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CMS NOTES de la SMC

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Taylor Series or Taylor Swift

Cover Article

December 2023 (Vol. 55, No. 6)

Termeh Kousha (Canadian Mathematical Society)

Executive Director

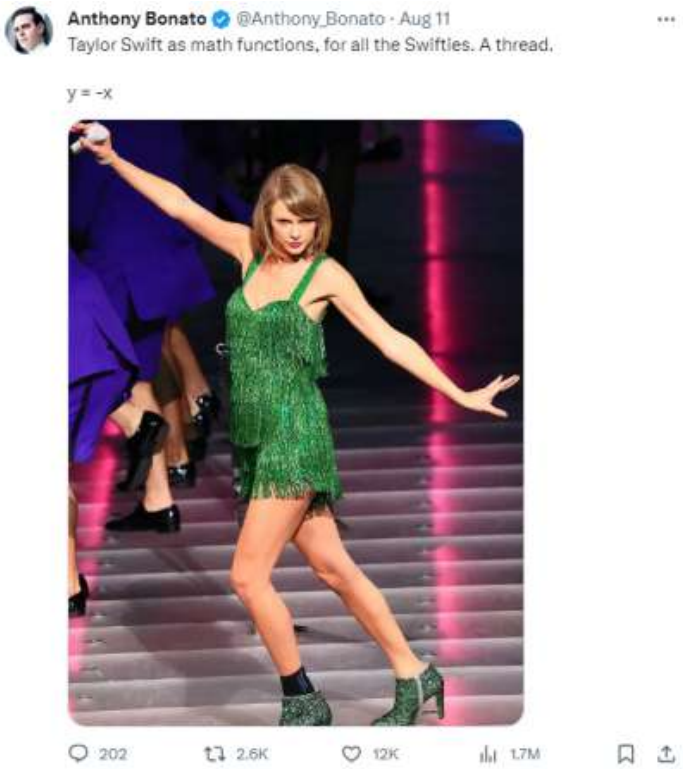
As I look back on the past twelve months, I find myself immersed in a tapestry of achievements, challenges, and invaluable experiences. Amidst the ever-changing landscape of education and outreach, I feel satisfied with the strides the Society has taken and are continuing to take. This year again, the CMS hosted and took part in successful competitions (including our newly launched Canada Lynx Mathematical Competition), we held productive and collaborative meetings (including a new online meeting), and we offered memorable camps, amongst many endeavours.

For the second year running, we were able to hold our Summer and Winter Meetings in person. For us at the CMS Executive Office, being in Ottawa for the Summer Meeting posed an added challenge: we had to juggle our family lives at home and host the meeting for long hours. Nevertheless, the Summer Meeting was a real success, in part thanks to our Scientific Directors Dr. Monica Nevins (University of Ottawa) and Dr. Aaron Tikuisis (University of Ottawa). We hosted a record number of attendees for an in-person Summer Meeting, 40 sessions were offered, as well as a public lecture in a full room.

What's more, at the end of November, our newly formed Education Meeting Committee hosted a new online meeting, the CMS Education Meeting, which was established with the purpose of complementing in-person math education sessions at both of our yearly meetings.

As I write these lines, I am looking forward to traveling to Montréal for our Winter Meeting! Our Scientific Directors (Dr. François Bergeron, UQAM; Dr. Simone Brugiapaglia, Concordia and Dr. Alina Stancu, Concordia) have prepared a high-quality program featuring 30 sessions, 4 mini-courses, and a workshop.

On a different note, we had to look for new dates for our 2024 Winter Meeting, as Taylor Swift announced new concert dates in Vancouver that are to take place at the same time as the originally planned meeting, in the same city, and even in the same neighborhood. Although I am a huge Taylor Swift fan, I already know which of the two events I would be attending (hint: it's the one where tickets don't cost thousands of dollars!). We can now officially announce that the 2024 CMS Winter Meeting will take place in Richmond, BC, from November 29 to December 2. I hope to see you there!



Mathematical Functions for Taylor Swift by Anthony Bonato posted on X

This year has been a great one for competitions.

At EGMO, all members of the Canadian girls' math team won medals. History was also made when the CMS sent the first ever transgender contestant to EGMO; we continue to work towards addressing the social and economic hurdles that hinder the participation of students from under-represented groups in advanced mathematics and STEM programs.

At IMO, I was very proud to see Math Team Canada rank 5th out of 112 participating countries, which tied our best result ever.

Then, in the fall, we launched a new competition, the Canada Lynx Mathematics Competition (CLMC), which was created to reflect our values at CMS of making mathematics more inclusive and accessible to all. In fact, the CLMC is open to students from kindergarten to grade 12 and aims to spark students' interest in mathematics, regardless of their skill level, to increase students' confidence in their mathematical abilities, and to present mathematics as a fun and playful subject to students. For its first edition, the CLMC attracted nearly 2,250 participants, a number we can be very proud of, given the limited publicity we had time to do prior to the competition.

In 2023, with the lifting of most pandemic-related restrictions, many Math Camps resumed operation in-person. We were able to organize 19 camps, including 14 Regional Camps. This enabled us to reach more young mathematical minds across the country, and we hope to continue expanding our activities in the years to come.

We were also very proud to host a new day camp in Ottawa, the CMS Summer Math Camp, where any youth interested in mathematics could join us without having received an invitation. Once again, in line with our CMS values of inclusion and accessibility, this camp gave everyone a fair chance to discover mathematics in a fun way. This is certainly another initiative we hope to repeat in the future.

Based on communications with past, present, and potential organizers, it is expected that 2024 will be a record year for the number of CMS Math Camps organized across Canada.

I am also delighted to announce that we have very recently renewed our partnership with Cambridge University Press, thanks to the many efforts of our colleagues Dr. David Pike, Dr. Javad Mashreghi, Dr. Patrick Ingram, and Dr. Barbarba Csima.

2023 was a year of new beginnings and new initiatives. None of this would have been possible without the amazing staff of the CMS Executive Office. Julia, Maria, Stephanie, Steve, Sarah, Trevor and Xinxin, your hard work and dedication are very important and appreciated. Last but by no means least, I'd like to thank Yvette and wish her all the best in her retirement. Yvette originally retired this summer, but she has agreed to stay with us and help out until the end of the year. Yvette, I can't thank you enough for all you've done for CMS. Your departure will be deeply felt, but I am truly grateful for all the knowledge and experience you have shared with us. I am very excited for Stephanie to take over for Yvette, and I am confident she will excel in this role (as she already has been).

To finish, I also would like to thank the members of the Executive Directors, Board of Directors, the members of the Committees and Editorial Boards, as well as all the CMS members for their continued support of the CMS. The trust you place in us is so valuable, and the Society would not be able to do all it does without your ongoing cooperation.

In 2023, my heart was broken more than once as a result of the many devastating events that took place throughout the world. My sincerest wishes for 2024 are that empathy, love, camaraderie, open-mindedness and, above all, peace, reign in the world.

I would like to finish this article with a quote from a famous Iranian poet Saadi Shirazi (13th century).

> *"Human being are members of a whole,*
> *In creation of one essence and soul.*
> *If one member is afflicted with pain,*
> *Other members uneasy will remain.*
> *If you've no sympathy for human pain,*
> *The name of human you cannot retain!"*
>
> *بنی آدم اعضای یکدیگرند، که در آفرینش ز یک گوهرند*
> *چو عضوی به درد آورد روزگار، دگر عضوها را نماند قرار*
> *تو کز محنت دیگران بی غمی، نشاید که نامت نهند آدمی*

The Point of the Exercise

Editorial December 2023 (Vol. 55, No. 6)

Professor Robert Dawson (Saint Mary's University)
Editor-in-Chief, CMS Notes

I am not certain what has motivated the Quebec government's proposal to raise tuition fees at McGill, Concordia and (perhaps) Bishop's to unaffordable levels. The suggestion that a few thousand Anglophone students are somehow threatening the French language in Quebec (or even in Montreal) is absurd. Not only do many of those students learn a reasonable amount of French, and use it when appropriate, but their numbers are put in the shade by the far larger numbers of Anglophone tourists who visit Quebec every year.

It's true that many Canadian universities outside Quebec have higher rates for international students and (to a much lesser extent) for students from other provinces. The first is unfortunate, and only justified by the contribution that it makes to the operation of the university. In Quebec, the plan seems to be that the planned $20,000 tuition increase for foreign students will not stay with the university that has to collect it (and lose students thereby): it will be taken from them and used to subsidise other universities. As for students from other provinces: those differential fees (though much smaller than what Quebec now proposes) are also invidious, and a mutual agreement to stop charging them would be an excellent idea. Quebec has entered into agreements with other countries to treat their students as local. Would they make the same sort of bilateral agreement with the rest of Canada that they are happy to make with France and Belgium? Sadly, it seems unlikely.

