NLC News

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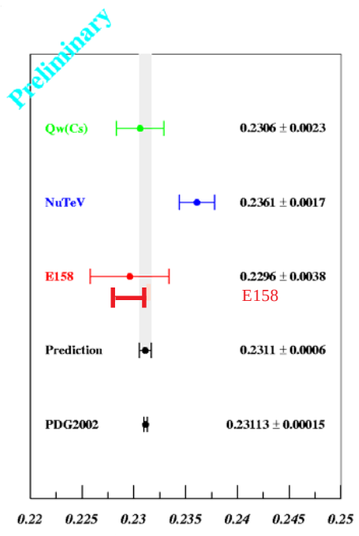
First Results from E-158

Michael B. Woods

SLAC E-158 is taking data in its final physics run this summer in End Station A. The experiment measures the amount of parity violation in electron-electron (Moller) scattering, determined from the rate asymmetry in the scattering of left-polarized and right-polarized electron beams from unpolarized electrons in a liquid hydrogen target. The experiment runs with beam characteristics similar to the beam required for the NLC injector (see September 2002 issue of NLC News).

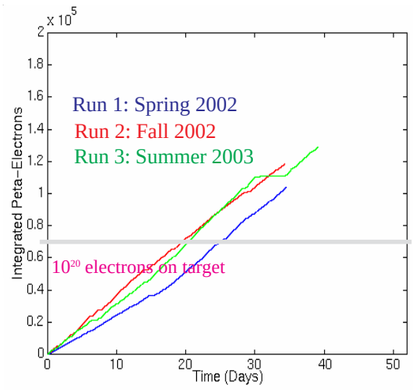
First results from E-158, released this spring, include the first observation of parity violation in Moller scattering and a first measurement of a single spin transverse asymmetry in Moller scattering.

E-158's parity violation measurement can be interpreted as a measurement of the weak mixing angle (θ_w). The figure below shows the E-158 result from its Run 1 data in comparison with other measurements, and the precision E-158 expects to reach with its full data set. The precise result tabulated by the Particle Data Group (PDG 2002) comes from measurements at SLD and LEP taken at the Z^0 resonance. E-158's goal is to make the best measurement of θ_w away from the Z^0, where it has sensitivity to new TeV-scale physics not accessible from the SLD and LEP measurements.



Comparison of $\sin^2\theta_W^{\overline{MS}}\left(M_Z^2\right)$ *measurements by E158 and previous experiments*

E-158 has collected data in two physics Runs in 2002 and is currently collecting data in its final run this summer. The data collection is summarized in the figure below. Run 1 data was collected while E-158 shared Linac pulses with PEP-II, whereas all Linac pulses for Run 2 and Run 3 data are dedicated to E-158 running. The only major downtime during these three runs happened recently in Run 3 due to a vent of the liquid hydrogen target that ruptured a protection burst disk. The repair for that included warming the target loop to room temperature to perform the repairs and then cooling back down to 18K. This took 4 days, during which time the accelerator performed necessary maintenance, and checks of the accelerator PPS (personnel protection system). One bonus for E-158's Run 3 is that we are taking advantage of polarized photocathode R&D, being conducted by the Polarized Electron Source Group as part of the NLC R&D. We are using a new structure, a gradient-doped strained superlattice, which is giving close to 90% polarization for the electron beam.



Linear Collider Collaboration Notes

http://www-project.slac.stanford.edu/lc/ilc/TechNotes/LCCNotes/lcc_notes_index_htmCalendar of Upcoming Events

LCC-0060 rev.1, "Guide to LIBXSIF, A Library for Parsing the Extended Standard Input Format of Accelerator Beamlines," P. Tenenbaum, July 2003

LCC-0120, "Tunnel Wall Heat Transfer," Gordon B. Bowden, July 2003.

