

Dark matter search in higgs portal scenario

'10 10/29

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status

- Next, setup the dark-matter mass **under** 60GeV and check the ILC sensitivity of higgs-dark matter coupling.
 - But, if dark matter mass is set under 60GeV, the cross-section become **wrong** value. So the generator code must be modified.
- Change the Γ_h from **0 to 0.1** and the no of samples from **8×10^4 to 5×10^5** .

Setup

- Checked dark-matter mass : 40GeV
- Ecm : 300 GeV
- Beam polarization : electron +0.8, positron -0.3

Modify generator code

Prebious code

Modified code

calculation of cross-section

```

<- Result of each iteration -> <- Cumulative Result ->< CPU time >
IT Eff R_Neg Estimate Acc% Estimate(+ Error)order Acc% (H: M: Sec)
-----
1 87 0.00 6.304e+10 69.829 6.303590(+4.401731)E 10 69.829 0: 0: 0.00
2 98 0.00 1.057e+07 85.934 1.057161(+0.908231)E 07 85.912 0: 0: 0.00
3 93 0.00 2.499e+05 37.269 2.509393(+0.931130)E 05 37.106 0: 0: 0.00
4 94 0.00 1.686e+09 93.237 2.509452(+0.931130)E 05 37.
5 84 0.00 3.251e+06 89.066 2.540441(+0.930649)E 05 36.
6 70 0.00 1.016e+06 93.333 2.613116(+0.926202)E 05 35.
7 86 0.00 9.469e+03 47.063 1.905037(+0.445109)E 04 44.288 0: 0: 0.00
8 80 0.00 8.235e+05 61.351 1.011350(+0.445091)E 04 44.010 0: 0: 0.00
9 94 0.00 7.368e+06 78.136 1.011790(+0.445091)E 04 43.990 0: 0: 0.00
10 97 0.00 7.735e+04 53.978 1.087338(+0.442583)E 04 40.703 0: 0: 0.00
-----

```

calculation of cross-section

```

<- Result of each iteration -> <- Cumulative Result ->< CPU time >
IT Eff R_Neg Estimate Acc% Estimate(+ Error)order Acc% (H: M: Sec)
-----
1 87 0.00 1.160e+08 2.641 1.160328(+0.030647)E 08 2.641 0: 0: 0.01
2 91 0.00 1.164e+08 1.027 1.163102(+0.011136)E 08 0.957 0: 0: 0.02
3 91 0.00 1.175e+08 0.811 1.169946(+0.007242)E 08 0.619 0: 0: 0.03
0.00 1.164e+08 0.768 1.167559(+0.005628)E 08 0.482 0: 0: 0.04
0.00 1.192e+08 0.789 1.174101(+0.004830)E 08 0.411 0: 0: 0.06
0.00 1.177e+08 0.802 1.174655(+0.004299)E 08 0.366 0: 0: 0.07
7 93 0.00 1.172e+08 0.734 1.174165(+0.003846)E 08 0.328 0: 0: 0.08
8 92 0.00 1.182e+08 0.717 1.175431(+0.003502)E 08 0.298 0: 0: 0.09
9 92 0.00 1.188e+08 0.733 1.177248(+0.003249)E 08 0.276 0: 0: 0.10
10 92 0.00 1.170e+08 0.696 1.176232(+0.003018)E 08 0.257 0: 0: 0.12
-----

```

accuracy up

Z decay mode

```

+-----+-----+-----+-----+
| E 01 | 0.000   E 00|
| 0.000 | 4.635+-4.159 E 04|o**
| 0.100 | 1.058+-0.591 E 04|o
| 0.200 | 7.657+-4.180 E 03|o
| 0.300 | 7.100+-5.028 E 03|o
| 0.400 | 1.145+-0.737 E 03|o
| 0.500 | 4.775+-4.082 E 03|o
| 0.600 | 7.171+-7.090 E 05|o*****
| 0.700 | 6.398+-2.380 E 03|o
| 0.800 | 4.113+-2.648 E 05|o*****
| 0.900 | 9.616+-4.677 E 04|o*****
| 1.000 | 1.223+-0.747 E 05|o*****
| 1.100 | 0.000+-0.000 E 00|
| E 01 | 0.000   E 00|
+-----+-----+-----+-----+