It doesn't seem plausible that raising fees will encourage students to speak French more. Do François Legault and Pascale Déry really have romantic visions of Madison (from Chicago) turning to Logan (from Edmonton) at a party and saying "Hey, Logan, seeing that we're paying so much to be here, maybe we oughta be practicing our French a little, huh? Know any good irregular verbs?" It might get a grin out of Logan, but probably no language practice. McGill's (refused) offer to require French classes would have been far more effective.

Is the idea to drive these students away, so that their voices will not disturb the peace of the Quebec streets? Even that makes no sense. Montreal has a huge non-student anglophone population, who will continue to speak English. As for Bishop's, I doubt if Legault and Déry have ever lost much sleep worrying about what language is spoken in the quiet streets of Lennoxville. In most other parts of Quebec, most of the English that gets spoken is spoken by or to tourists. To be consistent, perhaps the CAQ should institute a hundred-percent tax on hotel rooms rented to anybody without a Quebec driver's license, but I don't see this happening.

But driving so many students away would have one big effect within Quebec: it would do terrible damage to the Anglophone universities, maybe irremediable damage. It's just possible that Legault and Déry have overlooked this, in their enthusiasm to hear less English on rue Sherbrooke. I would hate to think that it was the point of the exercise.

Quebec has several excellent Francophone universities, notably the Université de Montréal and Laval. The last two, in particular, are ranked in the top few hundred in the entire world. But Quebec also has one university that is always ranked in the top hundred, often the top fifty: McGill. Driving away thousands of students — not just the ones paying the highest fees, but in many cases the ones who had their choice of many top universities and chose McGill — would make it difficult for this high profile to be maintained. Surely the CAQ cannot be intending such an act of cultural and intellectual vandalism, merely out of pique that the top-ranked university in the province is not francophone? Would Quebec really be better off with no world-class university than with one that operates in English?

Nora Franzova (Langara College, Vancouver)

Education Notes brings mathematical and educational ideas forth to the CMS readership in a manner that promotes discussion of relevant topics including research, activities, and noteworthy news items. Comments, suggestions, and submissions are welcome.

Les Notes pédagogiques présentent des sujets mathématiques et des articles sur l'éducation aux lecteurs de la SMC dans un format qui favorise les discussions sur différents thèmes, dont la recherche, les activités et les nouvelles d'intérêt. Vos commentaires, suggestions et propositions sont les bienvenus.

John Grant McLoughlin, *University of New Brunswick (johngm@unb.ca)*
Kseniya Garaschuk, *University of the Fraser Valley (kseniya.garaschuk@ufv.ca)*

The mathematical community at large is engaged in many endeavours at any given time. *Education Notes* offers an avenue for bringing attention to efforts bridging education and mathematics. The sharing of pertinent activities is encouraged. One such activity took shape in the summer of 2023 in Banff. A brief report on the experience is offered here from Nora Franzova, one of the participants at the workshop.

"Every year on a second Thursday
after the first full moon in July –
follow the Hoodoos Trail for 10 minutes
down the slope through the woods
to where it meets the river.

Mathematicians, artists and friends
are invited to swim together from
6pm – 7pm."

This invite can be found in a framed picture in one of the downstairs breakout rooms of the TransCanada Pipelines Pavilion in Banff International Research Station (for Mathematical Innovation and Discovery). The photo next to it depicts a happy group (most likely mathematicians) in bathing suits braving the shallow waters. The photo is not recent, but it made me wonder if this event is still happening. I was unable to check since the workshop I attended was a week after the second Thursday mentioned in the note.

The workshop that I attended was entitled *Putting Together Resources to Support Current and Future Elementary School Teachers*, and the organizers were Melania Alvarez Adem (UBC), Pamela Brittain (Fields Institute), Shawn Desaulniers (U Alberta), Frédéric Gourdeau (Laval) and John Grant McLoughlin (UNB). Perhaps missing from the title was that we would be creating resources only for our favourite subject, **mathematics.**

The organizers applied for the grant over two years ago, and now their efforts were ready to start to shape and bear fruit. During the introduction round I was fascinated by a very diverse group of participants with representatives from several universities (capturing the French and English speaking audience), elementary schools, and specific programs (like PIMS, JUMP Math, and Fields Institute). All of the participants have the mathematical preparation of future elementary school teachers as one of their professional priorities.

The meeting was held in mixed mode (a couple of participants were online only) and soon it was clear that we all came with a vision of what is needed, what can be done and what needs to be done.

We started by sharing many amazing resources that we all have used and enjoyed. Here is where our ***passion*** for mathematics really showed. Presentation of these readily available materials filled the program of the first day. Resources were from various parts of the country (both in French and English), and they ranged from preparation for elementary school teachers, through materials used directly by teachers to materials used for professional development of secondary school teachers. There is an incredible number of resources already prepared and ready, and we had a lot of fun comparing and sharing ideas, topics, games, puzzles, book titles, and prepared lecture notes. Here we realized that careful ***planning*** is needed if we want to create meaningful additions to the already plentiful materials.

The next step was to define our ***purpose***, since we noticed that we are mixing two large topics – materials that elementary school teachers use in their classroom and materials that we use in our classrooms while teaching the future and current elementary school teachers. Discussion naturally flowed between the two and several times we had to step back and make a focused decision about what we wanted to talk about. We also needed to clarify that our purpose was not focused on pedagogy but rather on the content and learning outcomes of the mathematics courses that future elementary school teachers take.

After stepping back from the initial excitement, we split the workshop into four groups that were each assigned a subject to tackle: *Fractions, Numeration, Geometry, and Algebra*. One might argue that other areas should also be included, but when we did our short prioritizing exercise, these four areas emerged as key points to address.

Each group started by gathering materials and preparing a few paths in tackling the topics. The following days were divided into short presentation talks and breakout session discussions within each topic area.

I have emphasized three P's of success (Passion, Planning, Purpose). However, it is actually known as the Four P's of success. The fourth P stands for ***perseverance*** and that is what we need now. After the week in Banff we realized that while this project exists in our minds loud and clear, it will take no small amount of work for our goals to be achieved. To complete all that we hope to do, we need at least two years, financial and technical support and lastly, but perhaps most importantly, perseverance. We need to be working on the project and coming back to our mission similarly like those mathematicians, artists and friends, mentioned at the beginning of this article, that come back

"Every year on a second Thursday
after the first full moon in July –…. "

We too will hopefully come back.

Participants of the *Putting Together Resources to Support Current and Future Elementary School Teachers* workshop, in Banff, July 23rd, 2023.

Summary: The diverse group of mathematicians, math educators and math enthusiasts that met in Banff on July 23, 2023 was able to close their meeting by drafting a mission statement:

Our objective is to provide materials and resources to strengthen the understanding of elementary school mathematics for both future and current teachers. This will be achieved through engagement with mathematical experiences designed to inspire curiousity and enjoyment through doing mathematics.

Watch for more to come.

Editor's Note: Those interested in learning more about the project can find a description along with select contributions to the workshop at https://www.birs.ca/events/2023/5-day-workshops/23w5150.

Christopher Baltus (SUNY Oswego [retired])

CSHPM Notes brings scholarly work on the history and philosophy of mathematics to the broader mathematics community. Authors are members of the Canadian Society for History and Philosophy of Mathematics (CSHPM). Comments and suggestions are welcome; they may be directed to the column's co-editors.

