A summary of Sim/Rec/Opt session (including Benchmark joint session)

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ICEPP, The Univ. of Tokyo

Benchmark/Sim/Rec/Opt Talks

Physics/Benchmark talks (3 sessions, 15 talks in total)

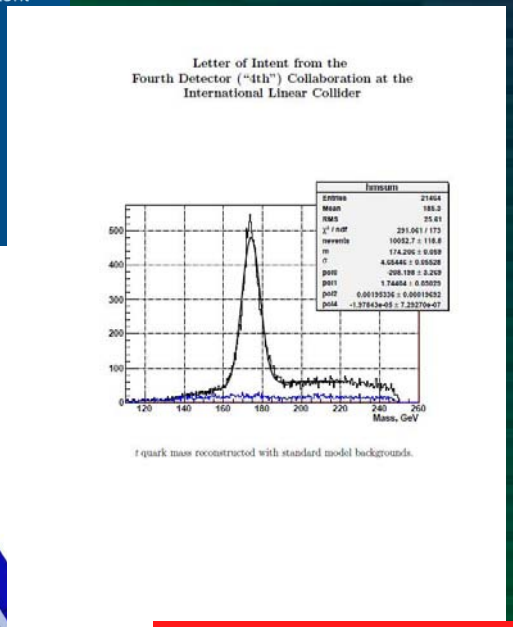
	H recoil	H jet/BR	SUSY p5	Tau	Top	Other	Total
ILD	1 talk	4 talks	1 combined talk		1 talk	1 talk	8 talks
SiD	1 talk	1 talk	1 talk	1 talk	1 talk	(1 in SUSY talk)	5 talks
4th	1 combined talk		(1 slide)	-	1 talk	-	2 talks

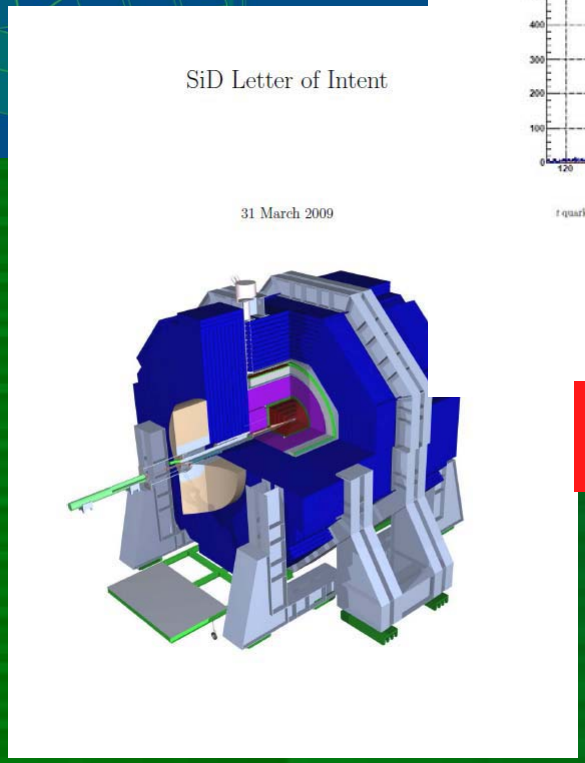
Sim/Rec/Opt talks (2 sessions, 8 talks in total)

- Software-oriented talks
  - Status of ILD/SiD(+SLAC SM)/4th Software tools
  - LHC software from CERN (WebEx)
  - Grid at KEK
- Analysis-oriented talks
  - Flavor tagging performance for ILD
  - Jet clustering with vertex information
  - PID by track + shower counter at BABAR

Otsukare-sama for the LOI analyses!

LoIs





- Benchmark physics analysis is one of the most important parts in the LoIs.
- Pages of analyses:
  - SiD: 32 out of 156 pages
  - 4th: 30 out of 117 pages
  - ILD: 24 out of 173 pages (with > 100 page notes)

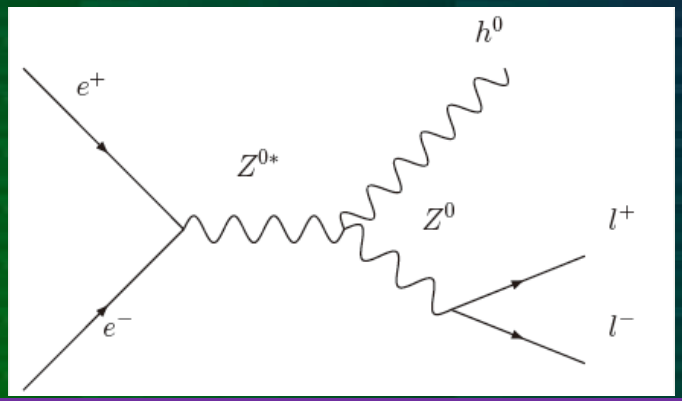
Great improvements in recent months!

お疲れ様! or "well done of hard work!" in English.

Benchmark processes

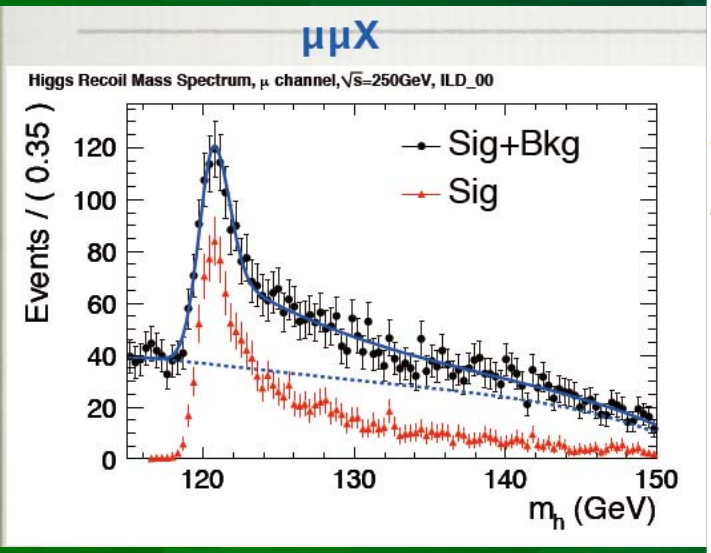
Processes ($e^+e^-\rightarrow$)	$\sqrt{s}$ (GeV)	Observables	Comments
$ZH, ZH\rightarrow e^+e^-X,$	250	σ, m_H	m_H=120GeV, test materials and γ_{ID}
$\rightarrow\mu^-\mu^+X$	250	σ, m_H	m_H=120GeV, test $\Delta P/P$
$ZH, H\rightarrow cc, Z\rightarrow\nu\nu$	250	$Br(H\rightarrow cc)$	Test heavy flavour tagging and anti-tagging of light quarks and gluon
$, Z\rightarrow qq$	250	$Br(H\rightarrow cc)$	Same as above in multi-jet env.
$Z^* \rightarrow \tau^+\tau^-$	500	$\sigma, A_{FB}, Pol(\tau)$	Test π^0 reconstruction and τ rec. aspects of PFA
$tt, t\rightarrow bW, W\rightarrow qq'$	500	σ, A_{FB}, m_{top}	Test b-tagging and PFA in multi-jet events. m_{top}=175GeV
$\chi^+\chi^-, \chi_2^0\chi_2^0$	500	$\sigma, m\chi$	Point 5 of Table 1 of BP report. W/Z separation by PFA

