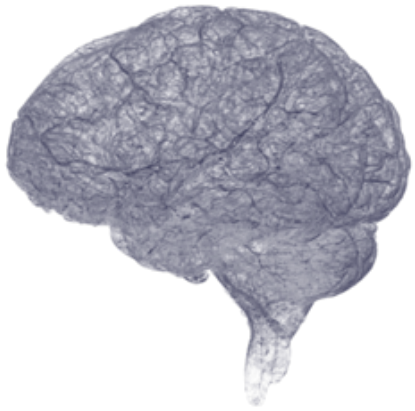
Concordia University
Arts and Science
Department of Physics

Funded Graduate Student Position Available, starting in Fall 2022 / Winter 2023

Group of Professor Claudine Gauthier

Department of Physics, Concordia University, Montreal, Canada.



Dr. Claudine Gauthier, head of the Quantitative Physiological Imaging laboratory of Concordia University is seeking an **MSc** or **PhD student** to join a multidisciplinary team of neuroscientists, physicists and engineers investigating changes in metabolism and hemodynamics with aging, lifestyle and vascular diseases.

The lab focuses on using advanced quantitative Magnetic Resonance Imaging (MRI) of the brain and the cardiovascular system to understand the impact of vascular disease on the brain. We study populations ranging from healthy adults, to seniors to patients who suffer from diseases such as heart diseases, stroke and COVID-19. The research will take place at the Montreal Heart Institute and the Physics department of Concordia University. Students will take part in all components of projects, including data acquisition, data analysis and development of biophysical models of MRI signals and physiology.

Two projects are currently available:

Brain health in females across the adult lifespan

Vascular diseases such as heart attacks and stroke are the main cause of death in women, and women diagnosed with these diseases are more likely to die from them than men. Despite this, most studies investigate vascular diseases in men, since women are commonly thought to be protected against them. Though there is evidence for a protective effect of estrogen, the lower estrogen levels at menopause leave women vulnerable to developing vascular diseases in later life. The decades following menopause often see the development of inflammation and vascular risk factors, including an increased stiffness of blood vessels. Decline in cognition and higher incidence of dementia are increasingly recognized impacts of inflammation, vascular risk factors and disease. We currently know little about the role of estrogen in mediating the link between vascular changes, cerebral health, and cognition across the lifespan in women. This knowledge is crucial if we are to eliminate the chasm in detection, management and prognosis of vascular diseases in aging women. The aims of this work are to: 1. Determine the timeline of vascular and cerebral changes across the lifespan in women; 2. Investigate the role of inflammation, estrogen and menopause on the link between vascular and cerebral health; 3. Investigate the impact of these relationships on cognition. Magnetic resonance imaging is an ideal tool for studying these effects as it can be used for measurement of cerebral health, and carotid stiffness. MRI will be used with ultrasound and metabolomics to identify key relationships between estrogen, cerebral health, vascular stiffness

and inflammation. This work is the first step in studying the changes in vascular health, cerebral health and cognition in women across the lifespan, and how these changes are related to estrogen and menopause. The knowledge gained will enable future studies on the impact of lifestyle and exercise to better preserve cerebral and cognitive health.

The long-term effects of COVID-19 on brain white matter, vascular and metabolic health

As the acute phase of the COVID-19 pandemic is ebbing, the long-term effects of infection are starting to appear. The virus causing COVID-19 can enter the brain and an increased number of stroke and neurological disease occurs following infection. However, more subtle sub-clinical changes to brain white matter (WM), vascular and metabolic health have not yet been systematically studied. Some WM health changes have been observed in both hospitalized and milder cases. Furthermore, some of the lesions in WM are vascular in nature, indicating that changes in blood flow are likely present. Changes to blood flow and brain metabolism have been little studied so far however. Since these changes occur upstream of permanent lesions, they are more likely to be sensitive to the effects of therapeutic interventions. Given the societal impact that brain damage following COVID-19 infection is likely to have, it is urgent that we understand how COVID-19 affects the brain.
The aim of this project is to understand the brain cerebrovascular and microstructural changes associated with COVID-19 infection in middle age and older adults, and how these are influenced by chronic systemic inflammation and arterial stiffness. Quantitative magnetic resonance imaging (MRI) will be used to measure brain WM, vascular and metabolic health. Arterial stiffness will be measured using applanation tonometry. Inflammatory factors will be assessed using clinical blood tests and mass spectrometry.
Worryingly, cerebral and psychiatric illnesses have been shown to increase in the months following a COVID-19 infection. Understanding the effects of COVID-19 on the brain is urgent if we are to leverage all the preventative and therapeutic tools at our disposal to mitigate the effects of this health crisis in the long-term.

Concordia's Department of Physics is growing rapidly in size, impact, and diversity. We have over 170 undergraduate students, 45 graduate students, several postdocs, and are regularly hiring new faculty members in cutting edge research fields such as Condensed Matter and Nanomaterial Physics (theoretical, computational, and experimental), Biophysics and Biomedical Physics (computational and experimental, from molecular-scale up to human-scale), Theoretical Particle Physics, and Physics Education. Successful MSc/PhD applicants will be offered complete financial packages consisting of research bursaries, teaching assistantships, and various awards totaling at least 20,000 CAD per year (often more) and additional tuition support for international students. For information about this specific position, please contact Dr. Claudine Gauthier at claudine.gauthier@concordia.ca