Contour advection tracer method in smoothed particle hydrodynamics

**Speaker:** Ms. Tiffany Fields (SMU)
**Time:** August 15, 2019 - 9:30 AM
**Location:** Atrium 305

Studying the evolution of galaxies is important in understanding many other astrophysical phenomenon such as star formation history, the interstellar medium, and more. However, this process required numerical work due to the long timescales over which evolution occurs. To study the effects of chaotic mixing within a galactic disk, we implemented a contour advection method using tracers to follow the flow of the gas within a galactic disk. In this thesis, we examined the effects of integration properties such as timestep normalization, tracer mass, artificial viscosity felt by the tracers, temperature ceiling, and more to determine the ways that our tracer method could produce errors during evolution. We found that the primary issue with the tracer method was how the tracers experienced shock regions, or regions of steep density contrasts. When tracers experienced too much shock heating, they overheated and were ejected from the disk. When the tracers experienced too little shock heating, however, they flowed through the shock without feeling the effects. Both of these instances led to incorrect following of the gas flow.

MSc Defence: Investigating X-ray variability of AGN through spectral and temporal analyses: Mrk 530 & Mrk 335

**Speaker:** Ms. Hannah Ehler (SMU)
**Time:** August 16, 2019 - 10:30 AM
**Location:** Atrium 305

X-ray observations of two Seyfert AGN were analysed in an effort to characterise the nature of their variability. A spectral analysis was performed on a Suzaku observation of the Seyfert 1.5 AGN Mrk 530, and a timing analysis on XMM-Newton observations of the narrow-line Seyfert 1 Mrk 335. Mrk 530 was found to exhibit two distinct spectral states over the course of a single observation, as well as apparent periodic variability in the light curve. Three physical models (blurred reflection, partial covering, and soft Comptonisation) were explored to characterise the spectrum however the spectral fits were indistinguishable. The timing analysis of Mrk 335 revealed evidence of nonstationary behaviour using multiple timing methods, though it is difficult to determine if these results are real or artifacts of undersampling. As such, further testing is required to confirm these results.

Number Density Distribution of Satellite Galaxies around Massive Central Galaxies in CLAUDS + HSC at 0:3 < z < 0:9

**Speaker:** Mr. Lingjian Chen (SMU)
**Time:** August 19, 2019 - 1:00 PM
**Location:** Atrium 305

Satellite galaxies around massive central galaxies can provide important information for environmental effect of galaxy evolution in groups or clusters. In this paper, we selected thousands of massive (log(Mcen) > 11.15) central galaxies using 20 square degree deep (iAB = 27) imaging data from Subaru-HSCSSP and CFHT-CLAUDS at 0.3 < z < 0.9 and investigated radial number density distribution of the satellite galaxies around them with appropriate corrections applied. We found that the number density of satellites can be described by the NFW profile at large projected radii from central but deviate from it in inner regions (within 100 kpc). We also found that redshift evolution of number density enhances number density in inner regions more significantly than outer regions. We found that central mass does not have a strong effect on slope of radial distribution of satellites, only the total number of satellites is different for different central masses. Galaxy conformity signal was found when separating star-forming and quiescent centrals. By dividing the satellite galaxy sample, we found that low massive satellite galaxies (9.5 < log(Msat) < 10.2) have more significant deviation from the NFW profile in inner regions than high mass satellites (log(Msat) > 10.2). Additionally, we compared our satellite distribution with IllustrisTNG simulation. Our results support the satellite population formation scenario in which the specific shape of the distribution is related to migration of satellites, which involves various environmental effects such as dynamical friction and the tidal stripping.

Diagnosing Light Pollution Sources: the physics and potential remediation

**Speaker:** Dr. Robert Stencel (Department of Physics and Astronomy, University of Denver)
**Time:** August 19, 2019 - 11:00 AM
**Location:** Loyola 171

In 1879, Thomas Edison was granted a patent for an improved version of an incandescent light bulb using a tungsten filament. Subsequently, improvements have enhanced the efficiency of lighting, most recently with the light emitting diode [LED, ref.1]. However, mis-aimed and reflected light at night waste energy, produce glare and trespass, and culminate in urban skyglow. Over metro Denver, for example, skyglow is measured to be more than 100X natural background, and increasing. This equates to hundreds of megaWatts of electrical power being wasted, a non-trivial fraction of the several gigaWatts consumed locally [2]. Considering the transition toward renewable energy sources and the growing demand for recharging electric vehicles, the inefficiency in night lighting energy can represent a substantial quantity of future energy needs. In addition, the spectrum of skyglow is trending toward shorter wavelengths as a result of widespread adoption of high color temperature (bluer) LEDs [3]. In this talk, I will describe some of the impacts of excess lighting, using local examples, touch upon the known and suspected health hazards of excessive blue/white lighting, and outline some cost effective solutions that can mitigate light pollution sources [4,5].

