Polarization Measurement with WW data at 1 TeV

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DESY

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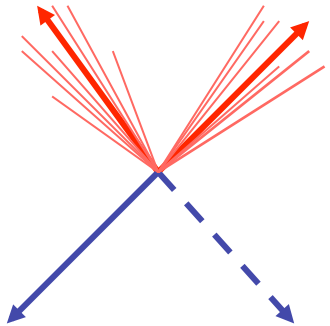
Introduction

- Assess the accuracy of the beam polarization measurement using annihilation data, at E_{CM} = 1 TeV.
- Use the process: $e^+e^- \rightarrow W^+W^- \rightarrow qql\nu$, l = e,$\mu$
  - High cross section, highly dependent on polarization
- Use signal and SM processes: 2f, 4f, 6f.
- Analysis done with 100 fb^{-1} for each polarization configuration.

Selection of Semileptonic Final State

- Event topology



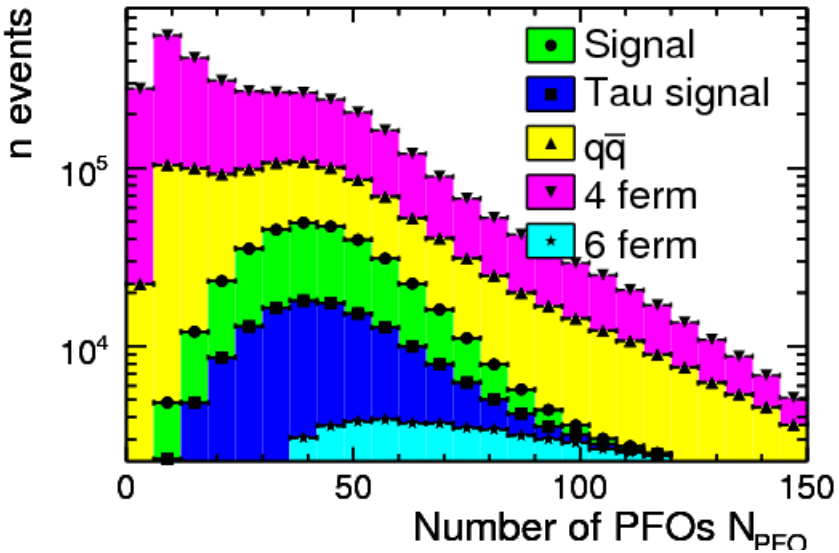
  - 2 jets
  - 1 charged lepton
  - 1 neutrino
- Straightforward reconstruction
- Low background

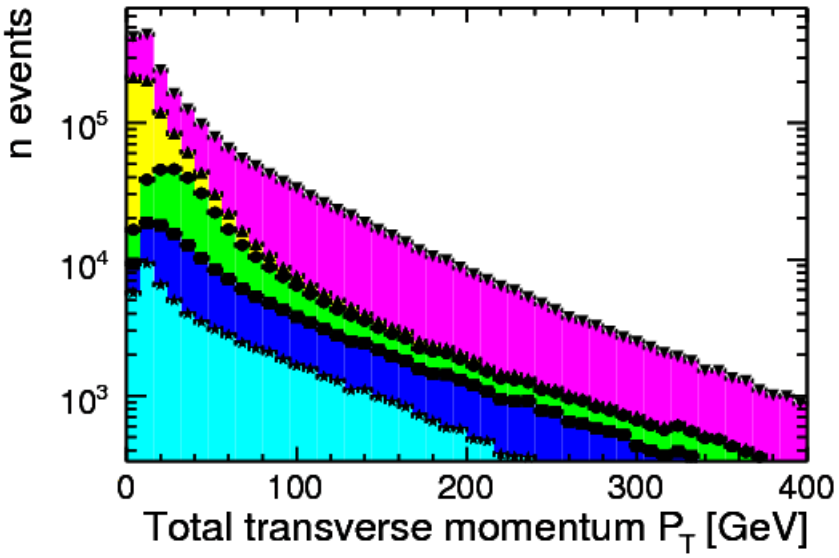
- Event selection
  - Cut based selection
  - Preselection
  - Dedicated lepton ID
  - Force event in two jets
  - Kinematic fit with 2C
  - Anti-tau discriminant variable
  - Cut on the reconstructed W mass
  - Cut on the W production angle

