PREFACE

SPECIAL ISSUE ON KrF LASERS FOR INERTIAL CONFINEMENT FUSION

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This special issue of *Fusion Technology* (*FT*) is devoted to KrF laser science and technology, an attractive candidate for an inertial confinement fusion (ICF) driver. Little more than a decade has passed since the invention of the KrF laser. Still, it has emerged as a promising contender for both single-pulse and repetitively pulsed fusion driver systems that can be extrapolated to commercial power plant requirements. KrF lasers, along with heavy-ion accelerators (to be featured in a later special issue of this journal), show promise of satisfying all the essential requirements of a commercial ICF driver. These requirements include repetition rates of a few pulses per second, overall efficiency of at least several percent, flexible pulse shaping and dynamic range, efficient target coupling, and a viable scaling path to the several megajoule energies expected to be needed for high target yields. Equally important, a driver must meet these requirements with an acceptable reliability and capital cost.

An attempt was made for this special issue to discuss not only the emerging technology of KrF lasers, but also to address many of the requirements enumerated above. Several significant developments for KrF lasers are presented, including the following:

1. advances in kinetics and intrinsic efficiency
2. high-contrast-ratio pulse shaping
3. multiplexing systems for pulse compression
4. induced spatial incoherence (ISI) for spot uniformity—a critical issue for direct drive
5. progress in optics, pulsed power, and control systems
6. an integrated technology demonstration—the AURORA laser system
7. comprehensive studies of prototypes and commercial power systems.

In the process of formulating this special issue, contributions were solicited from the international community involved in KrF research. In particular, we note the substantial effort by several institutions in Japan, both in laser kinetics and systems development. A glance at the table of contents reveals a spectrum of coverage from basic physics issues (e.g., kinetics research at several institutions and the innovative ISI research at the U.S. Naval Research Laboratory) all the way to applications for commercial electric power [e.g., the systems studies by Los Alamos National Laboratory (LANL), Spectra Technologies, Inc., and McDonnell Douglas Astronautics Company]. We particularly appreciate the overview of laser issues written by Reed Jensen, deputy associate director for research at LANL. His paper covers in detail the significant KrF laser issues being addressed in the various research programs. The paper by Lehmberg and Goldhar on ISI presents a lucid description of a technology identified by the U.S. National Academy of Sciences ICF Review Committee as crucial to the success of direct drive targets. Also, the paper by Bert Kortegaard describes an alignment control system for an angular multiplexed KrF laser system. This alignment system won an *Industrial Research* "IR 100" award for 1986.

Featured in this special issue are several papers related to the AURORA facility, the first large end-to-end demonstration of the technology required for an

ICF driver using multiplexed beam compression. A 10-kJ beam has already been generated in the main amplifier, and a demultiplexed 5-ns beam on target is anticipated for early 1988. It seems appropriate at this stage to report to the fusion community on the status of AURORA, as well as on its design features. Many of the issues discussed by Jensen and others are addressed in the AURORA facility, which demonstrates most of the technology required for a laser-fusion driver. Several aspects of this facility are discussed in the comprehensive systems paper by Louis Rosocha et al., and in several papers on individual AURORA component systems.

The ultimate practicality of KrF lasers for commercial ICF power plants must, of course, meet the test of time. However, the paper by Dave Harris et al. gives compelling arguments for cost reductions and scaling to viable megajoule-level systems configurations. Likewise, John Pendergrass shows an important technical and economic improvement by using the laser waste heat generated in a repetitively pulsed system to produce electricity, which can add a few percent absolute to overall effective laser efficiency.

Preparation of this special issue of *FT* has been a rewarding—and sometimes frustrating—experience for me. It has also been sad because of the loss of a personal friend and professional colleague, Ken Riepe, to whom we dedicate this special issue. Ken was respected not only as a leading expert on state-of-the-art pulsed power, but also as one who nurtured his personal interactions with his colleagues. Whether discussing a problem in pulsed-power, or the selection of a campsite while backpacking, he showed the same gentle nature. We miss him.

Specific thanks are due for the assistance of others in the myriad tasks I never anticipated when George Miley volunteered me as guest editor. Especially appreciated are the efforts of Dianne Hyer and Dave Harris, who served as assistant guest editors, doing most of the essential but often thankless tasks associated with the referee and editorial processes. Dianne Hyer's talented editorial skills and cheerful enthusiasm have made this issue much more than it would have been otherwise, both in content and form. All three of us gratefully acknowledge the patient cooperation of Chris Stalker, the *FT* editorial assistant, and the editorial staff at ANS headquarters. Finally, special credit for the excellent cover art work goes to Ruth Holt, who along with Sally Baca produced most of the illustrations in the LANL papers.