Latest Progress in Realization of ILC in Japan

Rong-Li Geng

Accelerator Seminar, JLab
November 21, 2013
World-wide Event

- On June 12\textsuperscript{th}, ILC TDR was published in Worldwide Event.

- End of major phase in ILC development – now what?
LCWS13 at U. of Tokyo (11/11-15,2013)

- First LC workshop under LCB/LCC
- ILC + CLIC, physics, detector
- 350 participants
- 120 institutions
- 20 countries
Accelerator Working Groups

AWG1: Sources
  Steffen Doebert, Wei Gai, Masao Kuriki

AWG2: Damping Rings
  Ioannis Papaphilippou, David Rubin

AWG3: Beam Delivery & Machine Detector Interface
  Gao Jie, Lau Gatignon, Rogelio Tomas

AWG4: Beam Dynamics
  Kiyoshi Kubo, Andrea Latina, Nikolay Solyak

AWG5: Conventional Facilities
  Atsushi Enomoto, Vic Kuchler, John Osborne

AWG6: System Tests and Performance Studies
  Roberto Corsini, Marc Ross, Daniel Schulte, Nobuhiro Terunuma

AWG7: Superconducting RF Technologies
  Hitoshi Hayano, Eiji Kako, Wolf-Dietrich Moeller, Akira Yamamoto
Physics and Detector R&D

RD1: Higgs / Electroweak Symmetry Breaking
  Tim Barklow, Chrstophe Grojean, Howard Haber, Shinya Kanemura, Philipp Roloff, Junping Tian

RD2: Beyond the Standard Model / Cosmology
  Max Chertok, Seong-Youl Choi, Debajyoti Choudhury, Keisuke Fujii, Christian Grefe, Geraldine Servant, Georg Weiglein

RD3: Top / QCD / Loopverein
  David Asner, Radja Boughezal, German Rodrigo, Frank Simon, Taikan Suehara, Sumino Yukinari

RD4: Gamma-Gamma
  Kingman Cheung, Jeff Gronberg, Maria Krawczyk, Tohru Takahashi, Valery Telnov, Mayda Velasco

RD5: Simulation / Detector Performance / Reconstruction
  Frank Gaede, Norman Graf, John Marshall, Akiya Miyamoto, Manqi Ruan, Graham Wilson

RD6: Detector Integration / Machine Detector Interface / Polarisation
  Karsten Buesser, Guinyun Kim, Tom Markiewicz, Marco Oriunno, Tomoyuki Sanuki

RD7: Tracking / Vertex
  Mahdu Dixit, Tim Nelson, Akira Sugiyama, Yasuhiro Sugimoto, Marcel Vos, Marc Winter

RD8: Calorimetry / Muon
  Daniel Jeans, Imad Laktineh, Roman Poeschl, Jose Repond, Felix Sefkow, Andy White, Tamaki Yoshioka
Organization

ICFA

Program Advisory Committee

Linear Collider Board

Regional Directors
  Brian Foster
  Harry Weerts
  Akira Yamamoto

Directorate
  Lyn Evans

Deputy (Physics)
  Hitoshi Murayama

ILC
  Mike Harrison

CLIC
  Steinar Stapnes

Physics & Detectors
  Hitoshi Yamamoto
Two Candidate Sites in Asia/Japan
Japan – Preferred Site selection

“Issues that could lead to particularly serious difficulties for the Sefuri site are that the route passes under or near a dam lake, and that the route passes under a city zone. Also, the lengths of access tunnels are longer for the Sefuri site than for the Kitakami site leading to a large merit for the latter in terms of cost, schedule, and drainage.”
Preferred Site selected
Site Specific Design

Need to establish the IP and linac orientation
Then the access points and IR infrastructure
Then linac length and timing
International review of Japanese candidate site

