

# ***RD-DBD Status***

# DBD Physics Chapter

Physics at the International Linear Collider

Physics Chapter of the ILC Detailed Baseline Design Report

Preliminary Version: Draft of October 10, 2012

please address questions or comments to: mpeskin@slac.stanford.edu

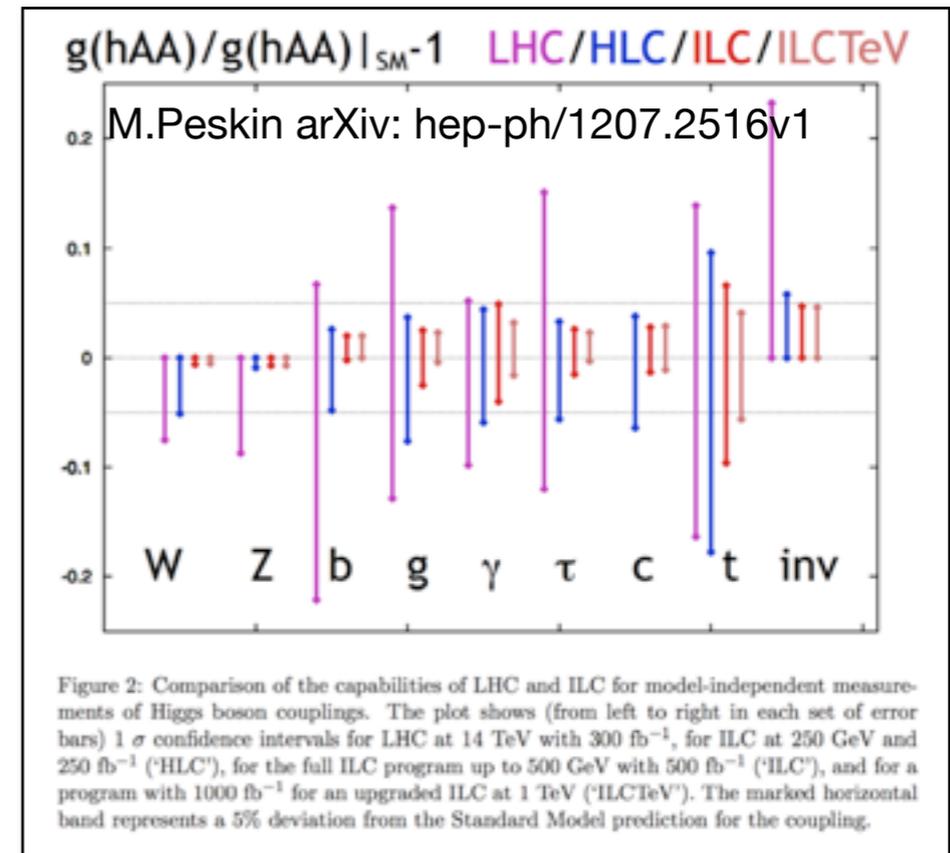
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Introduction	10 pages
Standard Model Higgs	45 pages
Two-Fermion Processes	12 pages
W and Z Boson Physics	39 pages
Top Quark	20 pages
Extended Higgs Sectors	26 pages
SUSY	34 pages
Cosmological Connections	26 pages

**Total ~220 pages**

Given the discovery of a 126 GeV Higgs candidate, emphasis is put on the electroweak symmetry breaking physics, **precision Higgs studies**, in particular:



**Maximum deviation** when nothing but the 125 GeV object would be found at LHC

	$\Delta hVV$	$\Delta htt$	$\Delta hbb$
Mixed-in Singlet	6%	6%	6%
Composite Higgs	8%	tens of %	tens of %
Minimal Supersymmetry	< 1%	3%	10% <sup>a</sup> , 100% <sup>b</sup>
LHC 14 TeV, $3\text{ ab}^{-1}$	8%	10%	15%

R.S.Gupta, H.Rzehak, J.D.Wells

arXiv: 1206.3560v1

Emphasis also on searches for new **color neutral particles** such as Dark Matter

