

ILC Physics, Detectors, & the Future

Preparing for Snowmass & P5,
& info on the June 12 TDR Launch Event

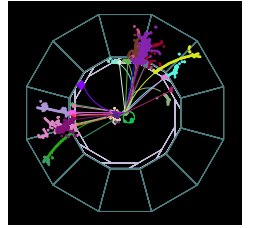
Jim Brau

DESY LC Workshop

May 30, 2013



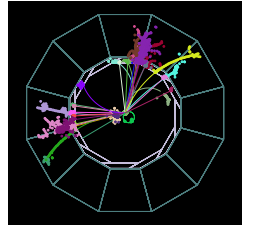
ILC Physics, Detectors, & the Future



- Snowmass and white papers
 - Four ILC Physics Topics
 - Submission to the Frontier Capabilities Snowmass Group
 - Instrumentation Frontier
 - CLIC white paper
- P5
- June 12 ILC TDR Launch Event



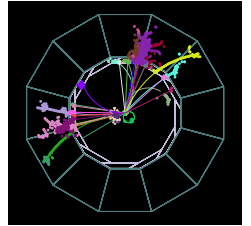
Snowmass Planning Process



- Snowmass Planning Process (aka CSS = Community Summer Study) organized around several “frontiers”
 - Energy Frontier
 - Intensity Frontier
 - Cosmic Frontier
 - Frontier Capabilities
 - Instrumentation Frontier
 - Computing Frontier
 - Education and Outreach
 - Theory Panel



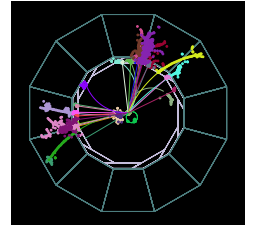
Snowmass Planning Process



- Snowmass Planning Process organized around several “frontiers”
 - **Energy Frontier**
 - *Conveners: Chip Brock (Michigan State), Michael Peskin (SLAC)*
 - Intensity Frontier
 - Cosmic Frontier
 - **Frontier Capabilities**
 - *Conveners: William Barletta (MIT), Murdock Gilchriese (LBNL)*
 - **Instrumentation Frontier**
 - *Conveners: Marcel Demarteau (ANL), Howard Nicholson (Mt. Holyoke), Ron Lipton (Fermilab)*
 - Computing Frontier
 - Education and Outreach
 - Theory Panel



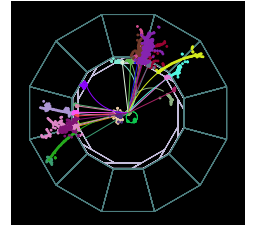
Energy Frontier Snowmass Group



- **Conveners: *Chip Brock (Michigan State), Michael Peskin (SLAC)***
- Snowmass Energy Frontier study organized into topical working groups:
 - HE1: The Higgs Boson
 - HE2: Precision Study of Electroweak Interactions
 - HE3: Fully Understanding the Top Quark
 - HE4: The Path Beyond the Standard Model
 - - New Particles, Forces, and Dimensions
 - HE5: Quantum Chromodynamics and the Strong Force
 - HE6: Flavor Mixing and CP Violation at High Energy
- Each will write a summary report describing the community consensus at the end of the process
- Summary reports will be input to the DOE P5 process



Energy Frontier Snowmass Group



Questions for all groups

ISSUES THAT WE WOULD LIKE TO UNDERSTAND ARE:

The evolution and upgrade of the LHC.

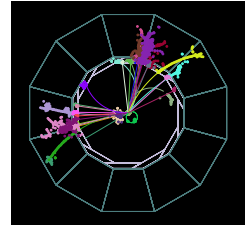
- In each of the topical areas, what are the most important physics measurements that should be carried out at the LHC?
- What are the most important measurements or issues that motivate upgrades of the LHC and its detectors?
- How do requirements of these physics measurements shape the requirements for the evolution of the LHC accelerator and detectors?

Opportunities provided by a new high energy accelerator.

- What are the most important physics measurements or programs that call for the construction of a new accelerator?
- What physics do we still need to learn to make a scientific case for this new accelerator?
- What are the instrumentation and computing challenges that experiments at this accelerator will face?



