Pacific Journal of Mathematics

VOLUME CXLVIII 1991

PACIFIC JOURNAL OF MATHEMATICS EDITORS

V. S. VARADARAJAN (Managing Editor) University of California Los Angeles, CA 90024-1555-05

HERBERT CLEMENS University of Utah Salt Lake City, UT 84112

THOMAS ENRIGHT University of California, San Diego La Jolla, CA 92093 R. FINN Stanford University Stanford, CA 94305

HERMANN FLASCHKA University of Arizona Tucson, AZ 85721

Vaughan F. R. Jones University of California Berkeley, CA 94720

Steven Kerckhoff Stanford University Stanford, CA 94305 C. C. Moore

University of California Berkeley, CA 94720

MARTIN SCHARLEMANN University of California Santa Barbara, CA 93106

HAROLD STARK

University of California, San Diego

La Jolla, CA 92093

ASSOCIATE EDITORS

R. ARENS

E. F. BECKENBACH (1906-1982)

B. H. NEUMANN

F. Wolf (1904-1989) K. Yoshida

982)

SUPPORTING INSTITUTIONS

UNIVERSITY OF ARIZONA
UNIVERSITY OF BRITISH COLUMBIA
CALIFORNIA INSTITUTE OF TECHNOLOGY
UNIVERSITY OF CALIFORNIA
MONTANA STATE UNIVERSITY
UNIVERSITY OF NEVADA, RENO
NEW MEXICO STATE UNIVERSITY
OREGON STATE UNIVERSITY

UNIVERSITY OF OREGON
UNIVERSITY OF SOUTHERN CALIFORNIA
STANFORD UNIVERSITY
UNIVERSITY OF HAWAII
UNIVERSITY OF TOKYO
UNIVERSITY OF UTAH
WASHINGTON STATE UNIVERSITY
UNIVERSITY OF WASHINGTON

CONTENTS

A - ALGEBRA AND NUMBER THEORY

 D. M. Arnold and C. I. Vinsonhaler, Duality and invariants for Butler groups CL. Chuang, An independence property of central polynomials R. W. Fitzgerald, Combinatorial techniques and abstract Witt rings III 	1 237 39
 KL. Kueh, Fourier coefficients of non-holomorphic modular forms and sums of Kloosterman sums C. I. Vinsonhaler, See D. M. Arnold and C. I. Vinsonhaler YQ. Wang, The p-parts of Brauer character degrees in p-solvable 	303
B – ANALYSIS	351
D - AIVALI 515	
Y. A. Abramovich, Operators preserving disjointness on rearrangement invariant spaces	201
A. Acker and K. Lancaster, Existence and geometry of a free boundary problem for the heat equation SC. Chen, Real analytic regularity of the Szegö projection on	207
circular domains	225
 P. L. Duren and M. M. Schiffer, Robin functions and energy functionals of multiply connected domains	251 59 81
 J. H. B. Kemperman, Sets of uniqueness and systems of inequalities having a unique solution	275
R. Lyons, <i>The local structure of some measure-algebra homomorphisms</i>	89
of p-adic GL_3 and GL_4 : The generic unramified case	107 319
H. Rouhani, <i>Quasi-rotation C*-algebras</i>	131
A. Ströh and J. Swart, A Riesz theory in von Neumann algebras. J. Swart, See A. Ströh and J Swart	169
H. Yoshida, Harmonic majorization of a subharmonic function on a cone or on a cylinder	369

D - GEOMETRY

Ph. Delanoë, Obstruction to prescribed positive Ricci curvature	11
M. J. Druetta, Nonpositively curved homogeneous spaces of dimen-	
sion five	17
I. Sols, M. Szurek, and J. A. Wiśniewski, Rank-2 Fano bundles	
over a smooth quadric Q_3	153
M. Strake and G. Walschap, Ricci curvature and volume growth	161
M. Szurek, See I. Sols, M. Szurek and J. A. Wiśniewski	
G. Walschap, See M. Strake and G. Walschap	
M. Wang, The classification of flat compact complete space-forms	
with metric of signature (2,2)	181
J. A. Wiśniewski, See I. Sols, M. Szurek and J. A. Wiśniewski	

