Linear collider physics and detector studies for ILC and CLIC

Juan A. Fuster Verdú, IFIC-Valencia

ECFA Plenary Meeting, November 22-23 2012

Thanks for providing material:

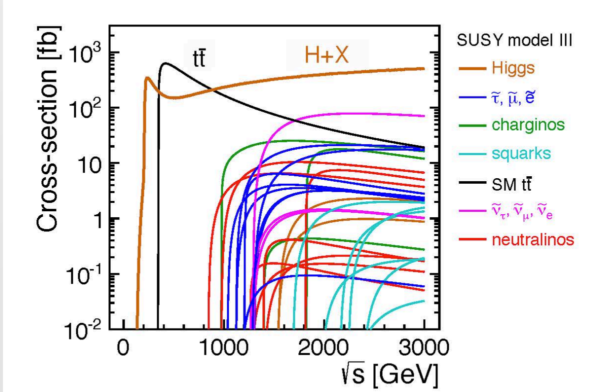
J. Brau, K. Fuji, C. García, L. Linssen, M. Peskin, G. Rodrigo, J. Wells

Outline

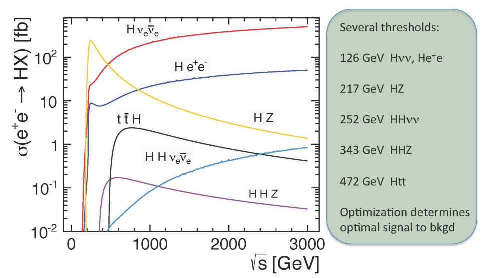
- Introduction: physics situation and detector challenges for linear colliders
- ILC detector R&D: status, activities, milestones 2011-2012 (DBD)
- CLIC detector R&D: status, activities, milestones 2011-2012 (CDR)
- Linear Colliders workshops in 2012 & future 2013 workshops
- Summary

Physics at Linear Colliders from 250 GeV to 3000 GeV

- **Physics case for the Linear Collider:**
  - Higgs physics (SM and non-SM)
  - Top
  - SUSY
  - Higgs strong interactions
  - New Z' sector
  - Contact interactions
  - Extra dimensions
  - ….
- **ILC and CLIC physics case is very similar,**
  (energy range and technical readiness are the issue)



Higgs boson Production Cross-Sections



Lebrun et al., arXiv:1209.2543

J. Brau et al.	The Physics Case for an e+e- Linear Collider, arXiv:1210.0202
L. Linssen et al **P. Lebrun et al**	CLIC CDR, arXiv:1202.5940,1209.2543
H. Baer et al.	Physics at the ILC, ILC TDR, Volume 1, Physics at the International Linear Collider (2012)

Documents for the European Strategy

ILC ESD-2012/4, CLIC-Note-949 (July 30, 2012)

The Physics Case for an e^+e^- Linear Collider

James E. Brau[a], Rohini M. Godbole[b], Francois R. Le Diberder[c], M.A. Thomson[d], Harry Weerts[e], Georg Weiglein[f], James D. Wells[g], Hitoshi Yamamoto[h]

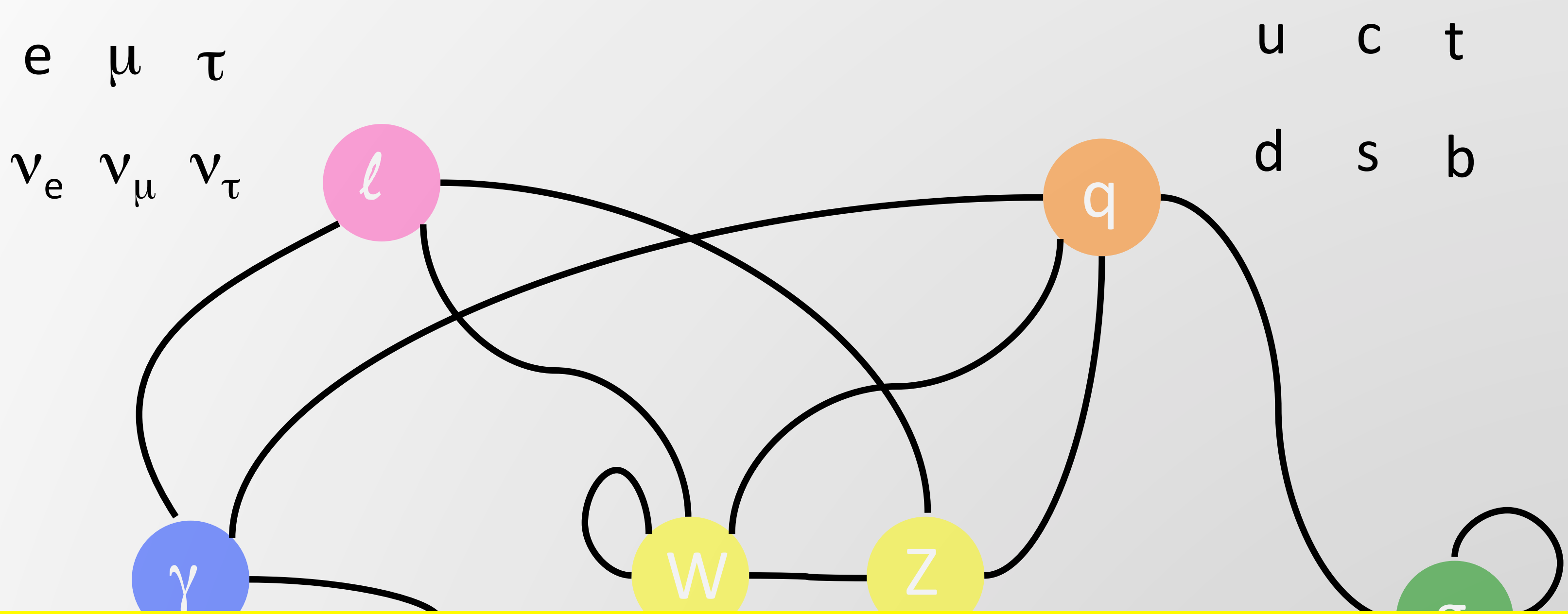
A Report Commissioned by the Linear Collider Community†

[(a)]Center for High Energy Physics, University of Oregon, USA; [(b)]Centre for High Energy Physics, Indian Institute of Science, Bangalore, India; [(c)]Laboratoire de l'Accélérateur Linéaire, IN2P3/CNRS et Université Paris-Sud, France; [(d)]Cavendish Laboratory, University of Cambridge, UK; [(e)]Argonne National Laboratory, Argonne, USA; [(f)]DESY, Hamburg, Germany; [(g)]CERN, Geneva, Switzerland; [(h)]Tohoku University, Japan

A joint ILC and CLIC contribution defending the Physics Case of an e+e- Linear Collider

Other documents for accelerator, detector, spin-offs and R&D were also presented

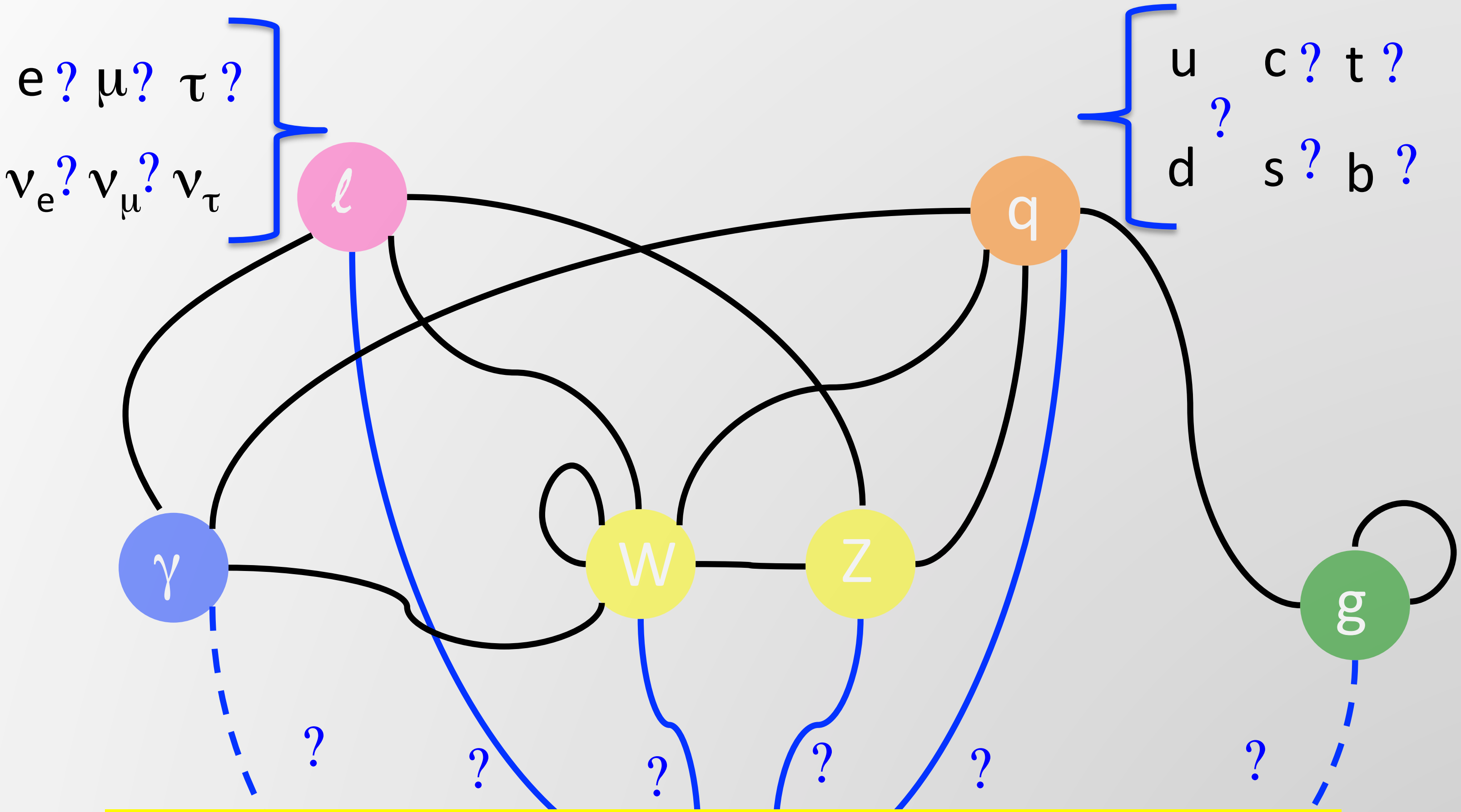
Physics situation before 4th of July 2012



