



ILD Analysis Activity in Berkeley

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$e^+e^- \rightarrow H^0 A^0$ for LCC-4 at 1 TeV

H⁰A⁰ Analysis with Full G4 + Marlin Reconstruction



Results of SI MDET study at the basis of comprehensive study of ILC reach in predicting DM density (**Phys.Rev.D74:103521,2006**).

Now repeat analysis with full simulation and attempt to improve result with new observables available at ILC

- Generate events with PYTHIA 6.58 + ISASUGRA 7.69
 - Full G4 Simulation with Mokka 6.01 for LDC02Sc
 - Reconstruction using Marlin + MarlinReco 00.09.06
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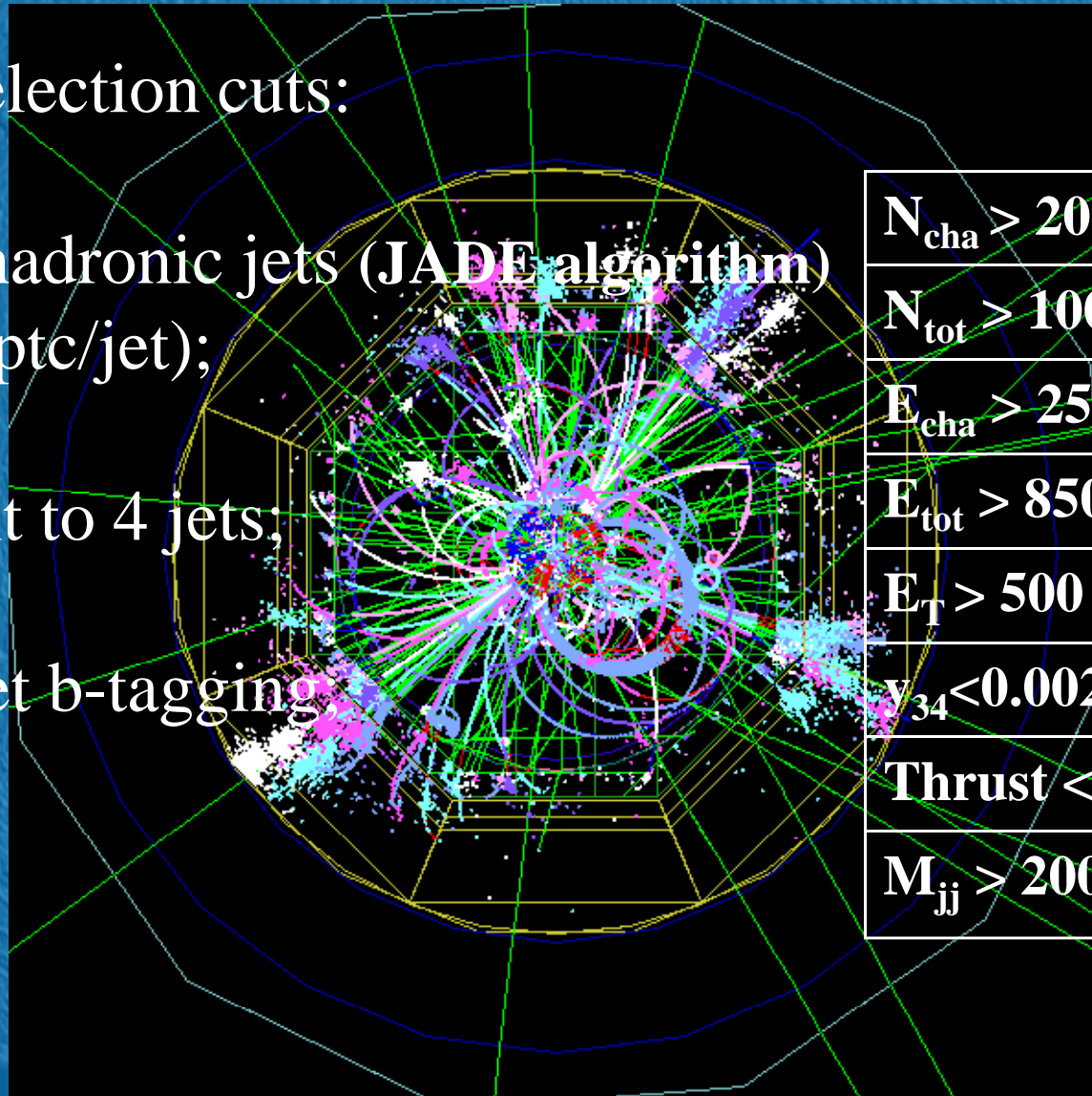
- 2500 HA at LCC4;
 - 30000 ZZ + WW + tt (PYTHIA generation)
 - 6000 tt (PYTHIA generation)
 - 2500 bbbb (EW + QCD) (COMPHEP+PYTHIA);
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G4 simulation performed at FNAL, Marlin reco on LBNL Babar/ILC cluster

