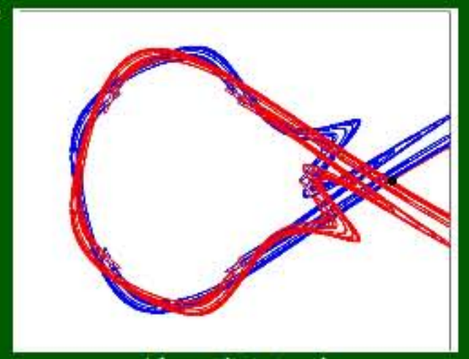
Kevin A. Mitchell

My work focuses on the theory of nonlinear dynamics and its applications to atomic and molecular systems. This includes the fields of classical and quantum chaos, semiclassical physics, phase space transport, and geometric (Berry's) phase. I am particularly fond of geometric and topological techniques.

Chaos-Induced Pulse Trains: Most recently, I have been investigating the chaotic ionization of hydrogen in electric and magnetic fields. This system is an excellent and clear theoretical example of chaotic dynamics that is also experimentally realizable. One of the primary results to come from our study has been the theoretical prediction of "chaos-induced pulse trains". After an initial excitation by an ultrashort laser pulse, a hydrogen atom can decay by emitting a train of electron pulses. This train bears the imprint of the underlying chaotic dynamics of the electron. Understanding the structure of this pulse train involves understanding in detail the chaotic transport of the electron.

Homoclinic Tangles: From the mathematical point of view, the chaotic motion of the electron is regulated by a "homoclinic tangle". Homoclinic tangles are an important theoretical structure for studying transport in many diverse systems, including fluid dynamics, molecular reactions and scattering, and celestial mechanics. We have developed a new theoretical framework, called "homotopic lobe dynamics", for the description and study of such tangles.



A homoclinic tangle

More details of this work can be found in my publications and preprints.

Publications and Preprints
Curiculum Vitae

Teaching:
Fall 2005: ICP: Integrated Calculus and Physics

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