COLLOQUIA 2012-2013

Friday, January 11, 3:00pm AT101

Dr. Dan Wilkins

IoA Cambridge

X-ray Reflection as a Probe of Accreting Black Holes

Material spiralling into black holes powers some of the most luminous objects we see in the Universe; AGN and galactic black hole binaries. X-rays are emitted from a corona of energetic particles around the black hole and are seen to reflect off of the accretion disc. As well as being impressive objects in their own right, the black holes in AGN can emit such large amounts of energy that they are important in governing the growth of galaxies and clusters.

Through detailed analysis of the observed X-ray spectrum and the variability of the detected emission showing reverberation time lags between the directly observed continuum and the reflection, it is possible to detect the emission from material right down to the innermost stable orbit around the black hole.

I will discuss how these observations, combined with general relativistic ray tracing simulations give us a multidimensional view of the accretion and emission processes, allowing us to locate the site of X-ray emission and trace how its properties change in time, giving us insight into the underlying processes powering these extremely luminous object.

Friday January 18, 3:00pm, L187 (please note location)

Dr. Hugo Martel

Laval University

The fate of dwarf galaxies in clusters and the origin of the intracluster light.
Between 25 and 50% of the visible light emitted by clusters of galaxies does not come from the galaxies themselves, but instead from the intracluster medium. This light is emitted by intracluster stars: stars that are not associated with any galaxy. Several scenarios have been proposed for the origin of intracluster stars, the most popular one being the tidal destruction of low-mass galaxy by high-mass ones during close encounters. However, such encounters can also result in galactic mergers, in which case far fewer stars would escape into the intracluster medium. We have performed a numericalstudy of the formation and evolution of galaxy clusters in a cosmological context, taking into account the formation, mergers, and tidal destruction of galaxies. We found that destructions by mergers greatly outnumber destructions by tides, but the latterare sufficient to reproduce the observed intracluster light.

Friday, January 25, 3:00pm SB160 (please note location)

Prof. Dr. Màrius Josep Fullana i Alfonso

Universitat Politècnica de València

What do we learn from the CMB?

A review on the cosmic microwave background (CMB) is presented. Observations, theoretical studies, and simulations are discussed. Thus, the following general question is partially answered: what can we learn from CMB studies? The work performed by our group is briefly described (including Hydra Consortium and SMU collaboration). Main perspectives are commented at the end.

The CMB is a nearly homogeneous and isotropic photon distribution filling the universe. It was firstly coupled with the primeval plasma. During decoupling, CMB photons started travelling freely. Small CMB temperature fluctuations -- the so-called anisotropies-- have been detected. They are due to the presence of cosmological structures evolving in a certain background universe. For this reason, the observations and the analysis of the CMB anisotropies supply substantial information about the composition and the large-scale structure of the universe. Cosmological structures produce correlations in the CMB temperature distribution through various effects which change photon frequencies. The correlation at a given angular scale, q, is measured by the associated C_l quantities ($l=\pi/$q). Due to the thickness of last scattering surface, primary anisotropies are erased at angular scales < 8' (l >1350). Thus, the superposition of secondary small anisotropies become dominant at small enough angular scales (l ~ 3000). Among these anisotropies, the Sunyaev-Zeldovic' (SZ) effect is the dominant one. Weak lensing (WL) is a smaller effect, and the Rees-Sciama (RS) anisotropy is even smaller. Measurements at these small scales have been recently performed with the ACT (Atacama Cosmology Telescope) and the SPT (South Pole Telescope).

In our collaboration with the Hydra Consortium, the three secondary anisotropies mentioned above are being estimated –for l > 3000--. Hydra parallel codes plus a certain ray-tracing method through N-body simulations designed by our group (pieces of universe fulfilled with cosmological structure) are used. Our algorithms have already predicted a WL anisotropy slightly greater than that estimated in previous works[1]. At present, we are studying the superposition of SZ, WL, and RS for comparisons with ACT and SPT observations.

1 M. J. Fullana, J. V. Arnau, R. J. Thacker, H. M. P. Couchman and D. Sáez, "Estimating Small Angular Scale Cosmic Microwave Background Anisotropy with High-Resolution N-Body Simulations: Weak Lensing", ApJ 712, pp. 367-379 (2010).