Energy Frontier Snowmass Group



POTENTIAL FUTURE FACILITIES TO BE CONSIDERED

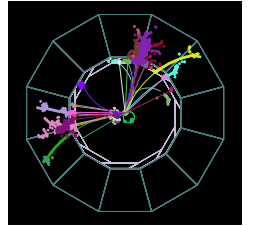
The physics questions given to the groups should be evaluated in the context of future accelerator facilities. Many ideas for future accelerators are on the table. These include:

1. The LHC with $E = 14$ TeV and $L = 10^{34}$
 2. A luminosity upgraded LHC with: $E_{cm} = 14$ TeV, $L = 10^{35}$
 3. An energy upgraded LHC
 4. The e+e- lepton colliders, $E_{cms} < 1$ TeV.
 5. A circular e+e- collider operating as a Higgs factory.
 6. A higher energy e+e- or gamma-gamma colliders, $E_{cms} > 1$ TeV.
 7. A mu+mu- collider.
 8. A lepton-hadron collider.
 9. A VLHC hadron collider with energy well above the LHC energy.
- Other possible future facilities may be proposed in the course of the year. The studies should look broadly at the opportunities for each of these machines. It is especially important to point out critical points in energy or luminosity that are essential to realize physics goals.
 - For experiments at hadron colliders, a specific question is the effect of the machine environment for high- luminosity running. Do high-luminosity conditions compromise the needed measurements? Are there detector designs or experimental strategies that can ameliorate these problems?
 - For the required measurements, evaluate also: (a) What new theoretical or simulation tools (for signal or background) are needed to achieve the goals? (b) What are the challenges for the detector and the computing capability?

We expect to have dialogues with the **Facilities** and **Instrumentation** study groups on all of these issues.



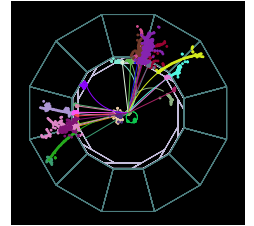
ILC Physics at Snowmass



- The ILC physics reach must be represented correctly and favorably in the Snowmass summary reports – they must conclude that the ILC is a valuable scientific opportunity.
- We, the ILC community, are in the best position to prepare input to the topical groups, ensuring that the working groups and their conveners have the correct and most persuasive information.
- The DBD Physics Volume is a resource for this, but it is inclusive, covering many topics in some depth.
- It is better to prepare concise, readable documents targeted at each topical working group.



Snowmass White Papers



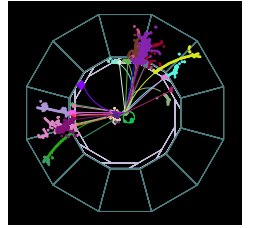
- **From the Snowmass web page**
- <https://www-public.slac.stanford.edu/snowmass2013/default.aspx>
- **Snowmass 2013 - Contributed Papers**
 - We encourage any group or individual with interest in the future of high-energy physics to submit a White Paper on any subject relevant to the study. We also encourage any person or group with new scientific results relevant to the Snowmass study to submit the writeup of their analysis.

To submit a paper of the Proceedings, please visit

[https://www-public.slac.stanford.edu/snowmass2013/
submissionform.aspx](https://www-public.slac.stanford.edu/snowmass2013/submissionform.aspx)



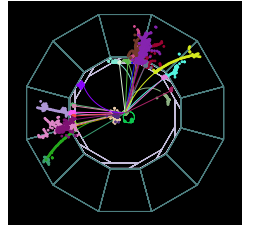
ILC Physics White Papers



- The DBD is a starting point for physics input to Snowmass
- But the LHC results are being updated, and ILC studies continue
- We have recruited teams of expert authors to prepare updated reports and to make presentations to the Snowmass workshops
 - BNL – (April 3-6)
 - Seattle – (June 30-July 3)
 - Minneapolis – (July 29-Aug 7)
 - DPF/Santa Cruz – (Aug 13-17)
- Key Energy Frontier topics
 - Higgs (HE1)
 - Precision Electroweak (HE2)
 - Top (HE3)
 - New Particles/SUSY (HE4)
- Also, Future Capabilities Group is important



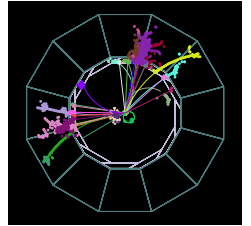
Higgs (HE1)