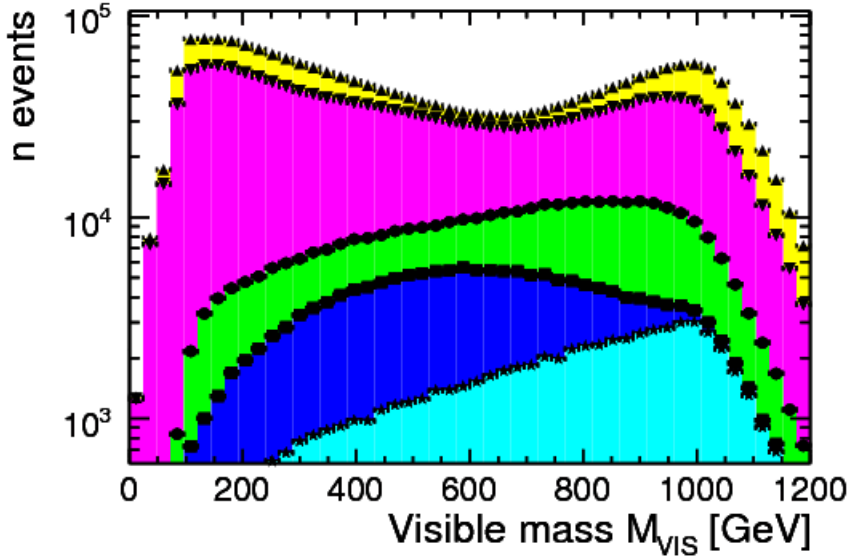
Selection cuts

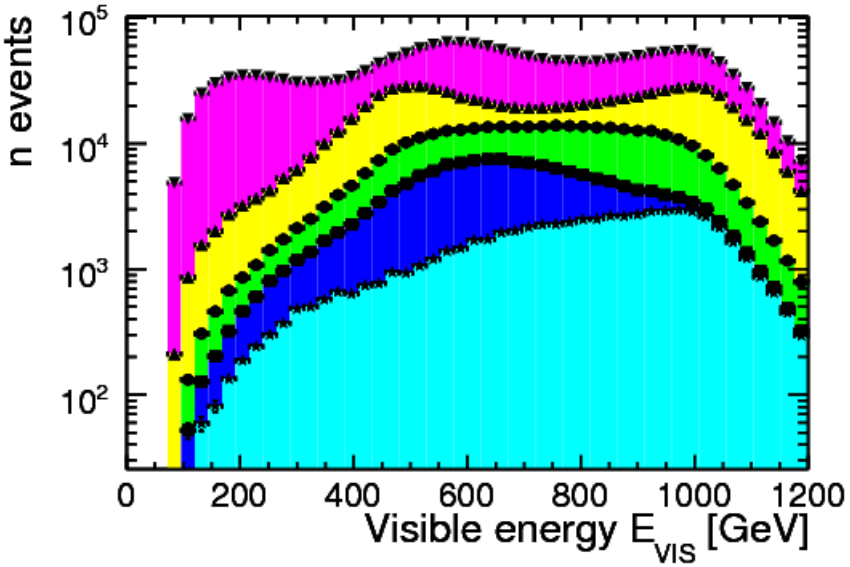
- Number of reconstructed PFOs > 15
- Visible energy < 1200 GeV
- Visible mass > 100 GeV
- Transverse momentum > 5 GeV
- One isolated lepton (muon or electron)
- Two jets reconstructed with the Kt algorithm in the exclusive mode with R=1
- 2C kinematic fit
- $40<M_W^{fit}<120\ GeV$
- $\cos\theta_W > -0.95$

Preselection







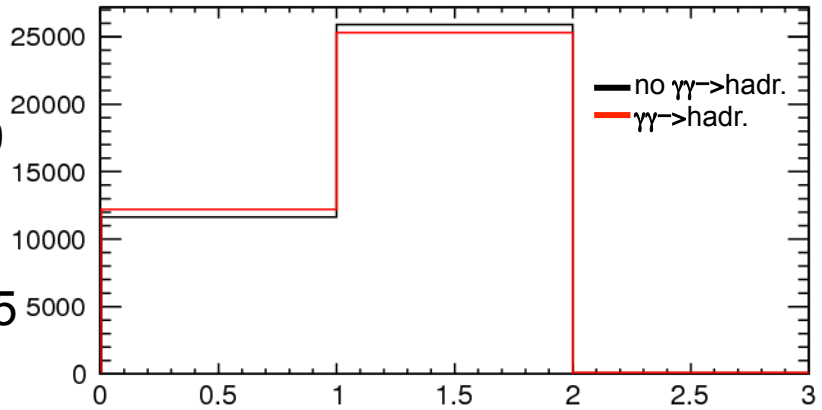


Lepton Identification

- Lepton ID

For e+/e- : $(En_{ECAL}+En_{HCAL})/P > 0.8$
$En_{ECAL}/(En_{ECAL}+En_{HCAL})>0.9$
Charge not-zero

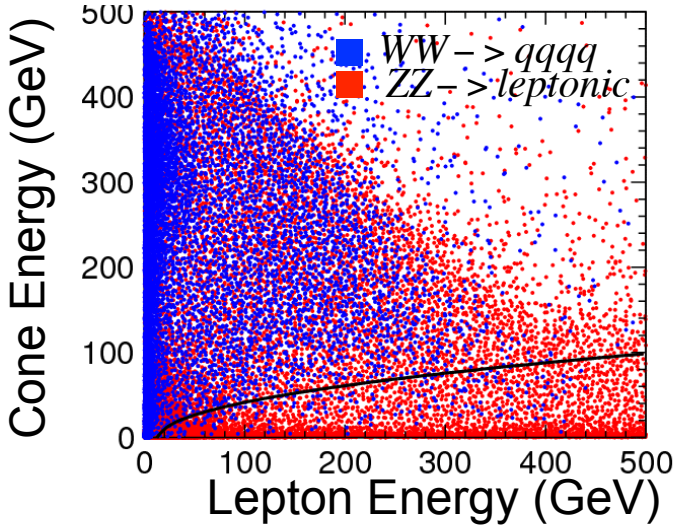
For μ+/μ-: $(En_{ECAL}+En_{HCAL})/P < 0.4$
$En_{ECAL}/(En_{ECAL}+En_{HCAL})<0.5$
Charge not-zero



