JSPS specially-promoted research

A Global R&D Program of a State-of-the-art Detector System for ILC

Annual Meeting

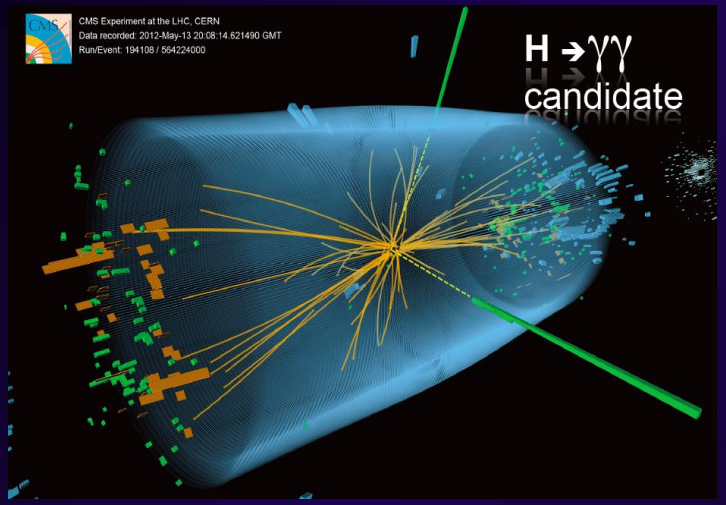
Hitoshi Yamamoto
Tohoku University

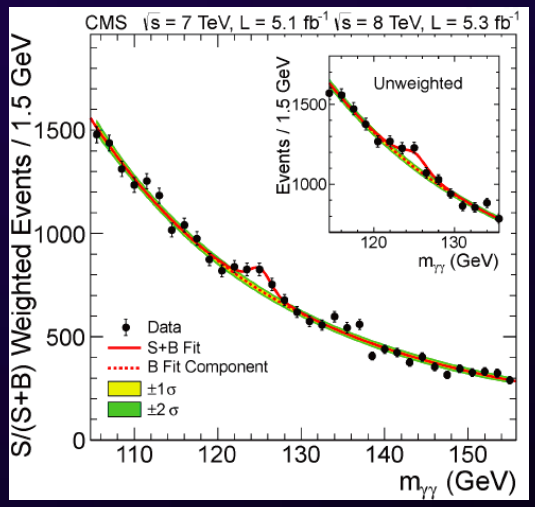
December 17, 2013
KEK

Recent Events

Discovery of Higgs

July 2012 : ‘New particle’ December 2012 : ‘Higgs-like’





- The fine-tuning problem of the SM became real. (unless ‘multiverse’)
- The problem of missing dark matter in the SM became accute
- and more …
- : Compelling reasons for the next step.

A new era of particle physics has begun!

The ILC is designed to lead the new era.

Press conference by the MEXT minister Shimomura

Jan 18, 2013

‘(On ILC) We would like to consider the plan for the near future, while as the government actively negotiating with relevant countries in the first half of this year … we are now studying the legal framework.’

The government has already started to contact relevant countries.

International Supports

- Europe : 'European Strategy' (March 22, 2013)
  - There is a strong scientific case for an electron-positron collider, complementary to the LHC, that can study the properties of the Higgs boson and other particles with unprecedented precision and whose energy can be upgraded … The initiative from the Japanese particle physics community to host the ILC in Japan is most welcome, and European groups are eager to participate. Europe looks forward to a proposal from Japan to discuss a possible participation.
- US : HEPAP facilities subpanel report (March 22, 2013)
  - The initiative from the Japanese particle physics community to host the ILC in Japan is very welcome, and the U.S. particle physics community looks forward to a proposal from Japan to discuss possible participation.
  - For the final US strategy, wait for the HEPAP subpanel (P5) report
    - First draft : March HEPAP meeting (tentatively 13-14 March, 2014)
    - Final report in May, 2014

