NLC News

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The University Based LC R&D Program

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Figure 1

A loose knit confederation of approximately 300 physicists has recently submitted to the U.S. Linear Collider Steering Group (USLCSG) an aggregate proposal for "A University Program of Accelerator and Detector Research for a Linear Collider." In this document, 48 U.S. universities, working with five national and industrial labs and eleven foreign institutions, offer 69 proposals in a broad coverage of the identified R&D needs of the Linear Collider (LC). The total request for $3.2M in FY04 follows on a similar proposal that was funded in FY03. The high level of interest and spontaneous self-assembly of this effort is a measure of the level of interest and commitment to the LC in the university community. See Fig. 1.

The proposal combines the work of two separate groups, organized around the somewhat different formal requirements of the two funding sources. The University Consortium for the Linear Collider (UCLC) is supported by the NSF, and the Linear Collider R&D group (LCRD) is supported by the DoE. The proposal is a joint submission by all of the UCLC and LCRD subgroups, written in a uniform format which can be read and judged as a whole, but which can also be easily rearranged for separate submission to the agencies. The full detail of the proposal, as well as some of the organizational trappings of the groups, can be seen at the websites:

http://www.lns.cornell.edu/public/LC/UCLC/

http://www.hep.uiuc.edu/LCRD/html_files/index.html

The work proposed is about evenly divided between topics on the machine and the detector. The breakdown by topic is as follows:

LCRD + UCLC	$ year 1	$ year 2	$ year 3	proposals
Accelerator Physics total	$1,126,162	$1,575,474	$1,554,058	29
Luminosity, Energy, Polarization total	$237,733	$462,277	$435,995	9
Vertex Detector total	$172,716	$319,140	$325,190	3
Tracking total	$596,660	$915,936	$932,386	11
Calorimetry total	$855,212	$1,903,475	$1,334,401	13
Muon system and Particle ID total	$194,188	$224,444	$230,991	3
Total	$3,182,671	$5,400,746	$4,813,021	68

The intellectual sweep of the work is illustrated by the titles of ten randomly chosen proposals:

•"Beam Test Proposal of an Optical Diffraction Radiation Beam Size Monitor at the SLAC Final Focus Test Beam"
•"Single-Shot, Electro-Optic Measurement of a Picosecond Electron Bunch Length"
•"Ring-Tuned, Permanent Magnet-Based Halbach Quadropoles
•"Design and Fabrication of a Radiation Hard 500-MHz Digitizer Using Deep SubMicron Technology"
•"Undulator-Based Production of Polarized Positrons"
•"An Explicitly Radiation-Hard Fast Gas Cerenkov Calorimeter for Bunch-by-Bunch SLuminosity Measurements at the Next Linear Collider"
•"Pixel Vertex Detector R&D for Future High Energy Linear e+e- Colliders"
•"R&D Towards a Silicon Drift Detector BasedMain Tracker for the NLC-SD Options"
•"Negative Ion TPC as the NLC Main tracker"
•"Development of a Silicon-Tungsten Test Module for an Electromagnetic Calorimeter"
•'Digital Hadron Calorimetry for the Linear Collider using GEM Based Technology"

The scope of the effort proposed here marks a significant increase since 2001. At that time, LC work was supported at 15 universities, and confined to physics and detector simulation studies. Here, the number of institutions is up by a factor of four, the detector proposals are directed at prototyping, and, in a significant broadening of focus, almost half of the proposals are for accelerator related work to be performed at universities.

The development of this confederation began with a series of grass-roots level meetings at Cornell, Fermilab and SLAC in the Spring of 2002. For the community of HEP experimenters, the challenges of the detectors were an obvious draw. In a new twist, the HEP community was also exposed to the large number of interesting R&D challenges still remaining on the machines. Although the critical path items were under investigation at the laboratories, there were still hundreds of machine issues grounded in fascinating physics and representing ideal fits to the skills and resources of university groups. Tom Himel did the legwork to assemble a convenient database of these projects, now known as “The List”. A typical entry in The List is as follows:

ID: 73 **project_size:** Small **skill_type:** physicist

short project description: electro-optic beam diagnostics

Detailed project description: When you pass a beam through an electro-optic material (like a pockles cell is made from) and then pass a laser through the material you can effectively measure the electric fields caused by the beam as it went through. This could be used to experimentally measure wakefields. A first prototype of this has been successfully tested at DESY.