Higgs recoil mass @ √s = 250 GeV

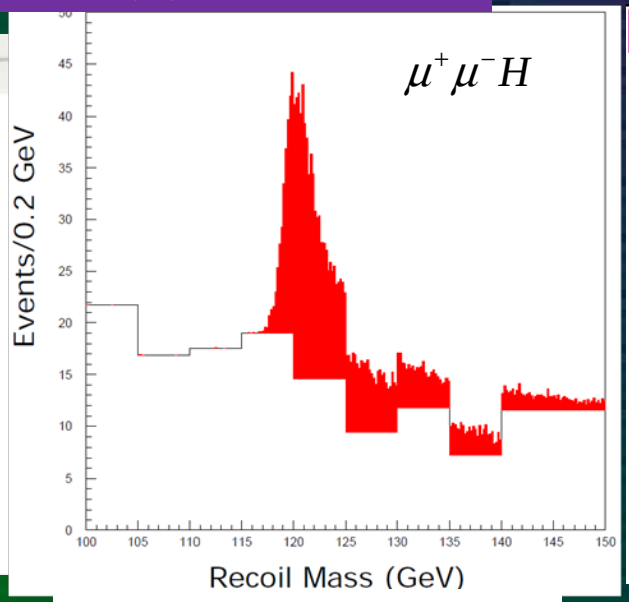


- The most powerful mode for Higgs mass determination.
- Mass obtained only from lepton tracks: tracking performance.

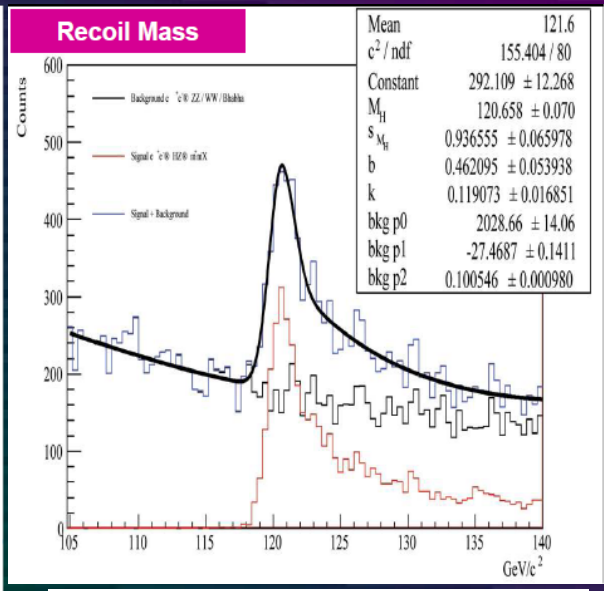
Recoil mass distributions in μμH mode



ILD by Hengne Li



SiD by Tim Barklow



4th by Corrado Gatto

Higgs recoil mass results

Claimed results:

Observables	ILD		4th
δ (μμH σ)	6.6%		5.7%
δ (μμH mass)		MeV	296 MeV
δ (eeH		7.8%	5.0%
δ (e	150 MeV	90 MeV	400 MeV

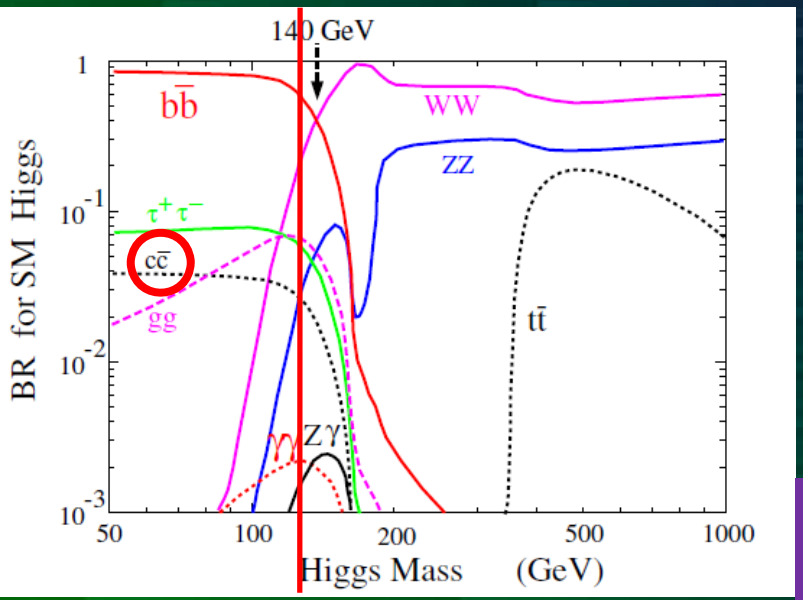
Analysis conditions are much varied,
DO NOT compare the numbers literally.

fb^{-1}, e^-_L initial state (80%/100%)

Discussions:

- Beamstrahlung of SLAC SM events is wrongly applied.
  - All concepts use the SLAC SM events (so no bias for that).
  - Results will be significantly improved with correct beamstrahlung.
- SiD result depends on a parabola fit of χ^2 with two points.
  - Controversy was raised for its reliability.