ILC TDR Completion

June 12, 2013

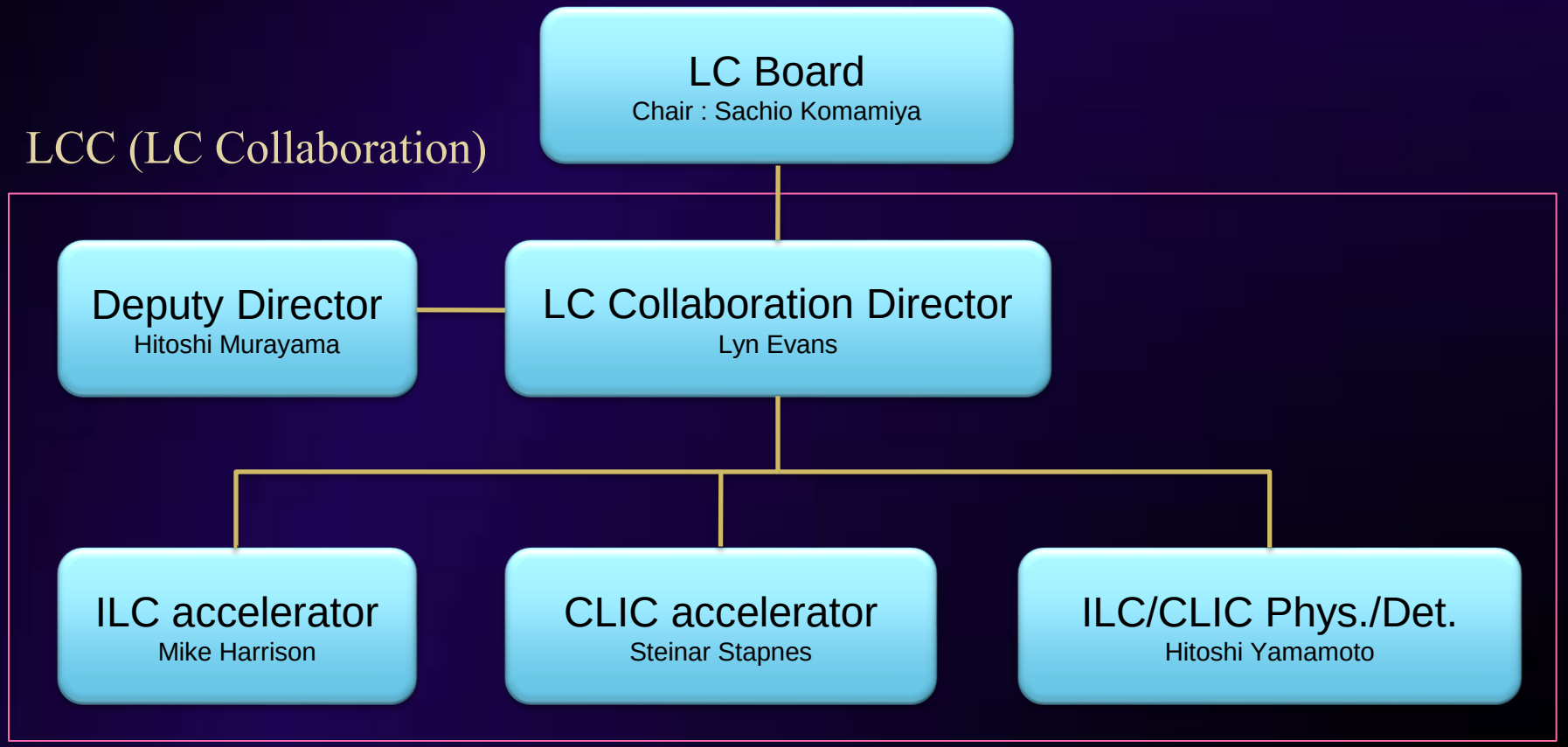
'A World-wide Event – from design to reality'

Fermilab

Tokyo

CERN

New International LC Organization



In full operation since June 12, 2013

Measurement errors of Higgs Couplings
(Snowmass on Mississippi, July 29 – Aug 6, 2013)

