Abstract for student Colloquium

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Title: Numerical integration of ordinary differential equations: motion of charged particles in electromagnetic fields
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Abstract:

Numerical simulations play an increasingly important role in physics.

In this Student Colloquium, I wish to outline how I made a simulation of classical non relativistic particles in various electric and magnetic setups. My simulation is based on the Runge-Kutta method for numerically solving ordinary differential equations, which I have implemented in C++ at various different orders, in particular, I have implemented and compare the 1st order "Euler" method, the 4th order Runge-Kutta method, and the adaptive step-size implementation of the Dormand Prince method.

In this Colloquium I will both go through how and why the Runge-Kutta based simulation works, while also demonstrating how large an error the method makes, when simulating an analytically solved system.

I have used my simulation to explore a particle in a constant magnetic field – an analytically solved system – , and a particle interacting with a magnetic dipole – which is a fine test of adaptive step-size algorithms. I have also looked at more systems, which we can talk about if time permits