Narrow-line Seyfert 1 galaxies - young rebels of the AGN family

**Speaker:** Dr. Emilia Jarvela (UC Santa Barbara)
**Time:** September 13, 2019 - 3:00 PM
**Location:** Atrium 101

Narrow-line Seyfert 1 galaxies (NLS1s) are young active galactic nuclei (AGN). They harbour low-mass black holes accreting close to or above the Eddington limit and are preferentially hosted by spiral galaxies. So far ~20 NLS1s have been detected at gamma-rays, confirming the presence of powerful relativistic jets in them. This discovery contradicts the conventional view that only supermassive black holes residing in massive ellipticals are able to launch relativistic jets and urges us to revise the evolution and unification schemes of AGN. On the other hand, NLS1s offer us an unprecedented opportunity to study the first stages of the AGN evolution.

Our knowledge of NLS1s is still very limited, excluding some outstanding individuals. Studying the whole population is challenging due to its seemingly heterogeneous nature; NLS1 class includes sources with powerful relativistic jets, as well as sources that are totally radio-silent. So far it has remained unclear what causes this disparity. To fully exploit their extraordinary nature, we need to understand them better as a class.

In this talk I will give an overview of our latest studies aimed at starting to unveil the nature of the NLS1 population, and to clarify their place in the big picture of AGN. To this end, we have performed statistical studies of large samples, concentrating on their large-scale environment properties, and multiproperty principal component analysis. In addition, we have completed targeted studies of smaller samples, investigating, for example, their radio continuum and morphology properties, and host galaxies.

HectoMAP Galaxy Cluster Surveys

**Speaker:** Dr. Jubee Sohn (Harvard-Smithsonian Center for Astrophysics)
**Time:** September 20, 2019 - 3:00 PM
**Location:** Atrium 101

HectoMAP is a dense redshift survey covering a 53 deg^2 of the sky enabling various studies of galaxies and galaxy systems. We survey galaxy clusters based on the dense spectroscopic data. We first test photometrically identified redMaPPer clusters with spectroscopic data. More than 90% of redMaPPer clusters in HectoMAP have at least 10 spectroscopic members even at the low richness. We then construct galaxy clusters based on the HectoMAP and ROSAT All-Sky Survey (RASS) data. We identify 15 galaxy clusters (7 newly discovered) to the X-ray flux limit of the RASS. Three X-ray clusters covered by Subaru/Hyper Suprime-Cam survey are impressive; one of them shows strong lensing arcs. We predict that there are ~ 12000 detectable X-ray clusters in the RASS. I will discuss how the dense spectroscopic data contribute to expand our knowledge on galaxy clusters.

Searching for the smallest-mass supermassive black holes

**Speaker:** Dr. Holger Baumgardt (University of Queensland, Australia)
**Time:** September 26, 2019 - 3:00 PM
**Location:** \*\*special time and place\*\* Burke 218

Supermassive black holes are thought to exist in the centres of most massive galaxies and their masses have been found to correlate strongly with the properties of their host galaxies like overall luminosity or central velocity dispersion. Yet it is unknown what processes have established these correlations and if they continue towards lower mass systems. In my talk I will present results from our search for massive black holes in ultra-compact dwarf galaxies in nearby galaxies and in massive globular clusters of the Milky Way. I will also briefly discuss constraints on the retention fraction of stellar mass black holes in these systems.

At the crossroads of galaxy evolution and cosmology: multi-wavelength studies of galaxy clusters

**Speaker:** Dr. Stefania Amodeo (Cornell University)
**Time:** October 4, 2019 - 3:00 PM
**Location:** Atrium 101

In the nodes of the cosmic web, galaxy clusters retain a wealth of information on the evolution of cosmic structures, that are accessible through a variety of observables across the electromagnetic spectrum.

