

NATIONAL RESEARCH CENTRE «KURCHATOV INSTITUTE»



Kurchatov Institute
for the Country
and the World

PROBLEMS OF ATOMIC SCIENCE AND TECHNOLOGY

Collected scientific and technical papers

Series

THERMONUCLEAR FUSION

PUBLISHED since 1978

Volume 46

Issue 3

[Voprosy Atomnoi Nauki i Tekhniki. Seriya: Termoyadernyi Sintez]

MOSCOW — 2023

Editor-in-Chief

E.P. Velikhov, Member of the Russian Academy of Sciences (RAS), Honorary President of the NRC «Kurchatov Institute»

Editorial Board:

A.B. Kukushkin, Deputy Editor-in-Chief, Leading Research Scientist, Dr. of Science Degree in Physics and Mathematics, NRC «Kurchatov Institute», Moscow

E.A. Filimonova, Editorial Management, Research Scientist, NRC «Kurchatov Institute», Moscow

A.B. Alexeev, Department Head in the ITER International Organization, Dr. of Science Degree in Engineering, Saint Paul-lèz Durance, France

A.V. Burdakov, Laboratory Head, Dr. of Science Degree in Physics and Mathematics, G.I. Budker Institute of Nuclear Physics. Siberian Branch of RAS, Novosibirsk

V.A. Bykov, Group Leader, PhD in Engineering, Max Planck Institute for Plasma Physics, Greifswald, Germany

Yu.M. Gasparyan, Acting Department Head, PhD in Physics and Mathematics, Associate Professor, National Research Nuclear University «Moscow Engineering Physics Institute», Moscow

L.E. Zakharov, Leading Research Scientist, PhD in Physics and Mathematics, LiWFusion, NJ, Princeton, USA

N.A. Kirneva, Laboratory Head, PhD in Physics and Mathematics, NRC «Kurchatov Institute», Moscow

A.E. Kiselev, Department Head, Dr. of Science Degree in Engineering, Nuclear Safety Institute of RAS, Moscow

D.V. Kovalenko, Chief Specialist of the R&D Management Division, Senior Research Scientist, State Corporation «Rosatom», Moscow

A.V. Kozlov, Advisor to the Director, Dr. of Science Degree in Engineering, joint-stock company «Institute of Reactor Materials» Zarechnyj, Sverdlovsk region

E.R. Koresheva, Principal Research Scientist, Acting Laboratory Head, Dr. of Science Degree in Physics and Mathematics, P.N. Lebedev Physical Institute of RAS, Moscow

S.I. Krashenninikov, Professor, Dr. of Science Degree in Physics and Mathematics, University of California at San Diego, San Diego, CA, USA

A.Yu. Leshukov, Deputy Head of Division, N.A. Dollezhal Research and Development Institute of Power Engineering, Moscow

I.V. Mazul, Principal Research Scientist, Dr. of Science Degree in Engineering, «D.V. Efremov Institute of Electrophysical Apparatus», St. Petersburg

V.B. Minaev, Leading Research Scientist, PhD in Physics and Mathematics, A.F. Ioffe Institute of Physics and Technology, St. Petersburg

A.B. Mineev, Leading Research Scientist, PhD in Physics and Mathematics, D.V. Efremov Scientific Research Institute of Electrophysical Apparatus, St. Petersburg

S.V. Mirnov, Scientific Head of Department, Dr. of Science Degree in Physics and Mathematics, Professor, Troitsk Institute for Innovation & Fusion Research (TRINITI) Troitsk, Moscow

A.N. Romannikov, Scientific Supervisor for CTF and plasma technologies, Dr. of Science Degree in Physics and Mathematics, Troitsk Institute for Innovation & Fusion Research (TRINITI) Troitsk, Moscow

P.V. Romanov, Advisor to the Division Head, PhD in Engineering, State Corporation «Rosatom», Moscow

V.Yu. Sergeev, Dr. of Science Degree in Physics and Mathematics, Professor, Peter the Great Saint-Petersburg Polytechnic University, St. Petersburg

A.V. Spitsyn, Laboratory Head, Senior Research Scientist, PhD in Physics and Mathematics, NRC «Kurchatov Institute», Moscow

I.L. Tazhibaeva, Deputy Director, Dr. of Science Degree in Physics and Mathematics, Professor, Institute of Atomic Energy, National Nuclear Centre, Kurchatov City, Kazakhstan

P.P. Khvostenko, Dr. of Science Degree in Engineering, Scientific Director of the Complex, NRC «Kurchatov Institute», Moscow, Russia.

V.I. Khripunov, Leading Research Scientist, PhD in Engineering, NRC «Kurchatov Institute», Moscow

V.M. Chernov, Principal Research Scientist, Dr. of Science Degree in Physics and Mathematics, Professor, A.A. Bochvar High-Technology Research Institute for Inorganic Materials, Moscow

Editor Karpova Tatyana Yurievna

karpova.tat@fc.iterru.ru, tel.: 7-499-196-98-31

Co-founders: Autonomous non-profit organization Coordinating center «Controlled Thermonuclear Fusion — International Projects» (CTF-Center); Federal state budgetary National Research Centre «Kurchatov Institute»

The journal (established in 1978) is filed in the registry of the Federal Service for Supervision of Communications, Information Technology and Mass Media PI № FS77-73164 of 02 June 2018; electronic periodical is filed in the registry El. № FS77-73162 of 22 June 2018

Subscription index in the catalogue of periodicals of the «Ural-Press» agency № 70541

The journal is included into the list of the Supreme Certification Commission key journals. Its indexes are available in the databases Scopus, the Ulrich's Periodicals Directory and the Russian Science Citation Index (RSCI) on the Web of Science platform. The papers published in it have digital object identification (DOI). The abstracts of the papers published in it are available in the abstract journal of the VINITI RAS. All the free access full-text electronic versions of the papers are available on the site <http://iterru.ru> and on the platform of the Russian Scientific Electronic Library <http://www.elibrary.ru>

The two-year impact factor of the journal in RSCI: 0,620