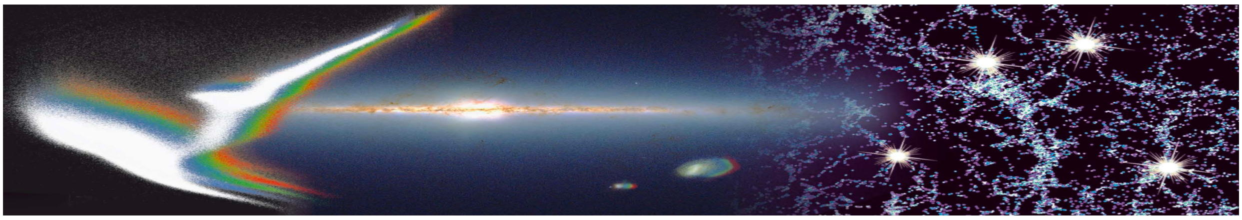


SDSS-V Collaboration Meeting

July 31 - August 4, 2023

Flatiron Institute / Center for Computational Astrophysics

Simons Foundation, New York, NY

Conference Booklet

SCIENTIFIC ORGANIZING COMMITTEE (SOC)

Keith Hawkins (University of Texas at Austin, Chair)
Liu Chao (NAOC)
Mike Eracleous (Penn State)
Nimisha Kimari (STScI)
Melissa Ness (CCA / Columbia)
Sebastian Sanchez (UNAM)
Mara Salvato (MPE)
Benny Trakhtenbrot (Tel Aviv University)
Boris Gaensicke (Warwick)

LOCAL ORGANIZING COMMITTEE (LOC)

Thavisha Dharmawardena (CCA, Chair)
Daniel Horta Darrington (CCA)
David Hogg (CCA / NYU)
Melissa Ness (CCA / Columbia)

CONFERENCE ADMINISTRATIVE STAFF

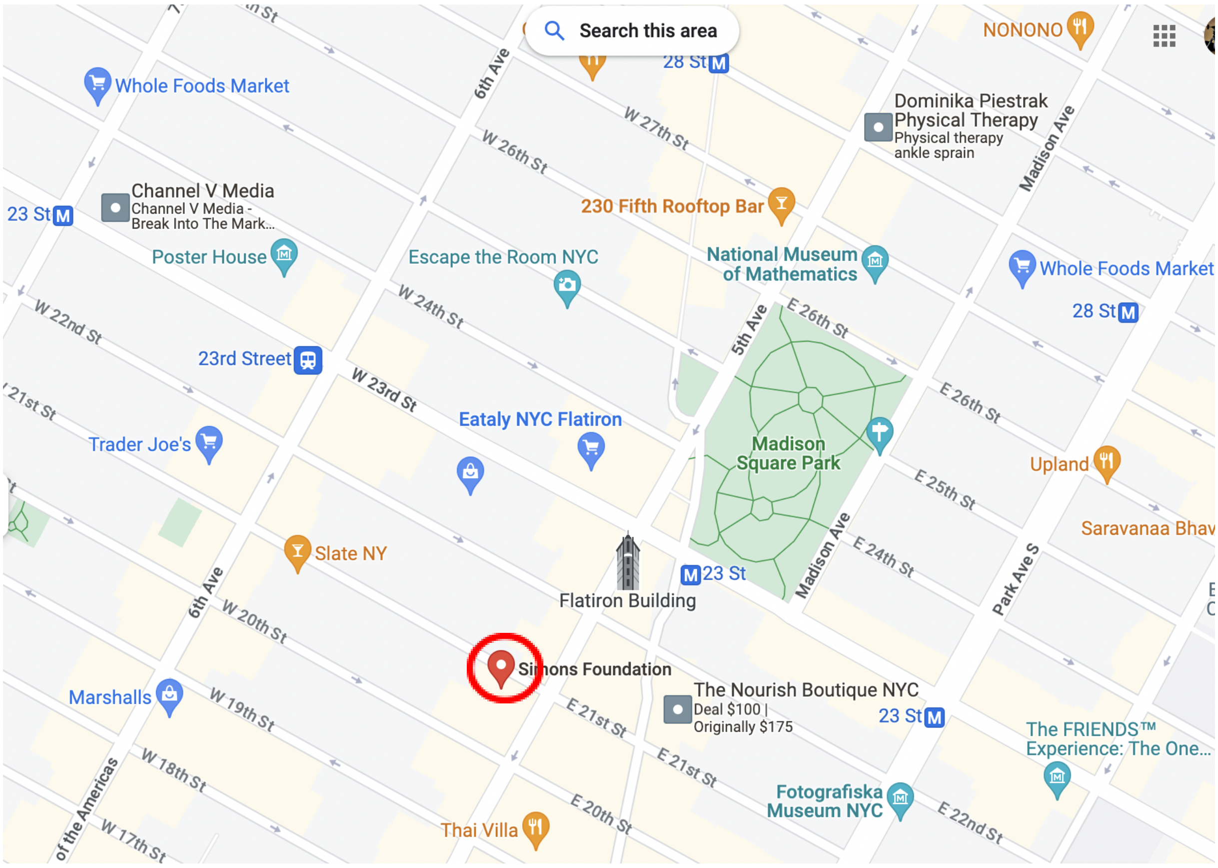
Abigail Creem (CCA)

A Word of Welcome

The Scientific and Local Organizing Committees welcome you to the Simons Foundation and New York City, NY. We are excited to host you for the 2023 SDSS-V Collaboration Meeting. The SDSS-V project involves three key projects — the Milky Way Mapper, the Local Volume Mapper, and the Black Hole Mapper — that will together observe nearly 6 million stars in the Milky Way and satellite galaxies, 400,000 black holes and galaxy clusters, and 3000 deg^2 of the ionized ISM from APO and LCO! The first public data release was in January 2023 with internal data products now being released to collaboration. With these exciting milestones, the collaboration meeting this year will be devoted to SDSS-V science talks, status updates, and tutorials, with both plenary and splinter sessions, from July 31-August 4, 2023. July 31st - 3rd August will be collaboration meeting talks/discussions and 4th August will be breakout sessions and workshops.

Venue/Local Maps

Gerald D. Fischbach Auditorium at the Simons Foundation
160 5th Ave, New York, NY 10010



Remote Connection information

For the first 4 days (July 31 - Aug 3) the meeting will take place in a hybrid format. The talks will be streamed via a *single* Zoom webinar with the following details below:
Webinar ID: 978 6383 1142
Passcode: 176884
https://simonsfoundation.zoom.us/j/97863831142?pwd=bFVNc3NjTms3YlIxQUYvRVpmS1BCZz09

Restaurant Recommendations

The LOC recommends looking at the following document for recommendations of things to do and restaurants to check out in New York City.

COINS Recommendations

1. Meeting Accessibility:

https://github.com/sdss/coins/blob/main/documents/md/meeting_accessibility.md

2. Guidelines for chairing sessions at SDSS meetings:

https://github.com/sdss/coins/blob/main/documents/md/chairing_guidelines.md

3. Other things can be found here:
https://github.com/sdss/coins/tree/main/documents/md

We found these links regarding COVID-19 policies/recommendations for scientific meetings that could be considered at the SDSS Science festival:

1. Policies on the last AAS meeting (Pasadena, California, US):
https://aas.org/meetings/aas240/COVID-policy
2. Policies on the last EAS meeting (Valencia, Spain):
https://eas.unige.ch/EAS2022/covid19.jsp
3. Policies on the upcoming DPS (Division for planetary sciences) meeting (London, Ontario, Canada):
https://aas.org/meetings/dps54/covid19-policy
1. The upcoming DPS meeting will be held in London, Canada, about 200 km from Toronto. We could use this policy as a reference. Although we should keep in mind that COVID policies might change from city to city, the LOC will have to see such specifics.

