Study of Higgs Self-couplings at ILC

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status

- checking the statistical independences for both llHH and nnHH analyses.
- investigating the generation of full simulated backgrounds llbbH and vvbbH which are not considered yet.

strategy used now for neural-net

- totally, one sample for every signal and every background.
- for each neural-net training, both signal sample and background sample are randomly selected into two halves: one for training, one for testing.
- finally while evaluating the efficiencies of signal and backgrounds, the whole samples (include training and testing events) are used.

considerations:

- there are several neural-net training in one analysis, it's better to use independent signal samples for each neural-net.
- while evaluating the efficiencies, the training samples should not be included. but if both the training and testing samples could be eliminated , it should be OK. for signal and survived backgrounds, we should use independent testing samples.

need to do

- increase at least three times signal statistics, then we can use one independent sample for each neural-net. (llHH 3 times, nnHH twice)
- increase the background statistics and separate them into training samples and testing samples, then we can only use the testing samples to evaluating the efficiencies. (llbb, llbbbb, nnbbbb, possible lvbbqq)
- now the llHH, nnHH samples are prepared, still generating llbb (expected 316K...), llbbbb, nnbbbb

Part II

problems about the full simulation with Physsim

problems about stdhep

- using Miyamoto-san's JSF framework, the stdhep file can be successfully generated. But from the particles list, there are some wrong mother-daughter relation ships in case of Higgs concerned generators.

ZH

Event listing (HEP format) Event: 99

I	particle/jet	ISTHEP	IDHEP	JMOHEP		JDAHEP		PHEP(1,I)	PHEP(2,I)	PHEP(3,I)	PHEP(4,I)	PHEP(5,I)
1	(H_10)	2	25	0	0	0	-1	60.75512	-24.07762	8.47056	136.90385	120.00000
2	(Z0)	2	23	0	0	3	4	-60.75512	24.07762	-7.60404	112.52689	91.28836
3	(nu_e)	2	12	2	0	0	-1	-72.37788	16.75378	-34.81501	82.04470	0.00000
4	(nu_e~)	2	-12	2	0	0	-1	11.62277	7.32384	27.21097	30.48220	0.00000
5	!H_10!	13	25	3	0	0	0	60.75512	-24.07762	8.47056	136.90385	120.00000
6	(W+)	2	24	5	0	8	9	72.10799	-10.33225	-6.34192	107.28300	78.50546
7	!W-!	13	-24	5	0	10	11	-11.35287	-13.74537	14.81248	29.62085	18.44349
8	e+	1	-11	6	0	0	0	47.46394	32.09433	-9.66548	58.10588	0.00051
9	nu_e	1	12	6	0	0	0	24.64405	-42.42658	3.32356	49.17713	0.00000
10	!s!	13	3	7	0	0	0	-9.22176	2.11457	4.21949	10.37142	0.50000
11	!c~!	13	-4	7	0	0	0	-2.13111	-15.85994	10.59299	19.24943	1.50000
12	(s)	2	3	10	0	14	14	-9.22176	2.11457	4.21949	10.37142	0.50000
13	(c~)	2	-4	11	0	14	14	-2.13111	-15.85994	10.59299	19.24943	1.50000

ZZH

Event listing (HEP format) Event: 1

I	particle/jet	ISTHEP	IDHEP	JMOHEP		JDAHEP		PHEP(1,I)	PHEP(2,I)	PHEP(3,I)	PHEP(4,I)	PHEP(5,I)
1	(H_10)	2	25	0	0	0	-1	64.76461	36.89882	-85.27080	165.00632	120.00000
2	(Z0)	2	23	0	0	4	5	-20.93803	74.93719	-46.09124	128.13017	90.76869
3	(Z0)	2	23	0	0	6	7	-43.82658	-111.83601	135.70969	202.97218	91.39216
4	(e-)	2	11	2	0	0	-1	-52.27536	39.18375	-5.40356	65.55363	0.00051
5	(e+)	2	-11	2	0	0	-1	31.33734	35.75344	-40.68767	62.57654	0.00051
6	(b)	2	5	3	0	0	-1	-46.32804	-126.68961	118.36577	179.52463	4.70000
7	(b~)	2	-5	3	0	0	-1	2.50146	14.85360	17.34391	23.44756	4.70000
8	!b!	13	5	1	0	0	0	-46.32804	-126.68961	118.36577	179.52463	4.70000
9	!b~!	13	-5	0	0	0	0	2.50146	14.85360	17.34391	23.44756	4.70000
10	!gen. code!	13	94	8	0	11	12	-43.82658	-111.83601	135.70969	202.97218	91.39217
11	!b!	13	5	10	0	0	0	-32.17294	-87.78651	82.77557	125.47591	12.28167
12	!b~!	13	-5	10	0	0	0	-11.65365	-24.04950	52.93412	77.49628	49.89456
13	!b!	13	5	11	0	0	0	-28.83106	-70.58688	67.73966	102.29365	7.84792
14	!g!	13	21	11	0	0	0	-3.34188	-17.19963	15.03590	23.18226	2.08411
15	!b~!	13	-5	12	0	0	0	-8.46566	12.69089	19.39651	26.00661	8.20933

problems about framework

- using Miyamoto-san's JSF framework, the stdhep file can be successfully generated, no matter how many events specified.