Facility	LHC	HL-LHC	ILC500	ILC500-up	ILC1000	ILC1000-up
$\sqrt{s}$ (GeV)	14,000	14,000	250/500	250/500	250/500/1000	250/500/1000
$\int \mathcal{L}dt$ (fb^{-1})	300/expt	3000/expt	250+500	1150+1600	250+500+1000	1150+1600+2500
κ_γ	$5-7\%$	$2-5\%$	8.3%	4.4%	3.8%	2.3%
κ_g	$6-8\%$	$3-5\%$	2.0%	1.1%	1.1%	0.67%
κ_W	$4-6\%$	$2-5\%$	0.39%	0.21%	0.21%	0.2%
κ_Z	$4-6\%$	$2-4\%$	0.49%	0.24%	0.50%	0.3%
κ_ℓ	$6-8\%$	$2-5\%$	1.9%	0.98%	1.3%	0.72%
$\kappa_d = \kappa_b$	$10-13\%$	$4-7\%$	0.93%	0.60%	0.51%	0.4%
$\kappa_u = \kappa_t$	$14-15\%$	$7-10\%$	2.5%	1.3%	1.3%	0.9%

(The ranges for LHC : conservative to aggressive projections)

- All assume generation universality, no BSM → Fit
- Apart from γ, ILC is 1/3 ~ 1/10 of HL-LHC
- With luminosity upgrade, additional ~1/2
- ILC can measure model-independently w/o assumptions above.

ILC Luminosity Upgrade Options

- 250 GeV CM (Higgs factory)
  - X4 luminosity @ 3E34/cm^{2}s
  - x2 Nbunch, x2 rep rate; 120 → 200 MW wall plug
- 500 GeV CM
  - x2 luminosity @3.6E34/cm^{2}s
  - x2 Nbunch; 160 → 200 MW wall plug
- 1 TeV CM
  - x1.4 luminosity @5E34/cm^{2}s
  - Aggressive beam params;

    Same wall plug power

Electron polarization

Specify the intermediate state

- Right-handed e- turns off A^0
  - Information on the gauge structure of the final state

Increase rates

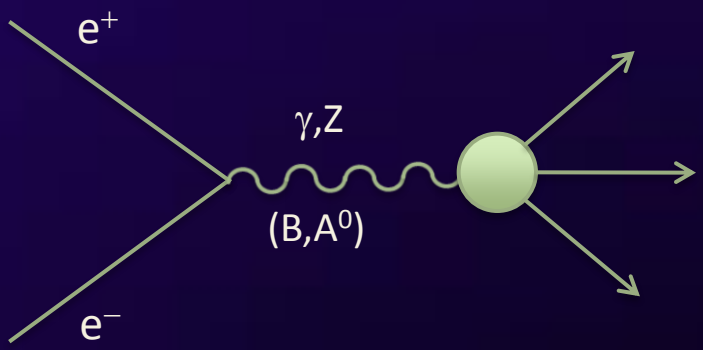
- e.g. $P^- / P^+ = -0.8/0.3$:

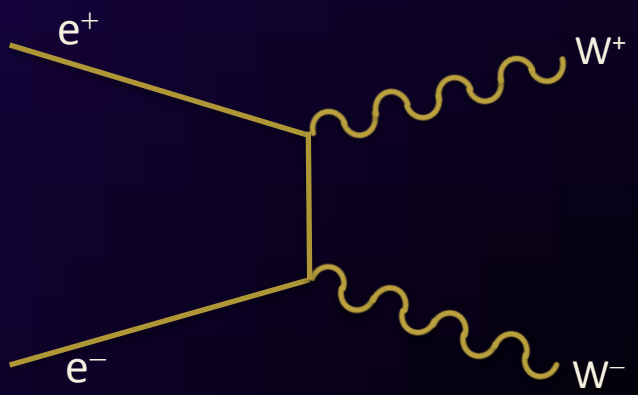
  Increases the H production mode

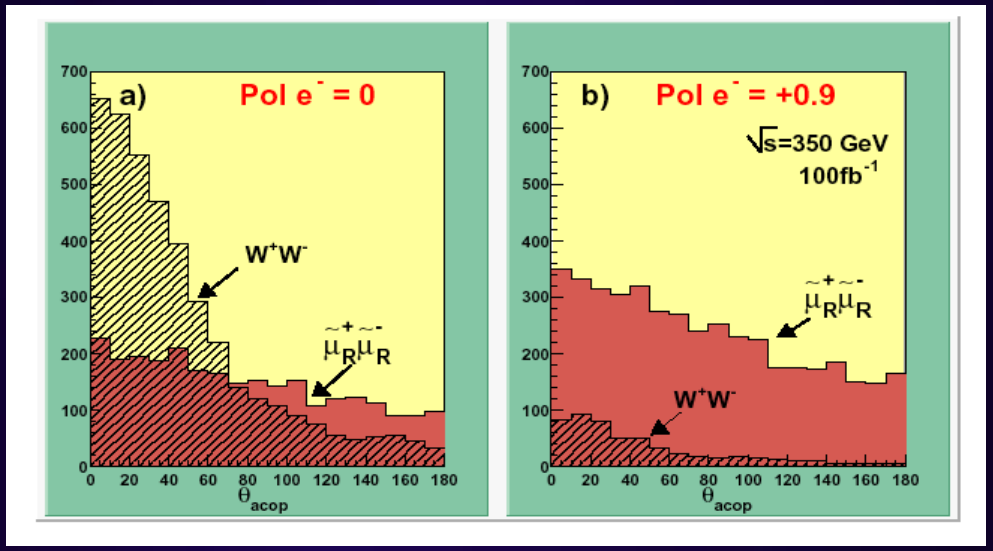
  $\sigma(\nu\nu H)$ by X 2.34 (=1.8 x1.3)

Background rejection

- Right-handed e- turns off W



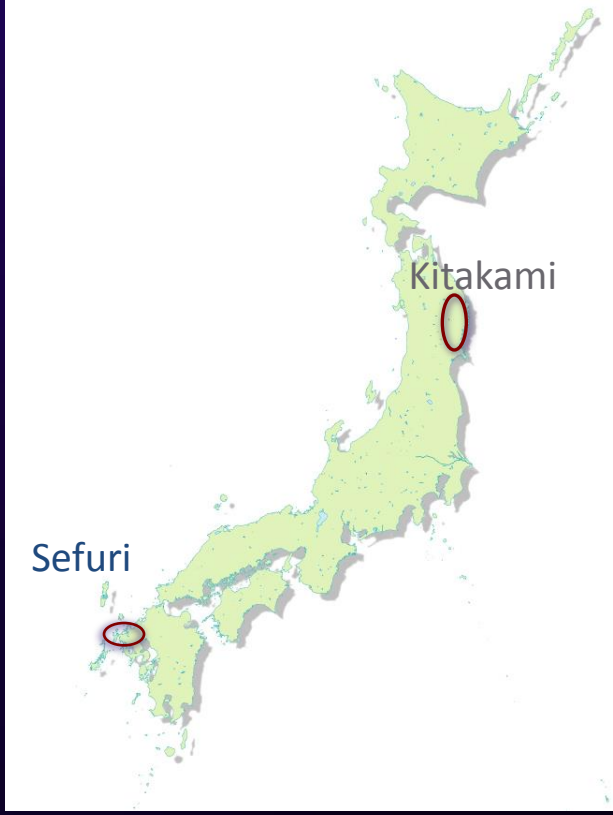




e.g. acoplanar muon pair produciton such as smuon pair production

ILC Candidate Site in Japan

- Kyushu
  - Sefuri mountains
- Tohoku
  - Kitakami mountains



‘ILC site evaluation committee’ (JAHEP)

