Adrien Pouliot Award

Joseph Khoury (University of Ottawa)

Over the last two decades, Joseph has worked tirelessly to promote mathematics and mathematics education at the University of Ottawa, within the local community, and on the national level. An extremely talented and dedicated teacher, Joseph was also awarded the 2020 Canadian Mathematical Society's Excellence in Teaching Award and the 2017 Graham Wright Award for Distinguished Service. Beyond the classroom, Joseph has produced a wealth of resources for both students and colleagues alike.

Joseph has also played a diverse and very significant role in promoting mathematics at the national level. Amongst his many valuable contributions, Joseph has served multiple terms as the Chair of the Canadian Mathematical Society's Education Committee and the Chair of its bilingualism committee. He leveraged his considerable experience gained in organizing highly successful math camps in Eastern Ontario to guide him as the Society's national coordinator of nearly two dozen camps held annually across all regions of the country.

In addition, Joseph co-authored of *The Mathematics that power our world, How is it made?* and *Jim Totten's Problems of the week* : two books dedicated to the beauty of Mathematics and the central role in plays in our modern society.

For his unwavering dedication to our discipline, Dr. Joseph Khoury is a most deserving recipient of this year's Adrien Pouliot Award.

Graham Wright Award for Distinguished Service

Kseniya Garaschuk (UFV)

Kseniya Garaschuk has made distinguished contributions to the Canadian mathematical community and, in particular, to the Canadian Mathematical Society (CMS) in numerous ways. She served on the CMS Student Committee (StudC) as Chair from 2009 to 2015, as Student Director on the CMS Board of Directors from 2009 to 2013, as Associate Editor of A-Taste-Of-Mathematics Editorial Board from 2016 to 2020, has been on the CMS Notes Editorial Board since 2018 and on the CMS Education Committee since 2014, where she has also participated in many Teaching in Excellence and Adrien Pouliot award selection committees. One of Kseniya's most important roles within the CMS has been her involvement with Crux Mathematicorum. She works tirelessly on this project because she believes in the importance of the publication within the international mathematical community.

As a graduate student, Kseniya began organizing and running annual CMS Math Camps in addition to other university outreach events. Many of the large StudC intitatives (all of which continue to this day) were founded by Kseniya, including the poster sessions held at CMS semi-annual meetings, *Notes from the Margin* (the StudC newsletter) and the introduction of *Guidebook*, the electronic conference brochure which is still used at CMS meetings.

Kseniya was one of the lead organisers of the Fraser Valley Math Education Sq'ep (2019 and 2020), a community-building event that explores Indigenous ways of learning and knowing with connections to mathematics. She was also a lead organiser of CMS COVID-19 Research and Education Meeting held last July.

G. de B. Robinson Award

Catalin Badea (Lille I)
Vincent Devinck (Artois)
Sophie Grivaux (Laboratoire Paul Painlevé)

The recipients are receiving the award for their joint paper "Escaping a Neighborhood along a Prescribed Sequence in Lie Groups and Banach Algebras" (Canadian Mathematical Bulletin; 63(3), 2020 pp. 484-505.)

The paper makes significant connections between many fields of analysis and algebra. It concerns a class of sequences of integers with remarkable properties, the so-called Jamison sequences, and provides various equivalent characterizations of Jamison sequences in terms of Lie groups, normed algebras, and Hilbert space operators. This work is a great example of 'hard analysis'. The authors exploit all the above-mentioned theories to provide a thorough description of Jamison sequences, a topic important by itself, and some of their applications.

Dr. Catalin Badea studied Mathematics for three years at the University of Bucharest in his native Romania and then continued his studies in France, at University Paris-Sud, Orsay (now University Paris-Saclay). He earned his PhD in 1995 under the supervision of Jean-Pierre Kahane. Badea is currently Full Professor at University of Lille. He has published more than sixty papers, supervised eight PhD students, taught a variety of courses and did administrative and service work.

Dr. Vincent Devinck wrote his PhD thesis under the supervision of Catalin Badea and Sophie Grivaux, and defended his dissertation at Lille University in 2012. He has since been teaching "preparatory courses" (in classes designed to prepare high-flying students for the "grandes écoles" entrance exams) in selective postgraduate (i.e. post-"Baccalauréat") classes (MPSI class, currently at Lycée Mariette in Boulogne-sur-Mer). He is also an associate researcher at Artois University (Laboratoire de Mathématiques de Lens).

Dr. Sophie Grivaux is a senior researcher at CNRS, and currently works at the Laboratoire Paul Painlevé in Lille, France. She joined CNRS in 2004 after completing her PhD at the Institut de Mathématiques de Jussieu in Paris under the supervision of Gilles Godefroy. Her mathematical interests concern various aspects of functional analysis and dynamical systems, and she is especially interested in problems which lie at the crossroad of these two topics.