- Snowmass conveners:
 - **Sally Dawson (BNL), Andrei Gritsan (Johns Hopkins), Heather Logan (Carleton), Jianming Qian (Michigan), Chris Tully (Princeton), Rick Van Kooten (Indiana)**
 - **Coordinated white paper effort with conveners**
- ILC white paper authors:
 - Tim Barklow (SLAC), Howard Haber (UCSC), David Asner (PNNL), Keisuke Fujii (KEK), Shinya Kanemura (Toyama), Akiya Miyamoto (KEK)
- Active participation at BNL
- Weekly telecons organized by Tim
- Planning first draft by June 6
 - Outline with assigned responsibilities
- Planning for participation in Seattle



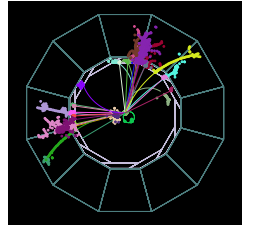
Top (HE3)



- Snowmass conveners:
 - **Kaustubh Agashe (Maryland), Robin Erbacher (UC Davis), Cecilia Gerber (Illinois-Chicago), Kirill Melnikov (Johns Hopkins), Reinhard Schwienhorst (Michigan State)**
 - **Encouraged by email exchanges with Kaustubh and Robin**
- ILC white paper authors:
 - Roman Poeschl (CNRS/IN2P3/LAL), David Asner (PNNL), Yoichiro Kiyo (Juntendo), Yukinari Sumino (Tohoku), Marcel Vos (Valencia), Andre Hoang (Vienna)
- Presentation at BNL
- Drawing on DBD Physics volume, a draft white paper has been prepared and will be polished before Seattle
- Will arrange for presentation(s) in Seattle



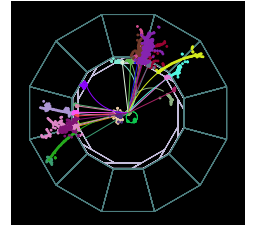
New Particles/SUSY (HE4)



- Snowmass conveners:
 - **Yuri Gershtein (Rutgers), Markus Luty (UC Davis), Meenakshi Narain (Brown), Liantao Wang (Chicago), Daniel Whiteson (UC Irvine)**
 - **Encouraged by email exchange with Meenakshi**
- ILC white paper authors:
 - Howie Baer (Oklahoma), Jenny List (DESY),
Maxim Perlstein (Cornell), Mikael Berggren (DESY),
Aaron Pierce (Michigan), Tomohiko Tanabe (Tokyo)
- Quite active at BNL
- White paper coming along – draft by end of May
- Preparing for strong participation in Seattle and Minneapolis



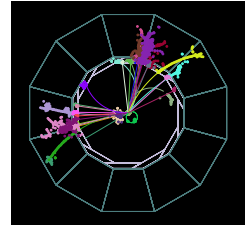
Precision Electroweak (HE2)



- Snowmass conveners:
 - **Ashutosh Kotwal (Duke), Michael Schmitt (Northwestern), Doreen Wackerroth (SUNY Buffalo)**
 - **Encouraged by phone conversation with Doreen**
- ILC white paper authors:
 - Graham Wilson (Kansas), Klaus Moenig (DESY),
Paul Langacker (Princeton), Masaharu Tanabashi (Nagoya),
Kaoru Hagiwara (KEK), Sven Heinemayer (Santander/Cantabria/)
- Presentation at BNL– nice telecon talk by Sven
- White paper developing



Frontier Capabilities Snowmass Group



Conveners: William Barletta (MIT), Murdock Gilchriese (LBNL)

Cornell University Library
We gratefully acknowledge the support of the Cornell University Library.
arXiv.org > physics > arXiv:1304.2586
Search or Art
Physics > Accelerator Physics

The International Linear Collider

Jim Brau, Paul Grannis, Mike Harrison, Michael Peskin, Marc Ross, Harry Weerts

(Submitted on 9 Apr 2013)

We present a brief summary of the International Linear Collider as documented in the 2013 Technical Design Report. The Technical Design Report has detailed descriptions of the accelerator baseline design for a 500 GeV e^+e^- linear collider, the R&D program that has demonstrated its feasibility, the physics goals and expected sensitivities, and the description of the ILD and SiD detectors and their capabilities.