Needed by who: generic accelerator **present status:** In progress, help needed
Needed by date: 1/1/2007

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This entry combines many of the ideal attractions for a university group: it is an instrumentation problem that can be attacked on a bench, that requires relatively little expertise in machine physics, and that might engender collaboration with some interested (and interesting!) non-HEP physicists down the hall.

The amazing thing about The List is that there are hundreds of items like this one, with cutting edge problems in modern optics, interferometry, motion stabilization, superconductivity, materials science, acoustics, plasma physics, microwaves, electronics, power systems, control systems, and so on. These areas have a strong overlap with the specialities of the physics, applied physics, and engineering departments at our universities.

It was clear that a joint proposal framed by these R&D issues would allow university groups to assume some responsibility and intellectual ownership over the detector and the accelerator, autonomously, guided by their interests. The idea was embraced by the Labs and the USLCSG, and, with the good will and concerted effort of all involved, we are now in the second year of the effort, with semblance of organization and procedure.

The organization has several interlocking parts. The UCLC is funded by the NSF through Cornell, and is administered as true consortium effort, in the manner of the “Muon Collaboration”. The LCRD, centered at FNAL and SLAC, is more like a detector collaboration, with the proposals funded independently by the DOE through the universities. Arching over these is the American Linear Collider Physics Group (ALCPG), whose goal is to “establish and manage a process that leads to a forefront experimental program at a high-energy electron-positron linear collider (LC)”. The ALCPG is the natural seat of the physics and detector expertise, and has been augmented by the self-assembly of the “American Working Group on Linear Collider Accelerator Technology” (ALCT), which adds the expertise on machine topics. More information can be found at the ALCPG Website

http://blueox.uoregon.edu/~lc/alcpg/

and the ALCT website

http://www-conf.slac.stanford.edu/lcprojectlist/projectlist/intro.htm.

(It is perhaps obvious from this URL that the ALCT website is the current resting place of The List.)

The entire organization works together as follows. In the Fall, new proposals and status reports are assembled into a first draft of the composite document which is sent to the ALCPG working group leaders. They return with suggestions on the individual projects, and also on optimizing the assemblage toward the overall goals of the LC. The draft is revised and then submitted to a review panel assembled by the USLCSG. The panel is an international team of machine and detector experts; they prioritize the individual projects, and transmit the scores to the Steering group and the agencies. The agencies then proceed with their usual methods.

Note there is no segregation by agency until the proposals are actually submitted. Before submission, the ALCPG and the USLCSG Review Committee view the aggregate proposals, arranged by topic, as a single entity, and can coordinate and optimize the parts of the effort as a single program. In addition, the biannual ALCPG meeting now includes sessions with reports from all UCLC and LCRD proponents, offering another venue where the full scope of the program can be aired and assessed.

We believe that in its inclusiveness, its interaction with established mechanisms, and its agency independence, the UCLC/LCRD effort is a model for a nationally coordinated university program on the detector and accelerator for the Linear Collider. It has been a collective pleasure to watch the entire structure evolve over a year through constructive discussions with all involved. We acknowledge the support of our university colleagues who are willing to take on the task of developing proposals in new areas, and of our ALCPG and Laboratory colleagues who have been willing to take on the mentoring role with new proponents. We also acknowledge the constructive engagement of the USLCSG and the agencies in guiding the effort from amorphous enthusiasm to funded projects.

Ultimately, this national effort on linear collider R&D will be integrated into and coordinated with the worldwide linear collider effort, now being planned by the International Linear Collider Steering Committee established by ICFA. For further information on the international coordination see the website:

http://blueox.uoregon.edu/~lc/wwstudy/

The UCLC/LCRD organization is now in its second year. The DoE funded the highest ranked detector LCRD proposals in March 2003, and after an additional round of reviews, funded the highest ranked LCRD machine proposals in May 2003. The level of support was roughly $400,000 each for machines and detectors. The NSF began funding the UCLC with $150,000 in summer of 2003, with the understanding that the full UCLC proposal be resubmitted early in the FY04 process.

