Department of Energy
Washington, DC 20585
March 6, 2008

Professor Stewart C. Prager
Chair, Fusion Energy Sciences Advisory Committee
Department of Physics
University of Wisconsin
1150 University Avenue
Madison, Wisconsin 53706

Dear Professor Prager:

Steady increases in the energy, power, and brightness of lasers and particle beams and advances in pulsed power systems have made possible the exploration of matter at extremely high energy density in the laboratory. In particular, new experimental regimes could be realized by exploiting fully the scientific capabilities of existing and planned Department of Energy (DOE) facilities, as well as the relevant Department of Defense (DOD) and university facilities. Progress in the exploration of extreme states of matter has also been facilitated by advances in computer simulation and diagnostic techniques. Japan, China, Russia and the European Union also have growing programs in high energy density sciences.

A recent interagency task force report found that stewardship of high energy density laboratory plasmas (HEDLP) should be improved, and recommended that the DOE National Nuclear Security Administration (NNSA) and the DOE Office of Science (SC) establish a joint program in HEDLP. NNSA and SC have now established a joint program in HEDLP. Initially, this program is a combination of work that was funded as part of the NNSA's Stewardship Sciences Academic Alliances Program and Inertial Confinement Fusion Program and the SC's HEDLP Program and Innovative Confinement Concepts Program. Depending on availability of funds, the joint program budget is expected to be in the $30-50 million range over the next several years.

To assist in planning this program, we request that the Fusion Energy Sciences Advisory Committee (FESAC) work with the HEDLP community to provide information that will inform a scientific roadmap for the joint HEDLP program in the next decade or so. This study should be done in the context of both OFES and NNSA programmatic interests and the need to steward the field of HEDLP. Specifically, FESAC should: 1) identify the compelling scientific opportunities for research in fundamental HEDLP that could be investigated using existing and planned facilities in support of the OFES and NNSA/DP missions; and 2) identify the scientific issues of implosion and target design that need to be addressed to make the case for inertial fusion energy as a potential future energy source. The recent National Academies of Science reports [1-2], the two community Workshop reports [3-4], and the Report of the Interagency Task Force on HEDP [5], provide seminal information for addressing this charge.

The first element of this charge is focused on stewardship of HEDLP by the Joint Program. It should provide a description of, and rationale for, scientific interest in investigating this unique physical regime. A prioritized list of issues and opportunities that could be pursued over the next decade or so in this program is desired.

The second element is meant to provide background for a scientific plan for energy-related HEDLP studies. Specifically, FESAC should identify and examine the underlying science questions that need to be addressed to obtain the product of fusion gain and driver efficiency, together with suitable or attractive targets, to support the case for energy applications of inertial fusion energy sciences (IFES). These questions should help develop the knowledge base for inertial fusion energy with a goal of motivating future initiatives in IFES (e.g., an Integrated Research Experiment as discussed in past FESAC Reports). It should identify and prioritize the gaps in knowledge and opportunities for research in energy-related HEDLP research. It should consider sequential phases of activity focusing on: 1) exploiting available capabilities to address HEDLP science in anticipation of future studies on NIF; 2) exploiting the expected new capability of ignition on NIF, and associated approaches, to address scientific challenges of ignition science with increasing relevance to IFES; and 3) resolving scientific issues to establish the basis for justifying a transition from a laboratory ignition feasibility experiment to a program focused on fusion energy science development.

In summary, FESAC should identify the scientific opportunities for a proposed HEDLP program that is exciting, challenging, and puts the United States in the position of a world leader in this field of research. FESAC should complete its work on this charge by October 2008.

Sincerely,

Raymond L. Orbach
Under Secretary for Science

Thomas P. D'Agostino
Under Secretary for Nuclear Security