Notre Dame Science
Department of Physics

A MECHANISM FOR FREE-ENERGY TRANSDUCTION BY MOLECULES

Colloquium

Professor R. Dean Astumian
Department of Physics and Astronomy, University of Maine

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(Refreshments at 3:30 p.m. NSH 202)

Proteins and other macromolecules can act as molecular machines that convert energy from one form to another through cycles of conformational transitions. In a macroscopically fluctuating environment or at the single-molecule level, the probability for a molecule to be in any state j fluctuates, and the probability current from any other state i to state j is given as the sum of a steady-state current and a pumped current, , where is the fraction of the fluctuating current into and out of state j coming directly from state i, and is the rate of change of the probability for the molecule to be in state j. If the fluctuations arise from an equilibrium source, microscopic reversibility guarantees that the time average of the pumped current is zero. If, however, the fluctuations arise due to the action of a nonequilibrium source, the time average of the pumped current is not in general zero and can be opposite in sign to the steady-state current. The pumped current provides a mechanism by which fluctuations, whether generated externally or arising from an internal nonequilibrium chemical reaction, can do electrical, mechanical, or chemical work on a system by coupling into the equilibrium conformational transitions of a protein. In this review I examine work elaborating the mechanism of stochastic pumping and also discuss a thermodynamically consistent approach for modeling the effects of dynamic disorder on enzymes and other proteins.

All interested persons are cordially invited to attend.