A large complete ULIRG sample at z~2

Speaker: Dr Jiasheng Huang   
Time: March 27, 2015 - 3:00 PM   
Location: SB 160 (Sobey Building)

Abstract: I will present a multiwavelegth study of a large MIPS selected galaxies and satisfy a certain IRAC color criterion. Stellar population modeling and IRS spectra together demonstrate that the double criteria used to select this sample have efficiently isolated massive star-forming galaxies at z ~ 1.9. This is the first starburst (SB)-dominated ultraluminous infrared galaxies (ULIRG) sample at high redshift with total infrared luminosity measured directly from Spitzer, Herschel FIR and millimeter photometry, and as such gives us the first accurate view of broadband spectral energy distributions for SB galaxies at extremely high luminosity and at all wavelengths. The HST images in optical and NIR bands show that most objects have very extended morphologies in the rest-frame ultraviolet and optical band, thus extended distribution of PAH molecules. We conclude that objects in this sample are ULIRGs powered mainly by SB; and the total infrared luminosity density contributed.

Quantum Physics in Your Light Bulb: A Colourful Story

Speaker: Dr. Kris Poduska, Memorial University  
Time: March 26, 2015 - 2:30 PM  
Location: Dalhousie Physics

Abstract: A white light bulb is just a light bulb...or is it? Edison's incandescent bulbs are now a thing of the past, and solid-state lighting, which is based on inorganic or organic light emitting diodes (LEDs or OLEDs), is gaining popularity. This talk will shed light on the many aspects of quantum physics that are required to produce white light from an LED-based bulb. Along the way, you'll also see why the human perception of light and colour plays a critical role in the evolution of this technology. Short Bio Kris Poduska is an experimental condensed matter physicist based at Memorial University of Newfoundland, where she has been on the faculty in the Department of Physics & Physical Oceanography since 2003. Originally from the United States, Dr. Poduska holds an undergraduate degree in physics from Carleton College (Northfield, Minnesota, USA), and a Ph.D. in physics from Cornell University. Her research is a blend between physics and chemistry, focusing on understanding structural and physical property relations in inorganic materials. The applications of the work span from technologically relevant semiconductors, to medically interesting biomaterials, to ancient archaeological materials.

Studying the Epoch of Inflation with the Cosmic Microwave Background — Lithographic Fabrication of Cold, Superconducting Electronics

Speaker: Dr. Scott Chapman, Dalhousie University  
Time: February 27, 2015 - 3:00 PM  
Location: Loyola 177

Abstract: In the first fraction of a second after the birth of the Universe, space underwent a period of superluminal expansion which we call cosmic inflation. The theory of cosmic inflation was originally proposed in the 1980s to explain the observed geometry and smoothness of the universe. The residual quantum fluctuations from this epoch of inflation seeded the formation of structure in the Universe and left behind a relic background of gravitational waves. These gravitational waves imprint a unique pattern of polarization onto the CMB which may have been recently detected by the BICEP2 experiment operating at the South Pole. This groundbreaking measurement would suggest that the epoch of cosmic inflation occurred t~1e–36 seconds after the Big Bang. The energy-density of the universe at this epoch was 13 orders-ofmagnitude larger than the energies probed by the LHC and near the GUT scale, where the strengths of the strong, weak and electromagnetic forces are thought to converge. The detection of this signal is a revolution in our understanding of the beginning of the Universe. It ties together the most disparate scales possible in science: quantum mechanics and cosmology; the beginning of the universe to the present day. If confirmed by the POLARBEAR-2 and SPT-3G experiments, the BICEP2 result may be the most important scientific discovery of this century.

