

ANNOUNCEMENT: Interested Members of the University Community are Invited to attend the Final Oral Examination for the Degree of Master of Science of

John Russell

of the Department of Physics, on Monday, December 5th, 2011 at 8:30am in SCIE 1504.

Thesis Title: **Development of a Self-Consistent Gas Accretion Model for Simulating Gas Giant Formation in Protoplanetary Disks**

Examination Committee: Dr. Robert Wickham, Chair,
Dr. Edward Thommes, Advisor
Dr. Eric Poisson

ABSTRACT

The number of extrasolar planet discoveries has increased dramatically over the last 15 years. Nearly 700 exoplanets have currently been observed through a variety of observation techniques. Most of the currently documented exoplanets differ greatly from the planets in our own Solar System, with various combinations of eccentric orbits, short orbital periods, and masses many times that of Jupiter. More recently, planets belonging to a new class of 'distant gas giants' have also been discovered with orbits of 30 to 100 times that of Jupiter. The wide variety of different planet formation outcomes stem from a complex interplay between gravitational interactions, hydrodynamic interactions and competitive accretion among the planets that is not yet fully understood.

Simulations performed using a series of modifications to an existing, widely used hydrodynamic code (FARGO) are presented. The main goal is to develop a more rigorous and robust gas accretion scheme that is valid and consistent for the ranges of exoplanetary gas giant masses, eccentricities and semimajor axes that have been observed to better understand the mechanisms involved in their formation. The resulting scheme is a more robust and accurate prescription for gas accretion onto planetary cores in a manner that is mostly resolution independent and valid over a large range of masses (less than an Earth mass to multiple Jupiter masses). The modified scheme accounts for multiple, competing, dynamic accretion mechanisms (including atmospheric effects) and their associated time scales between an arbitrary number of protoplanets. This updated accretion scheme provides a means for exploring the entire formation process of gas giants out of a variety of initial conditions in a self-consistent manner. The modifications made to the code as well as simulation results will be discussed and explored.

By: John Russell

Advisor: Dr. Edward Thommes

CURRICULUM VITAE

EDUCATIONAL BACKGROUND:

BSc (Honours) Physics, Minor in Computer Information Science, University of Guelph, 2009

ACADEMIC AWARDS:

2009 Undergraduate Research Award

2009 Dean's Scholarship

2010 Dean's Scholarship

2010 University of Guelph Phys Fest - 2nd Place Talk