Detailed Program with Abstracts
Tuesday, May 16th

9:00 – 9:20
Name: Renee Hložek
Title: LSST Overview
Abstract: The Vera C. Rubin Observatory will revolutionize optical photometric astronomy. The Rubin Observatory will conduct the Legacy Survey of Space and Time (LSST), which will produce a 500-petabyte set of images and data products, building up a detailed atlas of faint galaxies, transient sources that brighten and fade once, and stars and other objects that vary their brightness regularly or irregularly. LSST will enable researchers around the globe to probe the nature of dark energy and dark matter, take an inventory of the solar system, map our Milky Way and explore the optical transient sky. The data products from Rubin will consist of near-instantaneous 'alerts' of new objects in the sky and derived data products released through data releases. Access to Rubin data products and analysis tools to use the data for novel science is subject to Rubin 'data rights'. Canadian access to these Rubin data is achieved through our in-kind contributions to the software analysis of Rubin science collaborations and computational support. I will discuss the transformative Rubin science and exciting data and discuss the Canadian participation in Rubin.

9:20 – 9:40
Name: Will Percival
Title: Euclid science update
Abstract: I will give a short update outlining the status of the Euclid mission, focusing on the science. I will review the structure of how science will be undertaken, key projects, early data, data releases, etc.

9:40 – 10:00
Name: Jean-Charles Cuillandre
Title: UNIONS Overview
Abstract: Euclid will launch from Florida this coming July aboard a SpaceX Falcon9 rocket. This is the culmination of more than a decade of efforts by the European Space Agency (ESA), Thales Alenia Space, Airbus, and the Euclid Consortium to produce a one of a kind space telescope. Euclid is an optical/near-infrared survey mission to investigate the nature of dark energy and dark matter through two main probes: weak gravitational lensing which requires the precise measurement of the shape of nearly two billion galaxies, and galaxy clustering based on the measurement of the 3-dimensional distribution of a hundred million galaxies through their spectroscopic redshifts. The mission is designed for 6 years of nominal survey operations to cover one third of the entire sky. In doing so, it will build a dataset of immense interest for many astrophysical fields, the Legacy Science as it is called within the Euclid Consortium. This talk will present an up-to-date status of the mission, how the survey will unfold through the six years, and additional information on the scientific operation of the Euclid Consortium.

10:00 – 10:20
Name: Patrick Cote
Title: Status of the CASTOR Mission
Abstract: CASTOR is a wide-field, nearly diffraction-limited space telescope that is being developed by the Canadian Space Agency (CSA). The 1m CASTOR telescope will produce panoramic imaging of the UV/optical (150-550 nm) sky, using a three mirror anastigmat design to provide HST-like image quality over a wide field of view (0.25 sq. deg.) in three filters, simultaneously. Operating from low-earth orbit, CASTOR will be optimized for wide-field surveys, although the telescope also features low- and medium-resolution spectroscopic capabilities over the 150 to 400 nm region, and precision photometers for observations of transiting exoplanets. In this talk, I will give an update on the status of the mission, and describe its design and scientific capabilities across of range of fields: Cosmology; Time Domain and Multi-messenger Astronomy; Galaxy Evolution and AGNs; Stellar & Galactic Astronomy; Near-Field Cosmology; Exoplanets; and the Solar System.

10:20 – 11:00
Coffee break
11:00 – 11:20
Name: Stephen Gwyn
Title: The CADC, LSST, Euclid, UNIONS and CASTOR: a vision for the next decade
Abstract: The CADC is deeply involved with the four projects being discussed at this meeting. We will provide Canadians with not just access to the LSST and Euclid data, but also a science platform, with processing and user storage and database access so they can best exploit the data to achieve their science goals. For UNIONS, the CADC is processing the CFIS u and r bands as well coordinating the combination of the other surveys into one "Grand Unified Catalog". For CASTOR, we are planning to build and run the data pipeline as well as hosting the data set. The CADC will be unique in hosting all of these datasets in one location with a common interface and a common processing system. While this presentation will outline the current CADC plans, our main goal in attending S2D is to listen to Canadian astronomers, gather their science use cases and build a system that best meets their needs.

