Name of the Unit

Centre for Applied Mathematics in Bioscience and Medicine (CAMBAM)

Date of creation

Aug 2009

Unit Director (name, department/school/centre, email, phone)

Anmar Khadra, Department of Physiology, anmar.khadra@mcgill.ca, 514-398-1743

Date of nomination in the role

January 2020

Manager (name, email, phone)

Anmar Khadra, anmar.khadra@mcgill.ca, 514-398-1743

Mission statement (2 sentences max)

CAMBAM's mission is to lead nationally and internationally in applying mathematical and computational sciences to biological, physiological, and ecological systems, while fostering collaboration between quantitative and experimental life scientists. It achieves this through research, teaching, and training programs (including workshops, conferences, internships, and industry partnerships) that support trainee development and connect them with cutting-edge advances and professional opportunities.

Unit's website

https://www.crmath.ca/en/cambam/

Explain the significance of the Unit's mission at McGill and beyond (1/2-page max)

(1) Maintain international leadership in the emerging field of quantitative biosciences. To accomplish this, CAMBAM has been a partner with an FQRNT-funded multi-center grant headed by the *Centre de recherches mathématiques* since 2021.

(2) Connect researchers and students across faculties and institutions by creating interdisciplinary research teams and a framework for scientific and social interactions. That includes bridging complementary research programs together to establish

multidisciplinary teams in the quantitative and life sciences. To accomplish this, we organize workshops and retreats and invite known speakers to the seminar series organized by CAMBAM in collaborations with other centers at McGill.

(3) Support and prepare students and postdoctoral trainees for the expanding career opportunities in quantitative biosciences in both industry and academia. Trainee members of CAMBAM regularly get email announcements about different academic and industry-based job opportunities.

(4) Establish stronger connections with industry through partnerships with for-profit and not-for-profit biotechnology and pharmaceutical companies, such as Labfront (with CAMBAM member Caroline Palmer, Psychology, McGill), Cairn Scientific Imaging (with CAMBAM member Gil Bub, McGill), Blue Marble Rehab Inc (with CAMBAM member Suresh Krishna, McGill), iRhythm Technologies (with CAMBAM members Gil Bub and Leon Glass), Moderna and Curevo (with CAMBAM member Morgan Craig).

Highlight the Unit's alignment with the Faculty's Strategic Research Plan (1/2 page max.)

CAMBAM contributes to the Faculty's research mission through its members' involvement in developing mathematical methods and computational tools to understand complex medical and biological system functions, from molecular to organismal levels. CAMBAM's contribution was specifically mentioned in the 2017 McGill Faculties of Medicine and Dentistry Strategic Research Plan. Additionally, CAMBAM is currently forging strong connections with Axis 3 (Modeling and Numerical Methods) of the Digital Health Network, a newly established interdisciplinary network focused on digital health and tools. Furthermore, CAMBAM had close ties with the Initiative in Computational Medicine (MiCM). In partnership with the MiCM, CAMBAM co-organized online workshops focused on mathematical and statistical methodologies. MiCM also provided seed funding to CAMBAM members with research focused on complex systems and machine learning (e.g., Anmar Khadra and Pouya Bashivan). CAMBAM also collaborates with the Quantitative Life Sciences Program in organizing a very successful seminar series in computational medicine. These activities will continue in the near future. Finally, CAMBAM is heavily involved in the QLS program with many CAMBAM members teaching in the QLS foundation course QLSC 600 (e.g., Anmar Khadra, Erik Cook, Fred Guichard, Leon Glass, Gil Bob) and (co-)supervising many QLS PhD students (e.g., Shayan Hajhashemi, Jonas Lehnert, Louis Richez, Ryan Huang, Fritz Jalandoni). Bioscience and health research is quickly expanding from being an exclusively data collection endeavor to one that embraces the development of new technologies and quantitative methods. For example, much of the field of genetics is now driven by statistical and computational algorithms. To meet these changing needs, our researchers actively prepare students for life in both academic research and industry with the goal of bridging the "training gap" that exists between students in bioscience and those from mathematics, physics and engineering. Importantly, CAMBAM's interdisciplinary mission directly supports McGill's Strategic Research Plan to create a "convergence of life sciences, natural sciences, and engineering". During the next

few years, CAMBAM will continue its leadership role in Quantitative Biology at McGill, within Quebec and internationally. CAMBAM has regularly organized summer schools on the applications of mathematical sciences to physiology and medicine and helped sponsor several conferences such as the Canadian Biophysical Society Annual Meeting, and workshops focused on infectious disease transmission (an urgent topic in this international health crisis of COVID-19 pandemic) and cancer. We will continue to sponsor and promote interdisciplinary seminars, workshops, events and summer schools to bring together researchers from across faculties and institutions to solve critical problems in bioscience and medicine.

