The Fusion Science Center Summer School occurred at the Clark Kerr Campus at the University of Berkeley, California, 7 - 12 August 2005, and national and international participants, of which there were 96, included seniors, graduate students, and post docs and research scientists. A wide range of lectures, given by some of the world’s foremost authorities, focused on the fundamentals of high-energy density physics. (The presentations are contained in this CD). Essential to this summer school were student and participant posters, which were of excellent quality (several included in this CD), and which accompanied each day’s thematic focus. The poster session offered students a unique opportunity to discuss in detail their work not only with world authorities in an informal and congenial setting but with the many other students who were in attendance, challenging each to think more deeply, or perhaps along different lines, about their own research.

The topics covered on Monday’s first day of lectures were an “Introduction to High-Energy Density Physics,” by Professor Paul Drake of the University of Michigan; “Shocks,” by Dr. Marcus Knudson of Sandia National Laboratory (SNL); and the “High-Energy Density Physics of Z Pinches,” by Dr. Christopher Deeney of SNL. Common to these set of lectures, and those of the following days as well, was the truly remarkable set of diverse circumstances — from astrophysics to geophysics to laboratory physics — in which high-energy density phenomena, that for which the energy density exceeds $10^{12}$ erg/cc, occur. Monday concluded by several outstanding student posters on X-pinches and wire array Z-pinches.

Tuesday’s lectures included “Laser-plasma interactions,” by Dr. William Kruer of Lawrence Livermore National Laboratory (LLNL); an “Overview of High-Intensity Short Pulse Lasers,” by Dr. Bill White of Stanford Linear
Accelerator Center; and “Astrophysical High-Energy Density Physics,” by Dr. Dmitri Ryutov of LLNL. As in the other lectures, the focus was a mixture of fundamentals, needed for illuminating the basic concepts, as well as the exciting new frontiers emerging in high-energy density physics. The day concluded by a set of fine student posters on Laser-Plasma Interactions and on Plasma Diagnostics.

Wednesday’s lectures centered on “Inertial Confinement Fusion (ICF),” by Fusion Science Center Director Professor Riccardo Betti of the University of Rochester (UR); and on “Full Scale Comparisons between Simulations and Experiments,” by Professor Warren Mori of UCLA. One of the grand challenges of high-energy-density physics is the achievement of fusion ignition through ICF and, ultimately, of fusion energy. To that end, and using physically motivated considerations, Professor Betti analytically derived the basic equations necessary to understand the framework for implosion dynamics and for achieving ignition. From a contrasting point of view, Dr. Mori discussed the large computational requirements and methods that are required to simulate many of the experiments in high-energy-density physics, including that of fast ignition which is computationally one of the most difficult problems. In addition to another excellent student poster session, Wednesday’s activities included tours of the National Ignition Facility and of the Lawrence Berkeley Laboratory. The day concluded by a panel discussion of job opportunities in high-energy-density physics. This forum, comprised of leaders in the field, gave students the opportunity, through questions and dialog, to investigate different career options.

Thursday’s lectures were on “Fast Ignition,” by Dr. Max Tabak of LLNL; on “relativistic electron Transport,” by Professor Richard Freeman of Ohio State University; on “Equations of State,” by Dr. Gilbert Collins of LLNL; and on “Plasma Based Accelerators,” by Dr. Eric Esary of LBNL. The emphasis of these lectures was on the methods by which highly energetic particles are generated, both theoretically and experimentally; how these energetic particles are envisioned to be used in both the Fast Ignition scenario and in compact accelerators; and, finally, the equations-of-state needed to characterize highly compressed igniting matter as well as matter in the interior of giant planets and brown dwarfs, to name but two.
Thursday’s activities concluded with excellent student posters on, and lively discussions about, ICF, Fast Ignition, and astrophysics.

Friday’s lectures were on “Particle-in-Cell Simulations,” by Professor Chuang Ren of UR; and “Diagnostics Required for High-Energy Density Physics,” by Professor David Meyerhofer of UR. As was discussed, and the basic principles illuminated, particle-in-cell computational methods are one of the central means by which simulation is used to replicate actual experiments; and the diverse and complex set of diagnostics of HED Physics, as was elaborated, are the essential ingredients through which we ultimately learn about, and extend our understanding of, this exciting and challenging area of physics.

Friday’s session also saw the awards of outstanding student posters to eight students. The cash prizes were given to Patrizio Antici of LULI - Ecole Polytechnique (experimental) and Michael Tzoufras of University of California, Los Angeles (simulations). Making this selection most difficult was the fact that the entire set of student posters were of high quality and the Fusion Science Centers congratulates all students for their outstanding efforts.

Program Committee
The High Energy Density Summer School
University of California, Berkeley