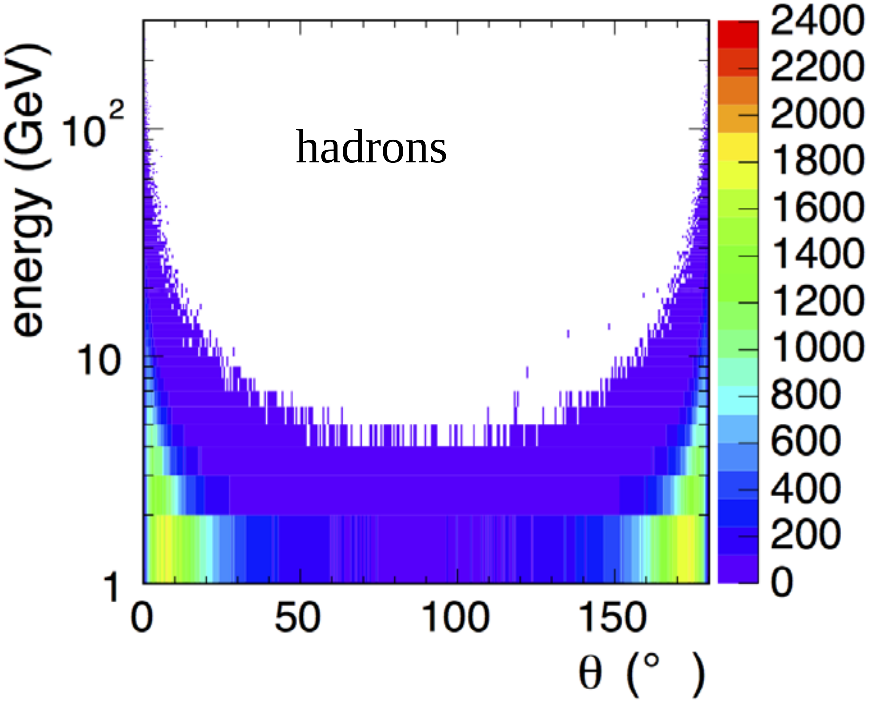
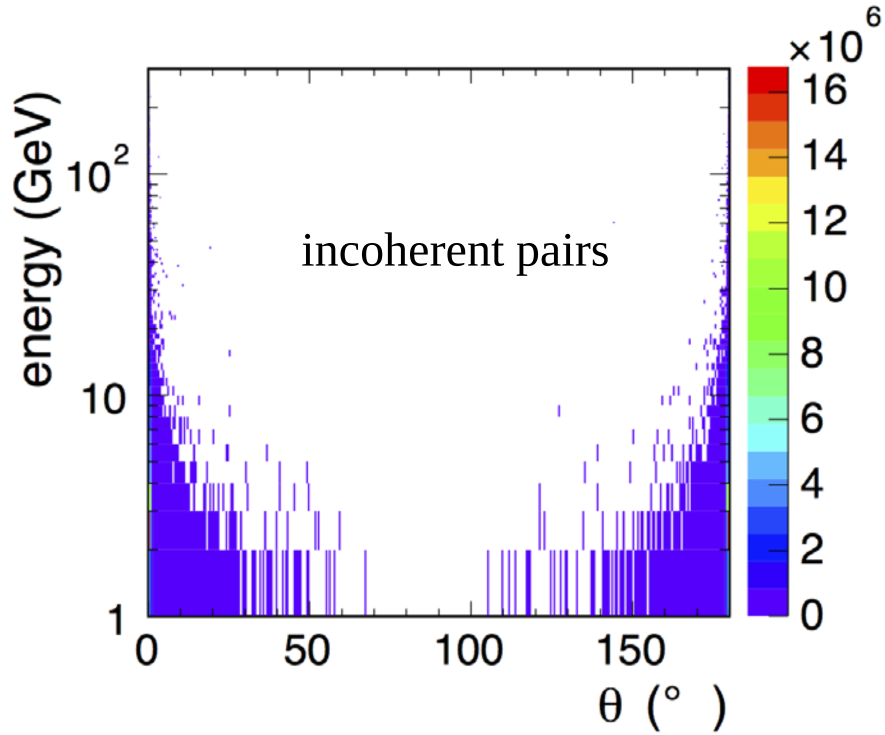
Possible Future SiD Benchmarking Studies

- Low angle electron tagging of $\gamma\gamma$ processes
- Study the possibility of starting the Higgs physics program at $\sqrt{s} = 350$ GeV instead of $\sqrt{s} = 250$ GeV.
- Expand invisible Higgs decay mode analysis to include general BSM Higgs decays, and include the searches for invisible and BSM decays in total width analysis.
- Improve $h \to ZZ^*$ analysis.
- Develop beam energy, luminosity and polarization analyses using extraction line instruments and well understood physics processes.
- Detector optimization benchmarks.

