

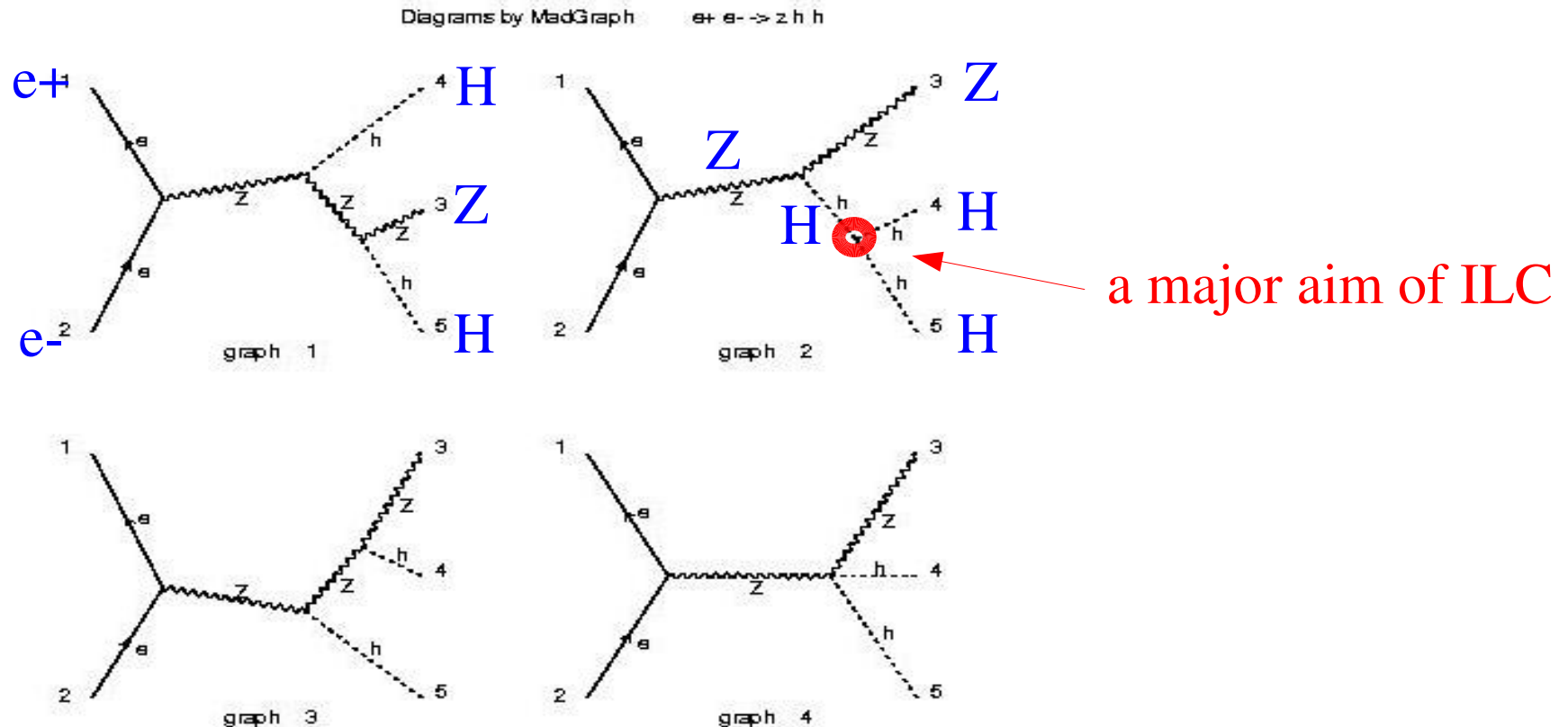
Measurement of $g(\text{HHH})$

generator level & first quicksim studies

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all rather preliminary

several groups looking at measurement of $g(\text{HHH})$ in

$m_{\text{H}} = 120 \text{ GeV}$ scenario, via *e.g.* $e^+e^- \rightarrow \text{ZHH}$

recently started to investigate more challenging case:

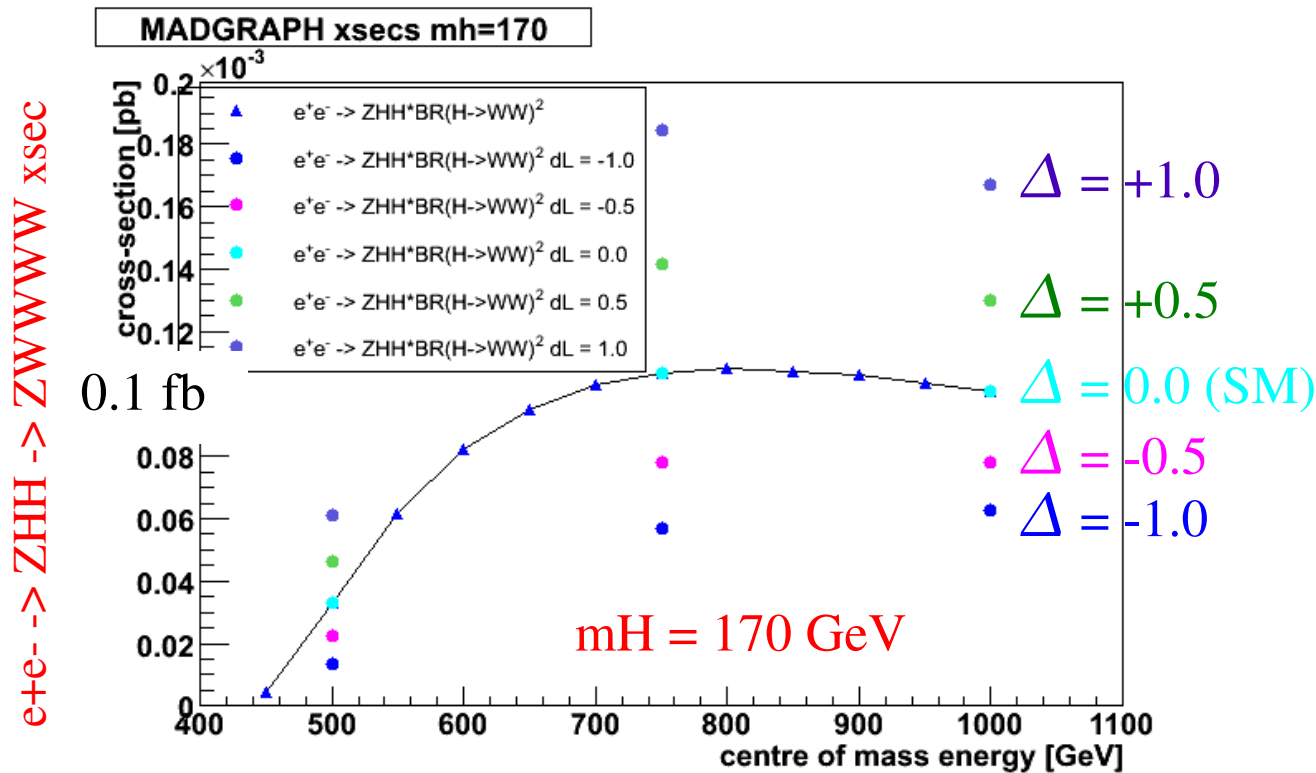
$m_{\text{H}} = 170 \text{ GeV}$, $e^+e^- \rightarrow \text{ZHH}$

predominant decay mode $\text{ZHH} \rightarrow \text{ZWWWW} \rightarrow 10f$

using MADGRAPH generator

implement anom. HHH coupling: $g(\text{HHH}) = (1+\Delta)*g_{\text{SM}}(\text{HHH})$

ZHH total cross-section sensitive to $g(\text{HHH})$

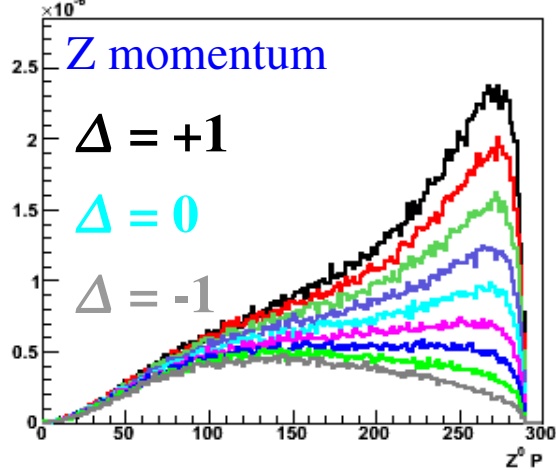


maximum xsec $\sim 750 \text{ GeV}$
 maximum $d(\text{xsec})/d(g_{\text{HHH}}) \sim 750 \text{ GeV}$

