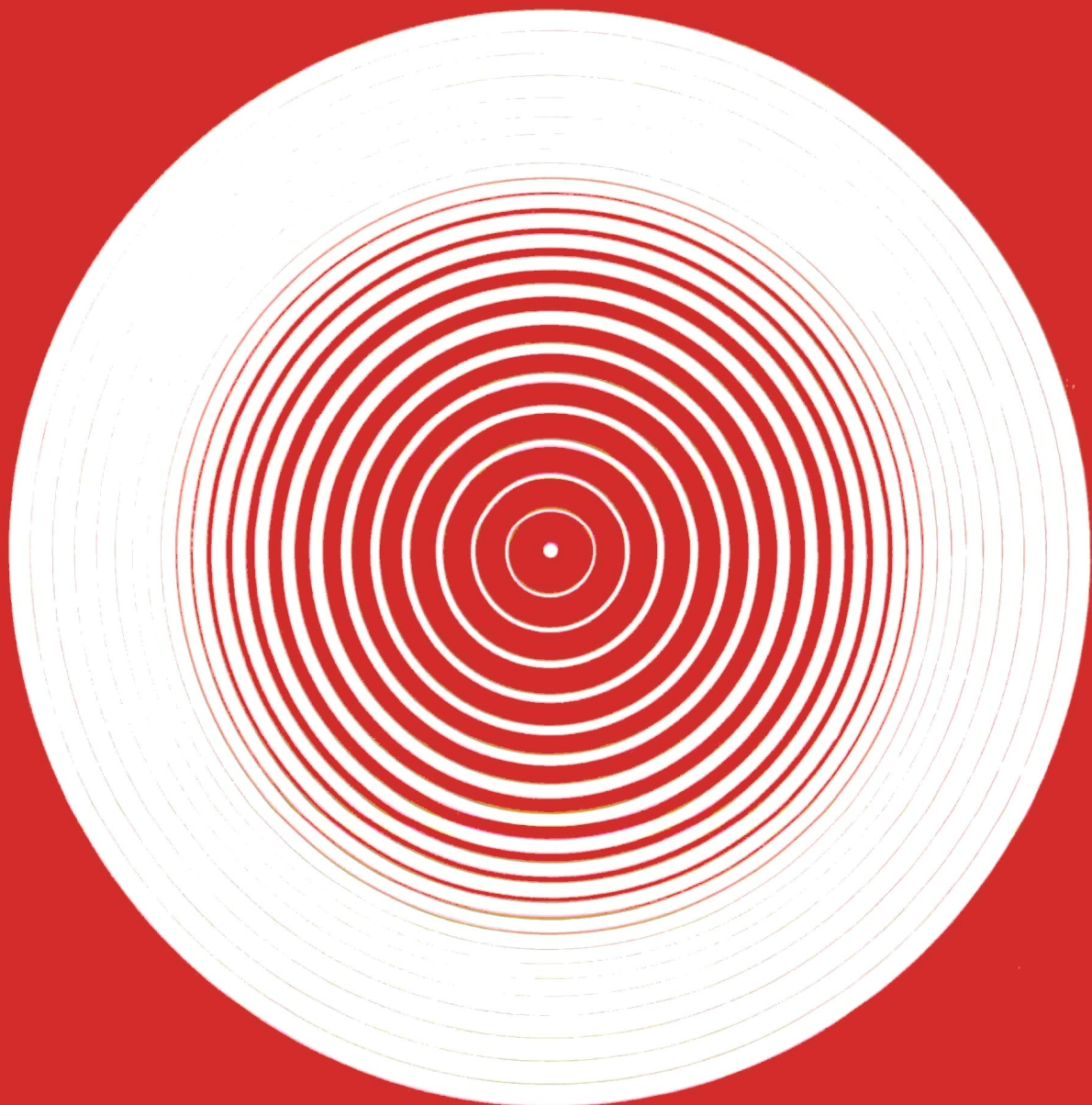


LASER AND PARTICLE BEAMS

VOLUME 8 NUMBER 4
1990

PAPERS FROM THE 5th INTERNATIONAL WORKSHOP
ON ATOMIC PHYSICS FOR ION DRIVEN FUSION



Cambridge University Press

Laser and Particle Beams

Pulse Power and High Energy Densities

Editor in Chief: HEINRICH HORA
Head, Department of Theoretical Physics
University of New South Wales
Kensington 2033, Australia

Managing (and USA) Editor:
G. H. MILEY (for USA)
Director, Fusion Studies Laboratory,
University of Illinois,
103 S. Goodwin Ave, Urbana, Il. 61801,
USA

