1077-92-2345 **M. Saleet Jafri*** (sjafri@gmu.edu), School of Systems Biology, 10900 University Blvd., MSN 5B3, Manassas, VA 20110, and **Minh Tuan Hoang-Trong**, **George S. B. Williams** and **W. Jonathan Lederer**. *Stochastic Multi-scale Modeling Suggests the Molecular Basis of Calcium-Entrained Cardiac Arrhythmia.*

Heart disease is the leading cause of death worldwide. Defects in cardiac calcium dynamics account for a class of these fatal arrhythmias. Calcium dynamics are governed by the coordinated stochastic action of over one million macromolecules known as calcium channels in an individual cardiac muscle cell. However, the un-coordinated behavior of a number of these calcium channels can trigger a cardiac arrhythmia. Computational modeling has proven to be an essential tool to understand this complex system. We have developed the first model of the cardiac myocyte that captures the biophysically realistic behavior of these channels as well as the myocyte calcium dynamics. In order to do so, we have had to develop our Ultra-fast Monte Carlo Simulation Methods and ported this method to use modern fast GPUs (Graphics Processing Units) to achieve a 15,000-fold increase in computational efficiency. By modeling the detailed behavior of the individual components correctly, higher level cellular function emerges that suggests the molecular basis of calcium-entrained arrhythmia. (Received September 22, 2011)