Friday February 1, 3:00pm, AT101

Dr. Robert Stellingwerf

Stellingwerf Consulting

SPH in Space!

Smoothed Particle Hydrodynamics, an analysis technique developed for astrophysical problems, has been used at NASA to model high velocity impacts, space vehicle design, shock phenomena, and fluid flow instabilities. Application areas include design of meteoroid shielding, modeling of possible launch debris damage, stage separation hardware design, weather damage effects, and modeling of plasma propulsion systems. Fluid instability models include Rayleigh Taylor Instability, Kelvin Helmholtz Instability and Richtmyer Meshkov Instability. Astrophysics examples include interaction of pulsation with turbulent flow in unstable layers of stellar envelopes and formation of shells and filaments in interstellar clouds.

Friday February 8, 3:00pm, AT101

Dr. Chris Geroux

University of Exeter

The Interaction Between Multi-Dimensional Convection and Radial Stellar Pulsation We have developed a three-dimensional radiation hydrodynamics code simulate the interaction of convection and pulsation in classical variable stars. One key goal is the ability to carry these simulations to full amplitude for comparison with observed light and velocity curves. The only previous multi-dimensional calculations were prevented from reaching full amplitude because of drift in the radial coordinate system, due to the algorithm defining radial movement of the coordinate system during the pulsation cycle. We remove this difficulty by defining our radial coordinate flow algorithm to require that the mass in a spherical shell remains constant for every time-step throughout the pulsation cycle. We present results from various tests and checks of our new numerical code SPHERLS such as comparison of our models pulsation periods with those of a linear adiabatic code and comparison to the analytic solution of a spherical blast wave. We have used our new code to perform 2D and 3D simulations of the interaction of radial pulsation and convection in RR Lyrae stars. We present comparisons between light curves from our 2D convective simulations with observed light curves from variables in M3. The observed relation between pulsation amplitude and effective temperature is compared to our 2D results. We examine the differences between the 2D and 3D convective flow patterns, and finally make a comparison between an observed light curve and our 2D and 3D light curves near the red edge of the RR Lyrae instability strip.

Friday February 15, 3:00pm, SB160 (please note location)

Dr. Roby Austin

Saint Mary's University

Studying Americium in America using Berkelium in Berkeley.

This talk will be, in the main, a general overview of some ways in which nuclei are interesting, and some of the interesting ways in which they get studied. The talk will include some motivations for studying nuclear reactions, and spontaneous and excited-state nuclear decays. It will also encompass explanations of how the measurements are made. In the end, I will describe some unexpected results from a study of americium we undertook at Lawrence Berkeley National Laboratory and Lawrence Livermore National Laboratory.

CAP Lecture Tour

Thursday February 28, 11:30 am

Location: Dalhousie University - Dunn 101

Dr. Blair Jamieson

University of Winnipeg

Discovering the properties of ghosts: experiments with neutrinos

The neutrino was originally proposed by Pauli as a mass-less, weakly interacting particle that carried away some of the energy in a beta decay reaction, to conserve energy, and allow for the continuous beta energy spectrum. In order to see these ghostly particles physicists have built very large detectors to detect neutrinos from intense natural and man-made sources. With these detectors physicists have learned that neutrinos come in three flavours, have mass, and can oscillate from one flavour to another. This talk will explore some of the interesting physics of these particles, the puzzles that have been discovered, how some of these puzzles have been solved, and what mysteries still remain.

Friday March 1, 3:00pm L187 (please note location)

Jodi Asbell-Clarke

Edge at TERC

Leveraging the Gaming Revolution

Games are exploding in popularity and educational research is showing that well-crafted games can provide powerful learning environments. Commercial game designers and educators are beginning to work together to learn how to harness the passion, inquisitiveness, and “blissful productivity” of game players (McGonigal, 2011, p. 34) for valuable educational opportunities. Game-based learning often involves tacit or intuitive knowledge building, collaborative skill development, and many modes of social and affective development that are hard to assess, yet these are the most critical skills for our future society and workforce (NRC, 2011). But, where does the authority of knowledge lie in these participative learning environments? How can games support and scientific inquiry in ways that might dig deeper and reach more learners than school settings? Should games replace school curriculum? Or can games bridge formal and free-choice learning “hard fun” so that learners choose to spend them gaming time learning through scientific inquiry. The answers to these types of questions may provide keys to opening the doors of science to an entire new audience of industrious, innovative problem-solvers – gamers!