Understanding the (W,Z,γ,g, leptons, quarks) sector of the Standard Model has implied:

- Continuous development of theory, detector technology and new accelerators in the past decades
- Several accelerators contributing: PEPI, PETRA, TRISTAN, SPS, LEP, SLC, HERA, BEPCII, TEVATRON, CESR, PEPII, KEKB …
- Combined use of different accelerator natures: e+e-, ep, $p\bar{p}$, and a world-wide effort: in America, Asia and Europe
- Final understanding has required high precision measurements

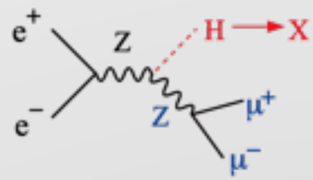
Now, the Higgs-like boson has been discovered at LHC

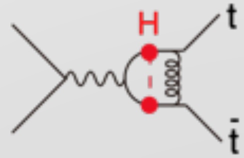


Testing the Higgs sector,
a new type of matter and a new interaction,
will require high precision measurements

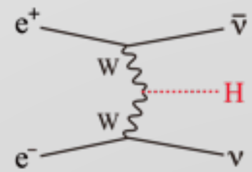
Physics program, 1st step: “uncover the secret of EWSB” <= 0.5 TeV (ILC & CLIC)

ZH @ 250 GeV (~m_Z+m_H+20GeV) : 250fb^{-1} to 500fb^{-1}
Higgs mass, width, J^{PC}
Gauge quantum numbers
Absolute measurement of HZZ coupling (recoil mass)
BR(h->VV,qq,ll,invisible) : V=W/Z(direct), g, γ (loop)

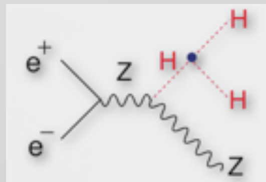




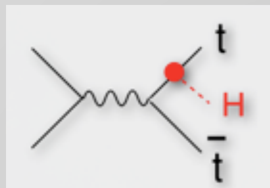
ttbar @ 340-350GeV (~2m_t) : 100-200 fb^{-1}
ZH meas. Is also possible
Threshold scan --> indirect meas. of top Yukawa coupling
AFB, Top momentum measurements
Form factor measurements (polarization important)



vvH @ 350 – 500 GeV : 500 fb^{-1}
HWW coupling -> total width --> absolute normalization of couplings

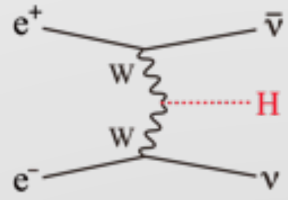


ZHH @ 500 GeV (~m_Z+2m_H+170 GeV) : 2 ab^{-1}
Prod. cross section attains its maximum at around 500 GeV -> Higgs self-coupling

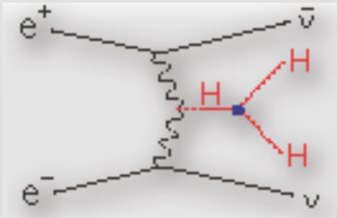


ttbarH @ 500 GeV (~2m_t+m_H+30GeV) : 1 ab^{-1}
Prod. cross section becomes maximum at around 700-800 GeV.
QCD threshold correction enhances the cross section -> top Yukawa measurable to 10% at 500GeV concurrently with the self-coupling

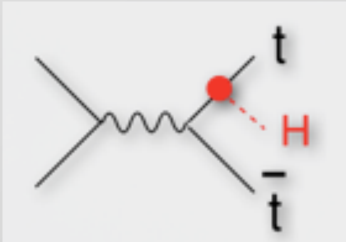
Physics program, 2nd step: "Higgs study at high energy" 0.5-1.0 TeV (ILC & CLIC)



vvH @ at >1TeV : 2ab^{-1} (pol e+, e-)=(+0.2,-0.8)
Allows to measure rare decays such as H -> mu+ mu-, ...



vvHH @ 1TeV or higher : 2ab^{-1} (pol e+, e-)=(+0.2,-0.8)
cross section increases with E_{cm} but the sensitivity might not, because of background diagrams.
Nevertheless, $\Delta\lambda/\lambda$ ~ 20% or better is expected.
If possible, we want to see the running of the self-coupling (very very challenging).



ttbarH @ 1TeV : 1ab^{-1}
Prod. cross section becomes maximum at around 700GeV.
QCD threshold correction enhances the cross section leading to top Yukawa measurable to ~5%. This measurement can be performed concurrently with the self-coupling measurement.

For models with extended Higgs sector, *higher energies imply higher mass reach to other Higgses and higher sensitivity to WLWL scattering* to decide whether the Higgs sector is strongly interacting or not

Physics program, 3rd -- 4th step: "Potential for New Physics" 1.0-3.0 TeV (CLIC)

Results of SUSY benchmarks at 1.4 TeV

$\sqrt{s}$ (TeV)	Process	Decay mode	SUSY model	Measured quantity	Unit	Generator value	Stat. error
1.4	Sleptons production	$\tilde{\mu}_R^+\tilde{\mu}_R^- \to \mu^+\mu^-\tilde{\chi}_1^0\tilde{\chi}_1^0$	III	σ	fb	1.11	2.7%
				$\tilde{\ell}$ mass	GeV	560.8	0.1%
				$\tilde{\chi}_1^0$ mass	GeV	357.8	0.1%
		$\tilde{e}_R^+\tilde{e}_R^- \to e^+e^-\tilde{\chi}_1^0\tilde{\chi}_1^0$		σ	fb	5.7	1.1%
				$\tilde{\ell}$ mass	GeV	558.1	0.1%
				$\tilde{\chi}_1^0$ mass	GeV	357.1	0.1%
		$\tilde{\nu}_e\tilde{\nu}_e \to \tilde{\chi}_1^0\tilde{\chi}_1^0 e^+e^-W^+W^-$		σ	fb	5.6	3.6%
				$\tilde{\ell}$ mass	GeV	644.3	2.5%
				$\tilde{\chi}_1^\pm$ mass	GeV	487.6	2.7%
1.4	Stau production	$\tilde{\tau}_1^+\tilde{\tau}_1^- \to \tau^+\tau^-\tilde{\chi}_1^0\tilde{\chi}_1^0$	III	$\tilde{\tau}_1$ mass	GeV	517	2.0%
				σ	fb	2.4	7.5%
1.4	Chargino production	$\tilde{\chi}_1^+\tilde{\chi}_1^- \to \tilde{\chi}_1^0\tilde{\chi}_1^0 W^+W^-$	III	$\tilde{\chi}_1^\pm$ mass	GeV	487	0.2%
				σ	fb	15.3	1.3%
	Neutralino production	$\tilde{\chi}_2^0\tilde{\chi}_2^0 \to h/Z^0 h/Z^0 \tilde{\chi}_1^0\tilde{\chi}_1^0$		$\tilde{\chi}_2^0$ mass	GeV	487	0.1%
				σ	fb	5.4	1.2%

