



The Spring 2007 Condensed Matter Seminar Series presents:

Prof. Roland Winkler
(Northern Illinois Univ. and Argonne National
Laboratory)

*“Oscillatory Spin and Orbital
Dynamics in Coupled Bands”*

Abstract:

In recent years the spin of electrons has attracted significant interest due to possible applications in the novel field of spintronics. Here one seeks to obtain devices that use not only the charge of the electrons but also their spin degree of freedom in order to achieve new functionalities. In my talk I will discuss how spin-orbit coupling forms a common theme underlying many spintronics concepts because spin-orbit coupling makes the spin respond to its spatial ("orbital") environment. Thus it gives us a "control knob" with which we can steer the purely quantum-mechanical spin degree of freedom.

Often spin-orbit coupling in semiconductors can be interpreted as an effective magnetic field. Like an external magnetic field, it results in an oscillatory motion of spin noneigenstates which is the well-known spin precession. The orbital dynamics of electrons in the presence of spin-orbit coupling is likewise characterized by an oscillatory component. In the context of relativistic quantum mechanics described by the Dirac equation, the oscillatory motion has long been known as Zitterbewegung [1]. I will show that many remarkable analogies exist between the Zitterbewegung of relativistic quantum mechanics and the oscillatory orbital dynamics of electrons in semiconductors [2]. Moreover, the oscillatory orbital motion is closely related to the precession of the spin degree of freedom.

Wed., Apr. 25
304 Robeson Hall
4:00 P.M.
