

Association for Women in Mathematics Series

Carolina Araujo
Georgia Benkart
Cheryl E. Praeger
Betül Tanbay *Editors*

World Women in Mathematics 2018

Proceedings of the First World Meeting
for Women in Mathematics (WM)²



Association for Women in Mathematics Series

Volume 20

Series Editor

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Microsoft Research

Redmond, Washington, USA

Association for Women in Mathematics Series

Focusing on the groundbreaking work of women in mathematics past, present, and future, Springer's Association for Women in Mathematics Series presents the latest research and proceedings of conferences worldwide organized by the Association for Women in Mathematics (AWM). All works are peer-reviewed to meet the highest standards of scientific literature, while presenting topics at the cutting edge of pure and applied mathematics, as well as in the areas of mathematical education and history. Since its inception in 1971, The Association for Women in Mathematics has been a non-profit organization designed to help encourage women and girls to study and pursue active careers in mathematics and the mathematical sciences and to promote equal opportunity and equal treatment of women and girls in the mathematical sciences. Currently, the organization represents more than 3000 members and 200 institutions constituting a broad spectrum of the mathematical community in the United States and around the world.

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Editors

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ISSN 2364-5733 ISSN 2364-5741 (electronic)
Association for Women in Mathematics Series
ISBN 978-3-030-21169-1 ISBN 978-3-030-21170-7 (eBook)
<https://doi.org/10.1007/978-3-030-21170-7>

Mathematics Subject Classification: 00B20

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The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

*Dedicated to the memory of Maryam
Mirzakhani, a shining light of inspiration for
women in mathematics.*

Preface

The International Congress of Mathematicians (ICM), the most important meeting of the international mathematical community, is coordinated every four years by the International Mathematical Union (IMU). ICM 2018 took place in Rio de Janeiro, Brazil, from August 1 to August 9, 2018. The first World Meeting for Women in Mathematics - $(WM)^2$ - was held in Rio de Janeiro on July 31, 2018, as a satellite event of ICM 2018. Conceived by the IMU Committee for Women in Mathematics (CWM), with a focus on Latin America, the World Meeting for Women in Mathematics brought together over 300 mathematicians from 51 nations to celebrate women mathematicians and also to reflect on gender issues in mathematics, challenges, initiatives, and perspectives for the future. The meeting was complemented by the panel discussion organized by CWM on August 2, as part of the ICM 2018 program. This volume, organized in coordination with the Association for Women in Mathematics (AWM), records the first World Meeting for Women in Mathematics and the CWM panel discussion in ICM 2018.

The first part of the volume is devoted to the World Meeting for Women in Mathematics. It starts with a short report on the activities of the $(WM)^2$, including pictures that attest to the lively and friendly atmosphere of the meeting. Following the report, survey research papers from four of the invited lecturers provide a panoramic view of different fields in pure and applied mathematics. The first paper, by Etienne de Klerk and Monique Laurent, is anchored in the keynote lecture delivered by Laurent. It is a thorough survey on the generalized problem of moments, a class of linear conic infinite dimensional optimization problems that arise in many areas of applied mathematics. In the next article, Alicia Dickenstein addresses biochemical reaction networks and how techniques from computational and real algebraic geometry have been successfully applied in recent years to analyze them. The paper by Stella Brassesco and Maria Eulália Vares builds on the lecture given by Vares. It gives an introduction to the stochastic modeling of metastability, a very frequent phenomenon in nature, which also finds many applications in science and engineering. Part I then closes with the inviting note by Maria J. Esteban, based on her public lecture at the World Meeting for Women in Mathematics, entitled “How mathematics is changing the world.”

The second part of the volume documents the CWM panel discussion at ICM 2018. The panel, “The gender gap in mathematical and natural sciences from a historical perspective,” was chaired by Caroline Series, and featured contributions from Marie-Francoise Roy (chair of CWM), June Barrow-Green, and Silvina Ponce-Dawson. The paper by Helena Mihaljević and Marie-Françoise Roy traces the footprints of women lecturers in the International Congress of Mathematicians since its inception. In particular, it pictures the first two women to give plenary lectures at an ICM, Emmy Noether in ICM 1932 in Zurich and Karen Uhlenbeck in ICM 1990 in Kyoto. (While this book was being prepared, we received the welcome news that Karen Uhlenbeck was awarded the 2019 Abel Prize!) June Barrow-Green’s essay investigates the historical context of the gender gap in mathematics, analyzing challenges faced by women mathematicians during the last two hundred and fifty years, and shedding light on some of the problems still encountered today. This part closes with the paper by Silvina Ponce Dawson, which describes a series of actions taken by the International Union of Pure and Applied Physics to reduce the gender gap and increase diversity and inclusion in physics.