all results with $L \Rightarrow 1.5\ ab^{-1}$

CLIC CDR Vol. 3

Higgs boson production event rates

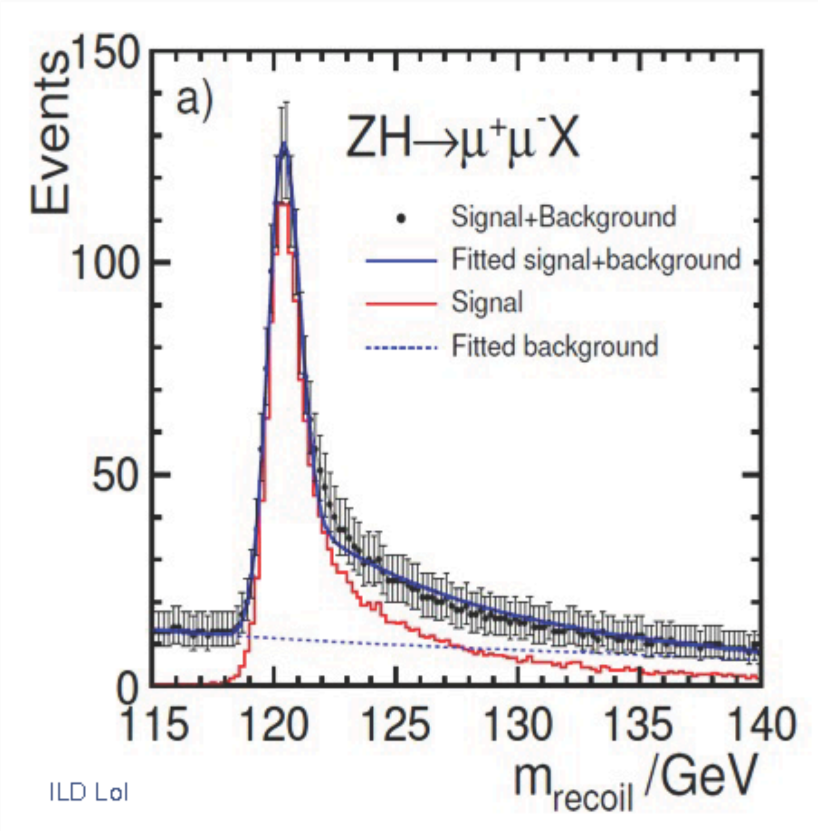
Brau et al., '12

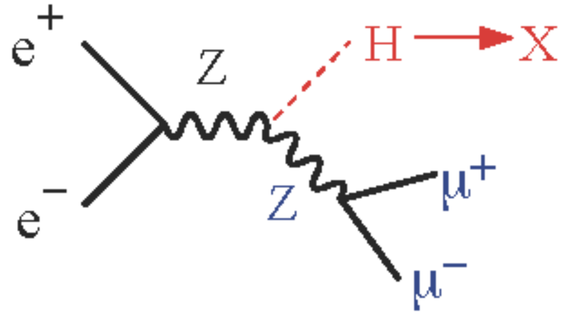
	250 GeV	350 GeV	500 GeV	1 TeV	1.5 TeV	3 TeV
$\sigma(e^+e^- \to ZH)$	240 fb	129 fb	57 fb	13 fb	6 fb	1 fb
$\sigma(e^+e^- \to H\nu_e\bar{\nu}_e)$	8 fb	30 fb	75 fb	210 fb	309 fb	484 fb
Int. $\mathcal{L}$	250 fb^{-1}	350 fb^{-1}	500 fb^{-1}	1000 fb^{-1}	1500 fb^{-1}	2000 fb^{-1}
# ZH events	60,000	45,500	28,500	13,000	7,500	2,000
# $H\nu_e\bar{\nu}_e$ events	2,000	10,500	37,500	210,000	460,000	970,000

Table 1: The leading-order Higgs unpolarised cross sections for the Higgs-strahlung and WW-fusion processes at various centre-of-mass energies for $m_H = 125$ GeV. Also listed is the expected number of events accounting for the anticipated luminosities obtainable within 5 years of initial operation at each energy.

Physics at Linear Colliders: Higgs Boson, invisible decay

Recoil Mass





$$M_X^2 = \left(p_{CM} - (p_{\mu^+} + p_{\mu^-})\right)^2$$

Invisible decay detectable!

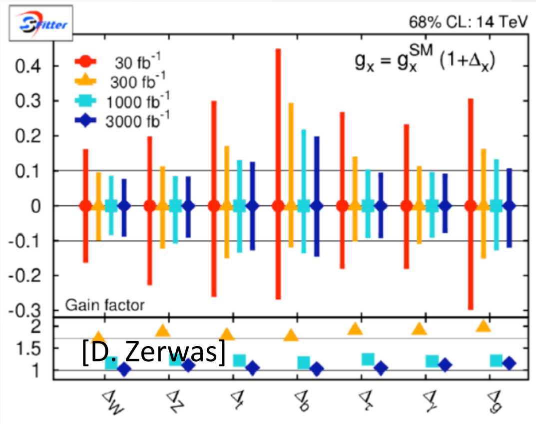
250 fb^{-1} @250 GeV
$\Delta\sigma_H/\sigma_H$ = 2.5%
Δm_H = 30 MeV

Model-independent absolute measurement of the HZZ coupling

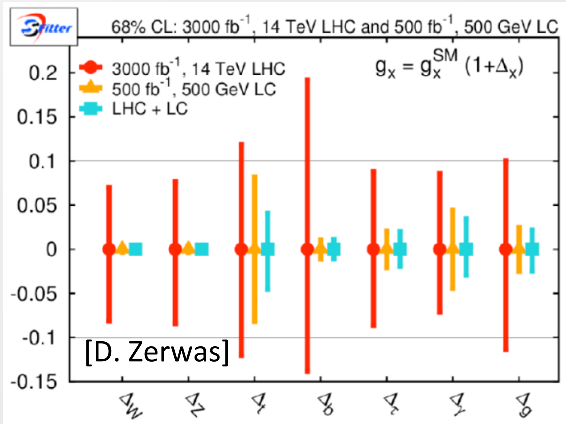
K.Fujii @ LCWS12, Oct.24, 2012

Physics at Linear Colliders: Higgs Boson, couplings

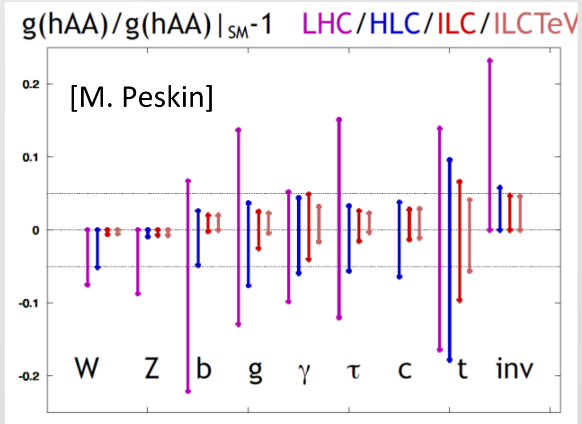
LHC (30/300/1000/3000 fb^{-1})



LHC (3000 fb^{-1}) ; LC(500GeV/500fb^{-1})



LHC (3000 fb-1);LC(HLC/ILC/ILCTeV)



Mode	BR	σBR	ΔσBR/σBR	ΔBR/BR
h→bb	65.7%	232.8	1.0%	2.7%
h→cc	3.6%	12.7	6.9%	7.3%
h→gg	5.5%	19.5	8.5%	8.9%
h→WW*	15.0%	53.1	8.2%	8.6%
h→ττ	8.0%	28.2	4-6%	5-7%
h→ZZ	1.7%	6.1	28(?)%	28(?)%
h→YY	0.29%	1.02	23-30%	23-30%

250 fb^{-1} @250 GeV

m_h= 120 GeV

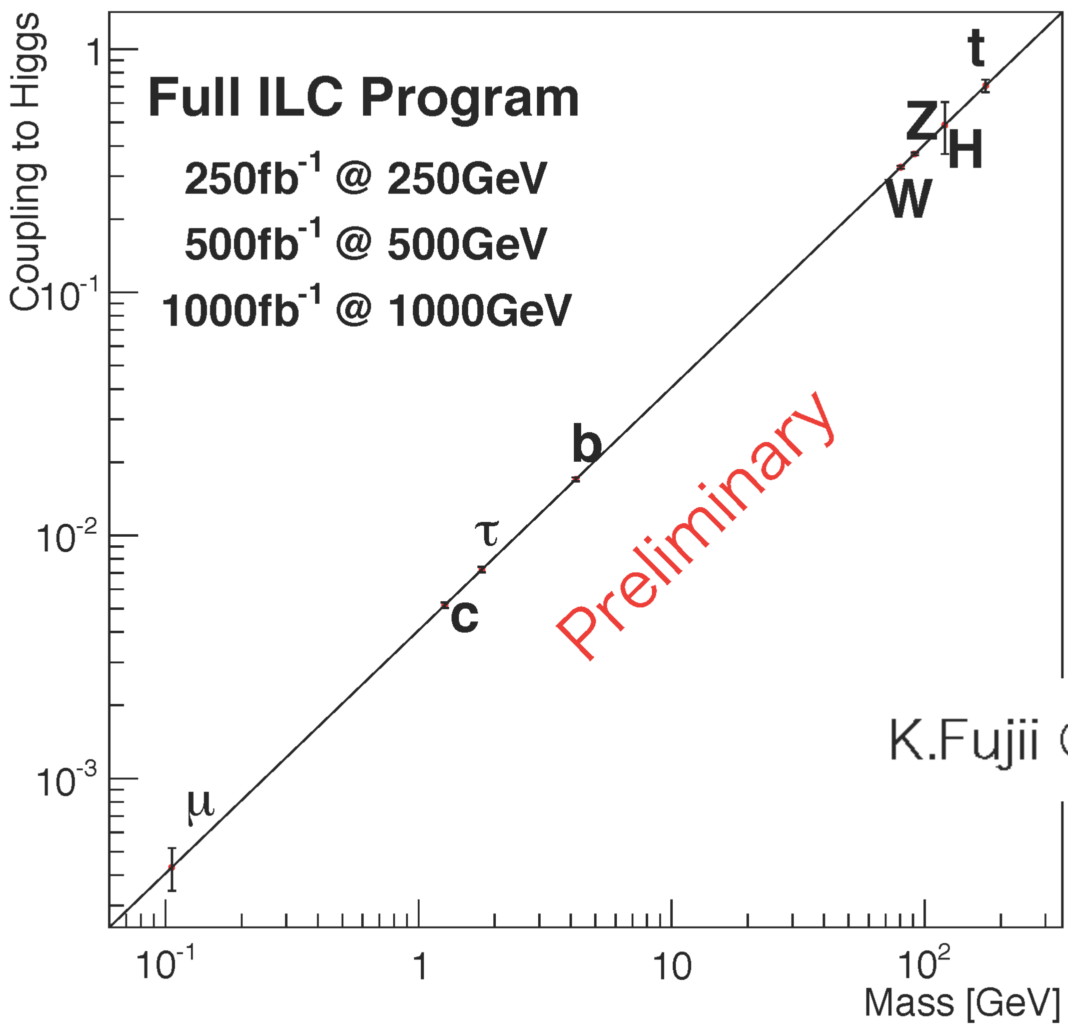
Mode	ΔBR/BR
bb	2.0 (2.7)%
cc	3.8 (7.3)%
gg	4.4 (8.9)%
WW*	3.5 (8.6)%

