

Department of Mathematics Distinguished Visitor's Lecture Series  
November 28-30, 2007

**Professor James Keener**  
University of Utah

Friday November 30 - 3:30 p.m. in room 105 MLH

Title:

**Modelling Stochastic Calcium Oscillations**

**Abstract:**

Calcium oscillations are an important means of signalling in many cell types. These oscillations have been studied extensively using ordinary differential equation (ode) models, some with a high degree of detail. These models generally show that the onset of oscillations is via a subcritical Hopf bifurcation. The experimental data, however, show that calcium release is not nearly as regular as the ode models suggest, but is highly stochastic in nature. In fact, these data show that oscillations are initially very irregular with large average interspike interval and large variance, eventually settling into a regular oscillation as the bifurcation parameter (in this case  $[IP_3]$ ) is increased.

The reason for the discrepancy between data and models is that calcium release is via events that are fundamentally stochastic in time and discrete in space. Furthermore, the assumptions that permit a whole cell ode model, namely uniformly distributed calcium and the law of large numbers, do not apply under many physiological conditions.

In this talk, I will describe our recent attempts to develop and analyze mathematical models of the events underlying stochastic calcium oscillations, including a model for spark generation, a model for the spark to wave transition leading to a model of stochastic whole cell calcium release. The result of these is a description of the onset of calcium oscillations that shows improved agreement with experimental observations.