Highlight <u>five top accomplishments</u> of the Unit over the past 12 months (1 page max.)

(1) The organization of a very successful CAMBAM/QLS seminar series between Sept 2024-May 2025 (https://www.mcgill.ca/qls/seminar-series) . The list of invited speakers sponsored by CAMBAM includes Kanaka Rajan (Harvard University), Chris Bauch (University of Waterloo), Kevin Thurley (University of Bonn), Chris Eliasmith (University of Waterloo), Timothy Brady (UCSD), Wiktor Mlynarski (University of Munich), Ilker Yildirim (Yale University), Mark Lewis (University of Victoria), Peter Mucha (Dartmouth College), Jason Bramburger (Concordia University), Yelena Simine (McGill University), Krasimira Tsaneva-Atanasova (University of Exeter), Priya Moorjani (Berkeley University), Patrick Desrosiers (U.Laval/CERVO) and Catie Chang (Vanderbilt University).

(2) CAMBAM member Anmar Khadra and associate member Claire Guerrier successfully secured the bid to host the International Conference on Mathematical Neuroscience (ICMNS) at McGill University in 2026. They also successfully obtained $7,000 CAD in funding from the *Centre de recherches Mathématiques* to support the organization of the event. Currently, they are in discussions with UNIQUE to obtain additional funding.

(3) A new homepage for CAMBAM was developed recently within the CRM website. It currently showcases past, current, and upcoming activities, as well as to provide a comprehensive directory of its members.

(4) CAMBAM member Caroline Palmer was awarded distinguished James McGill Professorship, July 2024. Furthermore, CAMBAM member Morgan Craig was awarded the Canada research chat in computational immunology. Finally, postdoctoral trainee Thomas M Bury successfully obtained a faculty position at the Mathematics Department UC Riverside.

(5) CAMBAM member Pouya Bashivan and CAMBAM trainee Saheb Pasand were awarded the best short paper at the NeurIPS Efficient Natural Language and Speech Processing Workshop. The title of the paper is: RGP: Achieving Memory-Efficient Model Fine-tuning Via Randomized Gradient Projection. Also CAMABAM member Michael Mackey has published a volume in the Lecture Notes on Mathematical Modelling in the Life Sciences: chrome-

extension://efaidnbmnnnibpcajpcglclefindmkaj/https://link.springer.com/content/pdf/10.1007/978-3-031-82396-1.pdf.

Major outreach activities (e.g., seminar series, general public events; 10 max.)

(1) The organization of a very successful CAMBAM/QLS seminar series between Sept 2024-May 2025 (see https://www.mcgill.ca/qls/seminar-series for more details). The list of invited speakers sponsored by CAMBAM are provided above. CAMBAM and QLS will continue collaborating in 2024-2025 in organizing this seminar series. A total of 12-14 talks will be allocated for CAMBAM. CAMBAM member Suresh Krishna will continue to co-organize it with the QLS.

(2) CAMBAM member Anmar Khadra and associate member Claire Guerrier are currently organizing the CAMBAM symposium Rhythms, Networks, and Slow-Fast Analysis in Neural and Endocrine Systems (June 2–6, 2025), to be held at McGill University: https://www.crmath.ca/en/activities/#/type/activity/id/4024. The symposium will feature 20 national and international speakers, along with 4 local speakers, and will include poster sessions (currently with 10 registered participants). The full program schedule is available here: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.crmath.ca/horaire/2025/Rhythms/pdf/Schedule.pdf.

(3) CAMBAM was a proud sponsor of the 2025 Mackey-Glass Research Bursary in Physiology, a competitive undergraduate award granted annually to two top McGill students pursuing summer research. CAMBAM members Gil Bub and Anmar Khadra served on the selection committee for this prestigious award. The 2025 recipients were Yifan Zhao and Sabrina Du.

(4) Several CAMBAM members, including Morgan Craig, Fred Guichard, Fahima Nekka, Erik Cook, and Anmar Khadra, continue to play active leadership roles in the newly established Digital Health Network. They are engaged in multiple strategic axes of the network, with some currently overseeing key initiatives, particularly in training and education. For example, Morgan Craig leads efforts in computational modeling under Axis 2, while Anmar Khadra contributes to the development and application of digital tools under Axis 3.

(5) CAMBAM member Morgan Craig has served as a member in an EDI Committee for the Society for Mathematical Biology. She also served as the leader of the Immunobiology and Infection Subgroup of the same society.