A key ingredient in cosmological studies that use the cluster mass function is a well calibrated relation between the observables and the mass. I will discuss the techniques used to estimate the cluster masses and their systematics, and I will present a mass calibration for a sample of Planck-selected clusters, using galaxy dynamics from Gemini optical spectroscopy.

I also will discuss the baryonic processes that govern the evolution of galaxies in clusters like star-formation, feedback and non-thermal pressure support, using observations of the intra-cluster gas through the Sunyaev-Zeldovich effect with the Atacama Cosmology Telescope and SDSS observations of the large-scale structure.

I will conclude moving to the high-redshift frontier to explore the role of the environment on galaxy evolution, and I will present results on the stellar populations of galaxies in protoclusters at z~2 from the CARLA (Clusters Around Radio-Loud AGN) survey.

Studying Star Formation from the Stratosphere

**Speaker:** Dr. Laura Fissel (Queen’s University)
**Time:** October 11, 2019 - 3:00 PM
**Location:** Atrium 101

The conversion of interstellar molecular gas into stars is an extremely inefficient process, due to regulation from a combination of turbulent gas motions, magnetic fields, and feedback from young stars. Of these the role played by magnetic fields is particularly poorly understood, largely because of the difficulty of making direct observations. In this talk I will discuss what we have learned about magnetic fields in star-forming regions using the Balloon-borne Large Aperture Sub-mm Telescope for Polarimetry (BLASTPol). BLASTPol operated from 38km above the Earth’s surface (above 99.5% of the atmosphere), mapping polarized radiation at sub-mm wavelengths from dust grains aligned with their local magnetic field. By statistically comparing BLASTPol-inferred magnetic field maps of the nearby giant molecular cloud Vela C with simulations, we find that magnetic fields play an important role in the formation of both low- and high-density molecular gas sub-structures. I will finish by presenting our nextgeneration balloon-borne polarimeter, BLAST-TNG, which is scheduled for a first Antarctic flight this December. With BLAST-TNG we will map dozens of molecular clouds at 5x better resolution and quantitatively determine the extent to which magnetic fields affect star formation efficiency.

The Launching and Evolution of the Relativistic Jets of SS 433

**Speaker:** Dr. Herman L. Marshall (MIT Kavli Institute)
**Time:** October 25, 2019 - 3:00 PM
**Location:** Burke 221

In the binary system SS 433, oppositely directed, precessing jets emit line emission from highly ionized plasma moving at 0.26c from the compact object. In high resolution spectra of SS 433 taken with the Chandra X-ray Observatory, we found a large Doppler shift change on a time scale of 20 ks, a time much shorter than the known dynamical Commented [SR1]: times. The rapid change could be related to the formation and ejection of a jet knot, as observed in VLBI observations, perhaps as a leptonic jet impinges on a disk wind and shock heats it. During eclipses of the jets by the companion star, we can estimate the length of the jet during its hot phase, cooling via expansion and X-ray line emission. Chandra imaging also shows X-ray emission well beyond the scale of the binary, after the jet has cooled to produce optical emission. We address a model in which this emission results from reheating due to jet velocity variations.

TRACKING THE ORIGIN OF SUPERMASSIVE BLACK HOLES OVER COSMIC TIME

**Speaker:** Dr. Priyamvada Natarajan (Yale University)
**Time:** November 1, 2019 - 3:00 PM
**Location:** Atrium 101

Nearly all galaxies appear to harbor a central supermassive black hole. The origin and properties of initial black hole seeds that grow to produce the detected supermassive black hole population are poorly constrained at present, as actively growing seeds are not directly observable near their birth epochs. Despite many open questions about the formation, fueling and feedback from accreting black holes in the universe, with multiwavelength data, we have been able to successfully model the growing black hole population over cosmic time. I will present the current status of our understanding of the assembly history of supermassive black holes and the prospects of constraining our best-to-date models with data from upcoming missions.