$e^+e^- \rightarrow H^0 A^0$ Selection Criteria

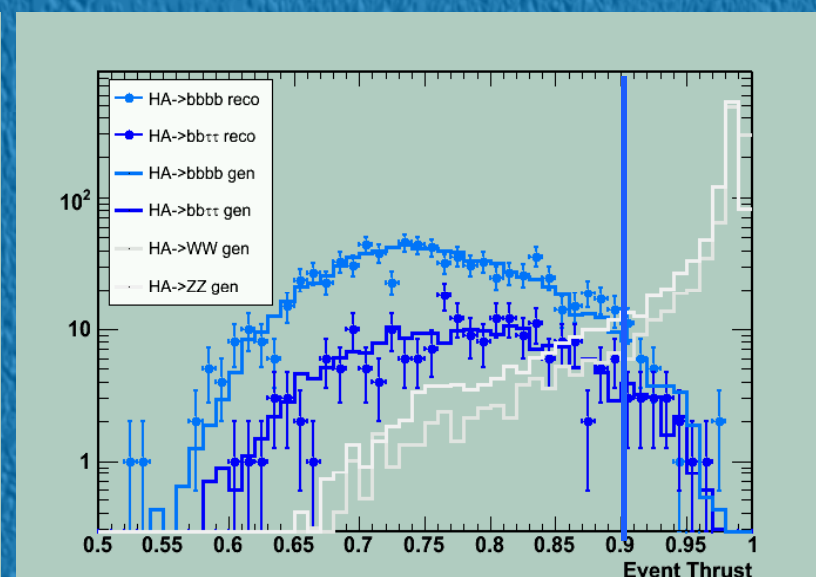
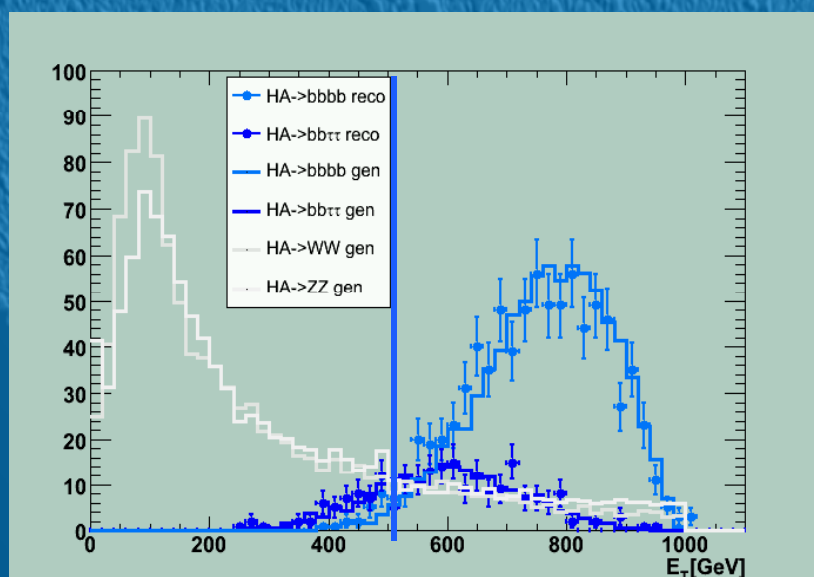
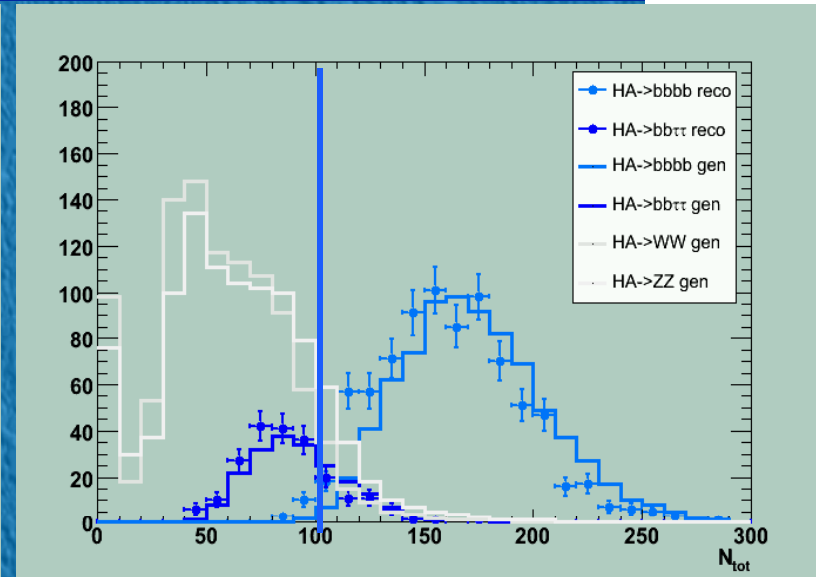
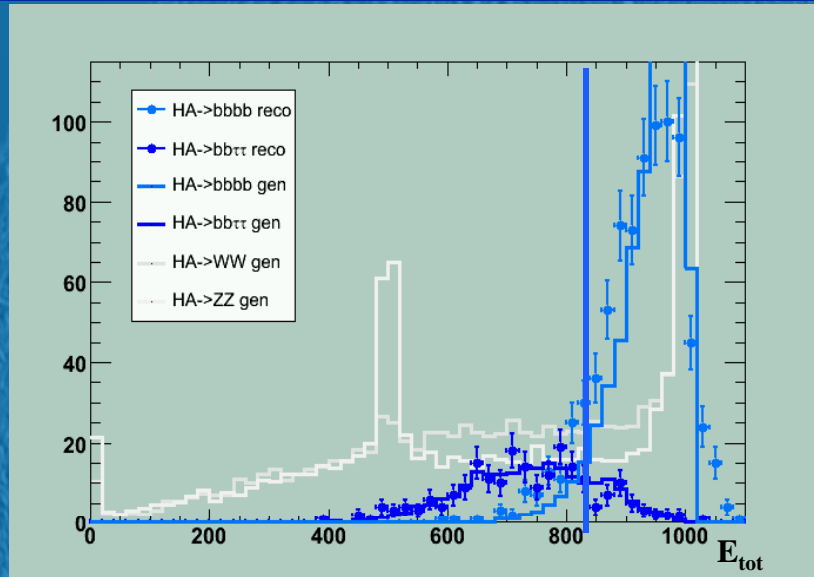