The organization of the $(WM)^2$ was greatly inspired by the shining light of Maryam Mirzakhani, the first woman mathematician to be awarded the Fields Medal, at ICM 2014 in Seoul. As a tribute, the CWM created *Remember Maryam Mirzakhani*, a memorial exhibition of 18 original posters portraying the late mathematician. Inaugurated at the $(WM)^2$, the exhibition remained open during ICM 2018. Since then, it has been shown in several venues. Maryam Mirzakhani will always be a beacon for women in mathematics, and we dedicate this volume to her memory.

Rio de Janeiro, Brazil
March 2019

Carolina Araujo

Acknowledgments

The World Meeting for Women in Mathematics was part of the Biennium of Mathematics in Brazil, officially sponsored by the Brazilian Development Bank (BNDES). It received financial/logistical support from the Committee for Women in Mathematics (CWM) of the International Mathematical Union (IMU), Institute for Pure and Applied Mathematics (IMPA), Brazilian Mathematical Society (SBM), Brazilian National Council for Scientific and Technological Development (CNPq), São Paulo Research Foundation (FAPESP), Serrapilheira, and L'Oréal Brasil. We thank these institutions for their support.

We thank the members of the organizing committee of the World Meeting for Women in Mathematics for the dedicated work to make the event happen and the members of the program committee for the excellent job in selecting the speakers for the meeting. We thank the invited lecturers for their efforts in making their presentations accessible to the general audience and the panelists for sharing their experience as members of active networks of women mathematicians. We thank the organizing committee of the ICM 2018 for the constant support and partnership and the staff of IMPA for the invaluable assistance with the organization. We thank Thaís Jordão and Rafael Meireles Barroso for their work on *Remember Maryam Mirzakhani* memorial exhibition. We thank the Simons Foundation for sponsoring the film “Journeys of Women in Mathematics” and the Association for Women in Mathematics (AWM) for the collaboration in creating this volume. We thank Aydin Tibet for the $(WM)^2$ logo and Bel Junqueira for the photography coverage.

Finally, we thank all the participants of the World Meeting for Women in Mathematics for their enthusiasm, making July 31, 2018, a day to remember.

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Part I
The First World Meeting for Women in
Mathematics

W²M
WORLD MEETING FOR WOMEN IN MATHEMATICS
July 31, 2018
Riocentro Convention Center, Rio

The IMU Committee for Women in Mathematics welcomes the mathematical community to the first World Meeting for Women in Mathematics, including mathematical talks and reflections on the gender gap, its challenges, initiatives, and perspectives.

INVITED LECTURES

-  **Monique Laurent**
(Centrum Wiskunde & Informatica and Tilburg University, Netherlands)
-  **Alicia Dickenstein**
(Universidad de Buenos Aires, Argentina)
-  **Salomé Martínez**
(Universidad de Chile, Chile)
-  **Maria Eulália Vares**
(Universidade Federal do Rio de Janeiro, Brazil)
-  **Maria J. Esteban**
(CNRS & Université Paris-Dauphine, France)

PROGRAM COMMITTEE

- Georgia Benkart (University of Wisconsin, USA) - chair
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- Christina Brech (UFPA, Brazil)
- Anne Brenot (INACM, Brazil)
- Patricia Cirio (UNESP, Brazil)
- Maria Isabel Cortez (Universidad de Santiago de Chile)
- Luciane D'Amico Costa (UFPA, Brazil)
- Lilliana Álvarez Diaz (Academia de Ciencias de Cuba)
- Lilliana Forzani (Universidad del Litoral, Argentina)
- Juliana Marta
- Lucía López de Medrano (UNAM, Mexico)
- Marie-Françoise Roy (Université de Rennes, France)
- Cecilia Salgado (UFPA, Brazil)
- Caroline Series (University of Warwick, England)
- Behlül Tanbay (Bogazici University, Turkey)

ICM PANEL
The Gender Gap in Mathematical and Natural Sciences from a Historical Perspective
 August 2, 2018 | 18:00 - 19:30

A SATELLITE OF

ICM 2018 RIO DE JANEIRO
 INTERNATIONAL CONFERENCE OF MATHEMATICIANS

for more info, & the full program
worldwomeninmaths.org

   

Fig. P1 Poster of the World Meeting for Women in Mathematics

Report on Activities of the First World Meeting for Women in Mathematics

Carolina Araujo

Abstract This is a short report of activities of the World Meeting for Women in Mathematics, which took place in Rio de Janeiro, Brazil, on July 31, 2018, as a satellite event of the ICM 2018.

