Matrix Element Method for ILC Physics Analysis

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http://ilcphys.kek.jp/meeting/physics/archives/2009-05-19/GGGuide.pdf

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status: Physsim-v01

- going to be released as one package in ilcsoft quite soon.
- core libraries implemented: HELLib (HELAS), LCME (so far LCMEZH, LCMENNH, LCMEEEH, LCMEZHH, LCMENNHH included).
- verified by using MC truth information.
  - typical way to use it: include physsim library in your $MARLIN_DLL; using namespace lcme; follow example marlin processor.

login.cc.kek.jp:/home/ilc/tianjp/analysis/PostDBD/Physsim-v01/lib/libPhyssim.so

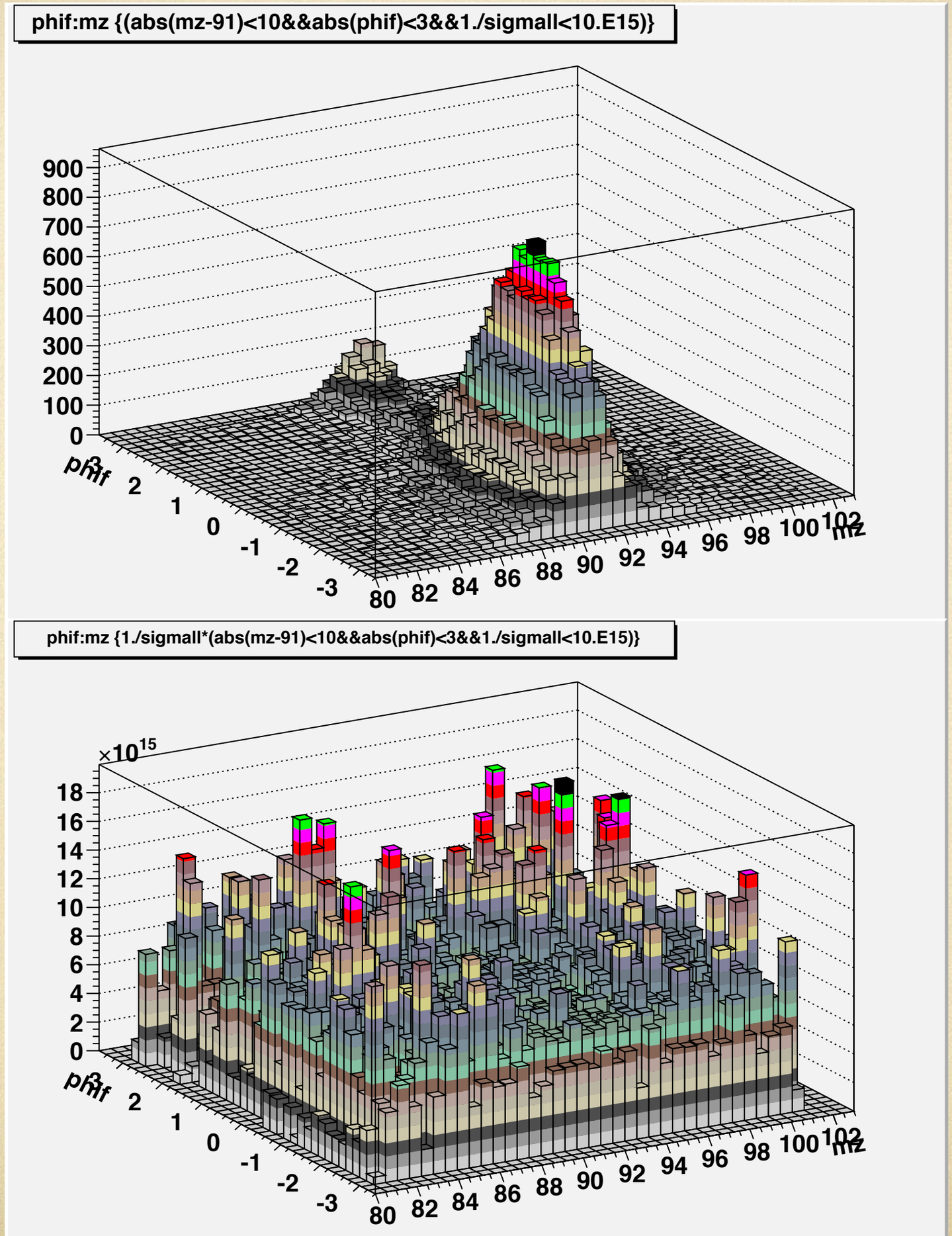
/home/ilc/tianjp/analysis/PostDBD/Physsim-v01/example_stdhep/src/MEMExampleProcessor.cc

