Honours Thesis Presentations (3 talks)

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PLACE: C3067

General Relativistic Modications on N-body Simulations of Globular Clusters Literature Review with suggested modications

Catherine Woodford (supervisor: John Lewis)

ABSTRACT: This work is focussed on the analysis of globular clusters through computer simulations. We analyze the results of a classical Newtonian N-body integrator and present an algorithm for implementing general relativistic considerations. Specifically, we are using the publicly available N-body integrator \Hermite Integrator using Graphics Processing Units", or HiGPUs, created and maintained by R. Capuzzo-Dolcetta and M. Spera (2013) as an evolutionary model and create the initial conditions for the simulation via the King Model. This integrator uses 6th order Hermite integration and gives exceedingly accurate results for non-relativistic N-body systems. We analyze the output from the original HiGPUs and suggest a general relativistic modication based on the work presented in \Gravity: Newtonian, Post-Newtonian, Relativistic" by E. Poisson and C. M. Will (2014), focussing on parametrized post-Newtonianism, or PPN. The algorithm presented in this work was implemented in a copy of HiGPUs. We have not as of yet obtained results from these modications due to technical and coding difficulties. We also present a method for analyzing potential gravitational radiation from simulated globular clusters: a by-product of general relativity, based on the gravitational analogue of the electromagnetic Larmor formula. We use this method on the classical globular cluster information to show its functionality and to give a complete classical data set for future comparisons with general relativistic data resulting from the same initial conditions for globular clusters.

Frustration of Dipolar Spins on the Kagome Lattice

Shane Holden (supervisor: Ivan Saika-Voivod)

ABSTRACT: Geometrical frustration is a source of complex degenerate ground states in systems comprising classical Heisenberg model spins. Studies on frustrated continuous spin systems have often been limited to short-range interactions due to computational limitations and comparative weakness of long-range dipole interactions. Results of Monte Carlo simulations are presented on the classical 2D kagome lattice with magnetic dipole interactions. Low temperature states consist of mixtures of degenerate ground state domains separated by domain walls. Results are also presented on the thermal behaviour of the systems magnetization order parameters, specific heat and magnetic susceptibility.

An Analysis of the Effects of Au Surface Morphology on the Deflection of Microcantilever Sensors - A Literature Review

Tyler Downey (supervisor: Luc Beaulieu)

ABSTRACT: Cantilever sensors are a relatively new technology with the potential to become some of the most accurate and robust sensors available. They are on the order of microns in size, with a small spring constant, making them very sensitive, and have applications across a wide variety of fields, including materials sciences, diagnostics, and explosives detection. These sensors are created by coating a silicon cantilever on one side with a thin gold film, and then functionalizing it for detection of specific phenomena. Target molecules will bind to the functional layer and induce a stress on the surface of the cantilever, causing a bend in the cantilever. Then, using a position sensitive device, the deflection of the sensor can be detected by reflecting a laser off the surface of the bent cantilever. It is believed that the gold film is responsible for extra surface stress across the coated face of the cantilever, which has caused the sensors to be inaccurate and give irreproducible measurements. It has been shown that this stress depends on the surface features of the gold film, however the exact relationship between gold surface morphology and cantilever deflection is unclear. The purpose of this project is to summarize the literature investigating the effects of the gold film surface morphology on the deflection of cantilever sensors. This will provide a quick reference for future research, and will help researchers to isolate the physical phenomena which may be affecting the measurements made by previous research groups.

ALL ARE WELCOME!!!