Remind participants:

- Travel with extra medications or other necessary items in case you do have to stay longer than anticipated

● Travel insurance, with medical support; should cover some costs, help with talking to a doctor in your home country for advice, medical translation (names of medicines in different countries); your institution may have travel insurance (and you might not know about it!

● Check your institutional policies with respect to extending travel, and what documentation/approvals would be necessary

● Check your institutional and gov't policies in regards to travel with COVID19; e.g., how long since the onset of symptoms are you allowed to travel

○ Carry documentation of past infection and/or recovery and vaccination.

○ If you do test positive, make sure that you get official documentation of your positive test while away, this is needed for insurance and for proof of having it and (later) **proving recovery (vs active infection).**

COVID Considerations

With NYC case numbers continuing to decline significantly, all NYC Department of Health indicators showing decreasing activity, and the Federal government declaring an end to the public health emergency on 11th May 2023, the foundation is making the following adjustments to our COVID protocols effective March 27, 2023.

● Testing will NO longer be mandatory upon return from international travel, whether personal or business.

● Gateway (i.e. pre- program) testing will NO longer be mandatory for large (>50) multi-day events with external attendees.

○ Event participants who wish to self-test may request and pick up COVID-19 rapid tests from the 162 5th Avenue lobby reception on an as-needed basis, as long as the current stock allows.

● Masking will NO longer be mandatory in group settings or restrooms.

○ Staff is welcome to continue masking in any setting at any time if they so choose. Please respect your colleagues’ choices as to where and when they wish to mask.

Block Schedule

**NOTE: All time in the block schedule are Eastern Daylight time*

	Monday, July 31, 2023	**Tuesday, August 1, 2023**	**Wednesday, August 2, 2023**	**Thursday, August 3, 2023**	**Friday, August 4, 2023**
8:00	Breakfast	Breakfast + **New Members Breakfast (led by COINS)*	Breakfast	Breakfast	Breakfast (Flatiron only)
9:00	**Session 0.1** **Chair : Keith Hawkins** **Welcome : SDSS-V : It's On (Juna Kollmeier)** ****Zoom link for all *main* sessions : Link (passcode: 176884)**	**Session 3 (101x2 + 3xC.)** **Chair: Nicola Gentile Fusillo** **Eduardo Méndez-Delgado (LVM101)** **Paula Jofre (MWM 101)** **Vedant Chandra** **Alexander Ji** **Viola Hegedűs**			
9:30	**Session 0.2** **Chair: Sebastian Sanchez** **COINS (Emily Griffith, Danny Horta)**		**Session 7 (6xC.)** **Chair: Sebastian Sanchez** **Dan Qiu** **David Nidever** **Aidan McBride** **Catarina Aydar** **Hector Ibarra Medel** **Alejandra Zaavik Lugo-Aranda**		
10:00	**Session 0.3** **Chair: Sebastian Sanchez** **SDSS Data 101 (Anne-Marie Weijmans)** **Survey Policies (Keith Hawkins)**			**Session 11 (4xC.)** **Chair: Maddie Lucey** **Jianhui Lian** **Keith Inight** **Lyra Cao** **Jamie Tayer**	
10:30	Coffee Break	Coffee Break	Coffee Break	Coffee Break	
11:00	**Session 0.4** **Chair : Danny Horta** **Niall Deacon (EPO/15min)** **Dhaneshvaran Krishnarao (FAST/15min)**	**Session 4 (2x101 talks)** **Chair: Nicola Gentile Fusillo** **Elenora Zari and Jon Bird (MWM 101)** **Johannes**	**Session 8 (4xC.)** **Chair: Mike Eracleous** **Santiago Bernal** **Logan Fries** **Collin Dabbieri** **Emma Galligan**	**Session 12 (4xC.)** **Chair: Thavisha Dharmawardena** **William Thomas** [illegible] **Yuxi Lu** **Zoltan Dencs** **Maddie Lucey**	**Splinter Sessions:** **BHM -- Simons Foundation*** **MWM -- NYU Physics Building** **LVM -- NYU Physics Building** ***only the promenade and lecture theater**

	Monday, July 31, 2023	Tuesday, August 1, 2023	Wednesday, August 2, 2023	Thursday, August 3, 2023	Friday, August 4, 2023
11:30	**Session 0.5** **Chair : Keith Hawkins** **Jennifer Johnson (MWM Overview)**	**Buchner (BHM 101)**			
12:00	Lunch / **MWM zero to hero session* (Adam Wheeler, Yuxi Lu, Danny Horta)	Lunch (COINS Town Hall, led by COINS co-chairs)	Lunch (Survey Efficiency Discussion led by John Donor and/or José Sánchez-Gallego)	Lunch	Lunch (Flatiron only)
12:30					
13:00					
13:30	**Session 0.6** **Chair: Keith Hawkins** **Andrea Merloni (BHM Overview)**	**Session 5 (5xC.) -** **Chair: Benny Trakhtenbrot** **Grisha Zeltyn** **Douglas Finkbeiner** **Andrew Saydjari** ***Emily Griffith*** ***Nicola Pietro Gentile Fusillo*** **+ Lighting talks + conference photo**	**Special Session: A visit from the Sloan Foundation President Adam Falk** **Chair: Juna Kollmeier**	**Session 13 (6xC.)** **Chair: Maddie Lucey** **Logan Sizemore / Diego Llanes** **Ahmad Nemer** **Andres Almeida** **Bruno Dias** **Jack Roberts** **Sara Frederic**	**Splinter Sessions:** **BHM -- Simons Foundation*** **MWM -- NYU Physics Building** **LVM -- NYU Physics Building** ***only the promenade and lecture theater**
14:00	**Session 0.7** **Chair: Keith Hawkins** **Evelyn Johnston (LVM Overview)**				
14:30	**Session 1 (101 x 1)** **Chair: Danny Horta** **Sebastian Sanchez (LVM 101)**		**Session 9 (2xC.)** **Chair : Mara Salvato** **Carlos Román Zúñiga** **Zoe Hackshaw**		
15:00	Coffee Break + *Speed geeking (led by COINS)	Coffee Break + Poster Session (lighting talks for posters)	Coffee Break + Poster Session	Coffee Break + Poster Session	
15:30	**Session 2 (2x101, 2xC.)** **Chair: Mike Eracleous** **Tom Herbst** **Jessie Runnoe (BHM 101)** **Qian Yang** **José Sánchez-Gallego (Software 101)**				
16:00		**Session 6 (4xC.) -** **Chair: Benny Trakhtenbrot** **Amy Rankine** **Alenka Negrete** **Szabolcs Mészáros** **Sophia Waddell**	**Session 10 (4xC.)** **Chair: Mara Salvato** **Jack Delaney** **Paul Green** **Amaya Sinha** **Danny Horta**	**Session 14 (4xC.)** **Chair: Thavisha Dharmawardena** **Lucía Adame Villanueva** **Ricardo López-Valdivia** **Rachael Beaton** **Shivani Shah**	
16:30					
17:00	**Reception (Flatiron)**	Downtime			
17:30					
18:00					

	Monday, July 31, 2023	Tuesday, August 1, 2023	Wednesday, August 2, 2023	Thursday, August 3, 2023	Friday, August 4, 2023
18:00+	Downtime	MWM "Breakfast" with the Southern Hemisphere (Jennifer Johnson/Danny Horta) 7-9pm	Downtime		

Abstracts

July 31, 2023

SDSS-V: It's On!
Juna Kollmeier

I will present an overview of the status of SDSS-V.

101: SDSS Data
Anne-Marie Weijmans

SDSS Data 101: in this talk I will discuss what types of data SDSS-V is generating, where to find it, and how to use it for your science. I will talk about data releases, the work that goes into them, and how collaboration members can contribute, e.g. with documentation writing or by contributing value added catalogs.