1 Attendance

The first World Meeting for Women in Mathematics - $(WM)^2$ - took place in Rio de Janeiro, Brazil, on July 31, 2018, as a satellite event of the ICM 2018. It had a total of 296 registered participants, mostly women, plus around 50 guest participants (accompanying people and participants of ICM 2018) (Fig. 1). Registered participants came from 51 different countries, distributed as follows.



Fig. 1 Participants of the $(WM)^2$

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C. Araujo et al. (eds.), *World Women in Mathematics 2018*, Association for Women in Mathematics Series 20, <https://doi.org/10.1007/978-3-030-21170-7>

| | | |
|----------------|---------------|----------------|
| Algeria—6 | Indonesia—8 | Russia—1 |
| Argentina—21 | Iran—7 | Senegal—2 |
| Australia—2 | Japan—2 | Serbia—4 |
| Belarus—1 | Kyrgyzstan—1 | Slovenia—1 |
| Brazil—123 | Mexico—5 | South Africa—1 |
| Burkina Faso—1 | Moldova—2 | South Korea—2 |
| Cambodia—1 | Montenegro—2 | Spain—2 |
| Cameroon—1 | Morocco—1 | Tanzania—1 |
| Canada—3 | Mozambique—1 | Tunisia—2 |
| Chile—8 | Nepal—2 | Turkey—5 |
| Colombia—2 | Netherlands—1 | Ukraine—5 |
| Congo—1 | Nigeria—8 | UK—1 |
| Denmark—1 | Pakistan—2 | USA—11 |
| Ecuador—1 | Peru—2 | Uruguay—1 |
| France—11 | Philippines—5 | Uzbekistan—1 |
| Ghana—2 | Poland—1 | Venezuela—1 |
| India—17 | Romania—1 | Vietnam—1 |

2 Program at a Glance

| | |
|-------------|--|
| 7:00–9:00 | Registration |
| 9:00–9:20 | World Premiere of the film “Journeys of Women in Mathematics” |
| 9:25–10:10 | Keynote Lecture: Monique Laurent “Convergence Analysis of Approximation Hierarchies for Polynomial Optimization” |
| 10:15–10:30 | Memorial for Maryam Mirzakhani |
| 10:35–11:20 | Lecture: Alicia Dickenstein “Algebra and Geometry in the Study of Enzymatic Cascades” |
| 11:25–12:25 | Group discussions |
| 12:30–14:20 | Lunch + Posters |
| 14:25–15:10 | Lecture: Salomé Martínez “Reaction-Diffusion Equations, Population and Gender Dynamics” |
| 15:15–16:00 | Lecture: María Eulália Vares “Revisiting the Contact Process” |
| 16:00–16:40 | Coffee break |
| 16:40–17:25 | Public Lecture: María J. Esteban “Why Mathematics Is Changing the World” |
| 17:30–18:45 | Panel discussion “Networks of Women in Mathematics” |
| 19:00 | ICM opening cocktail reception |



Fig. 2 Left: The protagonists of the first part of the film “Journeys of Women in Mathematics.” Right: Poster of the full length film

3 Journeys of Women in Mathematics

The program of $(WM)^2$ opened with the world premiere of the film “Journeys of Women in Mathematics.” The film was created by the IMU Committee for Women in Mathematics, filmed and edited by Micro-Documentaries, and made possible by a grant from the Simons Foundation. The first part of the film features Carolina Araujo from Brazil, Neela Nataraj from India, and Aminatou Pecha from Cameroon (Fig. 2). It describes their research, the mathematical aspirations, successes and barriers faced by women in their region, all told in the words of the women themselves.

The second part of the film was shot during $(WM)^2$ and ICM 2018. It gives a lively presentation of the atmosphere at the meeting, and features interviews of six women in mathematics from Latin America: Alicia Dickenstein from Argentina, Natalia García-Colín from Mexico, Salomé Martínez from Chile, Jaqueline Godoy Mesquita from Brazil, Carolina Neira Jiménez from Colombia, and Maria Eulália Vares from Brazil. The final full-length version of the film is available at the following webpage.

https://www.mathunion.org/fileadmin/CWM/Videos/Simons_Foundation-WM2_Conference-1363-02-T04_FINAL_Stitch.mp4.

4 Scientific Lectures

The scientific program of $(WM)^2$ included five 45-minute plenary lectures: keynote lecture by Monique Laurent (Netherlands), invited lectures by Alicia Dickenstein (Argentina), Salomé Martínez (Chile) and Maria Eulália Vares (Brazil), and public lecture by Maria J. Esteban (France). The lectures were aimed at a general audience of mathematicians, providing panoramic views of different fields in pure and applied mathematics.