```

Z decay mode

```

+-----+-----+-----+-----+
| E 01 | 0.000   E 00|
| 0.000 | 7.838+-0.046 E 06|*****
| 0.100 | 7.824+-0.048 E 06|*****
| 0.200 | 7.825+-0.048 E 06|*****
| 0.300 | 3.904+-0.042 E 06|*****
| 0.400 | 3.910+-0.038 E 06|*****
| 0.500 | 3.911+-0.040 E 06|*****
| 0.600 | 1.407+-0.006 E 07|*****
| 0.700 | 1.396+-0.006 E 07|*****
| 0.800 | 1.804+-0.007 E 07|*****
| 0.900 | 1.799+-0.007 E 07|*****
| 1.000 | 1.786+-0.007 E 07|*****
| 1.100 | 0.000+-0.000 E 00|
| E 01 | 0.000   E 00|
+-----+-----+-----+-----+

```

Definition of q square

Definition of q^2
in current code

```

Double_t rs = fEcmIP;
Double_t qmin = m3 + m4;
Double_t qmax = rs - 2*fMass;
#ifdef __ZEROWIDTH__
  fQ2Z = fZBosonPtr->GetQ2BW(qmin, qmax, fXQ2Z, weight);
#else
  fQ2Z = TMath::Power(fZBosonPtr->GetMass(),2);
  weight = kPi*fZBosonPtr->GetMass()*fZBosonPtr->GetWidth();
#endif
bsWeight *= weight;

// DD system
Double_t qhd2min = TMath::Power(2*fMass,2);
Double_t qhd2max = TMath::Power(rs - TMath::Sqrt(fQ2Z),2);
  fQ2HH = qhd2min + (qhd2max - qhd2min)*fXQ2HH;
bsWeight *= qhd2max - qhd2min;

```

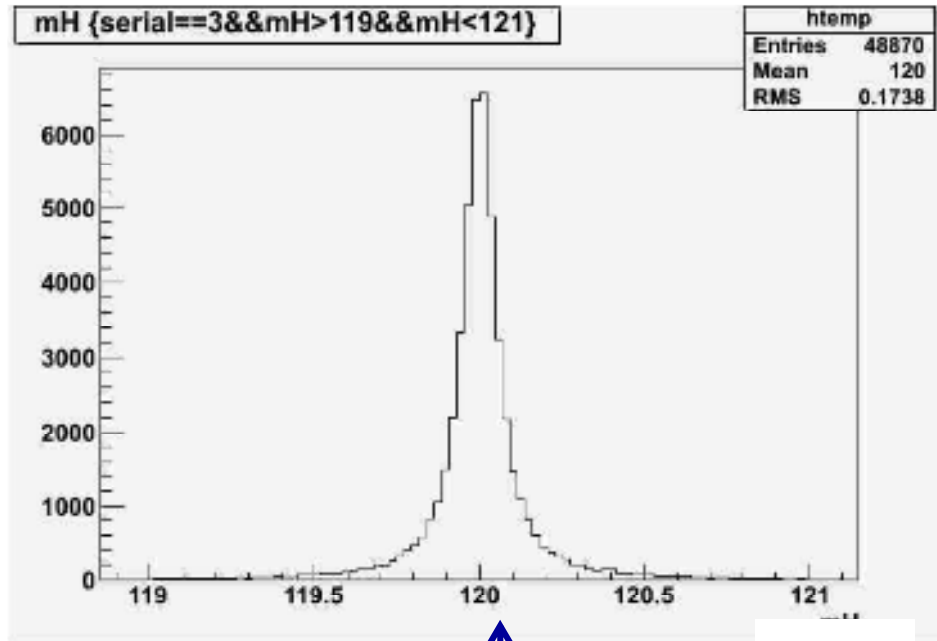
Z ; $q_z^2 = m\Gamma \tan \theta + m^2$; $(0 < \theta < 1)$ \longrightarrow **Breit Wigner** distribution

$$H ; q_h^2 = (2m)^2 + \left(\left(\sqrt{s} - \sqrt{q_z^2} \right)^2 - (2m)^2 \right) x ; (0 < x < 1)$$