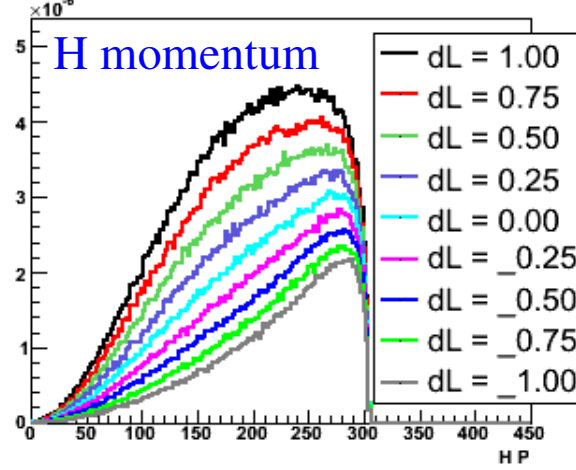
generator level studies

$$m_H = 170 \text{ GeV}, E_{\text{COM}} = 750 \text{ GeV}$$

zhh_750_anom1.00_z_p



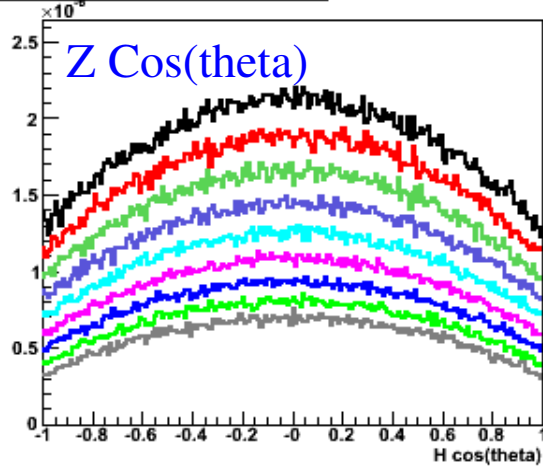
zhh_750_anom1.00_h_p



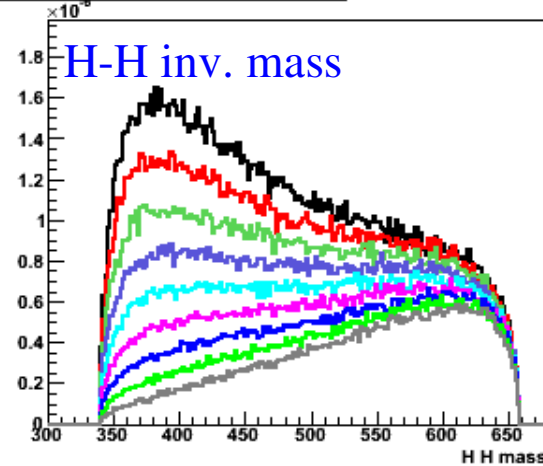
shape of kinematic distributions also sensitive to g (HHH)

- HH mass from $gHHH$ diagram pulled low by propagator

zhh_750_anom1.00_h_costh



zhh_750_anom1.00_mass_hh



- this affects Z momentum
maybe easier to measure?

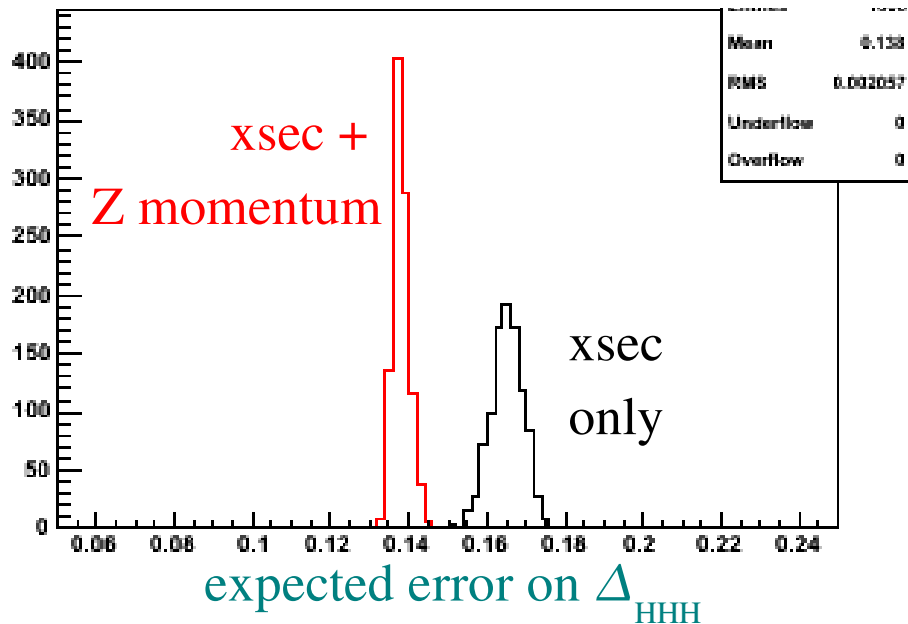
usefulness of kinematic/xsec information

generator-level, signal-only pseudo-experiments

- xsec only
- xsec + Z momentum distribution
(max. likelihood fit)
- 1 ab⁻¹ data

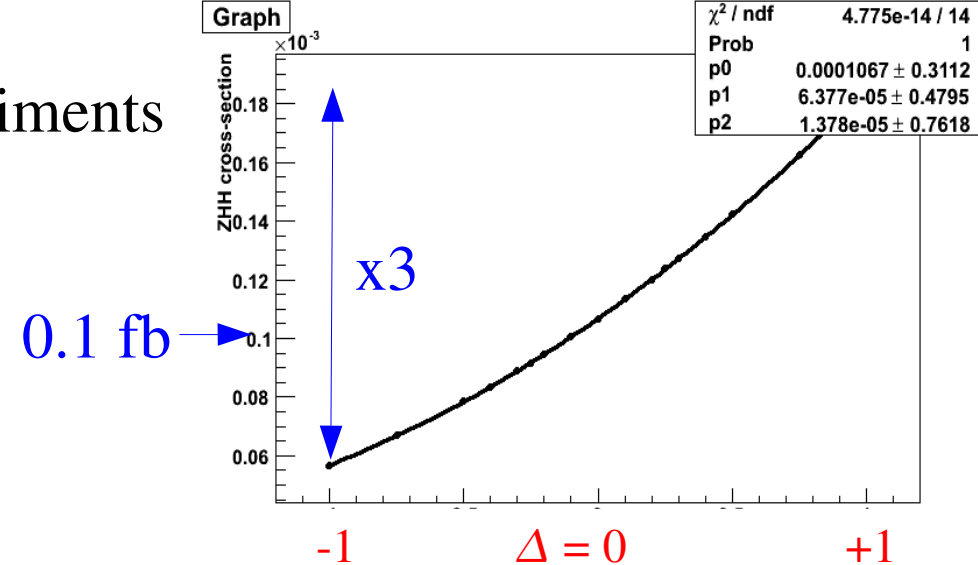
1000 1 ab⁻¹ pseudoexperiments @ $\Delta_{HHH} = 0$

m_H=170 GeV, E_{COM} = 750 GeV

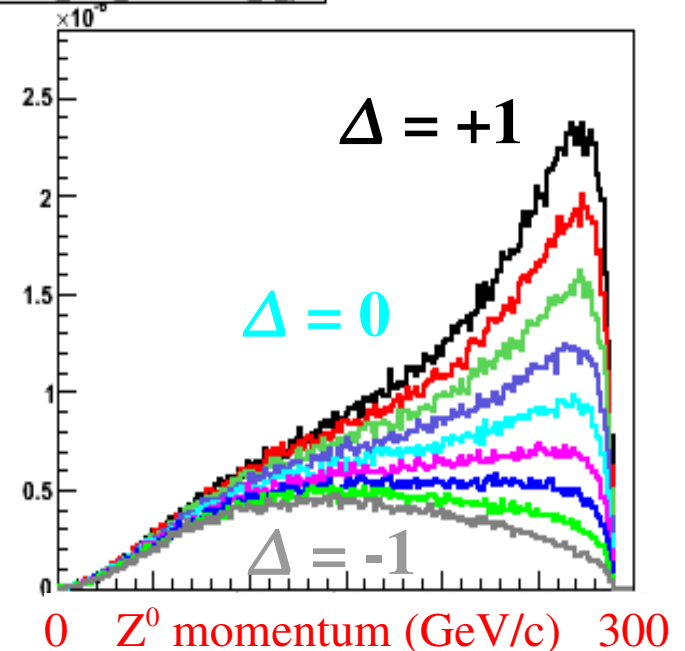


ZHH cross-section vs. Δ

(E_{COM} = 750 GeV, m_H = 170 GeV)



zhh_750_anom1.00_z_p



quicksim studies

$e^+e^- \rightarrow ZHH \rightarrow ZWWWW \rightarrow 10f$

many different final states:

- from 4 charged leptons + neutrinos
- to 10 quarks

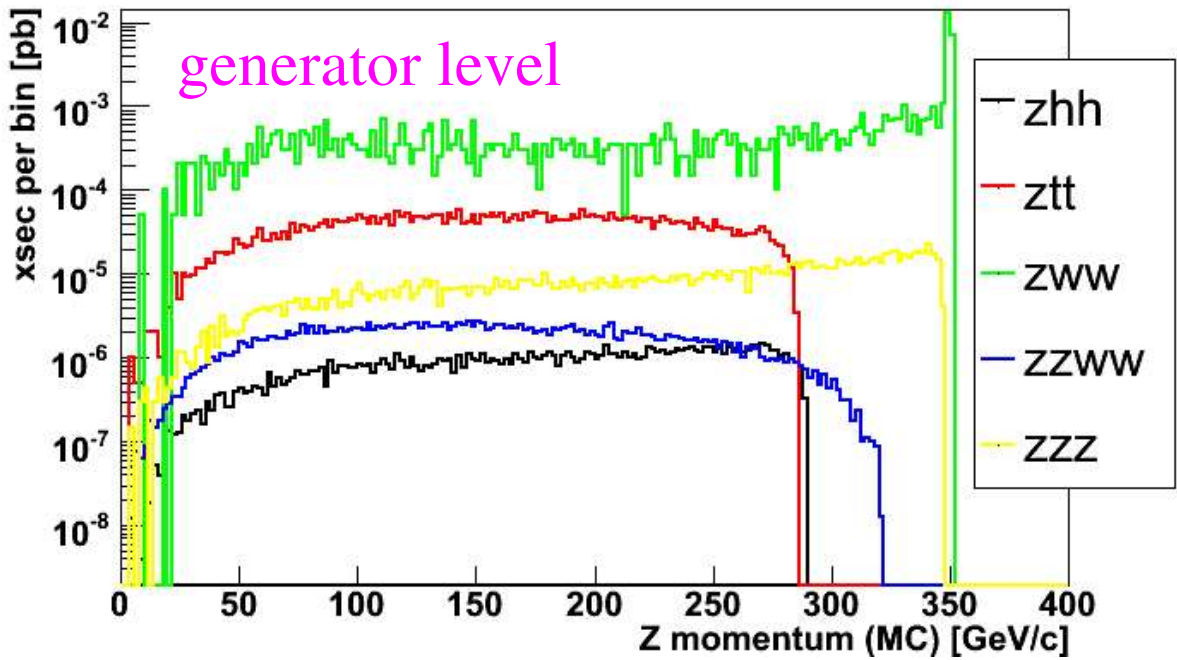
many background processes:

- initially consider a few processes with true Z^0 :
 $Ztt, ZWW, ZZZ, ZZWW$

for now, use very simple b-tagging

- angular match to b-quark + 10% inefficiency

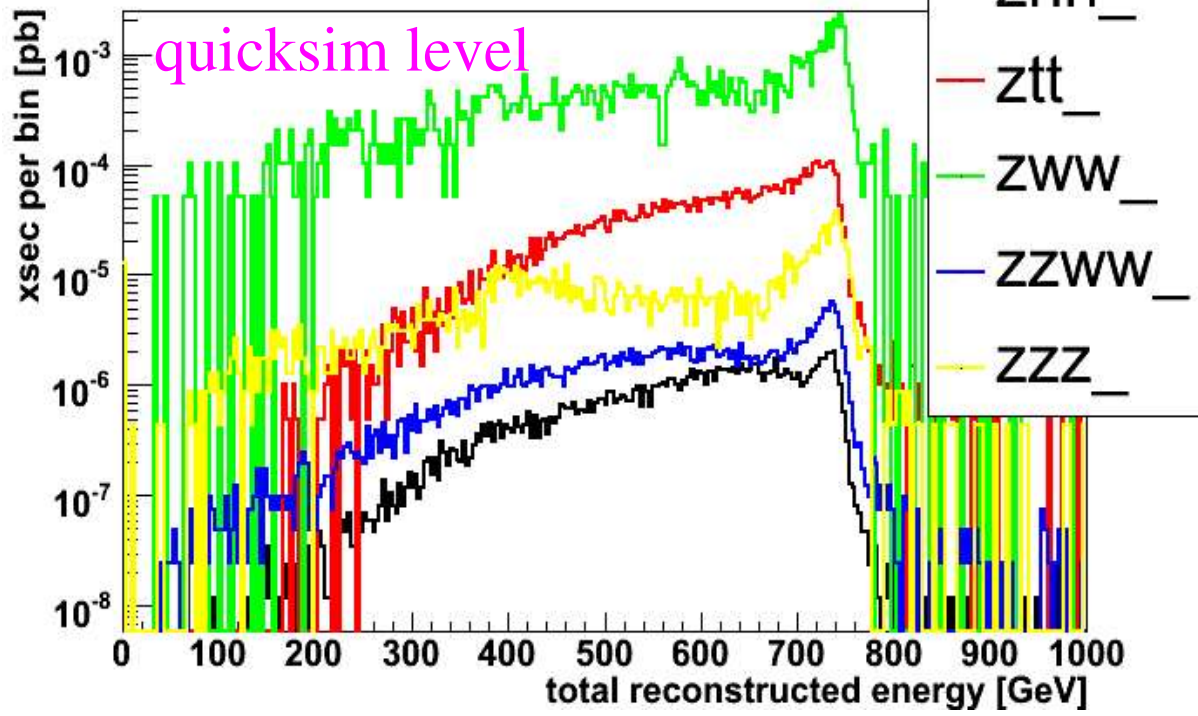
zhh_ZpMC



these backgrounds are orders of magnitude larger than signal:

	xsec [fb]
ZHH	0.12

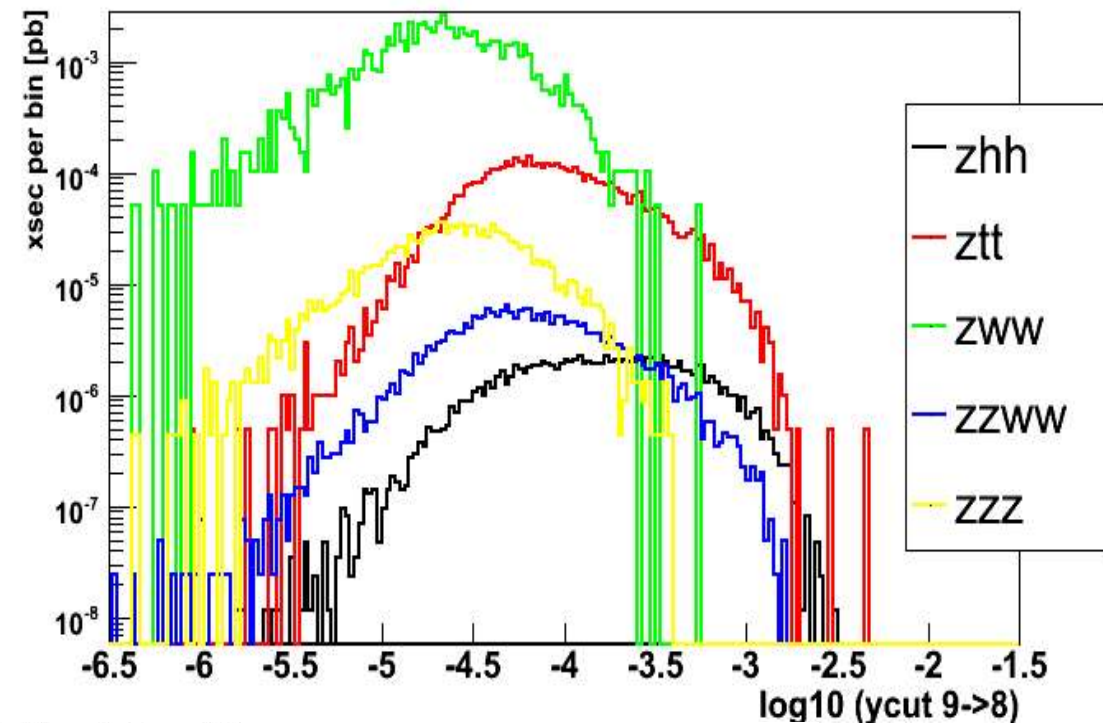
zhh_totalE



ZWW	81.2
Ztt	5.0
ZZZ	1.3
ZZWW	0.25

not trivial to distinguish

zhh_logycut8

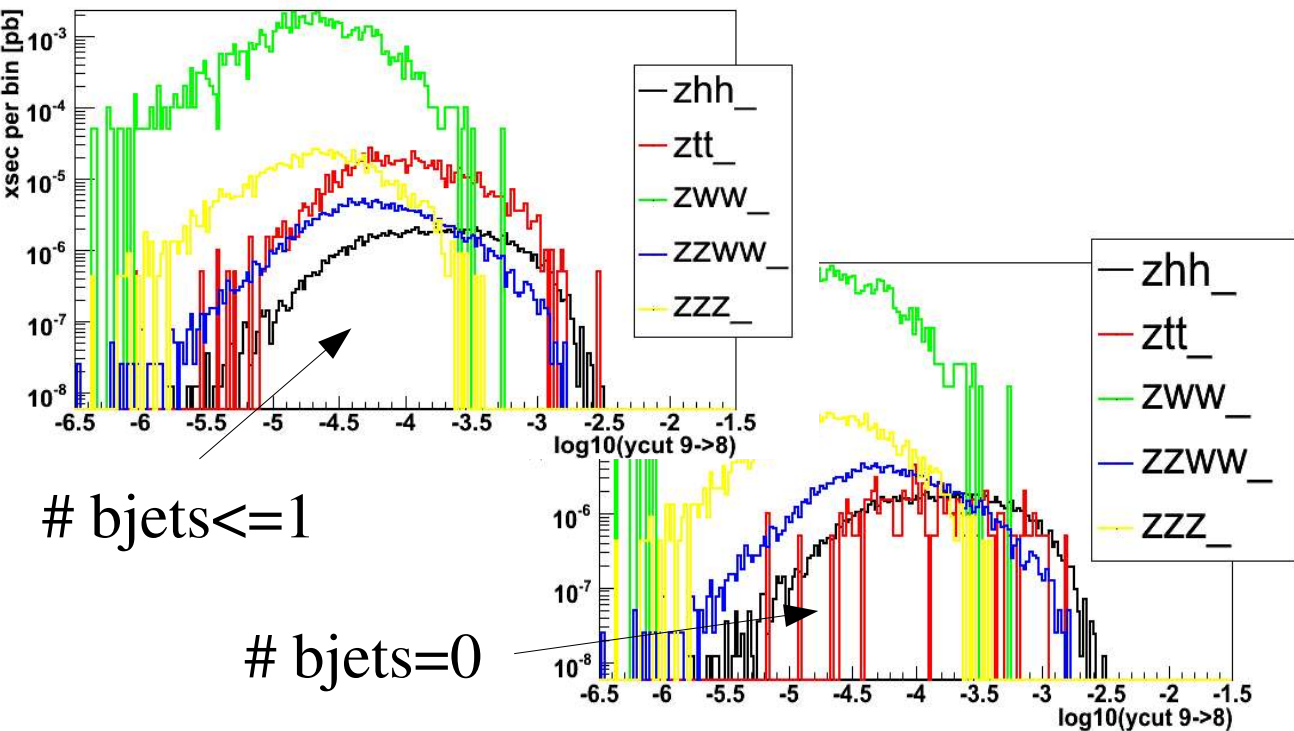


event shape variables

for example, Y_{cut} at which event goes from 9->8 jets

still large backgrounds

zhh_nob_logycut8



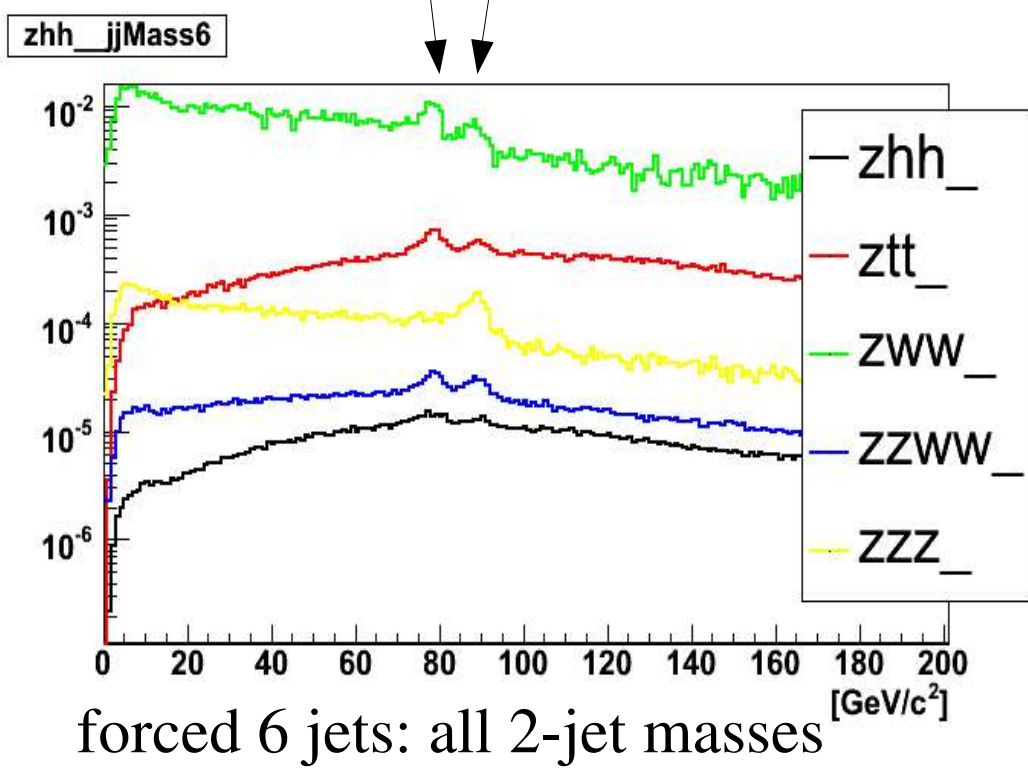
try anti-b cut to reduce top backgrounds

require < 2 or 1 b jets

n.b. $V_{cb} = 0$ in this simulation

significant reduction in Ztt

W Z



developing constrained kinematic fits for different event hypotheses

try to use fit χ^2 in event selection

many final state objects
=> large combinatorial background

← e.g. jet-jet mass

not easy... work in progress

summary

$g(\text{HHH})$ measurement at $m_{\text{H}} = 170 \text{ GeV}$

both production xsec and kinematic distributions of $e+e^- \rightarrow \text{ZHH}$ are sensitive to this parameter