Comments: 4 pages. This note is intended as a reference for the discussion of the U.S. High Energy Physics future program in the Community Summer Study (Snowmass on the Mississippi) in July 2013

Subjects: **Accelerator Physics (physics.acc-ph)**; High Energy Physics – Experiment (hep-ex); Instrumentation and Detectors (physics.ins-det)

Cite as: **arXiv:1304.2586 [physics.acc-ph]**
(or **arXiv:1304.2586v1 [physics.acc-ph]** for this version)

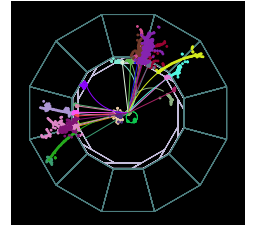
Submission history

From: Paul D. Grannis [view email]
[v1] Tue, 9 Apr 2013 13:43:16 GMT (30kb)

Refined version of document we prepared for HEPAP Facilities Subpanel



Instrumentation Frontier Snowmass Group



*Conveners: Marcel Demarteau (ANL),
Howard Nicholson (Mt. Holyoke), Ron Lipton (Fermilab)*

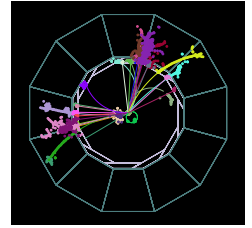
From their web page:

- The instrumentation group will have four levels of papers for the Snowmass process.
- Everyone is encouraged to submit one-pagers, that is brief papers that describe some key challenges or introduce some new technology
- The one-papers submitted to date can be found on the web page.
- At the second level we have the instrumentation summary whitepapers from the physics and technology frontiers. These papers will form the basis for the Instrumentation Summary paper.
- We will also submit an Instrumentation Executive summary.



Instrumentation Frontier

Snowmass Group



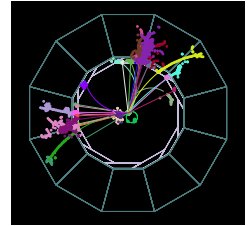
*Conveners: Marcel Demarteau (ANL),
Howard Nicholson (Mt. Holyoke), Ron Lipton (Fermilab)*

- Instrumentation Frontier Whitepapers
- Energy Frontier
 - Level 1 Track Triggers at HL-LHC
 - Tracker and Vertex Detector for a Muon Collider
 - Operation of Collider Experiments at High Luminosity
 - Noble Liquid Calorimeters
 - Triggers for hadron colliders at the energy frontier*
 - A Differential Time-of-Flight Technique for Collider Detectors
 - Hadronic dual-readout calorimetry for high energy colliders
- Cosmic Frontier
 - Ultra High Energy Neutrinos
 - nEXO Detector R&D
 - Large Arrays of Air Cherenkov Detectors
 - Low Background Materials for Direct Detection of Dark Matter
 - Dark Energy
 - Future Atmospheric and Water Cherenkov gamma-ray Detectors
 - Physics Motivation for WIMP Dark Matter Directional Detection
 - Direct Detection of WIMPs
- Solid Xenon R&D at Fermilab
- Applications of Laser Interferometry in Fundamental Physics Experiments
- Instrumentation for New Measurements of the Cosmic Microwave Background polarization
- Intensity Frontier
 - Advanced Water Cherenkov R&D for WATCHMAN
 - Liquid Argon TPC
 - LHCb Upgrade
 - Neutrino Detectors Working Group Summary
 - Electromagnetic Calorimetry in Project X Experiments
 - Liquid Scintillator Instrumentation for Physics Frontiers
- Technologies
 - Combination of Active Edge and 3D Electronics Technologies
 - Plasma Panel Detectors for Ionizing Particles
 - 3D Sensor Architecture
 - Development of Resistive Plate Chambers
 - Powering Future Particle Physics Detectors
 - Imaging Calorimetry
 - Future Crystal Electromagnetic Calorimetry
 - Development of Cost-effective Crystals For
- Homogenous Hadron Calorimetry
- Application Specific Integrated Circuits (ASICs) for HEP applications
- The Next Generation of Crystal Detectors
- Use of Flat Panel Microchannel Plates in Sampling Calorimeters with Timing
- Micro-Pattern Gas Detectors for Charged-Particle Tracking & Muon Detection
- Low Mass Support and cooling (1 page)
- Monolithic Pixel Sensors
- High speed, massively parallel, ATCA based Data Acquisition Systems using modular components
- The Next Generation of Photo-Detectors for Science in the Cosmic, Intensity and Energy Frontiers
- Future Developments in Gigasample-per-second Waveform Sampling Application Specific Integrated Circuits
- Micro-Pattern Gas Detectors for Calorimetry
- Emerging Optical Link Technologies for HEP
- Facilities
 - Irradiation Facilities at Fermilab
 - Irradiation Facilities in New Mexico
 - Beam Test Facilities
 - Synergies Between Detector Development in Nuclear and Particle Physics



