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In mathematics, women continue to be underrepresented in research positions and at the higher levels of education. Despite advances in narrowing this gap, the number of female mathematicians who hold positions at top universities or private sector research labs, are editors-in-chief of influential scholarly journals, or serve on decision making bodies of major funding agencies remains small. In many areas of mathematics, including number theory, women who deliver plenary talks at premier conferences continue to be in the minority.

In an effort to address this imbalance, the *Women in Numbers* (WIN) network [5] was established for the purpose of highlighting the accomplishments of female researchers in number theory. Its goals are to heighten the visibility of contributions by female scholars in the field, increase the participation of women in number theory research, grow the number of active female researchers in the discipline, and offer a research community for women number theorists at all career stages.

Group Photo
Inaugural Women in Numbers Workshop, November 2-7, 2008. Banff International Research Station.

WIN grew out of a fateful conversation at the Workshop on Computational Challenges Arising in Algorithmic Number Theory and Cryptography, hosted by the Fields Institute in Toronto in the fall of 2006. At the daily communal afternoon tea, WIN founders Kristin Lauter, Rachel Pries and I found ourselves discussing the lack of female invited speakers at number theory conferences with Barbara Keyfitz, who served as the Institute's Director at the time. We proposed the idea of organizing a research conference for women in number theory which, rather than following the traditional format of individual presentations, focused instead on research collaborations conducted in small groups. With Barbara's encouragement, we submitted a proposal to hold such a conference as a 5-day workshop at the *Banff International Research Station* (BIRS) in Banff, Alberta. Our BIRS proposal was successful and the series of WIN conferences was born, with the first of its kind held at BIRS in November 2008. In the aftermath of this event, the organizers and many of the participants worked to establish the Women in Numbers network, creating a website [5] and an email distribution list, and eventually forming a steering committee to plan future meetings.

WIN Founders (left to right): Renate Scheidler, Rachel Pries, Kristin Lauter.
Inaugural Women in Numbers Workshop, November 2-7, 2008. Banff International Research Station.

WIN's main mechanism for supporting new number theorists entering the "leaky pipeline" of female underrepresentation is a series of regular workshops where female scholars at all career stages gather to collaborate on cutting-edge research in the field and produce publishable results. These workshops provide an ongoing forum for involving each new generation of early career faculty, postdocs and graduate students in exploring state-of-the-art open problems in number theory. A total of 10 WIN workshops have taken place since 2008. Six of these were hosted by BIRS, approximately every three years, including WIN5 in 2020 which was conducted entirely online due to the COVID-19 pandemic. Four more meetings under the umbrella *WIN Europe* (WINE) were held in varying locations all across Europe, along with numerous other workshops, conferences and symposia spearheaded and organized by members of the WIN community.

The WIN workshops are highly regarded among the broader number theory community due to the excellent quality of research produced by the collaborations. The work is conducted in small groups, usually comprised of 4-6 female researchers at varying career stages. The groups are led by one or two senior women scholars with an outstanding research reputation and a proven track record of effective mentorship who propose the projects and direct the work. Following an open call for applications, the junior participants (doctoral students, postdocs and pre-tenure faculty members) are carefully selected via peer review. After several months of independent background study guided by the project leaders, groups gather at the workshop and sequester for five days of intense collaborative research that continues remotely afterwards and is subsequently published in a peer-reviewed conference proceedings. In many cases, these collaborations last well beyond the duration of the conference and lead to further publications.

Group collaboration at WIN6, March 27-31, 2023. Banff International Research Station.
From left to right: Elisa Lorenzo Garcia, Beth Malmskog, Heidi Goodson, Renate Scheidler, Juanita Duque Rosero.

The unique nature of the WIN conferences was evident from the very start. At the first WIN workshop in 2008, seasoned BIRS staff with many years of experience coordinating some 50 workshops annually remarked that they had never witnessed such a level of enthusiasm and vibrant energy at any BIRS workshop. Many junior WIN participants have stated that the workshops ignited their careers; they have gone on to permanent positions at major research universities and have themselves become successful mentors of young female number theorists, including in the capacity as WIN group leaders, workshop organizers or steering committee members. Several student and postdoc participants of early WIN workshops have grown to become award winning scholars and research leaders in the field. WIN group leaders have reported that finding new research problems and directing a WIN research team represented a formative career experience for them. The WIN network has grown substantially over the years, broadening its activities to include organizing special sessions, student symposia and poster sessions at the annual Joint Mathematics Meetings as well as foster collaborative research targeted at undergraduate students. The WIN initiative and its effort to promote collaboration through research mentorship were highlighted in New York Times bestselling author Janice Kaplan's 2020 book The *Genius of Women* [3].

Since WIN's inception more than 15 years ago, numerous sister research networks for women in a variety of mathematical areas have been established, and the collaborative workshop framework, now generally referred to as the *WIN conference model*, has been widely and fruitfully adopted by many research communities far beyond these networks, both all-female and mixed-gender. In 2015, recognizing the success of the WIN model, the US National Science Foundation awarded a 5-year ADVANCE grant in the amount of US$ 750,000 to the *Association for Women in Mathematics* (AWM). The goal of this grant, entitled "Career Advancement for Women through Research-Focused Networks", was to help build and sustain research networks for women in all fields of mathematics and provide financial support for the Research Collaboration Conferences for Women (RCCW) program. A second NSF grant was awarded to AWM in 2020.

Group Photo
Women in Numbers 6 Workshop, March 27-31, 2023. Banff International Research Station
(the latest WIN workshop).

Today, AWM's website [1] list 26 research networks for women. Their history and successes are chronicled in [2], along with information and guidance on how to start and grow such a network. In addition to BIRS, many major research institutes in the United States and across Europe now host RCCWs on a regular basis. Spearheaded by Founding Editor Kristin Lauter, the peer-reviewed AWM Springer Series [4] was launched in 2014 as a venue for proceedings of conferences worldwide organized by AWM, including the proceedings volumes of research articles produced by the collaboration groups at the RCCWs. To date, this series has published 31 volumes, six of them devoted to WIN conferences. At the time of writing, two more WIN proceedings volumes in this series (WIN5 and WINE4) are in production.

The WIN website [5] aims to be a resource both to women number theorists — as a clearinghouse of information and opportunities relevant to women in numbers — and to the number theory community as a whole, by showcasing the many contributions of women number theorists to the discipline. All are welcome to visit the site, subscribe to the WIN mailing list, or stay in touch via Twitter/X (@WINnumbertheory). Number theorists who identify as a woman in a way that is meaningful to them are also encouraged to add themselves to the WIN directory.

[1] AWM Research Networks; https://awm-math.org/programs/advance-research-communities/.

[2] Kristine Bauer, Erin Wolf Chambers, Brenda Johnson, Kristin E. Lauter, Kathryn Leonard, Research Networks for Women, Eur. Math. Soc. Mag. 126 (2022), pp. 41–50. https://euromathsoc.org/magazine/articles/92.

[3] Janice Kaplan. Genius of Women: From Overlooked to Changing the World. Penguin Random House 2020. https://www.penguinrandomhouse.com/books/598507/the-genius-of-women-by-janicekaplan/.

[4] Springer Association for Women in Mathematics Series, https://www.springer.com/series/13764/books.

[5] Women in Numbers Website, womeninnumbertheory.org.