office of high energy physics

DOE and the ILC

Department of Energy
Office of Science

The ILC has been proposed as the next major high energy physics facility after the LHC by panels in the US (HEPAP), Europe (ECFA) and Asia (ACFA), and endorsed by the Consultative Group of the Global Science Forum (OECD).

The DOE Office of Science is working actively to establish funding and program direction for the R&D phase of the ILC, and to understand what is needed to make the US a credible choice for hosting it.

DOE Funding for the ILC

DOE recognizes that the R&D phase of the ILC will require significant expenditures. The funding levels have been rising, after several years of capped budgets:

- FY05: $23.7M
- FY06: $30M
- FY07(President's budget): $60M

The FY07 President's budget includes an 8.1% increase in the DOE HEP budget.

The FY08 budget is now under discussion in Congress.

A plan for the full R&D phase will be needed.

DOE Funding for the ILC

The President's budget doubling in FY07 is a significant measure of the interest of the administration in pursuing the ILC.

Starting in FY07, the ILC funds are expected to cover all ILC-specific activities – laboratory ILC R&D, university grants for directed ILC accelerator research, detector R&D, support of US regional activities in support of a bid to host, and support of the GDE.

The ILC funds have been supplemented at the laboratories by operations funds for general research and infrastructure that could also benefit ILC, and this will continue.

DOE Perspective on the ILC

Ray Orbach, Director of the Office of Science has supported the ILC as the next large facility.

> Science Magazine, April 1, 2005: "The one big hope for U.S. accelerator physics is the ILC. 'We're going to go for the linear collider,' says Orbach."

The DOE Office of Science has given the ILC its highest priority among mid-term projects.

Future milestones that must be satisfied to approve construction include a realistic & affordable cost estimate, broad international agreement, and demonstration of a rich scientific potential based upon early LHC results.

DOE Perspective on the ILC

Secretary of Energy Samuel Bodman – address at Fermilab April 7, 2006.

"I fully support the possibility of bringing the International Linear Collider to this Lab. There are a great many difficult steps that will be needed for this to occur. This audience understands better than I just what those steps are and how difficult they will be. But it is a goal worth fighting for. This may turn out to be the most profound new science that we will be seeing in our lifetime."

National Academy Panel

The decadal National Academy EPP2010 Panel has just presented its report "Revealing the Hidden Nature of Space and Time" outlining a roadmap for High Energy Physics in the 21st century.

The EPP2010 panel was chaired by Harold Shapiro (ex President of Princeton, economist) and had members Norman Augustine (ex CEO Lockheed Martin), Harold Varmus (ex director of NIH), Joseph Hezir (EOP group, formerly in OMB), scientists from non-HEP disciplines, three Nobelists.

As a very broadly based panel, its recommendations should be taken seriously.

National Academy Panel

Chief recommendation:

" The United States should remain globally competitive in elementary particle physics by playing a leading role in the worldwide effort to aggressively study Terascale physics."

To implement this chief recommendation:

- Exploit the LHC …
- **"Plan and initiate a comprehensive program to become the world-leading center for R&D on the science and technology of the linear collider and do what is necessary to mount a compelling bid to build the proposed ILC on US soil."**
- Expand particle astrophysics …

International perspective

Europe is conducting a long range plan of its particle physics program under aegis of CERN Council. Report due in July 2006.

In 2003, Funding Agencies Linear Collider (FALC) was formed to help guide the international effort on ILC. FALC provides common fund for GDE activities. It is now beginning to take up issues of defining a site selection process, more formal oversight of the R&D phase, etc.

The recent initialing of the ITER agreement establishing an international organization is an excellent template for the ILC.

Pre-construction activities

Funding needs in the R&D and project engineering phase include:

- R&D on baseline and alternate technologies to reduce risk and lower cost.
- Support the Reference Design and cost estimation work, and the Technical Design that will follow.
- Develop the industrial capacity to produce high volume components reliably and cost-effectively, and the test facilities needed to support this effort.
- Detailed evaluation of a site to be proposed to host the ILC, and any site specific technological components.
- Do the needed detector R&D

US regional needs

The Linear Collider Steering Group of the Americas has impaneled a group to consider and advise on priorities for those activities which are needed in the US that would support the industrialization and bid to host efforts in the US.

Satoshi Ozaki (BNL) is the chair of this panel.

We hope for advice that can be folded into the FY07 budget process.

Importance of Industrialization effort

DOE understands that bringing major components to reliable and reproducible fabrication is one of the primary needs for funds in the pre-construction phase.

For critical SC rf components, US industry is not yet at the level found in Europe and Japan.

For the major cost components, we need all the help from industry we can get to learn how to do these in a cost efficient and reliable way. Your insights and guidance are needed to manage the industrialization effort within the overall budget constraints.