(This will be an updated version of the Data 101 plenary talk I usually give at the collaboration meeting, and include the IPLs, DR18, and an outlook to DR19).

101: SDSS Policies
Keith Hawkins
I will provide a quick overview of the SDSS-V Publication, External Collaborator, and Data Policies and introduce the Collaboration Council.

Inspiring the Public through SDSS scientific discoveries
Niall Deacon
Over more than two decades, SDSS has both inspired the public through scientific

discoveries & impactful outreach programs and created a wealth of material for use in the classroom. In this talk I will describe the work by SDSS scientists, educators and artists to bring SDSS results to a wider audience. I will also how you can use these resources in your own outreach and teaching. Be it an online outreach event, school class or university lab, SDSS has materials for you to use and adapt.

An Overview of SDSS FAST
Dhanesh Krishnarao

A summary of the Faculty and Student Team (FAST) program - our goals, current teams, and how to get involved and form new teams.

Milky Way Mapper: Observing All The Stars
Jennifer Johnson
The Milky Way Mapper is carrying out ambitious programs to understand Galactic star formation, chemical, and kinematic history, the architecture of stellar systems, and the physics of stellar structure and evolution. I will present the main science goals of MWM and how we are achieving them. I will discuss the status and plans of the data reduction and analysis. I will end by highlighting opportunities to upgrade MWM to the next level.

The Black Hole Mapper: an overview
Andrea Merloni
I will present an overview of the Black Hole Mapper and of all its components, together with a few early science highlights

LVM Overview and Status Update
Evelyn Johnston
The Local Volume Mapper (LVM) is an IFU survey of the Milky Way and the Magellanic Clouds, as observed from las Campanas Observatory in Chile. The telescope and instrument have been assembled on site in early 2023, with science commissioning and observations due to begin in June 2023. In this talk I will present an overview of the LVM, giving details of the current status of operations and the commissioning activities. I will also discuss some of the early science projects and any early science results obtained by the time of the meeting.

101: LVM
Sebastian Sanchez
MISSING ABSTRACT

Overview of the Local Volume Mapper Instrument
Tom Herbst

The Local Volume Mapper (LVM) survey employs four, 16-cm telescopes feeding 3 fiber-fed spectrographs at Las Campanas Observatory, with the goal of mapping the Galactic plane with 37” spatial resolution and R~4000 spectral resolution. One telescope hosts the science IFU, while two others observe adjacent fields to calibrate geocoronal emission. The fourth telescope measures bright stars to compensate telluric absorption. Four fiber bundles bring the light from the telescope chamber to the "sorting hat", which divides the fibers equally among the entrance slits of the three spectrographs. These slits intersperse the light from all three types of telescope, producing truly simultaneous science and calibration exposures. The demands of the survey have led to some unique challenges and unconventional design choices. We will present an update on the construction, testing, and commissioning of the LVM instrument, along with a look forward to Science Verification.

101: Spectroscopic Variability of Active Galaxies and Quasars
Jessie Runnoe
Active galactic nuclei (AGN), the visible result of supermassive black hole growth, are prevalent in many fields from galaxy evolution to gravitational wave astrophysics. However, our understanding of these objects has been limited because the primary emission regions surrounding the supermassive black hole, the accretion disk and broad-line region (BLR) that make up the central engine, cannot be imaged except in very special cases because of their small angular sizes. However, we can leverage time variability in photometric and spectroscopic observations as a powerful tool for revealing the physics and structure of these regions and also as signposts of exotic classes of objects like changing-look AGN or supermassive black hole binaries. This talk will provide an introduction to AGN in the time domain and highlight the design and discovery space of the Black Hole Mapper program. I will focus on the variability observed in optical spectroscopy of these objects on timescales of weeks to years, the physical view of the central engine that such observations provide, and opportunities for understanding exotic accretion behaviors.

Changing-Look Quasars: Zooming in on X-ray/Optical Variability, Zooming out to the Big Picture
Qian Yang
'Changing-look quasars' (CLQs), discovered less than a decade ago, show dramatic, rapid changes in optical/UV continuum and broad line emission strength. CLQ transitions have been attributed to tidal disruption events, changes in intrinsic absorption or in accretion rate, but all these hypotheses suffer theoretical or empirical challenges. X-ray observations can clearly distinguish between scenarios. Quasars monitored spectroscopically by the SDSS-V enable real-time detection of CLQ transitions. We select targets from X-ray detected SDSS spectroscopic quasars that have been recently re-observed by SDSS-V and confirmed as CLQs. We will characterize CLQ changes in X-ray luminosity, slope, and intrinsic absorption, testing models with promising analogies to X-ray binaries using joint VLA imaging.

101: SDSS-V Software
José Sánchez-Gallego

In this talk I will review recent software development in SDSS as part of our instrumentation, target selection, data analysis, and data archiving effort. I will highlight and demo key software that has been instrumental in getting SDSS-V on sky and taking data nightly. Finally, I will provide an overview of the collaboration policies and procedures for DevOps.

August 1, 2023

101: HII regions beyond spherical cows: temperature and density inhomogeneities
José Eduardo Méndez Delgado
HII regions, ionized nebulae associated to massive star formation, exhibit a wealth of emission lines that are the fundamental basis for estimating the chemical composition of the Universe. Heavy element abundances are particularly important because they are essential to the understanding of nucleosynthesis, star formation and chemical evolution. For more than 80 years, however, a discrepancy between heavy-element abundances derived with collisional excited lines (CELs) and recombination lines (RLs) has thrown our absolute abundance determinations into doubt in Galactic and extragalactic systems. Only

recently it has been shown that there are temperature inhomogeneities concentrated within the highly ionized gas of the HII regions, causing the reported discrepancy by introducing systematic underestimations of the metallicities based on CELs. Observations of Galactic ring nebulae created by mass-loss episodes from young very massive stars seems to link the temperature inhomogeneities with stellar feedback processes.

101: MWM: stars as probes of stellar (and planetary) structure and evolution
Paula Jofre
This talk will be an overview of how can we use thousands of stellar spectra to learn about the processes that shape the Milky Way or planetary systems.

Mapping the Milky Way's Outer Halo with BOSS
Vedant Chandra

I will present the data analysis pipeline our group has developed for BOSS spectra, which delivers stellar parameters, alpha abundances, and 6D kinematics for all stars in the Milky Way Mapper halo program. I will also present our selection procedure for the distant halo sub-program, in which we target luminous red giant stars in the uncharted outskirts of the Galaxy. Finally, I will summarize the progress of these surveys and the prospects for early results.

A Spectacular Star from Spectroscopic Followup of Milky Way Mapper Halo
Alexander Ji

The SDSS-V Milky Way Mapper halo program will obtain spectra of hundreds of thousands of stars in the local halo, distant halo, and metal-poor halo. The halo working group has a spectroscopic follow up program to investigate the most interesting stars identified based on their kinematics or chemistry, with a focus on metal-poor low-alpha stars that likely accreted onto the Milky Way in low mass dwarf galaxies. I will present early results from this ongoing search. One of the stars has a spectacular chemical composition: extreme odd-even ratios, enhanced iron-peak elements, and a unique neutron-capture element pattern. Despite having relatively high metallicity [Fe/H] = -1.8, the chemical composition strongly suggests this star formed out of gas predominantly enriched by metal-free Population III stars. The early discovery of a star with such unique composition bodes well for many more interesting stars to be identified in Milky Way Mapper.