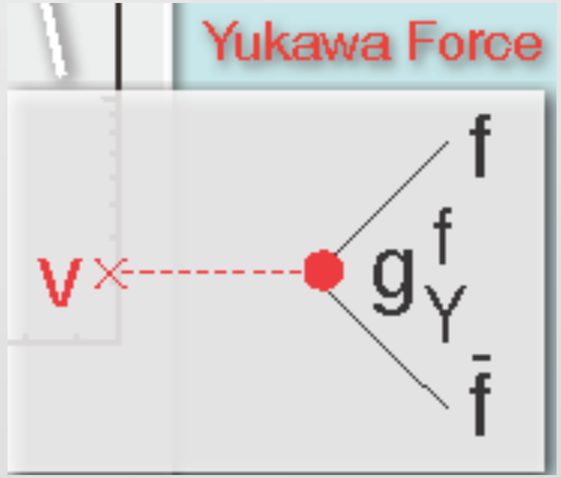
250 fb^{-1} @250 GeV + 500 fb^{-1} @500 GeV

Still very preliminary studies, need for optimization and learning…
Example: @LEP, Altarelli et al 1989, Yellow Report, $\Gamma(Z \to b\bar{b}) \approx 5-8\%$
final precision reached was $\Gamma(Z \to b\bar{b}) \approx 0.5\%$

Mass Coupling Relation

After Nominal Full ILC Program

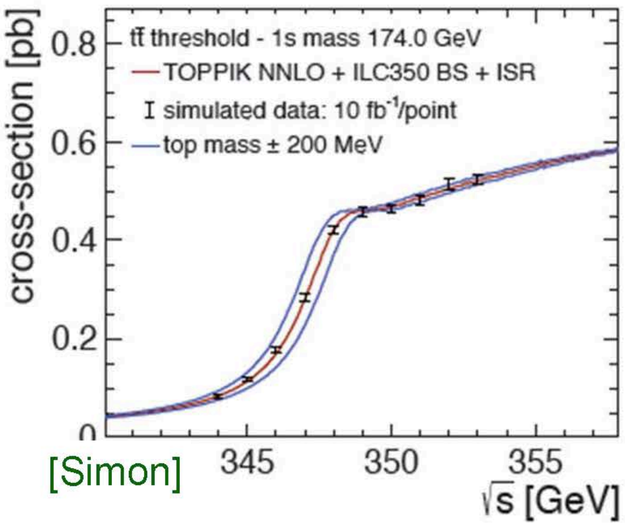


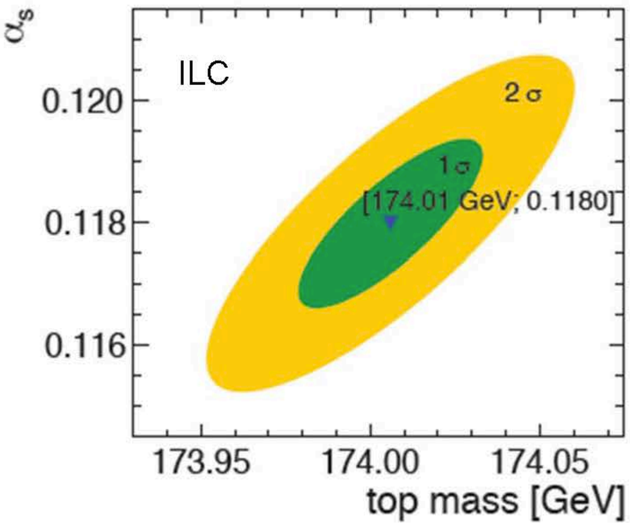


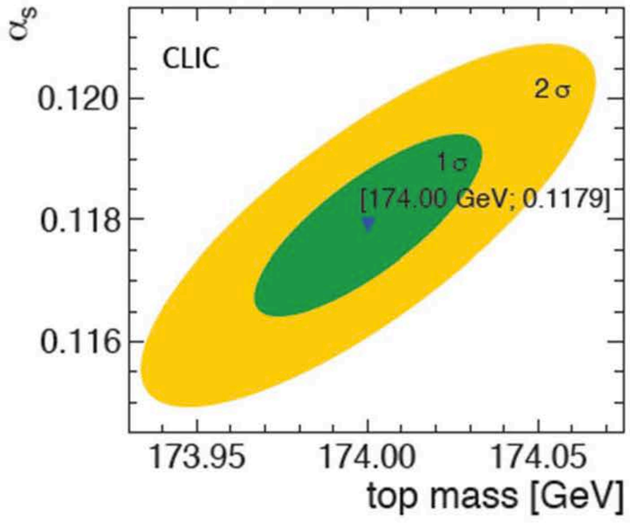
Any deviation from the straight line signals BSM!

K.Fujii @ LCWS12, Oct.24, 2012

Physics program, 2nd step: "top physics, more than Higgs" <= 0.5 TeV (ILC+CLIC)



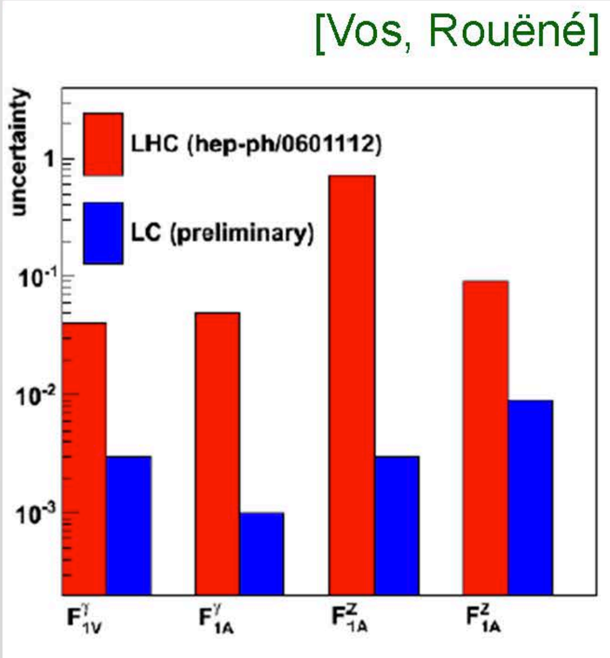




Top mass:

- At threshold, combined fit to 1S mass and α_s , Δm_t (stat.)=34 MeV and $\Delta\alpha_s$ (stat.)=0.0009, 100 fb^{-1} @500 GeV
- Above threshold reconstructing the invariant mass, Δm_t (stat.)=80 MeV, 100 fb^{-1} @500 GeV

Anomalous couplings: $t\bar{t}Z + t\bar{t}\gamma$



Physics at Linear Colliders: which precision ?

Decoupling Theorem

When new physics at scale *M* are large, low energy theory is the SM Up to m^2/M^2 [O(1-10)% for *M*=TeV]

i.e., 1% precision will mean M=3 TeV for ILC reach (M. Peskin)

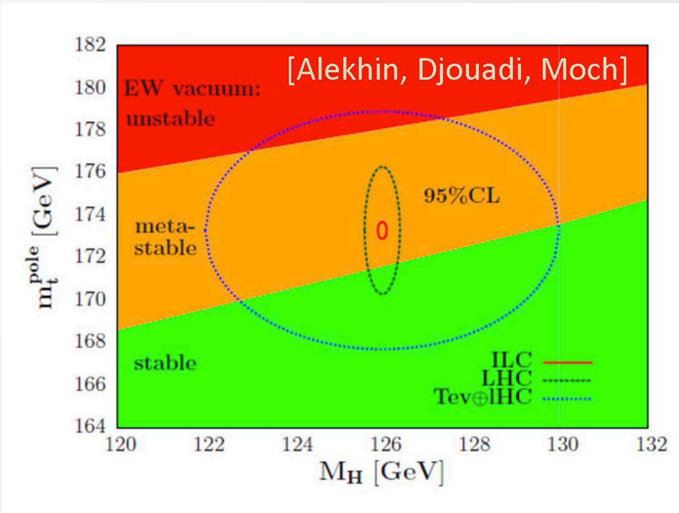
Supersymmetry: $g(\tau)/SM = 1 + 10\% \left(\frac{400\ \mathrm{GeV}}{m_A}\right)^2$

$g(b)/SM = g(\tau)/SM + (1-3)\%$

Little Higgs: $g(g)/SM = 1 + (5-9)\%$

$g(\gamma)/SM = 1 + (5-6)\%$

Composite Higgs: $g(f)/SM = 1 + (3-9)\% \cdot \left(\frac{1\ \mathrm{TeV}}{f}\right)^2$



Stability of the Standard Model vacuum,

Validity of the Standard Model up to the Planck Scale ?

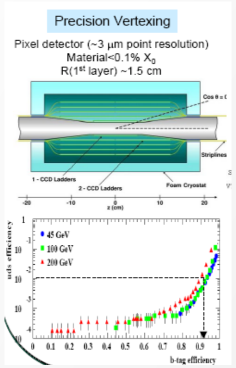
$\Delta m_{top} < 200$ MeV

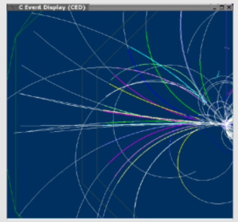
(Specially relevant to know if no NP are found at LHC

but..

if there are NP it will be even better, of course !!)