- General selection cuts:
- at least 4 hadronic jets (JADE algorithm)
(at least 5 ptc/jet);
- force event to 4 jets;
- apply di-jet b-tagging;



$N_{\text{cha}} > 20$
$N_{\text{tot}} > 100$
$E_{\text{cha}} > 250 \text{ GeV}$
$E_{\text{tot}} > 850 \text{ GeV}$
$E_T > 500 \text{ GeV}$
$\nu_{34} < 0.0025$
$\text{Thrust} < 0.90$
$M_{\text{jj}} > 200 \text{ GeV}$

$e^+e^- \rightarrow H^0 A^0$ Selection Criteria



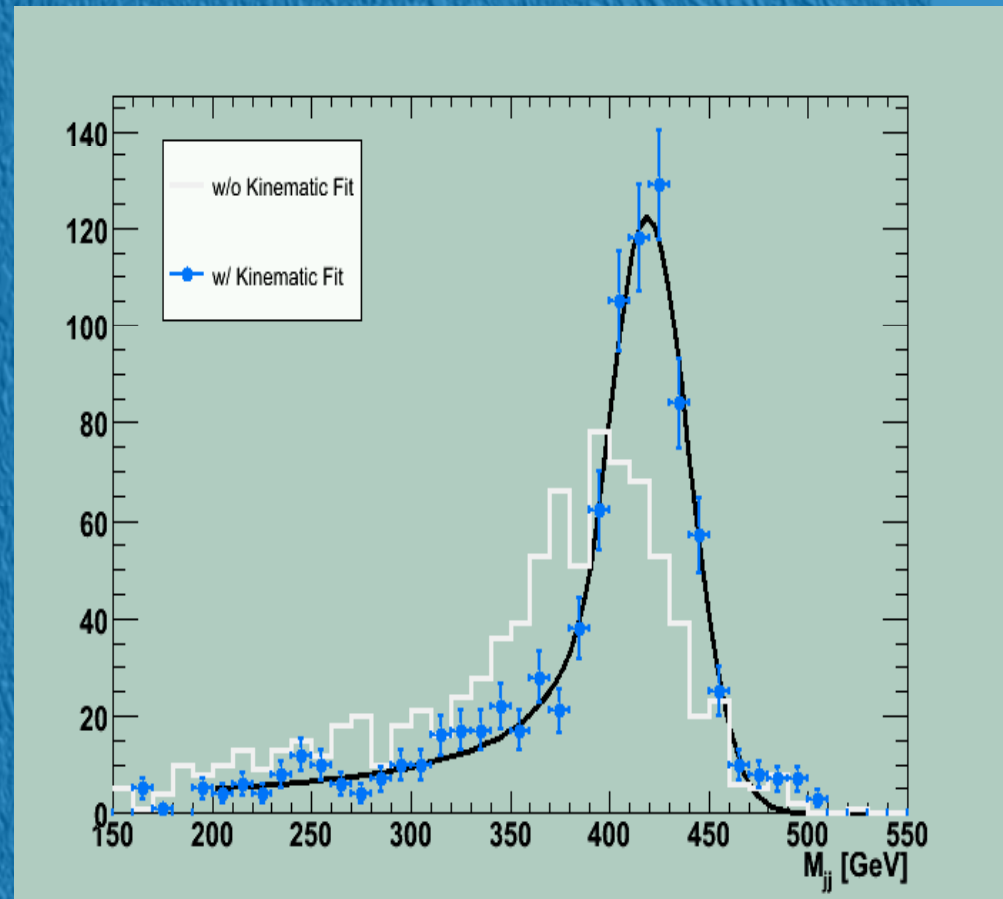
$e^+e^- \rightarrow H^0 A^0$ 4-jet Kinematic Fit



Perform constrained kinematic fit to 4-jet system, which uses Lagrange multipliers and minimises a χ^2 constructed from the measured energies and directions of the jets;

Impose centre-of-mass energy and momentum conservation;
Consider jj pairing giving smallest mass difference and plot di-jet masses M_{jj} (2 entries / evt);

Port of PUF1 TC+ developed for DELPHI at LEP2 (N Kjaer, M Mulders) to MarlinReco framework, now officially released.