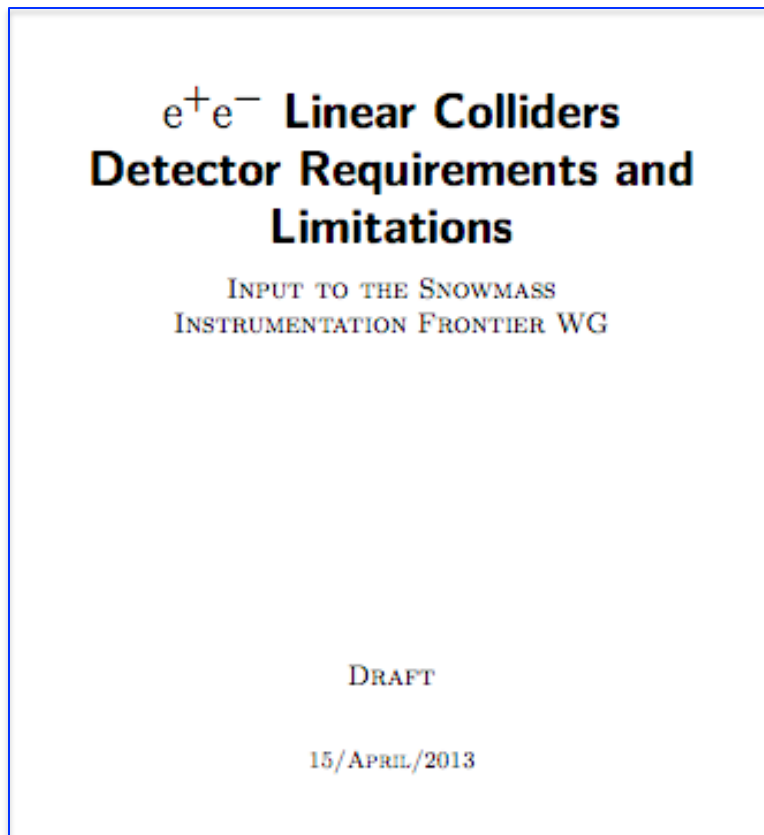
Instrumentation Frontier

Snowmass Group



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- Papers being prepared, including
 - A. White:



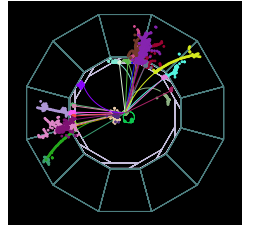
Comments from M. Demarteau

Abe Seiden and Marina Artuso submitted a sensor whitepaper. It includes: MAPS sensors, crystals for dual readout, 3D stacked silicon, 3D pillar silicon, hybrid pixels, 4D Silicon (with ultra-fast timing), diamond sensors, SiPMs, low mass supports.

LBL ASIC workshop being organized by Maurice Garcia-Sciverez Focused on effort for the US to move towards 60nm for all ASIC design



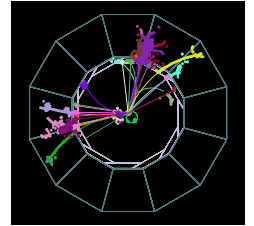
CLIC Whitepaper



- CLIC colleagues are working on a physics paper for Snowmass
 - covers the physics reach of CLIC
 - 20-25 pages, arranged following the relevant Snowmass working groups:
 - Brief introduction to CLIC (incl. physics sensitivity for a staged machine)
 - Higgs physics
 - Top physics
 - BSM physics
 - Electroweak/precision physics
 - Summary and outlook
- Mostly summary of existing results (all the benchmarks studies presented in the CDR volumes) complemented with additional Higgs benchmark studies at 350 GeV and 1.4 TeV.