The combined proposal for the next year is now in the hands of the USLCSG Review Committee. New in this round is explicit planning for a 3 year funding cycle, and the addition of support for efforts at the associated HEP laboratories ANL, Brookhaven, and LBNL. The healthy resurgence of interest in university based accelerator R&D remains in place. The team is 300 strong, representing 48 universities and 5 national labs in 25 states, plus collaborators at 11 foreign institutions.See Fig.2 below

Behind all the organizing, of course, is our desire to get to the high-energy physics of electron-positron annihilation at 500 GeV. But we have been reminded that getting to that physics requires the completion of *another* compelling program in physics and applied physics, the R&D program for the machine and the detector. The spirit of the University Proposal is that we can and should be getting started on that machine and detector R&D now, and that success of the Linear Collider depends on us.

We have also found that the R&D needs of the Linear Collider are a powerful organizing principle. They outline a broad interdisciplinary opportunity for university and industry participation, and are a topical guide for broadening the LC support base into these communities. At the same time, larger scale machine development projects, such as the positron production proposal E-166, can be the center of laboratory-university collaborations along the sociological lines of the large detector collaborations. The high energy physics is our goal, but the fascinating physics of the LC R&D catalog can be part of the glue for pulling our science departments and laboratories together in a national effort to make the Linear Collider a reality.

The LCRD Coordinators are D. Amidei, G. Gollin, J. Jaros, A. Kronfeld, U. Mallik, and S. Tkaczyk.

The UCLC Coordinators are G. Dugan and R. Patterson.

The ALCPG Leaders are J. Brau and M. Oreglia

The ALCTC Leaders are D. Finley, T. Himel, and J. Rogers

The USLCSG Review Committee Chairs are N. Holtkamp (Accelerator) and H. Gordon (Detector)

Geographical distributions for participants

Shown in the maps are the numbers of times a research group based in a particular state appears in the collaboration list for a subproposal submitted to LCRD or UCLC. Groups from national labs in New York (BNL), Illinois (ANL and Fermilab), and California (LBNL and SLAC) are included in the upper figure (and center column of the table), but not in the lower map.

CA	21	9
CO	3	3
CT	6	6
HI	1	1
IA	8	8
IL	24	12
IN	10	10
KS	1	1
LA	1	1
MA	6	6
MI	8	8
MN	1	1
NC	2	2
NJ	1	1
NM	1	1
NY	12	9
OH	2	2
OK	3	3
OR	4	4
PA	1	1
SC	3	3
TN	4	4
TX	6	6
VA	2	1
WI	1	1

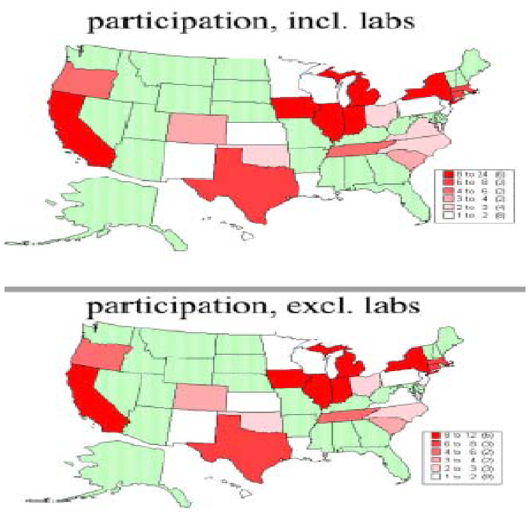

Figure 2

CoToGAN 2003

Rusty Humphrey

This meeting is the third in an international series of meetings on the Global Accelerator Network. It was organized by the Elettra Sinchrotrone of Trieste, Italy. Consider that an accelerator is built as the result of an international collaboration. The Global Accelerator Network is the name given to the concept of operating that accelerator remotely, where "operating" includes both a true remote Control Room and ongoing subsystem maintenance support. The Workshop lasted 3 days, with each day filled with reports and discussion. There were 42 attendees from 7 countries. My notes indicate 24 identifiable talks, plus the discussions. I describe some of these talks below.

The meeting opened with a review talk by Dave Rice of Cornell. This was a summary of the items addressed by the two previous meetings at Cornell and Shelter Island. He also mentioned a third meeting held at LBL on Collaboration Tools for GAN which lasted one day.

There were a number of talks on remoteness – remote operations support (SNS), remote collaborations (LHC), remote diagnostics (CERN), and remote access and development (DESY-TTF). Each speaker used the adjective "remote" in slightly different ways, but all those ways would meet the man-in-the-street's definition. All of speakers pointed out that the technical issues appeared solvable, but that management considerations often prevailed. Thus, some labs are not supporting GAN/remote functions because of the lack of commitment by lab management to provide funding and resources.

