

CONTEMPORARY MATHEMATICS

644

Analysis, Complex Geometry, and Mathematical Physics: In Honor of Duong H. Phong

May 7–11, 2013
Columbia University, New York, New York

Paul M. N. Feehan
Jian Song
Ben Weinkove
Richard A. Wentworth
Editors



American Mathematical Society

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American Mathematical Society
Providence, Rhode Island

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A Conference in Honor of Duong H. Phong
Columbia University, New York, May 7–11, 2013

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Preface

Analysis, Complex Geometry and Mathematical Physics: A Conference in Honor of Duong H. Phong was held at Columbia University, New York, May 7–11, 2013. The conference featured thirty speakers who spoke on a range of topics reflecting the breadth and depth of the research interests of Duong H. Phong on the occasion of his sixtieth birthday. These topics included the complex Monge-Ampère equation, pluripotential theory, geometric partial differential equations, theories of integral operators, integrable systems and perturbative superstring theory. A common thread, familiar from Phong’s own work, was the focus on the interplay between the deep tools of analysis and the rich structures of geometry and physics. The speakers, who ranged from rising young mathematicians to the most eminent of senior researchers, spoke about new developments in these fields and Phong’s fundamental contributions.

The conference attracted over 200 participants, included many who had travelled from afar together with a strong turnout from the greater New York mathematical community, and their participation and interest contributed in an essential way to the richness of this scientific event.

All speakers were invited to contribute to this conference proceedings volume. As editors, we were delighted by the strong response. We received nineteen excellent articles, encompassing a broad array of topics within analysis, complex geometry and mathematical physics. Together they live up to the extraordinarily high level of the conference talks, making this proceedings a fitting tribute to Duong H. Phong on the occasion of his birthday celebration. All manuscripts were carefully refereed and we take this opportunity to thank the anonymous reviewers for their expertise, timely reports, and effort in ensuring the high quality of this proceedings volume.

We thank our conference co-organizers Igor Krichever and Zhiqin Lu for their invaluable help, and together we acknowledge the generous financial support of the National Science Foundation¹ and the Mathematics Department of Columbia University. We also thank the Columbia University graduate students Tristan Collins, Thomas Nyberg, Daniel Rubin, and Yu Wang and staff member, Mary Young, for their assistance in the administration of the conference. We thank Val Red for creating and managing the website for the conference and are grateful to Peter Voit for related technical assistance. Sara Kerens was the official conference photographer and we appreciate her expertise and the wonderful collection of photographs she took during the event. We express our deepest gratitude to the Mathematics Department Administrator, Terrance Cope, who was single-handedly responsible for arranging many of the conference events, including a superb banquet on the

¹Grant number DMS-1266145

final night of the conference. Finally, we thank all the speakers for their wonderful contributions and the participants for making the conference such a success.

PAUL M. N. FEEHAN
Rutgers, The State University of New Jersey

JIAN SONG
Rutgers, The State University of New Jersey

BEN WEINKOVE
Northwestern University

RICHARD A. WENTWORTH
University of Maryland

December 2014

Scientific program

Tuesday morning

EDWARD WITTEN (Institute for Advanced Study)

On the work of Phong and D'Hoker on superstring perturbation theory

IGOR KRICHEVER (Columbia University)

The universal Whitham hierarchy and geometry of moduli spaces of curves with punctures

ERIC D'HOKER (University of California, Los Angeles)

Superstring perturbation theory at two loops

Tuesday afternoon

ANDREI OKOUNKOV (Columbia University)

Quantum groups and quantum cohomology

CLÉMENT HONGLER (Columbia University)

Planar Ising model: discrete and continuous structures

ZHIQIN LU (University of California, Irvine)

The essential spectrum of the Laplacian

Wednesday morning

ELIAS M. STEIN (Princeton University)

The development of some ideas of Phong in the theory of singular integral and pseudo-differential operators

ALLAN GREENLEAF (University of Rochester)

Is there a general theory of Fourier integral operators?