Associate Editors:
R. DAUTRAY (for Europe)
Scientific Director, CEA Limeil, B.P. 27
94190 Villeneuve St. Georges, France
A. H. GUENTHER (for Pulse Power)
Chief Scientist (Adv. Def. Tech.),
Los Alamos Nat. Laboratory,
Los Alamos, NM 87545,
USA
C. YAMANAKA (for Japan)
Director, Institute of Laser Engineering,
Osaka University, Suita,
565 Osaka, Japan

Editorial Board
N. G. Basov (Moscow)
P. van Devender (Albuquerque)
S. Eliezer (Soreq, Israel)
J. L. Emmett (Livermore)
A. J. Glass (San Francisco)
R. J. Jensen (Los Alamos)
G. Kessler (Karlsruhe)
M. H. Key (Rutherford Appleton Lab.)
M. Kristiansen (Pulse Power Lab,
Texas Tech)
R. L. McCrory (Rochester)
G. A. Mesyats (USSR)
P. Mulser (Darmstadt)
S. Nakai (Osaka)
K. Niu (Nagatsuta)
A. A. Offenberger (Alberta)
A. M. Prokhorov (Moscow)
B. Ripin (Washington)
D. D. Ryutov (Novosibirsk)
E. Storm (Livermore)
J. P. Watteau (CEA Limeil)

Laser and Particle Beams is an international journal which covers the generation, and the interaction with matter, of high intensity laser and particle beams. It also covers the physics of systems with high energy densities. Specific fields of interest include nuclear fusion, especially inertial confinement, magnetic confinement, diagnostics, material treatment, laboratory astrophysics, plasmas and spectroscopy at extreme conditions, physical properties of hot dense matter and intense particle beams and optical (laser) beams from the microwave to the X-ray region. The exploration of these fields and their new physics, including nonlinear and nonclassical phenomena, should find a forum in this journal.

As well as publishing original articles the journal also publishes occasional review articles, surveys of research at particular laboratories and reviews of recent books.

©Cambridge University Press 1990

Copying: This journal is registered with the Copyright Clearance Center, 27 Congress St., Salem, Mass. 01970. Organizations in the USA who are also registered with C.C.C. may therefore copy material (beyond the limits permitted by sections 107 and 108 of US copyright law) subject to payment to C.C.C. of the per copy fee of \$05.00. This consent does not extend to multiple copying for promotional or commercial purposes. Code 5/0263-0346/90/\$5.00 + 00.

ISI Tear Sheet Service, 3501 Market Street, Philadelphia, Pennsylvania 19104, USA, is authorized to supply single copies of separate articles for private use only.

For all other use, permission must be sought from Cambridge University Press.

Subscriptions: *Laser and Particle Beams* (ISSN 0263-0346) is published quarterly. The subscription price (which includes postage) of Volume 8, 1990 is US \$205 for the US and Canada (£99 in UK: £112 elsewhere). Single parts cost US \$55 for the US and Canada (£31 elsewhere) plus postage. Four parts form a volume. Orders, which must be accompanied by payment, may be sent to a bookseller, subscription agent, or direct to the publishers: Cambridge University Press, Journals Department, 40 West 20th Street, New York, NY 10011, USA; orders outside the US or Canada may be sent to Cambridge University Press, The Edinburgh Building, Shaftesbury Road, Cambridge CB2 2RU, England. Claims for missing issues should be made immediately after receipt of the next issue. POSTMASTER: Send address changes in the US and Canada to *Laser and Particle Beams*, Cambridge University Press, 110 Midland Avenue, Port Chester, NY 10573.

LASER AND PARTICLE BEAMS
Pulse Power and High Energy Densities

Papers from the 5th International Workshop on
Atomic Physics for Ion Driven Fusion
January 29–February 2, 1990, Schliersee, Germany

J. Meyer-ter-Vehn
Guest Editor

LASER AND PARTICLE BEAMS

Pulse Power and High Energy Densities

Papers from the 5th International Workshop on
Atomic Physics for Ion Driven Fusion,
Jan. 29–Feb. 2, 1990, Schliersee, Germany