- Isolation

$$\cos\theta = 0.98$$

$$E_{cone} < \sqrt{20E_{\ell} - 300}$$



Efficiency: 93%

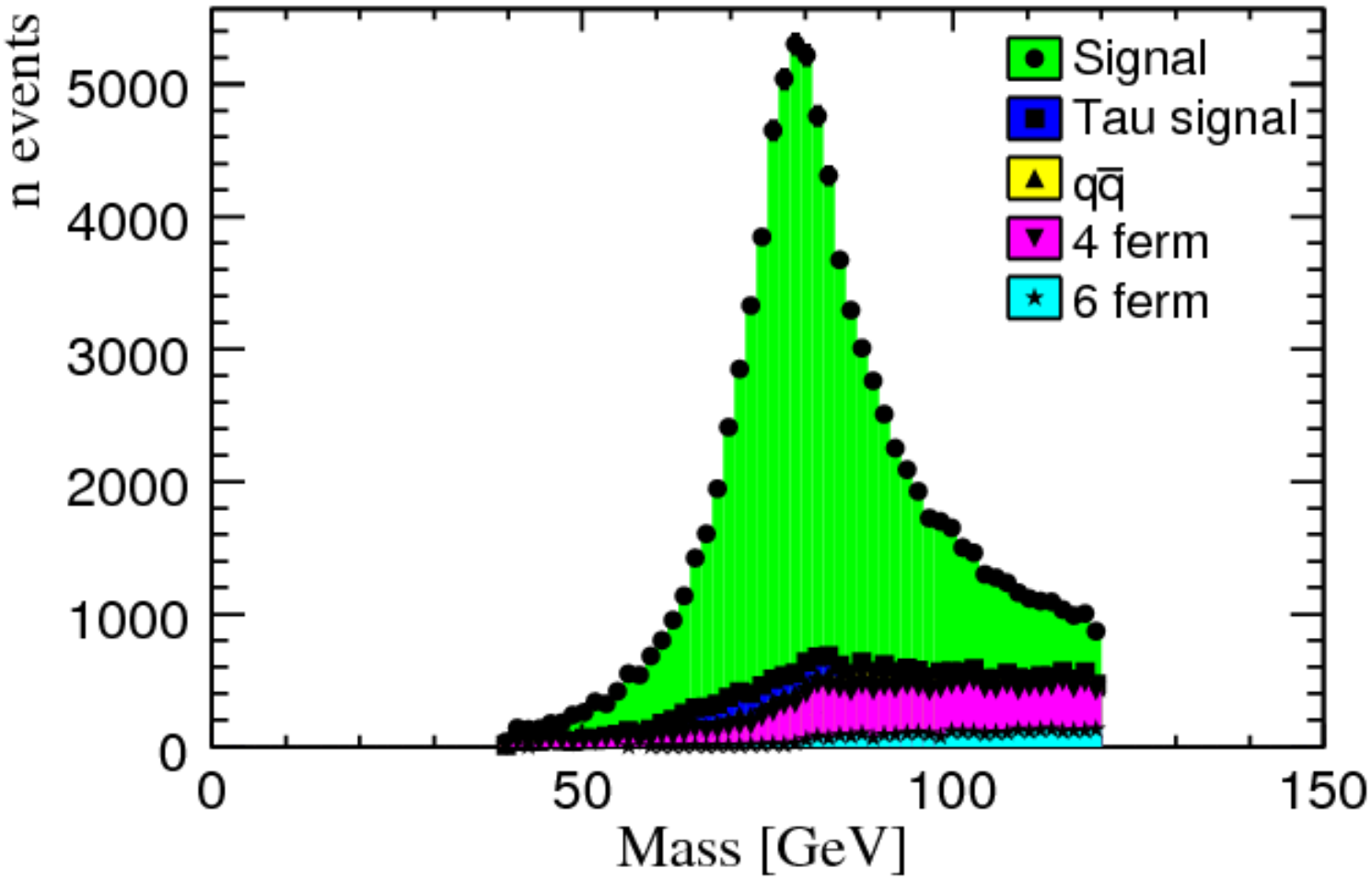
Data Reduction

Cut	qqlv	qqτv	2 ferm	4 ferm	6 ferm
Initial events	210841	104698	776759	2369330	69277
Preselection	192577	95783	427708	1130853	63785
One isolated lepton	117452	20010	19168	234110	22697
Fit probability	100232	17607	12491	68277	17983
Tau rejection	91282	5651	10295	52409	16445
Mass cuts	76415	4120	2550	14052	3010
Cosθ>-0.95	76102	4100	2370	12443	2887

