Status of the Higgs Sensitivity Study in $ZH \rightarrow \nu\nu bb$

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General Strategy

- IIa_LowL - used full GEANT simulation of the DØ detector for Run IIa (2E31), which reproduces most aspects of the current data
- IIa_HighL – same in high luminosity environment (2E32)
- IIb_HighL – same using full GEANT simulation of the DØ detector (mainly new SMT for b tagging) for Run IIb in high luminosity environment (2E32)

Predicting future performance based on today's best understanding of hardware and software

No time to fully optimise analyses or use relatively new analysis techniques – it will only get better

Results

The DØ Team: Boaz Klima (Fermilab, chair), Levan Babukhadia (Stony Brook), Wade Fisher (Princeton), Anna Goussiou (Imperial College), Qizhong Li (Fermilab), Meenakshi Narain (Boston univ.), Richard Partridge (Brown univ.), Flera Rizatdinova (Kansas State), Chris Tully (Princeton), Andre Turcot (BNL) + John Hobbs (Stony Brook) and Avto Kharchilava (Notre Dame)

Higgs Sensitivity Estimate for ZH→ννbb

(Run IIb, *L*~2E32, m_{Higgs}=115GeV)

Direct comparison with the 1999 study

- Assume 100% QCD contribution (a la SHWG)
- No trigger applied
- 35% b-tagging eff
  - 1 tight + 1 loose tag
  - 32% for 2 tight tags
- Number of events estimated in 1 fb^{-1}

Process	This	SHWG NN	Ratio
HZ, 115 GeV	3.82	3.15	1.22
HW, 115 GeV	2.78	2.39	1.16
Zbb	1.73	4.34	0.40
Wbb	3.59	9.45	0.38
ZZ	2.36	1.82	1.30
WZ	1.79	1.45	1.24
tt	6.53	3.00	2.18
qtb	0.80	0.31	2.62
tb	0.49	4.70	0.10
QCD	17.30	25.06	0.69
TOT:	34.59	50.11	0.69
Signif:	1.1221	0.7812	

~50% less luminosity is needed compared to the 1999 study

ZH→ννbb Analysis Updated Cross Sections

Process	New	SHGW	Ratio
Wbb	3.40	2.53	1.34
Zbb	0.90	0.70	1.28
tt	7.00	7.50	0.93
qtb	0.75	0.80	0.94
WZ	3.20	2.81	1.14
tb	0.80	1.00	0.80
ZZ	1.70	1.24	1.38
ZH, 115	15.80	19.00	0.83

Higgs Sensitivity Estimate for ZH→ννbb

(new x-secs, trigger eff., QCD)

Today's results compared with 1999 study

- Trigger efficiencies applied for this analysis
- QCD as calculated in current study
- 35% b-tagging eff
  - 1 tight + 1 loose tag
  - 32% for 2 tight tags
- Number of events estimated in 1 fb^{-1}

Process	This	SHWNN	Ratio
HZ, 115 GeV	2.86	3.15	0.91
HW, 115 GeV	2.08	2.39	0.87
Zbb	1.99	4.34	0.46
Wbb	4.34	9.45	0.46
ZZ	2.93	1.82	1.61
WZ	1.84	1.45	1.27
tt	5.48	3.00	1.83
qtb	0.68	0.31	2.22
tb	0.35	4.70	0.08
QCD	11.16	25.06	0.45
TOT:	28.77	50.11	
Signif:	0.9208	0.7812	

~28% less luminosity is needed compared to the 1999 study

Higgs Sensitivity Estimate
(Run IIb, function of m_{Higgs})

Today's results compared with 1999 study

Expected sensitivity in 1 fb^{-1}

mH	This	SHWG, NN	Δ Lumi (%)
105	1.035	0.913	-22.18
115	0.921	0.781	-28.05
120	0.820	0.708	-25.36
125	0.687	0.635	-14.55
130	0.626	0.562	-19.46

~20% less luminosity is needed compared to the 1999 study

Comments on $ZH \rightarrow \nu\nu bb$

- Bad news
  - **Our double b-tagging efficiency for Run IIa is currently estimated to be at 19% compared to 32% using our IIb SMT**

    if we do not upgrade we'll need more luminosity
  - **Whatever bad happens to the detector, which is not currently being simulated…**
- Good news
  - **Smart combination of results a la LEP (CLS vs straight counting) will buy us ~20% in luminosity wrt 1999 study**
  - **We have more new analysis techniques available today, e.g. see the recent m_{top} measurement (x2 in luminosity)**
  - **Our analysis is by no means fully optimised!**

Looks good…

Outlook

- Bad news?
  - **We still have to work hard to get to the assumed/expected sensitivity (we will!)**
  - **We may be statistically unlucky…**
- Good news
  - **We may be statistically lucky…**
  - **We know it will get better (tools, optimisation,…)**
  - **We expect it to get much better (remember Top in Run I!)**

Great Start…