- Review Committee members
- Eckhard Elsen (DESY)
- Lyn Evans (Chairman, Imperial College, London)
- Mike Harrison (BNL)
- Alain Herve (University of Wisconsin)
- Vic Kuchler (FNAL)
- Hitoshi Murayama (LBL/IPMU)
- John Osborne (CERN)
- Steinar Stapnes (University of Oslo/CERN)
- Daniel Schulte (CERN)
- Harry Weerts (ANL)
- Akira Yamamoto (KEK)
### Test Facilities around the world

<table>
<thead>
<tr>
<th>Test facility</th>
<th>Used by</th>
<th>Purpose</th>
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<tbody>
<tr>
<td>Facet-SLAC</td>
<td>CLIC</td>
<td>Beam-based alignment</td>
</tr>
<tr>
<td>CTF-CERN</td>
<td>CLIC</td>
<td>Two beam acceleration</td>
</tr>
<tr>
<td>ATF2-KEK</td>
<td>ILC/CLIC</td>
<td>Low emittance, final focus</td>
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<tr>
<td>STF-KEK</td>
<td>ILC</td>
<td>High gradient acceleration</td>
</tr>
<tr>
<td>FLASH-DESY</td>
<td>ILC</td>
<td>High gradient, high current</td>
</tr>
<tr>
<td>NML</td>
<td>ILC</td>
<td>Complete cryomodules</td>
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<tr>
<td>CesrTA</td>
<td>ILC</td>
<td>Electron cloud</td>
</tr>
</tbody>
</table>
## Production facilities

<table>
<thead>
<tr>
<th>Production Facilities</th>
<th>Institution</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cavities and cryomodules</td>
<td>KEK</td>
<td>Cavity R&amp;D</td>
</tr>
<tr>
<td>Cavities</td>
<td>DESY</td>
<td>24 cavities from XFEL production</td>
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<tr>
<td>Cavities</td>
<td>JLAB</td>
<td>High-gradient cavities</td>
</tr>
<tr>
<td>XFEL</td>
<td>DESY</td>
<td>Industrial production</td>
</tr>
</tbody>
</table>
LCC Pre-IL Accelerator Organization

- **Project Management**
  - Baseline, Schedule Cost, EDMS

- **Accelerator Design & Integration**
  - Electron Source
  - Positron Source
  - Damping Rings
  - RTML & bunch compressor
  - Main Linac
  - Beam Delivery
  - Machine-Detector Interface

- **Domestic Programs & System Tests**

- **Technical Board**
  - SRF
  - Conventional Facilities
  - Cryogenic Support
  - Safety
  - Electrical Support
  - Mechanical Support
  - Controls & Computing

- **LC Project Office (KEK)**

- **Controls & Computing Japan**

- **Safety Japan**

- **Electrical Support Japan**

- **Mechanical Support Japan**

- **Cryogenic Support Japan**

- **Conventional Facilities WW**

- **SRF WW**

- **Baseline, Schedule Cost, EDMS**

- **Domestic Programs & System Tests**

- **Technical Board**

- **Project Management**

- **Accelerator Design & Integration**
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- **Domestic Programs & System Tests**

- **Technical Board**
  - SRF
  - Conventional Facilities
  - Cryogenic Support
  - Safety
  - Electrical Support
  - Mechanical Support
  - Controls & Computing

- **Baseline, Schedule Cost, EDMS**

- **Domestic Programs & System Tests**
Japanese Status and Prospects

Satoru Yamashita (satoru@icepp.s.u-tokyo.ac.jp)
ICEPP, The University of Tokyo
Advanced Accelerator Association (AAA)
NOW is the time for phase transition!!

- From R&D phase (Scientists only)
- To project preparation phase (Scientists + Governments) for the Decision Process if the project goes ahead or not

The official process has been started!