Particle Physics Project Prioritization Panel (P5)

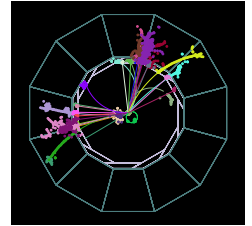




- P5 recommended by Barish-Bagger HEPAP Subpanel on Long-Range Planning for US High-Energy Physics in 2002
 - Two P5s were chaired by Abe Seiden and more recent P5 (2008) chaired by Charlie Baltay
- Planning for next P5 to follow the Snowmass process is happening now.




- Jim Siegrist, DOE HEP:
- After CSS2013 process completes, we plan to re-establish a Particle Physics Project Prioritization Panel (P5) to take the study output as input to the next round of prioritization, including budget projections.
- We expect to have an updated plan sometime in calendar 2014 that will shape the program going forward.





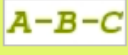


June 12 Event





[ILC Home](#) | [All about the ILC](#) | [Global Design Effort](#) | [Physics and Detectors](#) |   

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- [Calendar](#) 
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[Home](#) > [Events](#) > [2013](#) > ILC-TDR-event

The International Linear Collider - A World-Wide Event - From Design to Reality

The official and worldwide handover ceremony of the *Technical Design Report* for the International Linear Collider will happen on 12 June 2013 in all three regions of the ILC.

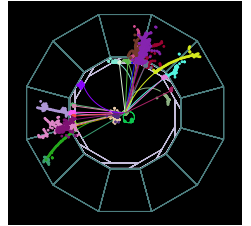
Many years of globally coordinated R&D culminate in the *Technical Design Report*, which presents the latest, most technologically advanced and most thoroughly scrutinised design for the potential next-generation particle collider to complement and advance beyond the physics of the Large Hadron Collider at CERN. In a global event starting in Japan and ending in the United States, scientists and their guests will celebrate this achievement in symposia, public events, receptions and a series of handover ceremonies.

Detailed programmes for the three regional events, including speakers and timing, will become available soon. Registration will open in January.

<http://www.linearcollider.org/events/2013/ilc-tdr-world-wide-event>



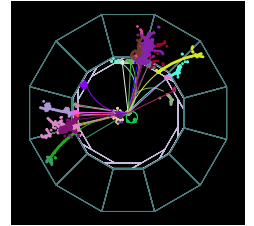
June 12 Event



- Official and worldwide handover ceremony of ILC *TDR* for the International Linear Collider
- 12 June 2013 in all three regions of the ILC.
 - Co-chairs: Brian Foster, Hitoshi Yamamoto, JB
- Many years of globally coordinated R&D culminate in the *TDR*, presenting the latest, most technologically advanced and most thoroughly scrutinised design for the potential next-generation particle collider to complement and advance beyond the physics of the Large Hadron Collider at CERN.
- In a global event starting in Japan and ending in the US, scientists and their guests will celebrate this achievement in symposia, public events, receptions and a series of handover ceremonies.
- Detailed programmes for the three regional events have been posted



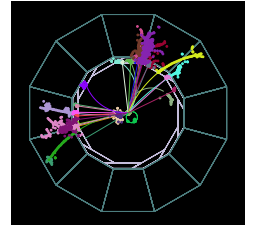
June 12 Program



- Order of programs
 - Japan (Tokyo)
 - Europe (CERN)
 - US/Canada (Fermilab)
- Each region
 - Hand-offs between regions
 - 2 hour symposium of talks on physics, accelerator, detectors, and spin-offs
 - Symposium concludes with hand over of the TDR from GDE rep to ICFA rep
 - Reception
 - Public Lecture



Summary



- ILC
 - White papers are being prepared
 - 4 topics (Higgs, Precision EW, top, New Particles/SUSY)
 - Talks are being given at Snowmass workshops
 - Interactions with the Energy Frontier topical WG conveners
- Frontier Capabilities Snowmass Group
 - White paper was submitted in April
- Instrumentation Frontier – white papers and one-pagers
- CLIC - white paper in preparation
- P5 will set prioritization in 2014
- June 12 TDR Launch Event
 - Planned for sequence of linked celebrations in each region
 - Tokyo, CERN, Fermilab
 - Symposium of technical talks / reception / public lecture