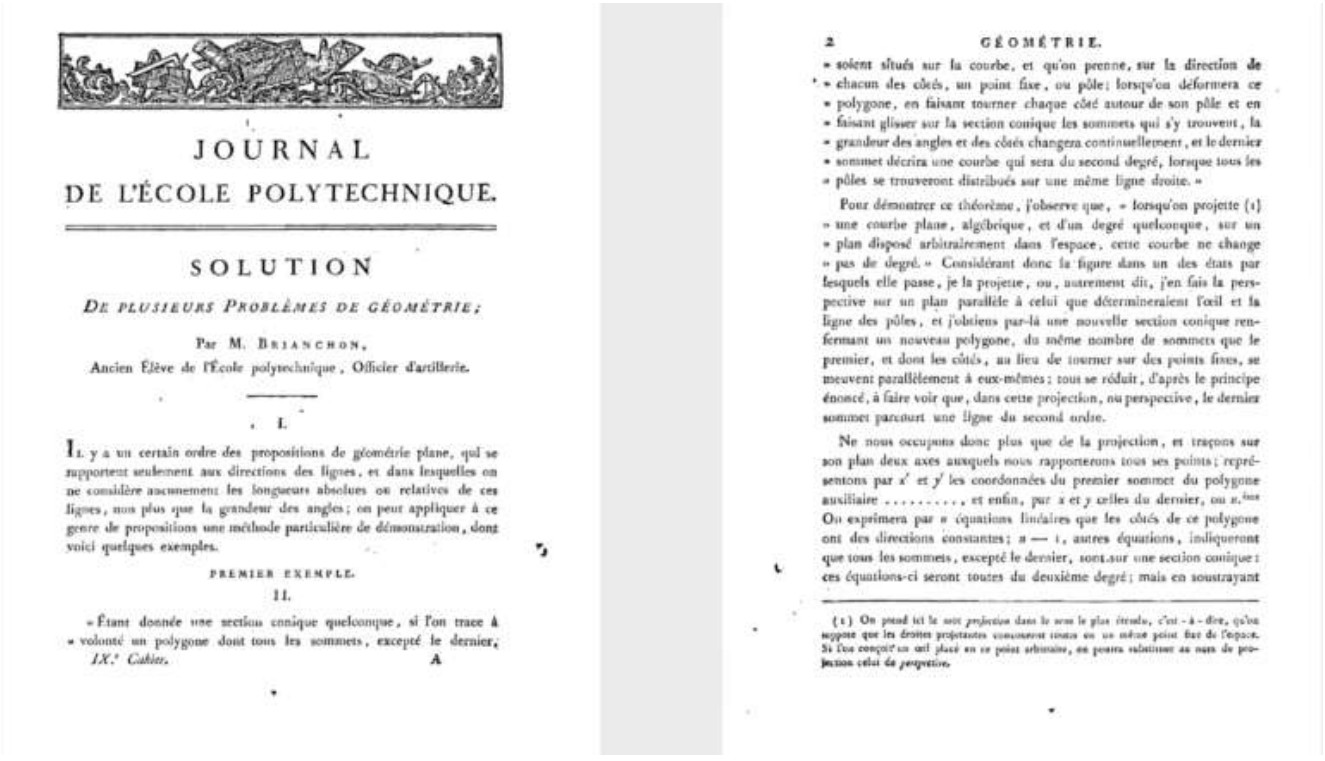
Amy Ackerberg-Hastings, *independent scholar (aackerbe@verizon.net)*

Hardy Grant, *York University [posthumous]*

The nature of geometry changed dramatically between 1800 and 1855. My interest in that topic and time period began a number of years ago, as my enthusiasm for geometry, particularly of the synthetic type, merged with an even older enthusiasm for history. Following geometry through the centuries, I saw an interesting story line emerging. Ancient Greeks envisioned geometric figures as stationary, and they showed almost no interest in propositions about collinear points or concurrent lines. The exceptions are Menelaus's Theorem and various propositions from Pappus, but those ideas emerged only in the late ancient period.

Coherent work involving movement of a sort, by plane-to-plane projection, together with incipient projective geometry and propositions about collinear points and concurrent lines, appeared in a burst in the 17th century, with Girard Desargues [6; 7], Blaise Pascal [15], and Philippe de La Hire [9]. (It is worth noting that Desargues made great use of Menelaus's Theorem.) But, for lack of interest, the publications by these authors that were the most projective in approach were soon lost or forgotten.

Around 1800, the atmosphere changed. After the publication of Adrien-Marie Legendre's *Éléments de géométrie* of 1794 [10], which would have felt familiar to Greek geometers of two millennia earlier, Gaspard Monge [14] and Lazare Carnot [4; 5] presented a variety of propositions involving collinear points and concurrent lines. Forgotten propositions, including Desargues's Theorem and Pascal's Hexagon Theorem, were rediscovered. They appeared at first without credit to their discoverers, and proofs were not projective, but in 1822 J. V. Poncelet [20] would prove them by projective methods and properly note their discoverers. Of particular importance to Poncelet was an 1810 article by Charles Julien Brianchon [3] in which he solved several problems by a plane-to-plane projection that let one line of points "pass to infinity," as Poncelet put it.



JOURNAL

DE L'ÉCOLE POLYTECHNIQUE.

SOLUTION

DE PLUSIEURS PROBLÈMES DE GÉOMÉTRIE;

Par M. BRIANCHON,

Ancien Élève de l'École polytechnique, Officier d'artillerie.

I.

Il y a un certain ordre des propositions de géométrie plane, qui se rapportent seulement aux directions des lignes, et dans lesquelles on ne considère aucunement les longueurs absolues ou relatives de ces lignes, non plus que la grandeur des angles; on peut appliquer à ce genre de propositions une méthode particulière de démonstration, dont voici quelques exemples.

PREMIER EXEMPLE.

II.

« Étant donnée une section conique quelconque, si l'on trace à « volonté un polygone dont tous les sommets, excepté le dernier,

IX.e Cahier. A

2 GÉOMÉTRIE.

« soient situés sur la courbe, et qu'on prenne, sur la direction de « chacun des côtés, un point fixe, ou pôle; lorsqu'on déformera ce « polygone, en faisant tourner chaque côté autour de son pôle et en « faisant glisser sur la section conique les sommets qui s'y trouvent, la « grandeur des angles et des côtés changera continuellement, et le dernier « sommet décrira une courbe qui sera du second degré, lorsque tous les « pôles se trouveront distribués sur une même ligne droite. »

Pour démontrer ce théorème, j'observe que, « lorsqu'on projette (1) « une courbe plane, algébrique, et d'un degré quelconque, sur un « plan disposé arbitrairement dans l'espace, cette courbe ne change « pas de degré. » Considérant donc la figure dans un des états par lesquels elle passe, je la projette, ou, autrement dit, j'en fais la perspective sur un plan parallèle à celui que détermineraient l'œil et la ligne des pôles, et j'obtiens par-là une nouvelle section conique renfermant un nouveau polygone, du même nombre de sommets que le premier, et dont les côtés, au lieu de tourner sur des points fixes, se meuvent parallèlement à eux-mêmes; tous se réduit, d'après le principe énoncé, à faire voir que, dans cette projection, ou perspective, le dernier sommet parcourt une ligne du second ordre.

Ne nous occupons donc plus que de la projection, et traçons sur son plan deux axes auxquels nous rapporterons tous ses points; représentons par x' et y' les coordonnées du premier sommet du polygone auxiliaire ....., et enfin, par x et y celles du dernier, ou $n.^{ième}$. On exprimera par n équations linéaires que les côtés de ce polygone ont des directions constantes; $n - 1$, autres équations, indiqueront que tous les sommets, excepté le dernier, sont sur une section conique; ces équations-ci seront toutes du deuxième degré; mais en soustrayant

(1) On prend ici le mot *projection* dans le sens le plus étendu, c'est-à-dire, qu'on suppose que les droites projetantes concourent toutes en un même point fixe de l'espace. Si l'on conçoit un œil placé en ce point arbitraire, on pourra substituer au nom de projection celui de *perspective*.

Figure 1. The first two pages of Brianchon's article [3]. Gallica.

This began a flood of geometric transformations and relationships, called *Verwandtschaften* by A. F. Moebius in his *Der Barycentrische Calcul* [11]. That 1827 work gave the first overview of transformations. Moebius examined four different geometric relationships, starting with *equality*, *similitude*, and *affinity*. *Similitude*, now called *dilation*, the topic of Euler's E693 [8], was thoroughly developed by Poncelet in 1813, 1820, and 1822 [18; 19; 20]. Moebius's fourth transformation was new and the most general, the *collineation*. He set his transformations in a plane whose elements were real triples, except $(0, 0, 0)$, with the homogeneity property, namely, that for $k \neq 0$ triples (a, b, c) and (ka, kb, kc) represent the same point. Moebius demonstrated a remarkable property, that given any four points A, B, C, D, no three collinear, then any point P could be represented as $aA + bB + cC + dD$, and for any choice of four points A', B', C', D', no three collinear, then $P' = aA' + bB' + cC' + dD'$ defines a collineation, and any collineation could be defined this way. (He characterized an *affinity*, a collineation mapping parallel lines to parallel lines, in a corresponding way, with three non-collinear finite points.) With modification to Moebius's homogeneous coordinate system by Julius Plücker in 1831 [17], the triples form what we now recognize as the *real projective plane*. In that plane, a *collineation* is the same as a *projectivity*.