(6) CAMBAM member, Lea Popovic was a co-organizer of the Conference on New Developments in Probability, hosted by the Women in Probability Group whose main goal is to provide a platform for early career women researchers in probability theory to gain access to mentorship in an environment which cultivates collaborations.

(7) The Centre de recherches mathématiques has launched a series of accessible training modules on topics at the intersection of health sciences and mathematics. This project is part of the "En avant math!" initiative, carried out in collaboration with CIRANO and funded by the Quebec Ministry of Finance. The first training modules, led by Professor Morgan Craig, focused on "Translating Biological Principles into Mathematical Equations."

Major training activities (e.g., summer schools, co-supervision of trainees, training workshops; 10 max.)

(1) CAMBAM members Suresh Krishna and Gil Bub teamed up to mentor 4 Google Summer of Code interns in 3 projects via the International Neurinformatics Coordinating Facility (https://summerofcode.withgoogle.com/archive/2024/projects/Tkk88oFl; https://summerofcode.withgoogle.com/archive/2024/projects/yvnc5UQy; https://summerofcode.withgoogle.com/archive/2024/projects/AizxM6Fo; https://summerofcode.withgoogle.com/archive/2024/projects/Mj4iyXH2).

(2) CAMBAM trainees (including PDF, PhD and MSc students) co-supervised by CAMBAM members:
Jonas Lehnert: Supervised by Anmar Khadra and Erik Cook
Xinyue Ma: Supervised by Anmar Khadra and Erik Cook
Rian Fritz Jalandoni: Supervised by Anmar Khadra and Erik Cook
Amin Akhshi: Supervised by Anmar Khadra and Maurice Chacron
Ramesh Arumugam: Supervised by Frithjof Lutcher and Fred Guichard
Thomas M Bury: Supervised by Gil Bub and Leon Glass
Khady Diagne: Supervised by Gil Bub and Leon Glass
Wendy Want: Supervised by Tony Humphries and Michael Mackey
Amirozhan Dehghani: Supervised by Pouya Bashivan and Maurice Chacron
Sara Beldjoudi: Supervised by Morgan Craig and David McLeod

(3) CAMBAM members Erik Cook and Anmar Khadra are collaborating on the new mouse brain wide-field imaging infrastructure that became fully operational in Cook Lab (McGill University, McIntyre, room 1225) during 2024. It has 3 mouse brain imaging rigs and 6 mouse training rigs. This infrastructure will require massive mathematical and computational support because of the complex and large data sets generated by the infrastructure. It will also provide significant training opportunity to many CAMABAM trainees.

(4) CAMBAM member Caroline Palmer directed the NSERC-CREATE training program in Complex dynamics of brain and behavior. It included 198 students and 26 mentors (including several CAMBAM members: Paul Francois, Anmar Khadra and Leon Glass). Placed 78 students in funded internships related to complex dynamics. This ended Aug 2024.

(5) AMBAM members Pouya Bashivan, Suresh Krishna, and Anmar Khadra served as project judges for PharmaHacks, McGill's annual AI and bioinformatics hackathon competition (https://www.facebook.com/StudentPharma/?locale=pt_BR).

Equity, Diversity, and Inclusion (EDI): explain how EDI is considered and incorporated within the Unit.

CAMBAM as a center is a strong and consistent advocate of EDI, actively promoting these values through its initiatives and leadership. For example, CAMBAM member Lea Popovic recently co-organized the Conference on New Developments in Probability, hosted by the Women in Probability Group, which aims to support early-career women researchers by fostering mentorship and collaboration in an inclusive environment. Also, Morgan Craig has made important contributions to EDI efforts, serving on the EDI Committee of the Society for Mathematical Biology. CAMBAM's commitment to representation is reflected in the makeup of its membership and board, with women and other underrepresented groups comprising nearly 50%, a proportion that continues to grow. Furthermore, in a recent effort to enhance visibility and inclusion, CAMBAM welcomed two new female members: Lea Popovic as a regular member and Claire Guerrier as an associate member. CAMBAM members are fully committed to upholding EDI in their lab recruitment practices and in collaborations with other research groups that prioritize inclusivity, particularly when selecting human participants to ensure gender balance and diversity in age and race. CAMBAM firmly believes that embracing EDI is not only essential to research excellence but the key path forward.

Membership, Budget, Grants, and Publications
(Non-anonymous question)
Your name and file upload actions will be recorded in OneDrive and visible to the form owner.
Please download this spreadsheet (File > Create a Copy > Download a Copy): https://tinyurl.com/mr2t35yu

Please complete all tabs, and upload below.

Reporting Period (Fiscal Year): May 1st to April 30th
-Please report on FY2025 for the "Most Recent Fiscal Year", and on FY2026 for the "Next Fiscal Year".