Dr. Chapman will present an overview of the scientific questions which are currently being addressed by studying the cosmic microwave background (CMB). He will discuss the signature of inflation, experimental techniques, and focus on detector technology for POLARBEAR-2 and SPT-3G. Dr. Chapman's group has initiated a program to lithographically develop cold, superconducting electronics for reading out arrays of TransitionEdge Sensor (TES) Bolometers. The POLARBEAR experiment, faced a challenging problem in that the LC resonators used in previous experiments were found to have too much loss to be used at the higher frequencies needed for the high multiplexing factor in second generation POLARBEAR-2 / Simons Array / SPT-3G experiments. Our group has played a key role in lithographically developing a new fully superconducting resonator which is now these experiments' baseline. The two layer process has explored Nb, Va, and Al, along with various etch and lift-off techniques. We describe the fabrication process and testing of devices leading to a mature technology which is entering a ‘mass production’ phase for the POLARBEAR-2 and South Pole Telescope experiments.

Femtosecond Pulse Shaping for Tailored Control of Semiconductor Quantum Bits

Speaker: Dr. Kimberley Hall, Dalhousie University  
Time: January 30, 2015 - 3:00 PM  
Location: L 177

Abstract: Femtosecond pulse shaping provides a flexible approach to tailoring the Hamiltonian governing the interaction of light with matter. Together with powerful adaptive feedback algorithms, this approach is now used routinely in the control of a variety of physical processes. For quantum computing applications, pulse shaping provides a means to optimize the speed and fidelity of elementary quantum gates, and may enable the realization of schemes for complex instruction set quantum computing. In this presentation, I will discuss our recent experiments demonstrating ultrafast quantum control of charge based (exciton) qubits in semiconductor quantum dots. Using optimal quantum control techniques, we show that pulse shaping provides a means to optimize the fidelity of a C-ROT gate in single quantum dots [1,2], and enables parallel single qubit gates on distant quantum dots within the laser focal spot [3]. We also demonstrate adiabatic rapid passage on a subpicosecond time scale in single semiconductor quantum dots, yielding new insight into the role of phonons in dephasing of exciton qubits [4].   
1. A. Gamouras, R. Mathew, and K. C. Hall, J. Appl. Phys. 112, 014313 (2012).   
2. R. Mathew, C. E. Pryor, M. E. Flatte, and K. C. Hall, Phys. Rev. B 84, 205322 (2011).   
3. A. Gamouras, R. Mathew, S. Freisem, D. G. Deppe, and K. C. Hall, Nano Letters 13, 4666 (2013).   
4. R. Mathew, E. Dilcher, A. Gamouras, A. Ramachandran, Hong Yi Shi Yang, Sabine Freisem, Dennis Deppe, and Kimberley C. Hall, Phys. Rev. B 90, 035316 (2014).

A video-plankton and microstructure profiler for the exploration of in-situ connections between zooplankton and turbulence

Speaker: Dr. Tetjana Ross, Dalhousie University  
Time: January 23, 2015 - 3:00 PM  
Location: SB 160

Abstract: Turbulence and mixing are both ubiquitous in the environment of marine organisms and a critical part of large-scale physical and chemical oceanographic budgets. Recent studies have shown conflicting results about whether zooplankton contribute to ocean mixing and whether turbulence affects zooplankton feeding and swimming behavior positively, negatively or not at all. At least some of the confusion likely arises from the lack of properly resolved, simultaneous and co-located observations of zooplankton and turbulence. This talk introduces and discusses results from preliminary deployments of a Video Plankton Recorder – Vertical Microstructure Profiler (VPR-VMP), which is shown to provide this type of data. There is evidence of avoidance of the VPR-VMP by krill, which raises questions as to whether any microstructure profiler can accurately assess zooplankton-generated mixing.

Exploring the Frontiers of Stellar Astrophysics with classical Cepheids: Rotation, Convection, Mass Loss and Multiplicity

Speaker: Dr. Hilding Neilson (University of Toronto)  
Time: December 5, 2014 - 3:00 PM  
Location: SB 265

Abstract: Classical Cepheids are evolved intermediate-mass stars that have formed a foundation of both cosmology and stellar astrophysics thanks to their brightness and the Leavitt Law (period-luminosity relation) for about a century. Thanks to their pulsation, these stars have been employed as laboratories for stellar structure and evolution models. In the past decade, new observations, from Xray to infrared to interferometric, are changing our view of these stars, leading to new insights into the details of their structure and evolution. In this talk, I will discuss these recent observations and how they are allowing us to probe the details of stellar rotation, convection, stellar winds, and binary star evolution.