Plane-to-plane projection was the basis for *homology*, as developed by Poncelet in his 1822 *Traité des Propriétés Projectives des Figures* [20]. The line of intersection of the two planes, the *axis*, is a line of fixed points. Poncelet showed that a homology can operate in a single plane when one of the two planes is rotated about the axis to coincide with the other, but still with a line of fixed points.

The *projective transformation*, in synthetic geometry, was created by Jacob Steiner [23]. He began with *elementary forms*, in particular the *line* of points and the *pencil*, *Strahlbüschel*, of concurrent lines; then related the elementary forms by *perspectivities*; and, finally, defined a *projectivity* as a composition of perspectivities.

Where Poncelet, in 1813, had declared that a conic section was the plane-to-plane projection of a circle, Steiner defined a point conic to be the set of points of intersection of corresponding lines in projectively related pencils. (Poncelet's *Notebooks*, written as a prisoner in Russia in 1813–1814, were only published in 1862 [21].)

Another transformation, *inversion* (over a circle), anticipated in work of the 1820s, was developed into modern form by Giusto Bellavitis in 1836 [2].

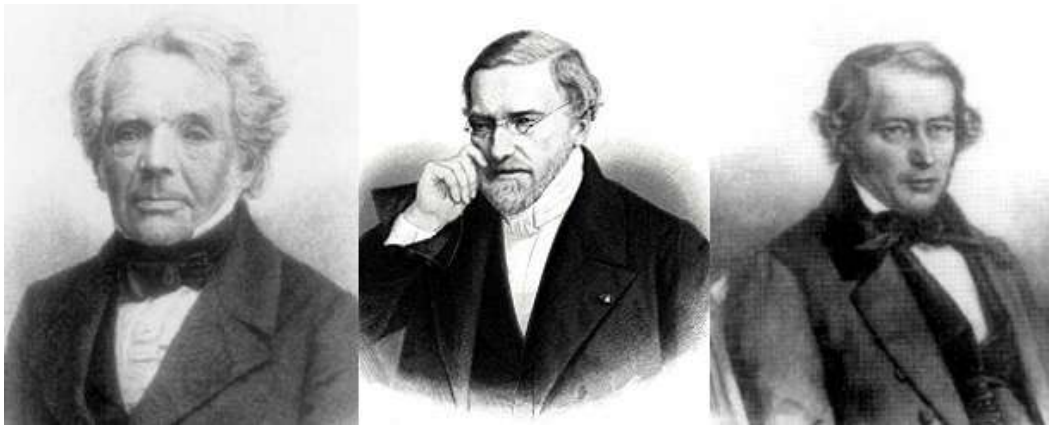


Figure 2. Moebius, Poncelet, and Steiner. *Convergence* Portrait Gallery.

Why do I end this period of transformations in 1855? First, I wished to include important works in the line of development sketched above, especially K. G. C. von Staudt's 1847 *Geometrie der Lage* [24]. Von Staudt placed projective geometry in a more abstract setting; his book, for example, has no figures. The book includes two proofs of Moebius's theorem that a projectivity is a collineation determined by four points, no three collinear, and their images. Von Staudt committed himself to removing any dependence on length from his geometry. Significantly, the cross-ratio of four collinear points, whose invariance was Steiner's main identifying property of a projective relation, depends on length, so von Staudt chose an alternative, invariance of the harmonic relation. That works because the *complete quadrilateral*, introduced by Carnot, was a non-metric concept, and it determined a harmonic set of four points. In later years, geometers tended to follow von Staudt's penchant for abstraction, and many would require that a truly projective geometry be non-metric.

A second important transitional work was Moebius's second paper [12] on what has come to be called the *Moebius transformation*. Without using the function definition of the *Kreisverwandtschaft*, as he called it, Moebius derived the familiar properties, including the invariance of the cross-ratio among four complex points, not necessarily collinear. He was a pioneer in setting his work in the complex plane.

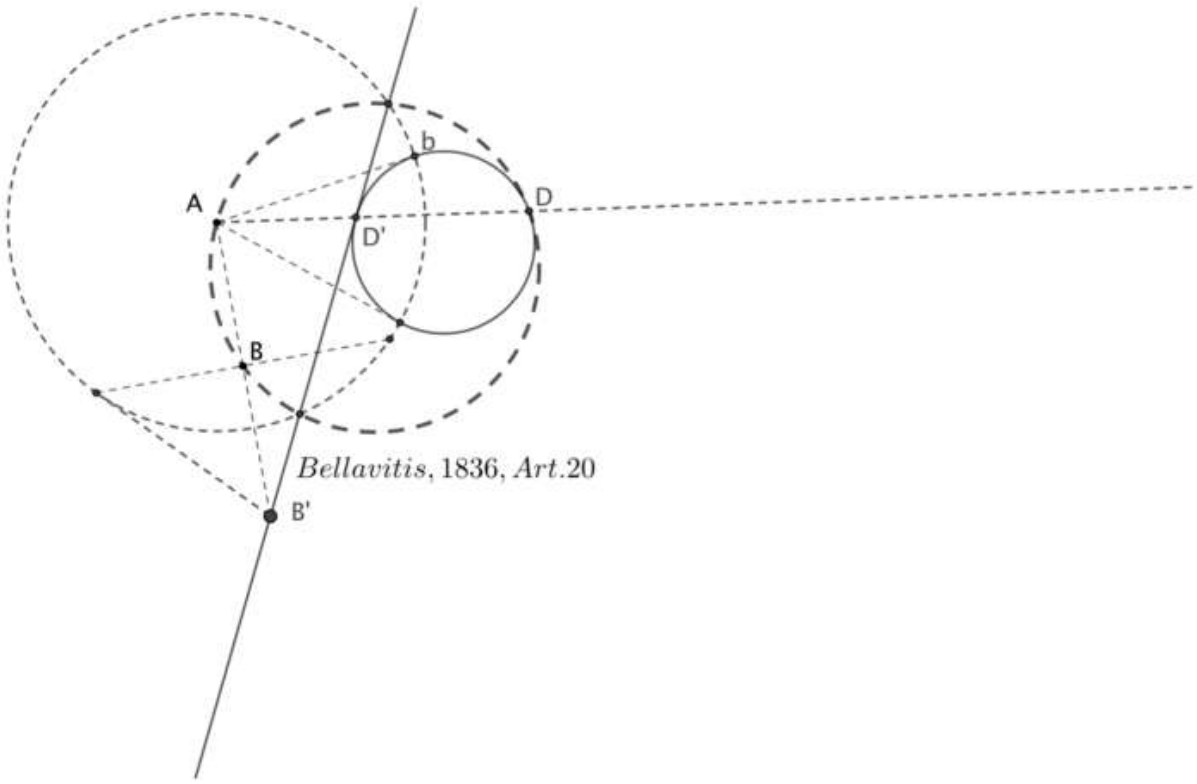


Figure 3. Illustration of inversion described by G. Bellavitis [1836, Art. 20], "Construct a circle which passes through two given points $A \backslash B$ and is tangent to a given circle Db." Figure created by the author.

Two notable works signaled a new direction in geometry. The first was Bernhard Riemann's inaugural lecture at Göttingen in 1854, on the bases of geometry [22]. The second involved von Staudt. While his 1847 *Geometrie der Lage* followed the trajectory of contemporary work in projective geometry, by contrast his *Beiträge zur Geometrie der Lage*, which appeared in three volumes from 1856 to 1859 [25], introduced a complex projective space and an algebra derived from geometric axioms, and it greatly influenced geometry in the coming years.

And where does my work with this material stand? A narrowly focused paper, "Poncelet's discovery of homology," was recently published [1]. My current project is a book that combines history with the exposition of the mathematics involved, written with an undergraduate mathematics major in mind. It is the sort of project that retirement makes possible.

Christopher Baltus earned a PhD at the University of Colorado in 1984, and taught 33 years at SUNY Oswego. He and his wife retired in 2019 and moved to Poughkeepsie, NY. In retirement he still rides a bicycle, reads history and mathematics, and is a volunteer mathematics aide in an elementary school. He notes that this article was written under guidance from Hardy Grant, whose wisdom and kindness will be greatly missed.

