

## Editorial To The Second Issue

Dear Friends and Ambassadors of the International Mathematical Union Committee for Women in Mathematics (CWM),

It is our great pleasure to welcome you to the second issue of the CWM newsletter. As you may recall, two issues per year have been planned and the first issue was launched on May 1. We wanted to announce the second issue approximately six months later, after having the CWM meeting which happened right after the final meeting of the Gender Gap in Science project (4-8 November).

Similar to the first issue, we start the newsletter by an interview with one of CWM members, Petra Bonfert-Taylor. Petra is responsible for managing the CWM web page. Petra tells us about her personal journey as a woman in mathematics and her various experiences in mathematics research and education. We hope that you find this interview as interesting as we did.

We then continue with "News From CWM". This includes the announcement of the funding call for 2020 and summary of the CWM meeting which took place on November 9-10. In the "Other News and Announcements" section we have much wonderful news including the announcement of the Australian Prime Minister's Science Prize which is given to CWM member Cheryl Praeger and the announcement of the documentary film, "Secrets of the Surface", about Maryam Mirzakhani. These happy news items are followed by many others and conference, meeting announcements geared towards women in mathematics.

The last pieces of this issue are two articles about Gender Gap in Science project. The first article is by Marina Menga reviewing the final meeting of the Gender Gap in Science project that took place in ICTP, Trieste. The second article is by Merrilyn Goos which focuses on the good practices database of the Gender Gap in Science project.

We invite your feedback and suggestions about the Newsletter. Hope you enjoy reading it! Please distribute it in your country and your scientific network.

Ekin Ozman

## Interview with Petra Bonfert-Taylor

We continue our interview series with Petra Bonfert-Taylor who is a CWM member, after having been an associate member in the period 2015-2018. Petra is also in charge of the design and update of the CWM web page which is a very well organized, resourceful web page for the community.



Petra is a Professor and Instructional Designer at the Thayer School of Engineering at Dartmouth College.

She received her Ph.D. from Technical University of Berlin and was a Postdoc at the University of Michigan. Prior to joining Dartmouth she was a Professor of Mathematics at Wesleyan University. Her research interests are in complex analysis, geometric function theory, hyperbolic geometry and the mathematics of medical imaging. She is also strongly interested in broadening access to advanced, high quality mathematics education.

**Q:** Could you tell us how you got into math?

**PBT:** I have always loved math. Already in high school I found deep satisfaction in solving a math problem. My parents always told me that I could do whatever I wanted to when I grew up and so without much consideration of what I would do with a math degree later on I decided to study mathematics in college. One thing led to another and I found myself getting a PhD in mathematics. Still unsure of what to do with my life I went to the University of Michigan as a postdoc and discovered that I enjoyed being in front of a class just as much as I enjoyed working on my research. Maybe this was the point when I truly made the decision to become a mathematician.

**Q:** Did you do stuff outside of school, or was it just in class? Were there any pivotal moments where you knew that you wanted to be a mathematician?

**PBT:** Outside of school I especially enjoyed activities that involved logical thinking and reasoning as well as discovering how things work. In particular I liked to take things apart (without necessarily being able to put them back together properly afterwards...). I also participated in long-term math competitions – a particular one comes to mind where four problems had to be solved over the course of three months. I loved working on these problems and still remember many of them to this day. I was never a fan of the type of competition where you had to find a super clever solution under time pressure. I much rather spent time thinking about problems and simply

loved those pivotal moments when I knew I had all of a sudden solved a problem (typically not while sitting at my desk but upon waking up in the middle of the night, waiting for the subway, and other such situations). I don't think I knew I wanted to be a mathematician in those moments, but it certainly became clear to me that I wanted to study more mathematics: in one of these competitions I discovered and used for my solution Euler's Polyhedral Formula and attempted a proof (without knowing any proof techniques). Needless to say, my proof wasn't perfect and I lost some points. The feedback I received said I should have simply quoted Euler's Polyhedral Formula, but without knowing of its existence how could I have done so (mind you, this was in the age before the internet). I decided right then and there that I needed to learn more mathematics.