Globular Clusters, Dark Matter, and Galaxy Masses

Speaker: Dr. William Harris (McMaster University)  
Time: November 21, 2014 - 3:00 PM  
Location: AT101

Abstract: Recent work from many directions clearly shows that the total stellar mass of a galaxy is a strongly nonlinear function of its the total "halo mass" dominated by the dark matter potential; both dwarfs and supergiants are much more dominated by dark matter than mid-range galaxies where the star formation efficiency was largest. But is there any type of stellar subpopulation that behaves linearly with halo mass? It seems that the total mass in the globular cluster population does exactly that, remarkably independent of galaxy size, type, or environment. I will review the recent evidence for this claim and discuss what it may mean for understanding early star formation in a galaxy.

Feedback and tidal stripping in dwarf galaxies

Speaker: Dr. David Williamson (Laval University)  
Time: November 14, 2014 - 3:00 PM  
Location: AT101

Abstract: The observed mass-metallicity relation demonstrates the metallicity of a galaxy increases tends to increase with its mass. Various mechanisms have been proposed to explain this trend, including suppression of outflows by a strong halo potential or by inflowing material, as well as processes such as ram-stripping and tidal-stripping of metal-rich ejecta. Although tidal stripping is not thought to be a key factor, it may have a significant contribution in the depletion of metals from dwarf galaxies. We are performing simulations to quantify the strength of this effect. Producing realistic dwarf galaxies necessitates the use of suitable star-formation and feedback methods, which I will review.

A New Path Towards Machine Intelligence

Speaker: Dr. Chris Adami (Michigan State University)   
Time: November 7, 2014 - 3:00 PM   
Location: AT101

Modified Title and Abstract

Abstract: For over fifty years, engineers have attempted to achieve intelligence that rivals human performance, but with only limited success in some specialized arenas such as chess. I will discuss what I believe is the central reason behind this failure, and how using the biological process of evolution can overcome that problem. I then discuss several applications of our "evolutionary intelligence" approach to understand brains and behavior.

GrayStar: A Web application for pedagogical stellar atmosphere and spectral line modelling and visualisation

Speaker: Dr. Ian Short (Saint Mary's University)   
Time: October 31, 2014 - 3:00 PM   
Location: AT101

Abstract: GrayStar is a stellar atmospheric and spectral line modelling, postprocessing, and visualisation code, suitable for classroom demonstrations and laboratory-style assignments in courses such as ASTR 2400 (Physics of Stars) at Saint Mary's. It has been developed in Java and deployed in JavaScript and HTML. The only software needed to compute models and post-processed observables, and to visualise the resulting atmospheric structure and observables, is a common Web browser. Therefore, the code will run on any common PC or related X86(-64) computer of the type that typically serves classroom data projectors, is found in undergraduate computer laboratories, or that students themselves own, including those with highly portable form-factors such as netbooks and tablets. The user requires no experience with compiling source code, reading data files, or using plotting packages. More advanced students can view and capture the JavaScript source code using the developer tools provided by common Web browsers. The code is based on the approximate gray atmospheric solution and runs quickly enough on current common PCs to provide near-instantaneous results, allowing for real time exploration of parameter space. I will describe the user interface and its inputs and outputs and suggest specific pedagogical applications and projects, and comment on the computational strategy and methodology as necessitated by Java and JavaScript, and on the vagaries of emulating a plotting package in HTML. I have made the application itself, and the HTML, CSS, JavaScript, and Java source files available to the community. The Web application and source files may be found at [www.ap.smu.ca/~ishort/GrayStar](http://www.ap.smu.ca/~ishort/GrayStar).

Toward model-independent calculations of atomic nuclei

Speaker: Thomas Papenbrock (University of Tennessee, USA)   
Time: October 24, 2014 - 3:00 PM   
Location: AT101

Abstract: In recent years, nuclear theory started to shift away from models to approaches with a stronger theoretical foundation. Effective field theory and renormalization group techniques are used for the development of nuclear interactions that are systematically improvable and linked to the strong interaction. The increasing availability of computational cycles has allowed practitioners to solve the nuclear quantum many-body problem for medium-mass nuclei, with a particular focus on neutron-rich isotopes. The goals of these calculations are reliable predictions for experimentally relevant nuclei with a quantification of theoretical uncertainties. This colloquium talk reviews some of the recent developments and highlights in the field.

