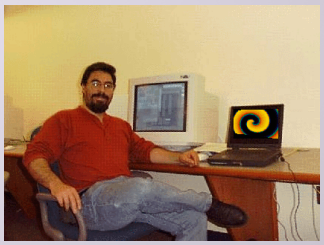
DEPARTMENT OF PHYSICS &ASTRONOMY COLLOQUIA SERIES

Friday, 5 February 2010, 3:00 PM
Science B 146

Spiral waves and the heart:
Modeling, simulating and visualizing the spatiotemporal organization of cardiac arrhythmias

The heart is an electro-mechanical excitable system that can exhibit a broad range of dynamical states. Under normal conditions, electrical activation resulting from diffusive wave propagation leads to a coordinated and efficient contraction. When this electrical wave propagation is disturbed, instabilities can develop and produce pathological states with a rich variety of spatiotemporal patterns. From a nonlinear dynamics perspective, arrhythmias can arise from period-doubling bifurcations resulting in quasiperiodic or spatiotemporally chaotic oscillations, which in turn can further evolve to form single or multiple rapidly rotating electrical spiral and scroll waves. These abnormal waves inhibit effective contraction and can be lethal if untreated.

In his talk, Dr. Fenton will discuss experimental and theoretical approaches to understanding the dynamics of cardiac arrhythmias. He will show how computer simulations and state-of-the-art voltage-sensitive fluorescent dyes can be used to image the electrical waves present in cardiac tissue, leading to new insights about their underlying dynamics. Dr. Fenton will discuss how period-doubling bifurcations that arise at fast heart rates, in conjunction with intracellular calcium cycling and cardiac tissue anisotropy, may give rise to arrhythmias. Finally, he will show how control algorithms and the application of a series of low-voltage electrical shocks can stabilize and terminate arrhythmias and may have future clinical applications.



Flavio H. Fenton, PhD (Northeastern U.)
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Flavio Fenton obtained his B.S. in Physics from the National University of Mexico (UNAM) in 1990, followed by M.S. and Ph.D. degrees in Physics from Northeastern University in 1993 and 1999. Originally he started working on his Ph.D in high-energy physics, but when they closed the superconducting supercollider project he changed his research area to complex systems. Since then he has been focused primarily on the nonlinear dynamics of the heart, especially the complex spatiotemporal patterns associated with arrhythmias.
Dr. Fenton completed his postdoctoral training at Long Island Jewish Medical Center and in the Department of Mathematics at Hofstra University (1998-2001), after which he became Director of Electrophysiology Research at The Heart Institute of Beth Israel Medical Center (2001-2006). Since 2006 he has been a research faculty member in the Department of Biomedical Sciences at Cornell University. Over his career he has had the opportunity to conduct theoretical, experimental, and clinical research.

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Everyone is welcome!

This event is jointly sponsored by MITACS, the Centre for BioEngineering Research & Education, the Complexity Science Group.

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