11:20 – 11:40
Name: Yashar Hezaveh
Title: Measuring the small-scale distribution of dark matter with strong lensing and large optical surveys
Abstract: TBD

11:40 – 12:00
Name: Melissa Amenouche
Title: Unlocking Type Ia Supernovae cosmology with the Zwicky Transient Facility (ZTF)
Abstract: The accelerated expansion of the Universe was discovered in the late 90s with Type Ia Supernovae (SNe Ia), unveiling for the first time the existence of Dark Energy (DE). Multiple precise measurements have validated its existence since. To understand the nature of DE is amongst the main goals of modern cosmology. SNe Ia are a powerful probe of the recent expansion history of the Universe ($z < 0.5$) driven by DE. In the past two decades, the number of SNe Ia has drastically increased along with our understanding of these objects and their ability to indicate distances. And this will continue with the new generation of surveys like the Large Survey of Space and Time (LSST). In the era of LSST, thousands of SNeIa will be observed at $0.2 < z < 1$ and will contribute to derive unprecedented cosmological constraints on the DE equation of state . However, low-z SNe Ia are critical and required to achieve the characterization of DE with LSST SNe Ia sample. With ~3700 observed and spectroscopically classified SNe Ia, the Zwicky Transient Facility (ZTF, 2018-2024) provides the largest nearby ($z < 0.1$) SNeIa existing sample. ZTF sample is the key low-z anchor required for the derivation of the cosmological parameters with LSST. Several efforts are ongoing to unlock cosmological measurements with this sample and many of them can be extended to LSST data. Amongst the ongoing studies and key steps in SNe Ia cosmology, we have sample selection and biases study. It is crucial to understand how SNe Ia in the ZTF sample are selected and ensure that their distances are unbiased. The only way to achieve the study is through realistic simulations. I will present how with a forward model that includes our understanding of SNe Ia and the real-time cadence of the survey we reproduced every SN Ia observed by ZTF in the first three years along with the sample selection function characterization.

12:00 – 12:30
Name: Liza Sazonova
Title: Unbiased galaxy morphology in the era of large surveys
Abstract: The structure of galaxies is a crucial piece of the puzzle for understanding their evolution. Non-parametric measurements, such as asymmetry, concentration, Gini, or M20, have historically been powerful tools to quantify and characterize galaxy structure in an automated way, and link the structure to the physical processes driving galaxy evolution. However, in the era of large surveys, these quantities are challenging to measure robustly. Morphology parameters depend strongly on image quality, and therefore it is difficult to compare them across different surveys, or even epochs of the same survey. To remedy this, we are developing a framework to measure intrinsic galaxy morphology independently of the image resolution and noise. As a first step, we tested existing morphological parameters to ensure they are well-defined. In particular, we found that the common definition of asymmetry disproportionately suffers from background noise. We define a new asymmetric metric that is robust to noise down to signal-to-noise / pixel of 1. As the next step, we are developing a machine learning model to obtain morphological measurements directly from imaging, further account for noise and seeing effects, and speed up the computation. This new framework will enable scientists to measure galaxy structure robustly across different surveys, filters, and redshifts. With the new data from LSST, UNIONS, and Euclid, and our new approach to galaxy morphology, we hope to finally definitively link together the co-evolution of star formation and structure in galaxies.

12:30 – 13:30
Lunch

13:30 – 13:50
Name: Ronan Legin
Title: Accelerating the Next-Generation of Strong Lensing Science using Machine Learning
Abstract: In the near future, a new generation of sky surveys conducted by the Euclid Space Telescope and the Rubin Observatory's Legacy Survey of Space and Time (LSST) is expected to discover over 200,000 new strong gravitational lenses. This surge in known samples demands an accurate and rapid analysis of massive amounts of data within a clear statistical framework to facilitate scientific breakthroughs enabled by strong lensing. In this talk, we will delve into the critical role of simulation-based inference (SBI) in strong gravitational lensing analysis for these surveys. Our proposed approach involves machine learning models to obtain posteriors of macro-parameters of individual strong lenses, which can be integrated into a hierarchical framework for inferring population-level statistics of strong lenses. We will also discuss the potential for modelling the selection function of strong lenses using neural networks and briefly touch on our recent work focused on learning the likelihood function in non-Gaussian observational noise cases.

13:50 – 14:10
Name: Laurence Perreault Levasseur
Title: Assessing Accuracy of Posterior Estimate in the Era of Machine Learning
Abstract: TBD

14:10 – 14:30
Name: Callum Dewsnap
Title: Morphologies of High-Redshift AGN Host Galaxies
Abstract: Quantitative morphology of AGN-hosting galaxies tells us about the relationship between galaxies and their central supermassive black holes. In measuring galaxy surface brightness profiles, accurate modelling of the AGN light with a well-understood PSF is important, particularly at high redshifts where galaxies appear fainter and smaller. Our recent study, Dewsnap et al. (2023), found that performing surface brightness profile fits on Deep/UltraDeep Subaru HSC imaging of AGN hosts at $0.03 < z < 6.5$ found results inconsistent with those measured by performing fits on the same sources imaged by HST ACS/WFC. Our results indicate that the Sérsic index of high-redshift galaxies that host AGNs imaged at ground-based spatial resolution should not be used as a reliable indicator of galaxy type. Our current work involves applying this technique to JWST NIRCam imaging from the CEERS survey. The exceptional resolution and sensitivity of JWST allows for a deeper understanding of the relationship between galaxies and supermassive black holes in the early universe beyond what has been accessible previously. However, these JWST data are limited in that the number of samples are very small relative to those of most ground-based surveys. Considering these limitations, it is important to determine for which instruments and associated surveys this technique is viable. Future instruments such as the Euclid Space Telescope and the Roman Space Telescope will be able to collect much larger samples of AGN hosts while retaining the high resolution imaging required for the AGN subtraction which only space-based observations can provide.

