Overview and Charge - Snowmass Workshop 2005

Edmond L. Berger*
Co-Chair, Organizing Committee, 2005 International Linear Collider Workshop and
High Energy Physics Division, Argonne National Laboratory, Argonne, IL 60439

This contribution to the published Proceedings records the opening talk I presented on the first morning of the 2005 International Linear Collider Workshop in Snowmass, CO, August 14 - 27, 2005. It includes a summary of the motivation for the workshop, the scientific goals and charges for the working groups, the initial plans of the accelerator, detector, and physics groups, and the activities of the communication, education, and outreach group. This document also records organizational aspects of the meeting, particularly the scientific committee structure, the self-organization of the working groups, the composition of the indispensable secretariat and computer support teams, and the sources of funding support. The report serves as an introduction to the proceedings whose individual papers and summary documents must be consulted for an appreciation of the accomplishments and progress made at Snowmass in 2005 toward the realization of an International Linear Collider.

1. INTRODUCTION

Remarkable strides were taken in 2004 and 2005 toward the achievement of an international electron-positron linear collider having an initial center-of-mass energy of 500 GeV and the capability of extension to higher energy. Particularly significant are the choice of superconducting technology by the International Technology Recommendation Panel in August 2004 [1]; the start of the Global Design Effort (GDE) led by Barry Barish; and the articulation of the essential and mutually supportive relationship of the Large Hadron Collider (LHC) and International Linear Collider (ILC) physics programs in the 2005 HEPAP subpanel document [2]. That great challenges lie ahead is an obvious understatement. A detailed design is required for the accelerator, along with full detector concepts, ever sharper physics arguments, and requisite funding.

At the Linear Collider Workshop in Victoria in July/August 2004, consensus developed that the summer of 2005 would be an opportune time for the full community of physicists and engineers to gather for an extended period to work together to advance the design of the detectors and to understand better the scientific case for a linear collider. A proposal was then formulated in the American Linear Collider Physics Group (ALCPG), in consultation with international partners, to host a fully international detectors and physics workshop of duration long enough to facilitate substantial progress in addressing many of the challenges. Uriel Nauenberg and I agreed to co-chair the Organizing Committee. In the fall of 2004, the ILC Steering Committee decided to hold the Second ILC Accelerator Workshop in conjunction with the Physics and Detector Workshop. This joint workshop was designed expressly with international participation in all the advisory committees and in the scientific program committees that organized the accelerator, detector, and physics activities.

The Local Organizing Committee (LOC) selected Snowmass, Colorado, as the site of the workshop, formulated a set of specific goals, and wrote a four-part charge for the accelerator, detectors, physics, and education and outreach components of the workshop. We submitted and defended successful funding proposals to the US Department of Energy and the National Science Foundation. We made other funding appeals, primarily to national laboratories. Scientific committees were organized. A web site, http://alcpg2005.colorado.edu/, was developed and updated reg-

*e-mail: berger@anl.gov

ularly by Will Ruddick of the University of Colorado. A computer support team and a secretariat were assembled. The scientific program was developed, special events were organized, wireless computer access was installed, meeting rooms were obtained and assigned, along with myriad other tasks.

It is highly gratifying that over 670 enthusiastic participants are assembled in Snowmass, eager to contribute to the exciting endeavor that the ILC represents.

2. CHARGE

There are four inter-related aspects of the Charge for the workshop.

The primary ILC **accelerator** goal is to define an ILC Baseline Configuration Document (BCD), to be completed by the end of 2005, and a research and development (R&D) plan. The BCD will be the basis for the design and costing effort as well as for developing the supporting R&D program. The accelerator working groups will work toward agreement on the collider design, identify outstanding issues and develop paths toward their resolution, start documentation of the BCD, and identify critical R&D topics and time scales.

The **detector** groups will develop design studies with a firm understanding of the technical details and physics performance of the candidate detector concepts, the required future R&D, test-beam plans, machine-detector interface issues, beam-line instrumentation, cost estimates, and many related topics.

On the **physics** front, the goal is to advance and sharpen ILC physics studies, including precise calculations, synergy with the LHC, connections to cosmology and astrophysics, and, very importantly, relationships to the detector design studies.

A fourth aspect of the charge has two components: to **facilitate and strengthen the broad participation** of the scientific and engineering communities in ILC physics, detectors, and accelerators, and to **engage the greater public** in the excitement of this work. The first component relates to the broad community of high energy physicists and engineers who may not have participated previously in linear collider activities or workshops. The second addresses our fellow scientists in fields other than particle physics as well as members of the general public.