ECOM $\sim 750 \text{ GeV}$ looks suitable for this m_{H}

many different final states

several huge backgrounds

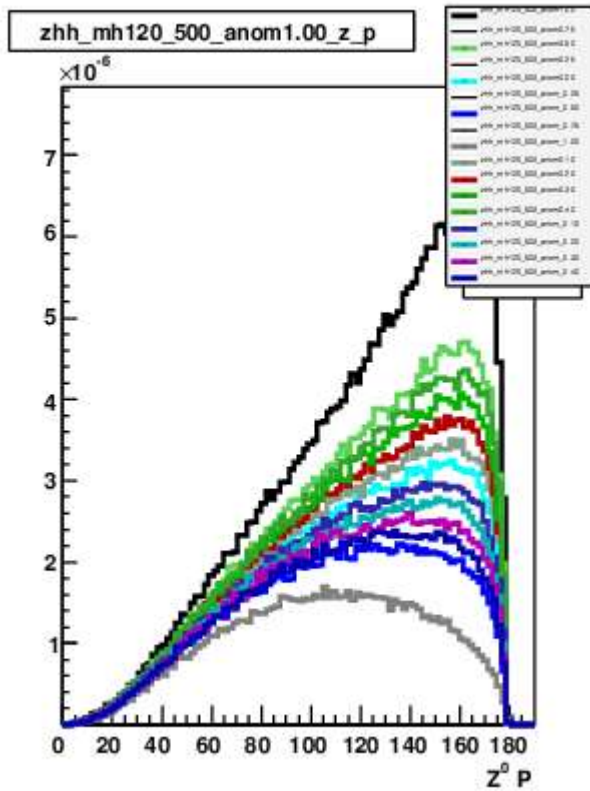
investigating possible analysis strategies...