14:30 – 14:50
Name: Dan Taranu
Title: Galaxy modelling and photometry for Rubin-LSST
Abstract: I will discuss Data Management plans for Rubin-LSST galaxy modelling, including the current status of the science pipelines, progress on multi-band galaxy modelling using the new MultiProFit code, and analyses of the performance of the science pipelines on precursor data (DC2 simulations and Subaru-HSC).

14:50 – 15:10
Coffee break

15:10 – 17:00
LSST Tutorial

Wednesday, May 17th

9:00 – 9:20
Name: Mike Hudson
Title: Weak Lensing with UNIONS, Euclid and Rubin
Abstract: We are in a golden age for weak gravitational lensing, with major surveys ongoing or imminent. UNIONS is the last major ground-based survey before Rubin, but is covering the Northern hemisphere (and providing photo-z's for Euclid). These synergies allow Canadians to develop analysis methods on UNIONS and "port" them to Euclid and Rubin. I will discuss the highlight science we aim to achieve with these major projects, ranging from cosmology to galaxy formation, and present some early results from UNIONS.

9:20 – 9:40
Name: Ludovic Van Waerbeke
Title: Weak gravitational lensing with UNIONS
Abstract: UNIONS is an essential component of the Euclid survey as the provider of the optical followup imaging in the northern hemisphere. In addition to its key role in measuring photometric redshifts, UNIONS also has fantastic potential as a standalone lensing survey. Currently, the leading weak lensing surveys are the Kilo Degree Survey (KiDS) and the Dark Energy Survey (DES), which are commonly referred to as stage III surveys. UNIONS/CFIS can be called a stage 3.5 survey as it surpasses KiDS and DES in many respects and represents a smooth transition towards stage IV surveys such as Euclid and LSST. In this talk, I will review the work that the lensing team (French and Canadian) has been doing over the past three years to make the lensing science in UNIONS/CFIS a reality. I will showcase some of the exciting lensing science we plan to publish in the coming year and highlight the unique elements that UNIONS/CFIS brings compared to KiDS and DES.

9:40 – 10:00
Name: Hunter Martin
Title: Detection of Weak Lensing Signal around Cosmic Voids
Abstract: In a typical weak gravitational lensing scenario, an overdensity induces tangential alignment amongst background galaxy images, which in turn lets us measure the matter density profile. In the case of underdense voids, the idea is the same: the alignment of background galaxy images should be a measure of the underdensity profile, and hence induce radial alignment. The question that remains is whether or not such a signal is detectable given current data sets. Given that overdensities are typically of order 200, and underdensities cannot be lower than -1, voids impart a very weak signal and detections from individual voids will not be possible. Using void catalogs from the LOWZ and CMASS catalogs of the BOSS survey, and background galaxy sources from the UNIONS survey, I will demonstrate that the method of "stacking" voids can be used to obtain a significant detection of the matter density profile of voids using weak lensing. I will also discuss the dominant sources of error and where future surveys such as Euclid can fit in to improve void lensing constraints.

10:00 – 10:20
Name: Marta Reina-Campos
Title: Tracing the structure of dark matter haloes using globular clusters: insights from the E-MOSAICS simulations
Abstract: Massive galaxies predominantly grow by accreting smaller satellite galaxies. During this hierarchical build-up, stars and massive stellar clusters are deposited in the outskirts of the massive galaxy, where most of the dark matter lies. Thus, diffuse stellar light and globular cluster populations are relics of the formation and assembly history of their host cluster. I will discuss how we can constrain the shape, orientation and radial profile of dark matter haloes using the spatial distributions of stellar light and globular cluster populations. I will test the method using simulated star cluster populations and their host dark matter haloes from the (34.4cMpc)^3 periodic volume from the E-MOSAICS project, and I will review how these numerical predictions can be tested using data from the Hubble and James Webb Space Telescopes, as well as from future data from the Euclid, Roman and Vera Rubin observatories.

10:20 – 11:00
Coffee break

11:00 – 11:20
Name: Jack Elvin-Poole
Title: Modeling the impact of cosmic magnification in DES and LSST-DESC
Abstract: Cosmic magnification modifies the observed number density of galaxies behind massive structures. This change in number counts causes a bias in the measured gravitational lensing signal around these galaxies, as well as a bias in the 2pt function of the galaxy positions. Computing this bias requires a deep understanding of the underlying galaxy selection function, and its response to small changes in galaxy flux and size caused by magnification. I will present our methodology for modelling this response in the Dark Energy Survey, including the use of injection imaging simulations to forward model the signal. I will also discuss the requirements and limitations for measuring it in the next generation of surveys, focusing on LSST-DESC applications.