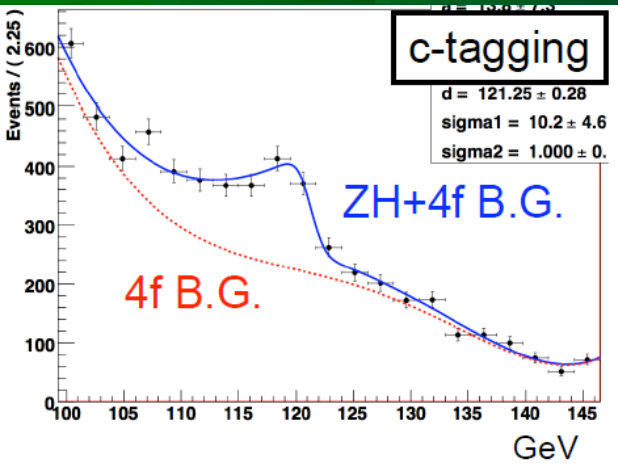
Higgs BR analysis @ √s = 250 GeV

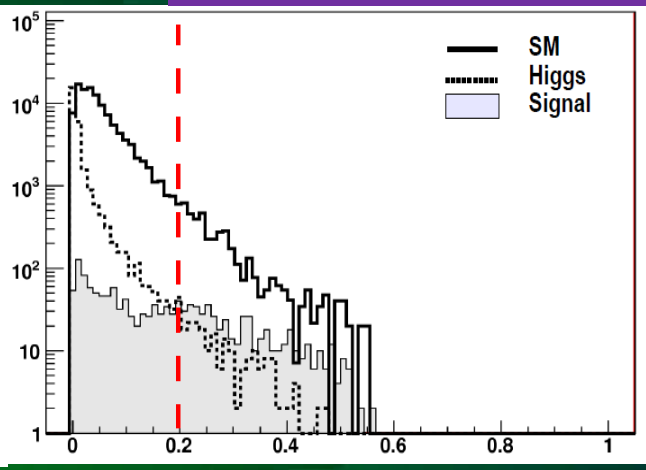


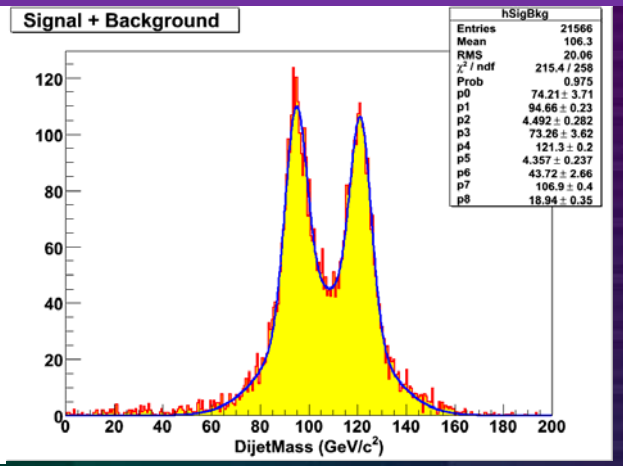
120 GeV

- H→cc branching ratio (~3.4%) needs c-tagging
- 2-jet and 4-jet channels
- Vertexing & c-tagging performance

Mass (ILD/4th) / NN output (SiD) plots for ZH→ννqq channel







ILD by Kohei Yoshida

SiD by Marcel Stanitzki

4th by Corrado Gatto

Higgs BR results

Claimed results:

Observables			4th
δ(Br(H		%	-
	30%	6%	-

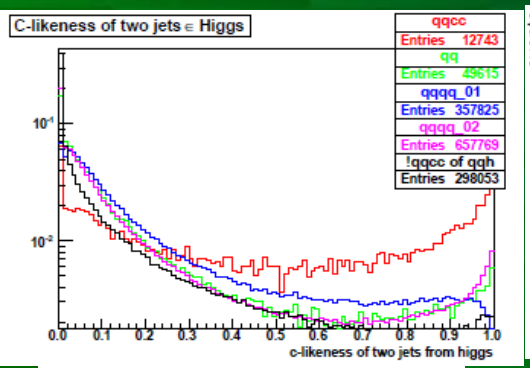
250 fb^{-1}

Analysis conditions are much varied,
DO NOT compare the numbers literally.

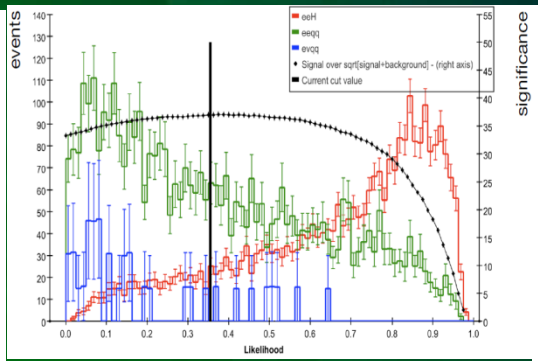
Discussions:

- # events with no cut is inconsistent between ILD & SiD?
- We should investigate cuts more carefully…