Efficiency: 36%
Purity: 82%

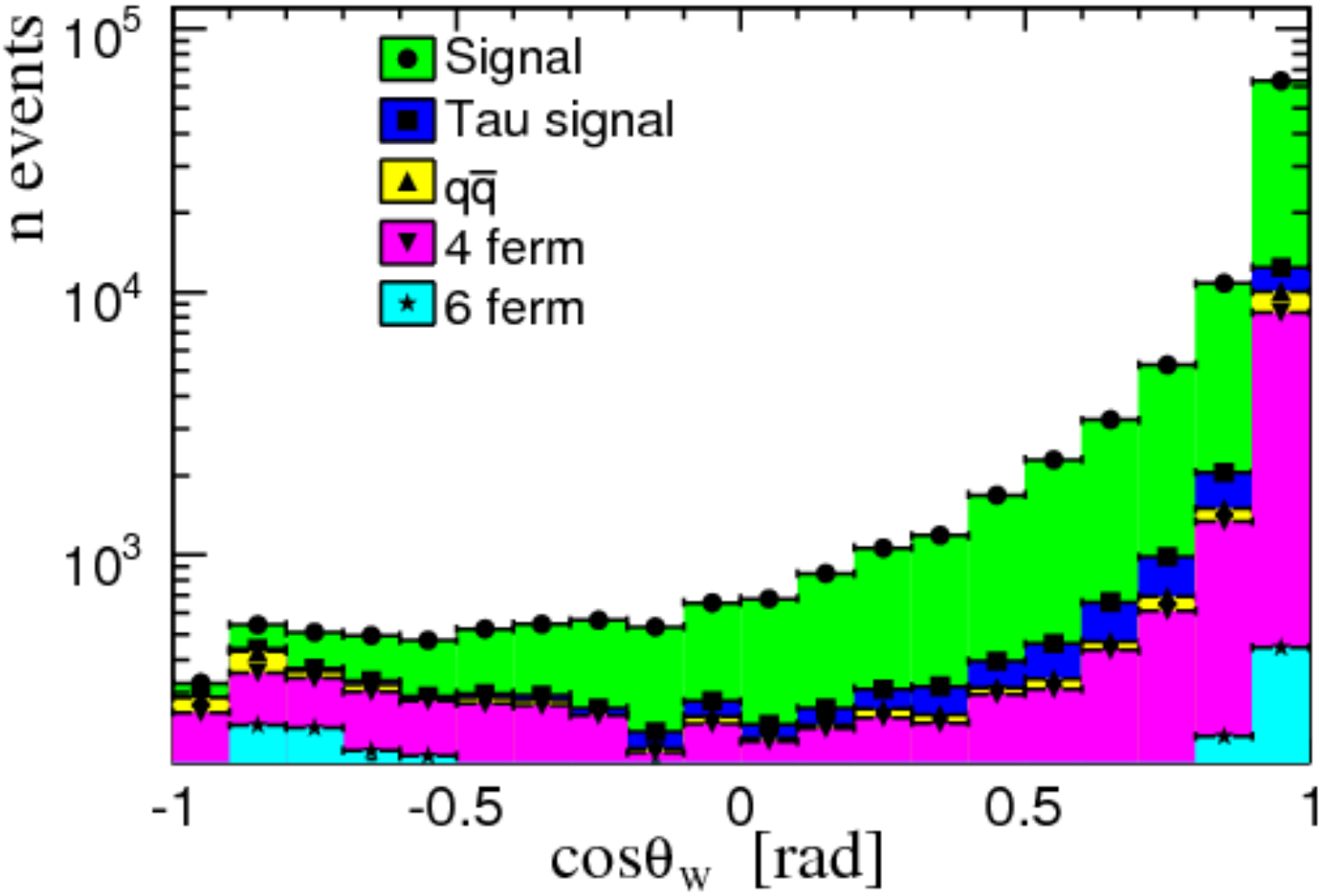
W Invariant Mass

100 fb^{-1} Pol(e^-/e^+) = -80%,+20%



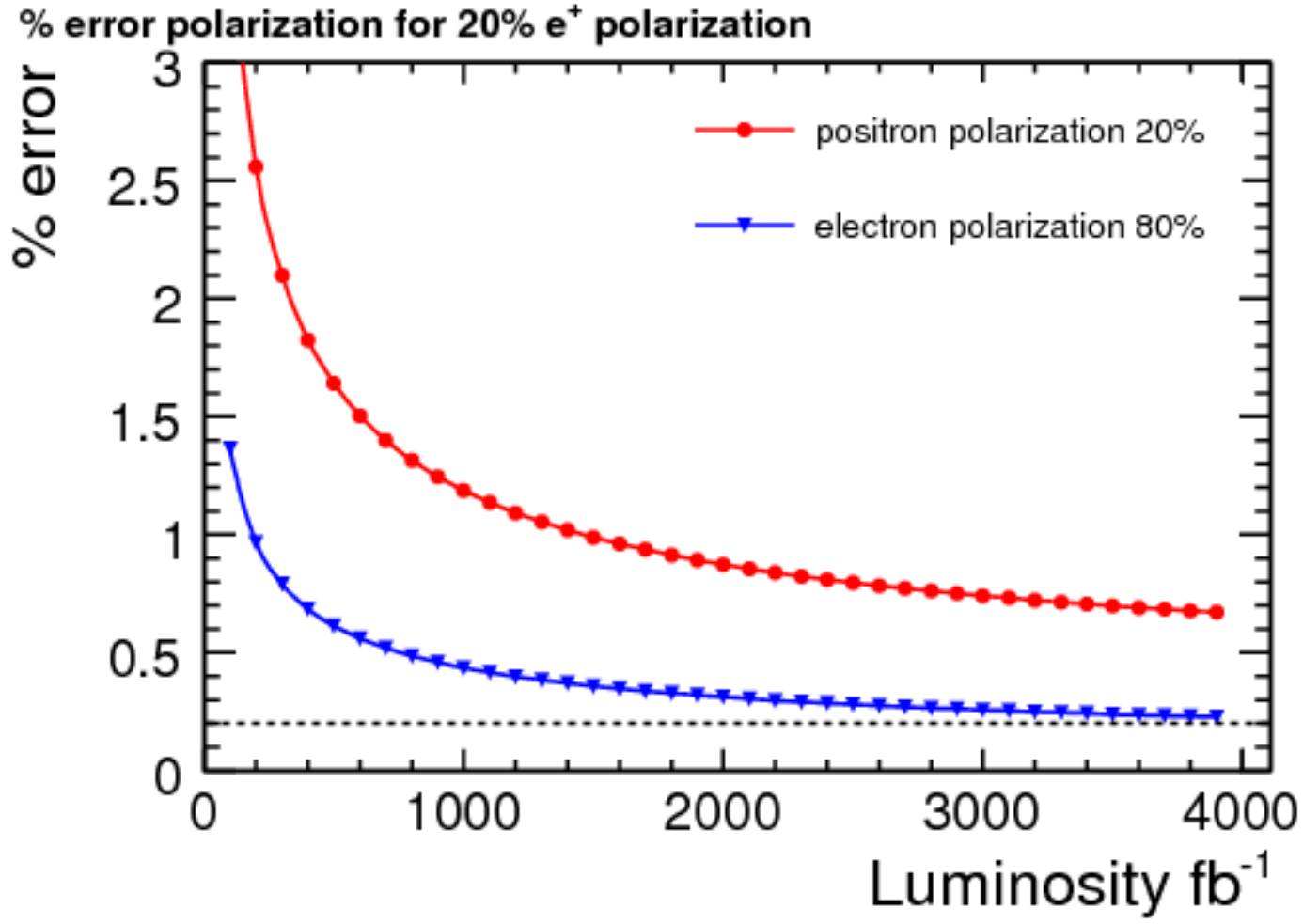
Cos W Production Angle