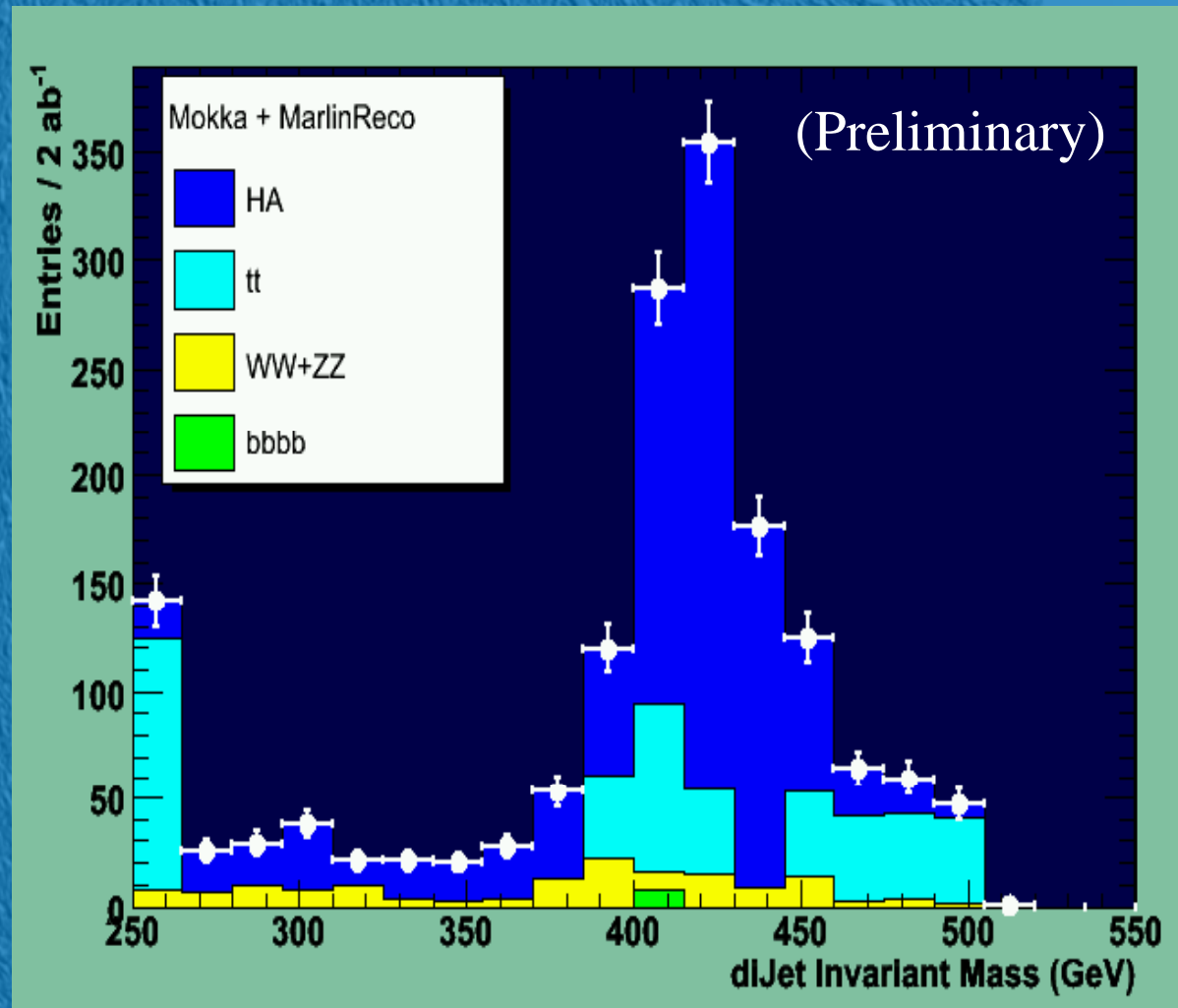


Still need larger bkg samples, in particular tt and bbbb, currently in production.

Optimise efficiency with $|M_{jj1} - M_{jj2}| < 45$ GeV

Total Efficiency 21%

Finalise analysis and bkg rejection, extract A mass and decay BRs accuracies.