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Graham Wright Award for Distinguished Service

Dr. Dorette Pronk (Dalhousie University)

Dr. Pronk has made consistent and significant contributions to the Canadian mathematical community and to the Canadian Mathematical Society. She has served as the Chair of the Math Competitions Committee since 2016, as Chair of the IMO Committee from 2014 till 2015 and as Chair of the EGMO committee since 2018. Additionally, she has represented Canada many times as leader and deputy leader of Math Team Canada, at the International Math Olympiad, the European Girls Math Olympiad and the Pan American Girls Math Olympiad. In 2018, she was instrumental in securing Canada's first participation in the European Girls Math Olympiad. She has also served as member of the Women in Math Committee and was part of the team organizing the first Connecting Women in Math Across Canada workshop.

Dr. Pronk is a Professor of Mathematics at Dalhousie University whose research program is in category theory with applications to geometry, topology, and computational semantics. She serves on the boards of the Applied Category Theory conferences and the Foundational Methods in Computer Science workshops, and she serves on the editorial board of two category theory journals: Cahiers de Topologie et Géométrie Différentielle Catégoriques and Applied Categorical Structures. She has also served on the Executive Committee of AARMS (the Atlantic Association for Research in the Mathematical Sciences) and the Mathematics and Statistics Committee of Science Atlantic.

She is active in local outreach in Nova Scotia, as organizer of the Dalhousie Math Challenge Club and former faculty advisor of the Nova Scotia Math Circles. She was instrumental in securing the second round of funding by Eastlink for this program. In collaboration with Nova Scotia Math Circles, she has recently started the Indigenous Math Circle, a new after-school math program for Indigenous students in the Halifax Regional Centre for Education.

A common theme expressed by those who nominated Dr. Pronk is her care and dedication to personal mentorship, providing encouragement and advice along with compassion. To quote some of their words:

> *"The essence of Dr. Pronk's activities is attention to each young person, and encouragement of their potential through personal effort."*
>
> *"Dorette made for a truly excellent leader beyond just organizing the opportunity as well; she was incredibly hands-on and made sure to provide us with much support, organize social activities, and get to know and support us as individuals. She made for a very compassionate and encouraging leader who would listen to our concerns and insecurities being young women in mathematics and make us feel heard and appreciated."*

Her contributions have been invaluable to raising passion for and access to mathematics among young Canadians, especially for female and non-binary students.

Dr. Pronk earned her doctorate in mathematics in 1995 at Utrecht University in the Netherlands. Since joining the faculty at Dalhousie University in 2000, she has supervised numerous undergraduate and graduate students as well as post-doctoral fellows, in whom she instills the importance of outreach work in addition to their research.

Adrien Pouliot Award

Dr. Edward Doolittle (First Nations University of Canada)

Dr. Doolittle is Kanyen'kehake, a member of the Lower Mohawk band of Six Nations. He earned a PhD in pure mathematics from the University of Toronto in 1997 with his thesis on partial differential equations. Since 2001, he has been first a faculty member at First Nations University of Canada (formerly the Saskatchewan Indian Federated College). His duties there include teaching, research, working with Elders, and service to the university and service to Indigenous communities.

Dr. Doolittle is an internationally recognized leader on Indigenous mathematics and related concepts like Indigenizing mathematics, traditional mathematics, and ethnomathematics. For two decades he has worked tirelessly to introduce us to insights around the ways in which mathematics as a field of study intersects with Indigenous knowledge systems, and the educational possibilities afforded by those different views of mathematics. Dr. Doolittle has done this through such things as his leadership of working groups at the CMS Mathematics Education Forum in 2005, a plenary address at the 2006 Canadian Mathematics Education Study Group (CMESG) Annual meeting, leadership of a working group at the 2010 CMESG Annual meeting, by playing a key role in a series of BIRS workshops dedicated to First Nations Mathematics, through his research projects with educational researchers, his publications in educational journals and books, and his extensive community outreach.

A quiet but passionate voice for change, Dr. Doolittle's service at the national, provincial, and local levels also includes serving as member of Revisioning, Reclaiming, Reconciling School Mathematics, a group of academics, educators, and administrators developing Indigenous math curriculum and policy proposals for the next round of K-12 math curriculum revision in Saskatchewan, 2015-2018; as a member of the Academic Restructuring Committee at First Nations University, 2016-2018, and as Secretary/Treasurer of the Native Heritage Foundation of Canada, 2015-2017.

Dr. Doolittle currently serves as a member of the Board of Equity, Diversity, and Inclusion for the Banff International Research Station and as a founding member of the Canadian Mathematical Society's Committee on Reconciliation in Mathematics. In addition, he makes regular invited visits to educational institutions across Canada where he shares freely his experiences and his wisdom on matters related to Indigenous knowledge and Indigenizing education.

G. de B. Robinson Award

Dr. Hector Pasten (Pontificia Universidad Catolica de Chile)

Dr. Pasten is receiving the award for his paper "Arithmetic derivatives through geometry of numbers." *(**Canadian Mathematical Bulletin**, 65(4), 906-923. doi:10.4153/S0008439521000990)*

This paper exhibits in concrete terms an analogy between derivatives in function fields, and phenomena in the geometry of numbers. Specifically, this work defines a certain class of arithmetic derivatives on the ring of integers, and shows that the existence of "small" arithmetic derivatives is equivalent to the abc Conjecture of Masser and Oesterlé. A major contribution to the Vojta dictionary between Diophantine geometry and Nevanlinna theory, this paper is sure to be a significant influence on further research in the field.

Dr. Hector Pasten is a Chilean mathematician. His research area is number theory and its connections with logic, complex analysis, and algebraic geometry. He graduated in 2014 from Queen's University (Canada) under the supervision of Ram Murty and spent the period 2014-2018 at Harvard as a Benjamin Peirce Fellow, with a stay at the Institute for Advanced Study at Princeton (2015-2016). In 2018 he joined the faculty of Mathematics at Pontificia Universidad Catolica de Chile, where he is now an associate professor. Pasten's research has been recognized with several honors such as the Governor General of Canada Academic Gold Medal (2014) the Doctoral Prize of the CMS (2015) and the Mathematical Council of the Americas Prize (2017).

CMS Blair Spearman Doctoral Prize

Dr. Toni Annala (Institute for Advanced Study, Princeton)

Dr. Annala is an exceptional researcher working at the interface of algebraic geometry and algebraic topology, focusing on the development of cohomology theories using derived techniques. During his doctoral studies at the University of British Columbia (2017-2020, 2022), where he worked under the mentorship of Dr. Kalle Karu, Annala wrote more than 10 original research articles — of which more than half are single author. Across his thesis and these articles, almost all of which are now published or accepted in excellent journals such as Annales de l'Institut Fourier, Journal of the European Mathematical Society, and Advances in Mathematics, Annala has made significant contributions to an emerging theory of derived algebraic cobordism.

In most branches of geometry and topology, mathematicians seek meaningful, computable invariants that can be used to decide when two spaces are distinct from one another from the perspective of some natural notion of equivalence. The invariants at play and the notions of equivalence are generally dictated by the level of structure enjoyed by the spaces — for instance, they may simply be topological spaces or they may be endowed with the structure of algebraic varieties over some field. They may also be smooth or singular, and this distinction often leads to significant leaps in the difficulty faced in defining invariants. Homology and cohomology are ubiquitous sources of invariants, taking on various flavours such as Chow theory and K-theory. A generalized cohomology theory that is in some sense universal amongst these is that of algebraic cobordism. It is the algebraic or motivic analogue of complex cobordism for smooth schemes (of quasi-projective type) over a field. In his thesis and papers, Annala significantly extends a deep sequence of existing work on Chow theory, K-theory, and algebraic cobordism theory, including results of Voevodsky, Fulton-MacPherson, Levine-Morel, and Levine-Pandharipande. One of the key challenges motivating this sequence of investigations has been to define bivariant versions of Chow theory and K-theory on singular varieties that include both a homology and a cohomology, so that classes can be multiplied or intersected. Annala's contribution to these works is a sweeping one: he has produced a bivariant cobordism theory, the cohomology of which generalizes the cohomology of the bivariant K-theory of Fulton-MacPherson and providing a candidate for a Chow cohomology theory, which has been open for some time.

To achieve this, Annala has made careful and deep investigations into derived algebraic geometry. Through associated techniques, he has been able to remove some restrictions in the prior work of others, such as the need for a certain homotopy invariance required to produce geometric descriptions of Grothendieck groups of vector bundles on schemes. One referee remarks that Annala's thesis work is "more on the level of a German Habilitation presented by an experienced researcher than what one might expect from a doctoral student. The work presented here has already had a significant impact on this area of research and has received corresponding international attention."

