the electrical current pumping it. The figure on page 21 shows the sharp rise in optical power above a drive current in each pulse of 0.85 A for one of the Bell Labs lasers. To date the best slope efficiency for the quantum cascade laser is 0.1 W/A. One can deduce from this value the internal quantum efficiency of the laser, a measure that is 100% if each electron yields 25 photons, or one for each active region. By his group's calculations, Capasso claims, the internal quantum efficiency of the new laser is 20%, or 5 photons per electron. The Bell Labs researchers are pushing that limit with the same determination they have shown in tackling the other challenges this laser has posed.

—BARBARA GOSS LEVI

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NEW STANFORD FACILITY SQUEEZES HIGH-ENERGY ELECTRON BEAMS

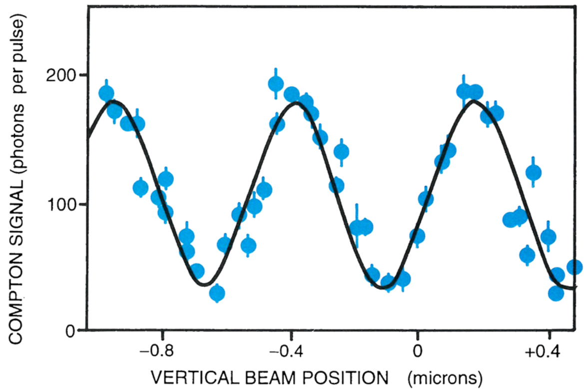
Accelerator physicists at the Final Focus Test Beam, a new facility at the Stanford Linear Accelerator Center, have managed to squeeze the vertical width of a high-energy electron beam down to 75 nanometers. That's an order of magnitude smaller than the focal spots of the 50-GeV electron and positron beams of the five-year-old Stanford Linear Collider. And it's almost small enough for the TeV beams envisioned for the next generation of electron–positron colliders. (See the article by Jonathan Wurtele on page 33.) Linear colliders, in which collisions must all happen in a single pass, require much tighter focal spots than do storage rings, where the beams pass through each other again and again. But for beam energies above about 100 GeV, circulating charged particles as light as electrons radiate away so much energy that storage rings would be prohibitively expensive. A TeV electron–positron collider will, perforce, be a pair of face-to-face linacs.

The FFTB is a 300-meter-long test beam line built during the last three years at the downstream end of the two-mile-long, 50-GeV SLAC linac. This $20-million facility is an international collaboration of groups from France, Germany, Japan, Russia and the US. Its principal purpose is to study techniques for achieving and controlling the very tight focal dimensions that will be required at the point where TeV electron and positron beams collide. The FFTB design goal is an electron-beam focal spot 60 nanometers high and 1 micron wide. That's an extraordinary vertical demagnification factor of 400. The 75-nm height achieved in May, just one month after the facility became operational, is encouragingly close to that goal. The horizontal width will have to remain closer to a micron, even in a TeV collider, to keep bremsstrahlung from electromagnetic beam–beam interaction to a tolerable level.

To achieve vertical demagnification 10 times better than that of the SLC beam lines, which are also fed by the two-mile linac, the FFTB beam optics have to do unprecedentedly complete 2rd-order correction of the chromatic aberation due to the beam's momentum spread. That involves the introduction of sextupole magnets and the control of magnet positions to *micron* tolerances all along the 300-meter beam line. Only the beam itself can monitor so sensitive an aligment, and each of the half-ton magnets has to sit on a precision platform that moves in micron steps.

The cover of this issue shows what it takes to measure a beam profile of 60 or 75 nanometers. The usual wire scanners are much too coarse for these unprecedentedly small focal spots. The trick is to sweep the electron beam across a very fine optical interference pattern and measure the resulting Compton scattering. The CCD image on the cover shows the interference pattern produced by the reuniting of a split beam from an infrared Nd:YAG laser in the FFTB focal plane. The fringe spacing can be varied by changing the angle at which the interfering laser beams meet. The CCD image shows 10-micron fringe spacing, but 0.5-micron spacing was used to measure the 75-nm vertical beam width. As the electron beam sweeps across the interference fringes, a downstream photon detector records the oscillating Compton scattering signal as the electrons encounter alternating lines of high and low photon density. (See the figure below.) The amplitude of this oscillating signal is an inverse measure of the electron beam width.

—BERTRAM SCHWARZSCHILD



Compton scattering signal oscillates as FFTB electron-beam focal spot sweeps across laser interference fringes spaced 0.5 microns apart. The smaller the beam spot, the greater the swing. These recent data measure a record beam focus only 75 nm high

VLT INTERFEROMETER TO BE DELAYED

In December the council of the European Southern Observatory approved a revised construction plan for ESO's Very Large Telescope. (See the article "The New Ground-Based Optical Telescopes," by Buddy Martin, John M. Hill and Roger Angel in PHYSICS TODAY, March 1991, page 27.) Although the four 8.2-meter telescopes will be constructed as scheduled, the VLT Interferometer, its subarray, the Coudé feed and the associated adaptive optics were postponed to reduce the expenditure in the next few years.

ESO has since been reformulating the interferometric part of the project. According to ESO senior astronomer Richard West, a plan has been developed to stretch the project over twice the original time interval while reducing the cost 30% and retaining "virtually all the scientifically desirable features." The council reacted positively in June, and a decision to reestablish the VLT interferometric option may be made later this year.

—DENIS F. CIOFFI ■