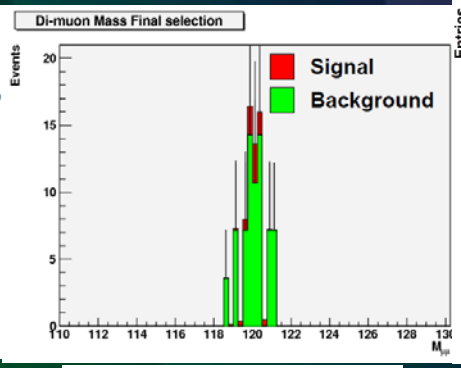
Other talks/plots for ZH



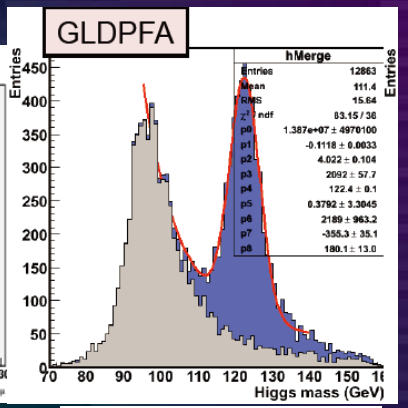
ILD qqqq by C.Liu



ILD llqq by R.Walsh

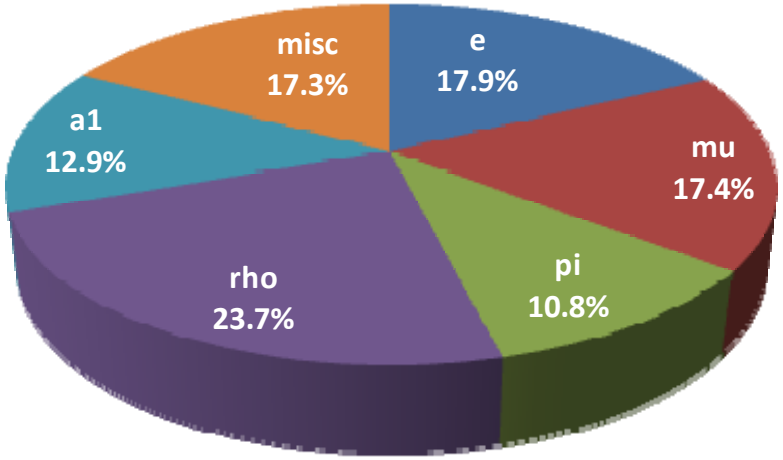


SiD H->μμ
by M.Stanitzki



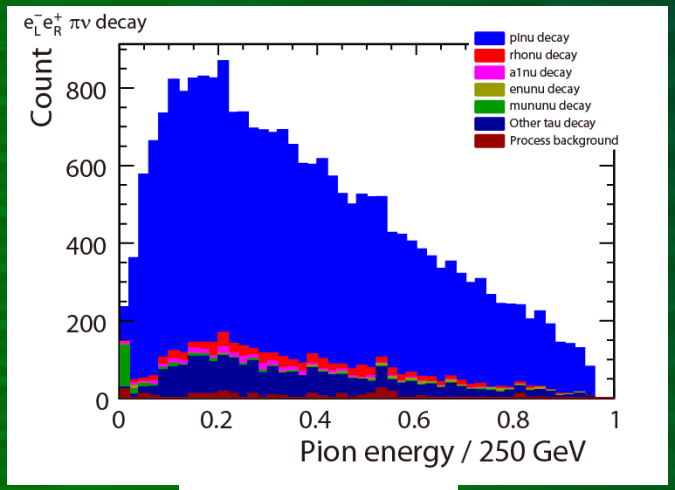
PFA in Higgs
by H.Ono

Tau-pair analysis @ √s = 500 GeV



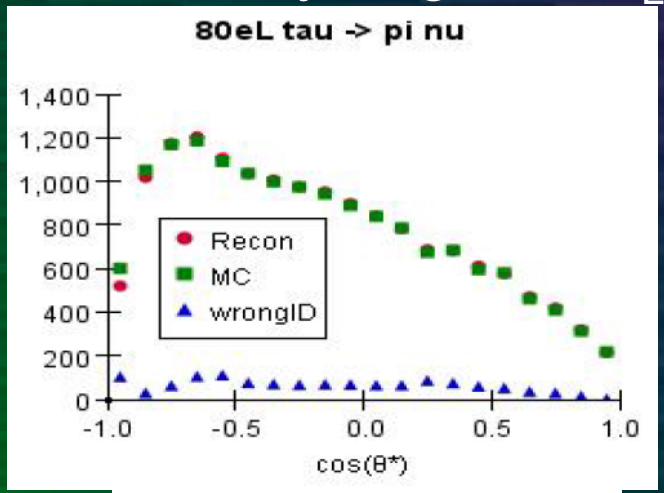
Branching ratio of tau

- Tracking/particle separation in narrow angle.
- Decay mode separation and polarization measurement.



ILD by TS

πν decay angle of e^-_L(80%)



SiD by Tim Barklow

No talk from 4th...

Tau-pair results

Claimed results:

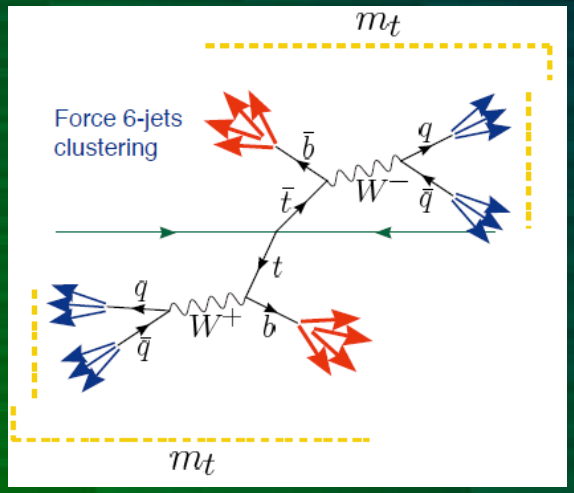
Observables	ILD		4th
$\delta(\sigma)$	0.33%(e^-_L) 0.37%(e^-_R)		-
$\delta(A_{FB})$	0.29% (all)	%(e^-_L) 0.24%(e^-_R)	-
$\delta(P(\tau)$ (Stati	L) %(e^-_R) ($\pi\nu$ only)	0.9%(e^-_L) 1.0%(e^-_R) (all except a_1)	-

Analysis conditions are much varied,
DO NOT compare the numbers literally.

Discussions

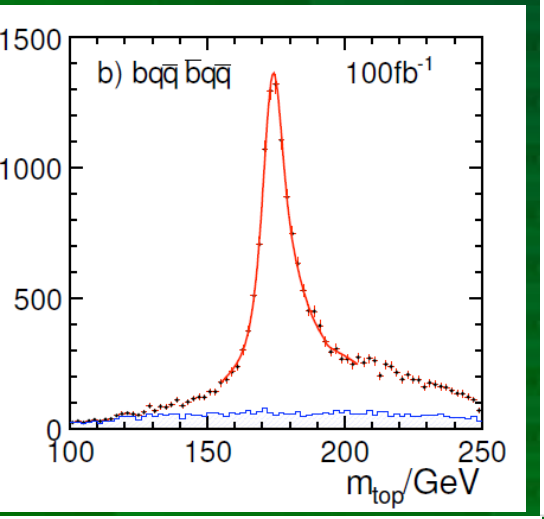
- Cross section and A_{FB} depends on acceptance of radiative tau-pairs

Top-pair analysis @ √s = 500 GeV

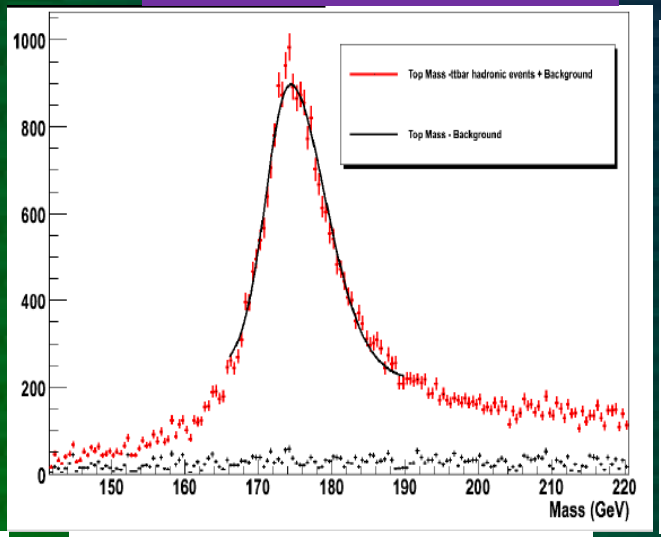


- Jet identification and b-tagging for 6-jet environment.
- Jet(or vertex) charge ID.
- Top mass, σ and A_{FB}.

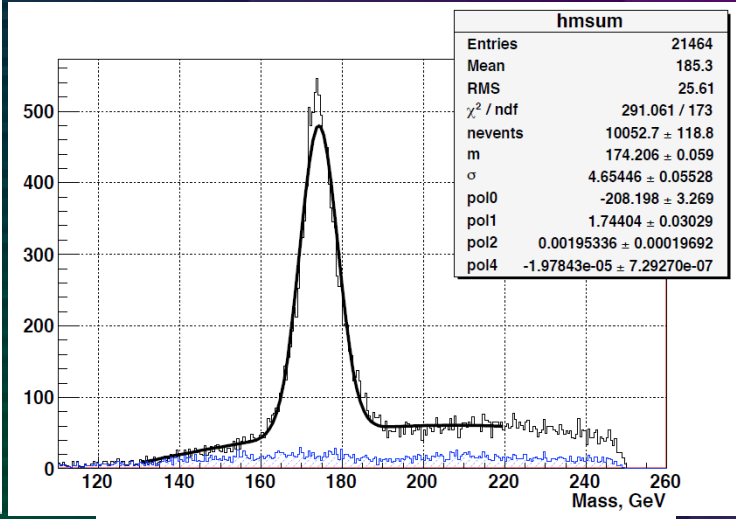
Top mass plots



ILD by Katsumasa Ikematsu



SiD by Norman Graf



4th by John Hauptman

Top-pair results

Claimed results:

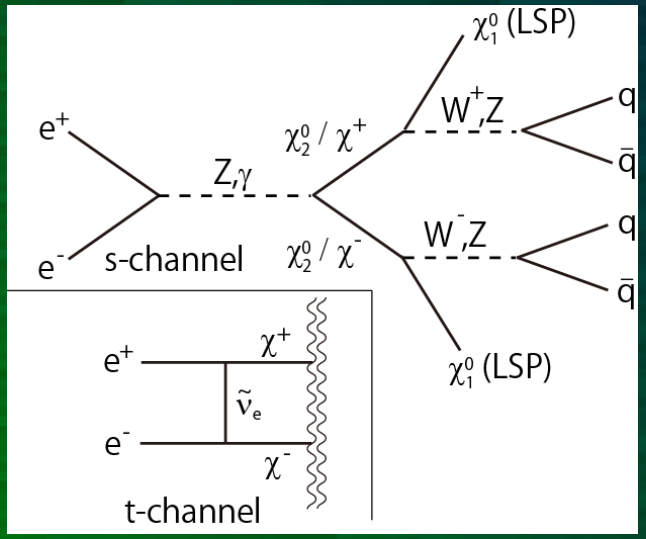
Observables	ILD		4th
$\delta(\sigma)$	0.4[illegible]		?
$\delta(m_{top})$	[illegible]	[illegible] MeV	50 MeV
	-	1.5%	-

Analysis conditions are much varied,
DO NOT compare the numbers literally.