example code in your marlin processor

```
  // initialize LCMEZHH with Higgs mass of 125 GeV and beam
polarisations P(e-,e+) = (0.,0.)
  _zhh = new LCMEZHH("LCMEZHH","ZHH",125.,0.,0.);
  // set mode of Z decay
  _zhh->SetZDecayMode(5);

  // ---------------------------------
  // calculate the matrix element
  // ---------------------------------
  // put four-momenta of final states to an array
  TLorentzVector vLortzMC[4] = {lortzLep1MC, lortzLep2MC, lortzH1MC, lortzH2MC};
  // pass kinematics to ME object
  _zhh->SetMomentumFinal(vLortzMC);
  // matrix element can be given for each combination of initial and final helicities
  Int_t vHelLL[2] = {-1,-1};
  Int_t vHelLR[2] = {-1,1};
  Int_t vHelRL[2] = {1,-1};
  Int_t vHelRR[2] = {1,1};
  Double_t dSigmaLL = _zhh->GetMatrixElement2(vHelLL);
  Double_t dSigmaLR = _zhh->GetMatrixElement2(vHelLR);
  Double_t dSigmaRL = _zhh->GetMatrixElement2(vHelRL);
  Double_t dSigmaRR = _zhh->GetMatrixElement2(vHelRR);
  // if no combination of helicities specified, final combinations are summed
  // and initial combinations are weighted by beam polarisations
  Double_t dSigma   = _zhh->GetMatrixElement2();
  // that's all need to do to get matrix elment for each event
  // ---------------------------------
```

