

# REU Talks

## August 7, 2012

### **Rick Presman:** *The Generalized Stokes Theorem*

This talk will prove the generalized Stokes Theorem over  $k$ -dimensional manifolds. We will begin from the definition of a  $k$ -dimensional manifold as well as introduce the notion of boundaries of manifolds. Using these, we will construct the necessary machinery, namely tensors, wedge products, differential forms, exterior derivatives, and integrals over manifolds, in order to prove the main result of this talk.

### **Daniel Older:** *Applications of Variational Principles to Dynamics and Conservation Laws in Physics*

Much of Physics can be condensed and simplified using the Principle of Least/Stationary Action from the calculus of variations. After introducing some basic concepts such as a functional, the variation of a functional and the condition required for a differentiable functional to have an extremum, the Action, Lagrangian and Hamiltonian of a physical system will be introduced. Applying the Principle of Least Action to a system of particles and then the Principle of Stationary Action to a physical field, not only do the Euler-Lagrange equations (the dynamic equations for particles or field equations for fields) come directly from the differential of the Action but so do all of the conservation laws associated with the physical system by Noether's Theorem. Applying the main results to particles, we will derive Newton's Second Law of Motion and the conservation of energy and momentum in Classical Mechanics. Then, applying the results to fields, Maxwell's Equations for Electromagnetism will be derived as well as well the Energy-Momentum Tensor for a Classical Field.

### **Daniel Kassler:** *Chaotic Behavior in the Damped, Driven Pendulum*

This is an introduction to chaotic behavior, focusing in particular on the example of the damped, driven pendulum. We will look at period doubling and bifurcation graphs, sensitivity to initial conditions, and graphical depictions of chaos such as state space orbits and Poincaré sections.

**Yan Shuo Tan:** *The Ham Sandwich Theorem and Other Tasty Treats*

Given a ham sandwich (two buns and a slice of ham in the middle, no lettuce or tomatoes allowed), are you able to slice all three pieces (bun, ham and bun) into precisely half with a single whack of the cleaver? We will answer this delectable question and more using some elementary techniques of algebraic topology.

**Kevin Qian:** *An analytic proof to why irrational rotations on the circle are dense*

In this talk, facts about consecutive rotations on the circle will be proven using analytic methods. A basic proof of Weyl's equidistribution theorem, a result about consecutive irrational rotations on the circle, will be outlined and used to prove the density of such rotations on the circle.

**Young Kun Ko:** *Probabilistic Checking of Proofs*