



NLC News -

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Program Director's Corner:

David Burke

Summer daze. The liv'n is easy, and it's not only Paris that's empty in August. Around the world, it's time for vacation, conferences, and summer schools. But it is also a good time to try out new ideas on your friends, and see what you can learn from them.

International conferences in Vienna, Osaka, and Monterey dominate itineraries this summer. The 7th European Particle Accelerator Conference, which alternates yearly with the IEEE/APS Particle Accelerator Conference, was held in Vienna, and the 30th International Conference on High Energy Physics took place in Osaka. In Vienna, Pantaleo Raimondi (SLAC) received the prestigious 2000 EPS-IGA Award for Excellence in Accelerator Physics for his work on the SLC final focus. And in Osaka, Nobu Toge (KEK) gave an excellent overview of the worldwide R&D on linear colliders. (Check it out at <http://ichep2000.hep.sci.osaka-u.ac.jp>.) The Linac 2000 meeting in Monterey will shortly bring together the world's experts to discuss the latest ideas and experimental results in the physics and technologies of linear accelerators; small topical workshops on beam-delivery issues (hosted by the Daresbury lab in the U.K.), and high gradients in rf systems (at SLAC in the U.S.) provide focus on important issues. See the following article by Peter Tenenbaum and Nan Phinney for more detail on EPAC and Daresbury.

Meanwhile, even the Members of the U.S. Congress left town in August to attend conventions in Philly and LA, but will return in September to "conference" on the fiscal year 2001 budget ... stay tuned.

On the Road -- European Particle Accelerator Conference and the Beam Delivery / Interaction Region Workshop

Peter Tenenbaum, Nan Phinney

The seventh European Particle Accelerator Conference (EPAC 2000) was held from the 26th to the 30th of June in Vienna, Austria. Over 700 scientists and engineers were in attendance, including Chris Adolphsen, Roger Jones, Pantaleo Raimondi, and Peter Tenenbaum representing the NLC collaboration. Adolphsen gave an invited talk on the experimental program for NLC technologies; Tenenbaum discussed the optics and scattering studies of the redesigned NLC collimation system in a

contributed talk. Raimondi received one of the two European Physical Society prizes for accelerator physics. His award talk was on the SLC, which included a discussion of his novel final focus design. Papers presented as posters included: results from the collimator wakefield experiment (Tenenbaum et al.), MAD-8 with linear acceleration (Raubenheimer et al.), several papers on ground motion models and measurements (Seryi et al.), and two papers on the X-band RF structure (Jones et al.).

The following week, July 3-6, the international Beam Delivery and Interaction Region Workshop 2000 (BDIR) was held in Daresbury, England. The workshop was dominated by the contributions of the TESLA and NLC groups, with two participants from CLIC and one from JLC. A relatively large number of UK physicists attended to learn more about what is going on in this area of collider design. Many of the participants have collaborated together on the SLC and FFTB and the meeting was highlighted by frank and animated discussions of technical problems, potential solutions, R&D plans, and the political status of the regional designs. Much of the material covered at the workshop had been presented before at the LC meetings in Sitges and Frascati. Two of the new topics, which generated the most interest and discussion, came from recent work for the NLC.

Nan Phinney presented the new NLC Final Focus design proposed by Pantaleo Raimondi and Andrei Seryi. By making the chromatic correction of the final quadrupoles as local as possible, the length of the Final Focus can be reduced substantially without sacrificing performance. The original NLC FF design for 1.5 TeV was 1.8 km long while the new FF is only about 0.3 km long. A preliminary design for 5 TeV is only 0.7 km in length compared with the CLIC 3 TeV conventional FF that is about 3.5 km. Because of the interest in this innovative design, the FF discussion was held at a joint session on Tuesday morning. KEK already plans to study the design and CLIC will definitely want to pursue it because of the huge reduction in required tunnel length. TESLA was less likely to use the new design because their FF is only 0.5 km for a maximum energy of 800 GeV. Moreover, the length of the whole TESLA beam delivery system is dominated by space for extraction, common dumps, positron production, etc. where the FF itself is a small fraction. Nonetheless, Nick Walker of DESY plans to study the design with his simulation code Merlin. There was

also discussion of a possible collaboration to test this design and other issues in a new run at the FFTB. There was interest from DESY, CERN, KEK and the British group and all agreed to discuss the possibilities and resources further with their home institutions.