11:20 – 11:40
Name: Jessica Muir
Title: So you want to extend your analysis beyond ΛCDM? Case studies in model validation from the Dark Energy Survey
Abstract: A primary goal of LSST and other surveys being discussed at this workshop is to test our standard cosmological model. While this can be done by checking consistency of ΛCDM constraints from different observables, we are motivated to extend survey analyses to models beyond ΛCDM, both to ascribe physical meaning to inconsistencies and to enhance the detection of possible hints of new physics. Doing so can present challenges, however, if the validation of available modelling tools or our description of systematic effects rely on assumptions broken by the beyond-ΛCDM physics being considered. As a case study for future analyses, I will present highlights from beyond-ΛCDM studies of Dark Energy Survey Year 3 galaxy clustering and weak lensing. The presentation will outline some practical aspects of extending the analysis and associated validation to models beyond ΛCDM and will highlight one or two examples where work is needed to improve constraining power in the future.

11:40 – 12:00
Name: James Taylor
Title: Cluster Structure as a Cosmological Test
Abstract: The abundance of galaxy clusters as a function of mass and redshift provides a classic cosmological test, constraining the parameters omega_m and sigma_8 in particular. Future cluster samples, notably those produced by Euclid, will contain much more information than just mass and redshift. We show that this additional structural information allows cosmological tests complementary to abundance. Galaxy distributions, weak lensing profiles, and X-ray or SZ follow-up all provide a path towards implementing these tests in the near future.

12:00 – 12:30
Name: Roan Haggar
Title: Constraining cosmology with galaxy clusters
Abstract: Many features of galaxy clusters, such as their splashback radius and depletion region, are consequences of the growth history of clusters. However, this growth is dependent on cosmological parameters, such as sigma_8 and Omega_M. In the past the splashback radius and depletion region have mostly been studied within simulations, but thanks to weak-lensing data and galaxy number counts from UNIONS, and in the future from Euclid and LSST, it has now become feasible to also study these features observationally. In this work, we utilise simulations of a large number of dark matter haloes run with different values of various cosmological parameters, to study how the position and depth of the splashback radius and depletion region vary with cosmology. We then discuss how data from UNIONS, Euclid and LSST can compliment these results; measuring these features in the outskirts of galaxy clusters will provide an exciting new way to constrain cosmology, and to study the growth of structure in our Universe.

12:30 – 13:30
Lunch

13:30 – 13:50

Name: Guillaume Desprez

Title: Combining the CLAUDS and HSC-SSP surveys: LSST-like data over 20deg2

Abstract: The Canada-France-Hawaii Telescope (CHFT) Large Area U-bands Deep Survey (CLAUDS) and the Hyper-Suprime-Cam (HSC) Subaru Strategic Program (HSC-SSP) deep surveys offer LSST-like observations over nearly 20deg2 thanks to a similar ugrizy wavelength coverage down to a mag~27 depth and a similar processing using the HSC/LSST pipeline. The data of both surveys have been combined together to obtain coherent photometric and photometric-redshift catalogs in two ways: one way is using the aforementioned HSC/LSST photometric pipeline and the future Euclid template fitting tool Phosphoros, the other is using a similar approach as the COSMOS survey using Source Extractor and Le Phare. Both combinations also include data from the Visible and Infrared Survey Telescope for Astronomy (VISTA) to extend the wavelength coverage up to the Ks band over ~5.5 deg2. I will present the description of the photometric and photometric-redshift catalogs, along with the assessment of the quality of the output data. The two versions of the catalogs have been compared with each others as well as with the latest results of COSMOS2020. Both photometric data sets are in good agreement in ugrizy down to magnitude ~26, and to magnitude ~24.5 in the YJHKs bands. The photometric redshifts achieve good performance, reaching precisions of $\sigma_{NMAD} \lesssim 0.04$ down to m ~ 25 in the i band, even using only the CLAUDS and HSC bands. At the same magnitude limit, we measured an outlier fraction of $\eta \lesssim 10\%$ when using the ugrizy bands, and down to $\eta \lesssim 6\%$ when considering near-infrared data. I will finally present some science results obtained leveraging the CLAUDS and HSC-SSP deep data which are now publicly available.