3. PLAN OF SCIENTIFIC ACTIVITIES

3.1. Accelerator

The Working Groups established for the First ILC workshop at KEK in 2004 form the basis of the organizing units through Snowmass: Low-Emittance Transport and Beam Dynamics, Linac Design, Sources, Damping Rings, Beam Delivery, Superconducting Cavities and Couplers, Communications and Outreach. In addition, six Global Groups were formed to work toward a realistic reference design: Parameters, Controls and Instrumentation, Operations and Availability, Civil and Siting, Cost and Engineering, and Options.

The accelerator activities kick off on the first morning with a presentation by Barry Barish on the Global Design Effort. The ILC working groups present introductory overviews in plenary sessions during the first afternoon. Lunchtime accelerator tutorials – **an accelerator school** – designed for experimenters and theorists begin on the second day of the workshop and continue through the next-to-last day.

The very ambitious schedule of accelerator activities leads to plenary ILC Global Group summaries and working group summaries by the end of the first week of this two-week Snowmass workshop.

3.2. Detectors

Three Detector Concept Studies are based on complementary philosophies: the Silicon Detector Concept (SiD), the Large Detector Concept (with Time Projection Chamber (TPC) tracking), and GLD (largest, with a TPC). These concepts are introduced in plenary sessions on the first afternoon. In the SiD approach, the calorimeter

consists of a tungsten absorber and silicon detectors. A relatively small inner calorimeter radius of 1.3m is chosen. Shower separation and momentum resolution are achieved with a 5 Tesla (T) magnetic field and silicon detectors for charged particle tracking. LDC, derived from the detector in the TESLA TDR, uses a somewhat larger radius of 1.7m, a silicon-tungsten calorimeter, and a large TPC for charged particle tracking. GLD chooses a radius of 2.1m, a calorimeter with coarser segmentation, and gaseous tracking similar to LDC. The Snowmass workshop is a major opportunity for the collaborations to draft their Concept detector outline documents before the international 2006 Linear Collider Workshop LCWS06 in Bangalore in March.

Detector capabilities are challenged by the precise physics planned at the ILC. The environment is relatively clean, but the detector performance must be a factor two to ten better than at LEP and the SLAC SLD. Tracking, vertexing, calorimetry, software algorithms, and other aspects of the detectors are all on the agenda. Among the leading questions and ambitions for the detector working groups are: R&D requirements; particle flow calorimetry for which a special session is organized on the second Monday; vertex detection at small radius; machine-detector interface issues (MDI) for which a joint MDI/accelerator/Concepts session is organized; agreement on feasible intersection-region (IR) parameters; the question of possibly two high energy IRs and detectors, discussed in a Town Meeting on the afternoon of Thursday during the first week; and the desirability of various options such as e^+ polarization, $\gamma\gamma$ collisions, $e\gamma$ collisions, and e^-e^- collisions.

3.3. Physics

The Physics activities begin on the first morning with presentations by Joe Lykken and Peter Zerwas on physics at the ILC and the LHC. The ILC offers the capability to control the collision energy, polarize one or both beams, and measure cleanly the particles produced. It will allow us to zero in on crucial features of the physics landscape, a rich world of Higgs bosons, supersymmetric particles, and extra spatial dimensions. Four physics working groups are assembled under the headings Higgs, Supersymmetry (SUSY), Beyond the Standard Model (BSM), and top quark plus quantum chromodynamics (Top/QCD), along with three cross-cutting Special Topics groups: Cosmology Connections, LHC/ILC Connections, and precise high-order calculations (Loopfest). Plenary sessions for the Physics working groups take place on the first Tuesday at which the conveners outline the activities planned for each group. A two-day Loopfest Conference takes place Thursday and Friday of the first week, and a day is devoted to Cosmology and the ILC on the second Wednesday, August 24.

A partial menu of physics topics includes Physics benchmarks, with a plenary session on the first Tuesday afternoon; the Higgs mechanism – lessons about electroweak symmetry breaking at the ILC that we can learn no other way; SUSY – determination of masses and other parameters at the focus point and for other Snowmass points and slope scenarios from a combination of LHC and ILC data; extra-dimensions and strings; and precise high-order calculations to match the expected high precision of the ILC data. Permeating all these discussions is the paramount question of what ILC detector capabilities are needed. Detector benchmarking adds an important dimension and emphasis to the physics discussions at Snowmass.