Modelling the Chemical Evolution of the Milky Way with OMEGA
Viola Hegedűs

We will present new models simulating the chemical evolution of our Galaxy using abundances from MWM for which we are using the multi-zone chemical evolution environment OMEGA+. We compare the observed elemental abundance patterns of stars with the theoretical prediction of various evolution scenarios, such as the two-infall and parallel formations. We also undertook a comparison between APOGEE, GALAH and Gaia-ESO surveys to uncover the systematical differences between survey, which is essential to understand the effect of discrepancies on existing Milky Way chemical maps.

101: Mapping hot massive stars in the Milky Way disc
Eleonora Zari and John Bird

Hot massive stars dominate the stellar energy input to the interstellar medium, are laboratories for stellar evolution and multiplicity, and are tracers of recent star formation. One SDSS-V's core goals is to obtain multi-epoch BOSS spectra of over 300.000 OBA stars brighter than G=16 mag in the Galactic disc. From these spectra we will get estimates for masses, ages, metallicity, multiplicity, and velocities. In this talk I will describe SDSS-V targeting and observing strategy and show first spectra and resulting stellar parameters form the "zeta-Payne" code. In the longer run these data will serve as the basis for modelling the "young Galaxy", to search for dark companions, and to provide the connection to the LVM mapping of the gas that has been ionized by these stars.

101: X-rays & eROSITA: Introduction to Röntgen-Astronomy
Johannes Buchner
The principles of X-ray imaging-spectroscopy telescopes like eROSITA are presented, including basics of data collection and forward-folding modelling of spectra. Properties of eROSITA's first all-sky survey and its detected sources will be discussed.

Exploring "Changing-look" AGNs: First Results from SDSS-V
Grisha Zeltyn

Recent advances in time-domain surveys have revealed dramatic changes to SMBH accretion and AGN appearance on surprisingly short timescales. Among those, changing-look AGNs (CL-AGNs) show the (dis)appearance of broad emission lines and/or the quasar-like continuum, on timescales of years and sometimes even months. These dramatic changes may be driven by significant changes to the accretion flow and/or circumnuclear gas, and can therefore provide key novel insights into these physical components. Among other science cases, the Black Hole Mapper (BHM) within SDSS-V is designed to detect and survey CL-AGN on multiple timescales, which can help us understand their physical nature. In this talk I will present the analysis of the largest sample of (candidate) CL-AGNs to date, obtained from the first year of (plate) SDSS-V observations. Our sample covers a broad range of timescales, redshifts, and black hole properties. Our preliminary analysis indicates that CL-AGNs occur at systems with relatively low Eddington ratios, but with no preference for certain black hole masses or AGN luminosities. Our sample will allow us to gain insights into the physical mechanisms driving CL-AGNs, with potential implications for the unified AGN model and thus for AGN demographics.

MADGICS
Doug Finkbeiner

Spectroscopic data reduction is confounded by unknowns such as the sky spectrum and the instrumental transfer function. It is important to marginalize over these (and not merely subtract a point estimate) in order to obtain unbiased results with correct error bars. When the priors on the nuisance components can be expressed as a Gaussian in the high-dimension pixel space (i.e., an Npix x Npix covariance matrix) the marginalization integral is analytic. Andrew Saydjari and I have pioneered an approach called Marginalized Analytic Data-space Gaussian Inference for Component Separation (MADGICS) and obtained promising results from the APOGEE data. In particular, MADGICS allows easy separation of multiple objects within the fiber, leading to a more complete catalog of binary stars.

A New MWM Pipeline: Separating APOGEE Spectra into Components
Andrew Saydjari

A ubiquitous problem in astronomy is correctly assigning absorption or emission features in a spectrum to the multiple processes occurring along the line of sight within the spectroscopic field of view. We introduce a new data processing pipeline to decompose APOGEE spectra into components associated with the target star, terrestrial atmosphere, and dust along the line of sight. In this model, the sum of the components is exactly the data, meaning unexpected signals are exactly retained. This decomposition is obtained by modeling each component as a draw from a high-dimensional Gaussian distribution in the data-space (the observed spectrum)---a method we call ``Marginalized Analytic Data-space Gaussian Inference for Component Separation'' (MADGICS). This technique provides statistically rigorous uncertainties and detection thresholds, which allows better leveraging of low signal-to-noise spectra. We will focus on applications to mapping Galactic dust via the 15273 Å diffuse interstellar band. Possible impacts on other science goals include radial velocity determination, spectroscopic binary (SB2) modeling, and stellar parameter inference.

Determining the intrinsic relation between X-ray and UV/optical tracers of supermassive black hole growth
Amy Rankine

Understanding the relationship between the UV/optical emission from the accretion disc and the X-ray emission associated with the corona is vital to understand differing AGN accretion states and thus the growth phases of black holes. The optical-to-X-ray spectral slope describes the relative strength of the hard X-rays to the accretion disc emission which peaks in the UV. The well-established anti-correlation between alpha_ox and UV luminosity has long suggested that the more luminous the quasar, the weaker the corona and the weaker the hard ionising radiation. However, this observational alpha_ox relation is subject to selection effects and biases. Utilising the optically-selected sample (from SDSS-IV) of AGN in the XXL field and Stripe 82 region ($0.5 < z < 4$), alongside their XMM X-ray observations, we have carefully controlled for the X-ray incompleteness, by way of maximum likelihood fitting, to derive the distribution of X-ray and UV luminosities and the intrinsic alpha_ox relation, while accounting for any possible redshift evolution. The next step in the project will be to utilise the quasar sample from SDSS-V in order to characterise the optical properties of an X-ray selected sample. As a result, we can evaluate our understanding of the connection between the accretion disc and corona.

UV spectral characterization of quasars at $z > 1.1$
Castalia Alenka Negrete Peñaloza

We present a UV parameter space as a spectroscopical sequence to organize quasars along the spectral diversity. In the optical range, quasar spectral diversity has been analyzed using the so-called Eigenvector 1 (E1) "main sequence", which involves the FWHM of the broad component of Hb and the flux ratio of FeII and Hb. The E1 also provides information on the physical conditions of the optical emitting regions, black hole masses, or accretion rates. We lack a diagram that organizes the spectral differences in the UV range. In part because the low S/N associated with distant objects does not permit us to carefully deconvolve the most prominent lines, such as CIV and the 1900A blend that includes the intermediate ionization lines CIII], SiIII, and AlIII. The 1900A blend emission lines are closely related to the physical conditions of the broad line region, including metallicity, density, and ionization parameter. In this work, we propose to use flux ratios in the 1900 A blend to build a diagram to organize the UV spectra into a sequence. We use the average spectra for each SDSS-V object to increase the S/N to avoid a large scatter in the UV diagram. Dividing this diagram into bins, we made average spectra for each one to analyze the line emissions in three regions: 1900A blend, CIV1549, and SiIV1400, to show the particular spectral characteristics in each bin. We present a preliminar analysis of the trends in those bins, such as the black hole masses and the accretion rates.

Disc winds and soft excesses in eROSITA-detected AGN
Sophia Waddell

The eROSITA all-sky survey has detected around a million X-ray point sources, most (80%) of which are Active Galactic Nuclei (AGN). The X-ray spectra of these sources is dominated by the hot X-ray corona, but additional emission and absorption components are often observed in the soft band, and their origin remains highly disputed. Using the hard X-ray selected sample in the eROSITA Final Equatorial Depth Survey (eFEDS) field, we apply various models to describe the soft X-ray complexity using Bayesian X-ray Analysis (BXA). We show we can distinguish between true soft excess emission and complex absorption, which can mimic the soft excess. We find that Comptonization in a warm corona generally provides the best fit for sources with true soft excesses, but find a similar number of sources are better fit with partial covering or warm absorption, e.g. from a disc wind. Furthermore, it is shown that a larger fraction of sources with lower Eddington accretion rates host warm absorbers, while sources with higher Eddington ratios tend to prefer a warm corona. The first hard all-sky survey from eROSITA will allow the expansion of this study using thousands of AGN, providing an even more complete picture of the prevalence and origin of complex absorption and soft excesses.