100 fb^{-1} Pol(e^-/e^+) = -80%,+20%



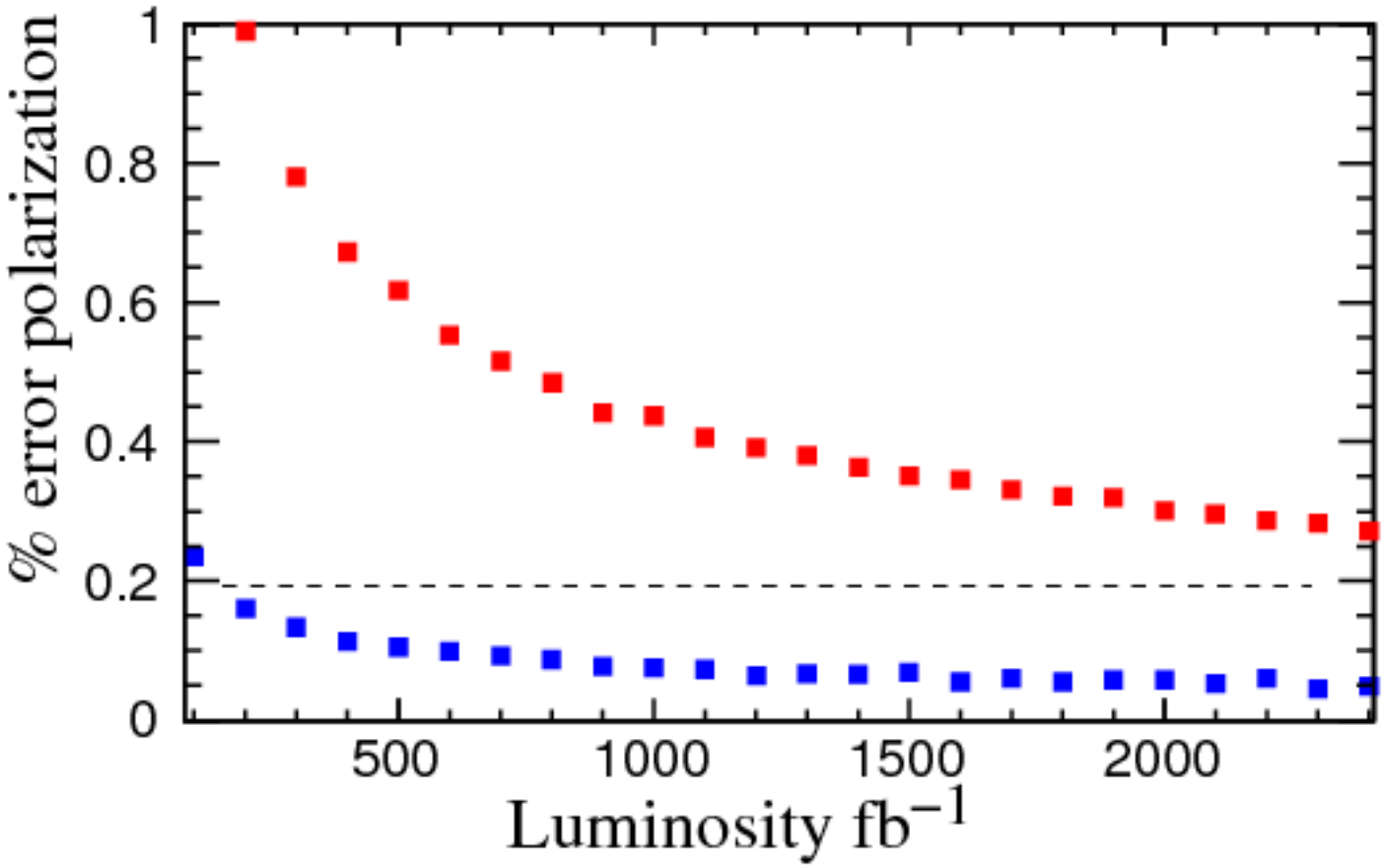
Polarization Measurement: Blondel Method

25%/25%/25%/25% (-0.8,-0.2)/(-0.8,+0.2)/(0.8,-0.2)/(0.8,0.2)