backups

Z momentum distribution at different g_{HHH}

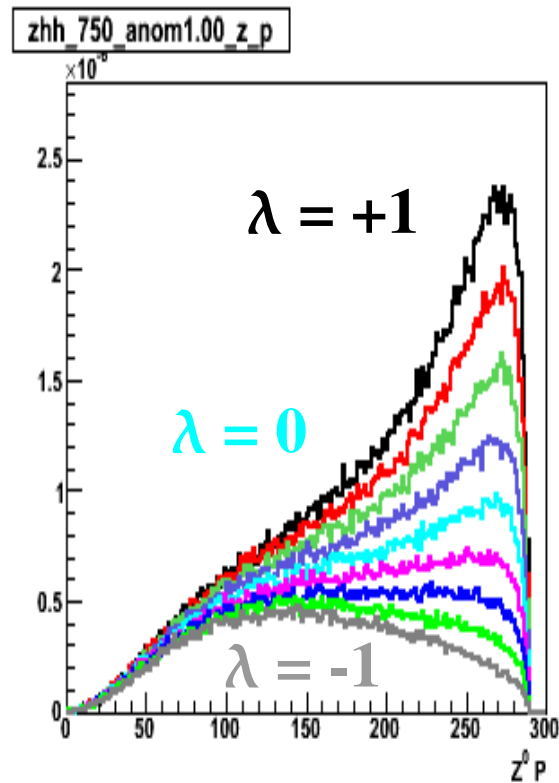
$E = 500$

$mh = 120$

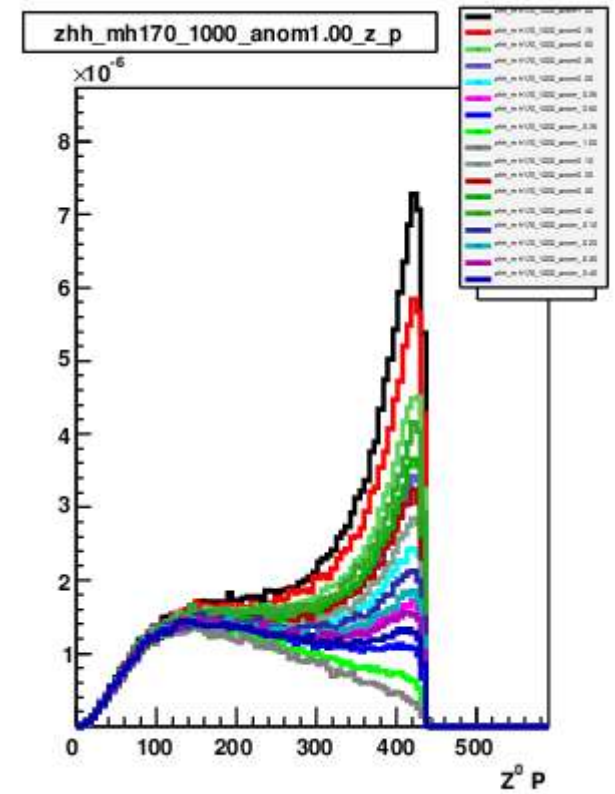


$E = 750$

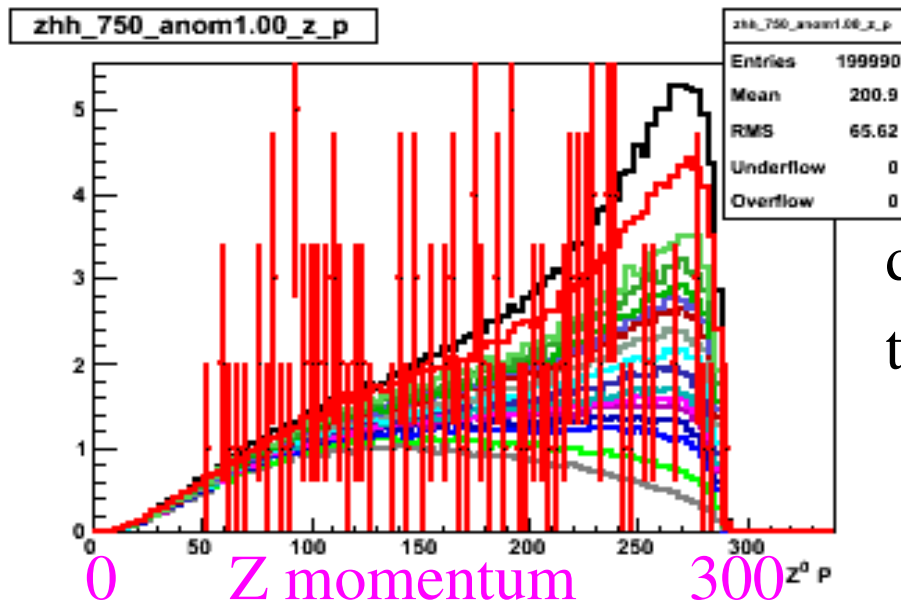
$mh = 170$



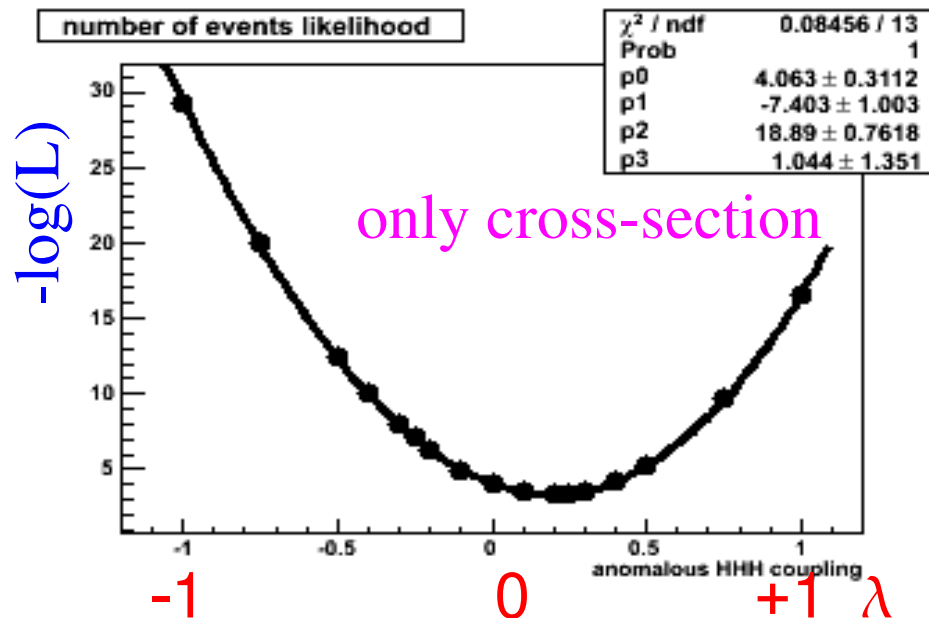
$E = 1000$



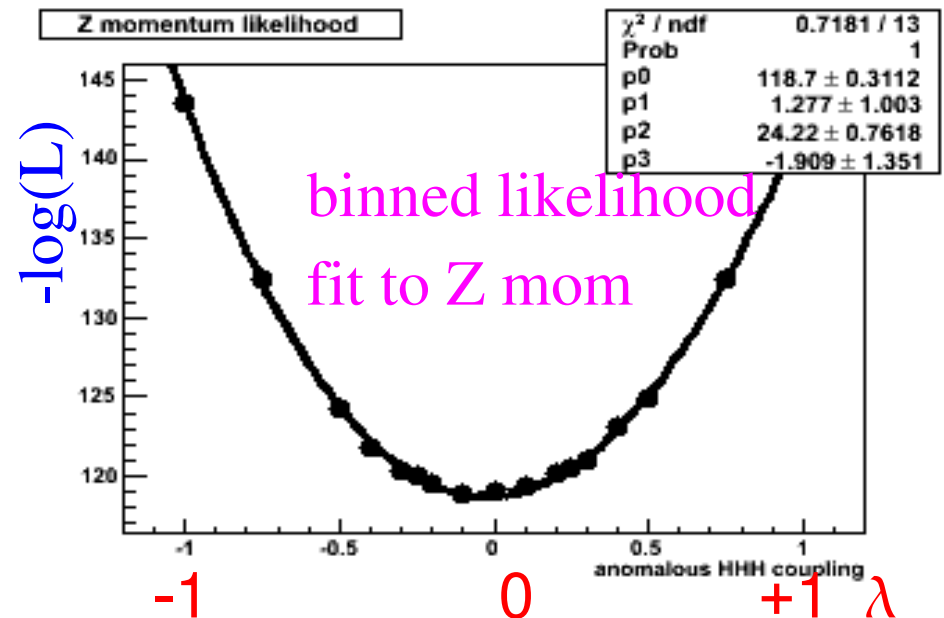
one pseudo experiment ($\lambda = 0$) ; $E_{\text{COM}} = 750 \text{ GeV}$, $m_h = 170 \text{ GeV}$, 1 ab^{-1}



different color curves =
templates with different g_{HHH}



only cross-section



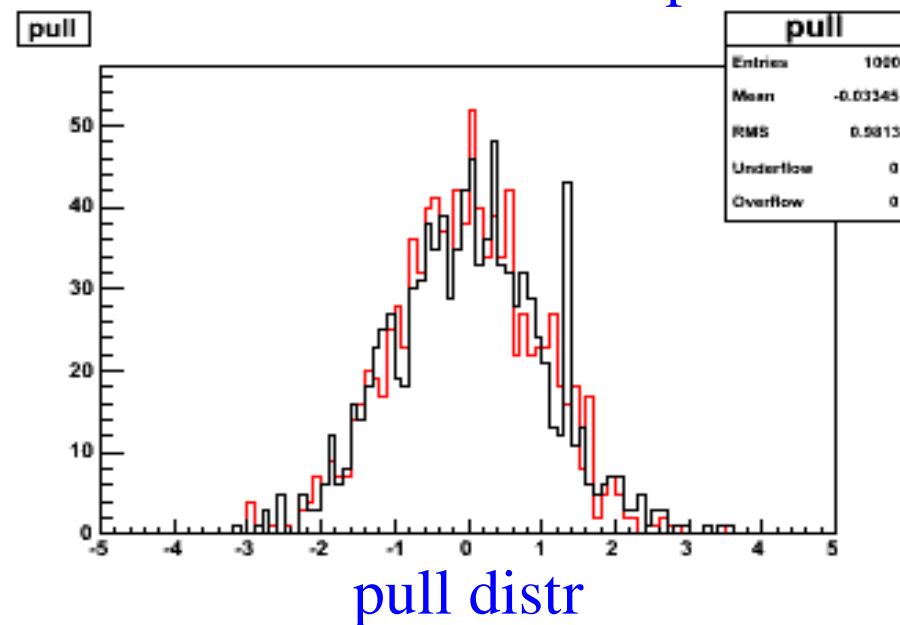
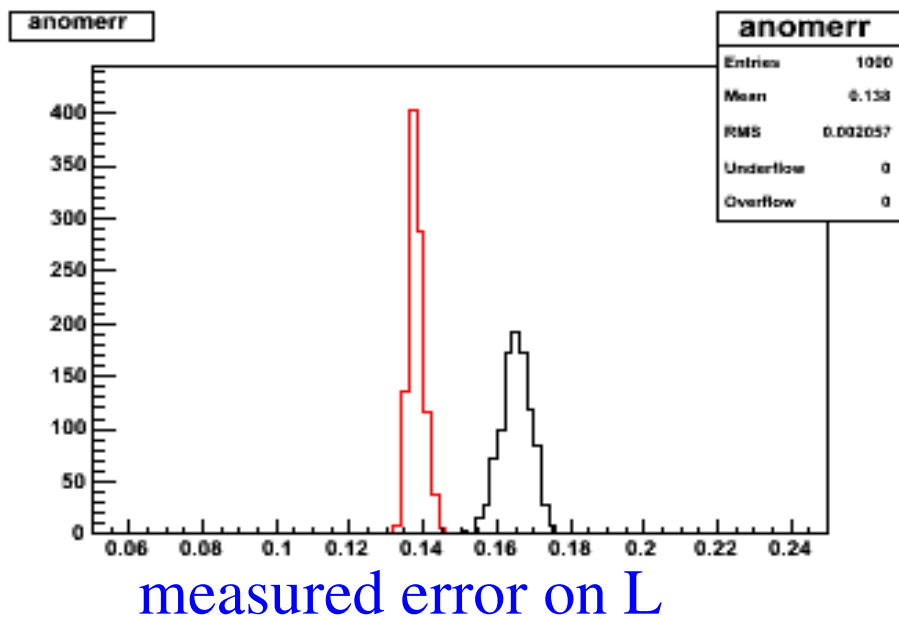
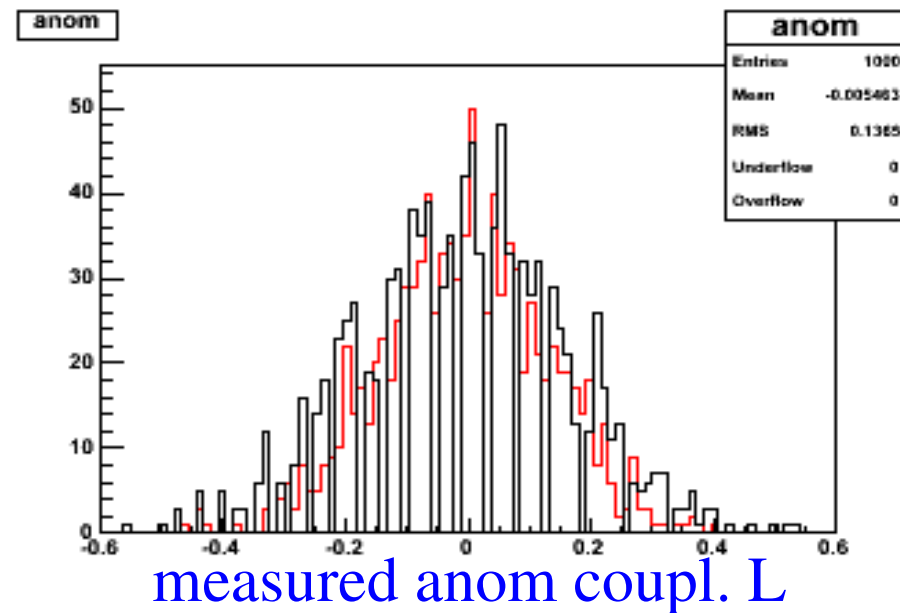
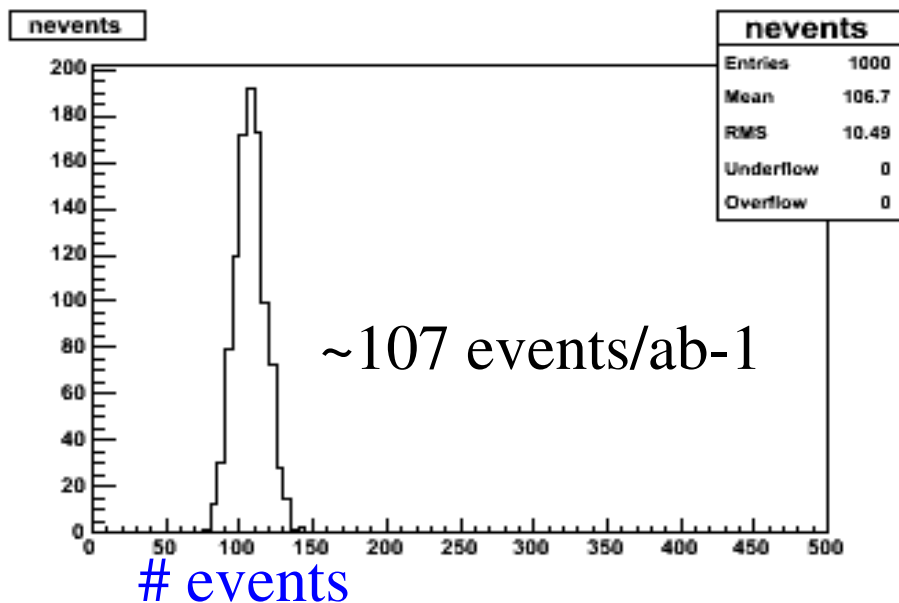
binned likelihood
fit to Z mom