Challenges for ILC (0.25-1.0 TeV)/CLIC (0.5-3.0 TeV) detectors





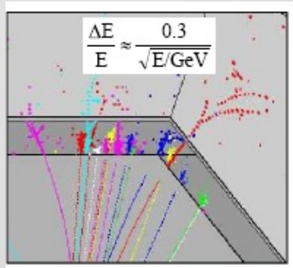
- Vertex, “flavour tag” (heavy quark and lepton identification)

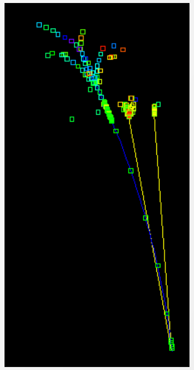
  ~1/5 $r_{beampipe}$, ~1/30 pixel size (ILC vs LHC),

  vtx 1-2 cm (ILC), vtx 2-3 cm (CLIC)

  $$(h \to b\bar{b}, c\bar{c}, \tau^+\tau^-)$$

  $$\sigma_{ip} = 5\mu m \oplus 10 - 15\mu m / p\sin^{3/2}\theta$$



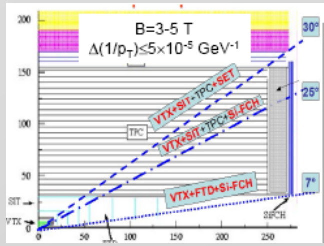


- Tracking, “recoil mass” $(e^+e^- \to Zh \to \ell^+\ell^- X)$

  ~1/6 material, ~1/7 resolution (ILC wrt LHC),

  B=4-5 T (CLIC and ILC)

  $$\sigma(1/p) \le 2 \times 10^{-5} \mathrm{GeV}^{-1}$$



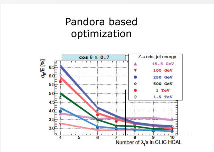
- Particle Flow, Jet Energy Rec. → Tracker+Calo.

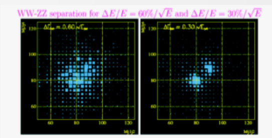
  Di-jet mass Resolution, Event Reconstruction, Hermitcity,

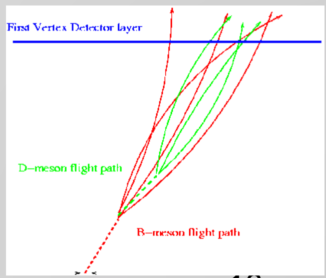
  Detector coverage down to very low angle

  CLIC vs ILC: Redesign Forward Region, HCAL 7,5 λ

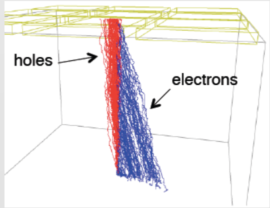
  $$\sigma_E / E = 0.3 / \sqrt{E(\mathrm{GeV})}$$

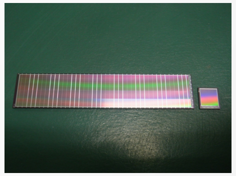




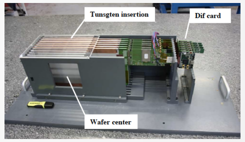


Challenges for ILC (0.25-1.0 TeV)/CLIC (0.5-3.0 TeV) detectors

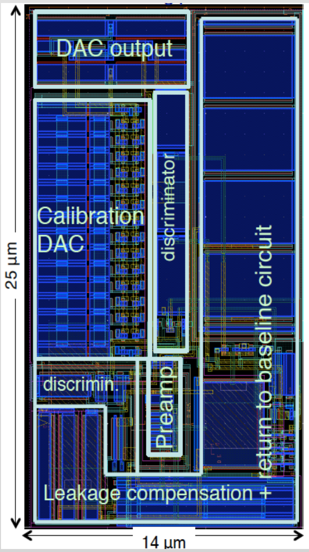


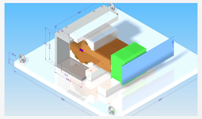


- Due to experimental conditions
  - Manageable occupancies in the presence of beam-induced background

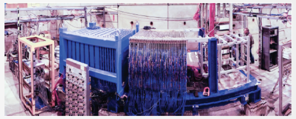


  - Radiation hardness for forward calorimetry

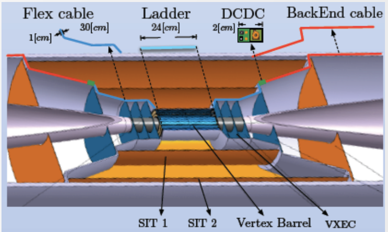


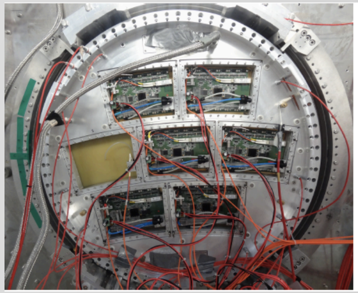


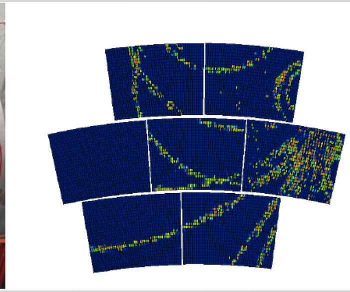
- Timing capabilities required for CLIC
  - All tracking detectors with ~10ns time-stamping capability



  - Time precision on calorimeter hits of ~1ns





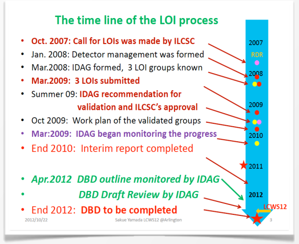


Linear Collider R&D

See talk by Lucie Linssen at LCWS12, Arlington, Oct. 22 2012

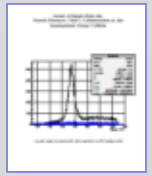
http://ilcagenda.linearcollider.org/conferenceOtherViews.py?view=standard&confId=5468

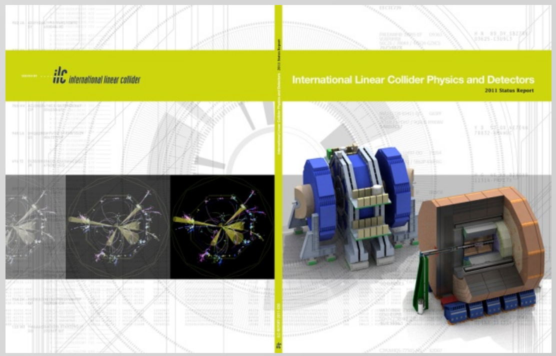
ILC Detector Roadmap



S. Yamada

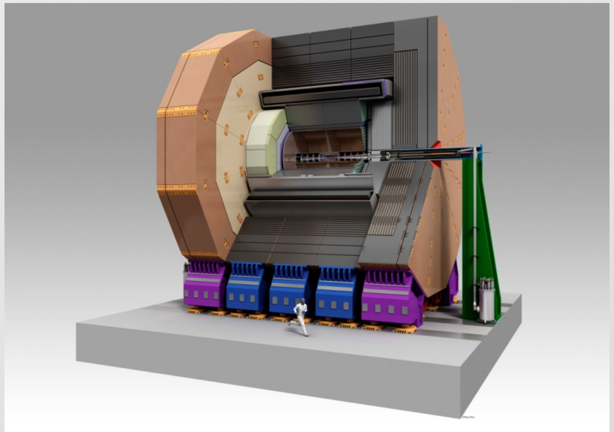
Aug. 2007	Detector Concept Report, Four detector concepts: LDC, GLD, SiD, 4th
Oct. 2007	ILCSC calls for LOIs and appoints Research Director (RD)
Jan. 2008	RD forms detector management
Mar. 2008	IDAG formed, Three LOIs grous identified
Mar. 2009	Three LOIs submitted (detector description, status of R&D, GEANT4 simulation, benchmark process, costs..)
Mar. 2009	IDAG began monitoring the progress
Aug. 2009	IDAG recommends validation of two (2) and ILCSC approves
Oct. 2009	Work plan of the validated groups
End 2011	Interim Report being produced (http://www.linearcollider.org/about/Publications/interim-report)
End 2012	Detailed Baseline Design Report (ILD TDR Volume 3) Including physics case for the ILC

