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)

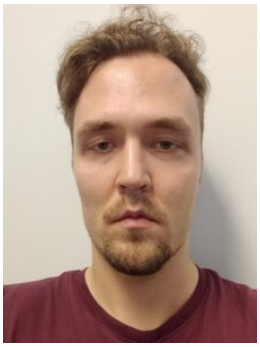
Dr. Pasten is receiving the award for his paper "Arithmetic derivatives through geometry of numbers." *(**Canadian Mathematical Bulletin**, 65(4), 906-923. doi:10.4153/S0008439521000990)*

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.