Volume 8, Number 4, 1990

- J. Meyer-ter-Vehn:** Preface 523
- I. Hofmann (GSI Darmstadt, Germany):** Principles of non-Liouvillean pulse compression by photoionization for heavy-ion fusion drivers 527
- C. Deutsch (L.P.G.P., Orsay, France):** Interaction of ion cluster beams with cold matter and dense plasmas 541
- J. Bailey, A. L. Carlson, G. Chandler, M. S. Derzon, R. J. Dukart, B. A. Hammel, D. J. Johnson, T. R. Lockner, J. Maenchen, E. J. McGuire, T. A. Mehlhorn, W. E. Nelson, L. E. Ruggles, W. A. Stygar, and D. F. Wenger (SNL, Albuquerque, NM, USA):** Observation of $K\alpha$ X-ray satellites from a target heated by an intense ion beam 555
- R. Bock (GSI Darmstadt, Germany):** German heavy-ion ICF activities: Status and prospects 563
- D. Gardes, R. Bimbot, M. F. Rivet, A. Servajean (Inst. Phys. Nucl., Orsay, France), A. Fleurier, D. Hong (GREMI, Orleans, France), C. Deutsch, and G. Maynard (L.P.G.P., Orsay, France):** New results obtained with sulphur and bromine ions interacting with a Z-pinch hydrogen discharge 575
- K.-G. Dietrich, K. Mahrt-Olt, J. Jacoby, E. Boggasch, M. Winkler, B. Heimrich, and D. H. H. Hoffmann (GSI Darmstadt, Germany):** Beam-plasma interaction experiments with heavy-ion beams 583
- H. Kunze, R. Noll, G. Herziger (Fraunhofer-Inst. Lasertechnik, Aachen, Germany), C. R. Haas, M. Elfers, and J. Hertzberg (Lehrstuhl Lasertechnik, Aachen, Germany):** Pulsed-power-generated plasma of high reproducibility 595
- Y. Setsuhara, H. Azechi, N. Miyanaga, H. Furukawa, R. Ishizaki, K. Nishihara, M. Katayama, A. Nishiguchi, K. Mima, and S. Nakai (Inst. Laser Engin., Osaka, Japan):** Secondary nuclear fusion reactions as evidence of electron degeneracy in highly compressed fusion fuel 609
- Khiet Tu (L.P.G.P., Orsay, France):** Nonlinear Z correction to the stopping power in a hot electron gas 621
- E. Nardi and Z. Zinamon (Weizmann Inst., Rehovot, Israel):** Atomic processes in ionic projectiles in plasma: End-of-the-range effects 635
- Th. Peter (MPI, Garching, Germany):** Scaling laws for the effective charge of heavy ions penetrating gas or plasma targets 643
- A. Ulrich, B. Busch, H. Eylers, W. Krötz, R. Miller, R. Pfaffenberger, G. Ribitzki, J. Wieser (Tech. Univ., München, Germany), and D. E. Murnick (Rutgers Univ., Newark, NJ, USA):** Lasers pumped by heavy-ion beams 659
- B. Kärcher and J. Meyer-ter-Vehn (MPI, Garching, Germany):** Ion-beam-driven plasma described by rate equations 679
- H. Mino, M. Cukier, and J. Haidar (L.P.G.P., Orsay, France):** Time-dependent collisional radiative model of ionizing and recombining plasmas 697
- E. Minguez (DENIM, Madrid, Spain):** Analytical approximation for oscillator strengths of H-like ions 709

A. Rickert and J. Meyer-ter-Vehn (MPI, Garching, Germany): Frequency-dependent opacity calculations for high-Z plasma including l splitting 715

J. J. MacFarlane, P. Wang, and G. A. Moses (Fusion Tech. Inst., Madison, WI, USA): Non-LTE radiation transport in moderate-density plasmas 729

G. C. Pomraning (Karlsruhe, Germany): Radiative transfer in Rayleigh–Taylor unstable ICF pellets 741

**T. Kahlbaum (Zentralinst. Elektronenphysik, Berlin, Germany) and A. Förster (Humboldt-
Univ., Berlin, Germany):** Thermodynamic properties of nonideal plasmas with multiple ionization and Coulomb and hard-core interactions 753

U. Reimann and C. Toepffer (Univ. Erlangen, Germany): Collision times in plasmas 763

U. Reimann and C. Toepffer (Univ. Erlangen, Germany): Temperature relaxation in a strongly coupled plasma 771

D. Léger and C. Deutsch (L.B.G.P., Orsay, France): Linear and electronic transport in strongly coupled binary ionic mixtures 781

V. Schneider, K. J. Lutz, and J. A. Maruhn (Univ. Frankfurt, Germany): Hydrodynamic flow simulations with relevance to heavy ion induced fusion 793

N. K. Gupta, C. D. Munz, and B. Goel (Karlsruhe, Germany): An efficient shock capturing scheme for ion beam target simulation 807

Regular Papers

**G. A. Kirillov, V. M. Murugov, V. T. Punin, and V. I. Shemyakin (All-Union Res. Inst., Gorky
Region, USSR):** High power laser system ISKRA V 827

V. Schneider and J. Maruhn (Univ. Frankfurt, Germany): Heating matter by intense heavy ion beams at SIS energies 833

Book Reviews 851

Index 855