**Q: Did you have any role models? (male or female?)**

**PBT:** I am discovering more and more that my dad was a big role model for me. I don't think I knew this at the time: my dad passed away when I was still in high school and my mom died soon thereafter. In my grief I failed to process much of what happened and submersed myself in work instead. But the more I finally think back and look at myself the more I see striking similarities between my dad and myself, both personally as well as professionally.

**Q: Can you tell us about your research area? What attracted you to this area?**

**PBT:** I fell in love with geometric analysis on the first day of my complex analysis class in college. I found striking beauty when going from the real into the complex and to this day remember the class during which I learned about the Riemann Mapping Theorem and (one of) its beautiful proof(s). The direction in which I would later specialize was determined back then. And things only kept getting better. The more I learned the more I discovered the inner beauty of quasiconformal mappings, hyperbolic geometry and more.

**Q: Can you tell us something about the latest work you are working on?**

**PBT:** On of my favorite theorems that I have been involved in discovering concerns bounds on the exponent of convergence of a discrete quasiconformal group in terms of the Hausdorff dimension of the group's conical limit set. It's simply beautiful how these two concepts interplay with each other, and the result is nice and tight and just what it ought to look like. I have also worked a lot on quasiconformal homogeneity of hyperbolic manifolds - basically this concept probes how much alike a manifold looks to itself when viewed from different locations. There are striking differences between dimension  $n=2$  and dimensions  $n \geq 3$ . A completely unrelated passion of mine is the analysis of data on how students learn to program and related questions such as how to best support a learner according to their personal coding style.

**Q: Do you think collaboration is very important for mathematical research?**

**PBT:** I do think collaboration is crucial, but this is probably a rather personal preference. I am a pretty social person and sitting alone at a desk day in and out does not appeal to me.

That said, I find it extremely important to take all the time I need to think through a problem on my own first. But there comes a time when I can make more progress by talking things through with a collaborator than by continuing to stare at my paper. Furthermore, collaborations add different perspectives to a problem. I tend to try to use those techniques with which I am most comfortable and familiar. But as the saying goes, if all you have is a hammer then everything starts to look like a nail. Collaborators can really help you dig out of such rabbit holes and set you on a fresh path.

**Q: You have worked in both mathematics departments and engineering departments, what are the main differences/challenges if any?**

**PBT:** My experience has been that there is quite a bit more collaboration going on in engineering, from weekly group meetings where each graduate student belonging to the same lab reports on their progress to a significant focus on student collaboration in undergraduate classes. I also find the sense of possibility at the engineering school refreshing. If I have a novel idea, something I'd like to try in the classroom for example, then I'll find 100% support to conduct an experiment without pressure to have to 100% succeed the first time around. This really allows for the freedom to innovate, learn, improve and iterate to a new solution of a problem. I am also learning about differences in culture when it comes to publications, conferences and grant funding. It's all super interesting and I wish we had more cross-collaborations so that we could all learn from each other's best practices across disciplines.

**Q: When did you move from Germany to the US?**

**PBT:** My permanent move was completely unplanned. I had just finished my PhD in Germany and was starting to think about what was next (I still had an assistantship at my university so no pressure to figure out the rest of my life quite yet). In early August of 1996 I received a phone call from my PhD advisor who asked me whether I was interested in going to the University of Michigan for a year. Since that sounded exciting I said "Sure!" and he asked whether I could be in Michigan three weeks later. In my youth, that didn't seem like a problem, and visas were way easier to obtain in those days. So, I stowed all of my belongings with friends, packed two suitcases and left for Michigan on August 24, 1996 on a plane ticket with a return date a year later. I still have that return ticket and wave it in my husband's face every now and then... I started teaching about a week later which was a bit scary since I was nowhere near fluent in English at the time. I remember the feeling of exhaustion every night from having to stumble around in English all day long. Fast-forward to today where speaking in German has become quite a bit more difficult for me than in English. It's funny how life takes you down unexpected turns.

**Q: Your daughter has just started college. What are the main differences you see in the college environment and perspectives now compared to when you were at this stage of your life?**

**PBT:** I didn't go to college in the US so it's hard to compare experiences. The German system, when I went to college, required you to choose a major upon entering college, and so all I ever

took was math classes (along with computer science classes since I chose CS as my minor). While for me there was never a question what I would major in I now see many students who simply have not yet found their passion. I really appreciate in the US system the idea that students can use their first year to explore the curriculum before having to decide on a major. The German system is also very different in that as a student you are pretty much on your own (at least that's how it was when I went to school). This means that you select whichever classes you think are right for you, without the guidance of an advisor. There is no system in place to catch those students who wander off or get lost, and so forth. On the other hand, higher education is still basically free in Germany whereas the cost of college here in the US is crippling. I could go on for a while on this topic...

