

SFIN year IX Series A: Conferences

No. A1 (1996)

Nasi UN

THE PHYSICS OF IONIZED GASES

Edited by

Z.Lj. Petrović B. Marinković

SPIG '94

SFIN, IX (A1) 1-215, Belgrade 1996

**INSTITUTE OF PHYSICS - BELGRADE** 



# свеске физичких наука

Series A: Conferences

Igor Ivanović

UDK 53 SFIN, year IX, No.A1 (1996) YU ISSN 0354-9291

Publisher Institute of Physics, Belgrade

Director Dragan Popović

Zoran Lj. Petrović

**Guest** Editors

Associate Editors Mirjana Popović-Božić

Editorial Board

Ivan Aničin Milan Vujičić Ljliljana Dobrosavljević-Grujić Nikola Konjević Milan Kurepa Dragutin Lalović

Advisory Board

Radovan Antanasijević Tasko Grozdanov Radoslav Žakula Igor Ivanović Djordje Jović Jovan Konstantinović Jaroslav Labat Zvonko Marić, president

> Editorial Office S F I N Institute of Physics P.O.Box 57 Pregrevica 118, Zemun 11001 Belgrade, Yugoslavia

Ministry of Science and Technology of Republic of Serbia supports the publication of this journal

Copyright @ 1996 by Institute of Physics, Belgrade, Yugoslavia

All rights reserved. This book, or parts thereof, may not be reproduced in any form or by any means, electronic or mechanical, including photocopying, recording or any information storage and retrieval system now known or to be invented, without written permission from the Publisher.

The price for this issue is din. 250.00 (foreign \$50.00). Students are qualified for reduced rates. Please place your orders and inquiries to "BF Club", P.O.Box 86, 11080 Zemun, Yugoslavia, fax # (381) 11 186-105.

Printed by: Tehnološko Metalurški Fakultet Beograd, University of Belgrade, Zavod za grafičku tehniku, Karnegijeva 4, 11001 Belgrade, Yugoslavia Number of copies: 280

Editor-in-Chief Relja Popić

Bratislav Marinković

Jovan Konstantinović

Božidar Milić Slavoljub Pešić Slobodan Stamenković Miodrag Stojić Djordje Šijački

Sava Milošević Relja Popić Dragan Popović Marko Popović Mirjana Popović-Božić Fedor Herbut Slobodan Cvejanović Miloš Škorić

# **SCIENTIFIC COMMITTEE OF SPIG'94**

Z.Lj.Petrović	Chairman, Institute of Physics, Belgrade, Yugoslavia
V.Čadež	Institute of Physics, Belgrade, Yugoslavia
M.Dimitrijević	Astronomical Observatory, Belgrade, Yugoslavia
T.Grozdanov	Institute of Physics, Belgrade, Yugoslavia
N.Konjević	Physical Faculty, University of Belgrade, Yugoslavia
T.Makabe	Department of Electrical Eng., Faculty of Science &
	Technology, Keio University, Yokohama, Japan
<b>B.Marinković</b>	Institute of Physics, Belgrade, Yugoslavia
M.Milosavljević	Institute of Nuclear Sciences "Vinča", Yugoslavia
A.Mihajlov	Institute of Physics, Belgrade, Yugoslavia
J.Purić	Physical Faculty, University of Belgrade, Yugoslavia
M.Škorić	Institute of Nuclear Sciences "Vinča", Yugoslavia
I.Vince	Astronomical Observatory, Belgrade, Yugoslavia
B.Vujičić	Institute of Physics, University of Novi Sad, Yugoslavia
R.Webb	Dept. Electronic and Electrical Eng., University of
	Surrey, Guildford, Surrey, United Kingdom

## **ORGANIZING COMMITTEE OF SPIG'94**

<b>B.Marinković</b>	Chairman, Institute of Physics, Belgrade, Yugoslavia
S.Ćirković	General secretary, Institute of Physics, Belgrade, Yugoslavia
N.Bibić	Institute of Nuclear Sciences "Vinča", Yugoslavia
G.Josifov	Institute of Physics, Belgrade, Yugoslavia
S.Jovićević	Institute of Physics, Belgrade, Yugoslavia
D.Lukić	Institute of Physics, Belgrade, Yugoslavia
D.Markušev	Institute of Physics, Belgrade, Yugoslavia
M.Minić	Institute of Physics, Belgrade, Yugoslavia
B.Tomčik	Institute of Physics, Belgrade, Yugoslavia

#### ACKNOWLEDGEMENTS

#### The XVII SUMMER SCHOOL and INTERNATIONAL SYMPOSIUM on the PHYSICS of IONIZED GASES, SPIG'94 was organized from August 29<sup>th</sup> to September 1<sup>st</sup>, 1994 in Belgrade, Yugoslavia by

#### Institute of Physics, Belgrade, Yugoslavia

under auspices of The Physical Society of Serbia The Union of Mathematicians, Physicists and Astronomers of Yugoslavia The Ministry of Science and Technology of the Republic of Serbia The Federal Ministry for Development, Science and Environment of Yugoslavia

> and sponsored by JAT, Yugoslav Airlines, Belgrade, Yugoslavia MTT-INFIZ, Belgrade, Yugoslavia

#### PREFACE

This volume contains 15 invited lectures and progress reports that were presented at the XVII Summer School and International Symposium on the Physics of Ionized Gases - SPIG'94, held at Sava Conference Center from August the 29<sup>th</sup> to September the 1<sup>st</sup> 1994 in Belgrade, Yugoslavia. The meeting was attended by 145 participants from eight countries.