$E_{\text{COM}} = 750 \text{ GeV}$, $m_h = 170 \text{ GeV}$, 1 ab^{-1}

results of 1000 pseudo experiments

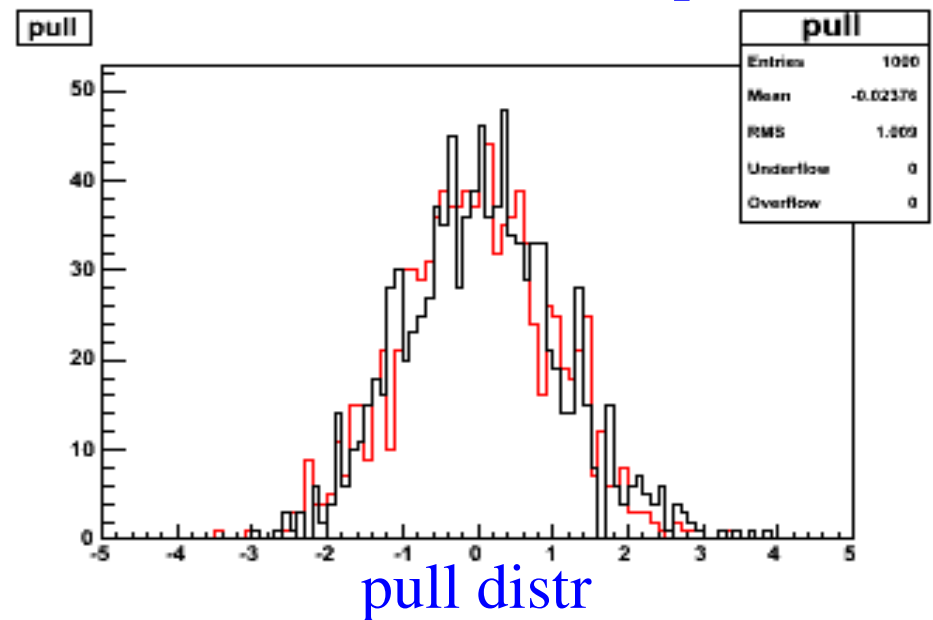
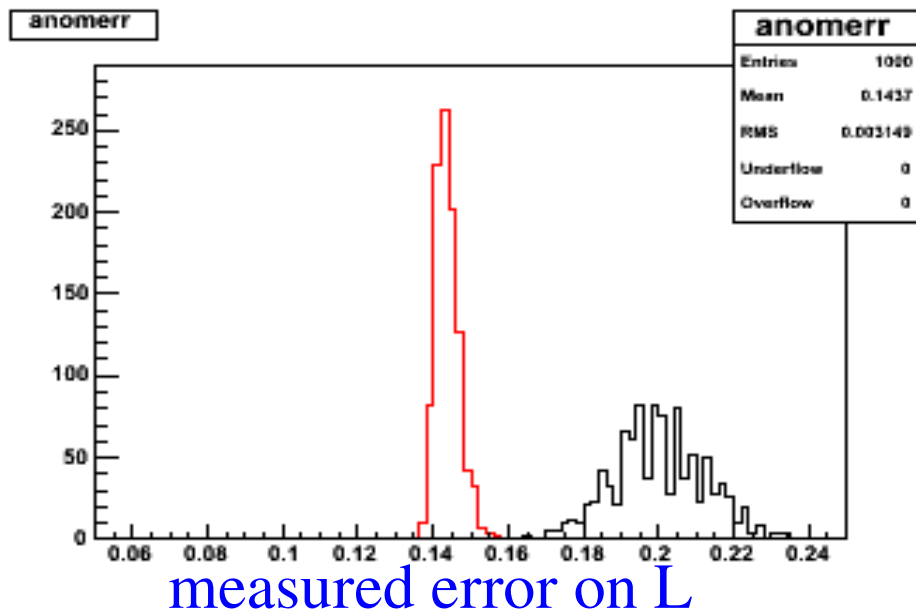
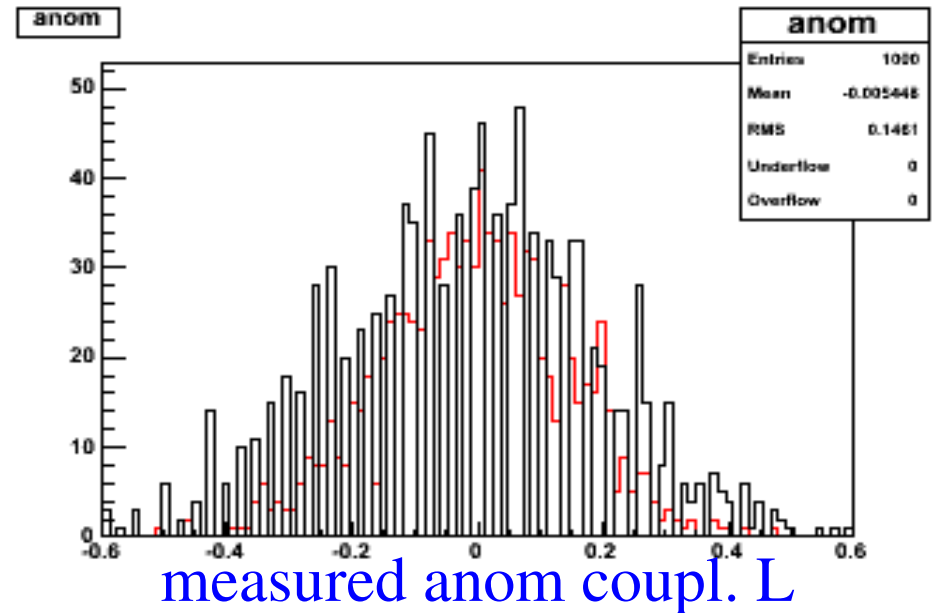
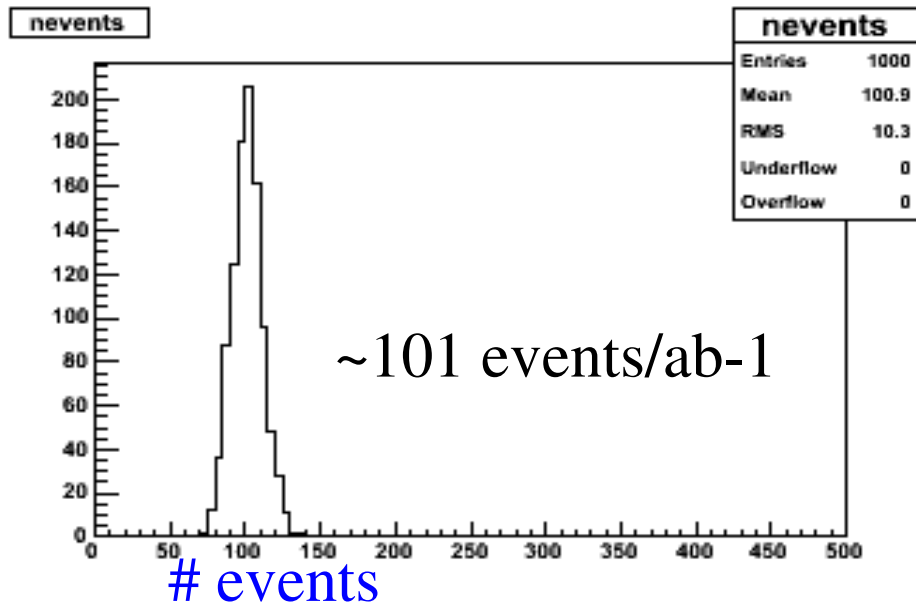
only xsec

