**KAVLI INSTITUTE FOR THEORETICAL PHYSICS**

*Presents*

*the Thirty First KITP Public Lecture*

# Alain Karma

## Bringing Order to Chaotic Hearts

TRANSITIONS from order to chaos have been widely studied by physicists in the context of fluid turbulence and other dynamical systems. Recently, physicists have teamed up with biologists and clinicians to help tame cardiac fibrillation, a form of wave turbulence that stops the heart from pumping blood and is the leading cause of sudden death among industrialized nations. Medical doctors routinely defibrillate patients on the show ER and in real life. Some high risk patients can carry implantable defibrillators. However, reducing mortality in the wider population of patients who die suddenly and unpredictably from ventricular fibrillation has remained a major challenge. At the heart of this challenge is a quest for a fundamental understanding of electrical waves that propagate contraction through the main chambers of the heart. These highly nonlinear waves behave quite differently from the linear waves that propagate sound or light. Plane waves annihilate when they collide and can break up into rapidly rotating spiral-shaped waves that are widely believed to cause fibrillation. Furthermore, wave propagation is governed by an electrical circuitry of bewildering complexity at molecular, cellular, and tissue scales. In this lecture, I will review the rich scientific history that has lead to modern conceptualizations of fibrillation. I will also discuss recent insights into wave dynamics from a physics perspective that offers new prospects to tame cardiac fibrillation and goes beyond the limitations of current therapies.

### About the Speaker

ALAIN KARMA is a Professor of Physics and College of Arts and Sciences Distinguished Professor at Northeastern University, as well as Interim Director of the Center for Interdisciplinary Research on Complex Systems. Prior to joining Northeastern, he received his PhD in Physics from the University of California at Santa Barbara in 1985 and subsequently held a 3-year postdoctoral appointment at the California Institute of Technology as a Weingart Research Fellow in Theoretical Physics. His research focuses on theoretical understanding of the emergence of non equilibrium patterns with applications to a wide range of problems in materials science and biology. He has authored widely cited ground-breaking papers that introduced a paradigm shift away from old beliefs about what causes electrical wave turbulence in the heart.

**Wednesday, July 26, 2006**

**8:00 pm**

*Kavli Institute for Theoretical Physics, Main Seminar Room*

## Admission is Free

**Limited Seating**

**Please Call**
**(805) 893-4111**
**for reservations.**

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KITP Public Lecture Series