**Q: How did you get involved with mathematical education?**

**PBT:** I think it all started when I came across an article that described a “flipped classroom<sup>1</sup>”. The concept sounded worth exploring but I didn't think I had the time. Then after receiving tenure, followed by a health crisis I decided that I needed to try something new and I flipped a class in discrete mathematics. It was a life-changing experience. I had never seen students this engaged and eager to learn and at the same time I had never had this much fun in a classroom before. After this experience I became really interested in how students learn and also became acutely aware of the inequities in access to high quality education. I started incorporating more and more active learning into my classrooms and also took the opportunity to create my first MOOC (Massively Open Online Course) when these first started appearing. This MOOC is still up and running and to this day I receive messages from students in far corners of the world to whom this type of material presents their only access to education. I have since created further online courses, namely an entire series on C-programming together with a French collaborator.



**Q: You have implementing various teaching methods in your classes. Could you tell us a bit about these methods? For what kind of courses would you use them?**

**PBT:** Research shows that students who are new to a field cannot pay attention and absorb content for much more than 10 minutes at a time. Thus, I teach pretty much all of my entry-level classes in an active learning style where I lecture for at most 10 minutes at a time before directing students to work on a problem. This of course takes

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<sup>1</sup> A **flipped classroom** is an instructional strategy that reverses the traditional learning environment by delivering instructional content, often online, outside of the classroom. In a flipped classroom, students watch online lectures, collaborate in online discussions, or carry out research at home while engaging in concepts in the classroom with the guidance of a mentor.

up more class time and I therefore create short recordings for the purpose of establishing some base knowledge that students have to watch before class. I also try to incorporate formative feedback mechanisms that allow students to gauge their own learning continuously.

**Q: You are involved with the “Curated Courses” project too. Could you tell us a bit more about it?**

**PBT:** I have this dream of one day creating an education system in which a learner could say “I’d like to learn about ‘B’.” The system would then assess the learner’s current knowledge ‘A’ and design the shortest path from ‘A’ to ‘B’, almost like a Google map. Or maybe the learner is not interested in the shortest path but rather the most scenic route. Or they want to make sure to also touch upon ‘C’ on the way (like the coffee stop-over in driving directions). Anyway, we are clearly nowhere near such a system these days but the Curated Courses project was born in part out of this rather crazy idea. We also wanted to make high quality educational content openly and freely accessible to both instructors and students, thereby for example enabling instructors to incorporate active learning methods into their classrooms without having to go through the efforts of having to create all of the materials from scratch. We made some good progress on learning how to curate materials but unfortunately ran out of funding. The project is currently on hold.

**Q: Have you faced any challenges as women in math? If yes, did you have other kind of support ?**

**PBT:** Unfortunately, yes. And I didn’t talk about these experiences with anyone when they happened, so no, I did not have support. But they affected me profoundly. Let me give two examples. When I was in high school I was the first girl ever to qualify for the German training team for the International Mathematics Olympiad. As part of this training we spent a week at the research institute in Oberwolfach where a professional math conference was being held at the same time. During our common lunch time with the researchers one of the professors said to me: “Of course there aren’t any girls here. They aren’t good enough!” I will never forget this comment and how it made me feel. Many years later, when I was looking



for a PhD advisor, one of my professors said to me: “Women just aren’t as good at research since they are not as playful as men are. You need to be playful to be a good researcher.” These types of experiences significantly affected my confidence for years and years to come. I often felt like an imposter when going to conferences, imagining that I really didn’t belong there. People need to be less careless with what they say. A few “misguided” (I am trying to be generous) words can have

such a profound and lasting effect on impressionable young people. I hope I have never and will never treat anyone in a similar fashion.