This is the first book from the series "The Physics of Ionized Gases" which is published as a special issue of the journal "Sveske FIzičkih Nauka" - SFIN (Lectures in Physical Sciences), a publication of the Institute of Physics aimed at presenting broader reviews, monographs and proceedings from conferences. We would like to thank the Editorial Board of the "SFIN" for their understanding and we hope that this form of publication will continue in future.

We would like to take this opportunity to thank all the members of the International Scientific Committee and of the Organizing Committee of the XVII SPIG for all their efforts. The editors are indebted to the invited speakers for presenting the manuscripts in the final form for publication. Special gratitude is due to the Ministry of Science and Technology of the Republic of Serbia and to the Federal Ministry for Development, Science and Environment. We would also like to thank our sponsors, Yugoslav Airlines JAT and MTT-INFIZ for providing funds for this publication and organization of the Conference.

The Editors

## CONTENTS

# ATOMIC COLLISION PROCESSES

CENTROL PLASTICS
<i>M.Perić</i> Ab initio Study of the Vibronic and Spin-Orbit Couplings in the $X^2\Pi_u$ State of $C_2H_2^+ \dots 1$
PARTICLE AND LASER BEAM INTERACTION WITH SOLIDS
I.N.Mihăilescu, <u>A.Barborică</u> , N.Chițcă, A.Liță, V.S.Teodorescu and G.Marin Laser Plasma Reactive Ablation: Physical Phenomena and Applications to Synthesis and Deposition of Performant Thin Films
<u>D.S.Karpuzov</u> and R.G.Vichev Time-Dependent Simulation of Sputtering and Cascade Development in Amorphous Copper Targets
<u>J.Vukanić</u> and R.Simović Multiple Scattering Theory of Slow Ion Reflection from Solids
LOW TEMPERATURE PLASMA
E.Gogolides Radio-Frequency (RF) Plasmas Used for the Fabrication of Submicron Structures: Experiments and Modelling
F.Tochikubo Diagnostics of RF Discharge Plasma by the Time-Resolved Optical Emission Spectroscopy
V.Zoita The X-Ray Emission of the Dense Plasma Focus
V.Lj.Marković Afterglow Kinetics in Nitrogen by the Breakdown Time Delay Method 109
<i>N.V.Novaković</i> Evaluation of Basic Parameters of High-Pressure and Low-Temperature Thermal Noble-Gas Plasmas with Alkaline Additives

D.Djordjević
Continuous Absorption Coefficients of Inert Gas Plasmas
GENERAL PLASMAS
<b>R.S.Pease</b> The Development of Fusion Plasma Physics
<b>R.S.Pease</b> Fusion Energy in the 21 <sup>st</sup> Century
<i>T.A.Davydova, D.Jovanović, J.Vranješ and J.Weiland</i> Annulment of Drift Wave Shear Damping in Tokamaks
<u>V.Čadež</u> and J.L.Ballester Waves in Solar Coronal Plasma with Magnetic Arcades
D.Ž.Gajić On the Kinetic Theory of Ion-Cyclotron and Ion-Ion Hybrid Instabilities in Two-Ion Plasmas
AUTHOR INDEX
e", Newscarbos Diagonarias, of 1937 Discharger Chemist Instatio Theory University (Optical, Edit count Spectra page
n an

х

CIP - Каталогизација у публикацији Народна библиотека Србије, Београд

537.56(063)(082)

SUMMER School and International Symposium on the Physics of Ionised Gases (17th : 1994 ; Belgrade)

[Physics of Ionized Gases]

The Physics of Ionized Gases / SPIG '94 [XVII Summer School and International Symposium on the Physics of Ionised Gases, from August 29th to September 1st, 1994 in Belgrade, Yugoslavia] : editors Z.[Zoran] Lj. Petrović, B. [Bratislav] Marinković. - (Belgrade : Tehnološko-metalurški fakultet, Zavod za grafičku tehniku). - X, 215 str. : graf. prikazi ; 24 cm. (Свеске физичких наука, ISSN 0354-9291. Ser. A, Conferences ; no A1)

Тігаž 280. - Bibliografija uz svaki rad. - Registar. ISBN 86-82441-02-0 1. Petrović, Zoran Lj. 539.186.2(063)(082) 33.9(063)(082) а) Гасови, јонизовани - Зборници б) Атоми -Елементарне честице - Интеракција - Зборници ц) Плазма - Зборници ID=48322316