We only have 2-3 years to complete the preparation phase to have the decision and conclusion (for Japan)

Need fully and timely coherent global efforts not only for the full design of the machine but also for the INTERNATIONAL PROCESS, and need timely official evidence of progress in establishing international partnership
MEXT
Ministry for Education, Culture, Sports, Science and Technology

- Establish **official** body: ILC-Taskforce in MEXT
  **headed by vice-Minister** (Feb. 2013)
- **Official** request to SCJ (Science Council of Japan) to assess the academic significance of ILC and issues to solve (May, 2013)
- Division in MEXT for all accelerator-related infrastructure: Quantum radiation research division → **Additional new division** is established in MEXT (June, 2013): **Particle and Nuclear Research Promotion Division**; Director: S. Odoi
- **Official** hand-in process to MEXT has been done for **TDR** (Oct, 2013)
- **Official** hand-in process to MEXT has been done for **Site Assessment** (Oct, 2013)
- Direct communications started between MEXT and LCC management team
- **Governmental Budget Request** by MEXT for ILC **Project investigation** for FY2014 (conclusion for request to come early in Jan. 2014)
- **Renewal** of ILC-Taskforce in MEXT **headed by vice-Minister** (Nov. 2013)
- Committees/working groups to be established under the ILC-Taskforce (to come)
Processes

1. **International Partnership in/by Researchers** (in good progress)
2. **Domestic Assessments/Review in academy** (Government/MEXT → SCJ) (done)
3. → International (unofficial/official) Discussions for Partnership
   → International (pre-)Negotiation
4. → Government Assessment / Judgment (MEXT/CSTP)
   CSTP = Council for Science and Technology Policy (総合科学技術会議)
   Chair: Prime Minister, Approval process (role of politics and government)
5. → Inter-governmental Official negotiations → Agreement → Authorization

**Government and Science Council of Japan**

- **CAO (内閣府) (Cabinet Office)**
- **MEXT (文部科学省)**
- **CSTP**
- **Science Council of Japan (日本学術会議)**

Advisory body (only academy side)

- In Feb 2013, MEXT formed a “task force” headed by vice Minister of MEXT for the ILC.
  (current head: Mr. Sakurada)
- In May 2013, MEXT asked Science Council of Japan to assess the ILC → SCJ
  (report back on Sep 30th)
From the beginning of 2013, I, Kawamura, have been working as the chairman of the Federation to promote the construction of an international laboratory for the linear collider, succeeding Mr. Yosano, who retired at the last election. It is our duty to realize this ILC project. At the very beginning of our activities in 2006 we started with a few dozen volunteers; today about 160 Diet members are registered in the Federation. There are just over 700 Diet members in total, so I think you can appreciate the significant proportion of Diet members involved.
Particular emphasis was put on the need for a more precise cost estimate, the need to discuss the required budget and international partnerships, and the necessary distribution of manpower over the next 2-3 years. To achieve these goals, 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, in addition to R&D funds for research laboratories.

Although this amount is not large compared to the R&D funds, it will be the first official governmental "investigative budget" aimed at realizing the ILC. This still needs to be approved by the Department of Finance, however once it has been approved, we members of the house will have achieved one of the most important milestones of recent years. We are aware that people are usually worried that an increase of academic budget in one field may mean a decrease in other fields. ILC is not simply an academic project within science. We shall arrange a dedicated budget to accommodate its much wider implications. It is the responsibility of the government to carry this out.
European activities

- N. Walker et al. have drawn up draft indication of how Europe could get involved in site-specific work for next few years prior to project approval. BF & SS looking at mods & expansion.

A Proposed European Regional Team for the pre-implementation phase of the ILC in Japan

Prepared by: Eckhard Elsen, Brian Foster, Nick Walker
24th September, 2013, DRAFT VERSION 5
Preamble to draft version

This draft document has been put together by the ILC DESY team as an instrument to develop consensus amongst primarily interested European parties, together with the broader worldwide ILC community. It is intended to form a starting point for future planning discussions.

- Any European plan can only be in world-wide context. Under discussion at LCC Directorate meeting this week.
Summary and Prospects

- There are signs that the monotonic decrease in ILC effort in Europe over the last few years is about to reverse. Many countries are restarting initiatives and getting ready to respond to a Japanese initiative.

