

FPCCD digitizer & $ZH \rightarrow l\bar{l}H$

Asian physics and software meeting

10th Dec. 2009

Tohoku University

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FPCCD digitizer

Status

Today

- Check background hits on VTX

Data

- /proj/soft/data5/samples/grid/users/miyamoto/samples/simulated/ILD_00fwp01
 - /GP/GP-500-SB2009-wTF/RGP01/slci/~.slcio
 - /cain/500.SB2009-wTF/All/~.slcio
 - /cain/500.nominalA/~.slcio

Background hits

#SimTrackerHits on each layer are checked.

- Statistical
 - GP(500.SB2009.wTF) : 59BX
 - cain(500.SB2009.wTF) : 188BX
 - cain(500.nominalA) : 86BX
- #Hits(Units: hits/cm²/BX)

Layer	GP(500.SB2009.wTF)	cain(500.SB2009.wTF)	cain(500.nominalA)
1	15.1	9.27	3.88
2	8.60	5.05	2.21
3	0.474	0.245	0.114
4	0.392	0.195	0.0942
5	0.0856	0.0439	0.0203
6	0.0717	0.0374	0.0171

Background pixel hits

#Pixel hits estimated by FPCCD digitizer were also checked.

- **No threshold to make fired pixel hits!**
 - Pixel hit is created when particle shaves pixel.
- #Pixel hits (Units: hits/cm²/BX)

Layer	GP(500.SB2009.wTF)	cain(500.SB2009.wTF)	cain(500.nominalA)
1	164	109	44.1
2	92	56.3	25
3	4.99	2.79	1.29
4	4.46	2.16	1.1
5	1.01	0.589	0.272
6	0.835	0.52	0.197

Question

Question

- Some events can not get Collection.

→ Is this OK?

```
void FPCDDigitizer::processEvent( LCEvent * evt) {  
  
    LCCollection* STHcol = 0;  
    try{  
        STHcol = evt->getCollection(“VXDCollection”)  
    }  
  
}
```

Summary

- Background hits are checked on each layer.

Value: #SimTrackerHits(#Fired Pixel Hits), Units: hits/cm²/BX

Layer	GP(500.SB2009.wTF)	cain(500.SB2009.wTF)	cain(500.nominalA)
1	15.1 (164)	9.27 (109)	3.88 (44.1)
2	8.60 (92)	5.05 (56.3)	2.21 (25)
3	0.474 (4.99)	0.245 (2.79)	0.114 (1.29)
4	0.392 (4.46)	0.195 (2.16)	0.0942 (1.1)
5	0.0856 (1.01)	0.0439 (0.589)	0.0203 (0.272)
6	0.0717 (0.835)	0.0374 (0.52)	0.0171 (0.197)

ZH \rightarrow llH Analysis

Status

Previous

- Lepton ID was considered with well-reconstructed events.

Today

- Lepton ID was applied for $e^+e^- \rightarrow ZH$ events.

Lepton ID

Procedure

1. Select isolated high-energy lepton
 - Cone energy $< 10\text{GeV}$
 - $20\text{GeV} < \text{Energy} < 90\text{GeV}$
2. Apply cuts using calorimeter Info.

Electron ID

$$0.5 < (\text{Ecal} + \text{Hcal ene}) / \text{mom} < 1.15$$

$$0.85 < \text{Ecal ene} / (\text{Ecal} + \text{Hcal ene})$$

Muon ID

$$(\text{Ecal} + \text{Hcal ene}) / \text{mom} < 0.7$$

$$\text{Ecal ene} / (\text{Ecal} + \text{Hcal ene}) < 0.85$$

Performance

- Efficiency
 - Electron ID : 96.8%
 - Muon ID : 98.3%

→ This lepton ID was applied for $e^+e^- \rightarrow ZH$ events.

#PFOs & #Events applied lepton ID

#PFOs and #Events were checked.

- #PFOs

Event	No ID	ElectronID	MuonID
ZH \rightarrow eeh	148938	98443	77
ZH \rightarrow $\mu\mu$ H	136522	165	121792
ZH \rightarrow $\tau\tau$ H	146210	1738	816
ZH \rightarrow qqH	4866350	660	47

- #Events (A event has at least 2 PFOs.)

Event	No ID	ElectronID	MuonID
ZH \rightarrow eeh	2777	1876 (68%)	7 (0.3%)
ZH \rightarrow $\mu\mu$ H	2601	14 (0.5%)	2331 (90%)
ZH \rightarrow $\tau\tau$ H	2596	49 (1.8%)	25 (1%)
ZH \rightarrow qqH	52507	8 (0.02%)	1 (0%)

\rightarrow We should include other ZH mode as background.

Summary

Summary

- Lepton ID was applied for $e^+e^- \rightarrow ZH$ events

Event	No ID	ElectronID	MuonID
$ZH \rightarrow eeh$	2777	1876 (68%)	7 (0.3%)
$ZH \rightarrow \mu\mu H$	2601	14 (0.5%)	2331 (90%)
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$ZH \rightarrow qqH$	52507	8 (0.02%)	1 (0%)

PLAN

- Run Marlin!!

Background Study in LOI

- Background study in LOI

Subdetector	Units	Layer	Nom-500	Low-P-500	Nom-1000
VTX-DL	hits/cm ² /BX	1	3.214±0.601	7.065±0.818	7.124±1.162
		2	1.988±0.464	4.314±0.604	4.516±0.780
		3	0.144±0.080	0.332±0.107	0.340±0.152
		4	0.118±0.074	0.255±0.095	0.248±0.101
		5	0.027±0.026	0.055±0.037	0.046±0.036
		6	0.024±0.022	0.046±0.030	0.049±0.044
SIT	hits/cm ² /BX	1	0.017±0.001	0.031±0.007	0.032±0.012