# The time line of the LOI process

- Oct. 2007: **Call for LOIs was made by ILCSC**  
**appointment of RD to conduct the process**
- Jan. 2008: Detector management was formed
- Mar.2008: IDAG formed, 3 LOI groups known
- Mar.2009: 3 LOIs submitted
- Summer 09: IDAG recommendation for validation and ILCSC's approval
- Oct 2009: Work plan of the validated groups
- **End 2011: Interim Report completed**
- **End 2012: Detailed Baseline Design Report**

2007

RDR

2008

2009

2010

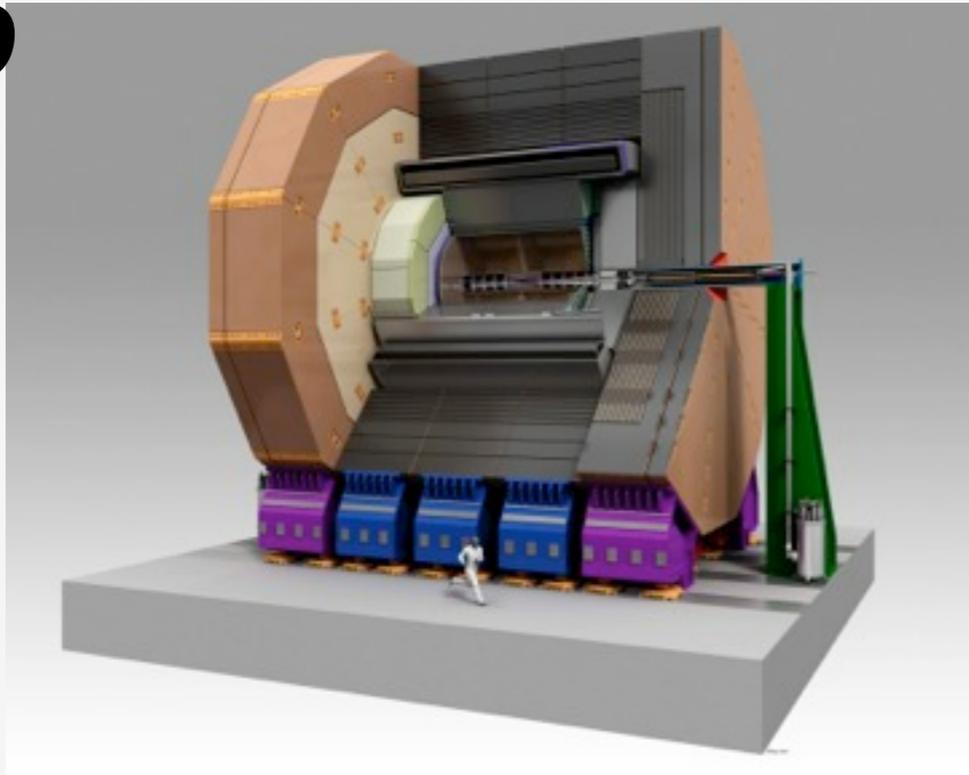
2011

2012

Now

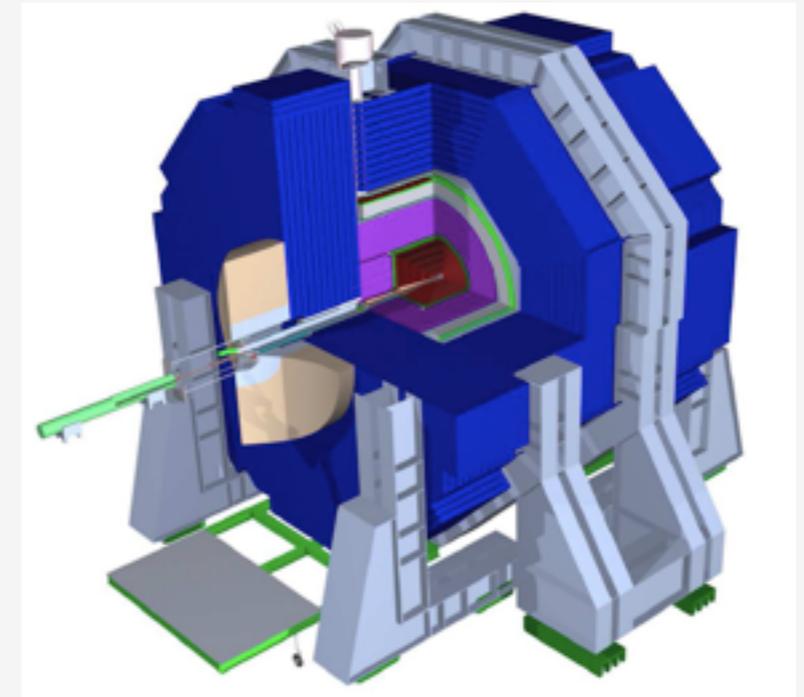
# Detailed **B**aseline **D**esign Document