There is a tremendous amount to accomplish in the two weeks of this workshop leading to the physics and detector summary talks at the end of the second week.

The individual papers and summary documents in these Proceedings must be consulted for an appreciation of the accomplishments of the workshop and progress made at Snowmass in 2005. A summary written for a more general audience is published in the December 2005 issue of the *CERN Courier* [3].

4. COMMUNICATIONS, EDUCATION, and OUTREACH

One of our important responsibilities is to engage our fellow citizens in the excitement of particle physics. Some of what we do may be mysterious, but none of it is a secret. Most of those with whom we speak are more curious and genuinely interested than we might guess.

A **Dark Matter Cafe and Quantum Universe Exhibit** will be set up on the Snowmass Mall during our first weekend here, with volunteers among us enjoying conversations with local residents and tourists. A **Workshop on Dark Matter and Cosmic Ray Showers** is organized for high school teachers on Friday of this first week, followed by a display of working cosmic ray shower detectors on the Aspen Mall on Saturday, staffed by members of the Education and Outreach working group and other volunteers from among the participants. A **Physics Fiesta** takes place on Sunday at the Roaring Fork High School in Carbondale, and volunteers, especially those with Spanish language skills, will meet with students, family members, and teachers.

Two Public Lectures are scheduled at 6:30 PM, one in Aspen on August 17 by Young-Kee Kim entitled $E = mc^2$*: Opening Windows on the World*, and the second in Snowmass on August 22 by Hitoshi Murayama, *Seeing the Invisible – Challenge to 21st Century Particle Physics and Cosmology.*

The importance of involving industry in the design and execution of the accelerator and detectors is recognized in an ILC Industry Forum on Tuesday, August 16 at 7:30PM.

An evening Forum on Tuesday the 23rd addresses **Challenges for Realizing the ILC: Funding, Regionalism, and International Collaboration**. Eight distinguished speakers representing committees and funding agencies with direct responsibility for the ILC share their wisdom and perspectives: Jonathan Dorfan (ICFA Chairman), Fred Gilman (US-HEPAP), Pat Looney (formerly of OSTP), Robin Staffin (US-DOE), Michael Turner (US-NSF), Shin-ichi Kurokawa (ACFA Chair and incoming ILCSC Chair), Roberto Petronzio (Funding Agencies for the Linear Collider, FALC), and Albrecht Wagner (incoming ICFA Chair). Ample time is set aside for animated questions and comments from members of the audience.

Workshop Dinners take place on Thursday of the first week and Wednesday of the second week. Tickets are available for purchase.

Complementing these activities organized by the Education and Outreach Committee of the Physics and Detectors component of this overall joint workshop, the ILC Communications group is hosting a series of workshops and invites all participants. The new website http://www.linearcollider.org is being launched at Snowmass, starting with daily coverage of the workshop, along with ILC NewsLine, http://www.linearcollider.org/newsline/, a weekly newsletter open to all subscribers.

5. FUNDING SUPPORT

We acknowledge and are most appreciative for generous grants from the US Department of Energy (DOE) and the US National Science Foundation (NSF). The DOE funds underwrite workshop expenses, such as meeting rooms and secretariat and computing expenses. The NSF funds provide subsidies for the local expenses of young participants and for the education and outreach activities.

We received indispensable financial contributions from Argonne National Laboratory, Cornell Laboratory for Elementary Particle Physics, Brookhaven National Laboratory, Lawrence Berkeley National Laboratory, and Thomas Jefferson Laboratory to assist with workshop expenses. We are most grateful for this support and for grants from the Universities Research Association (URA) and from Stanford University that subsidize the opening reception on Sunday, August 14, and the two workshop dinners.

Support for participants from Europe was received from DESY, PPARC (UK), IN2P3 (France), and CERN. We acknowledge both the funds provided and the instrumental assistance in obtaining and administering these funds by Rolf-Dieter Heuer, David Miller, Francois Richard, and Jos Engelen.

The workshop could not have taken place without the enormous in-kind contributions from Fermilab (leadership of the secretariat, members of the secretariat and computer support teams, and equipment), SLAC (proceedings, and members of the secretariat and computer support team), and Cornell (leadership of the computer support team).