GUNTHER UHLMANN (University of Washington)

Travel time tomography and boundary rigidity

Wednesday afternoon

MICHAEL E. TAYLOR (University of North Carolina)

Toeplitz operators on uniformly rectifiable domains

TIEN-CUONG DINH (Université Pierre et Marie Curie)

Positive closed currents and dynamics of Henon maps in higher dimension

TRISTAN C. COLLINS (Columbia University)

The boundary of the Kähler cone

Thursday morning

CHARLES FEFFERMAN (Princeton University)

Fitting a smooth function to data

ZBIGNIEW BŁOCKI (Uniwersytet Jagielloński)

Hörmander's $\bar{\partial}$ -estimate, some generalizations and new applications

JACOB STURM (Rutgers University)

Some applications of the Bergman kernel expansion

Thursday afternoon

XU-JIA WANG (Australian National University)

Potential theory for nonlinear elliptic equations

VINCENT GUEDJ (Institut de Mathématiques de Toulouse)

Regularizing properties of the twisted Kähler-Ricci flow

YU WANG (Columbia University)

Small perturbation solutions of the complex Monge-Ampère equation

Friday morning

NEIL S. TRUDINGER (Australian National University)

Weak continuity of nonlinear operators

SŁAWOMIR KOŁODZIEJ (Uniwersytet Jagielloński)

The complex Hessian equations

LEI NI (University of California, San Diego)

Entropy and Gauss curvature flow

Friday afternoon

PENGFEI GUAN (McGill University)

New curvature estimates for Weingarten equations

AHMED ZERIAHI (Institut de Mathématiques de Toulouse)

Convergence of the normalized Kähler-Ricci flow on Fano varieties

ADAM JACOB (Harvard University)

Stable Higgs bundles and Hermitian-Einstein metrics on non-Kähler manifolds

Saturday morning

SHING-TUNG YAU (Harvard University)

On the pseudonorm project towards birational classification of algebraic varieties

VALENTINO TOSATTI (Northwestern University)

The Chern-Ricci flow

STEVE ZELDITCH (Northwestern University)

Complex geometry of Laplace eigenfunctions

Saturday afternoon

JOSEPH J. KOHN (Princeton University)

Weakly pseudoconvex CR manifolds

MEI-CHI SHAW (University of Notre Dame)

Non-closed range property for the Cauchy-Riemann operator in L^2 on a Stein domain

BERNARD SHIFFMAN (Johns Hopkins University)

Critical points of random sections of holomorphic line bundles

List of additional participants

Ali Aleyasin
Stony Brook University

Xinliang An
Princeton University

Iris Anshel
Columbia University

Guillaume Bal
Columbia University

Turgay Bayraktar
Johns Hopkins University

Shabnam Beheshti
Rutgers University

Christian Benes
City University of New York

Stephane Benoist
Columbia University

Alexander Braverman
Brown University

Xiaodong Cao
Cornell University

David Catlin
Purdue University

Florin Catrina
St. John's University

Sagun Chanillo
Rutgers University

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Michigan State University

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Polytechnic Institute of New York
University

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University of California, San Diego

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Johns Hopkins University

Po Lam Yung
Rutgers University

Mahmoud Zeinalian
Long Island University

Anton Zeitlin
Columbia University

Xiangwen Zhang
Columbia University

Yingying Zhang
Lehigh University

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Indiana University-Purdue University
Fort Wayne

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Stony Brook University

Wei Zhang
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Peng Zhou
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Fan Zhou
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Seyed Mohsen Zoalroshd
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Louis Nirenberg (photo credit: *Paul Feehan*)

Richard Wentworth, Steven Zelditch, and Jacob Sturm (photo credit: *Paul Feehan*)