Co-chairs: Kawagoe, Yamamoto

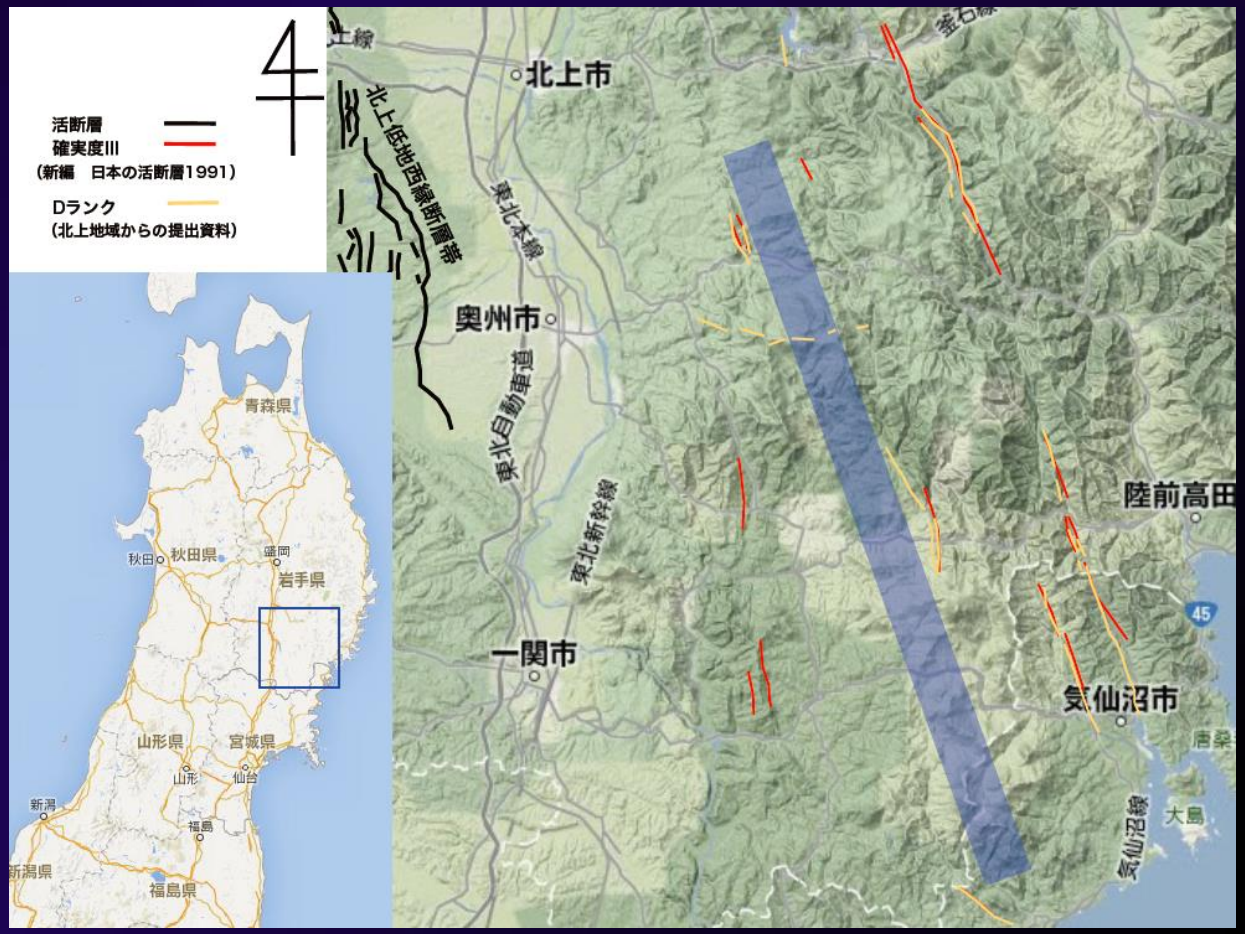
evaluated them based on

1. Geology and other technical aspects
2. Socio-economic conditions

Aug 23 2013, Selected the Tohoku Site

Tohoku Site (Katakami Mountains)

- Flexibility in positioning the 50 km route
- Shorter access tunnels
- Natural Drainage
- etc…



Science Council of Japan Report

Requested by the MEXT to review the ILC situation.
Report submitted : Sep 30, 2013.

- …we fully acknowledge the necessity and academic value of an electron-positron collider that is complementary to the LHC.

