MATHEMATICS + PHYSICS

Lectures on Recent Results

Volume 1

This page is intentionally left blank

MATHEMATICS + PHYSICS

Lectures on Recent Results

Volume 1

Editor: L. Streit

World Scientific
Singapore • Philadelphia

Published by

World Scientific Publishing Co. Pte. Ltd.

P. O. Box 128, Farrer Road, Singapore 9128

242, Cherry Street, Philadelphia PA 19106-1906, USA

Library of Congress Cataloging in Publication Data

Main entry under title:

Mathematics + physics.

Collection of lectures presented at the Center for Interdisciplinary Research, University of Bielefeld.

1. Mathematical physics – Addresses, essays, lectures.

2. Mathematics – Addresses, essays, lectures.

I. Streit, Ludwig, 1938- . II. Universität Bielefeld.

Zentrum für Interdisziplinäre Forschung. III. Title: Mathematics and physics.

QC20.5.M36 1985 530.1'5 85-9249

ISBN 9971-966-63-8

ISBN 9971-966-64-6 (pbk)

Copyright © 1985 by World Scientific Publishing Co Pte Ltd.

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.

Printed in Singapore by Kim Hup Lee Printing Co Pte Ltd.

PREFACE

In the past decade the Center for Interdisciplinary Research (ZiF) of Bielefeld University has established its name as an international scientific forum in many fields of academic research. It has done so by hosting hundreds of interdisciplinary workshops and symposia over the years and, most importantly, through Research Years which are devoted in each case to a prescribed interdisciplinary field and which bring together a large number of scientists for extended periods of residence and joint work in Bielefeld.

For mathematics and physics in particular Bielefeld has thus become an established meeting place for joint work and for the exchange of new results and ideas. It need hardly be emphasized how much of their intrinsic growth these two disciplines owe to the dialogue with each other. This has been so since the earliest times and indications are that the dialogue will continue to be necessary and potentially fruitful in the foreseeable future. ZiF has been contributing to this dialogue through a long series of symposia, the "Bielefeld Encounters in Mathematics and Physics" [1]. These meetings have "interpolated" between two Research Years in mathematics and physics, the first one in 1975-76, and "Project No. 2" in the academic year 1983-84.

Project No. 2 has seen about one hundred mathematicians and physicists of various specializations from 25 countries for extended periods of residence, as well as a comparable number of short-term visitors. ZiF Research Years serve the double purpose of furthering scientific production as well as interdisciplinary dialogue. The production aspect of Project No. 2 is documented by a bibliography of some 130 scientific articles written at ZiF under its auspices. Scientific dialogue was served by a large number of mathematics and physics seminars from resident and guest speakers and by a number of workshops and symposia within the framework of Project No. 2 [2]. Apart from these more technical presentations, a number of resident mathematicians and physicists have offered "Lecture Series" of a more expository nature, with the goal of acquainting a larger interdisciplinary audience with their particular field of research. The present book and its companion volume present a collection of these lectures.

Looking at the scope of methods and applications gathered in these two volumes it is instructive to think back for comparison to the first ZiF Research Year in 1975-76. Those years were the harvest time of the constructive quantum field theory program which had developed like an avalanche, but then stopped short of its great goal, the construction of a fundamental theory of matter. At present the interdisciplinary field of mathematics and physics brings in a harvest of a different

kind, yet of the same origin: while the first impetus of constructive field theory did not suffice to break a path all the way to a description of particle phenomena, it generated a vast amount of insight and renewed confidence in mathematical methods, from established ones such as analysis, operator and group theory to refined and well-founded numerical computations, with probabilistic methods in a central role. This second wave is one of a large breadth of physical applications and of mathematical research, as is exemplified by the contributions to these volumes. Advances on so many fronts encourage one to think that relativistic quantum field theory may yet, before reaching the age of one hundred, learn to describe the world.

Thanks are due to my friends and colleagues for their advice, and to the staff of ZiF. Everybody at ZiF had adopted Project No. 2 as their own with unlimited amounts of patience and enthusiasm, and all have worked for its success far beyond the call of duty. Preparation of the manuscript has profited from the skills and the help of Ms. A. Roggen and Dr. G. Rupp. It could not have been done so well and so quickly without the clerical and psychological expertise of Ms. L. Jegerlehner whose hard work and gentle insistence are acknowledged with warm gratitude.

- [1] "Quantum Dynamics: Models and Mathematics" (L. Streit, ed.), Springer, Vienna (1976)
- "Quantum Fields – Algebras, Processes" (L. Streit, ed.), Springer, Vienna (1980)
- "Dynamics and Processes" (Ph. Blanchard, L. Streit, eds.), Springer, L. N. M. 1031, Berlin (1983).
- "Trends and Developments in the Eighties" (S. Albeverio, Ph. Blanchard, eds.), to be published by World Scientific Publishing, Singapore
- [2] "Resonances – Models and Phenomena" (S. Albeverio, L. S. Ferreira, L. Streit, eds.), Springer L. N. P. 211, Berlin (1984)

CONTENTS

J. BELLISSARD, R. LIMA, D. TESTARD	
Almost Periodic Schrödinger Operators	1
M. FUKUSHIMA	
Energy Forms and Diffusion Processes	65
K. GAWĘDZKI	
Block Spin Renormalization	99
A. GROSSMANN, J. MORLET	
Decomposition of Functions into Wavelets of Constant Shape, and Related Transforms	135
T. HIDA	
Brownian Functionals and the Rotation Group	167
I. T. TODOROV	
Local Field Representations of the Conformal Group and their Applications	195