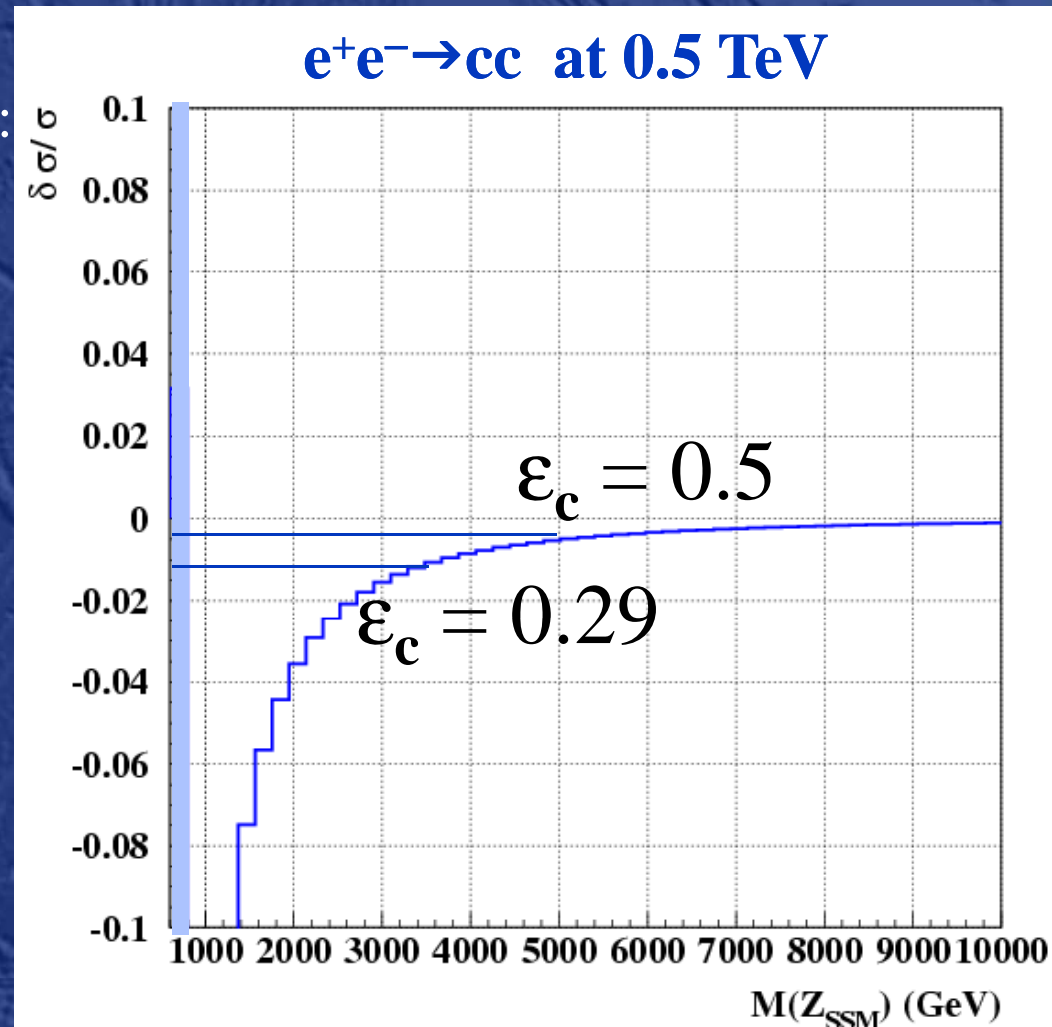
$e^+e^- \rightarrow cc$ at 0.5 TeV

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Measurement of cc cross section:
moderate cross section, requires
2 tags and low background;

	σ_{ff} (pb)
cc	0.74
bb	0.40
$\mu\mu$	0.45



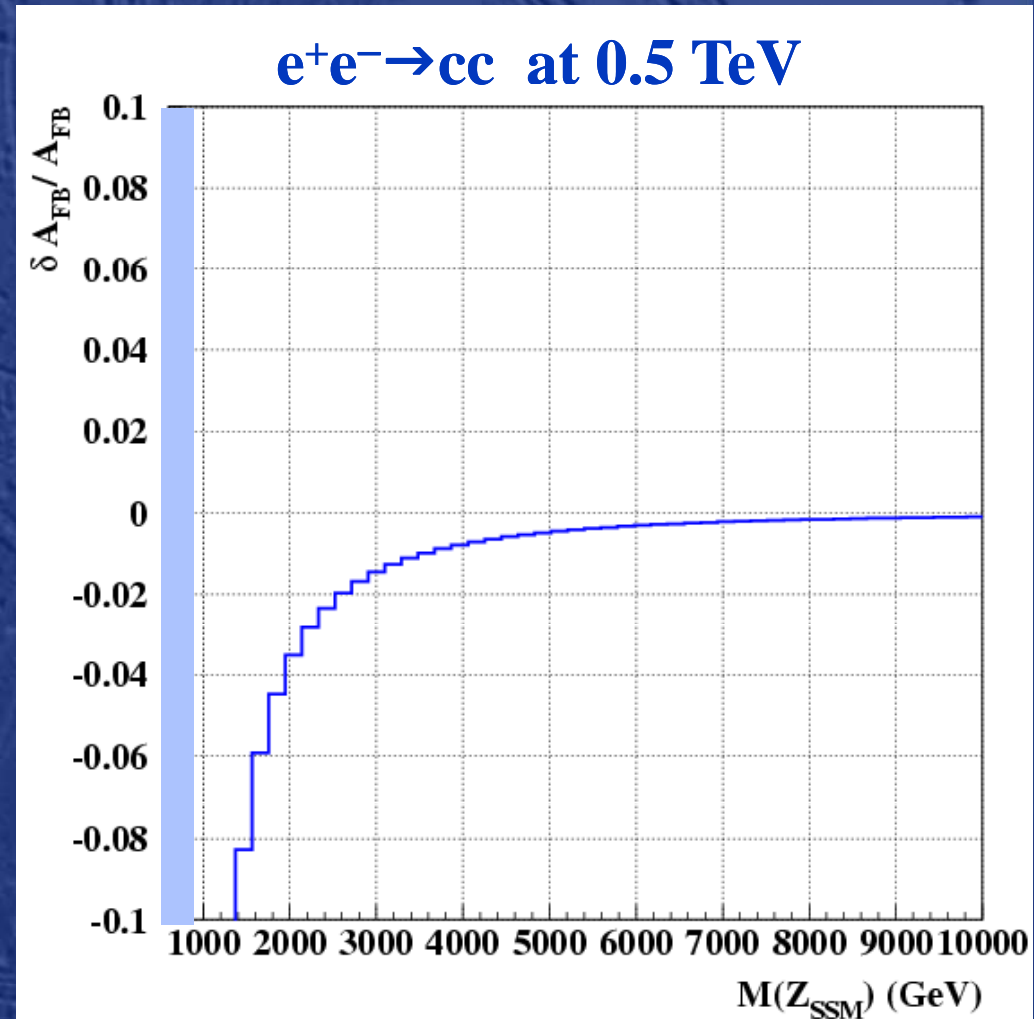
A_{FB} in $e^+e^- \rightarrow cc$ at 0.5 TeV