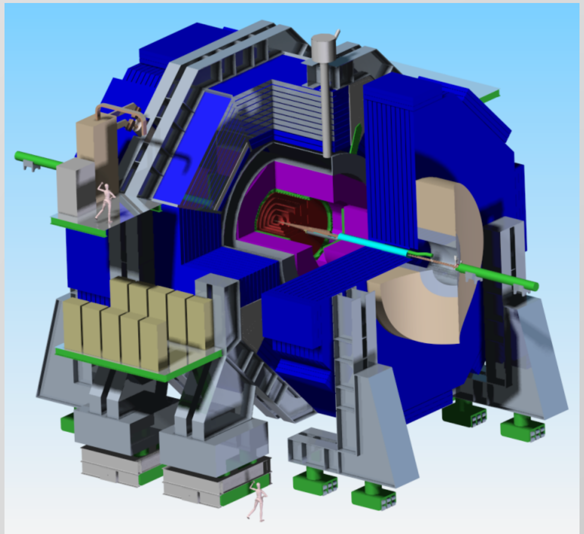




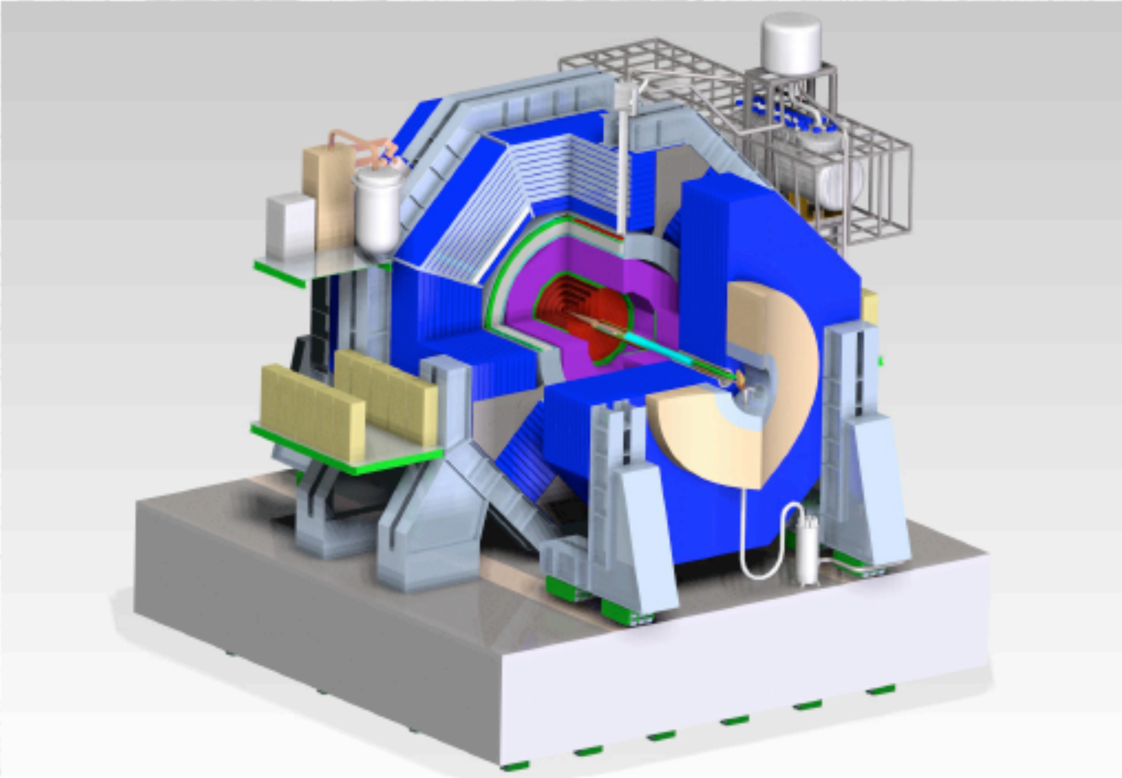
Validated ILC Detectors: SiD & ILD

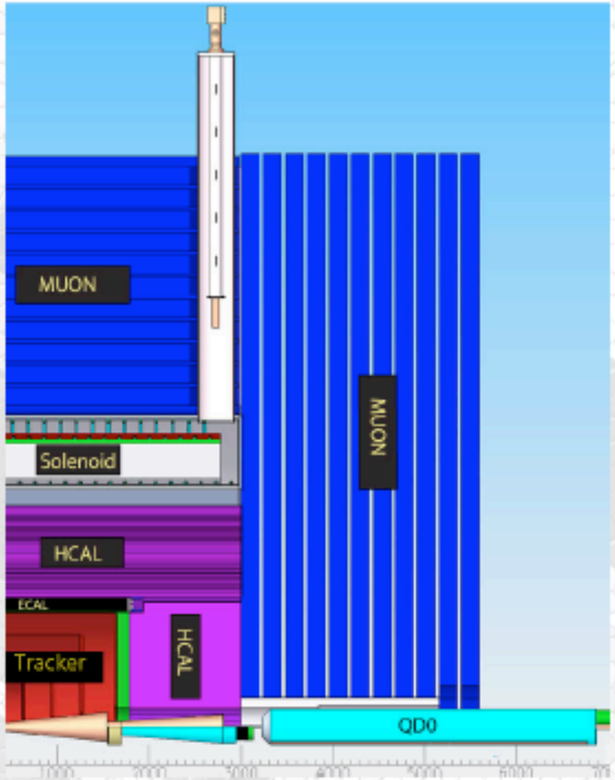
Both, ILD and SiD, are 4π detectors with complementary designs	
Common Systems	Thin pixel vertex detectors Si-W Electromagnetic Calorimeter
ILD	TPC tracking aided with silicon detectors
	Scintillator-Steel hadron calorimeter
	Excellent tracking and calorimetry performance for best possible event reconstruction
SiD	Silicon tracking
	Gaseous (RPC) digital hadron calorimeter
	Fast tracking and calorimeter for robustness





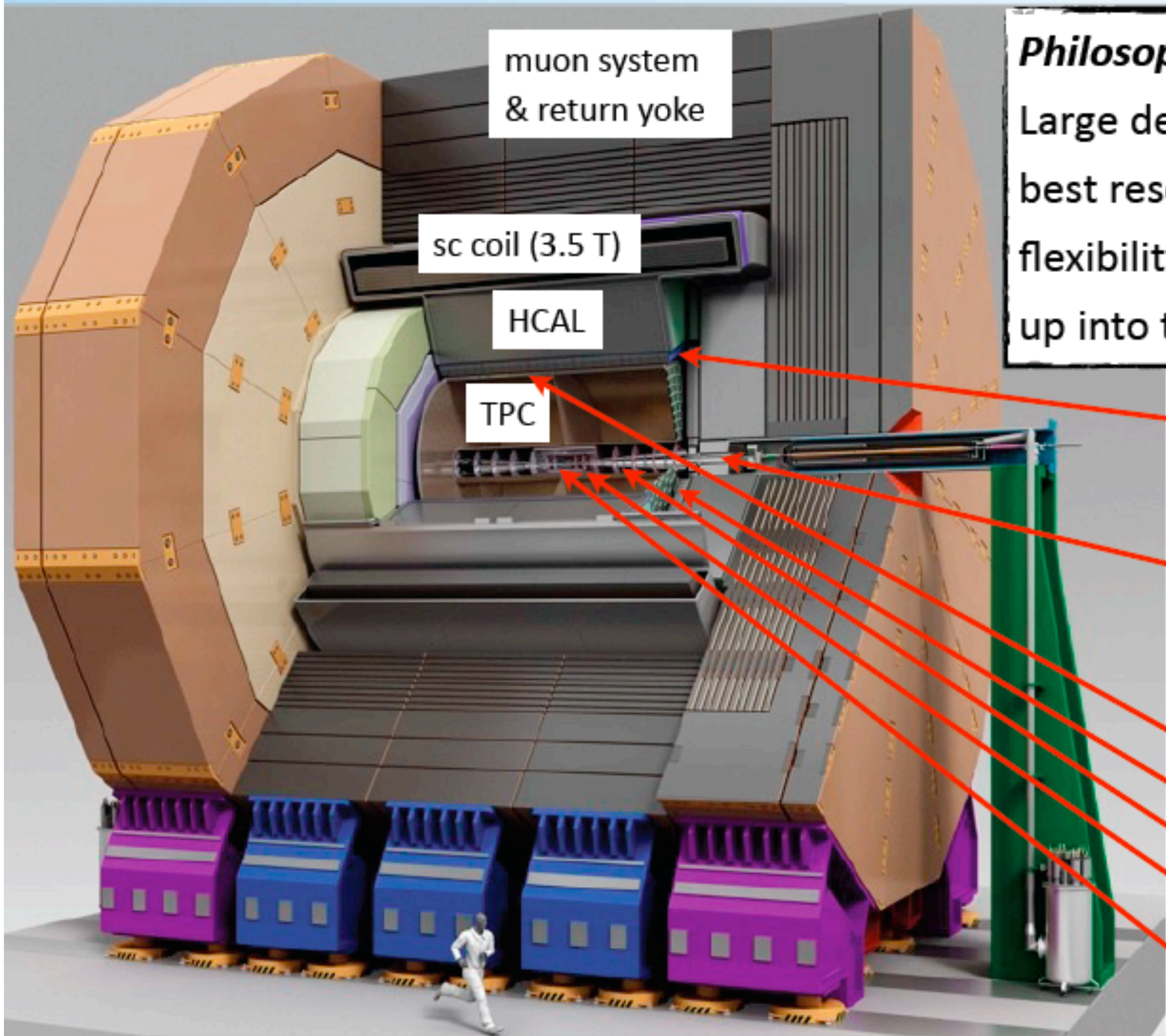
The DBD detector





- SiD is fully designed for push-pull (using a platform)
- PFA paradigm has driven design choices

ILD - Overall Design



Philosophy:

Large detector optimized for best resolution, providing flexibility for higher energies up into the TeV range

IDAG: International Detector Advisory Group (ILC)

Tasks:

- monitors the ILC detector research and development
- advises the Research Director
- reviewed 2009 Letters of Intent / recommended validation
- reviewed recent DBD drafts

Many thanks
for your help and dedication

IDAG membership includes

- experienced experimentalists:

  Michael Danilov (ITEP), Michel Davier (Chair, Orsay), Paul Grannis (Stony Brook), Dan Green (FNAL), Dean Karlen (Victoria), Sun-Kee Kim (SNU), Tomio Kobayashi (Tokyo), Weiguo Li (IHEP), Richard Nickerson (Oxford), Sandro Palestini (CERN)
- active phenomenology theorists