CMS Blair Spearman Doctoral Prize

Christopher Liaw (Toronto)

Christopher Liaw is an outstanding researcher whose work has contributed fundamentally to mathematical foundations of machine learning. His dissertation addresses two important problems in theoretical machine learning.

The first problem is on identifying the sample complexity of learning mixtures of Gaussians — a long-standing open problem, with previous solutions requiring extra assumptions. Working together with several collaborators (Hassan Ashtiani, Shai Ben-David, Nick Harvey, Abbas Mehrabian, and Yaniv Plan), Dr. Liaw gave a precise characterization with minimal assumptions. Moreover, this work developed a new tool for distribution learning, which has since been applied to give the sample complexity for learning other classes of distributions. This resulted in a "best paper award" at NeurIPS 2018, an extraordinary distinction.

On another line focusing on online learning, Christopher Liaw considers online predictions with expert advice, which is a classic model in learning theory. The problem is to find an optimal algorithm to choose a probability distribution over experts where at each day each expert receives a reward and the algorithm receives the expected reward under the chosen distribution. The goal is that, at all times, the total reward earned by the algorithm so far must nearly equal the maximum total reward of any expert by that time. It has been known for decades that there is an algorithm whose reward is only $O(\sqrt{t} \ln n)$ smaller than the best expert's reward and this is optimal up to constants. The open question of finding the optimal constant has been posed as early as 1997. Liaw's work (joint with Nick Harvey, Ed Perkins, and Sikander Randhawa) resolved this question exactly for n = 2.

Liaw completed his PhD at the University of British Columbia in 2020 under the supervision of Nicholas Harvey. He has received several awards including a NeurIPS Best Paper Award as well as CGS-M, PGS-D and PDF fellowships from NSERC. He has an excellent publication record with three journal papers and ten papers in computer science conferences. He is currently a postdoctoral fellow at the University of Toronto.

Krieger-Nelson Prize

Anita Layton (Waterloo)

Dr. Layton has been recognized as a distinguished figure in the applied mathematics research at the interface of mathematical computation and biomedical sciences with direct impact in clinical health care. She is the author of over 170 publications that include top journals in applied mathematics, physiology, and medicine.

In addition to Dr. Layton's ground breaking work in mathematical biology, she has also published many impactful and well-cited studies in computational fluid dynamics; in particular, computational methods for fluid-structure interaction problems. Here, a deformable object is immersed in an incompressible fluid so that the object moves with the fluid and also exerts forces on it. These problems are notoriously hard to solve, both analytically and computationally. Dr. Layton has been at the forefront of studying and developing numerical methods which preserve the sharp fluid-boundary interface. For example, with then colleague Tom Beale, she was the first to present a rigorous analysis of the immersed interface method of Li and LeVeque.

Dr. Layton's expertise on systems of nonlinear advection-diffusion equations coupled with algebraic equations has, in part, furnished her long-standing program of research on kidney function, and specifically on the kidney's ability to concentrate salt and other products in the outflow. Here she has addressed important problems in physiology and medicine, and corrected several misconceptions about kidney function that have plagued the textbooks for years. By working with renal physiologists, Layton was able to develop a model of fluid and solute exchange in the kidney that accounts for its concentrating ability. She developed a fast numerical solver that proved to be vital as it allowed for parameter sensitivity studies that are based on many repetitions of otherwise time-consuming and costly simulations.

It is worth noting that Dr. Layton's work has inspired new experimental and clinical studies in the area of renal physiology and associated medical care. Her work has also highlighted the importance of sex differences in mathematical models for biological systems.

Coxeter-James Prize

Luke Postle (Waterloo)

Dr. Postle established himself as a leading researcher in graph theory. He published in the top journals such as *Journal of Combinatorial Theory B* (JCTB), *Combinatorica, and Journal of Graph Theory*, and gave talks at conferences and universities around the world. He made ground-breaking progress on many famous conjectures in graph colouring, including Hadwiger's Conjecture, the Goldberg-Seymour Conjecture, Reed's Conjecture, and Jaeger's Conjecture.

Luke Postle has launched a new paradigm in graph coloring with his introduction of a new generalization of coloring. Namely in 2015, Luke Postle and his collaborator Zdenek Dvorak introduced correspondence colouring in article published in JCTB, now referred to as DP-colouring by the community after their surnames. Correspondence colouring is a generalization of list colouring. List colouring, itself a generalization of colouring, was first introduced by Erdos, Rubin and Taylor in the 1970s and is now the subject of over a thousand journal

articles. In list colouring each vertex has its own list from which it must be coloured. In correspondence colouring, they abstracted this by removing any `global' notion of colour and rather only using a `local' notion, individual to each vertex. Such a generalization can actually be used for inductive purposes to solve list colouring problems, namely they used the concept to solve a 15-year-old conjecture that planar graphs without 4 to 8 cycles are 3-list-colourable. Since then, their article has garnered 86 citations in 3 years according to Google Scholar and indeed the article is listed on JCTB's own website as its most cited article published since January 2018. Correspondence colouring has been used both to solve open colouring problems and been studied in its own right as a natural form of colouring. For example, correspondence colouring proved a key ingredient in Luke Postle's research on Reed's conjecture.