Discussion

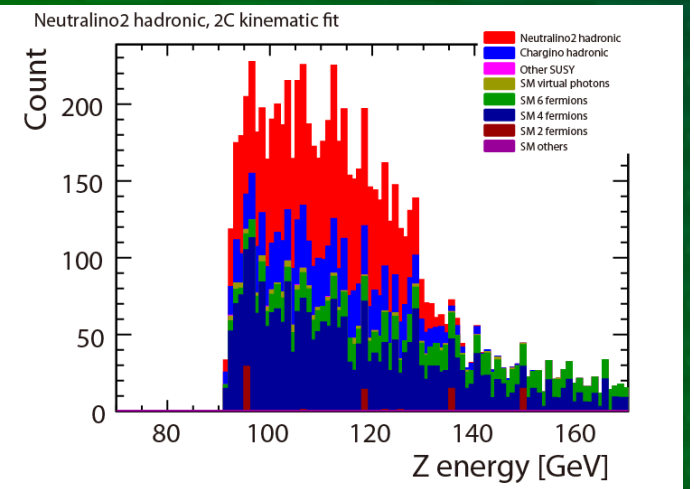
- Results are almost consistent.
- Anyway, threshold scan must give much better resolution for m_{top}.

SUSY point5 @ √s = 500 GeV

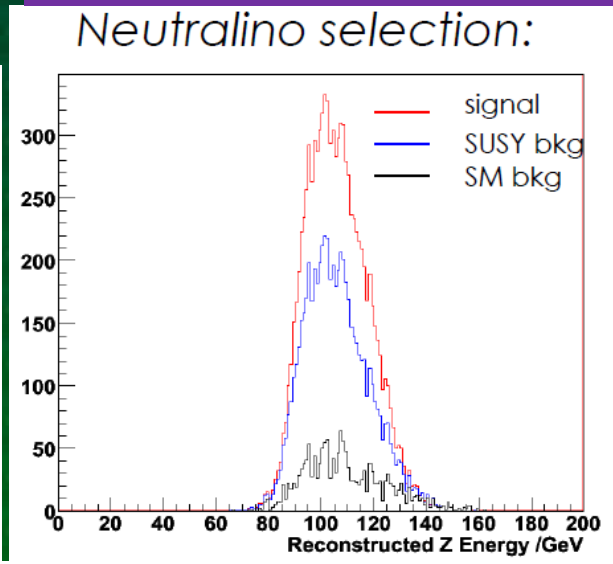


- W/Z separation is essential for degenerate $\chi^+_1\chi^-_1 \rightarrow WW \rightarrow qqqq$ and $\chi^0_2\chi^0_2 \rightarrow ZZ \rightarrow qqqq$
- Cross section and SUSY masses

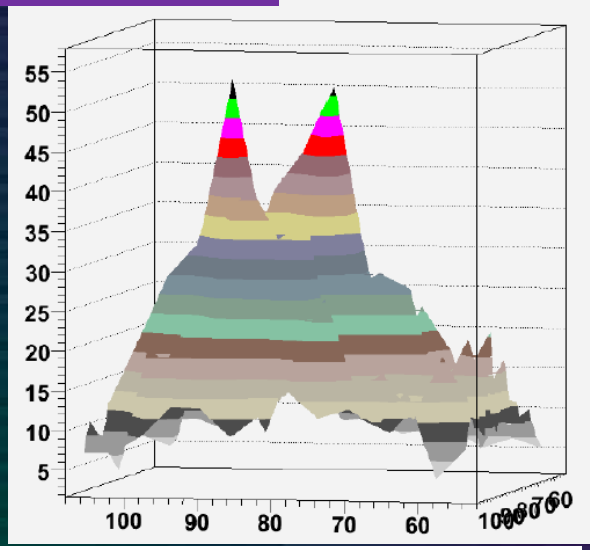
Mass plots of χ^0_2 (except 4th)



ILD by TS



SiD by Andrei Nomerotski



4th by Corrado Gatto (W/Z separation in SM)

Taikan Suehara et al., TILC09 in Ts

SUSY point5 results

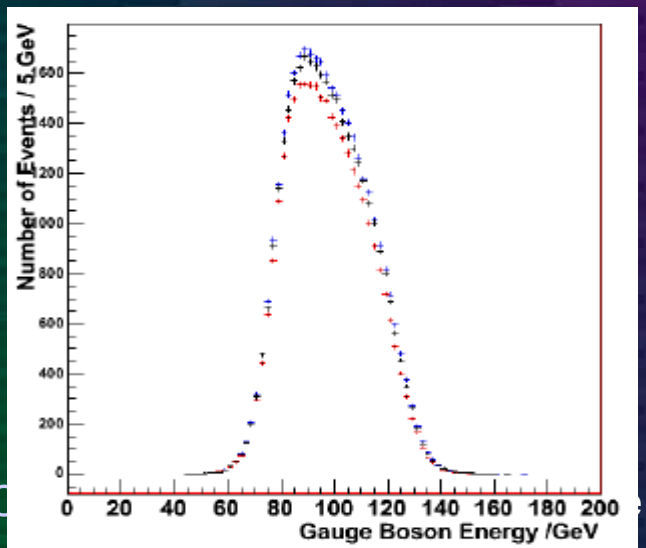
Claimed results:

Observables	ILD		4th
$\delta(\chi^+_1\chi^+_1\ \sigma)$	0.95/0.64%		-
$\delta(\chi^0_2\chi^0_2\ \sigma)$	2.0	4.2%	-
$\delta(\chi^+_1$ mass)		0.095 GeV	-
$\delta(\chi$	GeV	0.369 GeV	-
$\delta(\chi^0_1$	0.8 GeV	0.102/0.054 GeV	-

Analysis conditions are much varied,
DO NOT compare the numbers literally.