We also recognize that Annala, in parallel to his work in algebraic geometry, has been active in other areas of mathematics and science, such as topological aspects of condensed matter physics and the development of quantum algorithms, leading to further publications. His ability to pursue these investigations in parallel and with great success speaks to Annala's remarkable independence as a graduate student. Taken all together, Annala's works are suggestive of a broad vision for geometry, algebra, topology, and computation in mathematics and science. We foresee further groundbreaking work from Dr. Annala in the years to come.

Krieger-Nelson Prize

Dr. Johanna G. Nešlehová (McGill University)

Dr. Johanna G. Nešlehová (McGill University) has been named the recipient of the 2023 Krieger-Nelson Prize. Dr. Nešlehová is recognized for her exceptional contributions to Statistics, including multivariate analysis, stochastic dependence modeling, and extreme-value theory.

Dr. Nešlehová earned her PhD in Mathematics from Carl-von-Ossietzky-Universität Oldenburg in 2004. Since then, she has built an outstanding academic career with exceptional talent and a high rate of research productivity, with 43 peer-reviewed articles, as well as numerous other publications, including book chapters, conference proceeding articles, popular science articles, editorials, and the like, not to mention a popular undergraduate textbook, written in German no less!

Dr. Nešlehová is a world leader on copula models and their many ramifications in multivariate statistics, notably in relation to risk analysis and extreme-value theory, an area to which she has made numerous outstanding contributions. She is well-known for promoting statistical risk analysis in insurance and finance through her writing and through short courses. She has also made key contributions to the theory of empirical processes and has wide-ranging interests in the application of stochastic dependence and extreme values to climate and finance. In 2019, Dr. Nešlehová was the distinguished recipient of the CRM-SSC Prize in Statistics.

Her work has been published in top-ranked statistical journals, including The Annals of Statistics, ASTIN Bulletin, Biometrika, and the Journal of the American Statistical Association. She is highly engaged in international collaboration, conference speaking and organization, editorial work, and service to the profession. She is currently Editor-in-Chief for The Canadian Journal of Statistics, and she has served as Associate Editor for journals such as Test, the Journal of Multivariate Analysis and Statistics & Risk Modeling. In 2011, she received the distinction of being named an Elected Member of the International Statistics Institute, and in 2020 she was named a Fellow of the Institute of Mathematical Statistics.

In addition to these achievements, Dr. Nešlehová is also a generous and dedicated mentor for young researchers. In 2019, she was recognized for the excellence of her graduate training with the Carrie M. Derick Award for Graduate Supervision and Teaching from McGill University.
In sum, Dr. Nešlehová is an outstanding mathematical statistician and an exemplary role model. Her research accomplishments are all the more impressive given her active engagement in and service to the research community, her dedication to excellent mentorship, and her many other leadership qualities. Johanna G. Nešlehová is an indispensable member of the mathematical community, and the CMS is proud to award her the 2023 Krieger-Nelson Prize.

Coxeter-James Prize

Dr. Robert Haslhofer (University of Toronto)

Dr. Haslhofer was awarded his Ph.D. in Mathematics from ETH Zurich in 2012. Since then Dr. Haslhofer has continued on an impressive trajectory. After three years as a Courant Instructor at New York University's Courant Institute of Mathematical Sciences, he joined the Department of Mathematics at the University of Toronto in 2015. Recent recognitions of Dr. Haslhofer's work include the Andre Aisenstadt Prize (2020), a Sloan Research Fellowship (2018-2022) and an NSERC Discovery Grant (2016-2023).

Lauded by his colleagues as "one of the most distinguished and most promising mathematicians worldwide in Riemannian geometry and geometric analysis," Dr. Haslhofer's scientific work with various collaborators include novel characterizations of Ricci flows, study of mean curvature flows through neck singularities, and impressive contributions to stochastic analysis on path spaces.

In a remarkable paper with Bruce Kleiner, Dr. Haslhofer's work on mean curvature flow is largely set in a framework he developed that dramatically simplifies and unifies much of the classical theory on singularity formation. They also significantly strengthened earlier results, by establishing an interior gradient estimate that played a crucial role in their subsequent work (and independently that of Simon Brendle with Gerhard Huisken) constructing mean curvature flow with surgery for 2-convex hypersurfaces in arbitrary dimension. For surfaces in R3, this resolved a long-standing open problem.

Haslhofer's work with Aaron Naber on Ricci flow solves a deep and long-standing question in this active area: An ingenious notion of weak solution of Ricci flow is introduced through stochastic analysis on the Ricci-flow spacetime. This allows for the definition of Ricci-flow on singular spaces, and in particular yields the first satisfactory notion of Ricci flow through singularities. This work uses ideas from stochastic analysis in a profound and original way. It is a major result, likely to facilitate many important further developments. (One such is the Bochner formula that Haslhofer and Naber subsequently obtained for martingales on path space PM , a vast generalization of the classical Bochner formula for the heat flow on a manifold M . Their new formula is related to two-sided bounds on Ricci curvature in much the same manner that the classical Bochner formula on M is related to lower bounds on Ricci curvature. This breakthrough provides a new fundamental tool for the study of spaces with two-sided Ricci bounds, including Einstein manifolds and the Ricci flow.)

With Dan Ketover, Haslhofer used min-max theory to establish that every generic metric on the 3-sphere admits at least two embedded minimal two-spheres, thus disproving a conjecture of Shing-Tung Yau concerning ellipsoids.

However, his most spectacular achievement to date is the resolution of the mean-convex neighbourhood conjecture for singularities of mean-curvature flow, a twenty-year old conjecture of his PhD advisor Tom Ilmanen. Together with his collaborator Kyeongsu Choi and his former PhD student Or Hershkovits, Haslhofer resolved this conjecture first for surfaces (Acta Mathematica 2022), and then with the addition of Brian White in higher dimensions (Inventiones 2022). Instead of assuming that the initial condition possesses some form of symmetry or convexity, Ilmanen's conjecture states that it develops mean-convexity in a spacetime neighbourhood of any asymptotically cylindrical singularity (after which ex- isting theory can then be applied).

Jeffery-Williams Prize

Dr. Kumar Murty (Fields Institute)

V. Kumar Murty received his doctorate from Harvard University in 1982 as a student of John Tate. In 1987, he was appointed Associate Professor at the University of Toronto, and in 1991 he was promoted to Full Professor. He was Chair of the Department of Mathematics at the University of Toronto during 2008-2013 and again from 2014-2017. He is currently the Director of the Fields Institute for Research in Mathematical Science.

Dr. Murty's colleague, Dr. George Elliott, FRSC says, "I am happy to see my colleague's work in number theory and arithmetic geometry recognized with this prestigious award. He has made important contributions over many years, both scientifically, and in general to the discipline." Professor Murty's mathematical interests cover diverse areas including analytic number theory, algebraic number theory, information security, and arithmetic algebraic geometry.

His recent work has expanded to mathematical modelling in social, economic and health contexts. This includes his work on Smart Villages and on integrative modelling related to the COVID-19 pandemic. He has served on the Canadian Mathematical Society Board of Directors and held vice-presidency at the Canadian Mathematical Society. He was elected a Fellow of the Royal Society of Canada in 1995, Fields Institute Fellow in 2003, Fellow of the National Academy of Sciences (India) in 2011, Senior Fellow of Massey College in 2020 and a Fellow of the American Mathematical Society in 2021. He received the Coxeter-James Prize in 1991, the Balaguer Prize (together with M. Ram Murty) in 1996, and the University of Toronto's Inventor of the Year Award in 2011.

"I am touched and honoured to receive a prize named after two dedicated professionals, Jeffery and Williams, who did so much to promote the growth and development of mathematical research in Canada."—V. Kumar Murty

Cathleen Synge Morawetz Prize

Dr. Stefanos Aretakis (University of Toronto)

This prize was awarded for an outstanding research publication, or a series of closely related publications on the topic of Applied Mathematics for Dr. Aretakis' groundbreaking work on instability in extremal black holes (what has come to be known as *Aretakis instability)*, conservation laws for wave equations, and their long-term behaviour in asymptotically flat backgrounds. Highlights of this work include:

1. Aretakis, *Stability and Instability of Extreme Reissner-Nordström Black Hole Spacetimes for Linear Scalar Perturbations I*. Commun. Math. Phys. (2011) 307, 17–63.
2. Angelopoulos, S. Aretakis, and D. Gajic *Horizon Hair of Extremal Black Holes and Measurements at Null Infinity*, Phys. Rev. Lett. 121, 131102 (2018).
3. Aretakis, *The Characteristic Gluing Problem and Conservation Laws for the Wave Equation on Null Hypersurfaces*, Annals of PDE (2017), 3:3.
4. Angelopoulos, S. Aretakis & D. Gajic *A Vector Field Approach to Almost-Sharp Decay for the Wave Equation on Spherically Symmetric, Stationary Spacetimes*, Annals of PDE 4: 15 (2018).

