



## ESI Lectures in Mathematics and Physics

Editors

Christoph Dellago and Ilaria Perugia (University of Vienna, Austria)

Erwin Schrödinger International Institute for Mathematical Physics

Boltzmannngasse 9

A-1090 Wien

Austria

The Erwin Schrödinger International Institute for Mathematical Physics is a meeting place for leading experts in mathematical physics and mathematics, nurturing the development and exchange of ideas in the international community, particularly stimulating intellectual exchange between scientists from Eastern Europe and the rest of the world.

The purpose of the series ESI Lectures in Mathematics and Physics is to make selected texts arising from its research programme better known to a wider community and easily available to a worldwide audience. It publishes lecture notes on courses given by internationally renowned experts on highly active research topics. In order to make the series attractive to graduate students as well as researchers, special emphasis is given to concise and lively presentations with a level and focus appropriate to a student's background and at prices commensurate with a student's means.

Previously published in this series:

Arkady L. Onishchik, *Lectures on Real Semisimple Lie Algebras and Their Representations*

Werner Ballmann, *Lectures on Kähler Manifolds*

Christian Bär, Nicolas Ginoux, Frank Pfäffle, *Wave Equations on Lorentzian Manifolds and Quantization*

*Recent Developments in Pseudo-Riemannian Geometry*, Dmitri V. Alekseevsky and Helga Baum (Eds.)

*Boltzmann's Legacy*, Giovanni Gallavotti, Wolfgang L. Reiter and Jakob Yngvason (Eds.)

Hans Ringström, *The Cauchy Problem in General Relativity*

Emil J. Straube, *Lectures on the  $\mathcal{L}^2$ -Sobolev Theory of the  $\bar{\partial}$ -Neumann Problem*

*Noncommutative Geometry and Physics: Renormalisation, Motives, Index Theory*, Alan L. Carey (Eds.)

*Erwin Schrödinger – 50 Years After*, Wolfgang L. Reiter and Jakob Yngvason (Eds.)

Christian Gérard

# Microlocal Analysis of Quantum Fields on Curved Spacetimes



European Mathematical Society

Author:

Christian Gérard  
Département de Mathématiques Bâtiment 307  
Faculté des Sciences d'Orsay Université Paris-Sud  
91405 Orsay Cedex  
France

E-mail: christian.gerard@math.u-psud.fr

2000 Mathematics Subject Classification (primary; secondary): 81T13, 35L10, 35L40, 58J40; 81T28, 35L15, 35L45, 58J47, 53C50

Key words: Quantum Field Theory, curved spacetimes, Hadamard states, microlocal analysis, pseudo-differential calculus

ISBN 978-3-03719-094-4

The Swiss National Library lists this publication in The Swiss Book, the Swiss national bibliography, and the detailed bibliographic data are available on the Internet at <http://www.helvetica.ch>.

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, re-use of illustrations, recitation, broadcasting, reproduction on microfilms or in other ways, and storage in data banks. For any kind of use permission of the copyright owner must be obtained.

© 2019 European Mathematical Society

Contact address:  
European Mathematical Society Publishing House  
TU Berlin Mathematikgebäude  
Straße des 17. Juni 136  
10623 Berlin  
Germany

Email: [info@ems-ph.org](mailto:info@ems-ph.org)  
Homepage: [www.ems-ph.org](http://www.ems-ph.org)

Typeset using the authors' T<sub>E</sub>X files: le-tex publishing services GmbH, Leipzig, Germany  
Printing: Beltz Bad Langensalza GmbH, Bad Langensalza, Germany  
∞ Printed on acid free paper

9 8 7 6 5 4 3 2 1