Winter 2009
Astronomy & Physics - Colloquia Abstracts

SUBJECT TO CHANGE! Be sure to check back often.

Friday January 9
3:00 PM
SB 260
Mr. Jonathan Ramsey
Saint Mary's University
Jets launched from Keplerian discs extended to observational length scales
Jets and outflows are an integral part of the current star formation paradigm and are observed wherever star formation is ongoing. The importance of these objects lies in their ability to remove angular momentum from matter accreting onto a central protostar. While observations easily resolve these objects on scales of thousands, or even several hundred, of AU, the launching and collimating mechanism (which is < 10 AU in size) remains unresolved and is often obscured by a dusty disc or torus. In recent years, there have been many simulations of the jet launching mechanism, but they have not extended to spatial scales resolvable by existing observations. As such, there is a disconnect between the simulation and observation of protostellar jets and in this talk I will discuss how I am bridging the gap between the two. I will present preliminary results of simulations with AZEuS, an adaptive mesh refinement version of the ZEUS fluid code. AZEuS allows me to simultaneously model both the small jet launching region and large observational length scales. I will highlight new results which were not possible without AZEuS, where this project is going in the near future, and the importance of synthetic observations.

Friday January 23
3:00 PM
SB 260
Dr. Jolie Cizewski
Rutgers University
Probing reactions in stars with beams of radioactive nuclei
About half of the elements heavier than iron are understood to be produced in rapid neutron capture, r process, nucleosynthesis. The most likely isotopes to be created, those along the r-process path, have considerably more neutrons than their stable counterparts. Relatively little is known about their properties or the important neutron-induced reactions. Recently, we have begun a program to measure nuclear reactions on nuclei on or near the r-process path to provide some of the basic nuclear physics input into understanding r-process nucleosynthesis. The present talk will describe this new research program and present the first results.

Friday January 30
3:00 PM
SB 260
Dr. Larry Morgan

Saint Mary's University
Triggered Star-Formation in Bright-Rimmed Clouds
The photo-ionisation of molecular clouds by nearby massive stars and subsequent dynamical effects may directly lead to the formation of a secondary (tertiary) generation of stars through a process known as radiatively-driven implosion. The contribution of this mode of star-formation to both the Galactic stellar population and the interstellar mass function is significant, yet poorly understood. The last few years have yielded a wealth of new observations of bright-rimmed clouds (BRCs). A multi-wavelength approach to the study of these potential triggered star-forming regions has revealed a population of dynamically active intermediate- to high-mass early-phase protostars. Careful analysis of these sources may directly link their formation to the expansion of the HII regions around which they are located.

Friday February 6
3:00 PM
SB 260
Dr. Peter Mueller
Argonne National Laboratory
Laser Trapping and Probing of Exotic Helium Isotopes
We have succeeded in laser trapping and cooling of the exotic helium isotopes 6He (t1/2 = 0.8 sec) and 8He (t1/2 = 0.1 sec), and have performed precision laser spectroscopy on individual trapped atoms. Based on the atomic isotope shifts measured along the isotope chain 4He - 6He - 8He, and on the precise theory of the atomic structure of helium, the nuclear charge radii of 6He and 8He are determined for the first time in a method independent of nuclear models. The results are compared with the values predicted by a number of nuclear structure calculations and test their ability to characterize these neutron rich, loosely bound halo nuclei.

Friday February 13
3:00 PM
SB 260
Dr. Andrew Cumming
McGill University
Mapping the neutron star crust in low mass X-ray binaries
Neutron stars are important as laboratories for testing the physics of matter under extreme conditions of density, temperature, gravity, and magnetism, and also as an endpoint of stellar evolution. Our understanding of these objects has improved dramatically over the last few years, driven by new observational discoveries. In this talk I describe how X-ray observations of accreting neutron stars are being used to "take the temperature" of the neutron star interior. I will show that models of the cooling of the neutron star following extended accretion outbursts allow us to map out the properties of the neutron star crust, including the superfluid neutrons, the condensed matter physics of the crust, and the complex nuclear pathway that the matter follows as it is compressed towards nuclear density.

Friday February 27
3:00 PM

L 173
Dr. Jason Kalirai
Space Telescope Science Institute
Stellar Remnants as Astrophysical Probes
White dwarfs represent the eventual end products of 98% of all stars. As such, their luminosity and mass distributions can be used to understand the properties of their progenitor populations (e.g., the initial mass function of stars). In this talk, I will summarize recent results from two large imaging and spectroscopic surveys aimed at uncovering these stellar cinders in nearby resolved clusters. With ultra-deep HST/ACS imaging of globulars, we have now firmly established the ages of the first structures to form in the Galactic halo and disk. A similar survey of white dwarfs in rich open clusters (over a large range of age and metallicity) has uncovered hundreds of these objects that can be spectroscopically studied. The data have led to unprecedented constraints on the initial-to-final mass relation (i.e., what mass main-sequence star maps to white dwarf mass) over a large mass range (M_initial = 1 -- 7 Msun), and therefore are a powerful input to chemical evolution models of galaxies including enrichment in the interstellar medium. Finally, I will discuss direct empirical evidence that stellar mass loss is much more efficient in high metallicity environments. This result is critical in interpreting the UV upturn in elliptical galaxies, the dearth of planets around white dwarfs, and the different rates (and properties) of type Ia SNe in elliptical vs spiral galaxies.