Calibrations of the First Data Release of Milky Way Mapper
Szabolcs Meszaros

In this talk we will give an overview about how we plan to calibrate the atmospheric parameters and abundances of the first data release of MWM. To assess this accuracy and precision of these parameters, we need to compare the results of Astra with a validation set that represents well the different stellar types observed by the MWM and that is well-characterised. We are assembling and characterising this validation set by selecting stars with interferometry, good photometry, astrometry, stars observed by multiple high-resolution spectroscopic surveys, low-reddening and solar neighborhood stars, stars with asteroseismic information and binaries.

An Overview of FPS Survey Efficiency
John Donor

We present a summary of SDSS V Fiber Positioning System (FPS) operations through the present, including roughly one and a half years at Apache Point Observatory (APO) and 10 months at Las Campanas Observatory. We provide a high level summary of progress at the robot-configuration level, as well as a brief summary of progress towards specific science programs. We further compare to simulations of the survey and discuss various assumptions in the simulations that might affect our comparison. Finally, we highlight some areas where the survey is underperforming.

August 2, 2023

Calibration of metallicity of M dwarf stars using FGK+M wide binaries
Dan Qiu

In this work, we empirically calibrate the metallicity using wide binaries with a F, G, or K dwarf and a M dwarf companions. With 1409 FGK+M wide binaries well observed by LAMOST, we are able to calibrate M dwarf's [Fe/H] by using the Stellar LAbel Machine (SLAM) model, which is a data-driven method based on support vector regression. The [Fe/H] labels of the training data are from FGK companions in the range of [-1,0.5] dex. And the Teff s are selected from Li et al. (2021), spanning [3100,4400] K. The uncertainties of [Fe/H] and Teff estimated by SLAM are ~0.15 dex and ~40 K, respectively, at snri >100. We applied the trained SLAM model to determine the [Fe/H] and Teff for ~750,000 M dwarfs with low-resolution spectra in LAMOST DR9. Compared to other literature also using FGK+M wide binaries for calibration, our [Fe/H] estimates show no bias but a scatter of 0.13~0.19 dex. However, the [Fe/H] compared to APOGEE shows a systematic difference of 0.15~0.18 dex with a scatter of 0.15~0.23 dex. While the Teff compared to APOGEE has a bias of 3 K with a scatter of 67 K, it is systematically higher by 183 K compared to other literature calibrated by the bolometric temperature.

KPM: A flexible and data-driven K process model for nucleosynthesis
Emily Griffith
The element abundance pattern seen in Milky Way disk stars is close to two-dimensional, dominated by production from one prompt process and one delayed process. We fit the abundances of 14 elements for 48,659 red-giant stars from APOGEE DR17 using a

flexible, data-driven K-process model---dubbed KPM. In our fiducial model, with K=2, each abundance in each star is described as the sum of a prompt and a delayed process contribution.

How Prevalent is the Alpha-Bimodality in the Local Group?
David Nidever
The recent era of large, ground-based abundance surveys has unraveled the chemical structures of our Milky Way galaxy. The most striking abundance feature is the alpha-abundance bimodality. The low-alpha stars are younger (1-8 Gyr) while the high-alpha stars are older (8-12 Gyr) and have a thicker distribution. Interestingly, the APOGEE abundances of the Large and Small Magellanic Clouds do not show any alpha-bimodality but instead can be explained by a single, low star formation efficiency evolutionay sequence. While there are a number of models that can reproduce the Milky Way alpha-bimodality, none are strongly favored by the data. However, they do make different predictions about the prevalence of the alpha-bimodality in Milky Way-mass galaxies. Our Cycle 1 JWST NIRspec program has obtained high-S/N, medium-resolution spectra of over 100 stars in one M31 disk field. We have measured stellar parameters, radial velocities, and alpha-abundances using a set of synthetic spectra. Our preliminary results indicate that there no alpha-bimodality exists in the M31 JWST abundances and the data can be explainedy by a single, high star formation efficiency evolutionary track similar to what is seen in the MW bulge. While this result is somewhat surprising, the larger accretion and merger rate of M31 is likely responsible for the different chemical pattern.

Mapping the California Cloud's Dynamical Structure with APOGEE
Aidan McBride
The internal dynamics of giant molecular clouds (GMCs) are important tracers of their evolutionary history and the processes that cause them to coalesce from the warm neutral ISM. Kinetic tomography, a class of techniques for calculating distance-resolved velocities in the ISM, is an important tool for understanding the kinematics of nearby GMCs. Using the 1.527 micron diffuse interstellar band (DIBs) in specially-targeted APOGEE-2 spectra as a tracer of the ISM velocity field, we build a kinetic tomography model of the ISM within the California GMC to explore the cloud’s global dynamics and the effectiveness of the DIBs in fine-scale kinematic mapping. SDSS-V MWM will sample similar spatial densities for many nearby star-forming clouds, enabling the comparison of GMC kinematics across masses, structures, dust properties, and star-forming histories.

eROSITA-SDSS Data Level 1
Catarina Aydar

Multiwavelength information is crucial for a complete understanding of the Universe. Therefore, SPIDERS (Spectroscopic Identification of ERosita Sources) selected objects identified in X-rays with eROSITA to be observed in the optical domain by SDSS-V. We present the Data Level 1 of the collaboration between SDSS and eROSITA, in which we make available the main features of sources observed in optical and X-rays, such as position, spectroscopic redshift, object type, class, stellar templates, public photometric data, X-ray morphology, X-ray flux and likelihood, among other parameters. This catalog contains information on clusters of galaxies, quasars, AGNs, stars, and compact objects. It should be uploaded frequently as more Internal Product Launches of SDSS are released. Many scientific questions can be answered based on the statistics of this large sample, which can be of interest to the whole SDSS-eROSITA community.

The Host galaxies stellar populations with Active Galactic Nuclei with the SDSS-V
Hector Javier Ibarra Medel

We will present a first study of the host galaxy stellar populations with the SDSS-V. For that objective, we will use optical spectra within a redshift range of 0.1 to 0.9 and retrieve a set of stellar population syntheses to disentangle the non-thermal component arising from the active nucleus from the host galaxy. The analysis tests the feasibility of recovering the stellar masses, star formation quantities, ages, synthetic colours, etc., for the AGN-hosting galaxies in the SDSS-V. Therefore, we explored a possible impact on the host galaxies' star formation efficiencies when a galaxy has or hasn't had a strong non-thermal component along the star formation main sequence. This work will generate data products such as stellar masses, star formation rates, star formation histories, and stellar free AGB emission.

Finding HII regions
Alejandra Zaavik Lugo Aranda

In this work we present a new tool called pyHIIextractor used to search for HII regions in nearby universe galaxies observed with Integral Field Spectroscopy data. The code extracts the main properties of ionized gas emission lines and the underlying stellar populations. It also models the diffuse ionized gas component and decontaminates the information from the HII regions due to this contribution. The code has been applied in complete samples such as AMUSING++: 678 galaxies (obtaining a catalog with ~52,000 HII regions) or in particular data, e.g., CALIFA: NGC2906 and MaNGa: IC342.