## **ILD**



- **Large R** with TPC tracker
- 32 countries, 151 institutions, ~700 members
- Most members from Asia and Europe
- **B=3.5T**, TPC + Si trackers
- ECal: **R=1.8m**

## **SiD**



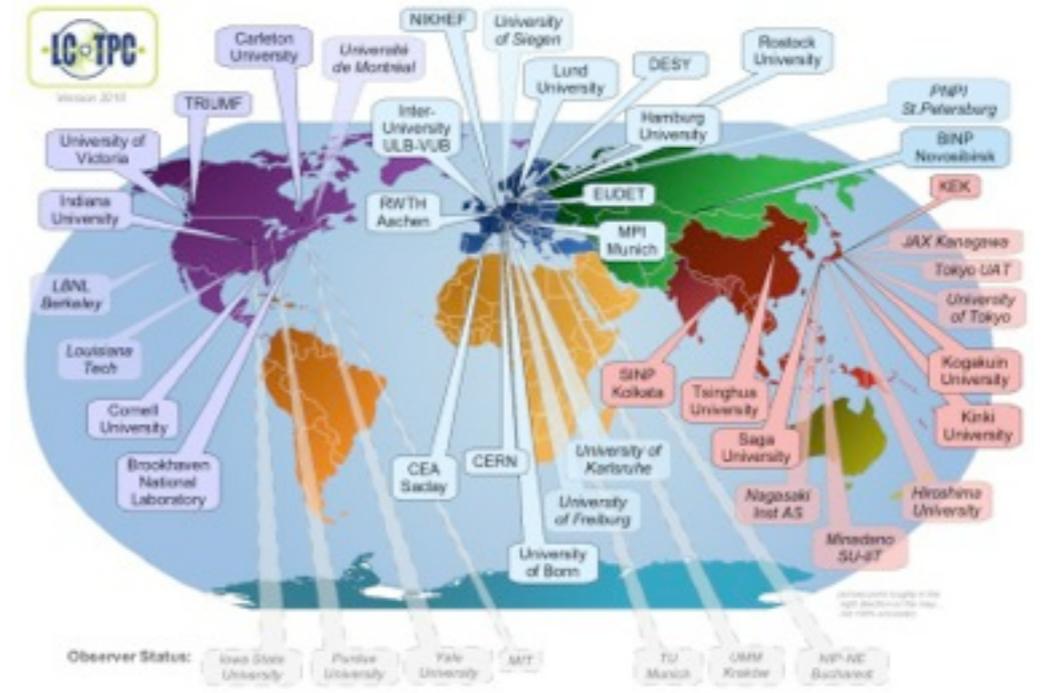
- **High B** with Si strip tracker
- 18 countries, 77 institutions, ~240 members
- Mostly American
- **B=5T**, Si only tracker
- ECal: **R=1.27m**