- The other side of the coin is that everything depends on such a Japanese initiative – without it these “green shoots of recovery” will wither away.

- Without exception, the funding authorities I have talked to have said that they can give no serious consideration to substantial increase in ILC funding without a Japanese government statement that they wish to negotiate to site ILC in Japan – and that such an initiative must entail Japan putting forward the majority of the necessary funding up front.
Summary and Prospects

- Assuming such a statement is forthcoming, it will be very tough to find a substantial European contribution. LHC upgrade will have priority and many countries are finding it hard to finance that. There is a contention with timing here, although it can be overcome.

- There is a perception, particularly stated by R-J Smits, that in Europe “Physics has had its share” of available funding. This refers to ITER, which has given all large infrastructure projects a bad name. We will need to work round this perception.

- Even so, there is a real sense of anticipation and excitement in Europe about ILC prospects. Given a prompt statement from Japan - & I emphasise time is critical – then I think there will be a positive response from Europe.
Status & Prospects in Americas

H.Weerts
Argonne National Lab & LCC
13 November 2013
LCWS2013, Tokyo
Some re-organization

After ILCSC, GDE and Research Directorate (RD) completed the TDR they & CLIC transformed into:

ILCS → LCB (S. Komamiya; chair)

GDE, CLIC & RD → LCC (L. Evans, director)

Had “separate” organizations for Accel and Phys & Det’s: LCSGA and ALCPG

Americas: They merged into new structure: American Linear Collider Committee (ALCC). Responsible for both.
Current organization

ALCC tasks:
- Be advocate for & enable LC case especially towards funding agencies
- Coordinate activities.
- Cover both ILC and CLIC.
- Provide connection/conduit to LCC
- Organize regional workshops

Membership:

Jonathan Bagger \textit{Johns Hopkins}
Nigel Lockyer \textit{Fermilab}
David MacFarlane \textit{SLAC}
Lia Merminga \textit{TRIUMF}
Hugh Montgomery \textit{JLab}
Director \textit{TRIUMF}
Harry Weerts \textit{ANL, chair}
Jim Brau \textit{Oregon}

Graham Wilson \textit{Kansas}
Mike Harrison \textit{BNL}
Marc Ross \textit{SLAC}
David Rubin \textit{Cornell}
Joe Lykken \textit{Fermilab}
Andy White \textit{UT Arlington}
Paul Grannis \textit{Stony Brook}
Dmitri Denisov \textit{Fermilab}

Try to represent all LC entities and communities

First meeting in June 2013
Recap of US activities/funding for LC

~2005 --FNAL, JLAB, Cornell, Argonne-- engage industry

Build up SCRF expertise -- FNAL, JLAB, Cornell, Argonne-- engage industry

Everything: Cavities to cryomodules

M.Harrison Monday talk

Plus: sources, damping rings, RF distribution, civil etc

Involve all labs & univ

Physics & Detector: physics, calorimetry, tracking (Si & TPC), vtx, MDI

Collaborations: SiD, ILC, CALICE, LCTPC

Funding available: ~$20-30M/yr for accelerator and ~$2-3M/yr detector R&D

For 2013: funding set to zero; detector R&D already earlier going away

Continue on: carryover funds, generic R&D; Project-X (SCRF), generic research funds

Based on: no LC in sight
US activities 2013

Developments 2013

Conclusion of Snowmass on ILC:

There is a clear and convincing science case for the ILC (250-> 500GeV)
Reiterated by M.Peskin in plenary on Monday here

Snowmass output serves as input into next step

Step 2:

Formation of Particle Physics Project Prioritization Panel (P5) in September 2013.

Charge:

“develop a strategic plan for U.S High Energy physics that can be executed over a 10 year timescale, in the context of a 20-year global vision for the field”

=fit within a given budget.