- …the Science Council of Japan proposes that the Japanese government appropriate necessary fund to study various issues toward deciding the implementation of the ILC project, and intensively conduct examinations and studies for 2 to 3 years by a group including experts outside of the relevant field and related government offices.

- In parallel with the above study and examination, negotiations should be conducted with research laboratories and funding authorities of relevant countries and regions to clarify the issues such as the international cost sharing.

(Unofficial translation by HY)

Science Council of Japan Report

- It also stated 'It is too early for the full implementation of the ILC'. (unofficial translation by HY)
  - This is a matter of course since the ILC is an international project that requires commitments of participating countries and regions before such can be decided.

- MEXT has requested ~$0.5M for the investigatory study on the ILC, and a committee is being formed responding to the report.
  - A major milestone would be reached when it is approved by the financial department.
  - The ILC task force had been formed in Feb 2013, headed by the MEXT vice minister.

Mr. Kawamura's Talk at LCWS13

- Text (in English)
  - Can be downloaded from the LCWS13 home page
- Highlights
  - We are aware that people are usually worried that an increase of academic budget in one field may mean a decrease in other fields. … We shall arrange a dedicated budget to accommodate its much wider implications. It is the responsibility of the government to carry this out.
  - The Department of Education has requested the Department of Finance to provide an ILC investigation fund of 50 million yen in next year's budget. … once it has been approved, we members of the house will have achieved one of the most important milestones of recent years.