6. HEAVY LIFTING

6.1. Local Organizing Committee

Recognition of the tremendous contributions of talent and time from many individuals begins with the members of the Local Organizing Committee. Foremost among these is my co-Chair Uriel Nauenberg, along with his associates Valerie Melendez and webmaster Will Ruddick from the University of Colorado. ALCPG Co-Chairs Jim Brau (Oregon) and Mark Oreglia (Chicago) along with accelerator community representatives Shekhar Mishra (Fermilab) and Nan Phinney (SLAC) round out the LOC. I am indebted to all my colleagues on the LOC for their constant dedication and many hours of effort on behalf of this workshop during the past year. And we have much left to do!

6.2. Executive Committee

Members of the international executive committee provided timely and valued assistance in many respects. They are Barry Barish (Caltech), Edmond Berger (Argonne, co-Chair), James Brau (Oregon), Sally Dawson (Brookhaven), Rolf Heuer (DESY), David Miller (UC London), Shekhar Mishra (Fermilab), Uriel Nauenberg (Colorado,co-Chair), Mark Oreglia (Chicago), Hwanbae Park (Kyungpook National University), Michael Peskin (SLAC), Tor Raubenheimer (SLAC), and Hitoshi Yamamoto (KEK).

Maury Tigner of Cornell and Pier Oddone of Fermilab were generous advisors, sources of good counsel and *savoir faire*.

6.3. Working Group Organizing Committees

Four working committees were appointed by the Local Organizing Committee and asked to define the topics of the working groups and to secure conveners of these working groups. The members of these four committees for the accelerator, detector, physics, and education and outreach efforts are:

6.3.1. Accelerator

David Burke (SLAC), Jean-Pierre Delahaye (CERN), Gerald Dugan (Cornell), Hitoshi Hayano (KEK), Steve Holmes (Fermilab), Olivier Napoly (Saclay), Kenji Saito (KEK), Nick Walker (DESY), and Kaoru Yokoya (KEK).

6.3.2. Detectors

Philip Bambade (Orsay), Ties Behnke (DESY), Tiziano Camporesi (CERN), John Jaros (SLAC), Dean Karlen (Victoria), Akiya Miyamoto (KEK), Mark Oreglia (Chicago, Chair), Daniel Peterson (Cornell), Harry Weerts (Michigan State/Argonne), and Satoru Yamashita (Tokyo).

6.3.3. Physics

Sally Dawson (Brookhaven, vice-Chair), Jonathan Feng (UC Irvine), Rohini Godbole (Bangalore), Norman Graf (SLAC), Howard Haber (UC Santa Cruz), Kaoru Hagiwara (KEK), Joseph Lykken (Fermilab), Michael Peskin (SLAC, Chair), W. James Stirling (Durham), Rick Van Kooten (Indiana), and Peter Zerwas (DESY).

6.3.4. Education and Outreach

Marjorie Bardeen (Fermilab), Neil Calder (SLAC), Ulrich Heintz (Boston University), Judy Jackson (Fermilab), Hitoshi Murayama (UC Berkeley, Chair), and Gregory Snow (Nebraska).

6.4. Working Groups

In a sense, the two-dozen or so working groups are self-organizing units. Individuals choose whether to participate, and the groups define how they will best use their time and talents at Snowmass to achieve their goals. Nevertheless, the international conveners of the working groups, with representation from all regions, are the unsung heroes and heroines. They must cajole and motivate their members, keeping them focused. I apologize for not listing all of the conveners by name. Their identities and the agendas of the working group programs can be found from links on the workshop program page: http://alcpg2005.colorado.edu:8080/alcpg2005/program/.

The number of different working groups requires 22 meeting rooms for break-out sessions. A few of these are obtained by partitioning the large ballroom used for the plenary sessions on the first day and for the summary talks on the final two days. Many of the other meeting rooms are distributed among the different properties at Snowmass. All are within walking distance of the central Conference Center. A spreadsheet on the workshop web page lists room assignments, but updates, additions, changes will be made as needed. Mark Oreglia did a heroic job juggling a complex mix of competing room requirements! Rooms are equipped with LCD projectors and screens; overhead projectors are also available by special request. Working group conveners are asked to provide laptop computers for projecting presentations, with file transfer to be done via USB thumb drives.