The first in this series of notable contributions is the influential, single-author publication in 2011 (and another in 2015) where Dr. Aretakis discovered a surprising instability mechanism in extremal black holes, which he established using conceptually and technically novel methods. This resolved a long-standing open question in General Relativity, and has had a major impact on research in the field. Coincidentally, Cathleen Synge Morawetz herself had studied an analogous mathematical question in R^n. Dr. Aretakis and his team subsequently used asymptotics of solutions of the wave equation to propose a new observational signature for extremal black holes, published as editor's selection in Phys. Rev Lett (2018) and later in full mathematical detail in Adv. Math. This line of Dr. Aretakis' work has continued to impact not only physics but also mathematics, identifying (2017) a novel set of conservation laws improving general understanding of wave equations in Lorentzian geometry, and, in a highly-cited Annals of PDE paper (2018), studying long-time behaviour of waves on very general classes of asymptotically flat backgrounds.

Dr. Stefanos Aretakis is an Associate Professor of Mathematics at the University of Toronto. He received his PhD in 2012 at the University of Cambridge, and held a Veblen Research Instructorship and Assistant Professorship at Princeton University prior to joining the University of Toronto. His main research interests are in Differential Geometry, Analysis of PDEs, and General Relativity.

Excellence in Teaching Award

Dr. Fok-Shuen Leung (University of British Columbia)

After earning a D.Phil. in Mathematics at Oxford University in 2008, Dr. Leung taught at the University of Waterloo for two years before joining the faculty at UBC. There he immersed himself in a wide range of teaching and curriculum projects, which led to Killam Teaching Prizes in 2012 and 2022, as well as the Pacific Institute for the Mathematical Sciences Education prize in 2020. In that same year, he was promoted to the rank of Professor of Teaching, the highest rank in the (tenured) Educational Leadership track at UBC.

One of his projects involves the development of a course structure in a large first-year calculus courses in which students are given a "small class" experience. The large lectures are supplemented with a weekly session of up to 60 students, during which students learn new material through activities that build their technical skills and deepen their conceptual understanding. To make this program effective, the graduate and undergraduate teaching assistants need to be trained and actively monitored; Fok-Shuen is involved in that as well.

This work connects with a much wider instructor-training program that spans graduate, postdoctoral, and faculty levels. Professor Brian Wetton former Head of the Math Department at UBC says that, "Fok-Shuen has developed a suite of training programs to support the professional development of graduate TAs and postdocs as they learn to become effective instructors. His unique instructional skills orientations for postdocs and the graduate course *Mathematics Teaching Techniques*, MATH 599, are outstanding, vastly improving our entire teaching mission."

Dr. Leung publishes and disseminates all this work. His ideas have improved mathematics education at UBC, and in addition, have been formally adopted at the Universities of Waterloo and Alberta. By now, his former trainees are teaching these methods in several Canadian and UK universities, positively affecting mathematics students elsewhere.

Dr. Leung has been engaged in a collaboration with the Nunavut Teacher Education Program at the Nunavut Arctic College in Iqaluit, NU, on teaching and learning mathematics for non-STEM students. This work will have long-term impact on the effectiveness of teachers being trained in Canada's high Arctic.

Dr. Leung has been a key leader in the development of the Science Stream at UBC's Vantage College, a program for international students who are simultaneously studying mathematics and learning English.

Association for Women in Mathematics

The *EvenQuads* project was created to commemorate the 50th anniversary of the Association for Women in Mathematics (AWM). It includes both an online treasure trove of information about amazing women mathematicians and physical decks of cards, posters, and stickers. For the decks, one side of each card features logos inspired from four mathematical organizations and the other side features a short biography and hand-drawn portrait of an inspirational woman mathematician.

Decks 1 and 2 together honor 128 mathematicians whose stories deserve their place in history. Both sides of the deck can be used to play at least 10 mathematical games. Deck 1 also features Canada's own Anita Layton, who was honored for her contributions to research mathematics and to establishing, cultivating, and sustaining mathematical communities.

Decks are available for purchase at the AWM e-store, as are sticker sets and full-size posters showing all 64 women on a deck. International shipping is available at the e-store.

This project would not have been possible without the help of hundreds of volunteers, details of which can be found on the site. There are far more than 128 women who merit featuring on cards, so there are two more decks planned to complete a full set of cards to play the original *EvenQuads* game. The *EvenQuads* project welcomes more nominations of women for consideration! (Use the form provided on the website.)

https://awm-math.org/publications/playing-cards/ (QR code below).

The Canadian Mathematical Society (CMS) welcomes and invites session proposals and mini-course proposals for the 2024 CMS Summer Meeting in Saskatoon from May 31 - June 3, 2024. In accordance with the CMS mandate to propose conferences that are accessible and welcoming to all groups, diversity amongst organizers and speakers is strongly encouraged. Diversity includes topics of interest, career stages, geographic location, and demographics.

CALL FOR SESSIONS:

Proposals should include:
(1) Names, affiliations, and contact information for all session co-organizers. Early career researchers are encouraged to propose sessions.
(2) A title and brief description of the topic and purpose of the session. This can include an overview of the subject.
(3) The total number of expected talks, with a list of possible speakers and/or papers in the theme. Sessions should strive to respect the above CMS policy of accessibility and diversity.

Open Call for Abstracts: The CMS will continue the open abstract submission process that was recently introduced to support session organizers in their important work and in their efforts towards inclusivity and diversity.

The CMS kindly asks session organizers to consider all eligible abstract submissions for their session, as up to 30 speakers per session can be accommodated.

The scientific sessions will take place from May 31 - June 3, 2024.

Deadline: Proposals should be submitted by **Wednesday, January 31, 2024 (TBD)** to the Scientific Directors and the CMS Office should be cc'ed. There will be a second deadline of **Mars 31, 2024 (TBD)**, but earlier submissions will be considered first. Their contact information is as follows:

Elana Kalashnikov: e2kalasheuwaterloo.ca
Steven Rayan: rayanemath.usask.ca
Jacek Szmigielski: szmigielemath.usask.ca

Sarah Watson: meetingsecms.math.ca

La Société mathématique du Canada (SMC) sollicite des propositions de sessions scientifiques et de mini-cours pour sa Réunion d'été 2024, qui se tiendra à Saskatoon du 31 mai au 3 juin. Conformément à son mandat de proposer des congrès accessibles et accueillants pour tous les groupes, la SMC encourage fortement la diversité parmi les personnes qui organisent ses réunions ou y donnent des conférences. La diversité s'applique aux domaines d'intérêt, à l'étape de la carrière, à l'emplacement géographique et aux caractéristiques démographiques.

APPEL DE SESSIONS :

Les propositions doivent inclure :
1) Les noms, affiliations et coordonnées de tous les co-organisateurs de sessions. On encourage les chercheurs en début de carrière à proposer des sessions.
2) Un titre et une brève description du sujet et de l'objectif de la session; peut aussi comprendre un aperçu du sujet.
3) Le nombre de conférenciers attendus, avec une liste de communications et/ou de conférenciers potentiels pour le thème. Dans la mesure du possible, les sessions devraient respecter la politique d'accessibilité et d'accueil de la SMC.