There were a number of talks on remote collaboration. Some were more academic in nature, and some were more practical. The best was Deb Agarwal (LBNL) who spoke on Collaboratories. This was an excellent talk on collaboration tools. There is much to learn from how under-25-year-olds use the web, computers/games, and cell phones. But there is also a large and growing academic literature. Many experiments have been done and prototype systems have been constructed. But Deb's strong caution is that collaboration takes effort, and the tools need to be used regularly.

Working Group 1 discussed remote participation in accelerator experiments. The RHIC-LHC collaboration was mentioned. Fulvia Pilat has developed a web-site listing such collaborations http:/ www.agsrhichome.bnl.gov/RemOp/docs/ WG1_ganprojects_020919.PDF. How to develop collaboration and how to exchange tools was discussed in this working group. Fulvia's website and the Cornell WIKI website (see below) are experiments or attempts by this community to build these collaborations.

There was an interesting talk which was a summary of a proposal for a GANMVL tool (Multipurpose Virtual Laboratory). This is a summary for a DESY supported proposal to the European Union (EU) for money to develop a set of tools and a workstation to support GAN connections to an accelerator control room for the purpose of running machine experiments. This turned out to be a controversial talk. First, because of a deadline for submission of the proposal, only DESY was the major participant. Then there was the issue of the functional requirements definition (a lot of focus on virtual presence – not supported by many at this workshop). Then there was the cost (5.4 X 10^6 Euros), only some of which was to come from the EU. The GANMVL continued to be a topic of conversation during the workshop. Note that the EU sent the proposal back for resubmission. Outlook: "Keep going. Prepare a new proposal. Find possible industrial partners. Find new (and better?) arguments." Hermann Schmickler, WG1 Chair, "Remote Machine Experiments cannot wait for a common specification and they will happen with whatever technical specification."

Working Group 2 was on Controls, Networking and Accelerator Hardware Issues Relevant for Remote Operation. The leader of this working group was Matthias Clausen from DESY. There were a number of interesting talks and discussions.

A most interesting talk was a report by Tim Wilksen of Cornell (LEPP) on Wiki technology, specifically the Wiki site for use by the TTF2 Data Acquisition System project. This project is a collaboration of Cornell (LEPP), DESY, DESY Zeuthen, and Ohio State University. This talk elicited a proposal for a GAN Wiki, which was moderately supported, and the Cornell team volunteered to build such a site: http://ganwiki.lepp.cornell.edu/ GANWiki.html.

What's Wiki? It's short for the Hawaiian "Wiki Wiki" which means "quick." Wiki is a set of web-based tools allowing one to create, modify, edit (!), and delete (!!) web pages. The idea was first introduced in 1995 as "the simplest online database that could possibly work." The target "market" is distributed collaboration and distributed management. Over 100 Wiki sites are known.

Rok Ursic (Instrumentation Technologies) gave a talk on Multi-Tiered Network Enabled Instrumentation. This described a vendor supplied NAD (Network Attached Device) for BPMs, etc. Most interesting for his discussion on comparing Moore's Law for digital electronics (1/2 X cost and 2 X Functionality every 18 months) versus the unnamed rule for analog electronics (5-10% less cost every 18 months), and the impact of that on analog system design.

Oliver Hemming (JET) gave an excellent report on the JET (Joint European Torus) entitled "Towards a Fusion Collaboratory." JET is working hard to provide an infrastructure which supports remote collaboration in the design of ITER. They are specifically working on videoconferencing (good results here) and remote presence in the JET Control Room (not so good experience).

Working Group 3 discussed various technical aspects of human-computer interaction. This group also continued a discussion begun in WG2 on videoconferencing (see previous paragraph). The consensus of the experts and experienced users of working videoconferencing is that money has to be spent on microphones (good ones, lots of them, well-placed, and with echo cancellation), on video displays (big ones, 4-5 or more), and on reliable dedicated links. One of the interesting results of the academic studies reported in this WG is that people tend to ignore comments from participants whose video image (head) is less than life-size.

My summary of the Workshop: The most interesting aspects of these workshops are the discussions around collaboration tools. We should invite Deb Agarwal from LBNL to give a talk at SLAC on this topic.

In general, GAN is still an idea looking for support. The technology for remote operation is here – and is being used when it's wanted. The management commitment for remote system responsibility is here for construction projects (e.g., SNS, TTF) but not yet for operating machines. Andrew Hutton (of TJNAF) and I coined the phrase "Law of [GAN] Desperation." This law states that support for GAN will be created when GAN is the only option; that is, when one is desperate for GAN.