**Both detector concepts are optimized for**  
**Particle Flow Analysis**

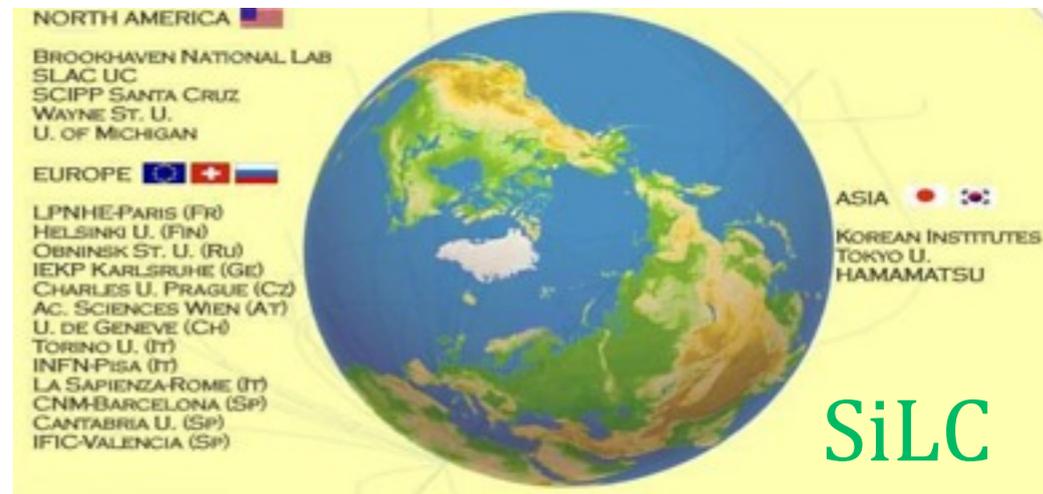
# Detector R&D

## International Collaboration

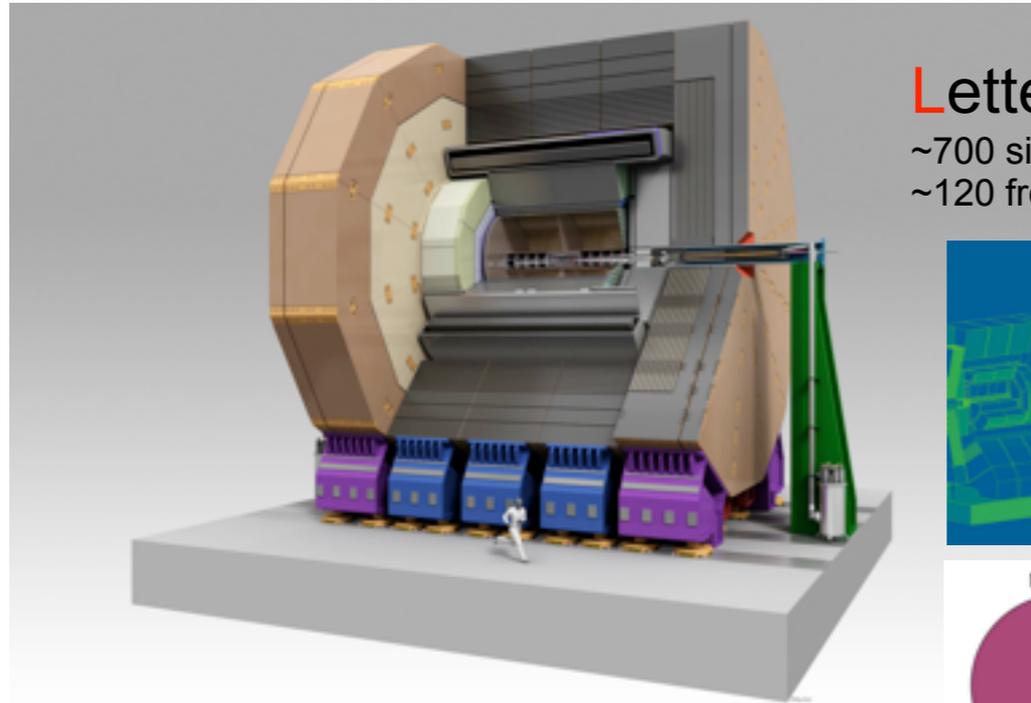
- Detector collaborations encompass concept groups to avoid duplicate effort.
- TPC : **LC-TPC**
- Calorimeter : **CALICE**
- Silicon tracker : SiLC
- Forward detector : FCAL