LCC-0121, Sensitivity to interaction region solenoid horizontal motion, Peter Tenenbaum and Tor O. Raubenheimer, August 2003

Conferences and Workshops of Interest

8th International Conference on Advanced Technology and Particle Physics (ATPP2003); Astroparticle,Particle; Space Physics, Detectors and Nuclear Physics Applications, 6-10 October 2003, Como, Italy, http://villaolmo.mib.infn.it/conference2003.html/

30th Advanced ICFA Beam Dynamics Workshop on High Luminsoity e+e- Collisions, October 13-16, 2003, Stanford, CA. http://www-conf.slac.stanford.edu/icfa03/

9th International Conference on on Accelerator and LArge Experimental Physics Control Systems (ICALEPCS2003), 13-17 October 2003, Gyeongju, Korea, http://icalepcs2003.postech.ac.kr

International Workshop on Astroparticles and High Energy Physics (AHEP2003) 14-18 October 2003, Valencia, Spain, http://nacisific.uv.es/conference/index.html

87th APS NYSS Semiannula Symposium of Particle Accelerator Frontiers and NEw Physics Potential, 17-18 October 2003, Upton, NY, http://www.aps.org/meet/calendar.html

IEEE Nuclear Science Symposium and Medical Imaging Conference (NSS/MIC 2003) October 19-24, 2003, Portland, Oregon, USA. http://www.nss-mic.org/.

9th International Workshop on Advanced Computing and Analysis Techniques in Physics Research (ACAT03), 1-5 December 2003, Tsukuba, Japan,http://www-conf.kek.jp

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

11th Advanced Accelerator Concepts Workshop (AAC 2004), 20-25 June 2004, Stony Brook, New York.

Director's Corner

David L. Burke

We have been reminded recently of the importance of safety in the workplace. A fire that started in one of the three NLCTA modulators was quickly put out by a rapid and sure response from the Palo Alto Fire Dept, but not before it consumed the capacitor-PFN network used to store and deliver energy to a pair of the NLCTA klystrons. No one was injured as emergency procedures worked well. And fortunately the replacement components are readily available, so we expect the modulator back in service by mid-September. We have been able to limit the impact on the structure testing program by temporarily rerouting power from the injector station. This leaves us without the capability to generate beam, but able to carry on the high-gradient testing program.

Certainly the modulator fire has received immediate attention, but there is a deeper lesson here. Activity in End Station B (ESB) around the NLCTA has expanded greatly in the recent past with construction of the new solid-state SLED-II system, the beginning of the E-163/ORION program, and the move of NLC vibration-stabilization R&D apparatus to the building. We need to expand our vigilance and coordination of ES&H in the area to keep up with these new activities. This begins at the top, and we have established a monthly "ESB ES&H Coordinating" meeting to go over present concerns, and look ahead to issues that might arise in the future. But safety is everyone's responsibility and authority. We all must stay alert to our business and surroundings, and we all have authority to flag dangers whether they are immediate or potential. Be a part of the solution. You always have a channel to express concerns either through me or the NLCTA Safety Officer, Keith Jobe.

Safety is not only a continuing part of the daily activities of the job, but a nontrivial problem in the design of something as big as a TeV linear collider. The safety features of the new solid-state modulator were reviewed along with those of the old-style NLCTA modulators even though the new modulator doesn't use oil-filled capacitors that were the fuel for the fire. Corrective actions are being taken for both systems. These will include recertification of the interlocks and fire-detection system, improved control of air flow through the modulator cabinets, installation of a primary fire-suppression system inside the cabinets in addition to the external building fire-suppression system, and a new look at containment of the insulating mineral oil used in the high-voltage sections of these devices. This will all filter into the final design of these devices.

Linear Collider Activities at LLNL

Jeff Gronberg

LLNL's contribution to the NLC R&D effort focuses on areas where the lab's unique strengths can advance the capabilities of the machine. Currently we are bringing the lab's experience in induction modulators to the design of the solid-state modulator, our laser and optics expertise to the photon collider design, and our skill in precision machining and metrology to a support structure for nanometer BPMs. We had previously worked on the issue of radiation damage in the positron targets, but that effort has been on hold. Given the interest in the wiggler-based positron source, it may be revived in the near future to examine the damage issues in those targets.

