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Editorial

X-Ray Lasers

The successful demonstration of soft X-ray gain by electron collisional and recombination pumping six years ago initiated a dramatic expansion of research efforts in the field of X-ray lasers. The continuing high level of interest is reflected in the excellent response received to *Applied Physics'* call for papers for a special issue on X-ray lasers. The unexpectedly large number of contributions has made it necessary to split the papers into two parts, with half appearing in the present issue, and the remainder in April 1990 (see list on next page). Rather than dividing the papers into theoretical and experimental contributions, it was decided that a mixture of both in each issue would give the reader a better impression of the importance of interaction between experiment and theory in X-ray laser research.

On surveying the various contributions, one may discern three major goals of present research: The majority of the work is motivated by the desire to attain shorter wavelength lasers, in particular, to demonstrate gain in the so-called water window (2.2–4.4 nm). Recent progress suggests that it will only be a matter of time before a laser in this wavelength region is produced. Another important goal is the realization of a true X-ray laser oscillator. This relates to the third major area – efforts to develop an X-ray laser that can operate with a considerably smaller pump laser than those required at present.

It is worth mentioning here that there are still only two pumping methods that have yielded soft X-ray gain in experiments: electron collisional and recombination pumping. Although the basic physics of both these mechanisms is well understood, there remain unanswered questions in each case. Notable examples are the $J=0$ to 1 problem for electron collisional pumping and the existence of a long pulse regime for recombination pumping. Furthermore, each of these methods suffers from certain limitations and there is thus strong motivation to investigate alternative means of excitation, the most prominent of these being photo-pumping. All of these aspects are addressed in these feature issues.

As a more general remark, it is satisfying and encouraging to observe the significant degree of cooperation in this field between laboratories from many different countries in both the East and the West.

I would like to thank all contributors for helping to make these feature issues a fine representation of the present state of the art in X-ray laser research. Special thanks go to Dr. A. M. Lahee of Springer-Verlag for truly professional work.

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To appear in *X-ray Lasers II* (Appl. Phys. B 50/4 1990):

D. Jamelot, A. Carillon, A. Klisnick, P. Jaeglé:
Recombination Scheme in Lithium-Like Ions for X-UV Amplification

Y. Kato, E. Miura, T. Tachi, H. Shiraga, H. Nishimura, H. Daido, M. Yamanaka, T. Jitsuno, M. Takagi, P. R. Herman, H. Takabe, S. Nakai, C. Yamanaka, M. H. Key, G. J. Tallents, S. J. Rose, P. T. Rumsby:
Observation of Gain at 54.2 Å on Balmer-Alpha Transition of Hydrogenic Sodium

C. J. Keane, B. J. MacGowan, D. L. Mathews, R. A. London, S. Maxon, M. D. Rosen, J. L. Bourgade, A. Decoster, S. Jacquemot, M. Louis-Jacquet, D. Nacchane:
Collisional Excitation X-Ray Laser Experiments in Plasmas Produced by 0.53 μm and 0.35 μm Laser Light

M. Steyer, F. P. Schäfer, S. Szatmári, G. Kühnle:
Feasibility of a Laboratory X-Ray Laser Pumped by Ultrashort UV Laser Pulses

C. H. Nam, W. Tighe, E. Valeo, S. Suckewer:
The Effect of Prepulse on X-Ray Laser Development Using a Powerful Subpicosecond KrF* Laser

T. Afshar-rad, O. Willi:
A Novel Technique for X-Ray Laser Beam Characterization

W. Brunner, R. W. John, T. Schlegel:
X-Ray Gain in Laser-Produced Carbon Plasmas Using Double-Layer Targets

A. V. Borovskii, E. V. Chizhonkov, A. L. Galkin, V. V. Korobkin:
The Theory of Recombination X-Ray Lasers

S. Kaushik, P. L. Hagelstein:
The Application of Conjugate Gradient Methods to NLTE Rate Matrix Equations

G. J. Pert, S. J. Rose:
Detailed Simulation of Recombination XUV Laser Experiments