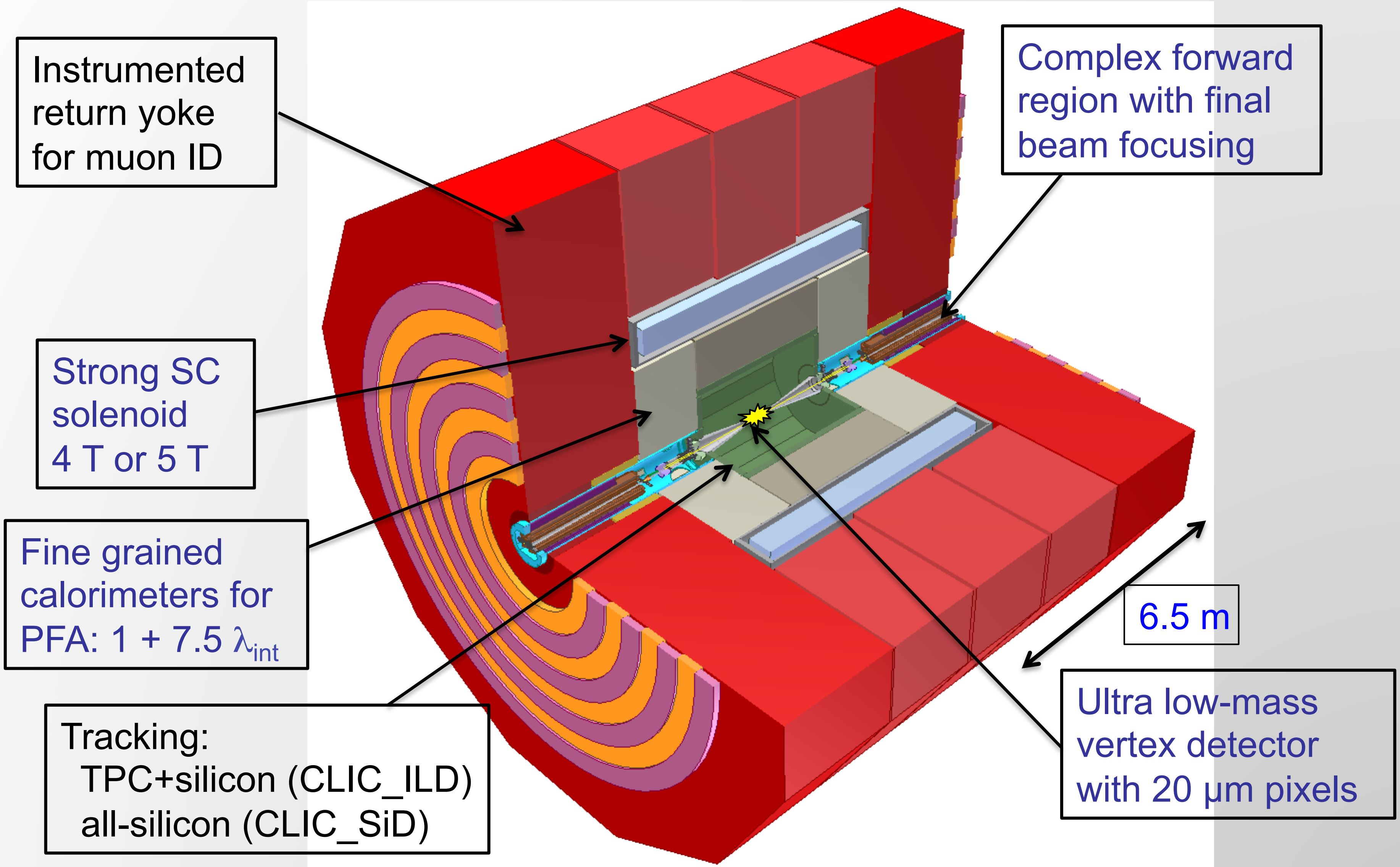
  Christophe Grojean (CERN & CEA-Saclay), Rohini Godbole (IIS), JoAnne Hewett (SLAC)
- ILC accelerator experts

  Thomas Himel (SLAC), Nobukazu Toge (KEK), Eckhard Elsen (DESY)

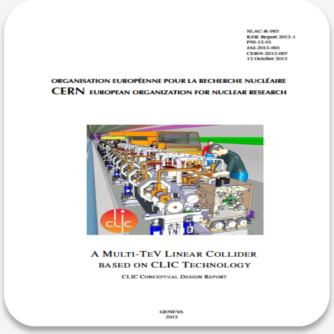
ILC Technical Design Report: Physics & Detector DBD

- Physics volume: ILC TDR, Volume 1, "Physics at the International Linear Collider"
- Detector volume: ILC TDR, Volume 3, "Physics and Detectors, Detailed Baseline Design"
- Chapters have been drafted and are in final phase of revision
  - Introduction (physics, organization, common detector aspects)
  - SiD & ILD
  - Future plans
- DBD drafts have been reviewed by IDAG
- Review by ILCSC's Project Advisory Committee (PAC), enlarged by a few IDAG members, at KEK 13-14 December
  - Revised Introduction to be submitted Nov 16
  - Final drafts of SiD & ILD to be submitted Nov 30
- Presented to ILCSC, February 21-22, 2013
- Published along with ILC TDR (Volume 1 –Physics- and Volume 3 –Detector-)

CLIC detector and physics study

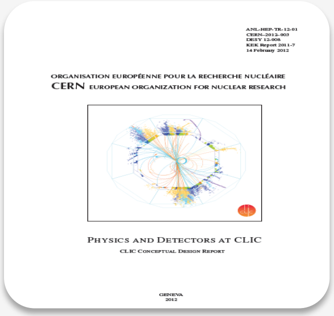


The CLIC CDR documents



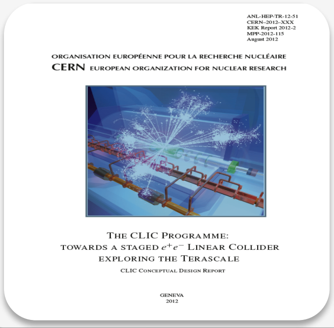
Vol 1: The CLIC accelerator and site facilities (H.Schmickler)

- CLIC concept with exploration over multi-TeV energy range up to 3 TeV
- Feasibility study of CLIC parameters optimized at 3 TeV (most demanding)
- Consider also 500 GeV, and intermediate energy range
- In print: https://edms.cern.ch/document/1234244/



Vol 2: Physics and detectors at CLIC (L.Linssen)

- Physics at a multi-TeV CLIC machine can be measured with high precision, despite challenging background conditions
- External review procedure in October 2011
- Completed and printed early 2012 http://arxiv.org/pdf/1202.5940v1



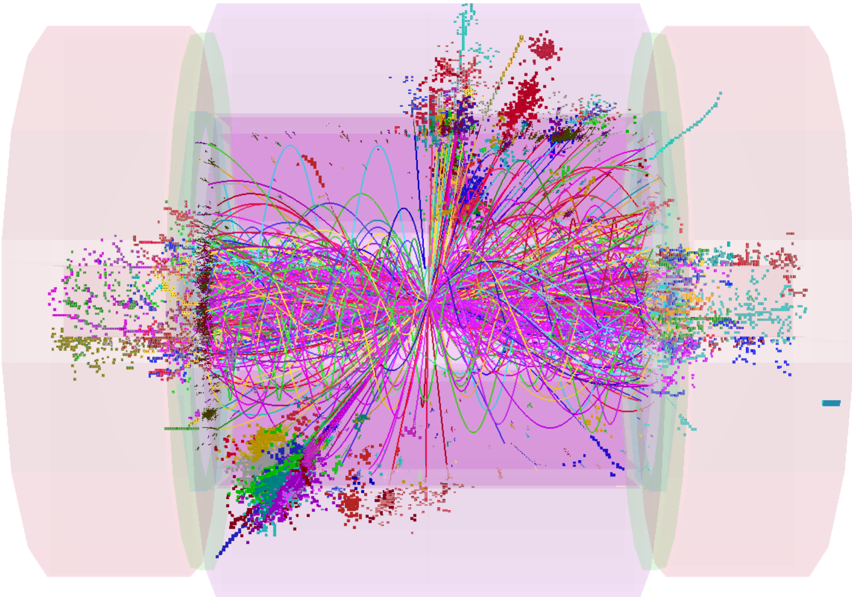
Vol 3: "CLIC study summary" (S.Stapnes)

- Summary and available for the European Strategy process, including possible implementation stages for a CLIC machine as well as costing and cost-drives
- Proposing objectives and work plan of post CDR phase (2012-16)
- Completed and printed mid 2012 http://arxiv.org/pdf/1209.2543v1

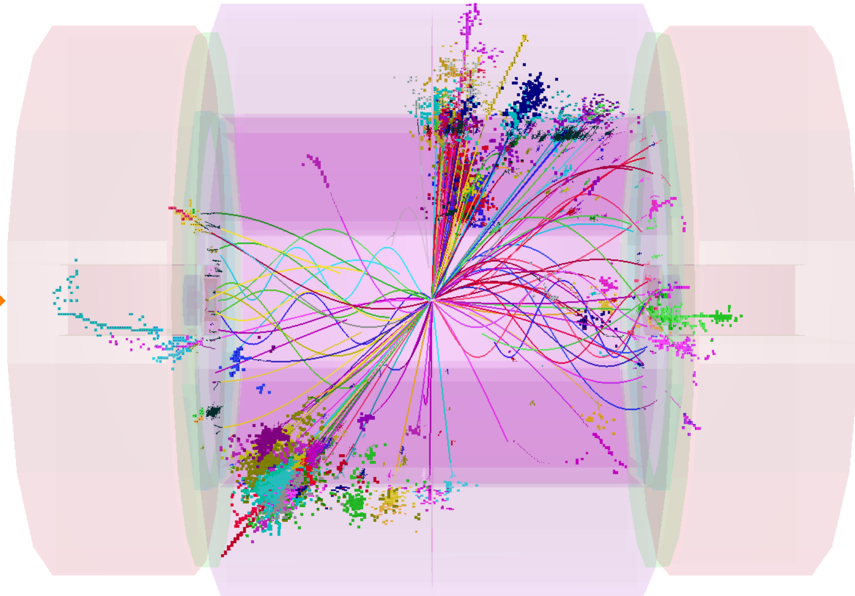
Involves Physics and Detectors

Methods for beam-induced background suppression are established

1.2 TeV



100 GeV



$$e^+e^- \rightarrow H^+H^- \rightarrow t\bar{b}b\bar{t} \rightarrow 8 \text{ jets}$$