Upload file
File number limit: 1Single file size limit: 100MBAllowed file types: Word, Excel, PPT, PDF, Image, Video, Audio

Uploaded.

Justification for funding request from FMHS; explain why continued support from the FMHS is vital to Unit (½ page max)
The funding request is to be indicated in "Budget" tab of the spreadsheet linked in Question 14 (i.e. in the "Revenues" section under "FMHS (CORU)" for the Next FY). The maximum funding request from FMHS is $50,000. Direct research costs, student stipends, and travel expenses are not covered; only operational costs for your Unit are eligible.

Year 2024-2025: Due to a financial shortfall carried over from the previous fiscal year, CAMBAM intentionally limited its training and outreach activities. Support was focused on two key initiatives: (i) a $4,500 contribution to the Mackey-Glass Undergraduate Bursary, awarded to two outstanding students; and (ii) a $500 sponsorship to host two in-person seminar speakers in Montreal.

Year 2025-2026: CAMBAM has already secured two grants (totalling $19,500): $16,500 from the Centre de Recherches Mathématiques (CRM) and $3,000 from the Department of Physiology at McGill University. These funds will primarily support a week-long symposium titled "Rhythms, Networks, and Slow-Fast Analysis in Neural and Endocrine Systems", with an estimated cost of approximately $22,000. The remaining funds will be allocated to support
1) training activities, by (i) awarding three graduate fellowships of $10,000 each, and (ii) providing $4,500 to the Mackey-Glass Undergraduate Bursary;
2) outreach activities, including (i) $4,000 to sponsor in-person speakers for the CAMBAM/QLS Seminar Series, and (ii) approximately $2,000 to organize a retreat for all CAMBAM members.

Governance (detail the governance body of the Unit)
As per McGill's Policy & Procedures for Research Units, the Units must have a governance structure in place adapted to its size and scope. This is to provide strategic direction, guidance on management, and to ensure accountability of the unit's activities.

The designation of members of the governance body must be approved by the Research Office of the Faculty of Medicine and Health Sciences.

The governance body must meet at least annually to review activities and membership, assess progress and performance, approve the Unit's annual report, budget, and to provide general guidance. The Vice-Dean or Associate Dean of Research will represent the Dean and will chair the Board Meeting.

Please issue an invitation to riac.med@mcgill.ca for scheduling Board Meetings.

The existing governance body of CAMBAM consists of the following:

(1) Lead Faculty Dean: Sylvain Baillet (The Neuro, McGill).
(2) Two co-directors: Anmar Khadra (Physiology, McGill) and Paul Francois (Bioinformatics, Biophysics, *Université de Montréal*).
(3) Four board members: Erik Cook (Physiology, McGill), Antony Humphries (Math, McGill), Suresh Krishna (Physiology, McGill), Fahima Nekka (Pharmacie, Université de Montréal), Fred Guichard (Biolog, McGill).
(4) One student representative: Nils Koch (IPN, McGill)

The governance body meets once a year in December. We always invite Sylvain Baillet as a representative from the Faculty of Medicine. In the future, we will also send an invitation to riac.med@mcgill.ca as instructed.

Governance visual summary (optional)
(Non-anonymous question

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Date of the Unit's last Board Meeting

Dec 4, 2024

Tentative date of the next Board Meeting

Dec 2025.

Date of the Unit's last External Review

October 11, 2021.

Tentative date of next External Review

October 2027.

Findings of the last External Review
(Non-anonymous question)

CAMBAM was evaluated as part of the FRQNT/NSERC grant application submitted by the Centre de Recherches Mathématiques (CRM). The application was successful, and the CRM (including all its affiliated laboratories such as CAMBAM) will receive funding through 2027.

By-Laws
(Non-anonymous question)
Your name and file upload actions will be recorded in OneDrive and visible to the form owner.
As per McGill Policies, all Research Units must develop written by-laws.

Please donwload this spreadsheet, complete the table inside, and upload below: https://tinyurl.com/8vca2dyt

File submitted.

Indicate how the Faculty could do better to support the Unit (no page limit but please be specific and unleash your creativity!)

Currently, CAMBAM operates without dedicated administrative support, relying solely on the efforts of its co-directors to manage all operations. While the CRM occasionally provides limited assistance, CAMBAM intentionally avoids spending any of its $15,000 annual funding from FMHS on administrative costs to maximize support for its core activities. Increasing our funding to $25,000 would greatly enhance CAMBAM's ability to recruit a person that can help organize the International Conference in Mathematical Neuroscience in 2026. Additionally, with extra funding, the number of workshops and symposia organized by CAMBAM could increase significantly, further advancing our mission and impact.