DOE/NSF Review

DOE and NSF conducted a review of the Americas Regional Team Apr. 4 – 6. Major conclusions and recommendations include:

- The scope and choice of R&D topics is appropriate. The most pressing R&D need is the demonstration of reliable, reproducible high gradient superconducting cavities.
- The baseline design is reasonable, but conservative, and the cost methodology seems appropriate.
- The management of the growing US ILC R&D effort should be expanded.

SBIR/STTR Grants

http://www.science.doe.gov/sbir
OHEP program manager:
LK Len (lk.len@science.doe.gov)

What are they?

- **SBIR** = Small Business Innovative Research – need not involve collaboration with research institutions
- **STTR** = Small Business Technology Transfer – must involve substantial (>30%) collaborative research with a research institution
- Government-wide set-aside programs (2.5% for SBIR and 0.3% for STTR)
- **Small Business** = 500 or fewer employees

- **Phase I** is for up to $100K for 9 months (feasibility study leading to a Phase II proposal)
- **Phase II** is for up to $750K over two years
- **Phase III** is funded through other sources of funding, e.g., venture capitals, etc.

SBIR/STTR Grants

Solicitation and Evaluation

- DOE-SBIR Office releases solicitation on the web, typically in September. Proposals must be submitted electronically – typically due in December.
- DOE HEP and SBIR Office screen all proposals, then send out for peer-review by expert external reviewers
- Reviewers provide written comments and ratings with criteria:
  - Scientific/Technical Approach
  - Ability to conduct project in cost effective manner
  - Impact
- OHEP uses the reviews to rank each proposal

SBIR/STTR Grants

In FY05 there was not a specific ILC SBIR/STTR category but about a dozen phase I proposals were aimed at ILC-related topics and are now being considered for phase II.

About 10 SBIR/STTR Phase II grants related to ILC development in FY05 were funded at a total level of about $6.5M

2006 SBIR ILC Topics

ACCELERATOR TECHNOLOGY FOR THE ILC – topics

a. Superconducting Radiofrequency Systems

- 1.3 GHz Superconducting RF Cavities
- Fundamental Power Couplers and Tuners for 1.3 GHz Superconducting RF Cavities
- 1.3 GHz High Power RF Generation & Distribution Systems
- Low Level RF Systems
- Processing of Nb Cavities
- Cryomodule Fabrication
- Cryogenics and Cryogenic Distribution
- Technologies for installation, support, and alignment of very large accelerator beam line lattice elements.

2006 SBIR ILC Topics cont.

b. Beam Instrumentation and Feedback Systems

- Fast Feedback Systems
- High Resolution Linac Beam Position Monitor Systems
- High Resolution Linac Beam Profile Monitors

c. Magnet and Fast Kicker Technology

- Damping Wiggler Magnets
- Fast Kicker Systems for Single Bunch Injection and Extraction in Damping Rings
- Undulator Magnets for Positron Production
- Final Focus Doublet Magnets

d. Polarized RF Photocathode Sources

2006 HEP SBIR Phase I Awards

13 Phase I Awards are ILC-related and funded at $100K:

1. Advanced Energy Systems, Inc.
Superconducting RF Photocathode Gun for Low Emittance Polarized Electron Beams

2. Black Laboratories, LLC
Engineered Surface Treatments for ILC Cavities

3. Diversified Technologies, Inc.
Fast Kicker Driver for International Linear Collider Damping Rings

4. Duly Research, Inc.
An Ultra-Low-Emittance, L-Band, Flat-Beam PWT Photoinjector

2006 Phase I Awards, cont.

5. Euclid TechLabs, LLC
Development of a Traveling Wave Accelerating Structure for a Superconducting Accelerator

6. Kapteyn-Murnane Laboratories, Inc.
Laser Systems Development for the ILC Photoinjector

7. Omega-P, Inc.
Fast Ferroelectric L-Band Tuner for ILC Cavities

8. SVT Associates, Inc.
Robust GaN-Based Photocathodes for High-Efficiency Polarized RF Electron Guns

2006 Phase I Awards, cont.

9. Square One Systems Design
An Integrated Support and Alignment System System for Large ILC Lattice Elements

10. Diversified Technologies, Inc.,
Single Cavity Amplifier for the International Linear Collider

11. Diversified Technologies, Inc.
Optimized Pulsed Power Systems for Large Physics Experiments

12. Tech-x Corporation
Modeling Accelerator Beam Dynamics Including Superconducting RF Cavities

13. Genesic Semiconductor Inc.
SiC Semiconductor Switches for Klystron Modulators

Outlook

The DOE position is that the ILC is our best candidate for a future high energy physics facility and that a vigorous R&D program to develop it is warranted. DOE recognizes that the funding for the R&D phase must continue to ramp up.

The US should seek to host the ILC.

The international collaboration to do the R&D and complete a cost-effective design has been initiated. Much remains to strengthen and internationalize the ILC organization.

The major technical challenges lie in the large scale fabrication of cavities, their assembly into modules, and the rf power systems to drive them. Industrial efforts are key to meeting these challenges.