Mapping the Gas Kinematics Around Luminous Quasars with BHM-RM
Logan Fries

Reverberation mapping (RM) has been successful in measuring the masses of quasars under the assumption that the gas in the broad-line region (BLR) is moving in orbits dominated by gravity. The multi-object SDSS-RM campaign expanded this effort to the first set of luminous and high-redshift quasars, and revealed cracks in the foundation of black hole masses by showing that many luminous quasars have more complicated BLR structures than simple photoionization-bounded gas. Within the last two decades, velocity-resolved RM has unveiled a diversity of non-virial kinematics in the BLR of AGN, putting additional pressure on the enterprise of black hole mass estimation. This is especially apparent in the case of the hyper-variable quasar RM160, where the dramatic radial-velocity shifts have been interpreted as inflow onto the BLR. I will show velocity-resolved RM of RM160 confirming the presence of inflow onto the BLR. This analysis represents the first of its kind for the SDSS-RM/BHM-RM dataset. Previous work has been limited to a set of nearby, low-luminosity AGN, while BHM-RM allows to expand to a broader sample of luminous quasars across cosmic time for which this analysis is possible. These results demonstrate how the high-cadence, long-duration, and multi-epoch time domain spectroscopy of SDSS-RM/BHM-RM is shedding new light on the detailed physics of the gas near luminous quasars.

A Structure Function for Variability of Hβ Radial Velocity of SDSS Quasars
Collin Dabbieri

Spectroscopic searches for Supermassive Black Hole Binaries (SMBHBs) aim to find quasars with broad emission lines whose velocity offsets show sinusoidal variation over periods of years to decades. This is thought to be an indicator of orbital motion in the case where one SMBH in the binary is actively accreting. One of the predominant limitations to this study is that single black hole quasars show Broad Line Region variability, and the extent of that variability has not been statistically characterized. In order to provide this characterization, we have developed a methodology for fitting variability in Sloan V spectra based on previous datasets. We fit a structure function to changes in the velocity of the centroid of broad $H\beta$ for all z<8 quasars with at least two SDSS I-IV spectra. The structure function provides characteristic variability amplitudes, as a function of the rest-frame time between observations, for all of the pairs of spectra in the sample. These amplitudes can be used to constrain the variability for normal quasars, improving the constraints available for spectroscopic searches for SMBHBs.

MWM: stars as probes of stellar (and planetary) structure and evolution
Emma Galligan

This talk will be an overview of how can we use thousands of stellar spectra to learn about the processes that shape the Milky Way or planetary systems.

Spectral Properties of Young Stars in Nearby Star Forming Regions. The road from APOGEE-2 to MWM
Carlos Román Zúñiga

We present the APOGEE-2 star forming regions catalog (Román-Zúñiga et al 2023) which is based on spectral labels (Teff, Logg, [Fe/H] from the APOGEE Net II neural network (Sprague et al 2022). We present preliminary follow-up work on the relation between young star and gas kinematics in 3 regions (Rosette, Cygnus-X, Vela Ridge). We also present preliminary results on applying the APOGEE spectral parameter fitting and interpolating code TONALLI (L. Adame et al. 2023), which provides spectral parameters based on the MARCS grid, with accurate confidence level calculations (Román-Zúñiga et al. in prep), and compare with those of APOGEE Net. We are currently studying the effects of circumstellar disk emission on parameter determination (C. Zepeda, master thesis project, UNAM) and investigate line parameters for accretion related features in BOSS counterparts using the Line Forest catalog. The main goal is to get closer to answer the question "How far we are from providing spectral parameters for pre-main sequence stars with comparable reliability to main-sequence and evolved populations, given the fact that young stars have accretion in play?"

Investigation Azimuth: Uncovering variations in elements beyond Fe
Zoe Hackshaw

Chemical cartography of the Galactic disk provides insights to its structure and assembly history over cosmic time. In this work, we use chemical cartography to explore chemical gradients and azimuthal substructure in the Milky Way disk with giant stars from APOGEE DR17. We confirm the existence of a radial metallicity gradient in the disk of ~ -0.0702 ± 0.0004 dex/kpc and a vertical metallicity gradient of ~ -0.164 ± 0.001. We find azimuthal variations (±0.1 dex) on top of the radial metallicity gradient that have been previously established with other surveys. The APOGEE giants show variations in their [Fe/H] gradient that spatially align with the position of the spiral arms. Beyond iron, we show, for the first time, that other elements (e.g., Mg, O) display azimuthal variations across the Galactic disk. The strength of the azimuthal variations appear to be age-dependent. This analysis, while completed with SDSS-IV, provides a blueprint for a future SDSS-V project.

Exploring Hard X-ray Selected AGN Populations with ExSeSS and SDSS-V
Jack Nathon Delaney

I will present results from the Extragalactic Serendipitous Swift Survey (ExSeSS) along with initial results from an SDSS-V open-fibre program that is providing spectroscopic follow-up of a bright, hard X-ray selected sub-sample. The ExSeSS sample has enabled us to measure the differential number counts of X-ray sources as a function of 2-10~keV flux, providing insight into the population of Active Galactic Nuclei (AGN) in an unexplored regime. We find discrepancies between the ExSeSS measurements and AGN population synthesis models, indicating a change in the properties of the AGN population over this flux range that is not fully described by current models. Based on the brightest sources from the ExSeSS sample, combined with additional 4.5-12keV selected sources from 4XMM, we created a new sample of ~10,000 hard X-ray selected sources for follow-up by SDSS-V as part of the open-fibre program. Our initial analysis has yielded spectroscopy for 975 of these sources to date and is still growing. Our ongoing work focuses on the classification of the sources and their redshifts, with the aim of creating a comprehensive understanding of the individual spectra of each source, as well as constructing composite spectra for AGN in this sample. We aim to compare this sample to the eROSITA sources and examine differences due to a harder selection. We anticipate that our findings will contribute significantly to our understanding of obscured AGN populations and have implications for future research in this field.

SDSS Spectroscopy of Chandra Source Catalog Counterpart
Paul J Green

With release imminent, the Chandra Source Catalog version 2.1 (CSC2.1) provides nearly four hundred thousand well-characterized X-ray sources observed by Chandra from launch (1999) through 2021, covering about 800 square degrees. The Sloan Digital Sky Survey V (SDSS-V) is obtaining new optical and infrared spectroscopy of Chandra source counterparts in fields across the entire sky. SDSS-V is expected to provide new spectra, pipeline classifications and velocities for tens of thousands of CSC source counterparts, mostly AGN. These will add to about twelve thousand such counterparts that have high quality spectra already in the SDSS public archive. SDSS-V will newly provide infrared spectra for a fraction of CSC2.1 sources, mostly in the Galactic plane, that have bright infrared but no optical counterparts.

Chemical Homogeneity Of Open Clusters In The Milky Way
Amaya Sinha

Stars in an open cluster are assumed to have formed from a broadly homogeneous distribution of gas, implying that they should be chemically homogeneous. We test this assumption by quantifying chemical scatter in Milky Way open clusters in a broad set of abundances, in order to probe a variety of nucleosynthetic pathways to learn about ISM pollution and gas-mixing in molecular clouds. We use APOGEE and Gaia kinematics to determine cluster membership. We constrain chemical scatter in a sample of giant stars in 16 open clusters, and show that many of the clusters are chemically inhomogeneous. We also explore the primary drivers of variation between the scatters of different elements and study the relationships between chemical inhomogeneity and other cluster properties.

August 3, 2023

The integrated metallicity profile of the Milky Way
Jianhui Lian

The heavy element abundance profiles of galaxies place stringent constraints on galaxy growth and assembly history. Low-redshift galaxies generally have a negative metallicity gradient in their gas and stars. Such gradients are thought to be a natural manifestation of galaxy inside-out formation. As the Milky Way is currently the only spiral galaxy in which we can measure temporally-resolved chemical abundances, it enables unique insights into the origin of metallicity gradients and their correlation with the growth history of galaxies. However, until now, these abundance profiles have not been translated into the integrated-light measurements that are needed to compare the Milky Way with the general galaxy population. In this talk I will introduce our recent work in which we report this measurement of the light-weighted, integrated stellar metallicity profile of our Galaxy using APOGEE data. We find that the integrated stellar metallicity profile of the Milky Way has a 'Λ'-like broken shape, with a mildly positive gradient inside a Galactocentric radius of 7 kpc and a steep negative gradient outside. This broken integrated metallicity profile of the Milky Way is not unique but is not common among Milky Way-mass star-forming galaxies observed in the MaNGA survey and simulated in the TNG50 cosmological simulation. Our results suggest the Milky Way might not have a typical metallicity distribution for a galaxy of its mass, and thus offers valuable insight into the rich variety of galaxy enrichment processes.