1.2 TeV background in reconstruction time window

100 GeV background after tight cuts

All studies have full detector simulation and background overlay

2012 LC Workshops

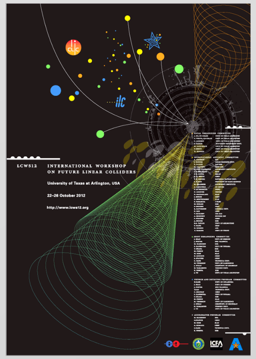
- **KILC12, Daegu, Korea, 23-27 April 2012,**
  Joint ACFA Physics and GDE
  http://kilc12.knu.ac.kr

- **LCWS12, University of Texas at Arlington 22-26 October 2012**
  http://www.uta.edu/physics/lcws12

  ILC: important discussions to achieve the ILC completion of Technical Design Report (end of 2012): machine TDR, Physics and Detector Detector Baseline Design (DBD) reports.

  CLIC: discussions on CDR volume 3 and R&D on going and future work

  First discussions within the LC community after the Higgs-like boson discovery at the LHC at LCWS12



- **IEEE NSS,/MIC Anaheim 29-30 October 2012, "Special Linear Collider Event"**
  https://indico.desy.de/conferenceDisplay.py?confId=6537

  Two days mini-workshop dedicated to the Linear Collider during the IEEE NSS/MIC conference.
  Well attended and followed by people outside the LC community

2013 LC Workshops

- **European Linear Collider Workshop, LC ECFA 2013, May 27-31 2013**
  DESY Hamburg
  http://lc2013.desy.de
  Local Chair: K. Buesser

- **LCWS13, Tokio, proposed dates are Nov. 11-15, 2013**
  Local Chair: S. Komamiya

Outreach and dissemination around the workshops

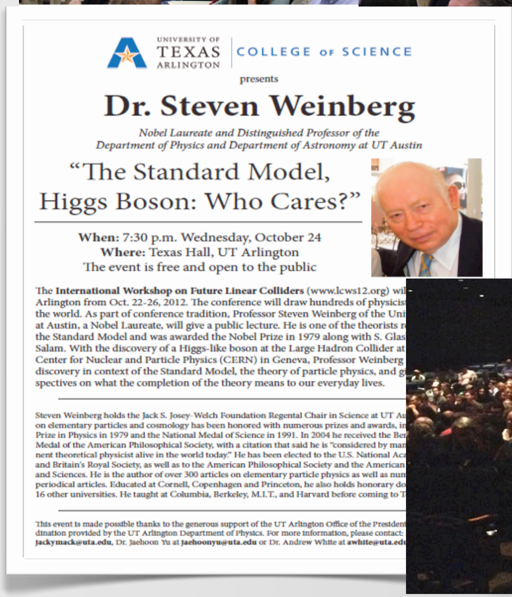
Particle Physics Slam - ALCPG11 - Eugene - March 22, 2011

Particle detectors: they're nearer than you think, **Marcel Demarteau**
Seeking hidden dimensions, **Brian Foster**
Neutrinos from outer space! **Garabed Halladjian**
An illumination of dark matter, **JoAnne Hewett**
Why physics, dude? **Marc Wenskat**

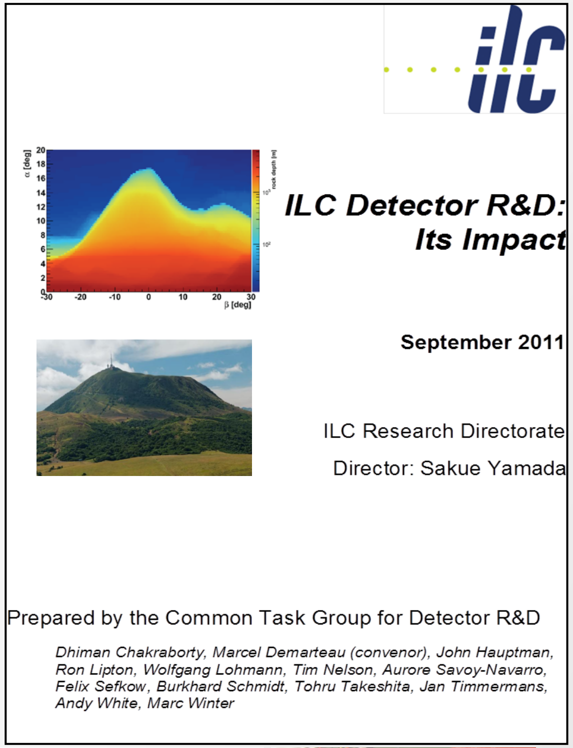
Global Event in June 2013

Celebrate ILC TDR/DBD completion

(see B. Foster talk for details)



Spinoffs derived from LC detector R&D


ILC Detector R&D: Its Impact

September 2011

ILC Research Directorate

Director: Sakue Yamada

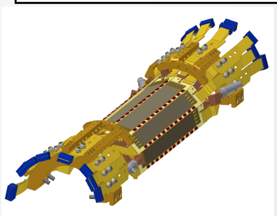
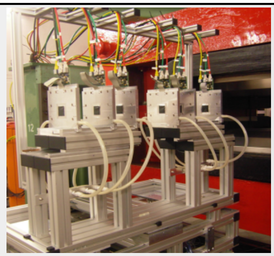
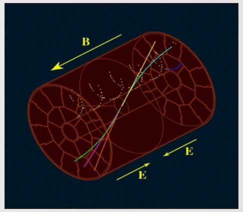
Prepared by the Common Task Group for Detector R&D

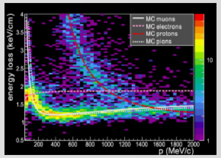
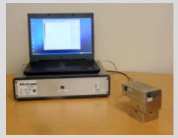
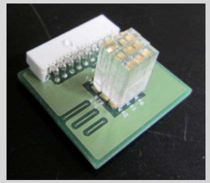
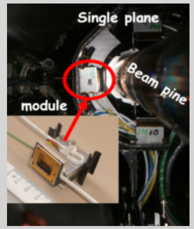
Dhiman Chakraborty, Marcel Demarteau (convenor), John Hauptman, Ron Lipton, Wolfgang Lohmann, Tim Nelson, Aurore Savoy-Navarro, Felix Sefkow, Burkhard Schmidt, Tohru Takeshita, Jan Timmermans, Andy White, Marc Winter

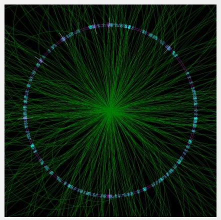
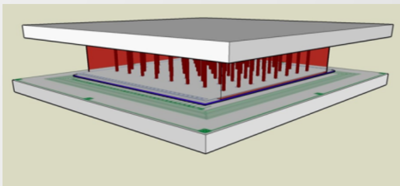
An study of the spinoffs derived by the LC detector R&D has been perfomed (worth reading!)

It includes:

- HEP applications:
  - ✓ vertex developments (FAIR, Star, BelleII)
  - ✓ TPC Micromegas (T2K)
  - ✓ forward calorimeters (LHC)
  - ✓ trigger development (LHC, CAST)
  - ✓ software (Belle II, NOVA, AIDA, CLIC, μ-collider)
- None HEP applications:
  - ✓ X-ray imaging (astronomy, medicine, proton tomography, volcano tomography)
  - ✓ ASICs for Balloon experiments


Future LC objectives

Lyn Evans statements at LCWS12 (Arlington, Oct. 22 2012):

- Strongly support the Japanese initiative to construct a linear collider as a staged project in Japan.
- Prepare CLIC machine and detectors as an option for a future high-energy linear collider at CERN.
- Further improve collaboration between CLIC and ILC machine experts.
- Move towards a “more normal” structure of collaboration in the detector community to prepare for the construction of two high-performance detectors.

Summary

- With present LHC results, Linear Colliders in the center-of-mas energy range from 0.25 TeV to 3.0 TeV present a clear, excellent and very challenging physics case:
  - ✓ understanding Higgs physics and top physics at low energy (below 1.0 TeV)
  - ✓ exploring new physics above 1.0 TeV in the range of potential LHC discoveries
  - ✓ this knowledge will become essential to understand the next steps of the field
- The physics and detector Linear Collider community is solid and existing since more than 15 years. It is well organized worldwide, and starting 2013 ILC and CLIC will live under the same structure
- Detector R&D for ILC and CLIC is progressing correctly despite the very limited amount of resources
- Detector milestones are accomplished during 2012-2013
  - ✓ CLIC: CDR (Volume 3) document ready mid-2012, and
  - ✓ ILC: physics and detector TDR (Volumes 1 –physics- and 3-DBD report-) will ready by the end of 2012 (15th December)
- Cooperation for detector R&D within ILC and CLIC is very good
- Pioneering R&D has resulted in many spinoffs useful for applications inside the HEP community and also outside the HEP community. An effort has been performed to follow and document it
- Most present LC workshops are being jointly organized by both communities, ILC and CLIC

Are you sure ?