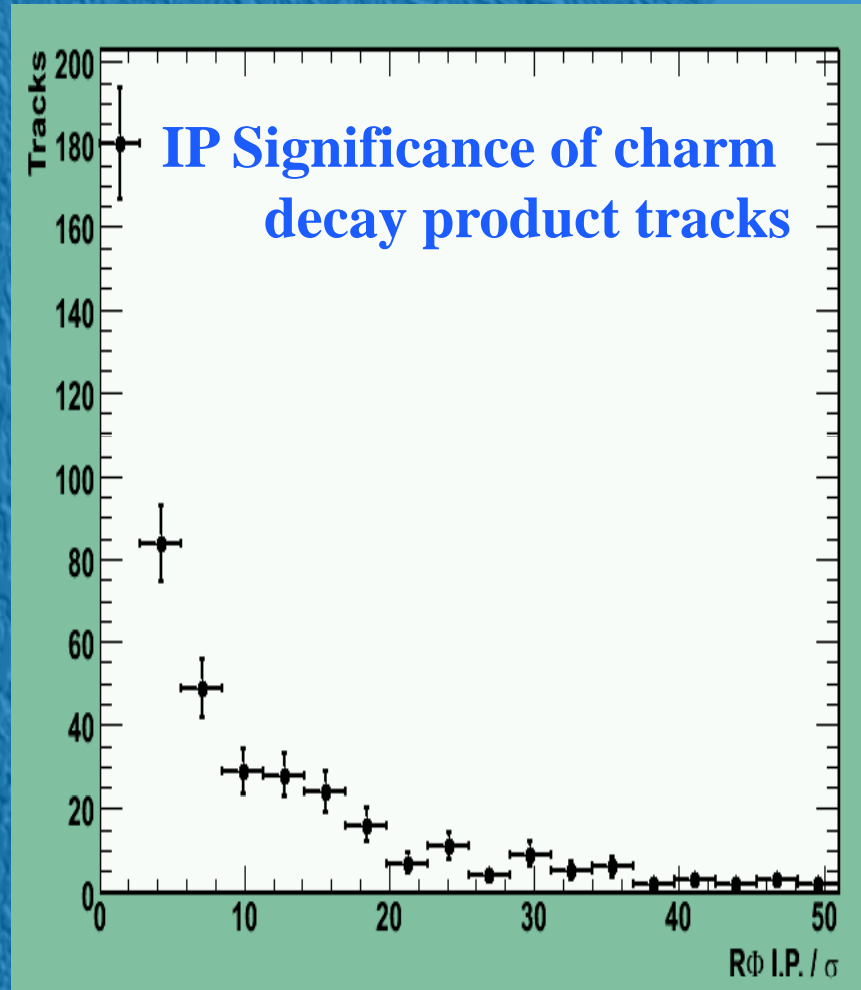
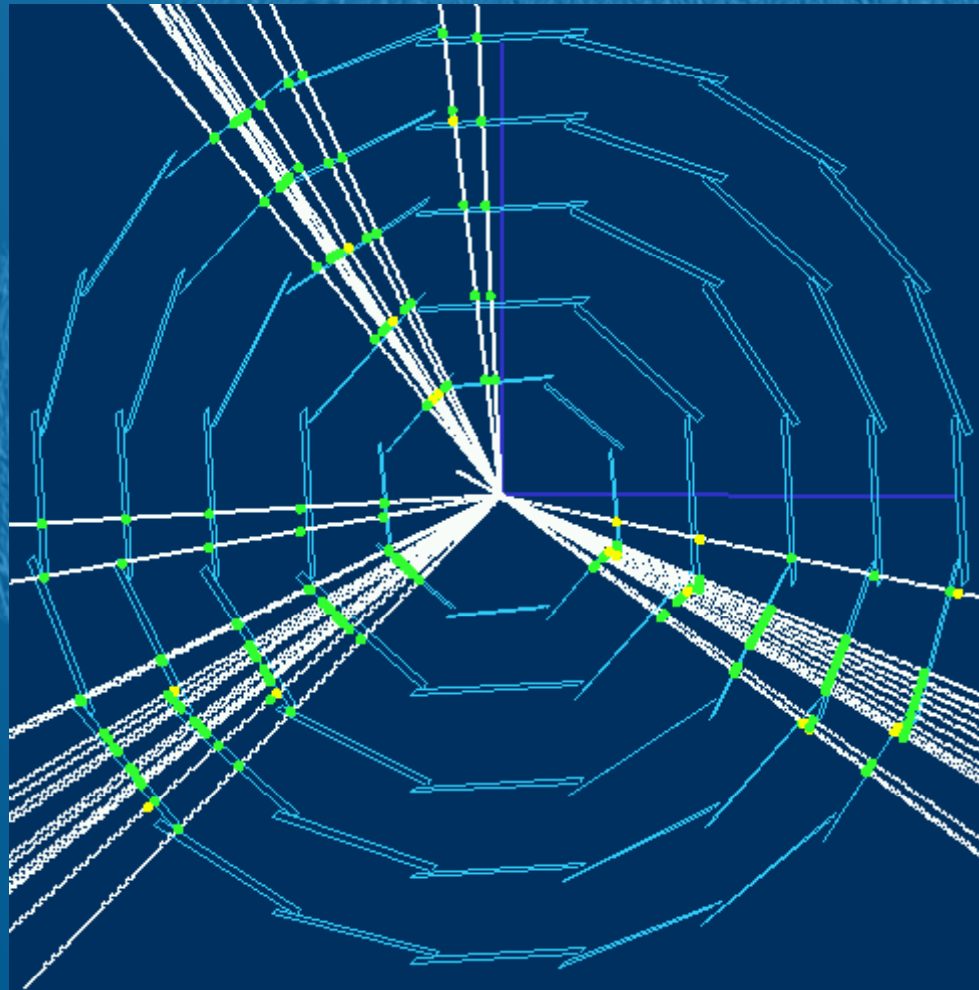