Budget scenarios:

• constant funding for 3 years and then +2%/yr
• constant funding for 3 years and then +3%/yr
• Unconstrained funding to mount a leadership program

Indicate priorities

It is clear that only a fraction of proposed fits
P5 membership & activities

Membership
Steve Ritz (UCSC) - chair
Hiroaki Aihara (Tokyo)
Marty Breidenbach (SLAC)
Bob Cousins (UCLA)
André de Gouvea (Northwestern)
Marcel Demarteau (ANL)
Scott Dodelson (FNAL/Chicago)
Jonathan Feng (UCI)
Bonnie Fleming (Yale)
Fabiola Gianotti (CERN)
Francis Halzen (Wisconsin)
JoAnne Hewett (SLAC)

Wim Leemans (LBNL)
Joe Lykken (FNAL)
Dan McKinsey (Yale)
Lia Merminga (TRIUMF)
Toshinori Mori (Tokyo)
Tatsuya Nakada (Lausanne)
Steve Peggs (BNL)
Saul Perlmutter (Berkeley)
Kevin Pitts (Illinois)
Kate Scholberg (Duke)
Rick van Kooten (Indiana)
Mark Wise (Caltech)
Andy Lankford (UCI) – ex officio

Members are/were associated with ILC; some are even here

- P5 is currently in “input mode” until end of 2013
- Then formulate roadmap.
- First draft ~March 2014

“input mode”: Get time lines and cost profiles from projects

Open Meetings:
2-4 November Fermilab
2-4 December SLAC
15-18 December BNL
P5 interactions “with ILC”

Goal: US ILC community wants to be part of “ILC in Japan”

- Need time lines and US cost profiles for “ILC in Japan”

ALCC has started interaction with P5 chair:

- One meeting so far
- Told us what P5 needs from “ALCC”
- ILC will be discussed at BNL meeting
- Public & Executive session presentation on US strategy/plan for “ILC in Japan”
- P5: physics case was made at Snowmass & accepted

ALCC in process of drafting a US strategy for “ILC in Japan” for P5. Plan is for draft by end of November

ILC director (M.Harrison) identifying possible US lab contributions to accelerator

- No clear definition of “ILC in Japan”
- Is there an agreed upon time line? (do not want to make one up)
- Are there expectations about contributions? Not known

Difficulty:

Inside Japan, ILC is obviously moving forward; however without a clearer sign it is difficult to incorporate in strategic plans of others, who want to participate
Summary

The physics case for a Lepton Collider has been made by the worldwide community & agreed upon

“ILC in Japan” (250 -> 500GeV) is currently the only option worldwide for realizing a lepton collider as the next step for particle physics at the energy frontier.

In US preparing the strategy to be presented to P5 in Dec 2013 for US participation in “ILC in Japan” so it becomes part of the US HEP roadmap

In Americas waiting for a clearer sign/indication from Japan on intentions to move forward, so “ILC in Japan” can be better included in the HEP roadmap.

“The car is running, all world regions are on board, but the driver (Japan) has to put it in first gear, so we can start the journey...... and see where it takes particle physics & the world”
Energy Management in Japan, Consequences for Research Infrastructures

Masakazu Yoshioka (KEK)

1. Electric power supply in Japan, before and after March 11, 2011 earthquake
   - High efficiency and “almost” environmental pollution-free electricity generators can save Japan, and contribute to reduce global CO2 problem
2. KEK Electricity contract as an example of large-scale RIs
3. Accelerator design by considering optimization of luminosity/electricity demand
   - Example: Super-KEKB
   - ILC
4. Accelerator component design by considering high power-efficiency
   - Klystron
   - Availability based on MTBF and MTTR
5. Summary

ILC: an amazing energy transformer
FROM eV TO TeV:

THE GREEN ILC

Energy Management at KEK, Strategy on Energy Management, Efficiency, Sustainability

Atsuto Suzuki (KEK)
Improve Efficiency of Power Consumption in Accelerator Operation

serious issue for ILC
Power Balance of Consumption and Loss in ILC

Requirements from Physics Exp.