The evolution of cataclysmic variables - an SDSS success story
Keith Inight

The study of cataclysmic variables (CVs) has historically suffered from severe selection effects – most CVs were revealed by their outbursts. SDSS spectroscopy has been transformational in identifying large numbers of CVs from their spectral lines. SDSS spectroscopy, in combination with photometric light curves enables reliable classification of CV subtypes. Following a major effort to catalog CV spectra from SDSS we show how this data can be used to infer space densities of subtypes leading to greater understanding of the evolution of CVs. Furthermore the specific targeting of white dwarfs in SDSS V has enabled a quantitative analysis of old “period bouncers” yielding a new insight into the final stage of a CVs life.

Starspots, magnetism, and Milky Way Mapper: the LEOPARD spot catalog
Lyra Cao

Dark magnetic starspots are ubiquitous on the surfaces of cool stars; however, it has been difficult to directly measure magnetic signatures for large stellar samples. We recently showed that spectroscopic starspot filling fractions can be measured in bulk using a two-temperature technique on APOGEE spectra. The resultant precise starspot measurements follow other activity scalings with Rossby number once cleaned of binaries, which implies a dynamo origin. We demonstrate a genuine spot coverage and magnetic field strength saturation in the Pleiades open cluster. In the Praesepe open cluster, we see a strong starspot enhancement feature in stars that are also experiencing stalled spin down. This magnetic enhancement appears to be evidence of a radial shear dynamo, a dynamo mode driven by strong velocity shears in the stellar interior—an effect which may last billions of years and strongly affect the magnetic and rotational evolution of cool stars. Applying a second temperature component to spectroscopic fits in the infrared also yields better fits for heavily spotted stars, resulting in an activity-dependent temperature and radius systematic relative to the non-spotted ASPCAP solution; we describe the role of starspots in producing more accurate and precise stellar masses and radii estimates for large populations of cool stars. We present the first LEOPARD catalog of dwarf starspot fractions for ~135,000 stars, and explore Milky Way Mapper’s potential in extending this discovery sample to a companion magnetic toolkit for stellar and exoplanetary astrophysics.

Mixing Near the Red Giant Branch Bump: Is it Thermohaline?
Jamie Tayar

The abundances of mixing sensitive elements are known to change near the red giant branch bump in metal-poor stars, something often known as “extra mixing”. The leading explanation for these changes has been the triggering of the double-diffusive thermohaline instability, but that theory makes specific predictions about the timing and trends of the mixing. With currently available spectroscopic datasets, I will show that while analyses using [C/N] seem consistent with extra mixing being related to the thermohaline instability, analyses using lithium as a diagnostic may be inconsistent with that theory. Finally, I will discuss how Milky Way Mapper may be able to better constrain the pattern and therefore the reason for extra mixing in the future.

Photo-z for AGN via Deep Learning
William Roster

A complete census of supermassive black holes (SMBH) increases our understanding of the role of Active Galactic Nuclei (AGN) in the formation and evolution of galaxies. As AGN detection is less affected by obscuration effects in the X-ray window, eROSITA offers an increased likelihood of detecting these kinds of objects. That being said, a substantial fraction of spectroscopic redshifts (spec-z) for AGN identified by eROSITA will be available only in 2-3 years from now at best. In the meantime, we must rely on photometric redshifts (photo-z). For wide-area surveys, the quality of current estimates of photo-z for AGN (both via SED fitting and ML techniques) using broad-band photometry is poor because the limited number of photometric bands is insufficient to disentangle the relative AGN/host-galaxy contribution, thus producing an undesired high fraction of outliers. More recent efforts to compute photo-z for AGN using a set of aperture photometry (as provided by Legacy Survey DR9 and DR10) via ML, have shown promising improvement. Catalogs, however, depend on parameters established by the source detection and flux estimate algorithms, where they are usually fine-tuned for galaxies and not AGN. For this reason, we provide a novel image-based Machine Learning (ML) algorithm, namely a convolutional neural network (CNN), to alleviate previous empirical approaches and decrease the fraction of objects with predicted redshifts classified as outliers. Special attention is given to creating a clean training sample and ML optimisation techniques for redshift determination specific to AGN. In my talk, I will show how our preliminary work already outperforms previous results.

There is No Place Like Home — Finding Birth Radii of Stars in the Milky Way
Lucy Lu

Stars move away from their birthplaces over time via a process known as radial migration, which blurs chemo-kinematic relations used for reconstructing the Milky Way formation history. One of the ultimate goals of Galactic Archaeology, therefore, is to find stars' birth aggregates in the disk via chemical tagging. Here we show that stellar birth radii can be derived directly from the data with minimum prior assumptions on the Galactic enrichment history. We discover the relationship and use it to recover the time evolution of the stellar birth metallicity gradient, $d\mathrm{[Fe/H]}(R, \tau)/dR$, through its inverse relation to the metallicity range as a function of age today, allowing us to place any star with age and metallicity measurements back to its birthplace, \rbir. Applying our method to a high-precision large data set of Milky Way disk subgiant stars, we find a steepening of the birth metallicity gradient from 11 to 8 Gyr ago, which coincides with the time of the last major merger, Gaia-Sausage-Enceladus (GSE). This transition appears to play a major role in shaping both the age-metallicity relation and the bimodality in the [α/Fe]-[Fe/H] plane. By dissecting the disk into mono-\rbir\ populations, clumps in the low-\alphafe\ sequence appear, which are not seen in the total sample and coincide in time with known star-formation bursts. We estimated that the Sun was born at 4.5 ± 0.4~kpc from the Galactic center. Our \rbir\ estimates provide the missing piece needed to recover the Milky Way formation history.

Properties of cold red giants from their spectra
Zoltan Dencs

The main goal of our investigation is to determine the atmospheric parameters as well as the chemical abundance of cold red giants. First, we selected a few dozen red giants with Teff<4200K from the APOGEE sample. We observed the spectra of the selected giants with a R=18000 spectrograph mounted on the 1-m diameter telescope of the Hungarian Piszkéstető Observatory. This is the first time the 1-m telescope has been successfully used for abundance analysis. We used a new spectral grid with updated line lists including 23 molecules to fit the observed spectra with FERRE. Moreover, we also observed some of the targets with the SONG telescope (Canary Islands) for comparison. We determined the Teff, logg, [Fe/H], and [alpha/Fe] parameters, as well as the Ba, Ca, Cr, Mn, Ni, Si, Ti, and V abundances of 18 stars in a relatively small error range with the Hungarian telescope.

The Dynamical Length of the Milky Way's Bar
Maddie Lucey

Knowing the length of the Milky Way's bar is crucial for correctly accounting for the non-axisymmetric effects in dynamical analysis. However, the mass distribution of the inner Galaxy is poorly constrained, including the length of the Galactic bar. In this talk, I will present a novel method for constraining the length of the Galactic bar using 6D phase-space information to directly integrate orbits. I then apply this method to APOGEE and Gaia data to measure the Galactic bar's length.

