FROM UNDERREPRESENTED TO UNSTOPPABLE: BUILDING INCLUSIVE STEM COMMUNITIES

SUMMARY: The CISE Atlantic Team is committed to building and enhancing inclusive STEM education, research and workplace ecosystems in Atlantic Canada (https://ciseatlantic.ca/).

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The Chairs for Inclusion in Science and Engineering (CISE) is a Natural Sciences and Engineering Research Council of Canada (NSERC) program that supports a team of researchers to advance a culture of inclusion in science, technology, engineering and mathematics (STEM) by undertaking initiatives to enhance equity, diversity and inclusion and to reduce barriers faced by underrepresented populations. The CISE program evolved from NSERC's current Chairs for Women in Science and Engineering (CWSE) program. The inaugural CISE chairholders are from Atlantic Canada and were announced in September 2023: Dr. Svetlana Barkanova (**SB**, Physics Program, School of Science and the Environment, Grenfell Campus, Memorial University of Newfoundland), Dr. Kevin Hewitt (**KH,** Department of Physics and Atmospheric Science, Dalhousie University) and Dr. Stephanie MacQuarrie (**SM**, Department of Chemistry, Cape Breton University). Japna Sidhu-Brar (**JSB**, Program Manager) and Kathryn White (**KW**, Project Coordinator) have joined the team. I first interacted with the CISE Atlantic Team in March 2024 on their "Physics in the Rural Classroom" initiative. I am also well aware of the Chairs' previous work to advance equity, diversity and inclusion in STEM and specifically Drs. Barkanova and Hewitt within the CAP and across our national physics community. This is important work that I believe needs to be highlighted, shared and supported.

To celebrate the first year of the CISE program, I interviewed the inaugural CISE Atlantic team members. I sent each team member a list of questions related to the program objectives, challenges, activities and outcomes. Their responses below are unedited to maintain their authentic voices. The responses presented here represent a subset of the total responses. The full interview will be linked to the *Physics in Canada* website.

WHAT ARE SOME OF THE KEY OBJECTIVES FOR THE CHAIRS FOR INCLUSION IN SCIENCE AND ENGINEERING (CISE) PROGRAM?

JSB: The main objectives of CISE-Atlantic are threefold, with programs and initiatives typically falling within:

1. Recruitment into, retention within and talent development for Equity-Deserving Groups in Science, Technology, Engineering and Mathematics from K-16 and into employment.
2. Catalyzing policy and systemic change to dismantle barriers to opportunity through connection-building.
3. Development of quality measurements, output, literature and resources to advance success in STEM through learning, collaboration and research.

Our programs and initiatives are all rooted in a social justice and equity ethic framework, i.e., a framework that recognizes a principled concern for reducing racial and other social inequities through and within STEM [1]. Our work is further guided by a multiple paradigm approach across a K-16 model of education, examining pipeline, pathway and ecosystem approaches to inclusion in STEM by supporting students' transition from high school to college, technical training, or other options for post-secondary learning. In this way, we strive for a diversity of programming that accounts for a diversity of needs, including rural and remote accessibility considerations.

Our work includes analyzing evaluation practices and developing promising measurement tools to gauge impact and effectiveness of all programs and initiatives. Ultimately, this work cannot be done individualistically or within silos. Hence, our program is underpinned by synergistic and meaningful collaborations and partnership-building.

WHY DID YOU DECIDE TO TAKE ON THIS ROLE?

SM: I joined CISE-Atlantic to work with a dedicated team advancing inclusion in STEM through systemic change, equity-driven programs, and meaningful collaborations. Contributing regionally and nationally to initiatives that connect equity-deserving groups with STEM opportunities resonated with me. As a white, neurotypical cisgender woman, I recognize my privilege but also the challenges of growing up in a rural area with limited STEM access. With this team, we're creating accessible pathways to STEM education and careers. Our program applies research, policy, and community engagement to dismantle barriers and drive measurable change.

JSB: The simple answer is that I like to help people and my community - whether that is a community of women, scientists, fellow workers, trade unionists, Black, Indigenous and Peoples of Colour etc. As a STEM educator (and astronomer), I am motivated by a desire to learn and share knowledge, to create spaces of mutual growth and understanding. As the CISE-Atlantic Program Manager, I am able to leverage my skills and experience as our team works collaboratively with many partners towards restorative and transformative spaces for equity-deserving groups in STEM. I believe that this is what we, as humans, owe to one another - the right to a life of dignity and authenticity.