\longrightarrow **uniform** distribution between q_{min}^2 and q_{max}^2 ? ⁴

Check the **generator** information

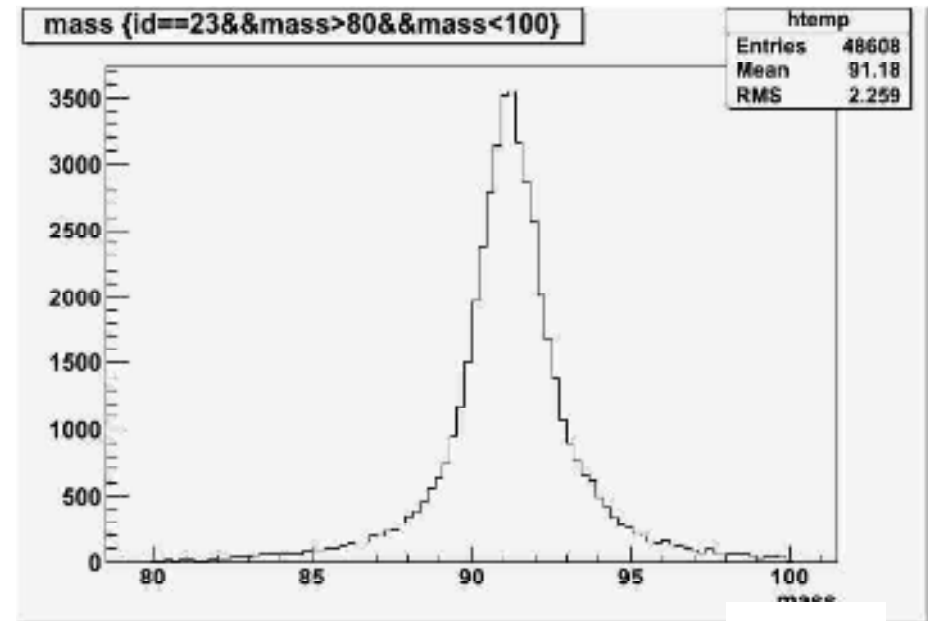
Higgs mass (generator level)



GeV

Set up : $\Gamma_h = 0.1$, Mass = 120 GeV

Z mass (generator level)



GeV

Higgs mass distribution is Breit Wigner type?