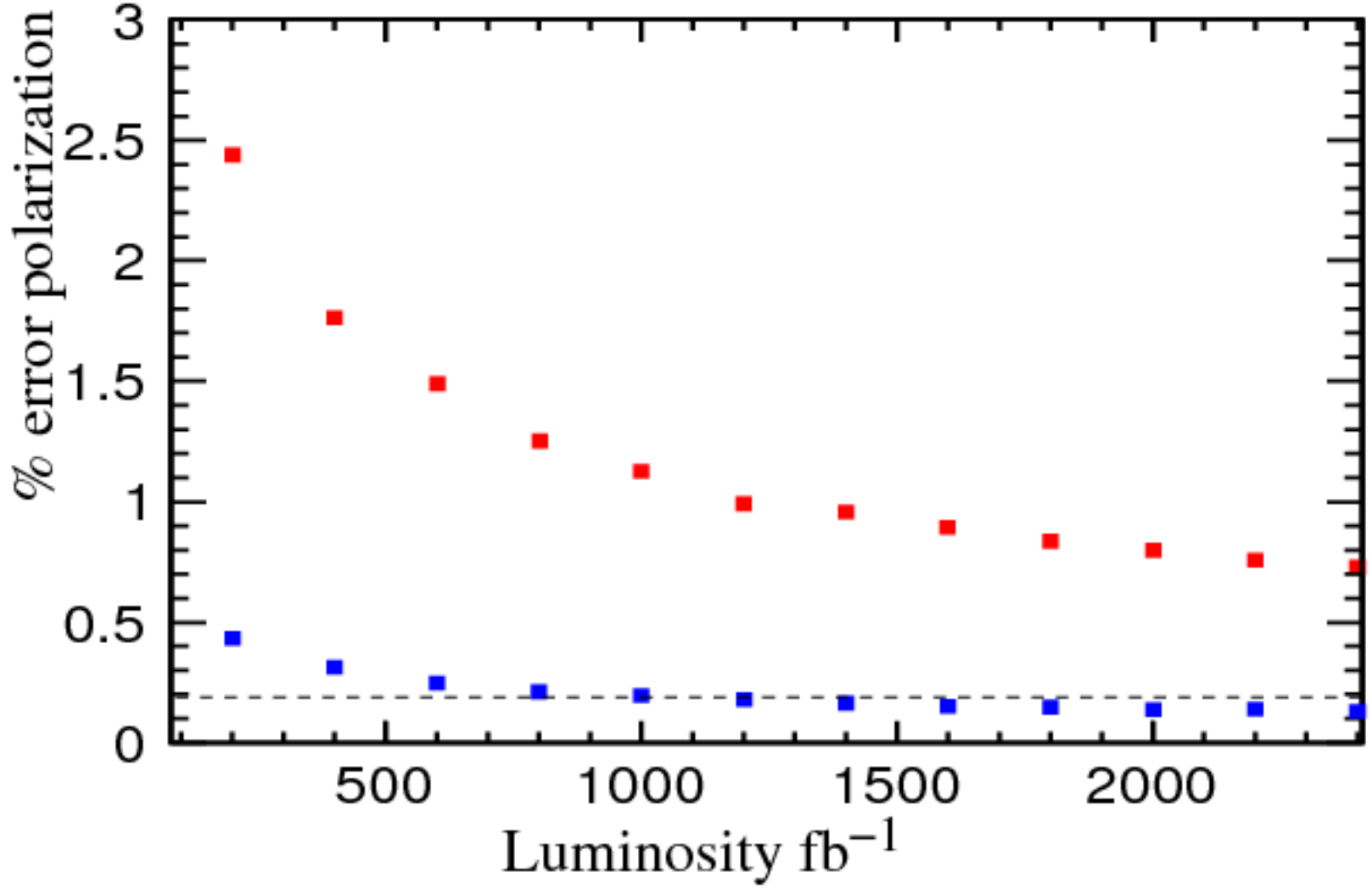
Polarization Measurement: Fit Method

25%/25%/25%/25% (-0.8,-0.2)/(-0.8,+0.2)/(0.8,-0.2)/(0.8,0.2)