KH: I decided to take on this role to learn from others that have created successful programs serving underserved communities in STEM, and to share the lessons learned from my own experience of creating long-lasting and successful organizations such as the Imhotep's Legacy Academy. When one enters conversations with humility, a great deal of good can emerge. "Certainty is the enemy of unity." Certainty in the context of Physics is an expectation, certainty in the face of the complexity of human behavior – the mission in which we are engaged - is a recipe for disaster. So, I engage in these conversations with the knowledge that the context will inevitably differ and we must listen meaningfully to uncover that nugget, or gold mine, of information that can apply to our own initiatives, enhancing its chances of success. I am intrigued by what we could do collectively - with the expectation that the whole is greater than the sum of its parts.

KW: I work with CISE Atlantic because I am passionate about knowledge mobilization, science promotion and community outreach. Our work reduces barriers to STEM for equity-deserving groups across Atlantic Canada. I previously worked as an Indigenous community liaison, helping link research projects with local Indigenous community priorities and ways of knowing. Knowledge mobilization, as defined by SSHRC, is a term used to describe a wide range of research activities, including knowledge synthesis, dissemination, transfer, exchange, and co-creation by researchers and knowledge users [2]. As liaison, I saw a lot of hesitancy from Indigenous communities towards STEM, communities often felt unreflected in the scientific community. Our team works to combat these inequities by ensuring that STEM topics are accessible and inclusive for all. By exposing equity-deserving communities from across Atlantic Canada to diverse STEM role models and perspectives, we are actively promoting pathways to STEM education and employment for all.

SB: While living in Latvia had its challenges, it was not until I moved to Canada that I was introduced to biases like "women are not good at math." I was asked if I was a mail-order bride, so I joked that I was a mail-order physicist! It broke my heart to see female students struggling with imposter syndrome. While tutoring female Indigenous students at the University of Manitoba, a physics textbook reference confused us all, assuming we all had the same experiences as the author. Fortunately, textbooks have improved, like "ASTRO" (2020) by Ghose, Milosevic-Zdjelar, Read and Reid, which intentionally includes multicultural examples. A newcomer to Canada, I was fortunate to find support systems, but would I stay in physics if I had landed in a less diverse and supportive community? I am not sure. Now, with funding from NSERC and Cenovus, we can change these environments so that they are more inclusive!

WHAT ARE SOME OF THE CHALLENGES THAT YOU SEE NEED TO BE ADDRESSED TO ENHANCE INCLUSION IN SCIENCE/PHYSICS?

JSB: Enhancing inclusion in science, and physics in particular, means understanding and acknowledging the inherent structures of power within academia and education, and how that has impacted the nature and quality of research that is pursued. What kinds of research are celebrated, and which ones are ignored? As scientists, we should counter the notion or assumption that the physical sciences are simply "objective" endeavours, that the consequences of discovery can be ignored for this so-called "pursuit of truth" or that the act of discovery can be divorced from its ultimate impact on ourselves, our neighbours, our global communities. Scientific endeavours are inherently human, susceptible to

human biases and the legacy of inequity, exclusion and exploitation within the wider society. There is work being done towards cultivating this kind of lens within science and Physics - we have come far but we still have a long way to go, together.

KH: Inclusion is an outcome, exemplified by a sense of Belonging, created when systemic barriers are identified and removed through the process of equity. I've often heard sentiments like "Oh, well we have a person of color on this committee or that, so we've solved the problem." While there is a correlation between inclusive outcomes and diversity, there is more to unpack. If we do not remove systemic barriers, existing exclusionary practices continue to be perpetuated, including by those from equity-deserving groups themselves. This is unsurprising as we have not reckoned with the system itself that measures success as adherence to the dominant group mindset or behavior. We have to guard against complacency in our work in transformative justice.

Removing systemic barriers needs meaningful input from those who are subject to the system - the students, and especially those who leave Physics. Surveys need to focus on these individuals and explore their motivations. If, for example, they do not see the connection between Physics and their own social justice principles, how can the Physics community reach out and acknowledge those motivating factors? Deeply consider what role Physics plays in response to social injustice faced by their communities. In my own research, I combine Physics with Black and African Diaspora Studies, pursuing interdisciplinary work that addresses Black women's health. When we make the connections clear between Physics, community and social justice, we may be able to draw those students to Physics, highlighting it as a field that can be rooted in humanity.