The latest NLC and TESLA collimation designs were presented, and are remarkably similar in design philosophy, although the TESLA design takes a more aggressive approach to machine protection issues (made possible by the long bunch-to-bunch separation for TESLA). The first results from the collimator wakefield experiment were presented, and plans were made to test graphite collimators from DESY in the SLAC wakefield test chamber - graphite is of interest to all laboratories because it is believed to be the best material for surviving instantaneous beam-heating damage, but is predicted to cause unacceptable wakefields. There was some discussion as well about performing an experiment to measure the halo generated in the SLAC damping rings quantitatively. In the Luminosity and Diagnostics working group there was also a proposal by Phil Burrows of Oxford to test high-bandwidth feedback hardware in the ASSET region of the SLAC linac.

Measurement of RDDS1 at the Accelerator Structure Setup (ASSET)

Chris Adolphsen and Juwen Wang

Over the past seven years, six prototype NLC accelerator structures have been built to test methods of long-range wakefield suppression, to study high gradient limits and to improve accelerator efficiency. This last goal has been the main focus behind the latest structure, Rounded-Damped-Detuned-Structure-1 or RDDS1, which was built in a SLAC-KEK collaboration. Like its predecessors, it is 1.8 m long and consists of 206 cells. To improve the rf-to-beam efficiency, the structure cells were made with a rounded shape compared to the disk shape used in the past structures. This change increases the cell shunt impedance by 19%, allowing operation at lower input power to achieve the same average gradient.

The RDDS1 structure was installed in ASSET in May and removed in early August. As in previous wakefield measurements, the positrons extracted from the South Damping Ring served as the drive bunch and the electrons extracted from the North Damping Ring served as the witness bunch. Data were taken between PEP II fills, which required streamlining the

magnet and timing setup procedure. Parasitic, single-beam measurements were also made of the manifold dipole signals versus beam position.

There is good agreement between the data and prediction with the frequency errors. This was surprising since the shift in frequencies of the damaged center cells is not known precisely (the prediction was made prior to measurements). The wakefield is likely dominated by a few modes in the region of the cell errors, which is supported by the fact that the wakefield phase shows a smooth variation relative to a single frequency oscillation (15.094 GHz).

Additional measurements to search for higher dipole band contributions were taken in the region where the wakefield dips. Although nothing obvious was found, 26 GHz wakefields were seen at shorter times once the 15.1 GHz components were removed. This wakefield is likely from modes in the third dipole band. Analysis of higher band contributions is still ongoing.

For the single beam studies, the manifold dipole signal was measured with a spectrum analyzer or with downmixers and digitizers. In one set of measurements the spectra from the nine RDDS1 ports that had cable connections were recorded. Each measurement was made with the beam roughly centered and offset by 0.5 mm in X and Y. The shape of the spectrum with the beam offset in X is in fair agreement with predictions from the model used to compute the wakefield. However, several narrow monopole-like signals were seen in the data and are not understood. There is a 10% X-Y power coupling of the 14.2 to 14.6 GHz signals that may be related to the cell ellipticity observed near the upstream end of the structure. Finally, the high end of the spectrum falls off smoothly indicating that the fundamental output ports are damping the uncoupled modes near the end of the structure.

Prototype components of the Structure Beam Position Monitor (SBPM) system being developed for the NLC were used to measure dipole signals versus vertical beam position in detail at the two higher frequencies; the lowest frequency results were hard to interpret due to the X-Y coupling and the contribution of a nearby monopole mode. The minimum power observed during the beam scans is a measure of the out-of-phase component of the signal. It is important that this component be small (equivalent to < 5 microns beam offset) to simplify the phase measurement requirements at the NLC (the goal is to use the phase only to determine the direction of the beam offset). At 15.0 GHz, the minimum power measured near the end of the run was equivalent to less than a few microns' beam offset while an earlier measurement showed 27 microns when the beam had a different upstream orbit that likely produced larger Y-Z correlations. At 15.7 GHz, the equivalent offset was first measured to be 12 microns, but it was reduced to a few microns by

skew quadrupole corrections that decreased the Y-Z bunch correlation via the vertical dispersion it introduced in combination with the energy-Z correlation in the bunch. Thus, the out-of-phase component of the signals due to the structure itself does not seem to be significant, and the dipole amplitude resolution is within NLC requirements.