Jeffery-Williams Prize

Joel Kamnitzer (Toronto)

Dr. Kamnitzer is a world leader in the field of geometric representation theory. He has had some of the most original and influential contributions of the past 20 years in his field.

His field of research can be described as an interface between algebra, geometry and modern mathematical physics. Among his recent interests are the categorification program and algebraic problems in modern mathematical physics.

One particular strand of Dr. Kamnitzer's research is a novel approach to knot homology based on the study of the affine Grassmannian, an infinite-dimensional manifold which is one of the main objects of modern geometric representation theory. In particular, he developed a geometric approach to categorification of knot homology.

Another important contribution of Dr. Kamnitzer is his work on symplectic duality, which involves the quantization of certain slices of the affine Grassmannian.

Joel Kamnitzer is a world-class mathematician whose influence significantly advanced a big portion of modern mathematics. The CMS is proud to award him the 2021 Jeffery-Williams Prize. Dr. Kamnitzer will give the Jeffery-Williams Prize Lecture at the Summer Meeting of the CMS in Ottawa.

Cathleen Synge Morawetz Prize

Ailana Fraser (UBC) and **Marco Gualtieri** (Toronto)

Ailana Fraser is an outstanding mathematician in the fields of differential geometry and geometric analysis. She has been awarded the Cathleen Synge Morawetz Prize for her sequence of works which connect the theory of minimal surfaces with free boundary conditions and extremal problems for the Steklov eigenvalues on the space of Riemannian metrics. Highlights of the work include, but are not limited to, three major publications:

1. Ailana Fraser and Richard Schoen, The firs Steklov eigenvalue, conformal geometry, and minimal surfaces, *Advances in Mathematics* 226 (2011), no. 5, 4011-4030.
2. Ailana Fraser and Richard Schoen, Sharp eigenvalue bounds and minimal surfaces in the ball, *Inventiones Mathematicae* 203 (2016), no. 3, 823-890.
3. Ailana Fraser and Richard Schoen, Shape optimization for the Steklov problem in higher dimensions, *Advances in Mathematics* 348 (2019), 146-162.

Marco Gualtieri is an outstanding mathematician the fields of differential geometry and complex geometry. He has been awarded the Cathleen Synge Morawetz Prize for his work on the foundations of generalized complex structures. This work opens up new connections between symplectic geometry and complex geometry, by initiating the study of a class of manifolds which interpolates between symplectic manifolds on the one hand, and complex manifolds on the other. Applications to Mirror Symmetry and String Theory abound. The principal paper the prize is awarded for is

Marco Gualtieri, Generalized complex manifolds, *Annals of Mathematics* 174 (2011), no. 1, 75–123.

Excellence in Teaching Award

Alfonso Gracia-Saz (Toronto)

Alfonso Gracia-Saz (UofT) has been named the 2021 recipient of the CMS Excellence in Teaching Award.

It is said that when Dr. Gracia-Saz teaches, he reinvents teaching. His work with the University of Toronto's legendary MAT137 (Calculus with Proof) is an excellent example of his dynamic teaching style; his reorganization, his attention to detail, his famous problem sets, and his inspiring lectures and videos have given this challenging course a new level of energy–particularly significant in this recent time of pandemic challenge. A second example is found in his design of the instructor training program at the University of Toronto, a program that has now been extended to all Teaching Assistants in the Mathematics Department.

According to his Toronto colleague, Professor Galvao-Sousa, Professor Gracia-Saz "belongs to this rare breed of born teachers that possess not only the knowledge and creativity but also the warm and dynamic personality that allows him to teach students in such a natural way that the barrier between teacher and student ceases to exist."

Over the past 13 years, Alfonso has served as an instructor and the Academic Coordinator of the Canada/USA Mathcamp. His calculus YouTube channel with 200 videos has over 10,000 subscribers and well over 3 million views. He is active in mathematics outreach through competitions, math camps, science fairs and undergraduate research. He has worked in a prison university project (currently Mount Tamalpais College) and has written a mathematical play. He and his partner, Nick, enjoy contra dancing, cooking and complex board games.

The Canadian mathematical community lost Dr. Gracia-Saz to COVID-19 in 2021. He was a mentor and an inspiration to many math educators. The CMS will continue to honour his memory."