WHAT ACTIVITIES AND/OR INITIATIVES ARE YOU WORKING ON (UNDER DEVELOPMENT OR UNDERWAY) IN ATLANTIC CANADA?

KW: One program we're working on is the Physics in the Rural Classroom (PiRC) pilot program (2024-2026). This program addresses the challenge of delivering quality physics education in rural Atlantic Canadian schools. Designed for educators teaching Grades 7-12, PiRC aims to enhance physics instruction through online curriculum-aligned workshops and career exploration sessions. Collaborating with teachers and STEM professionals, the program provides equitable access to physics content while exposing learners to diverse career pathways and inspiring role models, particularly from equity-deserving groups.

The pilot will deliver 64 interactive workshops annually, targeting physics curriculum objectives and supporting educators in schools lacking specialized physics teachers or resources. Educators gain access to tailored professional learning opportunities and an expanding network of peers. STEM volunteers contribute by delivering virtual talks, which are developed with comprehensive training in science communication and cultural inclusivity, ensuring engaging and meaningful student interactions.

Key outcomes include increased educator confidence in teaching physics, greater student interest in physics careers, and strengthened ties between STEM professionals and rural communities. With its

scalable model and sustainability-focused partnerships, PiRC aims to create lasting impacts on physics education in Atlantic Canada and beyond.

KH: We are also in the process of launching the three-year Bringing STEM to Life: Work-Integrated Learning Program in Physics - Nova Scotia Pilot Program 2025! A free four-week summer hybrid program that bridges work experience, mentorship, and high school Physics credit achievement, it is designed to support Black and African Nova Scotian High School learners as they decide whether to pursue careers in Science, Technology, Engineering, Math (STEM). The Program's basis is the successful Work-Integrated Learning Program established by Lisa Cole, Director of Programming of York University's k2i Academy. W-IL Physics is a collaboration between k2i Academy, the McDonald Institute, the Africentric Math cohort (AMC) program and Imhotep's Legacy Academy (ILA).

20 high school learners from participating schools will be hired by Dalhousie University as Lab Assistants. Learners will work on STEM research projects based on local research and the United Nations' Sustainable Development Goals. Hands-on STEM activities will facilitate the learners' understanding of Physics concepts and the development of their research projects. Activities will be designed and delivered by a team of Undergraduate Mentors, who will work closely with Dalhousie Faculty Members and a High School Physics teacher to ensure provincial curriculum alignment and achievement of a Physics credit.

The three-year period is a critical timeframe in which to evaluate and improve practice, assessing the significance of work-integrated learning opportunities in STEM at an academic juncture where many learners avoid a critical subject (Physics) that would take them along STEM pathways. We will be looking to maintain W-IL in Physics within the Nova Scotia education system and expand its reach, including by integrating Summer Internship pathways. Leveraging connections to regional and National networks, there can be crossover work with BESTSTEM, a national network of out-of-school-time programs, supporting Black, Indigenous, and LatinX learners.

WHAT DO YOU HOPE TO ACHIEVE DURING YOUR TENURE AS CHAIRS?

SM: As one of the three NSERC CISE Atlantic Chairs, one of my biggest priorities is making sure rural and underrepresented students see STEM as a place where they belong. That means building and expanding programs that don't just introduce students to science and technology but actually keep them engaged and supported along the way. For too long, we've asked students to overcome barriers that shouldn't exist in the first place. Our team is focusing on fixing the system, not the students, and that means addressing the structural challenges that keep underrepresented groups from accessing STEM. Through policy and institutional change, we are working with educators and policymakers to embed equity and diversity into STEM education policies. We are also working to ensure that outreach, mentorship, and community engagement is recognized and valued in the academic tenure and promotion process. We know impact comes not just from reaching large numbers of students but from meaningful, sustained engagement, ensuring youth, partners, and collaborators all feel supported and inspired in STEM. By working as a team, we will create a stronger, more inclusive STEM ecosystem in Atlantic Canada, one where opportunities aren't determined by geography, background, or circumstance.