Modulator

In a strong collaboration with SLAC and Bechtel/Nevada, LLNL has been working on the design of a Solid-State, IGBT-based, induction modulator. Ray Larsen has described the modulator program in detail in a previous note and we will not repeat those details here. The group reached a major milestone with the delivery of the 8-pack modulator prototype and, of course, the experience with this prototype has raised new issues with the design. LLNL has been supporting the 8-pack operations, working to improve the performance and solve the IGBT damage problem. With the adoption of SLED-II as the baseline, the group has embarked on a new modulator design, which would drive two modulators. This new model should allow the IGBTs to run faster with less possibility of damage and should provide for more robust operations of the accelerator.

Nanometer BPM

The technical issues involved in bringing nanometer-sized beams into collision reliably have been under study for many years. While simulation work has produced a high degree of confidence that a system of stabilization and feedback for the final focus magnets will succeed in reliably producing luminosity, it would be useful to be able to prototype and test these solutions in a real life situation. Until now it seemed impossible to construct such a system without actually colliding beams since beam diagnostics with nanometer position resolution were unavailable. However, cavity BPMs have been constructed which have signal-to-noise ratios that would seem to support nanometer position resolution. LLNL has been designing a frame for holding a set of three BPMs that would hold the BPMs steady with respect to one another at the nanometer level.

Based on a hexapod of solid metal flextures, as shown in Figure 1 (p. 2), this alignment frame would hold the BPMs rigidly while also allowing a range of position and angle adjustment for each BPM.

The design of the alignment frame has now finished the simulation and detailed drawing phase and is beginning fabrication and construction. Simulation studies of the entire structure, as shown in Figure 2 (p.2), have shown that the frequency of lowest mode is above 200 Hz. This mode is a drumhead where the main support rings tilt. The motion of this mode moves the BPMs transverse to the centerline and would show up as degraded resolution. With a fundamental frequency above 200 Hz, the ambient ground motion at the Aceelerator Test Facility (ATF) at KEK should not excite this mode. This should prevent relative motion of the BPMs, which is critical to demonstrating the nanometer resolution.

Photon Collider

Efforts toward a photon collider interaction region have been focused on developing Monte Carlo tools for developing the physics case, demonstration of a prototype MERCURY laser at LLNL, and a proposal for a technology demonstration test-bed at the SLC.

The MERCURY Laser recently completed its single-head commissioning run with a full complement of 7 amplifier crystals installed. During this run the laser demonstrated its full repetition rate of 10 Hz while producing laser pulses of 20 joules. A variety of running conditions were explored with peak laser power reaching 35 Joules. The laser is currently disassembled and the laser clean room is being upgraded for installation of the full two-head MERCURY system. The single-head testing revealed a number of ways to increase the reliability of the system and decrease the probability of damage and these are being incorporated into the new setup. Once all crystals are in place, the full power of 100 joules should be demonstrated.

Optics suitable for installation at the SLC have been procured and installed on a test bench at LLNL along with the lasers and diagnostics required for the interferometry-based alignment system. In addition, simulation studies are underway to design the "hall of mirrors" which splits the single pulse from the MERCURY laser into a train of pulses matched to the time structure of the NLC electron beam.

On the physics simulation front, a long-standing disagreement between the European and US gamma-gamma physics groups has been resolved on the question of the level of resolved two-photon hadronic events in the photon collider IR. Our European friends were right all along, which is fine with us since it reduces the extra hadronic background to the level of 1.5 events per beam crossing. The effect of this background on the mass resolution of Higgs events in the two-jet channel can now be evaluated. This will be critical input for the detector design since it will set the number of crossings that can be integrated in the detector without degrading the physics reach.