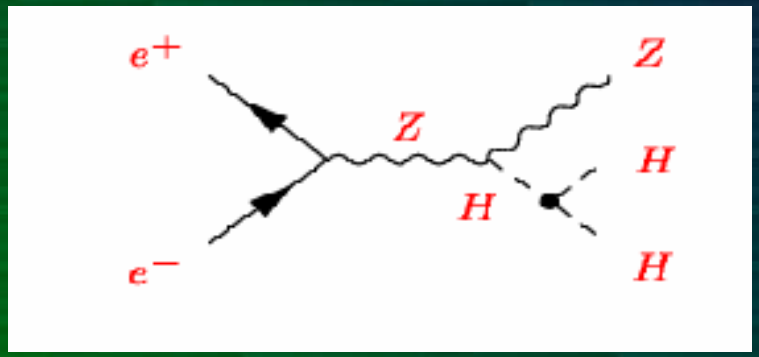
Much discussions for the large difference of SUSY mass resolution between ILD and SiD:

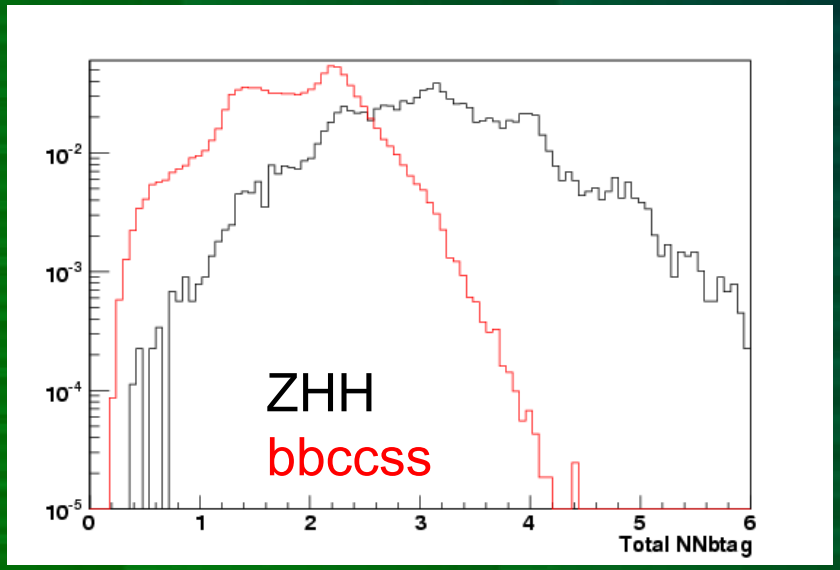
- SiD used difference on cross section in addition to the distribution shape



ZHH 6-jets (non-benchmark)

by M. Giannelli





- Higgs self coupling measurement is non-benchmark but very important mode for ILC.
- 6-jet ZHH has 0.18 fb cross section, along with > 500 fb tt background.
  B-tagging is essential.
- 44% error on ZHH cross section ($2ab^{-1}$) is obtained.
- Need updates…

General Remarks for Benchmark

- All concepts give very impressive results
  - especially progress since LCWS08 is great.
- In the current studies, difference on numbers seems to come from analysis conditions and methods rather than detector performance
  → Comparison of numbers is not so meaningful.

- Some analyses need to be improved to show performance of ILC (esp. to non-ILC people).
- We should concentrate more physically-motivated processes for further study.

4th Concept Software Framework: ILCroot

- **CERN** architecture (based on Alice's Aliroot)
- Full support provided by Brun, Carminati, Ferrari, et al.
- Uses ROOT as infrastructure
  - All ROOT tools are available (I/O, graphics, PROOF, data structure, etc)
  - Extremely large community of users/developers
- TGenerator for events generation
- Virtual Geometry Modeler (VGM) for geometry
- Virtual Montecarlo for particle transport
- Growing number of experiments have adopted it: Alice (LHC), Opera (LNGS), (Meg), CMB (GSI), Panda(GSI), 4th Concept, **LHeC and the forthcoming International Dual Readout Collaboration**
- Six MDC have proven robustness, reliability and portability

Do not Reinvent the wheel
Concentrate on Detector studies and Physics

Status of the 4th software tools

by C. Gatto

The talk concentrated on:

- Software framework (ILCroot)
  - ROOT-oriented framework
  - Virtual MC interface
  - Data-driven structure (rather than processor-driven)
  - Interoperability with other experiments
- Status of each detector
  - Silicon VXD/strips, Tracking, Calorimeter, PID, Jet…
- See very precise 60 page slides for details
- Discussion:
  - Event display is misleading: use fiber outputs instead of hits

Concentrate on Detector studies and Physics

Status of the ALCPG tools and lessons learned from the LOI process

by N. Graf

- We benefitted greatly from the use of common standards, common tools, and common interests.
  - stdhep allowed same events to be used
  - LCIO allowed different packages from different frameworks (e.g. LCFIVertex) to be used.
- We remain committed to the goal of interoperability and collaborative development of software, e.g.
  - Common (or at least interoperable) geometry
  - LCIO2.0 (both Event Data Model & persistency)
- Concerned about support for both software development and package maintenance.

Status of the ALCPG tools and lessons learned from the LOI process

by N. Graf

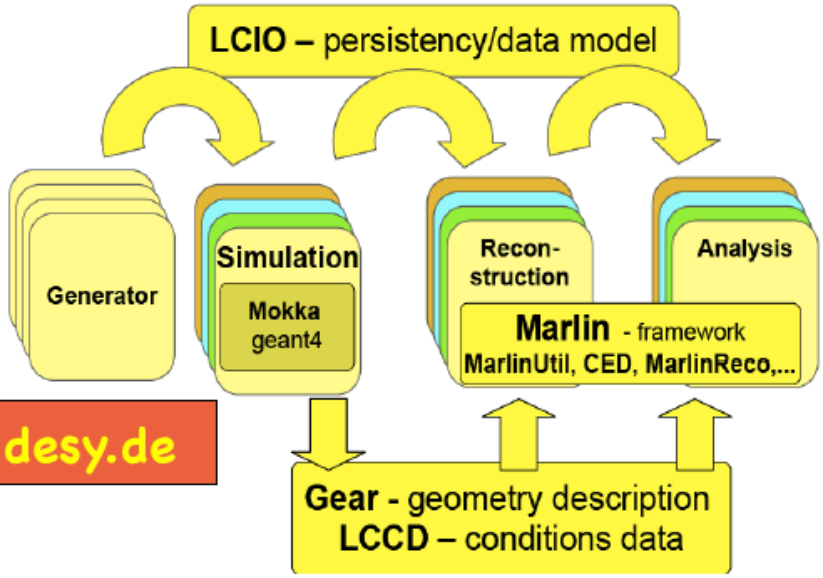
- The talk concentrated on:
  - SLAC SM data generation
    - Successfully delivered 250/500 GeV samples to all concepts.
    - Premixed sample was also supplied.
    - Found a beamstrahlung problem in 250 GeV SM sample
  - Sim/Reco for SiD LoI analysis was done successfully.
    - Grid managed to work.
    - Still a lot of things to do for improvements.
  - LCIO/stdhep worked for interoperability, will be updated.