Eight-pack Project Meets Crucial Milestone

Heather Rock Woods, David Schultz, Chris Adolphsen

A Stanford Linear Accelerator Center team led by physicist David Schultz, surpassed a crucial hurdle last week in the decade-long effort to develop the Next Linear Collider (NLC).

SLAC's 8-Pack Project squeezed an incredible 475 megawatts of energy into a 400-nanosecond pulse of radio frequency (rf) power. The peak power of 475 MW, although it lasts only for a brief period, is more power than produced by some nuclear power plants.

This demonstration proves the needed rf power to accelerate electrons can be successfully supplied at the tremendous energies needed in a new linear collider to search for the universe's missing particles. The International Linear Collider Technical Review Committee rated the rf source system as one of the two most critical goals to reach in order to consider building an X-band linear collider. An international panel of experts will recommend next year that either an X-band collider or a superconducting collider be built.

On Dec. 4, the innovative rf supply station delivered the desired 475 MW, 11.424 GHz, 400 ns pulses. This week, the new system is routinely producing 570 MW. This is 5 times the peak rf power SLAC currently generates to run the world's longest and most powerful linear accelerator.

At 30 kilometers long, NLC would need over 2000 such rf supply stations to add 65 MeV of energy to an electron bunch for every meter the bunch travels. The second technical requirement to meet for an X-band collider is to make accelerating structures that can sustain an accelerating gradient of 65 MV/m. Structures have operated successfully at 60 MV/m and new designs are closing in on the desired goal. These two major collider elements will be tested together next spring at the NLCTA.

The team designed and assembled the new rf system, originally designed to use eight klystrons in a package. For the current tests the "8-Pack" system needs only four klystrons, to be replaced next year with two 75 MW PPM klystrons. The klystrons are powered by short, high-voltage pulses from a new modulator with pioneering solid-state switches.

The rf power from the klystrons is transferred to the SLED II system, which triples the power and shortens the pulse by a factor of four. SLAC Professor Sami Tantawi announced the innovative new SLED system, enabling rf to be delivered in "dual mode," where the rf power is transported in two modes to halve the length of the required delay line.

All together, the rf supply system achieves more power, with the promise of a much longer lifetime than the current rf systems used at accelerators worldwide.

The NLC Team Wishes All
A Happy, Safe, and
Healthy Holiday Season

Dave Schultz and Sami Tantawi at the 8-Pack (Photo by Tor Raubenheimer)

Klystron Meets Critical Performance Parameters Simultaneously

George Caryotakis

The Klystron Department has recently tested a klystron (XP-3) to the full NLC specifications of 75 MW peak power, 1.6 microseconds pulse length, and 120 Hertz repetition rate. These performance objectives were met simultaneously, with a tube efficiency of 50 per cent. The XP-3 was a joint effort between SLAC and US industry (CPI). It is a periodic permanent magnet (PPM-focused) klystron operating at 500 kV and employing a reusable focusing structure external to the vacuum, much in the manner of a solenoid electromagnet. The XP-3 was operated at an average output power of 14.4 kW, which, together with the peak power demonstrated, and the focusing method, makes it by far the most advanced high power klystron ever built, anywhere in the world.

Upcoming Conferences and Workshops

Joint Universities Accelerator School: Two Courses On Physics, Technologies And Applications Of Particle Accelerators (JUAS 2004) 5 Jan - 12 Mar 2004, Archamps, France. http://juas.in2p3.fr

American Linear Collider Physics Group Winter Workshop (ALCPG 2004) 7-10 Jan 2004, Menlo Park, CA, http://www-conf.slac.stanford.edu/alcpg04/Default.htm

U.S. Particle Accelerator School (USPAS 2004) 19-30 Jan 2004, Williamsburg, Virginia, http://uspas.fnal.gov/

Aspen 2004 Winter Conference On Particle Physics: Where We Are And Where We Are Going, 1-7 Feb 2004, Aspen, Colorado http://gate.hep.anl.gov/berger/Aspen04/

Annual APS March Meeting 2004 22-26 Mar 2004, Montreal, Canada, http://www.aps.org/meet/MAR04

International Conference on Linear Colliders (LCWS), 19-24 April 2004, Paris, France.