Z mom distr



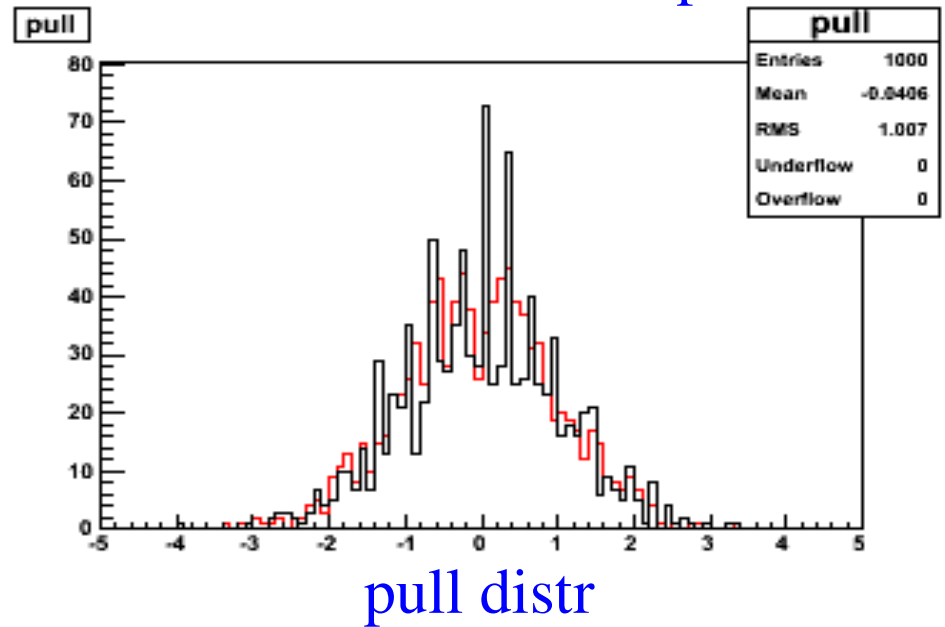
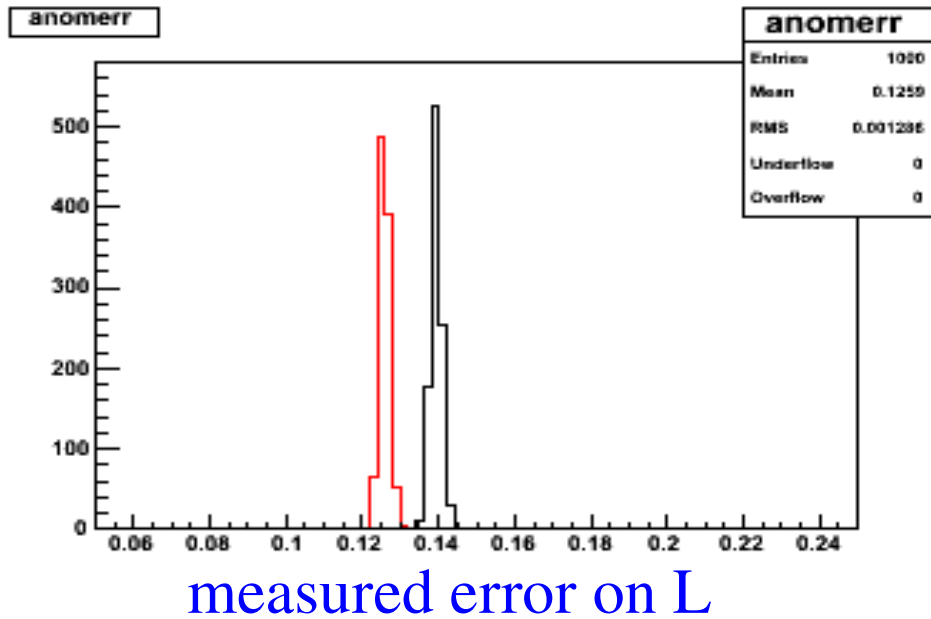
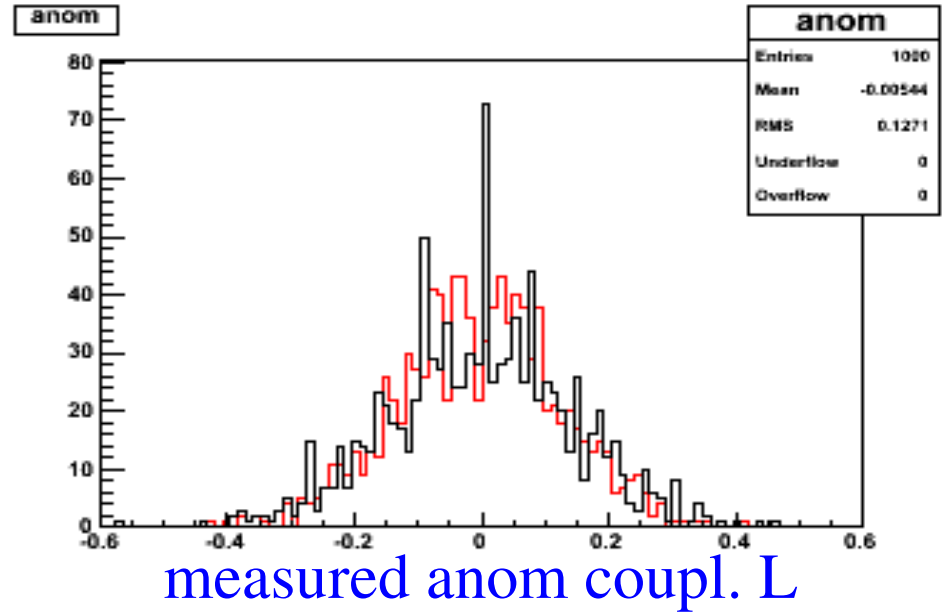
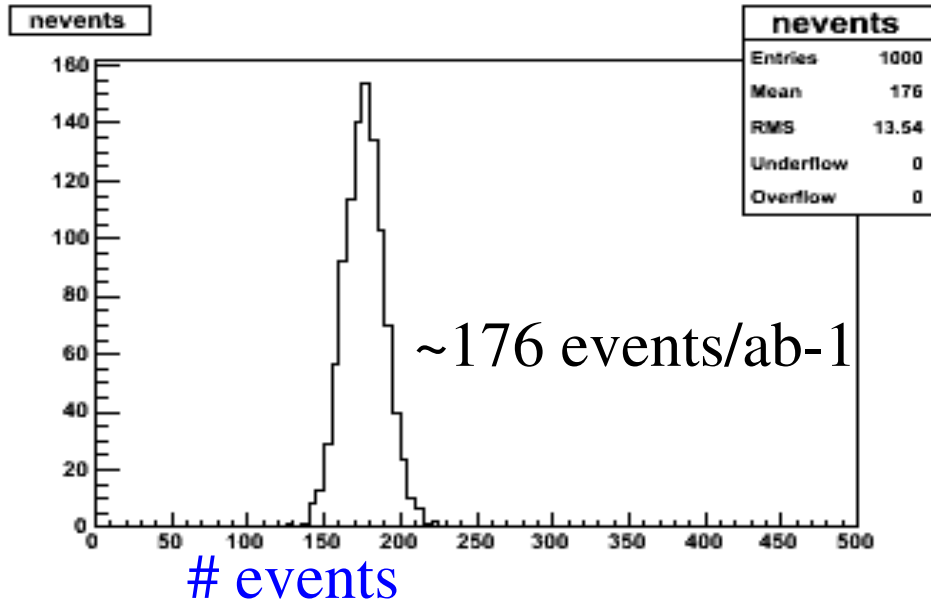
precision on λ : 16.5% \rightarrow 14% by including Z momentum information

ECOM = 1 TeV, mh = 170 GeV, 1 ab⁻¹



slightly larger improvement, precision ~20% -> ~14%

$$E_{\text{COM}} = 500 \text{ GeV}, m_H = 120 \text{ GeV}, 1 \text{ ab}^{-1}$$



similar improvement, precision ~12.5%