- using my JSF framework (20101024), stdhep file could be generated if I specified small number of events (about 100). If 10,000 events specified, every time the generation will be stopped at some event (only for Higgs concerned generators):

```
Error: Symbol G__exception is not defined in current scope  sim.C:49:
Error: type G__exception not defined FILE:/data17/jlc/tianjp/lcsoft/physsim/20101024/higgs/ZZHStudy++/prod/./sim.C LINE:49
*** Interpreter error recovered ***
Processed event 3289  End event 3289
```

differences between Miyamoto-san's and my JSF framework

	my	Miyamoto-san's
clhep	2.0.4.0	2.0.4.3
java	1.5.0_14	1.4.2_12
geant4	4.9.1.p03	4.9.2.p01

problems emerged in Mokka

- using Miyamoto-san's JSF framework, the stdhep file can be successfully generated, then be passed to Mokka.
- however, for ZZH and ZHH stdhep file, Mokka stopped after a few events:

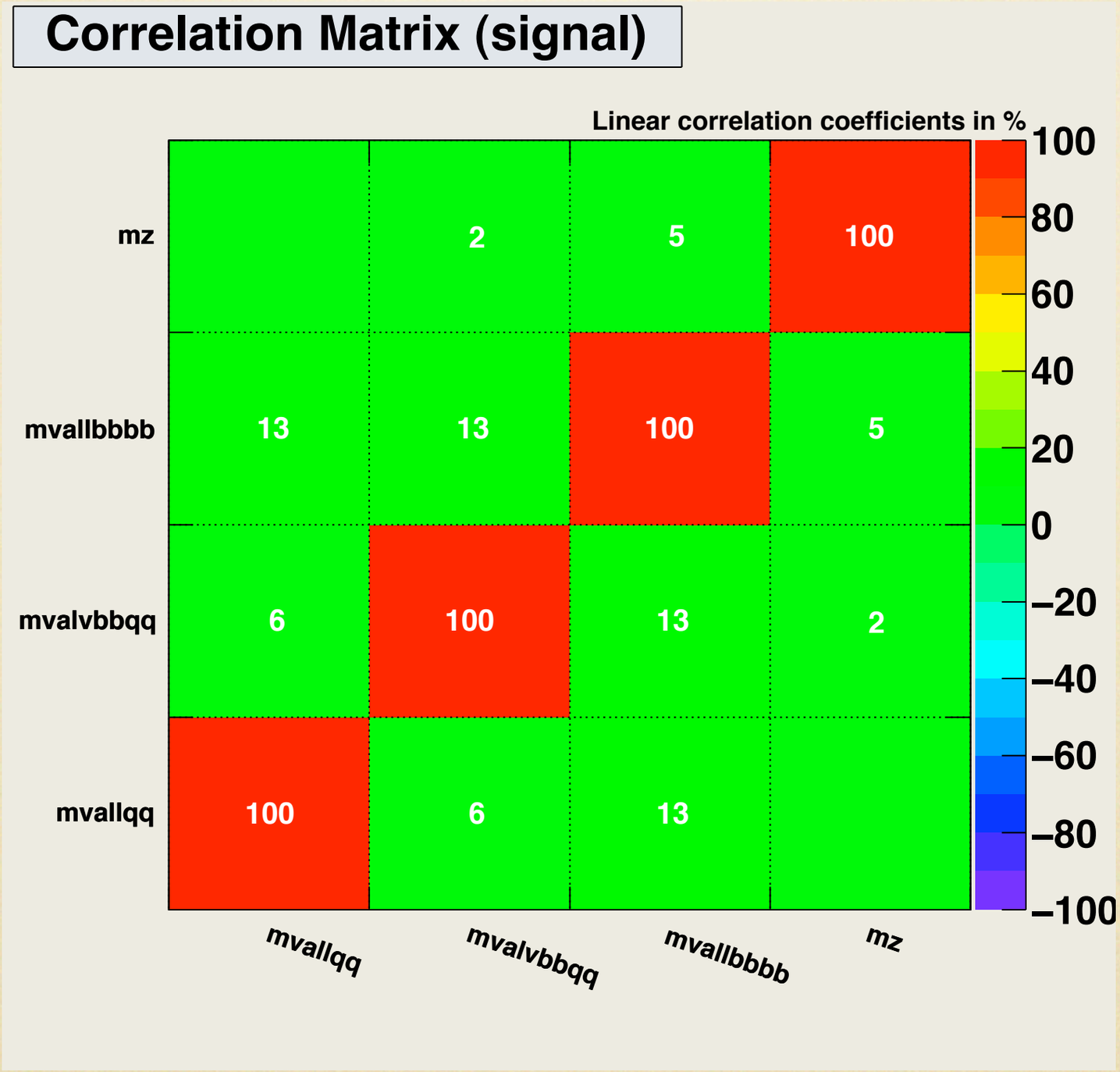
```
Mokka: src/HepLCIOInterface.cc:307: virtual void
HepLCIOInterface::GeneratePrimaryVertex(G4Event*): Assertion `mcpIT != Map.end()' fa
iled.
tmp/DST06-07-p01_kek-ppr004_pythia_physsim_e1e1bbh_01_s001.sh: line 2: 17009
Aborted
```

summary

- only full simulation of ZH with Physsim was successful, though there is wrong mother-daughter relation in the stdhep file.
- stdhep files of ZZH, ZHH though can be generated, but couldn't be simulated by Mokka
- Non-Higgs processes ZZZ, WWZ are OK.
- what should I investigate?

backup

correlation check between each neural-net output



due to the careful choice of variables in each neural-net training, the correlation is relatively small.