POLYTECHNIQUE MONTRÉAL

PhD position in
Ultrafast Quantum-Enhanced Multiphoton Microscopy

- novel femtosecond laser systems
- nonlinear and quantum photonics
- optical and biomedical engineering
- highly nonlinear microscopy

Description: Decorated by Nobel Prizes in Physics in 2005 and 2018, femtosecond (1 fs = 10^{-15} s) lasers delivered immeasurable technological advances over the last two decades. From enabling fabrication of precision surgical components to the development of attosecond science and high-precision metrology -- short-pulse lasers are ubiquitous in modern science and engineering. In parallel, fundamental principles of quantum science are being applied toward engineering of new quantum-enabled ways for securing communication, advancing computing and improving sensing, to name a few.

In this multi-disciplinary project at the intersection of laser engineering, quantum optics and biomedical engineering, the successful candidate will design and build a multiphoton microscopy system with quantum-enhanced sensitivity and apply it to deep-tissue imaging of the brain. The first part of the project will focus on the implementation of the fs amplified fiber laser system [1] offering lowest-possible timing and amplitude jitter in the near-infrared [2,3]. In the second part, entangled photon pairs via spontaneous parametric downconversion will be used to demonstrate quantum-enhanced imaging capability, based on a six-wave mixing process of three-photon absorption. The final part will focus on detailed performance analysis and application of the system to imaging of vasculature and quantitative blood flow analysis in sub-cortical tissue of the brain [4].

If you find this research exciting and you're highly motivated, enthusiastic and creative, we look forward to hearing from you! Strong background in fs lasers, nonlinear and quantum optics is desired but not required.

[1] D. Fehrenbacher, et al., Optica **2**, 917 (2015)
[2] A. Liehl, et al., Phys Rev Lett **122**, 203902 (2019)
[3] P. Sulzer et al., Opt Lett **45**, 4714 (2020)
[4] T. Wang and C. Xu, Optica **7**, 947 (2020)

contact Denis.Seletskiy or Frederic.Lesage (@polymtl.ca)
visit www.femtoQ.science for more info and reach out via an email.