Exoplanetary Worlds: Atmospheres and Architectures

Speaker: Dr Stanimir Metchev (University of Western Ontario)   
Time: October 17, 2014 - 3:00 PM   
Location: AT101

Abstract: The detection of global weather phenomena in irradiated extrasolar hot Jupiter planets has provided tremendous insights into their atmospheric structure. Non-irradiated substellar atmospheres probe weather in an entirely different regime, where global atmospheric flows result primarily from a combination of rapid rotation and internal convection - e.g., as in the atmosphere of Jupiter - rather than from external forcing. Isolated brown dwarfs are ideal targets for such investigations because they possess planet-like atmospheric dynamics, yet have greater intrinsic brightnesses and lack nearby bright stars to contaminate observations. I will overview recent results on non-irradiated brown dwarf atmospheres, focussing on a finding that large atmospheric features analogous to Jupiter's Great Red Spot are ubiquitous in cool substellar atmospheres. I will also discuss results on the occurrence of asteroid belts around solar neighborhood stars, as found in a recently completed study on WISE. Together with the direct characterization of exoplanetary atmospheres, resolved imaging of the frost lines and terrestrial zones of nearby planetary systems offers exciting prospects for the generation of extreme-contrast imaging telescopes.

The monsters within: The cosmic evolution of black holes, galaxies, and dark matter halos

Speaker: Dr. Ryan Hickox (Dartmouth College)   
Time: October 10, 2014 - 3:00 PM   
Location: AT101

Abstract: Recent years have seen remarkable advances in our understanding of how supermassive black holes form and grow over cosmic time, and how energy released by active galactic nuclei (AGN) connects the growth of black holes to their host galaxies and large-scale structures. Still a basic and essential question has remained largely unanswered: Does the fueling of AGN activity occur along with star formation in galaxies, or does feedback from AGN suppress star formation? I will argue that both scenarios are correct, depending on the properties of the galaxy and its dark matter halo. Specifically, I will review recent results suggesting that the longterm rate of black hole accretion is closely tied to the rate of star formation, so that essentially \*all\* star-forming galaxies may be thought of as hosting an AGN after accounting for rapid stochastic variability. I will further discuss the strong evidence that in passive galaxies in massive halos, mechanical feedback from AGN serves to heat gaseous atmospheres and suppress further star formation. These results suggest that the connection between black holes and their host galaxies changes significantly as halos grow and galaxies evolve from star-forming to passive systems.

The Advanced Spectral Library Project

Speaker: Dr Thomas Ayres (CASA, University of Colorado)   
Time: October 3, 2014 - 3:00 PM   
Location: AT101

Abstract: The Advanced Spectral Library (ASTRAL) is a Hubble Space Telescope (HST) Large Treasury Project, whose aim is to collect high-quality ultraviolet (115-310 nm) echelle spectra of representative stars with resolution and signal-to-noise rivaling the best that can be achieved at ground-based observatories in the visible. During HST's Cycle 18 (2010-2011), ASTRAL was allocated 146 orbits to record eight iconic bright late-type ("cool") stars -- all well-known cosmic denizens with vaguely unpronounceable names like Procyon and Betelgeuse -- utilizing the powerful Space Telescope Imaging Spectrograph (STIS). In current HST Cycle 21, ASTRAL was allocated an additional 230 orbits to extend the project to the hot side of the H-R diagram: 21 targets including equally iconic objects like Vega, Sirius, and Regulus. I will describe some of the scientific motivations for observing hot and cool stars in the ultraviolet, the unique instrumental characteristics of STIS that enable a broad survey like ASTRAL, the progress in the program to date, and prospects for the future.