	ILD	SiD
Vertex	Vertex R&D Groups	
Tracking	LC-TPC	SiD - Si
	SILC	
ECAL	CALICE	SiD - EM
HCAL	CALICE	
Coil	ILD - Coil	SiD - Coil
Muon	ILD - $\mu$	SiD - $\mu$
Forward	FCAL	
Testbeams	CERN - DESY - FNAL - SLAC	

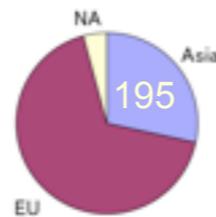


# ILD Detailed Baseline Design



## Letter of Intent

~700 signatories  
~120 from Japan



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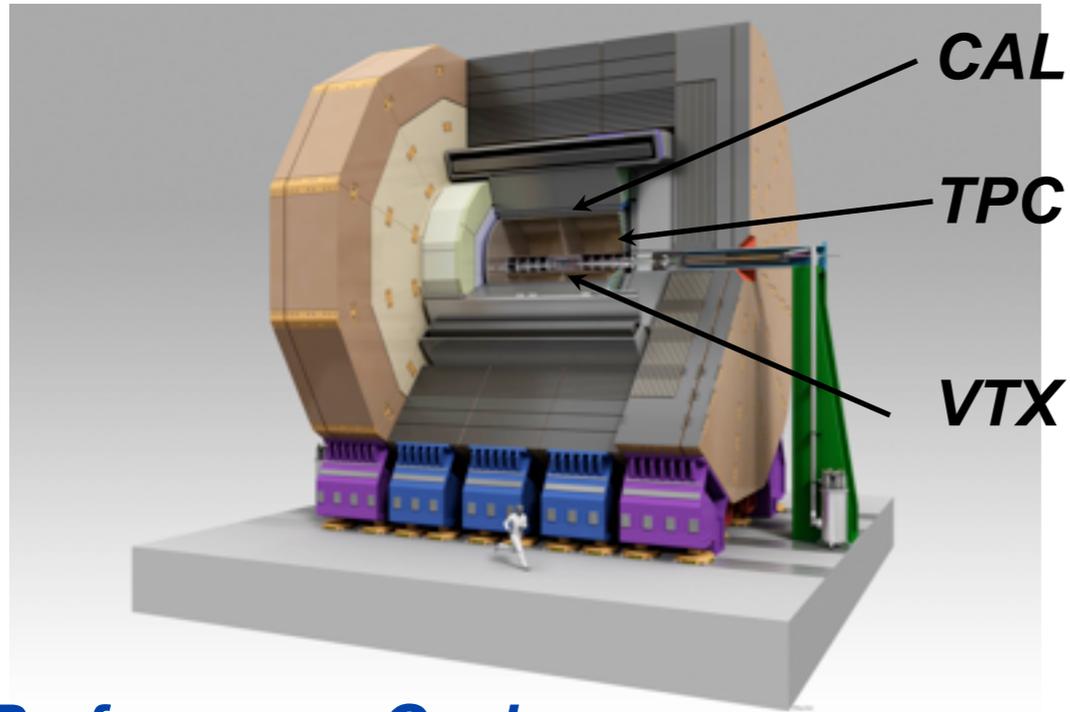
**Draft submitted to International Detector Advisory Group for Review at LCWS2012, Oct. 23-25, 2012**