SB: As a woman and an immigrant, I learned that diversity does not guarantee inclusion, but I found a support network in the CAP community. Now, one of my goals is to contribute to the development of the national and international networks, and to involve academia and industry groups to expand "Physics in Rural Classroom" nationwide. Achieving equity and inclusion in physics remains a long-term challenge [4], but data collection such as CanPhysCounts [5] and grassroots initiatives help drive systematic change. The Chairs for Women in Science and Engineering (CWSE) have led transformative work for over three decades [6], and we are working with the National Network on new initiatives in the Northwest Territories and Nunavut, to truly make a lasting impact cost-to-cost-to-coast. Another key network I rely on is my own research community, organized around the Canadian Institute of Nuclear Physics, the Institute of Particle Physics, the McDonald Institute, TRIUMF and SNOLAB, many of which are partnering with us on outreach initiatives. As equity, diversity and inclusion become central to the long-term planning in subatomic physics [BD9], my dream is to help build the "Network of Networks" in Canada to work for inclusion in STEM at the national level.

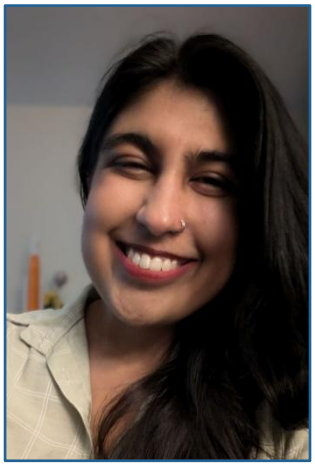
KH: During the women's movement in the 60s and 70s, Women of Colour were left behind, giving rise to the need to recognize intersectionality, as coined by Kimberlé Crenshaw. If you look at the proportion of Women in STEM in leadership roles in Canada, it remains white dominated. It is clear, institutional STEM leadership needs to pay more attention to ensuring the success of Women of Colour in STEM. If you're reading this and are in a position to elevate, celebrate or even step aside for a Woman of Colour in STEM, do it.

CISE Atlantic recognizes we must also collectively address the severe underrepresentation of Blacks in STEM in Canada. Only 1% of respondents to the aforementioned CanPhysCounts Survey self-identified as Black and stated possessing or pursuing degrees in Physics in Canada. In this era of nationalistic fervor where the movement of people and goods face ever increasing barriers, Canada's success will be determined by its ability to engage those at home, including the future 15% of the population under fifteen who self-identify as Black. We can't afford to leave them behind because with a more diverse STEM workforce, inclusive of Black Canadians, our innovation and discovery goals are that much closer and brighter.

Finally, having been the lonely only Black Physics professor in Canada for a large part of my career, I would like to highlight and address the isolation felt by Blacks in Physics. Looking at the success of Imhotep's Legacy Academy during its 22-year existence, we can see how the creation of programs to serve the diverse needs of the Black learner could lead to amazing outcomes when one focuses on the system. I would like to translate some of that hard earned success to other marginalized communities, always applying the principle of "nothing about us without us."

INFORMATION ON CISE-ATLANTIC TEAM MEMBERS

KW: Kathryn is a young Indigenous woman passionate about community engagement. Growing up and living in rural Newfoundland, she understands the diverse needs of rural and remote communities throughout Atlantic Canada. Kathryn is the Project Coordinator for CISE Atlantic at Grenfell Campus in Corner Brook, Newfoundland and Labrador. She completed her B.Sc. (Hons) in Geography and Biology at Memorial University (2020) and has a Certificate in Public Policy. Keen to understand the diverse and varied needs of organizations, teams, and individuals, Kathryn is completing her Master of Management at Grenfell Campus. Deeply involved in her community, she serves on the Board of Directors for the Elmastukwek Mawio'mi and is the Commanding Officer of the 511 Humber Royal Canadian Air Cadet Squadron. During the sunnier months of the year, Kathryn also works as a flight instructor within the Air Cadet Gliding Program. Since 2017 she's helped instruct and mentor over 100 young aviators from across Canada to earn their Transport Canada Glider Pilot licence.



JSB: Japna Sidhu-Brar (she/her/elle) is the Program Manager for CISE-Atlantic, whose activism and 10 years as a science communicator underpin her ongoing commitments to eradicating barriers to inclusion in STEM. Japna graduated from Mount Allison University in 2014, majoring in Physics and minoring in Astronomy, Mathematics and Philosophy. She has training in matters related to Human Rights, EDIA, and Anti-Oppressive Practice, growing out of her time with Unifor, the largest private sector union in Canada, in her roles as a Union Representative at Local and Regional Levels, the Atlantic Racial Justice Liaison, and a Discussion Leader. Additionally, Japna has a leadership certificate in Equity, Diversity and Inclusion from Dalhousie University's Faculty of Open Learning and Career Development. She has served as a Board member for Our Times Magazine and currently sits on the Board of Directors for Youth Science Canada. She is a part-time Organizer for the Public Service Alliance of Canada, and plays a Bugbear named Shump in a Dungeons and Dragons campaign.