verification: ZHH

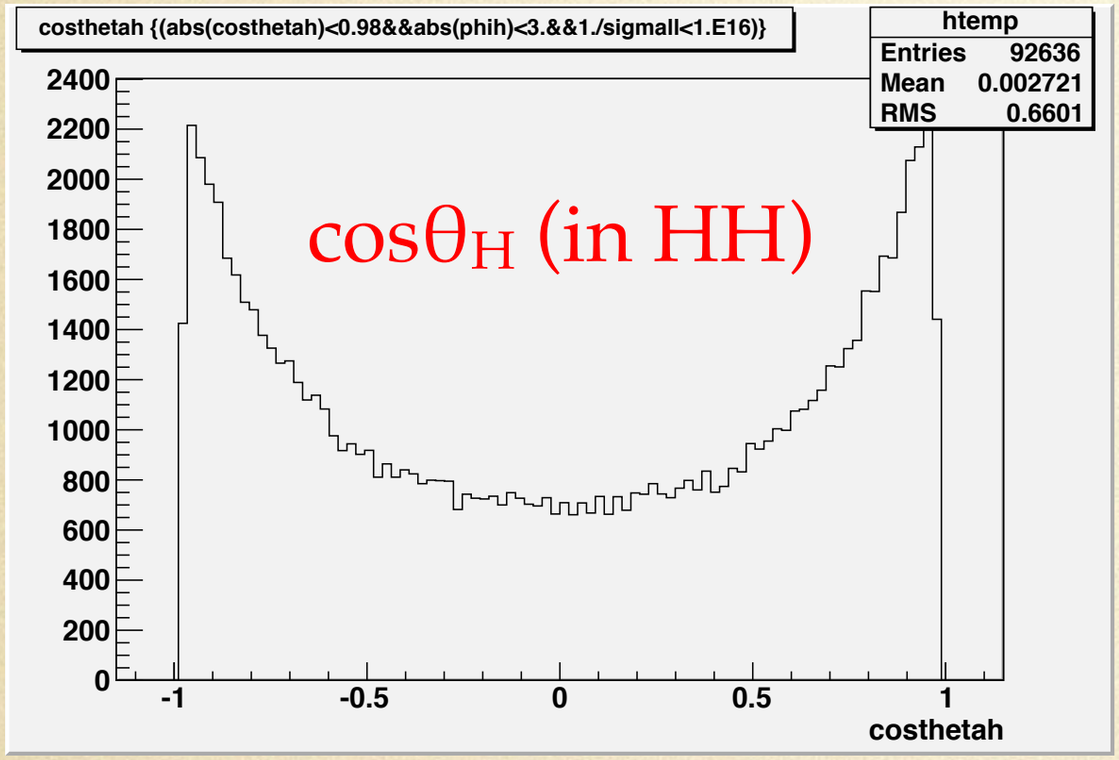


original events

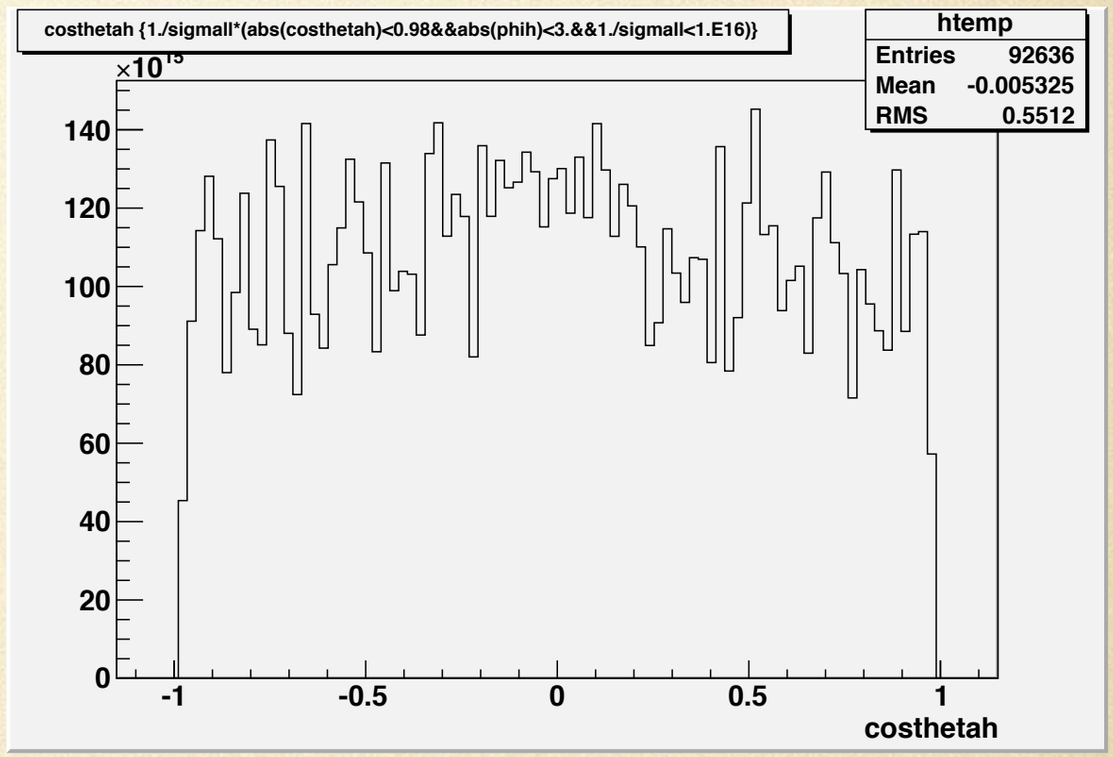
weighted by $\frac{1}{|\mathrm{ME}|^2}$

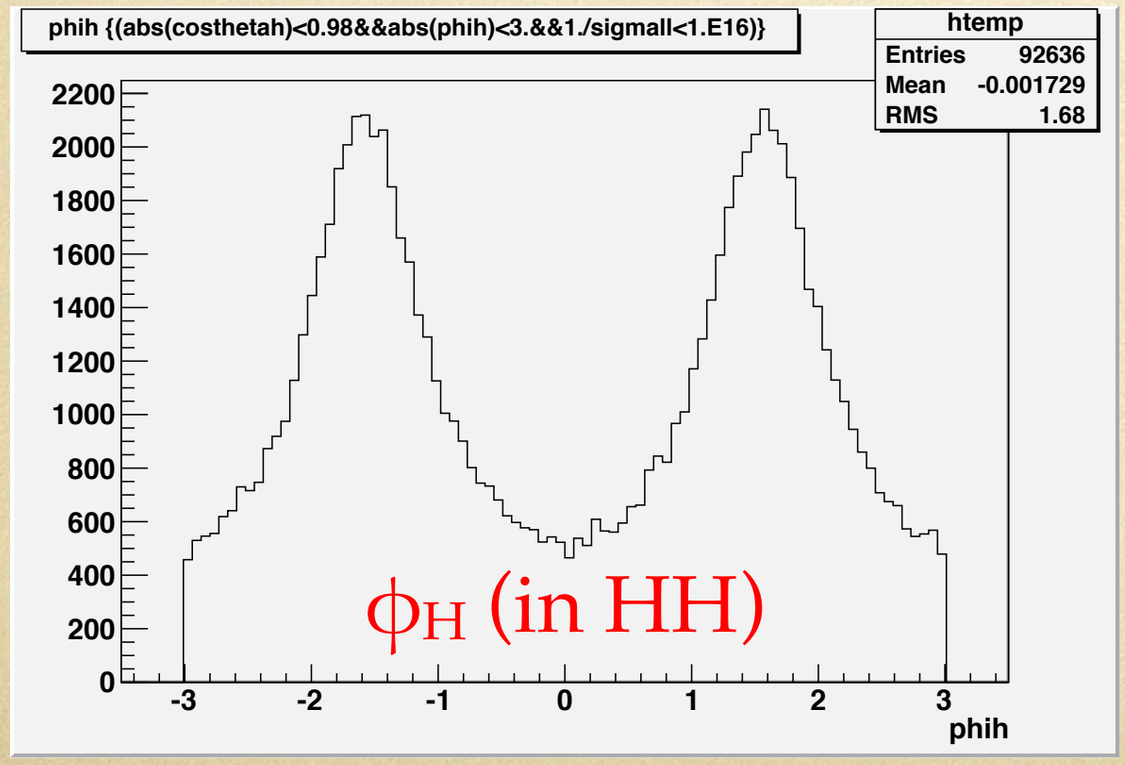
verification: $\nu\nu$HH

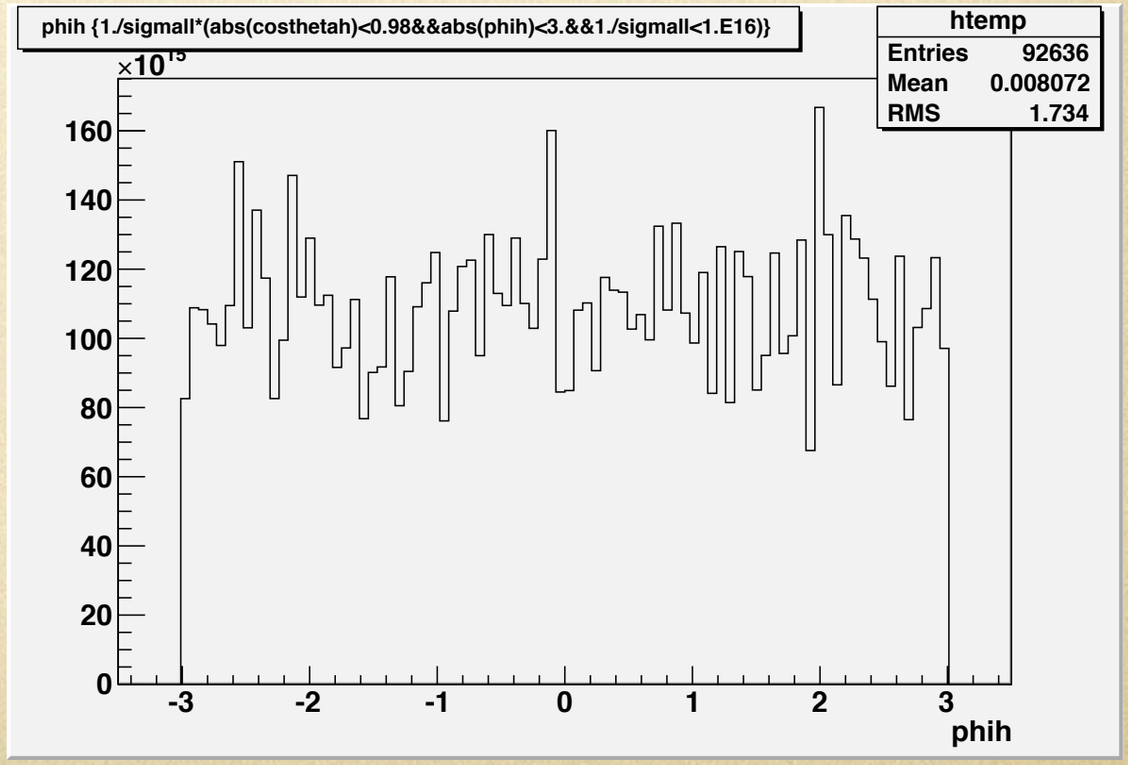
original events



weighted by $\frac{1}{|ME|^2}$







next plan

- apply ME method to some simple analysis: ννH, H—>bb (where both signal LCMENNH and dominated background LCMEZH are implemented).
- will soon meet the technical challenge: include detector resolution, integration of ME.
- if you are interested in applying ME to your analysis, or interested in developing this package, welcome to join us!