Angular distribution of background





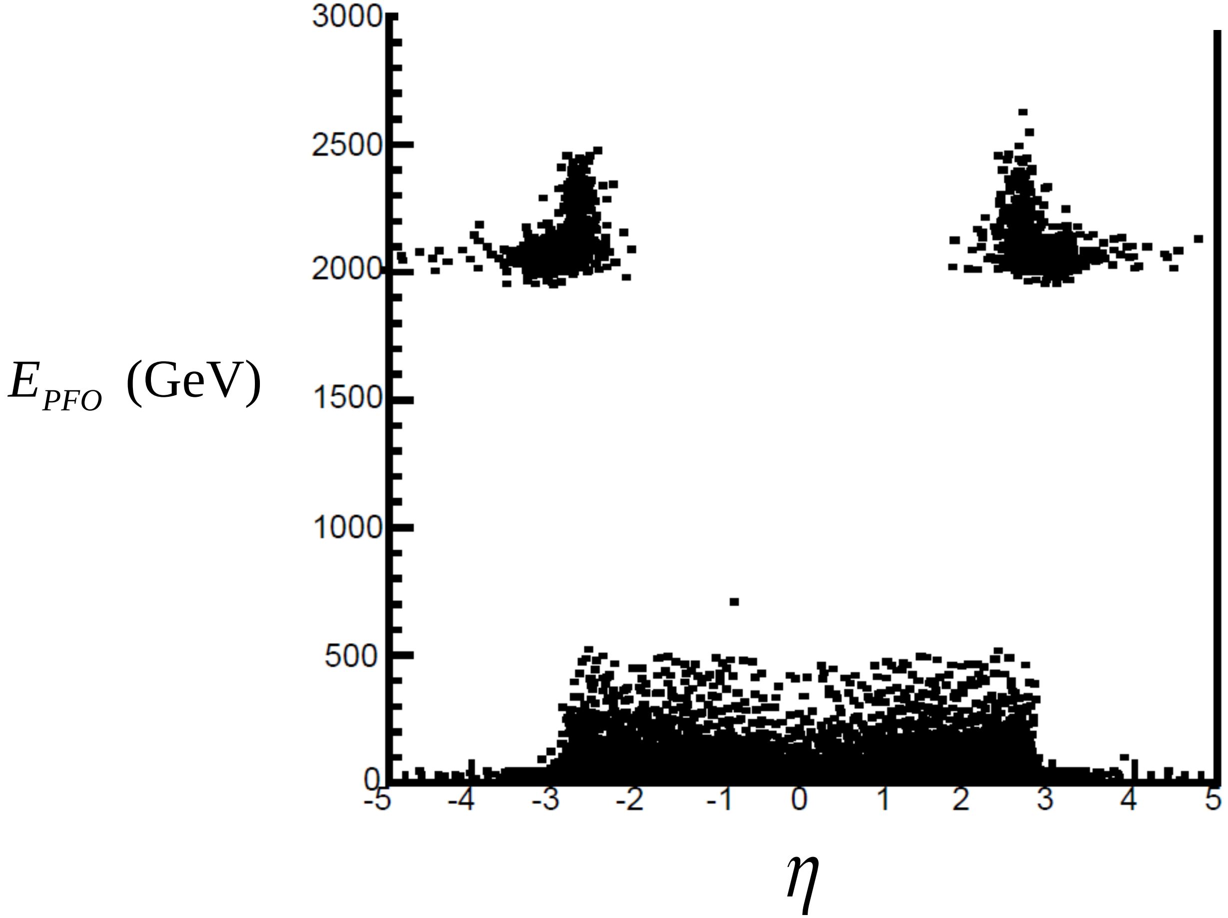
Incoherent pairs affect mostly occupancies and tracking efficiencies

Hadrons have enough energy to reach the calorimeter

Two large energy PFO's at large η

created each event by incoherent e^+e^- pairs.