Gamma-ray spectroscopy with rare isotope beams at NSCL – observatory for femtoscale objects

Speaker: Dr Hiro Iwasaki (Michigan State University)   
Time: September 26, 2014 - 3:45 PM   
Location: AT101

Abstract: The advent of rare isotope beams opens the possibility to study exotic nuclei which are more neutron-rich or neutron-deficient compared to stable nuclei in nature. Unexpected properties, such as nuclear shell evolution and emergence of halos, have been discovered in the past two decades, which has modified our vision of atomic nuclei and can even alter scenarios of nucleosynthesis in the Universe. As a way to observe unique forms and dynamics of new, exotic isotopes which are often produced in very low amounts, the advanced gamma-ray tracking array GRETINA (Gamma-Ray Energy Tracking In-beam Nuclear Array) has recently been commissioned at LBNL and employed in physics campaign programs with fast rare isotope beams at NSCL. This talk will provide an overview of our physics motivation and implementation of gamma-ray Doppler-shift techniques with GRETINA. Recent physics highlights from nuclear structure and astrophysics studies will also be introduced and discussed.

The Studio physics program at Florida State University

Speaker: Simon Capstick (Florida State University)   
Time: September 19, 2014 - 3:00 PM   
Location: AT101

Abstract: By changing the way that introductory physics courses are taught, using the results of more than a decade of physics education research, it is possible to make measurable improvements in student understanding of basic concepts and in their satisfaction, while retaining a focus on their ability to solve physics problems. The experience of a group at Florida State University who have established and offered a two-semester introductory 'Studio' physics sequence is described. This talk will outline our implementation of the studio physics program, what we have learned, and how we have adapted the most effective practices to improve the parallel traditional lecture, lab and recitation sections of the same course.

Exploring the Outskirts of Galaxy Clusters

Speaker: Dr Eric Miller (MIT Kavli Institute for Astrophysics and Space Research)   
Time: September 12, 2014 - 3:00 PM   
Location: AT101

Abstract: As the largest collapsed systems in the Universe, galaxy clusters grow and evolve under the dominant force of gravity. This process produces simple predictions about the thermodynamics of the diffuse hot intracluster medium (ICM), the dominant baryon component in these systems. Yet the state of the ICM can be substantially altered by non-gravitational processes such as radiative cooling, feedback from star formation and AGN activity, and turbulence, bulk motion, and gas clumping. These effects are especially important in the outskirts of clusters, where much of the mass resides and where accretion is ongoing. Understanding the conditions of the ICM here has consequences for cosmology, chemical enrichment, and cluster astrophysics.

Recent studies have traced the hot, X-ray-emitting ICM to the virial radius and beyond in several galaxy clusters, beginning to clarify the thermodynamics at the cluster edge and constrain models of cluster growth. In this talk, I will summarize these studies and describe our own program to observe a large sample of relaxed clusters with the Suzaku Xray Observatory. Our results show that the ICM is not in simple hydrostatic equilibrium in the outskirts, where we see indications of infalling, low-entropy substructures and evidence for azimuthal variations in temperature and surface brightness. The large sample of clusters now assembled is remarkable for the apparent "universality" of thermodynamic profiles out to large radius, yet there are notable deviations which I will explore. I will finally discuss the host of systematic effects that can bedevil these challenging, low-surface-brightness observations, and future prospects for probing the outer frontier of galaxy clusters.

Modelling Far-UV Photoevaporation in Protoplanetary Disks

Speaker: Dr Jon Ramsey (Institut für Theoretische Astrophysik, Heidelberg)   
Time: July 10, 2014 - 2:01 PM   
Location: AT101

It is well-established that protoplanetary disks transition from optically thick to thin in ~10 ^5 yr, much faster than the viscous accretion timescale. One of the proposed mechanisms to explain this rapid clearing is photoevaporation by stellar UV and X-ray photons. While extreme-UV and X-ray photoevaporation have been well-studied in the literature, due to its complexity, far-UV photoevaporation has so far been limited to 1D viscous evolution or static 2D thermochemical models. In this talk, I will present the first self-consistent radiation hydrodynamic models of far-UV photoevaporation in disks, and discuss the resulting consequences for disc structure and evolution.