WORKSHOP 2012 Kyushu University, Fukuoka, Japan 23-25 May, 2012

# Detector R&D : ILD

## Component R&D



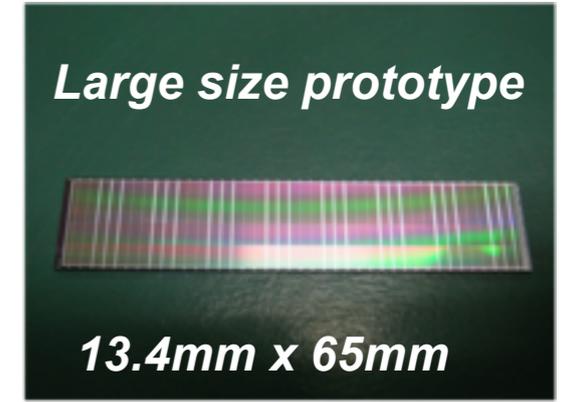
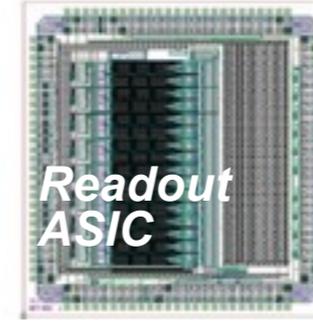
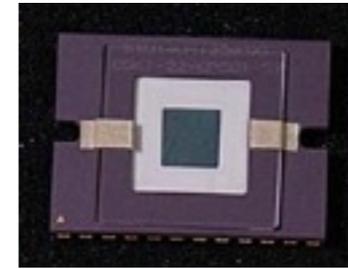
### Performance Goal as compared to LHC detectors

Vertex resolution	2-7 times better
Momentum resolution	10 times better
Jet energy resolution	2 times better

### Ultra high granularity is a key!

Detector	ILC	ATLAS	Granularity
Vertex Det.	5x5 $\mu\text{m}^2$	400x50 $\mu\text{m}^2$	x 800
Tracker	1x6mm $^2$	13mm $^2$	x 2.2
EM Calorimeter	Silicon: 5x5mm $^2$	39x39mm $^2$	x 61
	Scintillator: 5x45mm $^2$		x 7

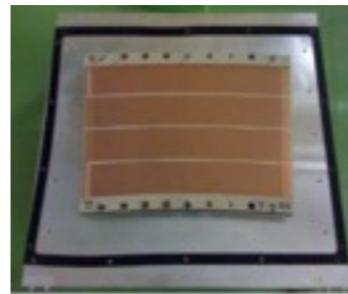
## Vertex Detector R&D



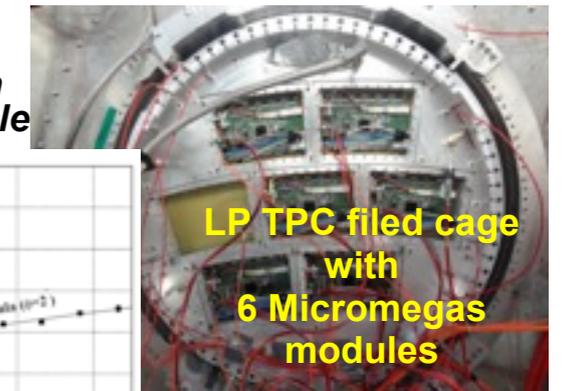
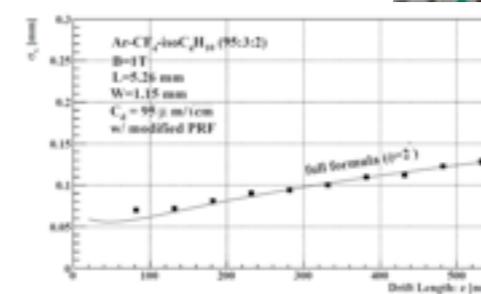
6 $\mu\text{m}$  pixel now working!

**Proof of principle for sensor technology finished!**  
Now R&D on ladder, support structure, and 2-phase CO<sub>2</sub> cooling system.