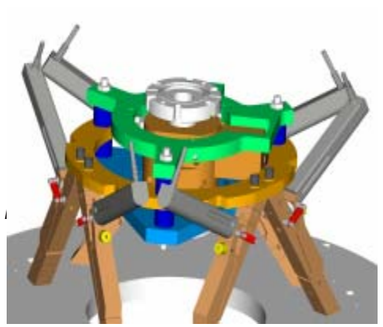


Figure 1: The Hexapod of flextures which holds the BPM.

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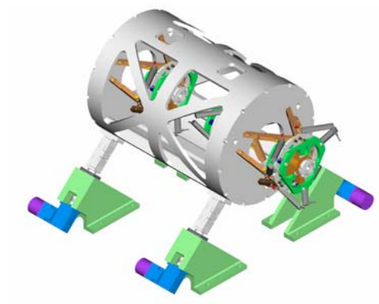

Figure 2:The full NanoBPM alignment frame.

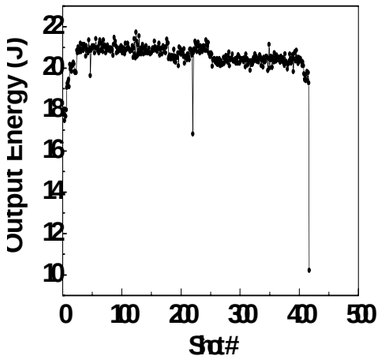

Figure 3: The MERCURY laser output at 10 Hz pulse frequency.

Figure 4: The Optics test bench at LLNL.

Notes from the ISG Working Groups, cont.

ISG-X: Accelerator Physics/WG1: Ground Motion and Stability Update

J. Gronberg, A.Seryi and T.Tauchi

The GLC and NLC groups are continuing studies aimed to ensure stability of the linear collider. With respect to the previous ISG-9 meeting at KEK, progress was made in the areas of measurements of the sites' stability and vibration transmission, modeling, vibration-proof design and development of nanoscale instrumentation.

Recently, vibration properties of the KEK site have been measured both on the surface and in the 80-m deep borehole located just near the Higashi-odori Road. Preliminary results discussed at the meeting show that the noise level in the borehole is significantly attenuated with respect to the surface, especially at high frequencies. These experimental data were used to create a model of ground motion, which in turn will be used to evaluate effectiveness of various aggressive methods of beam-based alignment and correction in the linac.

In the two tunnel linac configuration, when klystrons, modulators, and other equipment are located in the second tunnel, vibration transmission from the utility tunnel is an important parameter which needed to be quantified. Recently, vibration transmission between and along the tunnels was measured in the Los Angeles metro line, where the tunnel configuration and geology are similar to that foreseen for the linear collider. Results obtained will allow us to quantify the necessary vibration stability of the utility tunnel.

Development of vibration-proof designs of the linac components is essential for linear collider stability. Studies are ramping up at Fermilab to verify both the long-term stability of girders and rf-structures and the vibrational properties of the linac girders, emphasizing the linac quadrupole stability, and improving the design if necessary.

Nano-instrumentation is another area where the linear collider is successfully pushing the frontier of the achievable. The Feedback On Nanosecond Time-scale (FONT), was recently successfully demonstrated at NLCTA, and a similar system dubbed FEATHER that is being developed at KEK, would allow correction of the IP position of the bunches within a single train. The nanometer resolution beam position monitors (nano-BPM) are another area of active research. Such a tool, when it becomes available, would open new possibilities both for verification of the IP beam stabilization and for more accurate control of emittance along the linac.

Harry Carter's report is reprinted because a section was inadvertently omitted in the July NLC News.

NLC Collaboration Meeting: Structures Working Group Summary

Harry Carter

During the week-long ISG10/NLC Collaboration meeting, Working Group 3, "Structures", was led by co-conveners Harry Carter (FNAL), Toshi Higo (KEK), and Juwen Wang (SLAC). The goals set for the group were: (1) Review of progress and experiences in design and fabrication, (2) Review of high gradient tests, (3) Plan and schedule toward meeting the TRC R1 demonstration requirements, (4) Plan and schedule toward meeting the TRC R2 demonstration requirements, and (5) Prepare for the international technology selection process for the X-Band collider.