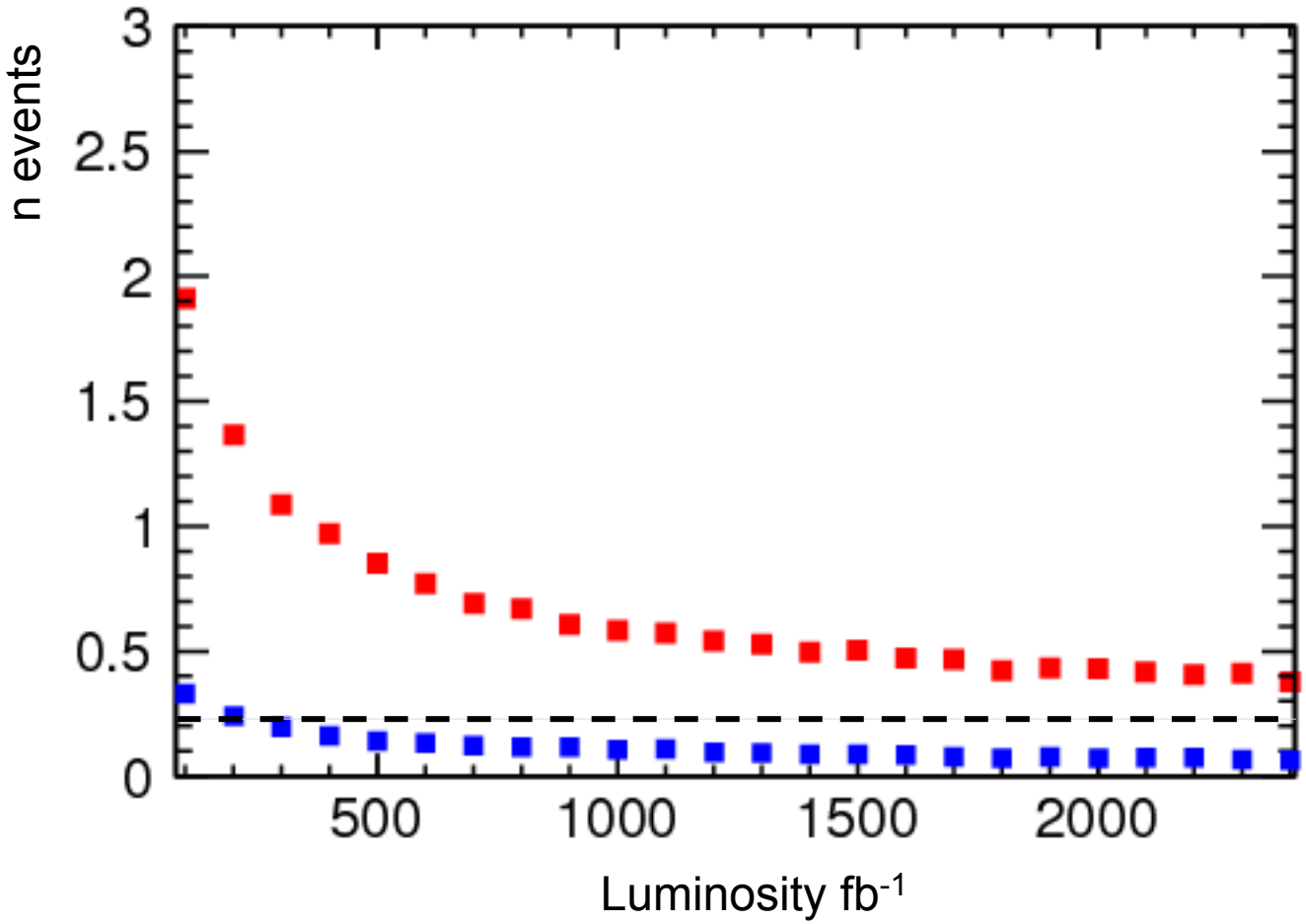
Polarization Measurement: Fit Method

50%/50% (-0.8,+0.2)/(0.8,-0.2)



Polarization Measurement: Fit Method

10%/40%/40%/10% (-0.8,-0.2)/(-0.8,+0.2)/(0.8,-0.2)/(0.8,0.2)