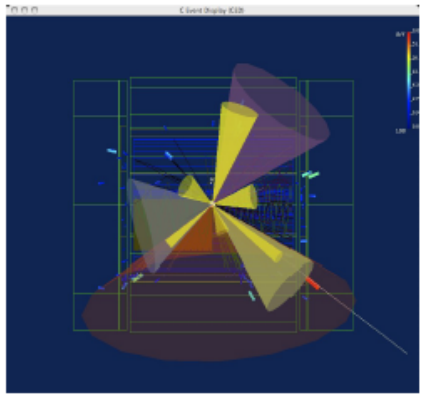
See the slides for details…

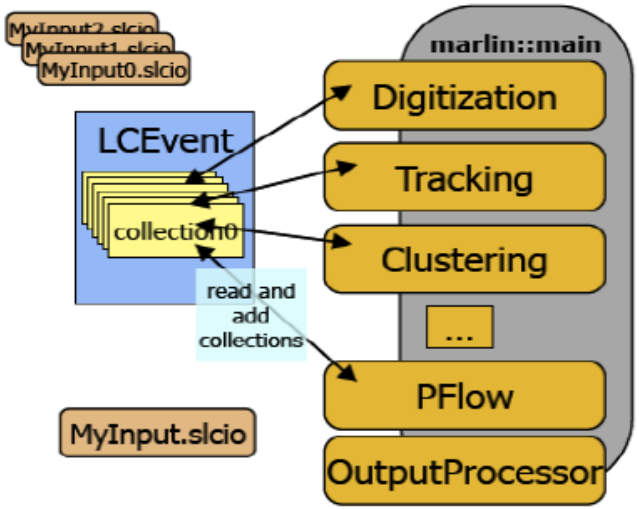
The ILD software framework - LDC flavor

- **Mokka** (LLR)
  - geant4 simulation application
- **LCIO** (DESY/SLAC)
  - international standard for persistency format / event data model
- **Marlin**
  - core application framework for reconstruction & data analysis
- **GEAR**
  - geometry package f. reconstruction
- **LCCD**
  - conditions
  - data toolkit (DB)
- **CED**
  - 3d event display

details at **http://ilcsoft.desy.de**







The ILD software framework – status and plans

by F. Gaede

- Mokka (LLR)

The talk concentrated on:

- ILD software framework
  - LCIO/Marlin/GEAR/Mokka
  - Interoperability of GLD/LDC software
  - Tracking/PandoraPFA/LCFIvertex
  - Mass production and Grid
- Planned or proposed ILD software improvements
  - LCIOv2 with consideration to ROOT
  - Geometry description
  - Testing and validation

Also see the slides for details.

- 3d event display

Summary

How LC software could profit from LHC software

by P. Mato

- LHC and ILC have been standardizing on different interfaces and packages
  - In some cases ILC is relying on packages considered 'obsolete' by the LHC community (e.g. CLHEP, AIDA, stdhep, …)
- Common interfaces/formats is good but adopting a common framework is even better
  - It would enable one level up in re-use
- ILC could leverage from existing structures and support for the common LHC software

Summary

How LC software could profit from LHC software

by P. Mato

An interesting talk presented by a software development leader of CERN:

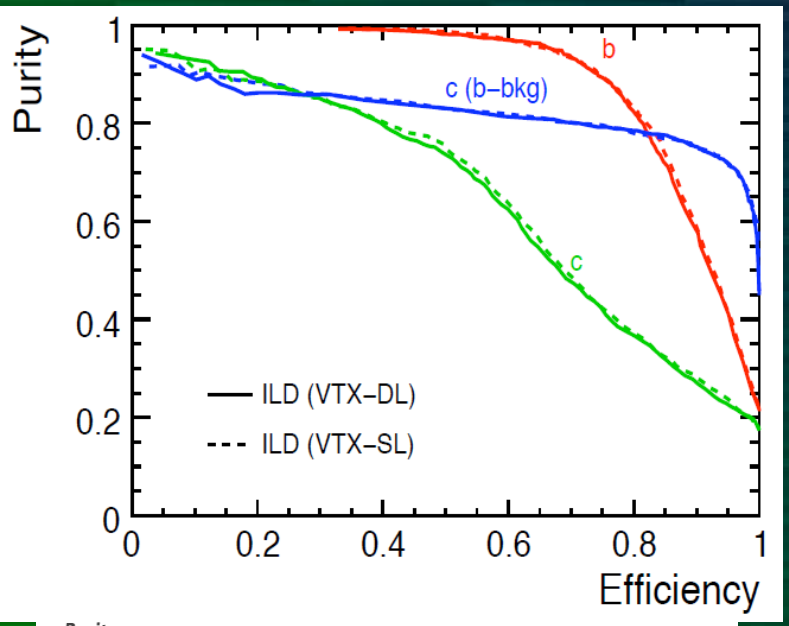
- For LHC, mostly C++, some Fortran, few Java is used.
- Python is widely used with ROOT interface for scripting.
- Framework is constructed over the base software by each group.
- Reflexion / ROOT I/O is critical in software integration.
- GDML & HepMC are used for Geo/MC information.
- No common object model as LCIO.
- Software configuration/Virtualization

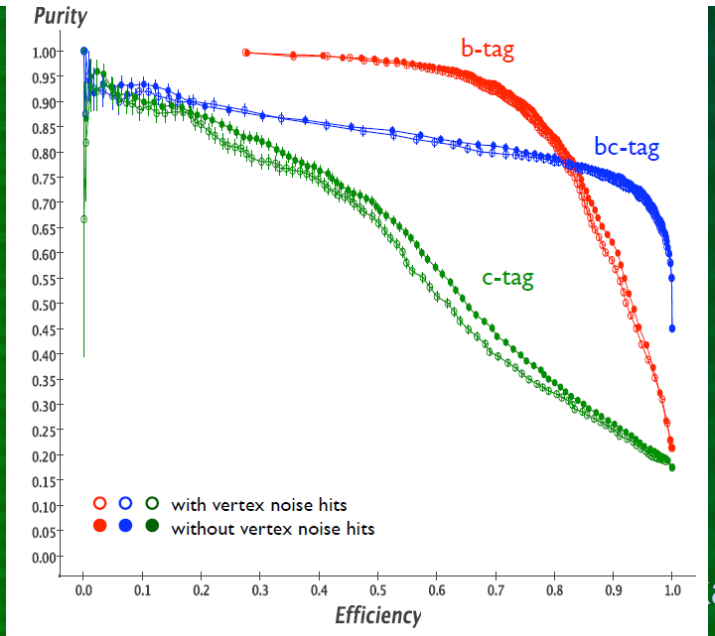
Current Status and Recent Activities on Grid at KEK by G. Iwai

- In International collaboration, e.g. ILC
  - Software infrastructure might be complicated
- For more general purpose e-science infrastructure over the multi-Grid middleware, e.g. gLite, TeraGrid, NAREGI and so on
  - SAGA-NAREGI has been released and is committed in repository soon
    - SAGA-PBS is also
    - ! Only for job adaptor currently
    - This project has been funded for 3.5 years and end in March 2012.
  - RNS might be a technical candidate
    - Perhaps 50% of users will be happy using RNS
    - Need more detailed plan before integration with LFC

