

# T<sub>c</sub>SUH Bi-Weekly Seminar

Texas Center for Superconductivity  
University of Houston



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### “Electromagnetic Probes of Enzymatic Activity in Live Organisms”

**Friday, May 25, 2007**

Room 102, University of Houston Science Center  
12:00 Noon – 1:00 p.m.

#### Abstract

We report on measurements of the harmonics generated by live cells, mitochondria, photosynthetic organelles, and whole organisms in response to sinusoidal electric fields. The frequency and amplitude dependence of the induced harmonics correlate with physiological processes occurring in various enzyme complexes. The motion of charged residues and ions leads to a nonsinusoidal response to an applied sinusoidal field, leading to the generation of harmonics. For example, H<sup>+</sup>-ATPase, a proton pump that plays an important role in yeast (*S. cerevisiae*) generates harmonics that are affected by suitable inhibitors or substrates, such as vanadate or glucose. A high-T<sub>c</sub> SQUID is used to measure its response at low frequencies (< 1 kHz). At higher frequencies the field capacitively couples through the plasma membrane and probes complexes within internal organelles. Some features in the frequency-dependent harmonics produced by whole cells appear to correlate with those seen in isolated mitochondria, which can be increased by adding substrates that activate the electron transport chain, or suppressed by inhibitors such as rotenone or antimycin A. Finally, both the linear and harmonic responses of whole leaves and thylakoid membrane (chloroplast) suspensions, responsible for photosynthesis in plants, are strongly affected by the presence or absence of light.

#### Bio

Prof. Miller received his Ph.D. at the University of Illinois in 1985, where he studied the dynamics of charge density waves under the direction of John Tucker and two-time Nobel laureate John Bardeen. He was a faculty member in the Department of Physics and Astronomy at the University of North Carolina - Chapel Hill from 1986-1989, receiving the prestigious Alfred P. Sloan Research Fellowship in 1987. In 1989, he joined the University of Houston as a faculty member in the Department of Physics and the Texas Center for Superconductivity. Prof. Miller's research has included experiments probing the pairing state symmetry of high-T<sub>c</sub> superconductors, applications of superconducting quantum interference devices, and noninvasive biosensors and their use to probe the electromagnetic properties of live cells and complex biological macromolecules.

*Persons with disabilities who require special accommodations in attending this lecture should call (713) 743-8210 as soon as possible.*



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