Remove with cuts on E_{PFO} and η



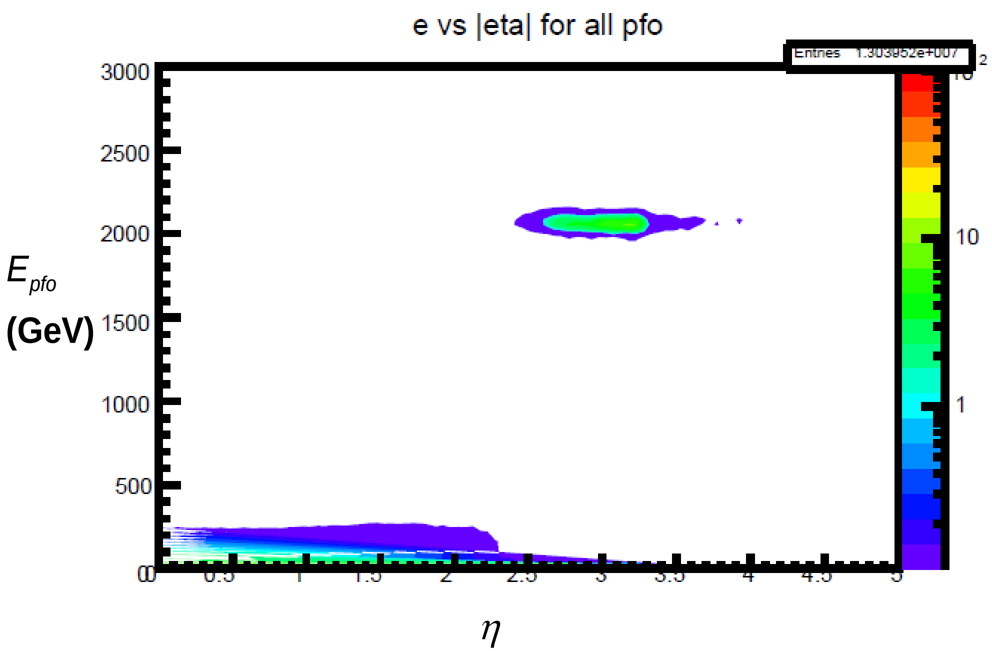
4

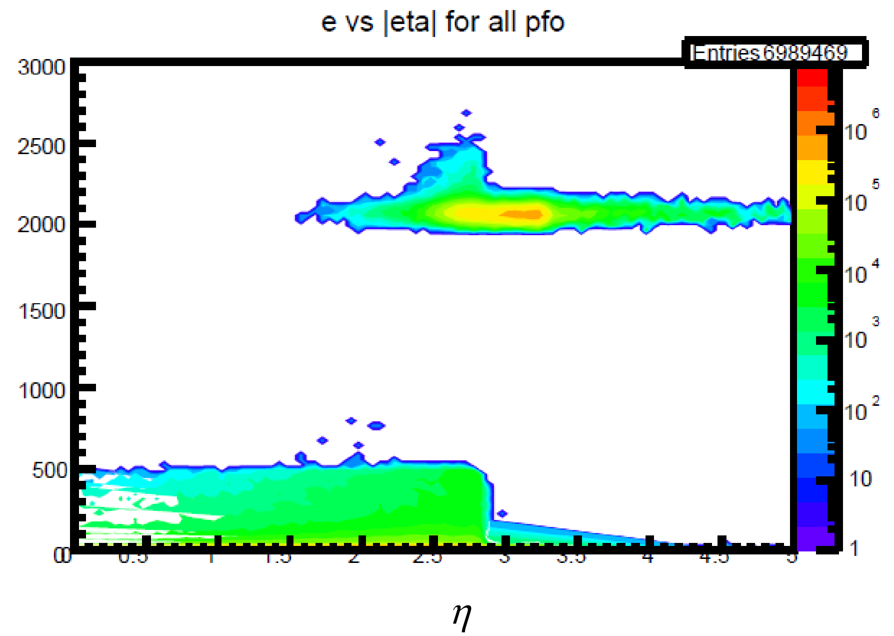
SiD *ffh_mumu*

$e^+e^- \rightarrow \nu_e\bar{\nu}_e h \rightarrow \nu_e\bar{\nu}_e \mu^+\mu^-$

SiD *4f_sze_l*

$e^+e^- \rightarrow e^+e^-\mu^+\mu^-$





Goal of new study is to do a proper analysis of the beamcal data and pull forward electrons out of the several TeV energy deposit. Then perform physics benchmark analyses that benefit from $\gamma\gamma$ vetoing such as $e^+e^- \rightarrow \nu_e\bar{\nu}_e h$, $e^+e^- \rightarrow \tilde{\tau}^+\tilde{\tau}^-$, etc.

If you look at the ILC Higgs results following 3 Snowmass years at the baseline luminosity at $\sqrt{s} = 250$ GeV, you don't see a big improvement relative to HL-LHC. It is only after running at $\sqrt{s} = 500$ GeV to get $\sigma \bullet BR(\nu_e \bar{\nu}_e h \rightarrow \nu_e \bar{\nu}_e b\bar{b})$ that we see a decent gain. Why not start at $\sqrt{s} = 350$ GeV where we can get all of σ(ZH), $\sigma \bullet BR(Zh \rightarrow Zxx)$, and $\sigma \bullet BR(\nu_e \bar{\nu}_e h \rightarrow \nu_e \bar{\nu}_e b\bar{b})$? (And measure $t\bar{t}$ threshold)

7 Parameter HXSWG Benchmark

Mode	LHC 300 fb^{-1}	LHC 3000 fb^{-1}	ILC(250)	ILC(500)
$\sqrt{s}$ (GeV)			250	250+500
L (fb^{-1})			250	250+500
$\gamma\gamma$	$(5-7)\%$	$(2-5)\%$	17 %	8.3 %
