BOOK REVIEW

Selection of books for review is based on the editor's opinions regarding possible reader interest and on the availability of the book to the editor. Occasional selections may include books on topics somewhat peripheral to the subject matter ordinarily considered acceptable.

The "Delfin" Laser Thermonuclear Installation: Operational Complex and Future Directions

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The potential reader of this book must first understand the context within which it is offered. It is one of a series of volumes published as the *Proceedings of the Lebedev Physics Institute, Academy of Sciences*, of the USSR. The series, like the ongoing work at Lebedev, covers divers topics. This book (volume 178 of the series) describes the Delfin laser fusion facility and gives a brief progress report on Lebedev's inertial confinement fusion (ICF) program. During the 1970s, Lebedev's ICF program was very active. Much state-of-the-art work on laser development for ICF was done there, including the development of the Kalmar and Flora lasers. The Soviets proposed building a multibeamline, several-kilojoule-class solid-state laser (Delfin) at about the same time as several other countries (e.g., the United States and Japan). However, in the 1980s, the Soviet experimental program proceeded significantly slower. Finally, in about 1984, at about the same time as facilities in the ten- and even hundred-kilojoule class were being completed in other countries, the Delfin facility, at 3 to 5 kJ of 1-μm light, was completed and target experiments began. This volume, published originally in the Soviet Union in 1987, describes that facility and Soviet thinking on ICF in the mid-1980s. It is a fairly comprehensive look at the major, known Soviet ICF facility, and it gives extensive references to the published Soviet literature on all aspects of ICF, from target design and fabrication to laser technology.

The first chapter is a good overview of the Soviet perspective on ICF as of ~5 yr ago. The chapter covers the Soviet views on the early developments of ICF target concepts and laser facilities, descriptions of Delfin and many of its subsystems, target fabrication techniques, target diagnostics, some results from target experiments, and plans for future facility developments beyond Delfin-1. The 211 references in this 92-page chapter point the reader to an extensive cross section of Soviet literature on all aspects of ICF.

The Delfin-1 laser is a 108-beam neodymium glass laser that can typically put $\cong$3 kJ of 1-μm light on a target with a pulse duration of ~1 ns. Power densities of 10^{13} to 10^{14} W/cm^2 are used to investigate laser-target coupling and capsule implosions. A single master oscillator provides a pulse that is divided and amplified in a series of rod amplifiers. The 108 beams are handled in 6 groups of 18, each cluster consisting of a 3×6 array of beamlets. For the desired power densities and a solid focusing angle of 0.1 sr, a laser brightness of $\geq 10^{16}$ W/(cm$^2 \cdot$sr) is specified. For a laser radiation divergence of 10^{-4} rad, a laser radiation flux density of $\leq 10^9$ W/cm^2 is found. While the first chapter of this book describes the elements of this laser in general terms, the following four chapters elaborate on the laser radiation concentration system, spatial coherence issues, the use of Faraday rotators, and the influence of active medium nonradiative transitions on lasing and gain kinetics. These chapters are also extensively referenced.

The capsule implosions discussed are large-radius, high-aspect-ratio (ratio of radius to shell thickness), direct-drive targets. Manufacturing techniques for capsules with diameters of ~1 mm and aspect ratios of one to a few hundred are discussed. The containers for either gaseous or cryogenic deuterium-tritium are made of polymers or glass shells, either plain or with a superlattice of metallic cluster particles 20 to 500 Å in diameter with a period of 200 to 2000 Å or microvoids from 0.05 to 5.0 μm in diameter. The last three chapters of the book describe target positioning and control and some of the target diagnostic and data collection methods used.

While this volume is a fairly comprehensive review of a major Soviet ICF facility, the reader should be aware of some shortcomings. The Soviet propensity to cite their own work is particularly evident in the references. For example, of the 211 references cited in the overview of ICF (chapter 1), only 10 are from the West. Furthermore, the Soviet view of early ICF history differs from that of others. For example, there is only a single citation of U.S. work during this period [Nuckolls et al., *Nature*, **239**, 139 (1972)], and the contents of that reference are misconstrued so that the U.S. contributions to the field are misrepresented. The translation is fairly good for the most part, but there are some translational and/or typographical errors that require reading much text to clear up what is meant. There is a paucity of figures, so the reader must have a good capability to do mental imagery. Finally, due to the lengthy publication, translation, and republication schedule, the book represents Soviet thought as of ~5 yr ago. The future plans discussed are less meaningful because of this and, in fact, by and large have not been followed.

In spite of these shortcomings, the book should be of value to those who wish to follow what is going on in the Soviet ICF program and do not have access, or time, to keep up with the Soviet literature. While the reader who wants a broad, comprehensive, accurate review of worldwide ICF history will not find it here, those who want a view of the Soviet (at least Lebedev) perspective on the subject will be satisfied. Furthermore, the book provides a good, in-depth look at one of the major Soviet ICF facilities. Laser and ICF facility designers who want to know what is driving the Soviets to design their facilities the way they do will find this volume particularly interesting. Finally, the extensive referencing of prior Soviet publications should be of value to those who want more detail on Soviet laser design thinking in general.

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