Friday March 6
3:00 PM
SB 260
Dr. Hendrik Schatz
Michigan State University
Rare isotopes on accreting neutron stars: from thermonuclear explosions to cold fusion
Matter accreted onto a neutron star undergoes a series of extreme transformations that involve the most exotic nuclei produced by nature. In X-ray bursts ordinary nuclei are transformed into extremely short lived neutron deficient isotopes for the short duration of the explosion. As the ashes is incorporated into the neutron star crust, the nuclei are then converted into extremely neutron rich rare isotopes, which turn out to be stable under the stellar conditions. Modern rare isotope facilities can now produce many of the extreme nuclei participating in the nuclear reactions in accreting neutron stars. I will discuss the role of rare isotopes in the astrophysical environments, recent progress in experiments producing and studying them, including new results obtained at the National Superconducting Cyclotron Laboratory, and give an outlook of the bright future of this field in light of new facilities on the horizon.

Friday March 13
3:00 PM
SB 260
Dr. Brian Mason
National Radio Astronomy Observatory
Probing the Evolution of Galaxy Clusters with the GBT and the Cosmic Background Imager
Measurements of the Cosmic Microwave Background (CMB) angular power spectrum in the past decade have precisely characterized the conditions in the early universe and strongly support

a picture in which present day structures result from the gravitational collapse of initial density perturbations generated in an early inflationary epoch. The power spectrum of CMB fluctuations on small angular scales is suppressed by photon diffusion in the early universe; this small-angle regime nevertheless carries important imprints of processes occuring in the more recent past, such as the scattering of CMB photons off of the hot plasma in galaxy clusters (the Sunyaev-Zel'dovich Effect or SZE). The Cosmic Background Imager (CBI) is a 30 GHz, small-angular scale CMB experiment which has detected an excess of power over that expected from intrinsic CMB anisotropy. The excess signal seen at 30 GHz is consistent with what is expected from an SZE signature of massive galaxy clusters. An important limiting factor in this measurement is the precision with which extragalctic foregrounds are known. To improve our knowledge of these foregrounds we have conducted an extensive survey of extragalactic radio sources with the Green Bank Telescope (GBT). I will discuss the implications of this survey and the most recent CBI power spectrum measurements. Finally I will briefly discuss prospects for detailed, high resolution imaging of the SZE with MUSTANG, the 90 GHz bolometer array which has recently been commissioned on the GBT.

Friday March 20
3:00 PM
SB 260
Dr. Chris Cameron
Saint Mary's University
Asteroseismic Tuning of the Magnetic Star HR 1217: Understanding magnetism and stellar structure through MOST spacebased photometry
The chemically peculiar A (Ap) stars show extreme examples of astrophysical processes that have only recently been studied in detail in one other star - the Sun. These stars exhibit spectral anomalies caused the delicate balance between mixing, gravitational settling and radiative levitation of some ionic species in a stellar atmosphere threaded by a strong (~ kG), globally organized magnetic field. Ap stars are also spectroscopically and photometrically variable. Over a rotation cycle (ranging from a few days to years) they show maximum light amplitude that is in phase with the maximum magnetic field strength and also coincides with the observed, spotty, abundance patches. The magnetic fields of the Ap stars seem to play a critical role in both the micro- and macroscopic physics that influence these unique stellar structures. This talk reviews the results from ~ 29 days of photometry on the roAp star HR 1217 collected by Canada's first space telescope MOST. This photometry represents the ultimate photometric study of this star to date, and likely for decades to come. The data show a number of new frequencies that present challenges for magnetic models of pulsating stars, including a number of second order frequency spacings that could potentially be used to probe the internal magnetic field of this star for the first time.

Friday March 27
3:00 PM
SB 260
Dr. Aneta Siemiginowska
Harvard-Smithsonian Center for Astrophysics
X-ray Jets and Evolution of Radio Sources

Chandra X-ray observations revealed powerful relativistic outflows associated with the AGN activity. Large scale X-ray jets extend to more than 100 kpc distances from the nucleus of the host galaxy. They indicate a long-term evolution of a powerful radio source and the importance of jets and radio source interactions with the environment on many different physical scales. Compact radio sources represent the first stage of the radio source growth. They are contained within their host galaxy and interact strongly with the dense ISM. I will describe the results of X-ray observations of a sample of such compact radio sources and discuss their evolution.

Friday April 3
3:00 PM
SB 260
Dr. Brian McNamara
University of Waterloo
A New Spin on AGN Feedback in Clusters and Galaxies
The hot, gaseous atmospheres of galaxies and clusters of galaxies serve as both the fuel supply and repository for the energy output from active galactic nuclei (AGN)over cosmic time. X-ray observations are showing that star formation fueled by gas condensing out of hot atmospheres is strongly suppressed by AGN feedback. Dubbed "radio mode" feedback, this mechanism may solve several outstanding problems in astrophysics, including the numbers of luminous galaxies and their colors, and the excess number of hot baryons in the Universe. I present new evidence that the most energetic AGN outbursts may be powered by rapidly-spinning, ultra-massive black holes.