7. SECRETARIAT, COMPUTER TEAM, and SNOWMASS PERSONNEL

7.1. Snowmass Personnel

The particle physics community in the United States has run many extended summer workshops in Snowmass over the past two decades. We return because we find the concentrated facilities we need for a large gathering with many breakout rooms, and a group of local representatives who go the extra mile to provide what a group of physicists requires. I wish to acknowledge the forthcoming assistance received from Jim Pilcher and his staff at the Silvertree Hotel, Jim O'Leary of the Snowmass Village Resort Association, and Maidy Reside of Top of the Village.

7.2. Secretariat

The local staff at Snowmass assisted admirably with lodging reservations for participants, but the innumerable aspects of registrations, negotiations with vendors, and daily logistics have fallen on the shoulders of the dedicated and most capable Secretariat headed by Cynthia Sazama of Fermilab. Cynthia was an enthusiastic member of the organization from the first moment she was approached and asked to participate. Her team is made up of Maura Chatwell, Albe Larsen, and Naomi Nagahashi (SLAC) and Carol Angarola, Jody Federwitz, and Suzanne Weber (Fermilab). Their main office is at the Top of the Village (ToV) in condo unit Slope 210, with weekday hours of operation 8:00 AM - 6:00 PM, and Saturday hours 8:00 AM - 1 PM. Registration takes place in the Conference Center on the first day and in ToV Slope 210 thereafter.

7.3. Computer Facilities and Support

Chips were down many months ago when we desperately needed a person to define the configuration of the workshop computer facility and to make it work. Maury Tigner stepped up to the plate as he has done so many times in his distinguished career. Maury offered the services of Ray Helmke, Director of the Computing Facility at Cornell's Laboratory for Elementary Particle Physics. The computer support team assembled under Ray's superb leadership includes his deputy John Urish (Fermilab), David Tang and Quinton Healy (Fermilab), Mike DiSalvo and Ken Zhou (SLAC), Bryan Abshier (LBL), and Andrew Hahn, Joseph Proulx, Martin Nagel, and Jason Gray (U Colorado).

Part of the networking and computing capacity is satisfied by an existing T1 line that serves the Silvertree Hotel and the Snowmass Conference Center, but a second dedicated line was brought into the Conference Center specifically for the greater requirements of the workshop.

The computer setup for this workshop is principally a laptop based facility, relying on equipment brought by individual participants, most functioning in wireless mode. There are also some hardwired connections and printers in the computer center rooms located in three condos at Top of the Village (ToV), Trails 109, 108, and 105, where 18 Windows PC's on loan from Fermilab may also be found. The computer center is staffed daily during the hours 8 AM to 10 PM. Wireless access in the computer center and in condos in the ToV complex relies on a commercial cable system recently installed by ToV.

The computer support team set up the facility in the three condos in ToV during the week before the workshop and tested it. They prepared a descriptive document, available on the workshop web site.

Our workshop and the international ILC effort owe a debt of gratitude to all members of the Computer Support Team and of the Secretariat.

8. PROCEEDINGS

Electronic files of all presentations at the workshop are linked on the web pages. Proceedings will appear on the SLAC Electronic Conference Proceedings Archive (eConf), a permanent repository for conference proceedings, and a CD will be produced of written contributions. Norman Graf (SLAC) is leading the editorial effort. The Proceedings link on the front page of the web site may be consulted for instructions and page limits.

9. L'ENVOI

The organization of this workshop has benefited from the dedication and talents of scientists, engineers, and support personnel from many institutions and all regions of the world. I reviewed the motivation for the workshop, the scientific goals and charge to the working groups, the initial plans of the accelerator, detector, and physics working groups, and the activities of the education and outreach working group. I also summarized organizational aspects of the meeting, particularly the scientific committee structure, the self-organization of the working groups, the composition of the indispensable secretariat and computer support teams, and the sources of funding support.

This 2005 Snowmass Workshop is now in your capable hands to:

- design the accelerator,
- flesh out the detectors,
- hone the physics reasoning, and
- engage your fellow citizens

all within a very ambitious time scale.

Acknowledgments

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[2] *Discovering the Quantum Universe - The Role of Particle Colliders*, Report of the 2005 DOE/NSF High Energy Physics Advisory Panel, Joseph Lykken and James Siegrist, co-Chairs, July 2005, http : //www.linearcollider.org/pdf/Report_7.26.pdf.

[3] *ILC Comes to Snowmass*, E. L. Berger *et al*, CERN Courier **45** 10 pp 24 - 27, December 2005.