13:50 – 14:10

Name: Marcin Sawicki

Title: Going deep, wide, and multi-wavelength in the Euclid Deep Field North

Abstract: The Euclid Deep Field North (EDFN) is rapidly turning into the premier wide-area, ultra-deep extragalactic survey field. It's contiguous 10 sq degrees already contains very deep Subaru HSC imaging and the deepest Spitzer IRAC imaging ever take over this wide an area; spectroscopy from HETDEX is underway and that from DESI is being planned; and, of course, very deep Euclid observations — both imaging and grism spectroscopy — are upcoming. Very soon, EDFN will contain the deepest multi-wavelength data ever taken over this wide a contiguous area and with an unprecedented combination of instruments, together making it an exceptional part of the sky for deep extragalactic research.

Canadian astronomers are contributing to this premier multi-wavelength dataset with ultra-deep (AB=27) u-band imaging that is being taken through a multi-semester CFHT program called DEUS (Deep Euclid U-band Survey — 50 nights of Canadian and French CFHT time). This u-band imaging is vital for providing secure and precise photometric redshifts and allowing measurements of galaxy star formation rates — key ingredients for any survey science on distant galaxies. Notably, four additional Canadian Euclid Consortium seats were secured by DEUS, allowing more Canadians to participate in Euclid science starting right away when Euclid launches later this year.

In this talk I will provide an overview of the EDFN and the multi-wavelength data we are assembling in this exceptional field. I will also describe some of the science that this dataset will enable, focusing on the DEUS goal to study galaxy evolution in the context of the Cosmic Web. And I will mention opportunities for Canadian researchers to get involved in this and other research in EDFN.

14:10 – 14:30
Name: Paul Ripoche
Title: The white-dwarf population from the CFHT Large Area U-band Deep Survey
Abstract: The Canada-France-Hawaii Telescope (CFHT) Large Area U-band Deep Survey (CLAUDS) produces images to a median depth of U = 27.1 AB. These U-band images are the deepest ever assembled over such a large area. The catalogue resulting from this survey contains a little more than 10,000,000 objects. We identified galactic white dwarfs in CLAUDS. Thanks to the depth of the survey, we can study extremely faint white dwarfs (beyond 1 kpc), including some strong galactic halo candidates. The U-band photometry allows us to fit for the physical properties of the white-dwarf candidates, such as surface temperature, surface gravity, age, mass, and distance. Furthermore, we explore the spatial-distribution model of the Milky Way, and we construct the volume-limited luminosity function of this white-dwarf population. We expect to do a follow-up study using data from the Ultraviolet Near Infrared Optical Northern Survey (UNIONS). Finally, we also plan to study star-formation history, thanks to the corresponding progenitor population from GAIA DR3

14:30 – 14:50
Name: JJ Kavelaars
Title: Surveying the Solar System to Discovery Planet Formation
Abstract: The combination of surveys that will be conducted with the Vera Rubin Observatory, EUCLID and CASTOR provide an unparalleled opportunity to measure the sizes, orbits and surface compositions, of the minor planets in the outer solar system. These measurements will be in quantity and quality that has not yet been achieved at wavelengths that will provide transformative insights into the assembly of the system of outer planets. In this presentation I will describe what information these surveys combine to provide and what insights about assembly of our planetary system we hope gain.

14:50 – 15:10
Coffee break

15:10 – 15:30
Name: Kristine Spekkens
Title: Surveys with the SKA
Abstract: TBD

15:30 – 15:50
Name: Scott Chapman
Title: Wide field surveys with CCAT-prime; synergies with optical-nearIR
Abstract: Starting early in 2024, the FYST telescope at the CCAT-prime observatory will begin surveys with the 280GHz (1.1mm) camera module, providing sensitive imaging and polarization measurements over hundreds of square degrees. Following this first light instrument, the Canadian-built 850GHz (350micron) imaging polarimeter will be installed along with an 850micron camera and the Epoch of Reionization Spectrometer. CCAT-prime will be the preeminent submm-wave facility for many years to come, eventually finding an important role in the CMB-S4 experiment.
In this presentation, I will discuss synergies with other wavelengths (e.g. UNIONS/Euclid/Rubin), and focus attention on the large range of CCAT-prime science cases, from cosmology and galaxy evolution to star formation and transients, which will benefit from such synergies.

15:50 – 16:10

Name: Tyrone Woods

Title: FORECASTOR: Getting ready for Canada's first flagship space telescope

Abstract: The Cosmological Advanced Survey Telescope for Optical and ultraviolet Research (CASTOR) will provide an essential bridge in the post-Hubble era, preventing a protracted UV-optical gap in space astronomy, and enabling an enormous range of discovery opportunities from the solar system to the nature of the Cosmos, in conjunction with the other great wide-field observatories of the next decade (e.g., Euclid, Roman, Vera Rubin). FORECASTOR (Finding Optics Requirements and Exposure times for CASTOR) will supply a coordinated suite of mission-planning tools that will serve as the one-stop shop for proposal preparation, data reduction, and analysis for the CASTOR mission in an open-source and user-friendly format. In this talk, I'll present the first results of this effort, including photometric and spectroscopic exposure time calculators, and image simulation tools for galactic and resolved stellar populations, providing illustrative examples of their use. I'll close by presenting key science results drawn from the concluding Phase 0 study, including highlighting predictions for several of CASTOR's planned legacy surveys and their synergies with other wide-field surveys.