**Q: Did you have any notions or worries in advance about how the growth of your family would intersect with the growth of your career?**

**PBT:** I was rather unprepared in terms of understanding what motherhood would be like. So, no, I had no real worries. Once I had children it became clear to me that if I ever had to choose between family and career I would choose my family. Thankfully I never had to make this choice. It was definitely not always easy to try to be at my best in both of those departments. Oftentimes I felt like I was neither spending enough time with my family nor was I spending enough time proving theorems. But somehow it all worked out in the end.

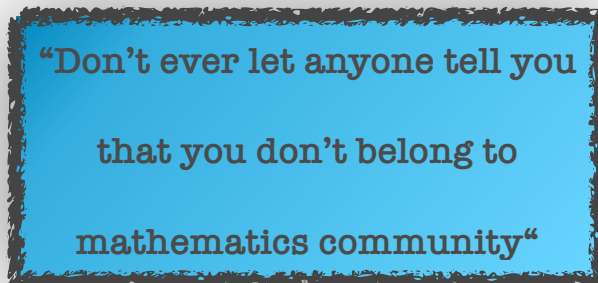
**Q: Tell us about your responsibility for the [CWM webpage](#). It's such a great resource for CWM. Is it a lot of work?**

**PBT:** It's wonderful to have an up-to-date resource for CWM. Thankfully there are others who constantly pay attention and alert me of places and events that need updating. In an ideal world one would spend a lot more time optimizing the organization of materials and finding new sources to add. But we all have many other obligations so we simply do the best we can with the limited amounts of time we have.

**Q: Do you have advice for young people who might be thinking about doing math?**

**PBT:** Do it! Mathematics is such an interesting and varied field with a community filled with wonderful people.

Don't ever let anyone tell you that you don't belong. I know that's easier said than done. And form communities, talk to others, find things to work on that make you excited. Follow your dreams!



**Q: What advice would you give to a beginning graduate student in mathematics?**

**PBT:** Be sure to explore lots of areas of mathematics. You never know what techniques you might pick up in one area that will later come in handy in a different area. Ask questions. Take advantage of opportunities that are offered to you. Go to conferences and meet people. Ask for help when you need it. And first and foremost: have fun.

# NEWS FROM CWM

## ● CWM Funding Call for 2020

CWM invites proposals for funding of up to €3000 for activities or initiatives taking place in 2020, with deadline **15 January, 2020**. Applications should be sent to [applications-for-cwm@mathunion.org](mailto:applications-for-cwm@mathunion.org) aimed at either:

- Establishing or supporting networks for women in mathematics preferably at the continental or regional level,
- Organizing a mathematical school open to all with all women speakers and mainly women organizers,
- Organizing research workshops geared towards establishing research networks for women by fostering research collaborations during the event,
- Other ideas for researching and/or addressing issues encountered by women in mathematics.

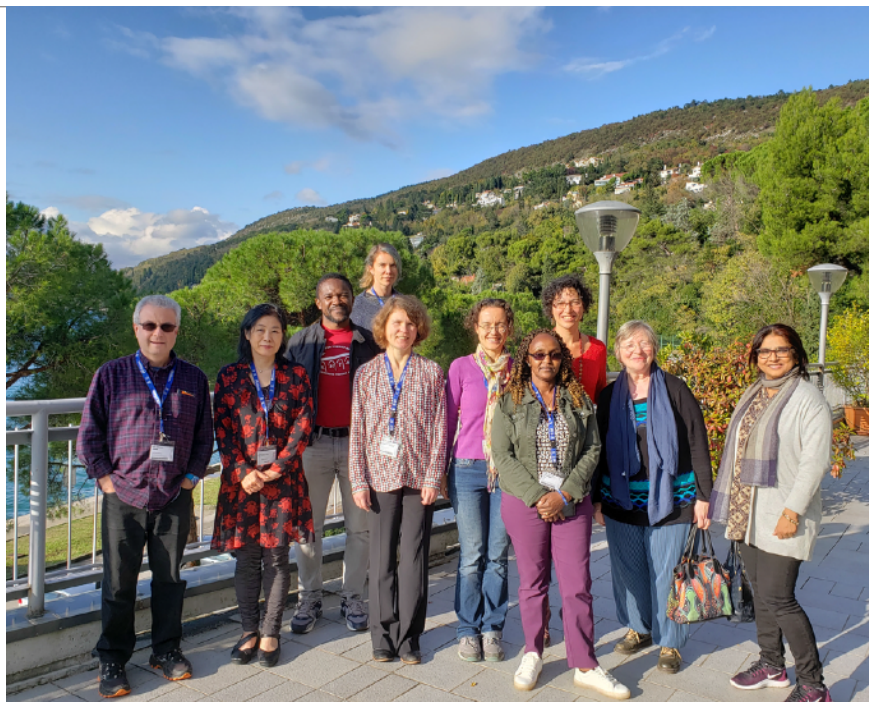
Note that:

- There will be only one call for applications regarding activities in 2020,
- Priority will be given to events taken place in developing or emerging countries,
- Funding for individual research projects is not available.