Flavor tagging performance studies at ILD

by R. Walsh





Using LCFIvertex

Performance comparison

- GLD with size varied
- LDC with size varied
- ILD with 5/3 double layer (upper plot)
- ILD with solt'n'pepper background hits (lower plot)

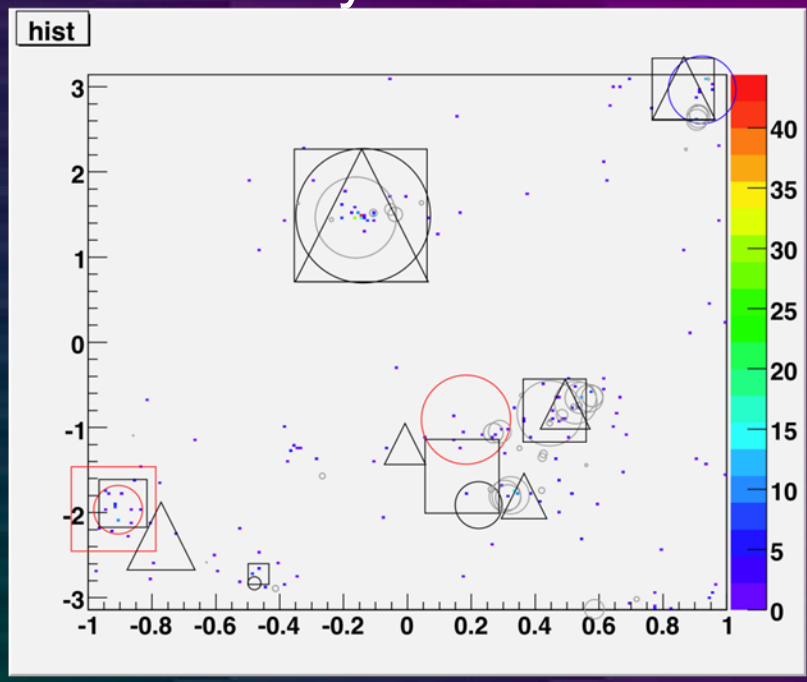
Planned improvements

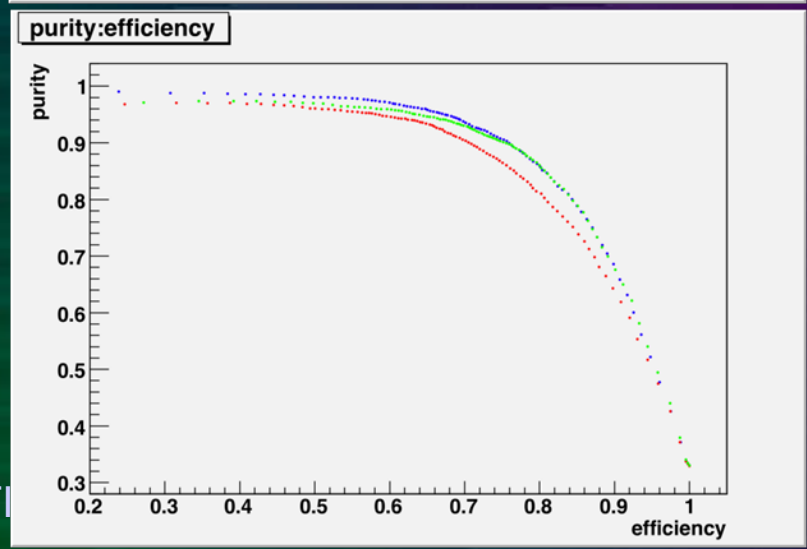
- More background study
- etc.

A new jet clustering with vertex information

by H. Kawahara

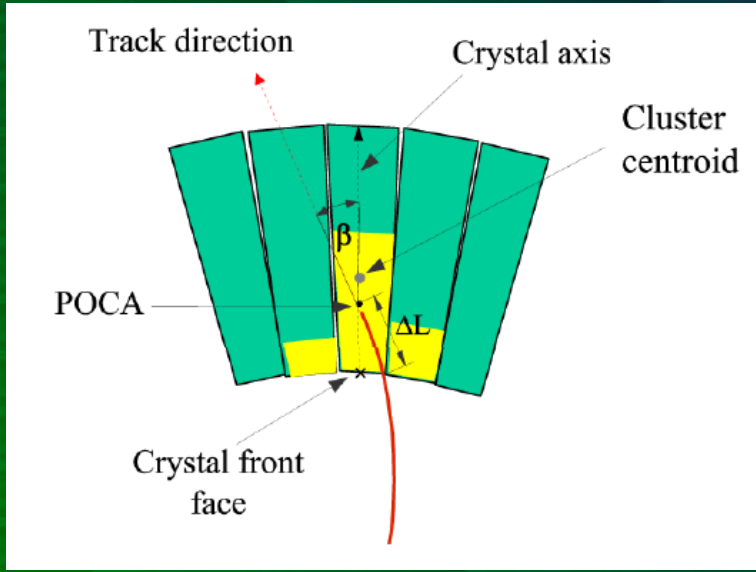
- Jet clustering with vertex information can improve performance – especially for multi-b & multi-jet (>=6) environment.
- Clustering with ZVTOP gives comparable result with combining to Durham method.
- Vertex finder should be improved.

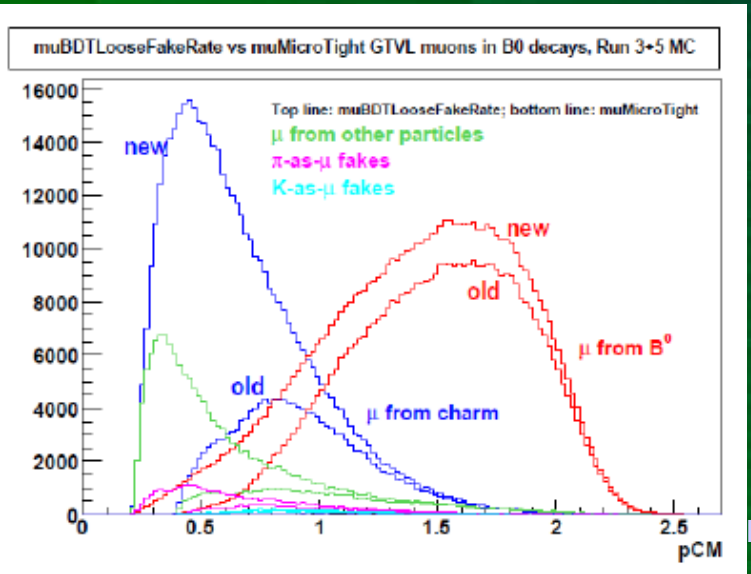




Extracting longitudinal shower depth from calorimetry plus tracking

By G. Mohanty





- Presenting analysis on BABAR
- Track direction is used to obtain longitudinal shower development information by calorimeter with no separation along depth.
- PID/B tagging is improved.

Summary in total

- Congratulation again for finishing the hard work and managing to write the physics analysis for the LoIs.
- In all concept groups, software groups took very hard work for generating, simulating and reconstructing various signal/background events in full simulation and it was basically successful.
- Since we have several issues, we can go further from now towards the real ILC.