## TPC R&D

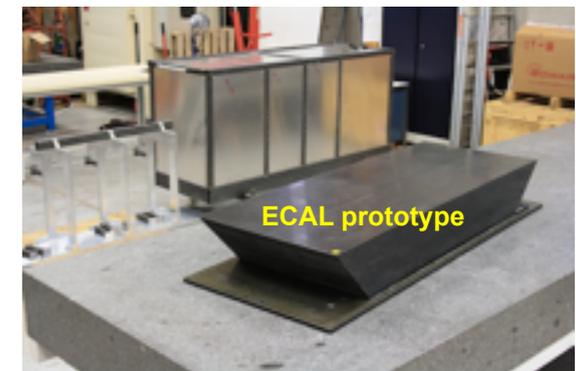
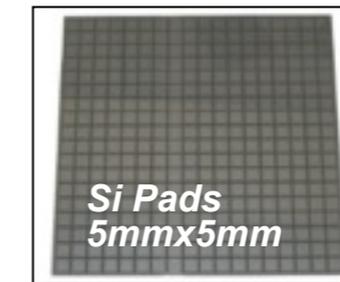
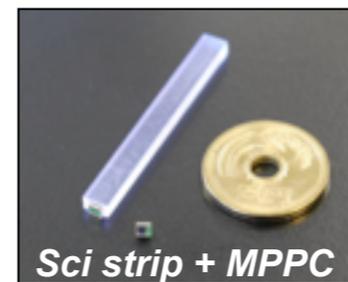


Spatial resolution  
Asian GEM module



**Both GEM and Micromegas modules have achieved the performance goal: point resolution < 100 $\mu\text{m}$  (3.5T)**

## Calorimeter R&D



**Test beam data well reproduced by MC simulation, one-particle energy resolution has reached performance goal!**

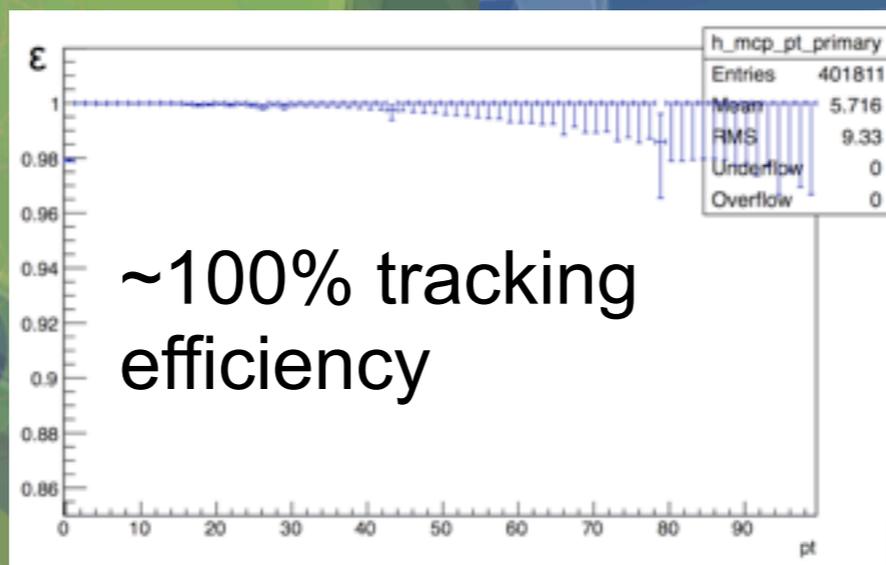
# Software R&D

## Tracking Code (MarlinTrk): now fully C++

Raw Hits

$e^+e^- \rightarrow t \bar{t}$  @1TeV

KEK developed Kalman Filter Package (KalTest)



Reconstructed Tracks

## Particle Flow Analysis

Despite the more realism (cracks, support structures, and service materials) brought in to the simulator,

**PFA performance is now better than that of Lol!**

Simulation of benchmark process is on going!

**~20M events/week** at peak, using GRID (Dirac)  
stdhep -> Mokka (G4) -> MarlinRec (Full rec.)

91 GeV	rms90	dE/E [%]*
ILD_00 [LOI]	2.40	3.71+-0.05
MarlinTrk v01-15-01	2.38	3.73+-0.05
MarlinTrk v01-15-02	2.32	3.64+-0.05
500 GeV		
ILD_00 [LOI]	11.10	3.17+-0.05
MarlinTrk v01-15-01	11.26	3.15+-0.05
MarlinTrk v01-15-02	10.76	3.05+-0.04