- **Basic requirements:**
  - Luminosity: $\int L dt = 500 \text{ fb}^{-1} \text{ in 4 years}$
  - $E_{\text{cm}}$: scan $200 - 500 \text{ GeV}$ and the ability to
  - $E$ stability and precision: $< 0.1\%$
  - Electron polarization: $> 80\%$
- **Extension capability:**
  - Energy upgrade: $500 \rightarrow 1000 \text{ GeV}$

Power Balance:

<table>
<thead>
<tr>
<th>Component</th>
<th>Power (MW)</th>
</tr>
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<tbody>
<tr>
<td>Infrastructure</td>
<td>50</td>
</tr>
<tr>
<td>RF System</td>
<td>70</td>
</tr>
<tr>
<td>Cryogenics</td>
<td>70</td>
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<tr>
<td>Beam Dump</td>
<td>10</td>
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</tbody>
</table>

Total Power: $\approx 200 \text{ MW}$

- **Obligation to Us**
  - Loss rates:
    - 50%: 25 MW
    - 50%: 35 MW
    - 90%: 60 MW
    - 100%: 10 MW
  - ~130 MW

- **Improve efficiency**
- **Increase recovery**
Yield of usable and maximum gradient of 100 cavities (2. pass):
73 cavities passed in 1. pass + 27 cavities after re-treatment

(Usable gradient = Quench, field emission > 1x10^-2 mGy/min, Q_0 < 1x10^{10})

Average maximum gradient:
(31.9 ± 5.5) MV/m
EZ: (30.1 ± 5.2) MV/m
RI: (34.5 ± 4.7) MV/m

Average usable gradient:
(28.8 ± 5.2) MV/m
EZ: (27.8 ± 5.1) MV/m
RI: (30.2 ± 5.0) MV/m
XFEL news

European XFEL Status Report

XFEL planned schedule

<table>
<thead>
<tr>
<th></th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
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<tbody>
<tr>
<td><strong>Civil Construction</strong></td>
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<tr>
<td>XTL</td>
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<tr>
<td>Halls XHEE, XHE1</td>
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<tr>
<td><strong>LINAC Fabrication</strong></td>
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<td>Cavity Production</td>
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<td>String Assembly</td>
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<tr>
<td>Module Assembly</td>
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<tr>
<td><strong>XTL Installation &amp; Commissioning</strong></td>
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<tr>
<td>Infrastructure</td>
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<tr>
<td>Machine</td>
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<tr>
<td>final installation &amp; cool down</td>
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<tr>
<td>first beam in LINAC</td>
<td></td>
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<tr>
<td>first SASE (earliest possible date)</td>
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</table>
(1) Deep Technical Review of Input Couplers

TTF3/XFEL coupler

TDR coupler

STF-2 coupler
TOWARD HIGHER GRADIENT AND $Q_0$

Rong-Li Geng
Why higher gradient and Q0 R&D

- Enable ILC 1 TeV energy upgrade ➡️ Performance
- Enable higher luminosity within cryogenic limit ➡️ Cost
- Enable reliable and repeatable cavity fabrication
- Preserve cavity gradient and Q0 ➡️ Operation performance
Ingot Niobium Cavity Performance at 2K

- JLAB LG#1 at 2K - 16may11
- PKU2 at 2K - 7feb11
- AC155, 2K - DESY, 15apr11
- AC158, 2K - DESY, 19sep11
- G2, 2K - JLAB, 13sep13
- PJ1-2, 2K - JLAB/PKU, 4nov13
- ILC spec
- ILC 1 TeV Goal
Summary

• Strong momentum in Japan – a formal government statement anticipated by end of this year
• Other regions show interest to join – timing is critical
• Science case is strong and phased construction is favored – high luminosity at 250 GeV
• LCC has expectation for JLab to continue high gradient cavity work in next 2-3 years – and I believe JLab should be in a good position to contribute cryomodule production whenever ILC in Japan begin to construct