# Communications in Mathematical Physics <br> Volume 1471992 

Chief Editor A. Jaffe, Cambridge, MA<br>Editorial Board M. Aizenman, Princeton, NJ<br>H. Araki, Kyoto<br>A. Connes, Bures-sur-Yvette<br>J.-P. Eckmann, Genève<br>M. E. Fisher, College Park, MD<br>J. Fröhlich, Zürich<br>K. Gawedzki, Bures-sur-Yvette<br>M. Herman, Palaiseau<br>J. L. Lebowitz, New Brunswick, NJ<br>N. Yu. Reshetikhin, Berkeley, CA<br>B. Simon, Pasadena, CA<br>Ya. G. Sinai, Moscow<br>T. Spencer, Princeton, NJ<br>S.-T. Yau, Taiwan<br>Advisory Board M. F. Atiyah, Oxford<br>F. Hirzebruch, Bonn<br>G. 't Hooft, Utrecht<br>R. Schrieffer, Santa Barbara, CA<br>I. Singer, Cambridge, MA<br>C. N. Yang, Stony Brook, NY

## Springer International

## Copyright

Submission of a manuscript implies: that the work described has not been published before (except in the form of an abstract or as part of a published lecture, review, or thesis); that it is not under consideration for publication elsewhere; that its publication has been approved by all coauthors, if any, as well as by the responsible authorities at the institute where the work has been carried out; that, if and when the manuscript is accepted for publication, the authors agree to automatic transfer of the copyright to the publisher; and that the manuscript will not be published elsewhere in any language without the consent of the copyright holders.
All articles published in this journal are protected by copyright, which covers the exclusive rights to reproduce and distribute the article (e. g., as offprints), as well as all translation rights. No material published in this journal may be reproduced photographically or stored on microfilm, in electronic data bases, video disks, etc., without first obtaining written permission from the publisher.
The use of general descriptive names, trade names, trademarks, etc., in this publication, even if not specifically identified, does not imply that these names are not protected by the relevant laws and regulations.
While the advice and information in this journal is believed to be true and accurate at the date of its going to press, neither the authors, the editors, nor the publisher can accept any legal responsibility for any errors or omissions that may be made. The publisher makes no warranty, express or implied, with respect to the material contained herein.

Special regulations for photocopies in the USA:
Photocopies may be made for personal or in-house use beyond the limitations stipulated under Section 107 or 108 of U.S. Copyright Law, provided a fee is paid. This fee is US $\$ 0.20$ per copy, plus a basic fee of US $\$ 2.00$ per article. All fees should be paid to the Copyright Clearance Center, Inc., 21 Congress Street, Salem, MA 01970, USA, stating the ISSN 0010-3616, the volume, and the first and last page numbers of each article copied. The copyright owner's consent does not include copying for general distribution, promotion, new works, or resale. In these cases, specific written permission must first be obtained from the publisher.

Springer-Verlag Berlin Heidelberg New York Tokyo Hong Kong Barcelona Budapest
Printers: Brühlsche Universitätsdruckerei, Giessen
Printed in Germany - © Springer-Verlag Berlin Heidelberg 1992
Springer-Verlag GmbH \& Co KG, 1000 Berlin 33, Federal Republic of Germany

## Contents

Adler, M., Moerbeke, P. van: A Matrix Integral Solution to two-dimensional $W_{p}$-Gravity 25
Ashbaugh, M. S., Benguria, R. D.: A Second Proof of the Payne-Pólya-Weinberger Conjecture 181

Bach, V.: Error Bound for the Hartree - Fock Energy of Atoms and Molecules 527
Bell, J. B., Marcus, D. L.: Vorticity Intensification and Transition to Turbulence in the Three-Dimensional Euler Equations 371
Benguria, R. D. $\rightarrow$ Ashbaugh, M. S. 181
Bloch, A. M., Brockett, R. W., Ratiu, T. S.: Competely Integrable Gradient Flows 57
Bratteli, O., Kishimoto, A.: Non Commutative Spheres. III. Irrational Rotations 605
Brockett, R. W. $\rightarrow$ Bloch, A. M. 57