Summary

$qq\ell\upsilon$ events, $\sqrt{s} = 1$ TeV, lumi 1000 fb^{-1}

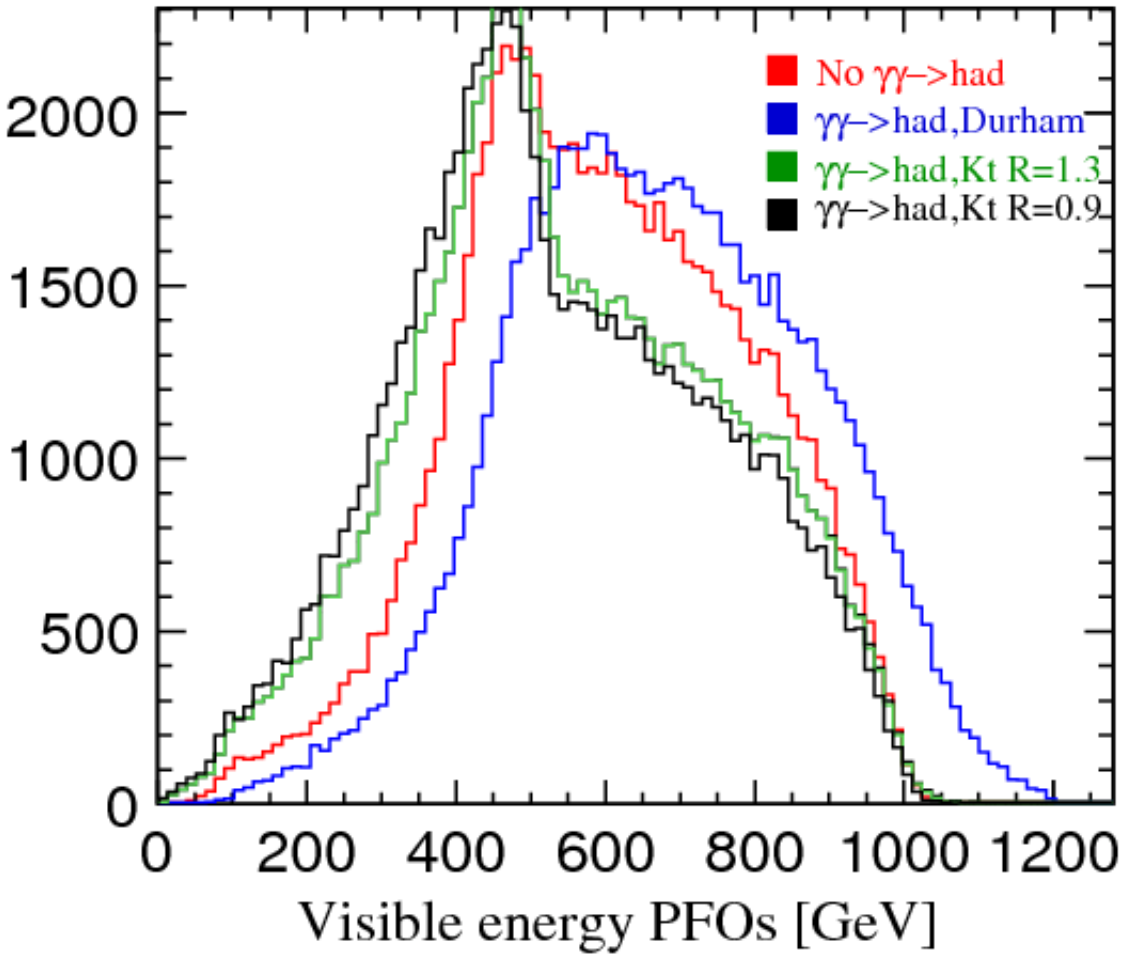
efficiency 36%, purity 82%

	P_{e-}	ΔP_{e-}	$\Delta P_{e-}/P_{e-}$	P_{e+}	ΔP_{e+}	$\Delta P_{e+}/P_{e+}$
Blondel method (25% --/-+/+-/--)	0.8	0.00351	0.44%	0.2	0.00239	1.19%
Fit method (25% --/-+/+-/--)	0.8	0.00060	0.07%	0.2	0.00086	0.43%
Fit method (10% --/++) (40% -+/+-)	0.8	0.00084	0.105%	0.2	0.00120	0.6%
Fit method (50% -+/+-)	0.8	0.00155	0.19%	0.2	0.00227	1.13%

BACKUP

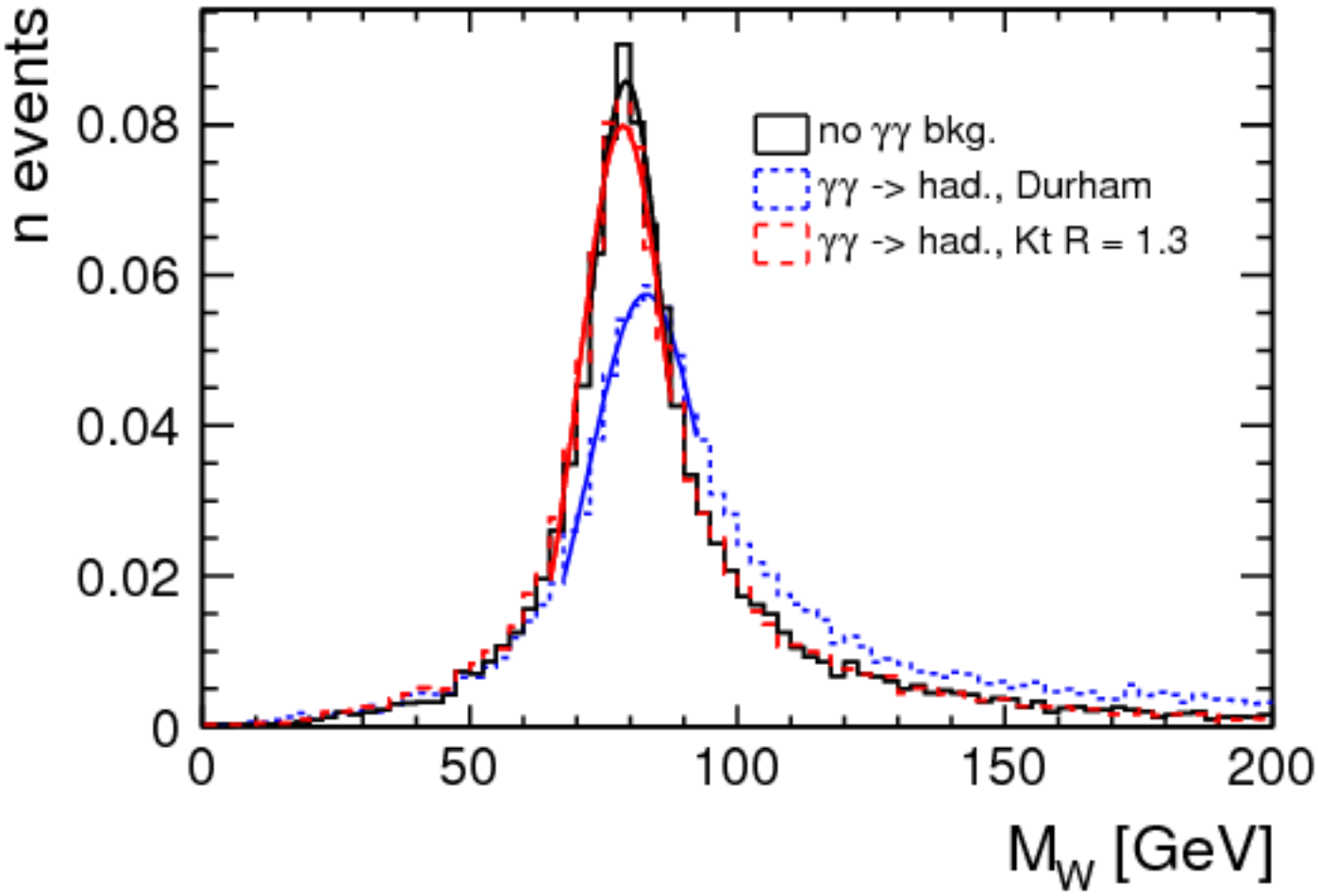
Jet Clustering and Rejection of $\gamma\gamma \rightarrow$ hadrons

Jet clustering with kt algorithm, R=1.3



2C Kinematic Fit

W-boson reconstructed mass after a 2C kinematic fit



Tau rejection