For further details please check the CWM [web page](#).

## ● CWM Meeting

The meeting of CWM took place on November 9-10 at ICTP, Trieste. It was the first meeting face to face of the CWM members for the period 2019-2022. Eight members of CWM (M-F. Roy, C. Araujo, P. Bonfert-Taylor, T. Ezome, J. Kagunda, M. Kotani, N. Nataraj, E. Ozman) along





with IMU president Carlos Kenig and member of the Local Organizer Committee of ICM 2022 Julia Pevtsova physically attended the meeting. The last two CWM members C. Praeger and A. Adem could not attend but had prepared actively for the meeting. The agenda of the meeting featured presentation of CWM members, including activities for women in mathematics in which they have been involved, summary of CWM activities that took place in the last years, plans for the future CWM activities until and during ICM2022 including the second World Meeting for Women in Mathematics and discussions about Gender Gap in Science project. An electronic CWM meeting will take place during October 2020.

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## ● **CWM Ambassadors**

CWM has established about 140 special correspondents worldwide, each of whom has the job of disseminating information such as CWM funding calls in her geographical or mathematical neighbourhood, and also of keeping CWM informed about activities or initiatives to be announced on this website. Here is the [list](https://www.mathunion.org/fileadmin/CWM/About/CWMAmbassadorslist.pdf) of ambassadors as of November 2019: <https://www.mathunion.org/fileadmin/CWM/About/CWMAmbassadorslist.pdf> If you want to contact one of them and do not know how to do it please write to [cwm.info@mathunion.org](mailto:cwm.info@mathunion.org)

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## ● **Remember Maryam Mirzakhani**

Remember Maryam Mirzakhani is an exhibition with 18 original posters. Institutions interested in hosting the exhibition can consult the [rules of use](https://www.mathunion.org/fileadmin/CWM/Initiatives/HostingRememberMaryamMirzakhani.pdf) (<https://www.mathunion.org/fileadmin/CWM/Initiatives/HostingRememberMaryamMirzakhani.pdf>) and contact CWM at [exhibition-cwm@mathunion.org](mailto:exhibition-cwm@mathunion.org). The exhibition opened at the (WM)<sup>2</sup>, the World Meeting for Women in Mathematics, and remained open during ICM 2018. It contained also a book of condolences, and volumes with Maryam Mirzakhani's mathematical papers as well as a book with papers about her. Curator: Thais Jordao. Designer: Rafael Meireles Barroso. See flyer describing the exhibition [here](https://www.mathunion.org/fileadmin/CWM/Initiatives/rememberMM-flyerWEB.pdf). (<https://www.mathunion.org/fileadmin/CWM/Initiatives/rememberMM-flyerWEB.pdf>)

In 2020, CWM has an agreement with the following institutions:

- Dipartimento di Matematica "Levi-Civita" Padova, Italy, 10- 25 May 2020

- Department of Mathematics at the University of Ottawa, 6-13 March 2020. The posters will be introduced by Prof Sara Maloni (Virginia), whose presentation will be the first annual Distinguished Women in Mathematics Colloquium at the University of Ottawa.
- [Universitat Politècnica de Catalunya](#) in **Barcelona-Spain**, 10<sup>th</sup> February - 24<sup>th</sup> April 2020. Several activities will be organized around this exhibition, taking advantage of the celebration of the International Day of Women and Girls in Science (11 February), the International Women's Day (8 March) and the International Day of Mathematics (14 March).
- **Joint Mathematics Meeting in Denver**, January 15-18, 2020, organized by The National Academy of Sciences U.S. National Committee for Mathematics. In 2019, CWM has an agreement with several other institutions. The ones below are those taking place in the following weeks. Visit CWM [web page](#) to see the older ones.
- [Canadian Mathematics Society's Winter Meeting](#) hosted by **York University**, held from December 6 to 9, 2019 at the Chelsea Hotel in Toronto.
- **INMOST is a science museum affiliated with the Ministry of Science, Research and Technology in Iran** and opened in 2010, working to for developing scientific and technological literacy. INMOST will run a permanent exhibition on the scientific achievements of Maryam Mirzakhani at the beginning of September 2019 for about 5 years, including the exhibition "Remember Maryam Mirzakhani".
- [Fields Day @ Queen's](#) on November 19, 2019.
- **University of Rennes, France**, at Diapason from 14 to 25 October as part of the annual "Festival des Sciences" and at the University Library on Beaulieu Campus from 18 November to 15 December. On October 15 the amphitheater Maryam Mirzakhani was inaugurated with two mathematical talks from Elise Goujard and Olga Romaskevich.

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## OTHER NEWS AND ANNOUNCEMENTS

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- **Praeger receives the Prime Minister's Prize for Science**

We are thrilled to announce that CWM member Cheryl Praeger was awarded the Australian Prime Minister's Prize for Science during a gala dinner in the Great Hall of the Australian Parliament House in Canberra on October 16, 2019

for her foundational contributions to group theory and combinatorics. This is the first time in the twenty year history of the Prizes that a pure mathematician has been the recipient of the top award. Cheryl Praeger is a Professor Emeritus at the University of Western Australia. [Out of the seven Prime Minister's Prizes for Science five of them were awarded to women this year.](https://www.sbs.com.au/news/acclaimed-women-dominate-pm-s-prizes-for-science) (<https://www.sbs.com.au/news/acclaimed-women-dominate-pm-s-prizes-for-science>) This also drew the attention of the International Science Council. They have asked whether there is a [diversity issue in international science prizes.](https://council.science/current/blog/diversity-in-science-prizes-a-call-to-action) (<https://council.science/current/blog/diversity-in-science-prizes-a-call-to-action>)

Professor Praeger hopes that receiving Australian top award in science encourages young women to believe that a top-tier career in science is possible.

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- **Secrets of the Surface**

The [Mathematical Sciences Research Institute \(MSRI\)](#) and George Csicsery have started production of a one-hour documentary film, "[Secrets of the Surface: The Mathematical Vision of Maryam Mirzakhani](#)", about Maryam Mirzakhani. ([www.zalafilms.com/secrets/#preview](http://www.zalafilms.com/secrets/#preview))

"The biographical film is about Maryam Mirzakhani, a brilliant woman, and Muslim immigrant to the United States who became a superstar in her field. The story of her life will be complemented with sections about Mirzakhani's mathematical contributions, as explained by colleagues and illustrated with animated sequences. Throughout, we will look for clues about the sources of Mirzakhani's insights and creativity." The documentary is scheduled to premiere at the [Joint Mathematics Meetings](#) in Denver, Colorado, in January 2020. ([jointmathematicsmeetings.org/jmm#](http://jointmathematicsmeetings.org/jmm#))

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- **Maryam Mirzakhani Prize in Mathematics**

In recognition of Dr. Mirzakhani's remarkable life and achievements, the National Academy of Sciences has established a newly named Maryam Mirzakhani Prize in Mathematics (formerly the NAS Award in Mathematics, which was established in 1988 by the American Mathematical Society in honor of its centennial). The prize will be awarded biennially for exceptional contributions to the mathematical sciences by a mid-career mathematician. For more information see [here](http://www.nasonline.org/programs/awards/mathematics.html). ([www.nasonline.org/programs/awards/mathematics.html](http://www.nasonline.org/programs/awards/mathematics.html))

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- **[Carola Schönlieb receives the 2019 Calderon Prize](#)**

Carola Schönlieb has received the 2019 Calderon Prize, which is a prize for the Inverse Problems field (awarded biennially starting in 2007). Schönlieb, who is the current covenor of [European Women in Mathematics](#), is the first woman mathematician that received this award, her work being in image processing and partial differential equations.