Cazenave, T., Weissler, F. B.: Rapidly Decaying Solutions of the Nonlinear Schrödinger Equation 75
Chamseddine, A. H., Fröhlich, J.: TwoDimensional Lorentz - Weyl Anomaly and Gravitational Chern-Simons Theory 549
Chruściel, P. T., Singleton, D. B.: Non-Smoothness of Event Horizons of RobinsonTrautman Black Holes 137
Chryssomalakos, C., Drabant, B., Schlieker, M., Weich, W., Zumino, B.: Vector Fields on Complex Quantum Groups 635
Collet, P., Koukiou, F.: Large Deviations for Multiplicative Chaos 329

Drabant, B. $\rightarrow$ Chryssomalakos, C. 635
Drabant, B., Schlieker, M., Weich, W., Zumino, B.: Complex Quantum Groups and Their Quantum Enveloping Algebras 625

Feigin, B., Frenkel, E.: Semi-Infinite Weil Complex and the Virasoro Algebra (Erratum) 647

Fokas, A. S., Its, A. R., Kitaev, A. V.: The Isomonodromy Approach to Matrix Models in 2D Quantum Gravity 395
Forman, R.: Determinants, Finite-Difference Operators and Boundary Value Problems 485
Frenkel, E. $\rightarrow$ Feigin, B. 647
Frenkel, E., Kac, V., Wakimoto, M.: Characters and Fusion Rules for $W$-Algebras via Quantized Drinfeld-Sokolov Reduction 295
Freund, P. G. O., Zabrodin, A. V.: Macdonald Polynomials from Sklyanin Algebras: A Conceptual Basis for the $p$-Adics-Quantum Group Connection 277
Fröhlich, J. $\rightarrow$ Chamseddine, A. H. 549
Govindarajan, S., Nelson, P., Wong, E.: Semirigid Geometry 253

Hara, T., Slade, G.: Selv-Avoiding Walk in Five or More Dimensions. I. The Critical Behaviour 101

Its, A. R. $\rightarrow$ Fokas, A. S. 395
Jaskólski, Z.: The Polyakov Path Integral Over Bordered Surfaces. III. The BRST Extended Closed String Off-Shell Amplitudes 343
Jeffrey, L. C.: Chern-Simons-Witten Invariants of Lens Spaces and Torus Bundles, and the Semiclassical Approximation 563

Kac, V. $\rightarrow$ Frenkel, E. 295
Kennedy, T., Tasaki, H.: Hidden Symmetry Breaking and the Haldane Phase in $S=1$ Quantum Spin Chains 431
Kishimoto, A. $\rightarrow$ Bratteli, O. 605
Kitaev, A. V. $\rightarrow$ Fokas, A. S. 395
Klein, A., Perez, J. F.: Localization in the Ground State of a Disordered Array of Quantum Rotators 241
Kontsevich, M.: Intersection Theory on the Moduli Space of Curves and the Matrix Airy Function 1
Koukiou, F. $\rightarrow$ Collet, P. 329

Liu, V. X.: Instability for the Navier-Stokes Equations on the 2-dimensional Torus and a Lower Bound for the Hausdorff Dimension of Their Global Attractors 217

Marcus, D. L. $\rightarrow$ Bell, J. B. 371
Moerbeke, P. van $\rightarrow$ Adler, M. 25
Nelson, P. $\rightarrow$ Govindarajan, S. 253
Paycha, S.: The Faddeev-Popov Procedure and Application to Bosonic Strings: An Infinite Dimensional Point of View 163
Peckham, S., Waymire, E.: On a Symmetry of Turbulence 365
Perez, J. F. $\rightarrow$ Klein, A. 241

Ratiu, T. S. $\rightarrow$ Bloch, A. M. 57
Schlieker, M. $\rightarrow$ Chryssomalakos, C. 635
Schlieker, M. $\rightarrow$ Drabant, B. 625
Schonmann, R. H.: The Pattern of Escape from Metastability of a Stochastic Ising Model 231