In summary, results from the RDDS1 measurements in ASSET, even with the center cell frequency errors, show that the wakefield can be modeled accurately and that the cells can be made with high precision. The use of the fundamental output ports to damp the modes furthest downstream appears to work well. Finally, the SBPM results indicate that such a system will keep the structures centered about the beams in the NLC.

Research Notes

Motion and Vibration Studies: Andrei Seryi is investigating ground motion and vibrations in the SLD Interaction Region. Vibrations produced by various detector subsystems are being studied with the help of Marty Breidenbach and his colleagues. These studies will help to understand better the detector requirements and also will help to develop an appropriate strategy for stabilizing the NLC interaction region (IR). Some results will be reported at the upcoming Linac 2000 and a complete report will be presented at the Workshop on Ground Motion in Future Accelerators organized by SLAC with the help of the ICFA Beam Dynamics panel. The Workshop will be held at SLAC on November 6 - 9, 2000.

Collimator Wakefield Experiment: The experiment has been measuring the centroid deflections experienced by the electron beam in the SLAC linac when it passes off-center through a vertical collimator, which is tapered, in the longitudinal direction. The measurements are performed just downstream of the damping rings, and typically involve bunches with a charge of 2×10^{10} electrons at a bunch RMS length of approximately 600 microns. The results have indicated a transverse wake, which is much smaller than, predicted by the theory - the measured deflections are over an order of magnitude smaller than the predictions - but which is comparable in size to the deflections predicted by numerical electrodynamic simulations. These results have led to a qualitative modification of the theory, which accounts for the smaller wakefield. Results have been reported at EPAC (SLAC-PUB-8512) and will be presented at the LINAC conference.

At this time the NLC project is collaborating with the TESLA project (centered at DESY) to produce additional collimators constructed from graphite in order to test the wakefields of a material, which is essentially nonconductive. Measurements of these collimators should begin in the next few months.

Simulation Studies: Brian McCandless and Linda Hendrickson have generated parallel computing versions of LIAR and ION_MAD - the linac and fast beam-ion simulation codes - making full simulations now possible. In addition, Linda and Pantaleo Raimondi have compared the LIAR simulations of emittance growth with measurements from the SLAC linac. Results will be reported at Linac 2000.

Recent Linear Collider Publications

Note: If you would like an NLC-related paper listed, please send information to amlarsen@slac.stanford.edu

I. Linear Collider Collaboration Notes

LCC-0043, "Dipole Mode Detuning in the Injector Linacs of the NLC," K. Bane and Z. Li, 07/00.

LCC-0044 (FERMILAB-PUB-00-072-T), "Preserving High Multibunch Luminosity in Linear Colliders," C. Bohn and K-Y Ng, 08/00.

LCC-0045, "Study of Beam Energy Spectrum Measurement in the NLC Extraction Line," Y. Nosochkov and Tor O. Raubenheimer, 08/00.

Calendar of Upcoming Events

I. Conferences

Linac 2000, Monterey, CA, August 21 - 25
<http://LINAC2000.slac.stanford.edu/>

RADCOR, Carmel, CA, September 11-15, 2000, <http://radcor2000.slac.stanford.edu/>

5th International Linear Collider Workshop (LCWS 2000), 12-28 Oct 2000, Batavia, Illinois, http://d0server1.fnal.gov/users/hefisk/LCWS2000/Linear_Collider_Workshop_2000.htm

The 22nd Advanced ICFA Beam Dynamics Workshop, Nov. 6-9, 2000, SLAC, Menlo Park, CA. <http://www-project.slac.stanford.edu/lc/wkshp/GM2000/default.htm>

Nuclear Science Symposium, Lyon, France, October 15 - 20, <http://NSS2000.in2p3.fr/>

2001 Particle Accelerator Conference, Chicago, IL, June 17-22, 2001.

II. Meetings

Workshop on RF Breakdown in Copper Structures, August 28 - 30, 2000, SLAC, Menlo Park, CA. <http://www-project.slac.stanford.edu/lc/wkshp/RFBreakdown/announce2.pdf>

September 21, 22, Internal NLC Review, SLAC.

October 3 - 6, Collaboration /MAC Meeting, SLAC, Menlo Park, CA.