SM: Dr. MacQuarrie is the Dean of Science and Technology and Full Professor of Organic Chemistry at Cape Breton University and NSERC Chair for Inclusion in Science and Engineering. Originating from Nova Scotia, she obtained her B.Sc. from Mount Allison University in 1996 starting her research career with Dr. Langler studying thiols. She continued to pursue chemistry in graduate school at Virginia Polytechnic Institute and State University where she earned her Ph.D. in organic chemistry practicing asymmetric synthesis. In Dr. Crudden's group at Queen's University during her post-doc, she had the opportunity to step outside of organic and into materials and metals. Now at CBU, Stephanie's research includes finding high value applications for waste streams, reducing the total carbon footprint of advanced materials and the

development of functional materials for electronics, catalysis and absorption. With her partner she has raised three awesome kids in Cape Breton and they enjoy hosting visitors on North America's #1 Island!

KH: Dr. Hewitt is a full Professor in the Department of Physics & Atmospheric Science at Dalhousie University, inaugural Associate Dean of Equity and Inclusion for Dalhousie's Faculty of Science, and Natural Sciences and Engineering Research Council of Canada Atlantic-region co-chair for Inclusion in Science & Engineering. In his Bionanophotonics lab, he's developing novel nanoparticle probes for bioimaging and treatment, optical imaging approaches combining Holography and Raman Spectroscopy, and a prototype medical diagnostic tool for liver transplantation and uterine fibroids applications. Completing his B.Sc. in Physics & Biology at the University of Toronto (1992), he received the UofT Physics prize. At Dalhousie he unified his deep and abiding interests in science and community engagement by co-founding (in 2003) the award-winning Imhotep's Legacy Academy, a STEM outreach program for Black students from junior high to university and established in 2021 the Canadian Black Scientists Network Youth regional science fair. He's featured in Cool Black North, a film which explores the unique and vibrant Canadian Black Community and was a guest on CBC Ideas. He's been recognized with the top awards for science promotion in the province (Nova Scotia Discovery Centre Science Champion, 2018) and country (NSERC Award for Science promotion, 2021). His community engagement has been recognized with Nova Scotia's Queen Elizabeth II's Platinum Jubilee medal (2023) and Youth Community Service Award in British Columbia (1999). National awards for professional excellence (Harry Jerome Award for Professional Excellence, 2014), service to students at Dalhousie (Rosemary Gill award, 2021) and international leadership (2025 Robert Holland Jr. Award for Excellence in Research and Leadership) round out the breadth and depth of his contributions.

SB: Dr. Svetlana Barkanova is a professor of physics at Grenfell Campus, MUN. She began her career at the Nuclear Research Center in Latvia in 1994, moved to Canada in 1998 to expand her expertise, and earned a Ph.D. in Theoretical Subatomic Physics from the University of Manitoba in 2004. An internationally-recognized researcher, Dr. Barkanova seeks to uncover the fundamental building blocks of the universe and their interactions, with emphasis on hadron structure and multi-loop calculations for precision experiments. Throughout her career, Dr. Barkanova has been committed to improving diversity, equity, and inclusion in research and education, and developed a wide coast-to-coast-to-coast professional network. She has served on Boards such as WISE NL and Science Atlantic, held leadership roles within the CAP, including chairing the Division of Theoretical Physics and the Division for Gender Equity in Physics, organized national and international conferences, and contributed her expertise to grant and prize selection committees. An award-winning teacher and

dynamic public speaker, she is passionate about science outreach and enjoys sharing her love for physics with audiences of all ages.

CONCLUSION

The CISE Atlantic Team is now more than one year into a 5-year funded program. Their individual perspectives on and passion for equity, diversity and inclusion are certainly front and center in this interview. Their ongoing initiatives and the early outcomes are fantastic, and I believe are positioned to advance inclusion in STEM in Atlantic Canada and nationally. More information on the CISE Atlantic initiatives and how you can get involved can be found on their website (https://ciseatlantic.ca/). The national CISE program is ongoing, next accepting team applications from the province of Quebec, for a start date of September 1, 2025.

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