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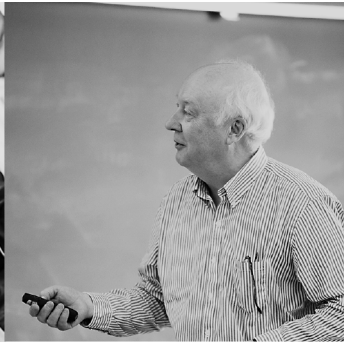
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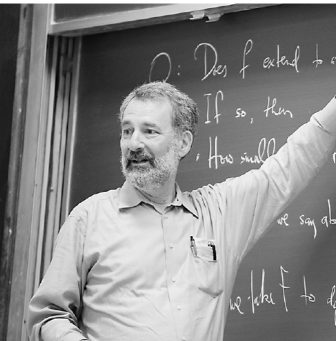
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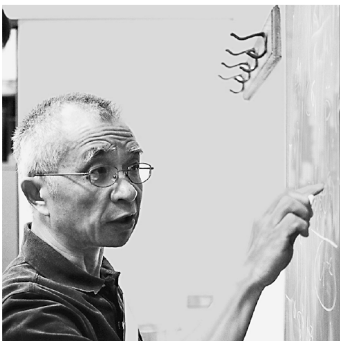
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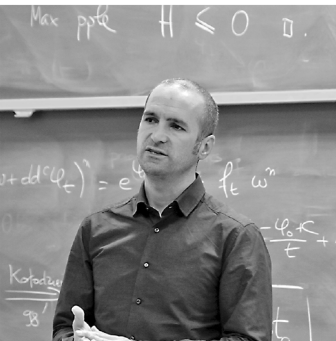
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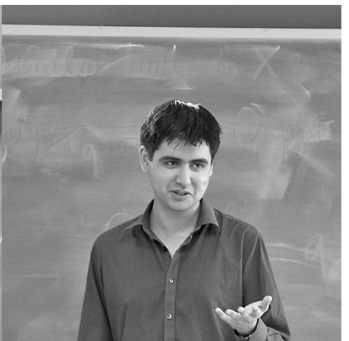
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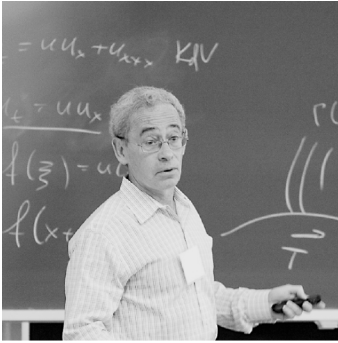
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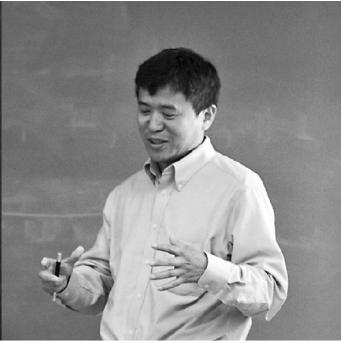
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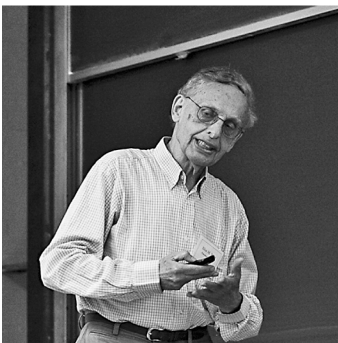
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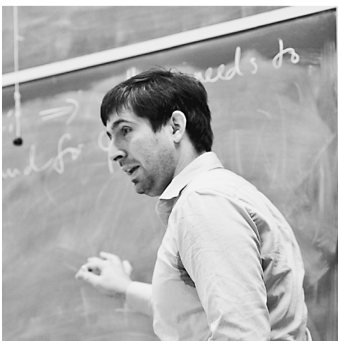
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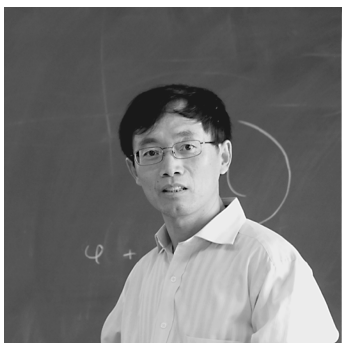
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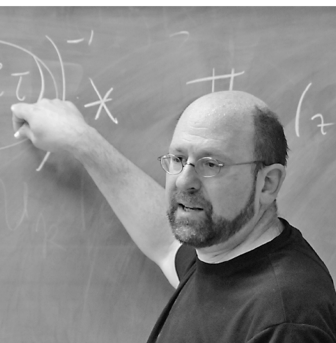
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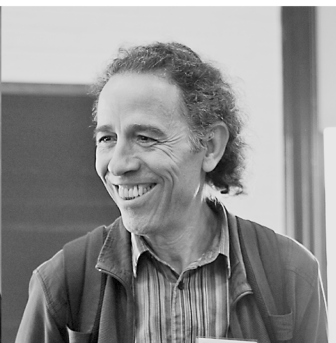
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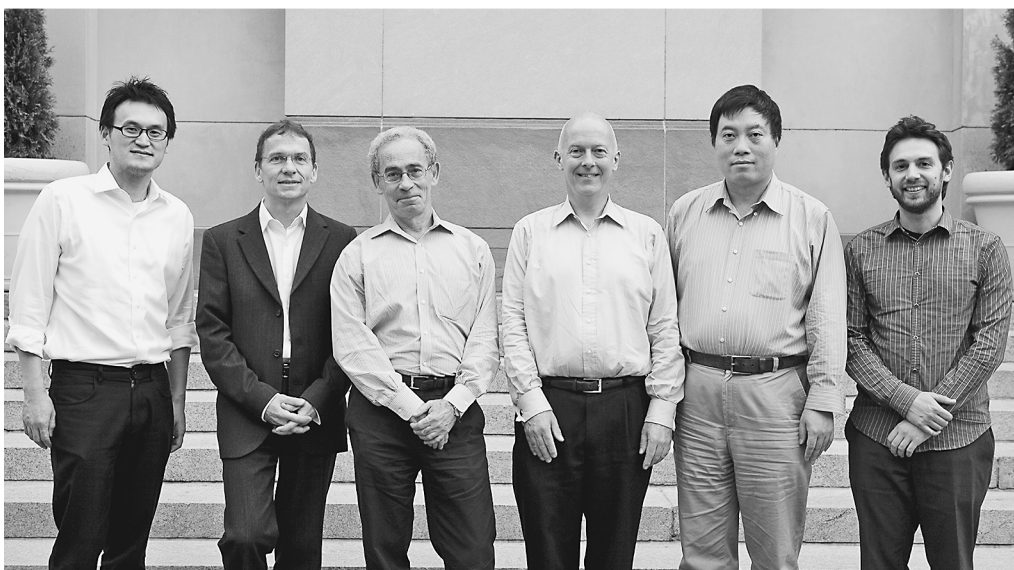
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Richard Wentworth, Steve Zelditch
and Jacob Sturm



Duong H. Phong
and Jian Song



Eric D'Hoker, Duong H. Phong
and Edward Witten



Igor Krichever and Andrei
Okounkov



Joseph J. Kohn and Shing-Tung Yau



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This volume contains the proceedings of the Conference on Analysis, Complex Geometry and Mathematical Physics: In Honor of Duong H. Phong, which was held from May 7–11, 2013, at Columbia University, New York. The conference featured thirty speakers who spoke on a range of topics reflecting the breadth and depth of the research interests of Duong H. Phong on the occasion of his sixtieth birthday. A common thread, familiar from Phong's own work, was the focus on the interplay between the deep tools of analysis and the rich structures of geometry and physics.

Papers included in this volume cover topics such as the complex Monge-Ampère equation, pluripotential theory, geometric partial differential equations, theories of integral operators, integrable systems and perturbative superstring theory.

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