Physics and Detectors

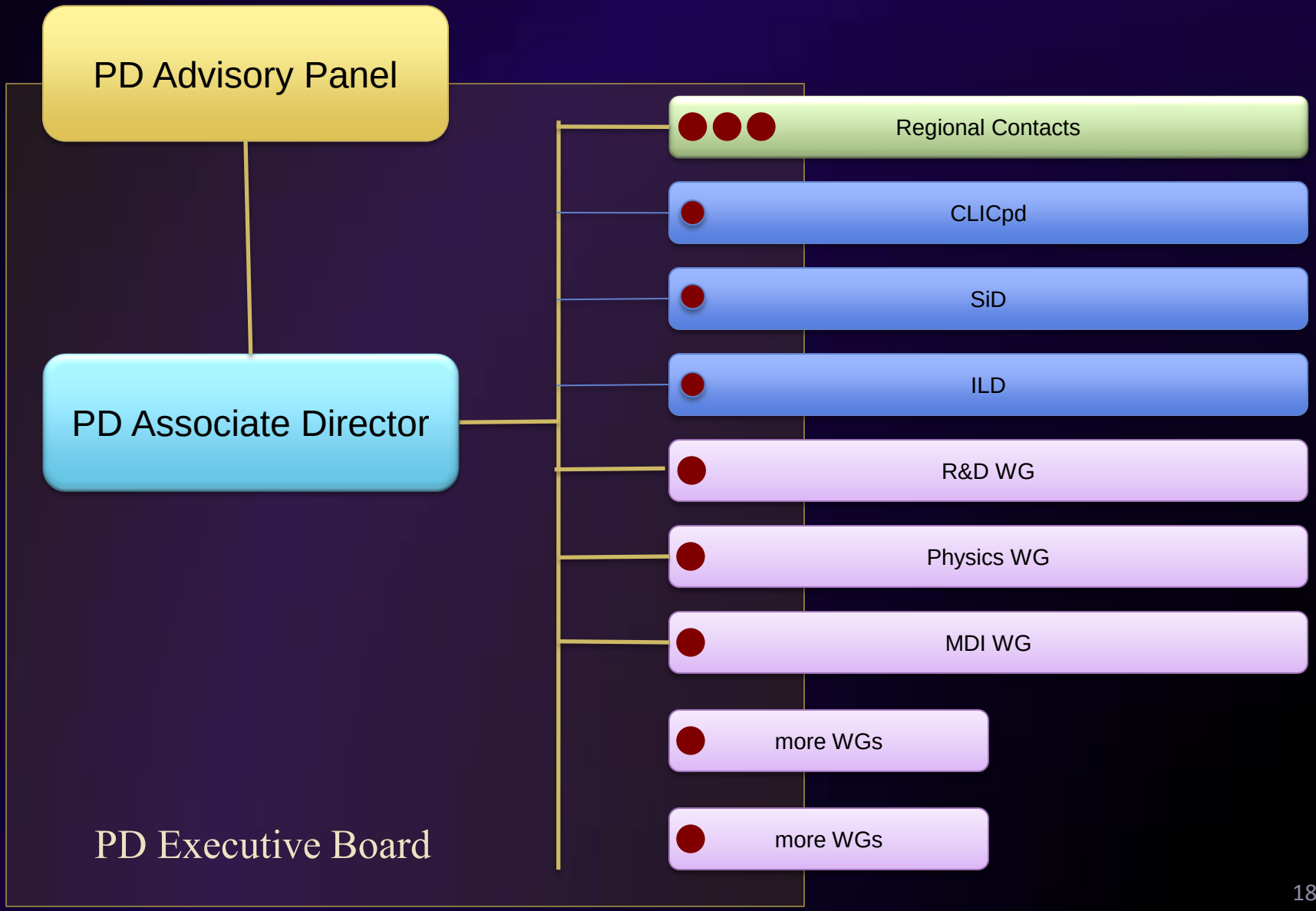
LCC Physics&Detector Charge

- The Associate Director for Physics and Detectors will be responsible for activities that advance the physics and detectors of the linear collider. He/she will coordinate the world-wide effort to develop advanced detectors that are appropriate for either accelerator technology.

- The Associate Director will report to the Director. Working with the community, he/she will prepare the way for collaboration formation and detector construction for when the project is approved.

- Initially, the Associate Director will focus on
  - Building the physics case for a linear collider;
  - Coordinating R&D on advanced detector technologies;
  - Developing validated detector concepts for both accelerator technologies.

LCC PD Structure



LCC Physics and Detectors

EB members status

- SiD representative : Marcel Stanitzki
- ILD representative : Ties Behnke (Interim)
- CLICdp representative : Mark Thomson (Interim)

- European regional contact : Juan Fuster
- North American contact : Dmitri Denisov
- Asian contact : filled in by HY

- MDI WG convener : Karsten Buesser
- Software&Computing : Akiya Miyamoto, Frank Gaede, Norman Graf, Andre Sailer (one of them will be the convener)
- ILC parameter WG convener (PD side) : Jim Brau
- … more to come

ILC ‘strategy’ workshops

Many mini workshops worldwide to discuss how to participate in the ILC, how to obtain funds for the ILC.

In the past

- May 16-17, 2013 : Como, Italy
- Sept 2-3, 2013 : United Kingdom
- Nov 22, 2013 : Germany
- Nov 29, 2013 : Paris, France
- Dec 13, 2013 : Seoul, Korea