McGonigal, J. (2011). Reality Is Broken: Why Games Make Us Better and How They Can Change the World. New York: Penguin Press.

National Research Council (2011). Learning Science Through Computer Games and Simulations.

Committee on Science Learning: Computer Games Simulations, and Education. Margaret A. Honey and Margaret L. Hilton (Eds.), Board on Science Education, Division of Behavioral and Social

Sciences and Education. Washington, DC: National Academies Press.

Retrieved from http://www.nap.edu/catalog/13078.html.

Friday March 8, 3:00pm, AT101

Dr. Pauline Barmby

University of Western Ontario

Andromeda's coat of many colours Andromeda is the nearest large galaxy and provides the best view of what our own Milky Way might look like from the outside. Although Andromeda's nearness makes it possible to see the fine details of its internal structure and stellar populations, only recently have observational facilities been able to also provide a global portrait at many wavelengths. Finally we can begin to compare and contrast Andromeda and the Milky Way on both large and small scales in order to understand how local environment shapes a galaxy’s history. I will discuss how multi-wavelength observations of Andromeda’s stars, star-forming regions, and stellar clusters are shaping our picture of this touchstone galaxy.

Friday March 15, 3:00pm, AT101

Michael Gruberbauer

Saint Mary's University

The Trouble with Asteroseismology Recent developments in instrumentation (e.g., in particular the Kepler & CoRoT satellites) provide an opportunity to probe the interiors of stars using asteroseismology. This enables us to check and improve our stellar models, but also to potentially provide valuable additional constraints for the analysis of exoplanets, in particular around sun-like stars. However, the confidence in detailed asteroseismic studies of sun-like stars has to be calibrated with the successes and problems of helioseismology. For the Sun, several problems still persist, such as the "surface effects", the age calibration, and the discrepancies between helioseismic inversion and recent analyses on the solar mixture and abundances. In this talk, I will present a new angle on these issues from a probabilistic viewpoint and how they affect asteroseismology of solar-like stars in general.

Friday, April 5, 3:00pm, AT101

Dr Reiner Kruecken

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TRIUMF

Understanding the Universe using rare isotopes

TRIUMF’s science program is centred on two themes: (1) probing the structure and origins of matter and (2) advancing isotopes for science and medicine. While the talk will provide a brief overview of the full TRIUMF program it will concentrate on the current and future rare isotope program at TRIUMF’s ISAC facility. Exotic nuclei far from stability, so called rare isotopes, play an essential role in the quest to understand some of the most fundamental questions about our Universe from describing the inner workings of atomic nuclei from first principle to understanding the origin of the heavy elements and their role in various astrophysical environments. Also, rare isotopes offer unique opportunities to search for physics beyond the standard model or particle physics by precision measurements of their electro-weak decay. The ISAC facility at TRIUMF is one of the world leading rare isotope beam facilities pursuing these questions in nuclear structure, nuclear astrophysics and electro-weak interaction studies. The Advanced Rare Isotope Laboratory (ARIEL) currently under construction at TRIUMF will vastly expand the scope of this research program.

Thursday June 6, 2013, AT301
Dr. Travis Metcalfe
Space Science Institute, Boulder
Magnetic Activity Cycles and the Solar-Stellar Connection

Observations of magnetic activity cycles in other stars provide a broader context for our understanding of the 11-year sunspot cycle. The discovery of short activity cycles in a few stars, and the recognition of analogous variability in the Sun, suggest that there may be two distinct dynamos operating in different regions of the interior. Consequently, there is a natural link between studies of magnetic activity and seismology, which can characterize some of the internal properties that are relevant to dynamos. I will provide an historical overview of the connection between these two fields and I will discuss how recent observations of the young solar analog epsilon Eridani might teach us something useful about the rotational history of our own Sun.