Further sensitivity on NP scale and nature can be obtained with $A_{\text{FB}}^{\text{cc}}$ determination;

Experience at LEP with Jet charge algorithms;

Improved sensitivity expected using vertex charge, requires fwd coverage;



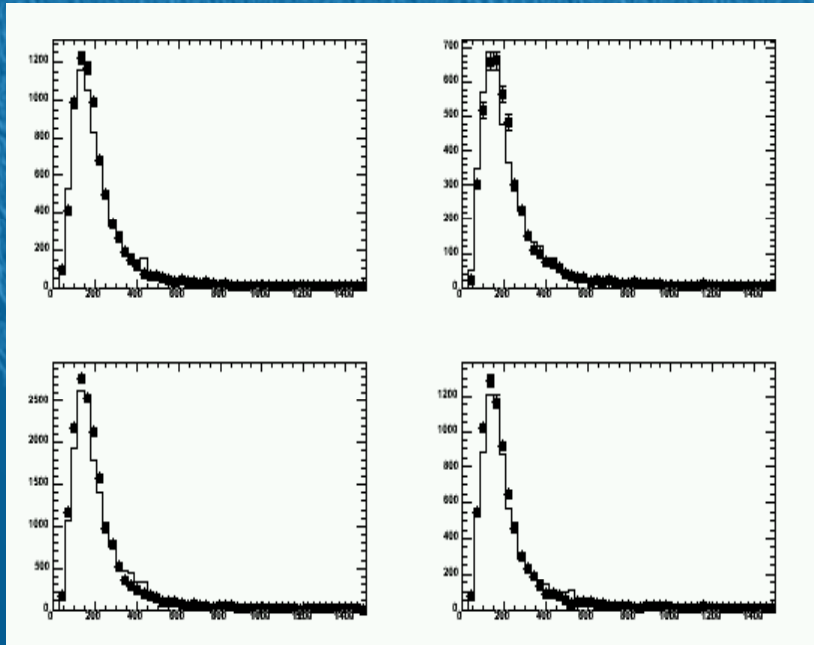


VTX Digi Validation

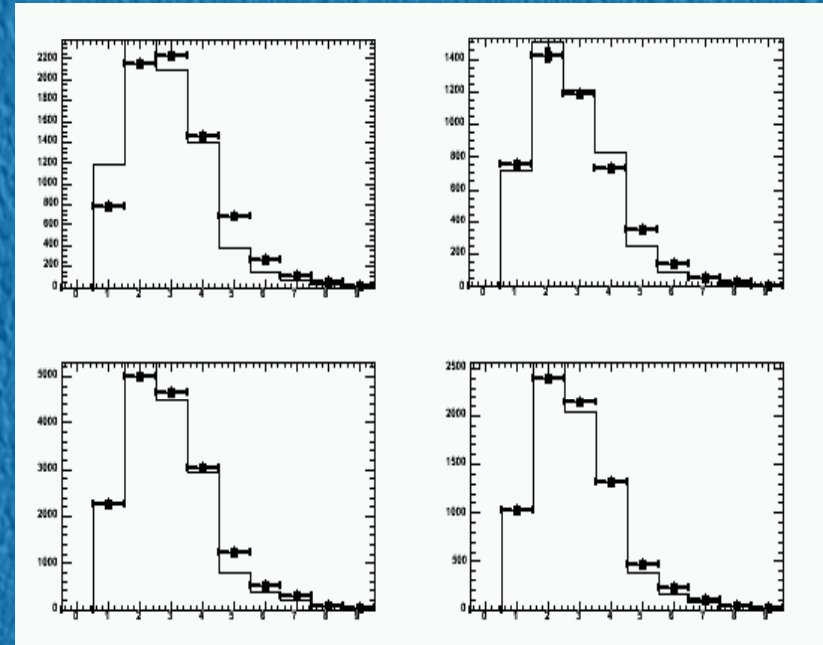


Validation of CMOS pixel signal generation (PixelSim) and cluster reco (PixelAna) using T966 beam test data (four-layered thin CMOS pixel telescope on 120 GeV p beam at MTest)

Cluster Pulse Height



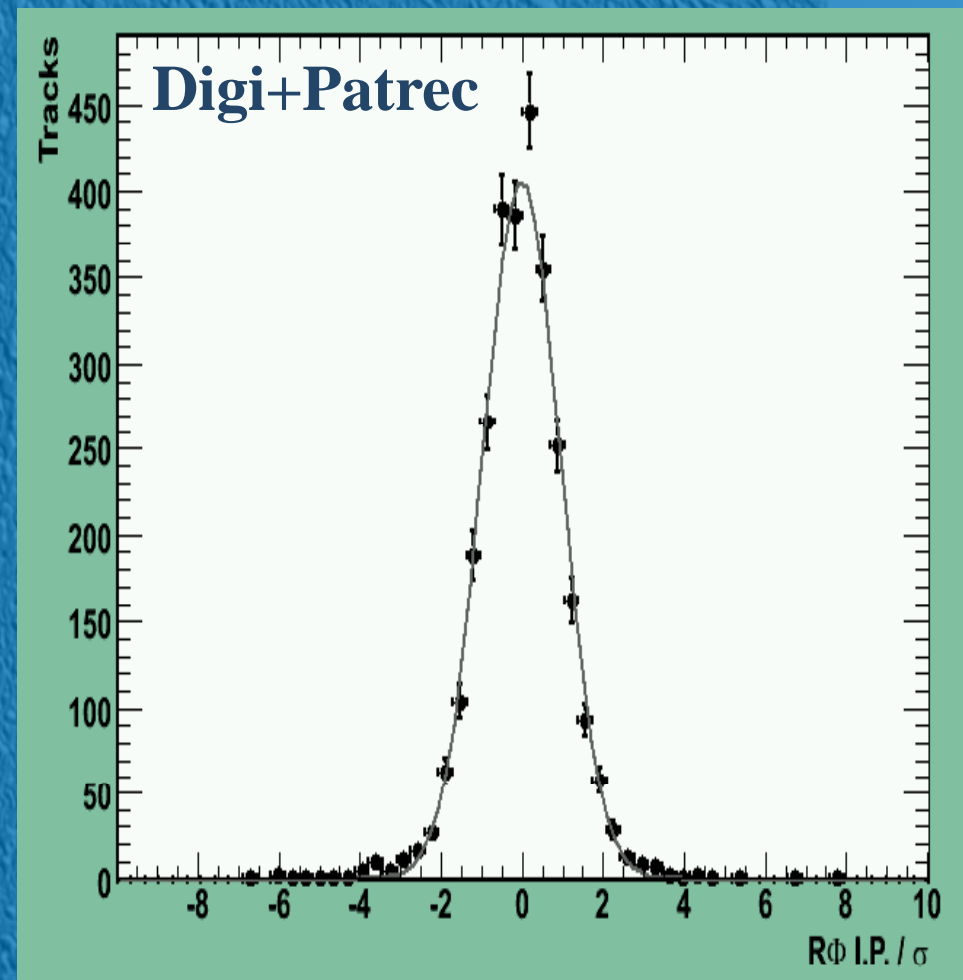
Pixel Multiplicity in Cluster



Perform full Digitisation from G4 energy deposits, local pattern recognition and simple helix fit of cc events at 0.5 TeV;

Compare width of pull distribution with same Mokka data set processed using simple hit smearer and patrec cheater:

Smear & Cheater	0.985
Digi & Patrec	0.992





Plan to finalise and publish HA analysis and carry out detailed cc analysis in the framework of the ILD Optimisation effort;

Adopt LCFI Vertexing, Flavour Tagging and Vertex Charge packages and use Digi + Patrec validated on beam test data;

Workforce is limited and shared with R&D effort, count on ~1 FTE in Berkeley and collaboration with Hawaii U, pending review of ILC activities at LBNL.