[Title]

Workshop on Applications of Coherent Infrared Synchrotron Radiation

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A workshop focused on scientific applications of and plans for a coherent far-infrared (FIR) synchrotron source at the ALS was convened on October 11, 2002 as part of the annual Advanced Light Source users' meeting. It was organized by Michael C. Martin (ALS), Wayne McKinney (ALS), Dmitri Basov (University of California, San Diego), and Joseph Orenstein (University of California, Berkeley, and Berkeley Lab). Coherent synchrotron radiation (CSR) presents an opportunity to create a source with intensities about six orders of magnitude higher than conventional FIR sources. This workshop was held to further explore different types of science that could be enabled by such a novel source in this traditionally difficult spectral region.

Following a welcome by Martin, the first speaker was Tatiana Globus (University of Virginia). She described her group's recent measurements and theoretical modeling of the transmission spectroscopy of biological macromolecules at submillimeter wavelengths. High resolution and very good signal-to-noise ratios are required for these measurements, and a higher intensity source extending to wavelengths longer than a millimeter would be very useful for these studies. Next, Erik Helgren (University of California, Los Angeles) discussed his recent investigations of a Coulomb glass system with microwave and millimeter-wave spectroscopy.

The workshop then turned towards recent CSR source developments starting with a talk by Martin, standing in for George Neil (Thomas Jefferson National Accelerator Facility), describing the very high-power THz CSR observed using a energy-recovery linac. These exciting results were recently published [Nature **420**, 153, (2002)]and verify that a gain of 100,000 in intensity over conventional far-IR sources is truly achieved. John Byrd (ALS) then presented recent work showing that the onset of broadband self-amplified spontaneous coherent terahertz synchrotron radiation in a storage ring is now understood and can be avoided in the design of a dedicated CSR source.

The workshop attendees then heard from Ulrich Shade (BESSY) about the recent achievement of powerful, steady-state coherent THz synchrotron radiation at BESSY II. This accomplishment, made possible by lowering the momentum compaction in the storage ring, provides the first demonstration of stable CSR from a storage ring. This talk was followed by a presentation by Jason Singley (ALS) who described the general need for a new far-IR source for the study of strongly correlated materials and a proposal for a specific experiment to try and measure the Josephson plasma resonance in the high-temperature superconductor $Bi_2Sr_2CaCu_2O_8$ with the CSR source at BESSY II.

The workshop concluded with a presentation by Martin on the current state of plans for a dedicated coherent FIR storage ring at the ALS. This source would be built on top of the

ALS booster ring, and would be designed specifically for creating and using CSR in the THz region. Several unique features of the ring design were pointed out, and the planned next steps towards a full proposal for this source were presented.

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[Figure Caption—IRring.tif]

Drawing showing the main ALS storage ring and a proposed dedicated coherent far-infrared (FIR) ring (in color) located on top of the shielding for the ALS booster ring. The red and purple show the shielding for the new IR ring, and the green tables schematically show where FIR beamlines can be located.