Summary & plan

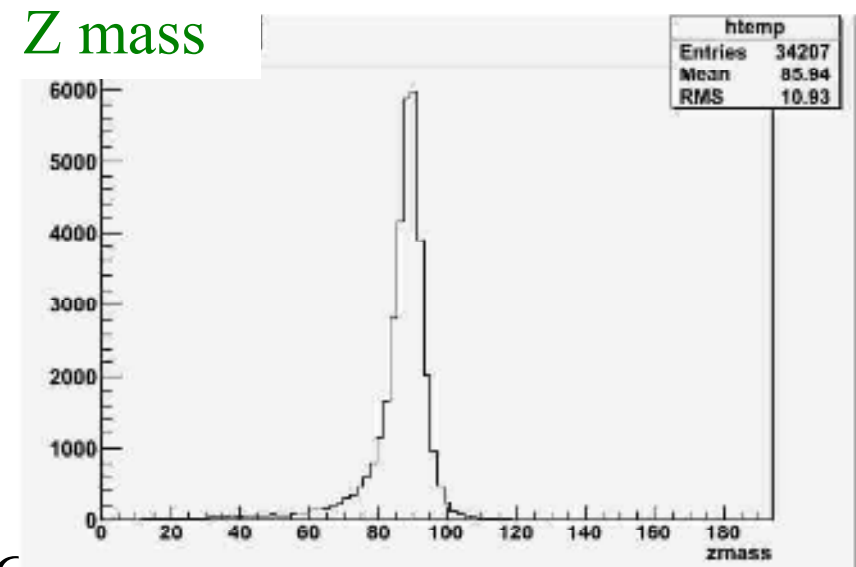
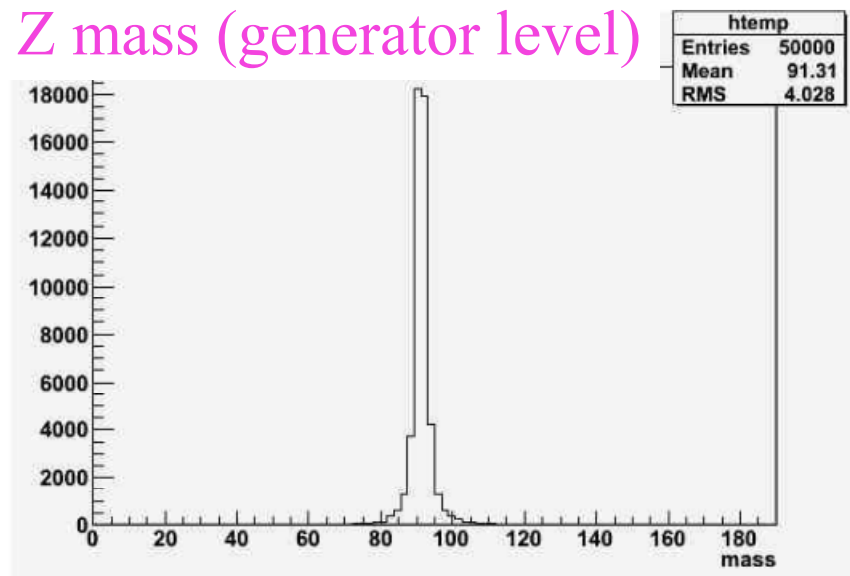
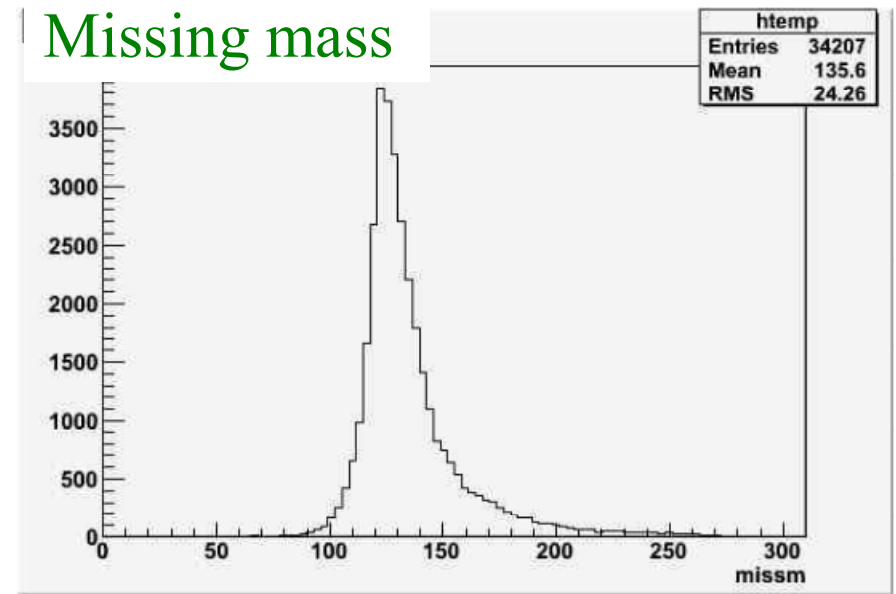
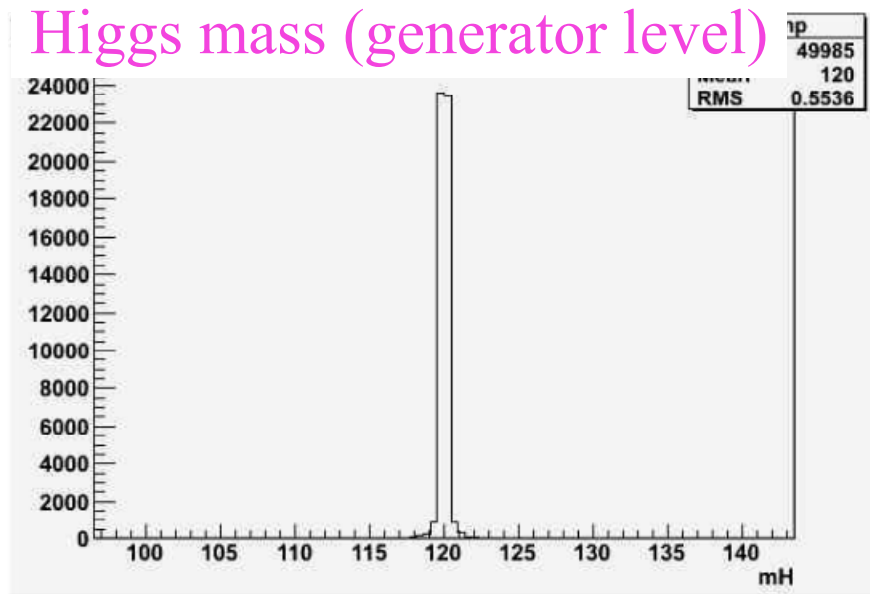
Summary

- The generator code was modified in order to fit the On-Shell case.

Plan

- check the ILC sensitivity of higgs-dark matter coupling.

Check the generator information and the detector one



Good reconstruction