16:10 – 16:30

Name: Gaël Noirot

Title: The CASTOR Grism Simulator & Exposure Time Calculator

Abstract: In my tutorial on the CASTOR Grism Simulator & Exposure Time Calculator (https://github.com/gnoir0t/ETC_grism), I will present and show with concrete examples through jupyter notebooks how to use the tool functionalities to generate CASTOR grism spectra in the UV and U-band, including realistic noise properties (sky-background, read noise, …), and proper forward-modelling of spectral templates that accounts for the source-dependent morphological broadening of slitless grism data. I will then show how these simulated data can be used in the context of extragalactic astronomy to estimate redshift-fitting recovery, useful for the planning of CASTOR observations. I will finally show the latest developments of the tool for the future of the mission.

16:30 – 17:00

Name: JJ Kavelaars

Title: CADC Memo

Abstract: TBD

Thursday, May 18th

9:00 – 9:20
Name: Michael Balogh
Title: Spatially resolving the evolution of star formation in galaxies with deep CASTOR surveys
Abstract: Deep surveys with CASTOR, overlapping with LSST, Euclid and Rubin fields, will provide images and spectroscopy for tens of millions of galaxies out to z=2.5. The depth and spatial resolution of CASTOR allows us to uncover the spatial distribution of star formation within galaxies over this span of cosmic time, while with spectroscopy we can reconstruct the large-scale cosmic web at z~2. This allows an unprecedented look at how and where star formation evolves, and is able to distinguish between different physical models for quenching. I will summarize the Galaxies Science Working Group contribution to the CASTOR Phase0 study.

9:20 – 9:40
Name: Ivana Damjanov
Title: CASTOR's view of star formation in the cosmic web
Abstract: We have designed a 83 square degree UV- and u-band grism survey with the proposed Canadian-led space mission, Cosmological Advanced Survey Telescope for Optical and ultraviolet Research (CASTOR). Our survey will identify hundreds of thousands of Lyman alpha emitters (LAEs) at $0.4 < z < 2.2$. We will use LAEs together with Lyman break galaxies (LBGs) to map the cosmic web at $2 < z < 3$, enabling detailed studies of galaxy environments and their effects on galaxy evolution in the redshift regime where the cosmic web is uniquely traced by CASTOR grism capabilities. In addition to constraining the local LAE luminosity function that will complement those at high redshift, our statistically large sample will form the basis for a suite of studies on LAEs, the fundamental tracers of star-forming galaxies. I will review the primary goals of the proposed survey and additional opportunities that it will provide, describe its technical requirements, and show how augmenting wide-field multi-wavelength datasets in the visible regime (e.g., from LSST) and NIR (e.g., from Euclid) with CASTOR grism spectroscopy will advance our understanding of galaxy transformations within the large scale structure at the peak epoch of cosmic star formation.

9:40 – 10:00
Name: Ting Li
Title: Near Field Cosmology: from ground to space
Abstract: I'll summarize the search for dwarf galaxies and stellar substructures in the Milky Way and local group with past imaging surveys, e.g. the Dark Energy Survey, and discuss the future in near-field cosmology with Rubin, Euclid, and CASTOR, and their implication to the nature of dark matter and galaxy formation.

10:00 – 10:20
Name: Joel Roediger
Title: Studying Galactic Behemoths and the UV Upturn with CASTOR
Abstract: Massive quiescent galaxies (MQGs; M_* > 10^11 M_sun) are a rare but extreme class of galaxy and are relevant to the study of many fundamental topics in galaxy evolution. A long-standing issue regarding MQGs is why some of them exhibit an increase in their emission at UV wavelengths (1000-2500 A), which runs contrary to expectations of their (presumed) passive, old, and metal-rich stellar populations. Numerous explanations of this so-called UV upturn have been offered, all rooted in stellar evolution, yet the phenomenon remains misunderstood. There is cause for optimism that this situation may change though through the CASTOR mission. Its wide field-of-view, high sensitivity, and three-channel design make it an unprecedented facility for photometric characterizations of MQGs and the UV upturn. The Phase 0 study of the CASTOR mission has defined a number of cornerstone surveys to be executed within its baseline five-year lifetime. Chief among these is the so-called Wide Survey, which will map the entirety of the Roman High Latitude Survey area (~2200 deg^2) in five effective bandpasses across the UV and blue-optical domain. Based on existing multi-wavelength surveys and semi-analytic models, the Wide Survey is expected to detect more than one million MQGs up to z < 0.9, including >10^5 UV upturns, far surpassing all catalogues of such objects to date. This will facilitate unprecedented lookback studies of the UV upturn, which has been shown to have discriminating power on models of this phenomenon. Additionally, the union of photometry from the CASTOR/Wide, Rubin/LSST, and Roman/HLS surveys will allow us to overcome uncertainties on the stars responsible for the UV upturn and obtain robust inferences of MQG ages and metallicities. CASTOR's unique capabilities will be transformational for studies of the most evolved galaxies in the Universe and bring us closer to reconstructing their evolution over cosmic time.