In the future

- Jan~Feb, 2014 : Germany
- Feb (1 day of)12-14, 2014 : Spain

JSPS specially-promoted research

A Global R&D Program of a State-of-the-art Detector System for ILC

Goal

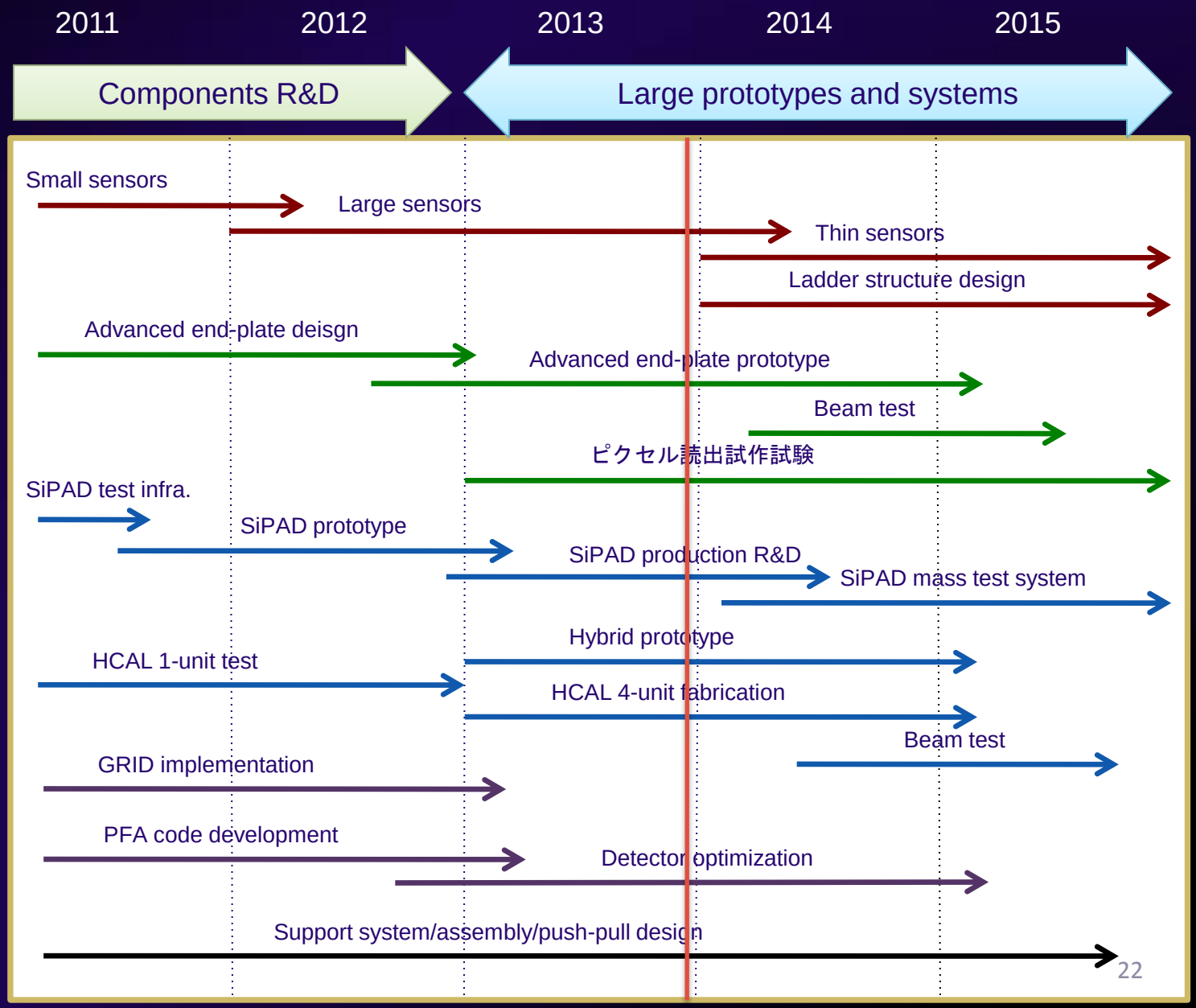
Develop the state-of-the-art components and systems, and complete the detector design based on the concept of PFA that realizes the physics of ILC within a framework of international collaboration.

→ lead the formation of a detector collaboration

PFA

Key components : Vertex detector, TPC, Calorimeters

Timeline of the JSPS Program



ILC Timeline
Proposed by LCC

- 2013 - 2016
  - Negotiations among governments
  - Accelerator detailed design, R&Ds for cost-effective production, site study, CFS designs etc.
  - Prepare for the international lab.
- 2016 – 2018
  - 'Green-sign' for the ILC construction to be given (in early 2016)
  - International agreement reached to go ahead with the ILC
  - Formation of the ILC lab.
  - Preparation for biddings etc.
- 2018
  - Construction start (9 yrs)
- 2027
  - Construction (500 GeV) complete, (and commissioning start)

    (250 GeV is slightly shorter)

Summary

- With the discovery of Higgs, the physics case for the ILC is now stronger than ever
- ILC design is ‘ready’ with the completion of TDR
- Japanese government is now willing to negotiate with other governments toward siting the ILC in Japan (when will be the official announcement?)
- There are strong supports and enthusiasm of the international scientific communities.
- This program is well-positioned to complete the preparatory phase for the ILC detector efforts as it moves toward real collaborations

Backups