Uncovering the nature of dark matter with stellar streams in the Milky Way

**Speaker:** Dr. Ana Bonaca (Harvard-Smithsonian CfA)
**Time:** November 8, 2019 - 3:00 PM
**Location:** Atrium 101

Stars escaping globular clusters form thin, long and kinematically-cold tidal streams. In pristine conditions, these streams have nearly uniform density, however, new Gaia observations of one such structure in the Milky Way halo have revealed a likely site of perturbation. In this talk, I will show that the on-sky morphology suggests a recent, close encounter with a massive and dense perturber. Known baryonic objects are unlikely perturbers based on their orbital properties, but observations permit a low-mass darkmatter subhalo as a plausible candidate. This discovery opens up the possibility that detailed observations of streams could measure the mass spectrum of dark-matter substructures and even identify individual substructures and their orbits in the Milky Way halo. I will discuss the observational and modeling efforts I am leading to follow up this feature, review prospects for discovering evidence of similar events in other stellar streams, and forecast the sensitivity of stellar streams to low-mass perturbers in the era of LSST.

Satellite Galaxies as Tracers of Dark Matter Halos

**Speaker:** Dr. Tereasa Brainerd (Boston University)
**Time:** November 22, 2019 - 3:00 PM
**Location:** Atrium 101

Small, faint satellite galaxies, orbiting within the gravitational potentials of large, bright “host” galaxies have the potential to place powerful constraints on the relationship between dark and luminous matter on scales < 500 kpc. It has long been hoped, and a number of simulations have strongly suggested, that the satellites of isolated host galaxies are “fair tracers” of the dark matter distribution that surrounds the hosts. Over the past decade or so, observational studies of the satellites of isolated host galaxies have led to a number of interesting conclusions. In terms of their spatial distributions, satellite galaxies are, on average, distributed anisotropically with respect to their hosts’ major axes. In addition, some observational studies have concluded that the radial density profiles of satellite galaxies (i.e., the number of satellites per unit area on the sky) are consistent with the expectations of the Cold Dark Matter (CDM) model, but others have suggested that the profiles are inconsistent with CDM. Here I’ll discuss a number of recent observational and theoretical studies that are aimed at answering two key questions: [1] In the context of CDM, should we actually expect satellite galaxies to be fair tracers of the dark matter distribution around isolated host galaxies? and [2] Is the CDM model able to reproduce all of the observations of satellite galaxies that we currently have?

Undergrad Career Seminar I

**Speaker:** Jean-Marc Samson and Fernando Pena-Silva
**Time:** January 17, 2020 - 3:00 PM
**Location:** AT 101

Jean-Marc Samson (high school science teacher) and Fernando Pena-Silva is originally from Chile, where he completed his BSc in Astronomy before coming to Canada for graduate studies, obtaining his PhD in Astrophysics from the University of Toronto. He was then a Postdoctoral fellow in Astrophysics at Saint Mary’s University and a Postdoctoral fellow in Medicine at Dalhousie University before moving to industry, first as a Senior Consultant at Ernst & Young Center for Advanced Analytics in Halifax, and now as a Load Forecaster for Nova Scotia Power. He has a passion for statistics, data science, math, research, electromagnetism, data visualizations… and soccer! (data scientist, Load Forecaster for Nova Scotia Power) will share their professional experience following studies in physics and astronomy, respectively. You can find their short bio below. There will be time for students to ask questions and also an opportunity for them to meet with the speakers for individual/small group discussions after the presentations.

**Jean-Marc Samson** started his physics training at Mount Allison university completing a BSc Honours in Physics, then continued his studies at Dalhousie University studying models of decoherence of spin states in quantum dots. Shortly after passing his doctoral candidacy exam, he decided to change careers and become a high school teacher. He travelled to Korea to teach ivy league bound students physics. He then came back to Canada and has taught a variety of math and science course at the junior high and high school level. He is currently teaching Math 10, Pre IB Math 10 and Physics 11 and 12.

**Fernando Pena-Silva** is originally from Chile, where he completed his BSc in Astronomy before coming to Canada for graduate studies, obtaining his PhD in Astrophysics from the University of Toronto. He was then a Postdoctoral fellow in Astrophysics at Saint Mary’s University and a Postdoctoral fellow in Medicine at Dalhousie University before moving to industry, first as a Senior Consultant at Ernst & Young Center for Advanced Analytics in Halifax, and now as a Load Forecaster for Nova Scotia Power. He has a passion for statistics, data science, math, research, electromagnetism, data visualizations… and soccer!