10:20 – 11:00
Coffee break

11:00 – 11:20
Name: Viraja Khatu
Title: UV Alert: CASTOR to Characterize Active Galactic Nuclei in a Unique Phase Space
Abstract: In the cores of massive galaxies, supermassive black holes accrete through a disk of ionized gas; such black hole systems are called active galactic nuclei (AGN). Accretion in AGN releases tremendous energy over a broad range of the electromagnetic spectrum. This energy output peaks in the ultraviolet (UV). Therefore, UV is a critical spectral regime to study AGN. Because AGN appear point-like in images, the time-domain technique of reverberation mapping (RM) is applied to map their inner regions. The light output from AGN varies over time; RM translates the timescale of this variability into a distance measurement (here, size of AGN). Combining AGN sizes and gas velocities (obtained from the widths of broad emission lines in AGN spectra) yields masses of the central black holes in these systems. Deriving black hole masses for a large number of AGN spanning a breadth of redshifts and luminosities is important for addressing the long-standing question, 'How do supermassive black holes grow over cosmic time?'. Understanding this unsolved problem is one of the key science goals of the Cosmological Advanced Survey Telescope for Optical and ultraviolet Research (CASTOR) – a Canada-led UV mission proposed to the Canadian Space Agency. The UV eyes of CASTOR will penetrate the heart of AGN variability. With its excellent imaging and spectroscopic capabilities, CASTOR will provide the "gold standard" for AGN black hole masses with RM in a unique luminosity-redshift parameter space as compared to all previous RM studies. In my talk, I will cover how we are planning large-scale AGN variability surveys with a survey simulation tool and how CASTOR will be able to uniquely deliver for AGN science.

11:20 – 11:40
Name: Hossen Teimoorinia
Title: AI and Big Astronomical Data Sets
Abstract: We use CFIS images to develop a method that maps the images onto a two-dimensional plot and clusters them. This method uses various state-of-the-art deep machine learning (ML) algorithms to create a fully unsupervised image quality assessment. In addition to CFIS image-quality checks, our approach can help experts label images in a considerably shorter time with minimum human intervention. It can also be used as a content-based recommendation system to filter images based on the desired content. We have extended this method to other astronomical data sets, such as galaxy spectra, to discriminate active galactic nucleus (AGN) in data sets and also to decompose composite galaxy spectra to AGN and star-forming components to measure star-formation rates more accurately.

11:40 – 12:00
Name: Joshua Speagle
Title: Photometric Biases in Modern Surveys
Abstract: Modern pipelines often rely on maximum-likelihood methods to extra fluxes for individual sources within images. I will describe a generic bias that is introduced by these methods which leads to an overestimation of the flux by on order 1-3%, with behaviour that can vary sensitively depending on how the co-adds/detections/fitting take place. I will then discuss a battery of numerical tests and "real-world" tests on HSC and SDSS data showing this bias exists, the potential impacts it may have on various science applications, and approaches to mitigate it in ongoing and upcoming surveys.

12:00 – 12:30
Name: Scott Wilkinson
Title: Quantifying the Completeness of Detected Galaxy Mergers in Large Photometric Surveys
Abstract: Mergers have been shown to be a fundamental mechanism driving both the growth of galaxies and ultimately quenching star-formation. Despite their importance to galaxy evolution, reliable and repeatable merger identification has been inhibited by differences in data quality, merger identification techniques, and galaxy samples. In this talk, I will discuss how I have used the UNIONS r-band imaging, garnered from the Canada France Imaging Survey (CFIS), to assess the merger prevalence of rare post-starburst galaxies, which are thought to have recently and rapidly quenched their star-formation. To do this, I use a suite of common merger identification methods including non-parametric morphology statistics (e.g. Gini-M20 and asymmetry), convolutional neural networks, and visual inspection. Furthermore, I quantify the efficacy of these methods for identifying interacting galaxies using recent mergers drawn from the IllustrisTNG cosmological simulation. The simulated post-mergers from IllustrisTNG are degraded to varying image qualities, in terms of depth and atmospheric blurring, ranging from worse than SDSS to that of the 10-year depth of the LSST. The completeness of recovered mergers is shown to depend on both image quality and the merger identification method, thus providing integral insight into the prospect of studying galaxy mergers in present and forthcoming large photometric surveys.

