Livermore-MIT group uses plastic doped with conducting polymer as a low-cost alternative to scintillator for large area counting. Tests with a radioactive source indicate rate capability to 1 kHz/cm^2, substantially higher than bakelite RPCs currently in use. GEM groups working with PDTs and CSCs had been concerned that their chambers would pick up spurious signals from the RPCs, but TTR tests show clearly this is not the case.

Such excellent and rapid results were possible because of advances in chamber design, a sophisticated DAQ system, and the TTR's size and flexibility, despite its being limited to cosmic rays.

Advanced Light Source (ALS) management and staff met with Lawrence Berkeley Director Director Charles Shank to discuss successful storage-ring commissioning. Left to right are (seated) accelerator physicists Hiroshi Nishimura and Malika Meddahi, operator Cheryl Hauck, and Jay Marx, who guided the ALS construction project until last October; (standing) ALS Director Brian Kincaid, LBL Director Shank, Accelerator Group Leader Alan Jackson, Electrical Group Leader Henry Lancaster, Head of Operations Ben Feinberg, and Accelerator-physics Section Leader Rod Keller. ALS Project Manager, Ron Yourd, was not present.

BERKELEY ALS ring

Everybody at Lawrence Berkeley Laboratory's Center for Beam Physics is pleased with the rapid progress in commissioning LBL's Advanced Light Source (ALS) electron storage ring, the foundation for this third-generation synchrotron-radiation facility. Designed for a maximum current of 400 mA, the ALS storage ring reached 407 mA just 24 days after storing the first beam on 16 March.

ALS construction as a US Department of Energy (DOE) national user facility to provide high-brightness vacuum ultra-violet and soft x-ray radiation began in October 1987. One technical requirement marking project completion was to accumulate a 50-mA current in the storage ring. The ALS passed this milestone on 24 March, a week ahead of the official deadline.

Once injected, the electron beam decays quasi-exponentially primarily because of interactions with residual gas molecules in the storage-ring vacuum chamber. Eventually, when the pressure in the vacuum chamber with beam decreases toward the expected operating level of 1 nanoTorr, it will only be necessary to refill the storage ring at intervals of four to eight hours. At present the vacuum is improving rapidly as surfaces are irradiated (scrubbed) by the synchrotron radiation itself. At 100 mA, beam lifetime was about one hour (9 April).

To generate high-brightness VUV and soft x-ray synchrotron radiation, the ALS electron storage ring is designed to have very low emittance. The calculated natural emittance of the ring is 3.5 nm-rad at the normal operating energy of 1.5 GeV. However, the ring is capable of operating over the range 1-1.9 GeV.

The triple-bend achromat (TBA) magnet lattice contains 12 superperiods with a total of 36 gradient magnets, 72 focusing quadrupoles, and 48 sextupoles, with horizontal and vertical orbit correction by auxiliary windings on the sextupoles and by 46 dedicated corrector magnets.

The first successful attempt to inject beam into the storage ring came on 19 January when, just before midnight, a jubilant accelerator crew successfully guided an electron beam around the storage ring for the first time. In subsequent days, the number of turns was gradually raised beyond 400, nearly the maximum possible without the radiofrequency system to replenish energy lost to synchrotron radiation.

By mid-March, the 500-MHz storage-ring rf system was ready. On 16 March, with a little fine tuning, the ALS crew was gratified to see the number of turns on the beam-position monitors increasing dramatically from several hundred to several million. Beam started to accumulate immediately. The dc current transformer reported a stored current of 6 mA in four bunches, and the vacuum gauges shot up from about 10 nanoTorr to 1 microTorr as a result of desorption induced by synchrotron radiation.

After carefully tuning the rf cavities and optimizing rf power and phase, another try on 19 March resulted in a current of 42 mA in four bunches. This exceeded a performance goal of 7.6 mA in a single bunch, a specification that will be useful when operating in a single- or few-bunch mode for time-resolved experiments. March 24 saw the passing of the milestone known as the "DOE Project Plan Technical Baseline" requirement of 50 mA, a figure well below the maximum current of 400 mA but chosen in recognition that accelerators seldom reach full design performance levels without extensive commissioning and extended operating time. To surpass the 50-mA figure, the ALS accelerator crew further optimized the rf power, phase, and cavity tunes, adjusted the vertical closed orbit, and shifted to a more uniform multi-bunch filling pattern. These improvements took the current to 67 mA and brought a congratulatory letter from Secretary of Energy Hazel O'Leary.

The accelerator crew kept pushing and boosted the stored current to 90 mA the next day after carefully adjusting most of the available corrector magnets and a subset (QFA) of the horizontally focusing quadrupole magnets in the storage-ring TBA lattice. At this point, the beam decayed from 90 to 20 mA in 16 minutes.

A week later, the peak current reached 290 mA, and the accelerator crew decided to limit the current temporarily to 200 mA for further machine studies until they were sure that no ring component could be overheated by spilled photons or beam-induced effects. Occasional attempts to raise the current were permitted during continuing machine refinements, and the maximum current at the time of writing was 407 mA.

As a third-generation source of VUV and soft x-ray synchrotron radiation, the ALS emphasizes insertion devices in the straight sections between the 12 arcs of the ring. Ten sections are available for undulators and wigglers up to 4.5 m in length. Of the two remaining, one is occupied by injection hardware and the other by two rf cavities. In addition, each arc of the storage ring is fitted with four ports for access to bend-magnet radiation.

Completion of the initial accelerator studies early in May is followed by a three-month shutdown for installation of the first two undulators and front-end hardware for the two undulators, as well as one undulator and three bend-magnet photon beamlines. One of the bend-magnet beamlines is designated for machine diagnostics. It is hoped that completed beamlines for synchrotron-radiation research will gradually become available beginning around August. Over the summer, the ALS accelerator crew will attack the problem of operating with first one and then multiple undulators in the storage ring with their gaps closed to the maximum magnetic-field value.

RUTHERFORD/ STANFORD
First physics from novel detector

Pixel-based tracking detectors are making their mark. The first such detector used for high energy physics was a twin charge coupled device (CCD) assembly at the front end of the CERN fixed target experiment NA32, completed in 1986. Measuring space points on the particle tracks with five-micron precision and having unprecedented track resolu-

The vertex detector for the SLD experiment at Stanford's SLC linear collider, prior to assembly round the beam pipe. The innermost of the four concentric barrels has a radius of 29 mm. The detector consists of 60 ladders, each fitted with 8 CCDs. Each CCD comprises 250,000 independently digitized pixels.