After the opening plenary session, a joint session was held with the RF Power Working Group (WG1) in which presentations were given and discussions held on the topics of power distribution, breakdown studies, and high power testing. The configuration for Phase II of the 8-Pack Project was discussed as well as staging options that might be considered in order to maintain flexibility for testing of structures in NLCTA during the Phase II power distribution installation work in the NLCTA enclosure. Several issues remain to be resolved before a final configuration will be determined.

A joint session was held with the Accelerator Design Group in which presentations on the subjects of structure parameter optimization, fabrication tolerances, wakefield calculation, and structure fabrication at FNAL and KEK were given. During subsequent discussions of these topics, several important decisions were made: (1) In order to assure sufficient "overhead" between the nominal unloaded structure operating gradient of 65 MV/m and the value of the unloaded gradient at which the breakdown rate exceeds the specified limit of 0.1/hour, an optimized structure design was adopted. This structure will be designated H60VG4S17 in SLAC/KEK nomenclature and FXD in FNAL nomenclature. This structure design features a tapered front end resulting in a significantly lowered gradient from the H60VG3S18 design, while the back end has a higher gradient than the H60VG3S18 design (see Fig.1). The resultant average energy gain through the structure is the same as the H60VG3S18 structure, but the belief is that the breakdown rate in the front end of the structure will be reduced markedly. Since the front end of the structure is the area where the RF energy is the highest, damage resulting from breakdowns is more severe and is evidenced by a phase shift in the damaged area of the structure. The combination of lowered gradient and a reduced breakdown rate in the front end of the new design should result in little or no damage in this area. (2) KEK agreed to immediately produce cells for two structures of the new design, with a projected delivery date to SLAC for final assembly in September 2003. (3) Since they had already ordered cells for four FXC (H60VG3S18) structures, Fermilab will complete these structures before switching to the new design. Both the FXC and the SLAC/KEK structures will satisfy the TRC R1 requirements and will be used in Phase II of the 8-Pack Project.

In all, the participants felt that the sessions were very useful and that the important decisions that were made with respect to the next structure design will place us in the best possible position to meet the TRC R1 and ultimately R2 requirements prior to the linear collider technology decision in June 2004.

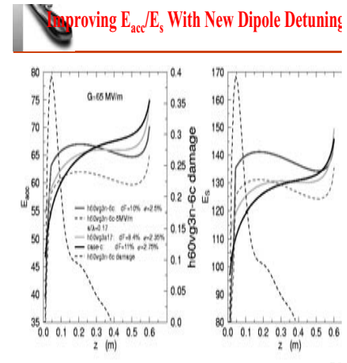

Figure 1 : Improving E_{acc}/E_s with new dipole detuning

Kudos to Naomi and Nixx

Our administrative team, Naomi Nagahashi and Nick Arias, have been participating in SLAC's Certificate in Supervision training program. As part of this program, teams are formed to design and complete an experiment modeled on the course designed by Woody Flowers for his mechanical engineering undergraduates at MIT. In this case the project, called "The Ovoidal Anti-fragmentation Collider Project" required the design and execution of an experiment in which an egg is dropped three meters in such a way that it does not break, or if it does, that it does not splatter beyond defined bounds. Using peanut butter, plastic sheeting and ingenuity, their team, consisting of Naomi and Nick and SLAC staffers Cathy Knotts, Nina Adelman Stolar and Forest Brown designed and implemented the most successful project: their egg landed safely, they met the ES&H and other requirements and their team held first place unequivocally. Congratulations to all, and additional congratulations to Naomi who has completed her certificate. Nick will complete his shortly.

Correction:

In Cherrill Spencer's article on the ISG Plenary Sessions, I changed the text to say that the international "wise persons" committee would render a decision on next linear collider technology in late 2004. Indeed, the correct date is early 2005.
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