12:30 – 13:30
Lunch

13:30 – 13:50

Name: Pablo Lemos

Title: Machine Learning Powered Inference in Cosmology

Abstract: The main goal of cosmology, is to perform parameter inference and model selection, from astronomical observations. But, uniquely, it is a field that has to do this limited to a single experiment, the Universe that we live in. With very powerful existing and upcoming cosmological surveys, we need to leverage state-of-the-art inference techniques to extract as much information as possible from our data. In this talk, I will begin by introducing the inference problems we aim to solve in cosmology. I will then talk about Machine Learning based methods to improve on techniques traditionally used in the field, such as simulation-based inference, and stochastic control sampling approaches. I will finish by showing how these methods are being used to improve our knowledge of the Universe.

13:50 – 14:10

Name: Oliver Müller

Title: Dwarf galaxies in the UNIONS survey

Abstract: Dwarf galaxies are the most abundant and most dark matter dominated galaxies in the Universe. However, they are also the faintest and therefore most difficult galaxies to detect. Classical methods to detect dwarf galaxies are either coming from visual inspection or software like Source Extractor. While the former works well on small data sets, it is impossible to do it on such a large survey like UNIONS. The latter however, yields lots of false positives (up to 99.9% of the detections may be false positives). In my talk, I present our current efforts to detect dwarf galaxies in the UNIONS survey, using different strategies from the literature, as well as developing our own tools.

14:10 – 14:30

Name: Alan McConnachie

Title: The definitive census of the Nearby Universe with UNIONS, Rubin and Euclid

Abstract: UNIONS will cover 5000 square degrees of the northern hemisphere to a depth roughly equivalent to one year of the LSST. Already, it is being used to find new stellar systems, dwarf galaxies and stellar streams within the Milky Way and Local Group, and is allowing us to develop algorithms directly applicable to LSST. The true power of these surveys for resolved stellar population studies, however, will only be found in combination with Euclid, where the space-based image quality over the full magnitude range of ground-based sources will allow for very robust star-galaxy seperation that essentially increases the depth of these surveys by a full magnitude or more. I will discuss the current status of these searches and highlight the potential of uniting UNIONS and Rubin with Euclid for our knowledge of galaxies in and around the Local Group

14:30 – 14:50

Name: Andy Sheinis

Title: Update on the Maunakea Spectroscopic Explorer and the MSE Pathfinder

Abstract: MSE is a massively multiplexed spectroscopic survey facility that will replace the Canada-France-Hawaii-Telescope in the coming decade. This 12-meter telescope, with its 1.5 square degree field-of-view, will observe 18,000 – 20,000 astronomical targets in every pointing from 360 nm through H-band at low/moderate resolution (R=3,000/7,000) and 360-1000nm at high (R=30,000). A fiber positioner enables simultaneous full field coverage for both resolution modes. MSE will unveil the composition and dynamics of the faint Universe and impact nearly every field of astrophysics across all spatial scales, from individual stars to the largest scale structures in the Universe, including (i) the ultimate Gaia follow-up facility for understanding the chemistry and dynamics of the distant Milky Way, including the outer disk and faint stellar halo at high spectral resolution (ii) galaxy formation and evolution at cosmic noon, (iii) derivation of the mass of the neutrino and insights into inflationary physics through a cosmological redshift survey that probes a large volume of the Universe with a high galaxy density. The instrument suite, dedicated to large scale surveys, will enable MSE to collect a massive amount of data: equivalent to a full SDSS Legacy Survey every several weeks. We present an overview of the MSE science case and an update to MSE. In addition, we present the plan to develop in the near future a Pathfinder instrument at CFHT to fast-track development of the MSE technology as well as provide a dedicated transient followup capability featuring IFU spectroscopy in the visible mated to high-resolution single object spectroscopy with continuous coverage from 370nm-2.3um.

14:50 – 15:10
Coffee break

15:10 – 16:30
Name: Bruno Altieri
Title: Euclid tutorial
Abstract: TBD

16:30 – 17:00
Name: Connor Stone
Title: AutoProf: fast, flexible, and robust photometry for the next generation of surveys
Abstract: In this talk I will discuss AutoProf, a modern photometry code developed for the next generation of surveys. Taking advantage of GPU acceleration and automatic differentiation, it is capable of quickly performing sophisticated analysis on an unprecedented amount of data. Advanced surveys like UNIONS, Rubin, Euclid, and CASTOR are poised to open doors to unprecedented scientific discoveries, but only if the tools which process these data are similarly advanced. As open source code written entirely in python, AutoProf is designed to meet these needs and flexibly adapt to unique challenges for any observing pipeline. I will demonstrate how AutoProf is capable of state-of-the-art image processing, including joint multi-band and/or time series modelling, score based sampling, and low-surface-brightness analysis.