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978-0-521-11354-0 - Nuclear Fusion  
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Nuclear fusion

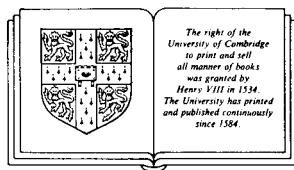
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KEISHIRO NIU

TOKYO INSTITUTE OF TECHNOLOGY



CAMBRIDGE UNIVERSITY PRESS

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NEW YORK NEW ROCHELLE

MELBOURNE SYDNEY

Cambridge University Press  
978-0-521-11354-0 - Nuclear Fusion  
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[More information](#)

CAMBRIDGE UNIVERSITY PRESS  
Cambridge, New York, Melbourne, Madrid, Cape Town, Singapore, São Paulo, Delhi

Cambridge University Press  
The Edinburgh Building, Cambridge CB2 8RU, UK

Published in the United States of America by Cambridge University Press, New York

[www.cambridge.org](http://www.cambridge.org)  
Information on this title: [www.cambridge.org/9780521113540](http://www.cambridge.org/9780521113540)

Originally published in Japanese as *Kakuyūgo* by  
Kyoritsu Shuppan Co., Ltd, Tokyo, Japan  
and © 1979 K. Niu and M. Sugiura

First published in English by Cambridge University Press 1989 as  
*Nuclear Fusion*

English edition © Cambridge University Press 1989

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This digitally printed version (with corrections) 2009

*A catalogue record for this publication is available from the British Library*

*Library of Congress Cataloguing in Publication data*

Niu, Keishirō, 1929–  
Nuclear fusion.

Translation of: *Kakuyūgō*.  
Includes index.

1. Nuclear fusion. I. Title.  
QC791.73.N5813 1988 539.7'64 88-16130

ISBN 978-0-521-32994-1 hardback  
ISBN 978-0-521-11354-0 paperback

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## Foreword to the Japanese edition

The oil crisis of 1973 generated great disturbances in the economies of advanced countries. As the economic inactivity after that crisis began to turn into prosperity, the Iranian revolution in 1978 caused a further increase in oil prices. So by the time there was an accident at an atomic reactor in the USA in the following year, the whole world had become aware of the problem of energy.

The accelerated growth in world population in the twentieth century and the recent rapid increase in energy consumption per person that has accompanied modern life styles are the fundamental causes of the present energy problem in human affairs. This problem arises not only in the fields of science and technology; it penetrates deeply into modern ways of life, economics and international relations, as well as more metaphysical concerns such as human happiness. The old idea of easily-obtainable, low-priced energy resources must be given up and a new one found to replace it. New energy resources may indeed be developed, but this will involve complex technology and long-term research by teams of scientists and engineers. And it will cost a lot of money.

This series of books was planned when the Department of Energy Sciences of the Graduate School of the Tokyo Institute of Technology was founded in Nagatsuta in 1975. It is to the authors' great pleasure that *Nuclear Fusion* is now published. The technology of nuclear fusion is incomplete at present; nor can it be deemed likely to solve the energy problem in the near future. But ultimately it may do so, and it is up to scientists and engineers to pursue this great possibility. That is why many have dedicated themselves to work on nuclear fusion.

The book consists of four chapters. In the first chapter, K. Niu sets out the fundamentals of nuclear fusion, and in the second and third chapters the principles of magnetic-confinement fusion and



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inertial-confinement fusion. In the final chapter, K. Sugiura discusses fusion reactors. The authors invite interested readers to indicate by direct communication where the text is incorrect or incomplete.

In closing this foreword, the authors would like to express their gratitude to the editors of the Kyoritsu Shuppan Company, who contributed to the publication of this book.

*October 1979*

K. Niu  
K. Sugiura



## Foreword to the English edition

Energy is a source of negative entropy, in the sense that energy supplies the high-temperature thermal fluxes for human societies. As food is necessary for the growth of a human being, so is energy necessary for the development of human societies. The recent economic recession halted the increase in oil consumption, and currently the price of oil is relatively low. However, demand for oil will exceed supply, and the price of oil will rise again, when energy consumption per person in developing countries, which make up the majority of the world's population, approaches that of advanced countries. If enduring world peace at a high level of cultural development is to be realised, and by good will in accord with moral principles rather than otherwise, the world needs a source of energy whose price is both low and free from the fluctuations in supply and demand characteristic of oil.

Nuclear fusion may well provide such an energy source, and so offers us the prospect of an ultimate solution to the problem of energy. In this way, it lights a fire of hope for the future of human society. But while it holds out this great hope, nuclear fusion also presents profound scientific and technological difficulties that must be overcome before this hope can be realised. This book seeks to describe the present state and the ultimate goals of research into nuclear fusion, and to indicate some of the difficulties which lie in the path of the successful harnessing of this source of energy.

In the Japanese edition of this book, the fourth chapter, on the fusion reactor, was written by Dr Ken Sugiura, President of the Electro-Technical Laboratory in Tsukuba. Because of Dr Sugiura's heavy commitments, Dr Niu has translated that chapter, with some modifications, for publication in this English edition. Elsewhere, the principal change is in the third chapter, where there is a new section on particle-beam fusion (see K. Niu: *Frontiers in Physics Research 1*, Kyoritsu Shuppan Co, 1986, in Japanese).

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978-0-521-11354-0 - Nuclear Fusion  
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*Foreword to the English edition*

The author would like to express his gratitude to Professor Heinrich Hora of the University of New South Wales, and Dr Simon Mitton of Cambridge University Press for kindly arranging the publication of this English edition of *Nuclear Fusion*. He would also like to thank Dr Erich Stuhlträger for help during his stay at the Tokyo Institute of Technology in correcting the English proofs.

*January 1987*

K. Niu