Pacific Journal of Mathematics

D. M. Arnold and C. I. Vinsonhaler, Duality and invariants for Butler groups	1
Ph. Delanoë, Obstruction to prescribed positive Ricci curvature	11
M. J. Druetta, Nonpositively curved homogeneous spaces of dimension five	17
R. W. Fitzgerald, Combinatorial techniques and abstract Witt rings III	39
M. Girardi, Dentability, trees, and Dunford-Pettis operators on $L_1 \ldots \ldots$	59
K. Jarosz, Ultraproducts and small bound perturbations	81
R. Lyons, The local structure of some measure-algebra homomorphisms	89
F. Murnaghan, Asymptotic behaviour of supercuspidal characters of p-adic GL ₃	
and GL ₄ : The generic unramified case	107
H. Rouhani , Quasi-rotation C^* -algebras	131
I. Sols, M. Szurek, and J. A. Wiśniewski, Rank-2 Fano bundles over a smooth	
quadric Q_3	153
M. Strake and G. Walschap, Ricci curvature and volume growth	161
A. Ströh and J. Swart, A Riesz theory in von Neumann algebras	169
M. Wang, The classification of flat compact complete space-forms with metric of	
signature (2, 2)	181

Subject listing on back cover

Vol. 148, No. 1 March 1991

PACIFIC JOURNAL OF MATHEMATICS **EDITORS**

V. S. VARADARAJAN (Managing Editor) University of California Los Angeles, CA 90024-1555-05

HERBERT CLEMENS University of Utah Salt Lake City, UT 84112

THOMAS ENRIGHT University of California, San Diego La Jolla, CA 92093

R. FINN Stanford University Stanford, CA 94305

HERMANN FLASCHKA University of Arizona Tucson, AZ 85721

VAUGHAN F. R. JONES University of California Berkeley, CA 94720

STEVEN KERCKHOFF Stanford University Stanford, CA 94305

C. C. Moore

University of California Berkeley, CA 94720

MARTIN SCHARLEMANN University of California Santa Barbara, CA 93106

HAROLD STARK

University of California, San Diego

La Jolla, CA 92093

ASSOCIATE EDITORS

R. ARENS

E. F. BECKENBACH (1906-1982)

B. H. NEUMANN

F. Wolf

K. Yoshida

(1904 - 1989)

SUPPORTING INSTITUTIONS

UNIVERSITY OF ARIZONA UNIVERSITY OF BRITISH COLUMBIA CALIFORNIA INSTITUTE OF TECHNOLOGY UNIVERSITY OF CALIFORNIA MONTANA STATE UNIVERSITY UNIVERSITY OF NEVADA, RENO NEW MEXICO STATE UNIVERSITY

OREGON STATE UNIVERSITY

UNIVERSITY OF OREGON UNIVERSITY OF SOUTHERN CALIFORNIA

STANFORD UNIVERSITY UNIVERSITY OF HAWAII UNIVERSITY OF TOKYO UNIVERSITY OF UTAH

WASHINGTON STATE UNIVERSITY UNIVERSITY OF WASHINGTON

The Supporting Institutions listed above contribute to the cost of publication of this Journal, but they are not owners or publishers and have no responsibility for its content or policies.

Mathematical papers intended for publication in the Pacific Journal of Mathematics should be in typed form or offset-reproduced (not dittoed), double spaced with large margins. Please do not use built up fractions in the text of the manuscript. However, you may use them in the displayed equations. Underline Greek letters in red, German in green, and script in blue. The first paragraph must be capable of being used separately as a synopsis of the entire paper. In particular it should contain no bibliographic references. Please propose a heading for the odd numbered pages of less than 35 characters. Manuscripts, in triplicate, may be sent to any one of the editors. Please classify according to the 1991 Mathematics Subject Classification scheme which can be found in the December index volumes of Mathematical Reviews. Supply name and address of author to whom proofs should be sent. All other communications should be addressed to the managing editor, or Elaine Barth, University of California, Los Angeles, California 90024-1555-05.

There are page-charges associated with articles appearing in the Pacific Journal of Mathematics. These charges are expected to be paid by the author's University, Government Agency or Company. If the author or authors do not have access to such Institutional support these charges are waived. Single authors will receive 50 free reprints; joint authors will receive a total of 100 free reprints. Additional copies may be obtained at cost in multiples of 50.

The Pacific Journal of Mathematics (ISSN 0030-8730) is published monthly except for July and August. Regular subscription rate: \$190.00 a year (10 issues). Special rate: \$95.00 a year to individual members of supporting institutions.

Subscriptions, orders for numbers issued in the last three calendar years, and changes of address should be sent to Pacific Journal of Mathematics, P.O. Box 969, Carmel Valley, CA 93924, U.S.A. Old back numbers obtainable from Kraus Periodicals Co., Route 100, Millwood, NY 10546.

The Pacific Journal of Mathematics at P.O. Box 969, Carmel Valley, CA 93924 (ISSN 0030-8730) is published monthly except for July and August. Second-class postage paid at Carmel Valley, California 93924, and additional mailing offices. Postmaster: send address changes to Pacific Journal of Mathematics, P.O. Box 969, Carmel Valley, CA 93924.