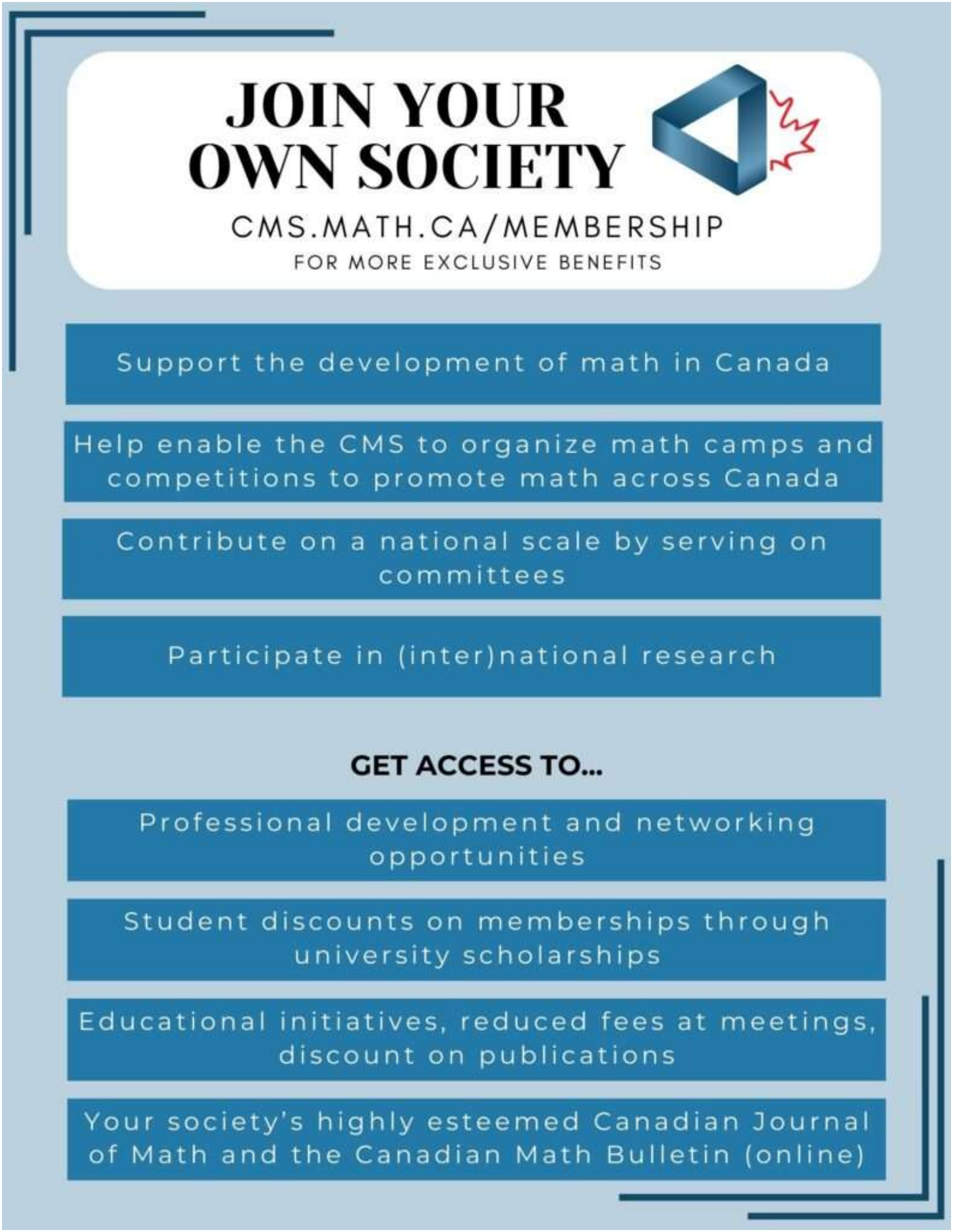
Appel ouvert de résumés : La SMC met en place un appel ouvert de résumés pour aider les organisateurs de sessions dans leur important travail et dans leurs efforts d'inclusion et de diversité.
La SMC vous prie de considérer les soumissions de tout candidat admissible. Nous jusqu'à 30 conférenciers par session seront accommodés.

Les sessions scientifiques se dérouleront du 31 mai au 3 juin 2024.

La date limite pour présenter une proposition de session ou de mini-cours est le **mercoredi 31 janvier 2024 (à déterminer).** Une deuxième date limite sera fixée au **31 mars 2024 (à déterminer**), mais les demandes antérieures seront examinées en premier lieu. Toute demande doit être envoyée aux Directeurs scientifiques et le bureau de la SMC doit y être copié. Vous trouverez ci-dessous leurs coordonnées :

Elana Kalashnikov : e2kalash@uwaterloo.ca
Steven Rayan : rayan@math.usask.ca
Jacek Szmigielski : szmigiel@math.usask.ca

Sarah Watson: meetings@cms.math.ca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Tenure Track Faculty Position in Fluid Mechanics
Department of Applied Mathematics
University of Waterloo

The Department of Applied Mathematics at the University of Waterloo invites applications for a tenure-track Assistant Professor position in **Fluid Mechanics**. Areas of particular interest include environmental and geophysical fluid dynamics and sustainability related to climate, atmosphere, oceans and lakes. In special cases a position at the rank of Associate or Full Professor may be considered. The successful candidate will be expected to establish an outstanding research program. We are looking for applicants with an enthusiasm for teaching at both the undergraduate and graduate level, and for the supervision of graduate research. In exceptional cases, outstanding applicants in other areas of Applied Mathematics may also be considered.

The Department of Applied Mathematics is one of four departments that, together with the School of Computer Science, comprise the Faculty of Mathematics at the University of Waterloo. The department has 30 regular faculty members, and has leading research programs in Scientific Computing Methods, Mathematical & Quantum Physics, Environmental & Geophysical Fluid Dynamics, Control & Dynamical Systems, and Mathematical Medicine & Biology. With 300 faculty members, 8,000 undergraduate students and more than 1,000 graduate students in mathematics and computer science, Waterloo's Faculty of Mathematics is a global powerhouse in research, education and innovation. Research in the department is enhanced by interdisciplinary and industrial collaborations and links to interdisciplinary institutes including the Waterloo Climate Institute, the Water Institute, the Waterloo Institute for Sustainable Aeronautics, the Waterloo Artificial Intelligence Institute, the Centre for Computational Mathematics, the Institute for Quantum Computing, and the Perimeter Institute for Theoretical Physics. The department has a substantial graduate program with over 100 graduate students pursuing Masters or PhD degrees, and strong undergraduate programs in applied mathematics, scientific computing and mathematical physics. More information about the department can be found at https://uwaterloo.ca/applied-mathematics/.

Candidates interested in this position should have a PhD or equivalent in Applied Mathematics or a related field. The salary range for this position is $110,000-$160,000. Salary will be commensurate with qualifications, experience, and research record. Negotiations beyond this salary range will be considered for exceptionally qualified candidates. The effective date of appointment is July 1, 2024. Interested individuals should apply using **MathJobs** (https://www.mathjobs.org/jobs/list/23161). Applications should include a cover letter, a curriculum vitae, research and teaching statements, teaching evaluation summaries (if available) and up to three reprints/preprints. Applicants are welcome to include a statement on Equity, Diversity and Inclusion. In addition, applicants should arrange to have at least three reference letters submitted on their behalf.

Applications will be reviewed starting **November 1, 2023**, but all complete applications received by **December 1, 2023** will receive full consideration.

The University of Waterloo understands the impact that career interruptions (e.g. parental leave, leave due to illness) can have on a candidate's achievement and encourages potential candidates to explain in their application the impact this may have on their record; this information will be taken into careful consideration during the assessment process.

If you have any questions regarding the position, the application process, assessment process, eligibility, or a request for accommodation during the hiring process, please contact: Prof. Hans De Sterck, Chair, Department of Applied Mathematics, University of Waterloo, Canada (hdesterck@uwaterloo.ca).
The University of Waterloo acknowledges that much of our work takes place on the traditional territory of the Neutral, Anishinaabeg and Haudenosaunee peoples. Our main campus is situated on the Haldimand Tract, the land granted to the Six Nations that includes six miles on each side of the Grand River. Our active work toward reconciliation takes place across our campuses through research, learning, teaching, and community building, and is centralized within our Indigenous Initiatives Office (https://uwaterloo.ca/human-rights-equity-inclusion/indigenousinitiatives).

The University values the diverse and intersectional identities of its students, faculty, and staff. The University regards equity and diversity as an integral part of academic excellence and is committed to accessibility for all employees. The University of Waterloo seeks applicants who embrace our values of equity, anti-racism and inclusion. As such, we encourage applications from candidates who have been historically disadvantaged and marginalized, including people with disabilities and applicants who identify as Indigenous peoples (e.g., First Nations, Métis, Inuit/Inuk), Black, racialized, women and/or 2SLGBTQ+.

The University of Waterloo is committed to accessibility for persons with disabilities. If you have any application, interview or workplace accommodation requests, please contact Maureen Fraser (mcfraser@uwaterloo.ca).

All qualified candidates are encouraged to apply; however, Canadians and permanent residents will be given priority.

Three reasons to apply: https://uwaterloo.ca/faculty-association/why-waterloo.