Sengupta, A.: The Semiclassical Limit for Gauge Theory on $S^{2} 191$
Singleton, D. B. $\rightarrow$ Chruściel, P. T. 137
Slade, G. $\rightarrow$ Hara, T. 101
Stanciu, S.: The Energy Operator for Infinite Statistics 211

Tasaki, H. $\rightarrow$ Kennedy, T. 431
Wakimoto, M. $\rightarrow$ Frenkel, E. 295
Waymire, E. $\rightarrow$ Peckham, S. 365
Weich, W. $\rightarrow$ Chryssomalakos, C. 635
Weich, W. $\rightarrow$ Drabant, B. 625
Weissler, F. B. $\rightarrow$ Cazenave, T. 75
Wong, E. $\rightarrow$ Govindarajan, S. 253
Zabrodin, A. V. $\rightarrow$ Freund, P. G. O. 277
Zagier, D.: Realizability of a Model in Infinite Statistics 199
Zumino, B. $\rightarrow$ Chryssomalakos, C. 635
Zumino, B. $\rightarrow$ Drabant, B. 625

Indexed in Current Contents
Evaluated and abstracted for PHYS on STN

## Communications in

## Mathematical

 PhysicsVolume 147 Number 31992
T. Kennedy, H. Tasaki

Hidden Symmetry Breaking and the Haldane Phase in $S=1$ Quantum Spin Chains 431
R. Forman Determinants, Finite-Difference Operators and Boundary
Value Problems 485
V. Bach Error Bound for the Hartree - Fock Energy of Atoms and Molecules 527
A. H. Chamseddine,
J. Fröhlich
L. C. Jeffrey
O. Bratteli, A. Kishimoto
B. Drabant, M. Schlieker, W. Weich, B. Zumino
C. Chryssomalakos,
B. Drabant, M. Schlieker, W. Weich, B. Zumino
B. Feigin, E. Frenkel

Two-Dimensional Lorentz-Weyl Anomaly and Gravitational Chern-Simons Theory 549
Chern-Simons-Witten Invariants of Lens Spaces and Torus Bundles, and the Semiclassical Approximation 563
Non-Commutative Spheres. III. Irrational Rotations 605
Complex Quantum Groups and Their Quantum Enveloping Algebras 625
Vector Fields on Complex Quantum Groups 635

Semi-Infinite Weil Complex and the Virasoro Algebra
(Erratum) 647 (Erratum)647

Contents of Vol. 147
Indexed in Current Contents
Evaluated and abstracted for PHYS on STN

## Springer International

## Acta Informatica

## Archive for

Mathematical Logic
Communications in Mathematical Physics Economic Theory Inventiones mathematicae
Journal of
Mathematical Biology Mathematische Annalen Mathematische Zeitschrift Numerische Mathematik Probability Theory and Related Fieds

## Theoretica Chimica Acta

## Acta Informatica

## Archive for

Mathematical Logic

## Communications in

Mathematical Physics Economic Theory Inventiones mathematicue
Journul of
Mathematical Biology Mathematische Annalen Mathematische Zeitschrift

## $T_{E} X$ users do it with Springer macros

If you are used to preparing your manuscripts with plain- $T_{E} X$, you may be interested to hear that we have created a macro package for the layout of the journals listed here.

Articles may now be submitted as plain$\mathrm{T}_{\mathrm{E}} \mathrm{X}$ files using our macros. They will be phototypeset directly from your $T_{E} X$-file, thus cutting down proofreading and publishing times.

The macros plus AMS fonts are available on 3.5" DOS diskettes and are free of charge.

Please order your copy by writing to

e-mail: Springer @dhdspri6.bitnet
An e-mail to suser@@dhdsprib containing help will provide you with info on our mailserver.

Please do not forget to indicate the journal for which you are intending to submit your manuscript.

LATEX stylefiles are in preparation.