gg	$(6-8)\%$	$(3-5)\%$	6.1 %	2.0 %
WW	$(4-5)\%$	$(2-3)\%$	4.7 %	0.4 %
ZZ	$(4-5)\%$	$(2-3)\%$	0.7 %	0.5 %
$t\bar{t}$	$(14-15)\%$	$(7-10)\%$	6.4 %	2.5 %
$b\bar{b}$	$(10-13)\%$	$(4-7)\%$	4.7 %	1.0 %
$\tau^+\tau^-$	$(6-8)\%$	$(2-5)\%$	5.2 %	1.9 %

Model independent fit of total Higgs width is based solely on $\sigma \bullet BR$ for SM Higgs decays and does not include limits on direct searches for invisible decays are other non-SM Higgs decays. The total width precision can be improved significantly if the search results are included.

Table 9.1. Summary of expected accuracies $\Delta g_i/g_i$ for model independent determinations of the Higgs boson couplings. The theory errors are $\Delta F_i/F_i = 0.1\%$. For the invisible branching ratio, the numbers quoted are 95% confidence upper limits.

	ILC(250)	ILC(500)	ILC(1000)	ILC(LumUp)
$\sqrt{s}$ (GeV)	250	250+500	250+500+1000	250+500+1000
L (fb^{-1})	250	250+500	250+500+1000	1150+1600+2500
$\gamma\gamma$	18 %	8.4 %	4.0 %	2.4 %
gg	6.4 %	2.3 %	1.6 %	0.9 %
WW	4.8 %	1.1 %	1.1 %	0.6 %
ZZ	1.3 %	1.0 %	1.0 %	0.5 %
$t\bar{t}$	–	14 %	3.1 %	1.9 %
$b\bar{b}$	5.3 %	1.6 %	1.3 %	0.7 %
$\tau^+\tau^-$	5.7 %	2.3 %	1.6 %	0.9 %
$c\bar{c}$	6.8 %	2.8 %	1.8 %	1.0 %
$\mu^+\mu^-$	91%	91%	16 %	10 %
$\Gamma_T(h)$	12 %	4.9 %	4.5 %	2.3 %
hhh	–	83 %	21 %	13 %
BR(invis.)	< 0.9 %	< 0.9 %	< 0.9 %	< 0.4 %