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- **[Prize of the Tatiana Pérez de Guzmán el Bueno Foundation](#)**

Carmen Torras and Elisa Lorenzo Garcia received the Prize for Pioneer Women in the Physical, Chemical and Mathematical Sciences of the Tatiana Pérez de Guzmán el Bueno Foundation. The awards ceremony took place on June 4 2019 at the Spanish Royal Academy of Sciences.

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## CONFERENCE ANNOUNCEMENTS

- [Summer Research for Women in Mathematics \(SWiM\)](#), MSRI, Berkeley, USA, June 15- August 7, 2020. The purpose of this program is to provide space and funds to groups of women mathematicians to work on a research project at MSRI.
  - [Women in Mathematical Physics](#), The Banff International Research Station will host the "Women in Mathematical Physics" workshop in Banff from September 20 - 25, 2020.
  - [WIN5: Women in Numbers 5](#), The Banff International Research Station will host the workshop in Banff from November 15- 20, 2020.
  - [WAM, The Women and Mathematics Program](#) at the Institute for Advanced Study is an annual program. The 2020 WAM program is about the Mathematics of Machine Learning.
  - [Women in Algebraic Geometry](#) July 27 - 31, 2020 at ICERM.
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## MEETINGS

- [MSRI Symposium in Honor of Julia Robinson's 100th Birthday](#), MSRI, USA, December 9, 2019. A workshop, free and open to the public, to celebrate the legacy of UC Berkeley mathematics professor Dr. Julia Robinson (1919-1985) who was an internationally renowned logician, the first woman president of the American Mathematical Society, and the first woman mathematician elected to the National Academy of Sciences.

## GENDER GAP IS REAL

Article written by Marina Menga reviewing the final meeting of the Gender Gap in Science project (the article is published on [ICTP web page](#))

ICTP hosted during the week of November 7 the “[Conference on Global Approach to the Gender Gap in Mathematical, Computing and Natural Sciences: How to Measure It, How to Reduce It?](#)”: [indico.ictp.it/event/8731/](http://indico.ictp.it/event/8731/). The conference marks the end of a three-year collaborative project called “[Gender Gap in Science](#)”: <https://gender-gap-in-science.org/>, whose goals were to study the barriers that prevent women from achieving success in science research and to produce data to eliminate these barriers and promote equity in science.

The multidisciplinary project was funded by the [International Science Council](#) : <https://council.science/>, and involved 11 international scientific organizations, including such as the [International Mathematical Union](#) (IMU), the [International Union for Pure and Applied Chemistry](#) (IUPAC), the [International Union for Pure and Applied Physics](#) (IUPAP), [UNESCO](#) and the [Organization for Women in Science for the Developing World](#) (OWSD).

Marie-Françoise Roy, emeritus professor of mathematics at the [University of Rennes 1](#), France, and IMU's chair of the [Committee for Women in Mathematics](#), was also a director of this conference and explained that the project will actually last two more months, with the final recommendations and conclusions to be presented in December. “The main goal of this event is to distribute the preliminary report of the project and then to receive an input from all the participants,” said Roy. “At the end of this week all the suggestions and feedback will be put together and every participant will feel that they played a significant role in designing the final recommendations.”

The project, which started in 2017, had three main tasks to complete. The first one was the “[Global Survey of Mathematical, Computing, and Natural Scientists](#)”, <https://gender-gap-in-science.org/work-packages/global-survey/>. This survey collected the answers of more than 30,000 respondents in more

than 150 countries. Its objective was to ask scientists, both male and female, about their career experiences and about the challenges that they encountered to achieve success in academia. The collected data will allow a deep overview of the situation, focusing on women working in the fields of physics, chemistry, astronomy, biology, computer science, mathematics, and history and philosophy of science and technology.

“At the moment, the main message that we can draw from the survey is that the gender gap is very real,” said Roy. “This is true globally and almost in every discipline, although there are some fields like biology in which women are more present, if compared to other fields like physics or mathematics. Particularly significant is the evidence of gender discrimination and sexual harassment.”

The project's second task was the “[Joint Data-backed Study of Publication Patterns](https://gender-gap-in-science.org/work-packages/publication-patterns/)”, <https://gender-gap-in-science.org/work-packages/publication-patterns/>, an online tool aimed at investigating the gender imbalance of the scientific publications output between female and male researchers, across countries and fields of research. “What we can see is that the proportion of women publishing science papers is increasing over time,” said Roy. “But we can also see that women scientist are not more present than they were in the past in the highest institutions and journals, and therefore they never seem to reach the top level in research.”

The third and final task of the project was the “[Database of Good Practices for Girls and Young Women, Parents, and Organizations](https://www.mathunion.org/cwm/gender-gap-in-science-database)”, <https://www.mathunion.org/cwm/gender-gap-in-science-database>, intended to work as a collector of all the initiatives that exist around the world to encourage the involvement of women in science.

“The database is already online on the IMU website,” added Roy, “and is expected to expand with the addition of more and more initiatives, like the [Career Development Workshop for Women in Physics](https://indico.ictp.it/event/8877/), [indico.ictp.it/event/8877/](https://indico.ictp.it/event/8877/), that took place last week here at ICTP.”

The organizers chose ICTP as the ideal environment for hosting such a conference. “We wanted to do something at an international level, and ICTP has

been crucial in helping us support people coming from developing countries,” said Roy.

In December the project will be concluded, but many things still need to be done. The organizers hope that the activities will continue for at least another year, to finalize the tools developed over the past three years and start new initiatives.

“I am very optimistic about the future of the project,” said Roy, “but for the moment we are not sure of what will happen. We are happy with what we were able to do until now, but the long-term plan is to produce useful tools capable of living after the end of the project.”



# A global approach to the gender gap in the mathematical, computing, and natural sciences: How to measure it? How to reduce it?

by Merrilyn Goos

The aim of this ISC-funded project is to collect and analyse data on the gender gap in sciences and to provide easy access to materials proven to be useful in encouraging girls and young women to study and pursue education and careers in the mathematical, computing, and natural sciences. (More information about this project can be found at <https://gender-gap-in-science.org/>.) To achieve the latter aim the project team has created a database of good practices that address the gender gap in sciences.

The database comprises 67 gender initiatives from more than 44 countries in Africa, the Asia-Pacific, North America, Latin America and the Caribbean, Oceania, Eastern Europe and Western Europe. We sourced these initiatives using conference networks, online searches, and targeted requests to ensure global coverage.

The initiatives are categorised according to several dimensions such as Target Level, Country, Discipline, Evidence of Effectiveness, Impact, and Gender Objective. For the latter dimension we adapted the Science, Technology and Innovation Gender Objectives List (STI GOL) developed by UNESCO. The STI GOL was used as a conceptual schema to capture elements of “good practice” regarding each initiative.

The STI Gender Objectives that structure the good practice database are:

- 1: Change perceptions, attitudes, behaviours, social norms and stereotypes towards women in STEM in society;
- 2: Engage girls and young women in STEM primary and secondary education, as well as in technical and vocational education and training;
- 3: Promote access to and retention of women in STEM higher education at all levels;





- 4: Promote gender equality in career progression for scientists and engineers;
- 5: Promote the gender dimension in research content, practice and agendas;
- 6: Promote gender equality in STEM-related policy-making
- 7: Promote gender equality in science and technology-based entrepreneurship and innovation activities.

As well as providing web links to each initiative, the database will include summaries of the initiatives in English, French, and Spanish. It will be hosted by the IMU and will be accessible via a web link from the IMU website.

Links to three examples of initiatives in the database are provided below:

WiSci Girls STEAM Camp: <https://www.girlup.org/wisci/#sthash.M3OsO2F3.dpbs>

Indian Girls code: <https://www.robotixedu.com/indian-girls-code.html>

Hungarian Women in Science: <https://www.efforti.eu/consortium/association-hungarian-women-science-nate>

The finished database will have a facility for users to submit their own gender initiatives for review and possible inclusion. We invite readers to try out the database when it “goes live” on the IMU website, and to consider contributing their own gender initiatives to this important repository of good practices.



### About the Author:

Merrilyn Goos is Professor of STEM Education and Director of EPI\* STEM, the National Centre for STEM Education, at the University of Limerick, Ireland.

She is an internationally recognized mathematics educator whose research is known for its theoretical innovation and strong focus on classroom practice. Her research interests have included students' mathematical thinking, the impact of digital technologies on mathematics learning and teaching, the professional preparation and development of mathematics teachers, numeracy across the curriculum, curriculum and assessment reform, and teaching and learning in higher education.