BOSS Net: self-consistent model of determining stellar parameters for optical spectra in SDSS-V
Logan Sizemore and Diego Llanes

Throughout SDSS-III and -IV, multiple pipelines have been developed to extract stellar properties from APOGEE spectra. Among them, APOGEE Net stands out due to: a) its speed, and b) the ability to predict stellar parameters (such as Teff, logg, and Fe/H) for all stars with Teff ranging between 3,000 and 50,000 K, including pre-main sequence stars, OB stars, main sequence dwarfs, and red giants, - all as a part of a single model, in a self-consistent manner. With the transition to SDSS-V, a number of spectra of stars will be observed not just with APOGEE in near-IR, but also with BOSS in optical regime. We aim to develop a complementary model, BOSS Net, that will replicate the performance of APOGEE Net in these optical data through label transfer. Although current overlap between sources observed with APOGEE \& BOSS is limited, this can be achieved using LAMOST as an intermediary, as this instrument is similar to BOSS in terms of its wavelength coverage and resolution. We further improve the model through extending it to brown dwarfs, as well as white dwarfs, resulting in a comprehensive coverage between 1700<Teff<100,000 K and 0<logg<10, to ensure BOSS Net can reliably measure parameters of all stellar objects observed by both BOSS and LAMOST. We also update APOGEE Net to achieve a comparable performance in near IR. The resulting models provide a robust tool for measuring stellar evolutionary states, and in turn, enable characterization of the star forming history of the Galaxy.

Studying the magnetized protoplanetary disk winds with optical spectroscopy of forbidden emission lines
Ahmad Nemer

Protoplanetary disk (PPD) winds play an important role in disk dispersal. Constraining disk wind models, along with accretion and jets, is necessary to understand its evolution, and eventually, planet formation. We trace these winds with optical forbidden emission lines of [OI], [SII], [NII], and [NeII] to estimate the wind kinematics and mass loss rates. The emission lines are comprised of multiple components that probably trace a different region in the system. At least one of these components was found to trace an ideal-MHD wind which was not considered in previous models. In addition, disk emission lines were found to be correlated to the accretion luminosity which means that the two processes are related. The correlation between emission lines and the FUV source (accretion) could provide a method for measuring the disk magnetic field.

Exploring the Origin of the Distance Bimodality of Stars in the Periphery of the Small Magellanic Cloud with APOGEE and Gaia
Andres Almeida

Given its proximity and dramatic dynamical history, the Magellanic Cloud system represents a unique laboratory for the study of not only interacting dwarf galaxies but the ongoing process of the formation of the Milky Way and its halo. Here we focus on one aspect of the complex, 3-body interaction — the dynamical perturbation of the Small Magellanic Cloud (SMC) by the Large Magellanic Cloud (LMC), and, very specifically, on potential tidal effects seen most recognizably on the side of the SMC closest to the LMC (the eastern side of the SMC), where previous studies have reported a greater line-of-sight depth compared to its western side. Using a combination of Gaia astrometry and SDSS-IV APOGEE-2 DR17 spectroscopic data — including precise radial velocities and multi-element chemical abundances — we explore the well-known distance bimodality on the eastern side of the SMC. Through a variety of means, including estimated stellar distances, proper motions, and radial velocities, we characterize the two populations in the bimodality and compare their properties with those of populations elsewhere in the SMC. For example, by analysis of the APOGEE chemical abundances, we find that, while all regions explored by APOGEE seem to show a single chemical enrichment history, the metallicity distribution function (MDF), of the “far” heliocentric distance stars on the eastern periphery of the SMC resembles that for the more metal-poor fields of the western periphery, whereas the MDF for the “near” stars on the eastern periphery resembles that for stars in the center of the SMC, most especially in having a metal-rich tail extending more metal rich than [Fe/H] = −0.85. The closer eastern periphery stars also show radial velocities (corrected for SMC rotation and bulk motion) that

Studying Star Clusters in the Magellanic Clouds using the LVM
Bruno Dias

The Magellanic Clouds are a pair of galaxies currently in their first infall into the Milky Way, and the effects of their close interaction are evident in their structure, star formation, and gas budget. The star cluster population in the outskirts of the Large Magellanic Cloud (LMC) and Small Magellanic Cloud (SMC) can provide insight into the disturbed structures, as their full 6D phase-space vector, age, and metallicity reveal the chemical and dynamical evolution history of these galaxies. The VISCACHA photometric data, Gaia proper motions, and VISCACHA spectroscopic follow-up have been used to derive distances, ages, and metallicities, but only a limited number of star clusters have been observed spectroscopically so far. The LVM/SDSS-V survey will provide integrated spectra of star clusters in the LMC and SMC, complementing other large spectroscopic surveys covering the Magellanic Clouds. The LVM will allow for a broad view of the kinematics of star clusters, particularly those with known line-of-sight distances, and age and metallicity will be derived from the integrated spectra and compared to those derived from colour-magnitude diagrams. The project focused on the star clusters of the Magellanic Clouds observed with the LVM aims to provide a deeper understanding of the evolution of these galaxies. Simulations have been conducted to predict the observations expected later this year. By analysing the star cluster population of the Magellanic Clouds, we can gain insight into the formation and evolution of galaxies, and the LVM/SDSS-V survey is a valuable tool in this effort.

Orbital Torus Imaging: Using elemental abundances to map orbital structure and mass in the Galactic disc
Danny Horta

Under the assumption of a simple and time invariant potential, many Galactic dynamics techniques use tools (e.g., Jeans or Schwartzchild models) to infer the Milky Way’s potential from stellar kinematic observations. Albeit useful, these methods rely heavily on parameterised potential models of the Galaxy and must take into account non-trivial selection function effects. However, large-scale spectroscopic surveys now supply information beyond kinematics in the form of precise stellar label measurements (e.g., elemental abundances). In this talk, I will present a new framework that uses kinematic and element abundance measurements for dynamical inference: Orbital Torus Imaging. This method is advantageous as it is much less affected by selection function effects and does not require parameterisation of a potential model. Using this framework, I will present preliminary results utilising the latest APOGEE and Gaia data on mapping the orbital structure and mass of the Galactic disc using chemical abundance information. Our findings reveal the power of Orbital Torus Imaging, and highlight a promising new avenue for dynamical inference that synergises stellar labels and kinematic observations delivered by large scale stellar surveys of the Galaxy.

Everything you need to know about The First Dredge-Up
Jack Roberts

The surface [C/N] ratios of evolved giants are strongly affected by the first dredge-up (FDU) of nuclear processed material from stellar cores and have therefore been used as a mass diagnostic. Past studies have assumed scaled solar mixtures of carbon and nitrogen. We use subgiants identified in APOGEE DR17 to map out the birth trends of these elements. We find [C/N] has strong trends with [Fe/H] and an offset between the alpha-rich and alpha-poor populations. With APOKASC3 data, we find functions that describe the post-FDU [C/N] of red giants relative to their mass and metallicity. These functions can be used to obtain masses for stars up to 1.5-1.7 solar masses, but [C/N] as a diagnostic loses predicting power at higher masses. We show that the observed pattern arises from the combination of birth trends and the dredge-up. Additionally, by examining red clump stars, we extend our functions into higher mass ranges, reaching 2 solar masses before the fit loses predictive power. By comparing the red clump and red giant stars, we are also able provide tests for the extra mixing effects that occur on the upper giant branch. This data will place powerful constraints on theoretical stellar models and stellar population studies.

Extreme Variability in Quasar Broad Line Profile Shapes in SDSS V
Sara Frederick

The All-Quasar Multi-Epoch Spectroscopy (AQMES) Survey in the fifth iteration of the Sloan Digital Sky Survey (SDSS V) will yield multi-epoch spectroscopy for approximately 20,000 quasars on long timescales of years to decades. This program is complementary to ongoing reverberation mapping campaigns, as it provides the opportunity to monitor the variability of broad emission-line shapes that result from dynamical changes in a quasar broad-line region. I will introduce a pilot study to search for extreme cases of variability in the shapes of H-beta line profiles, and demonstrate the potential to detect and characterize unique physical changes in accretion disks and winds occurring on the dynamical timescale of the broad line emitting region. I will present examples of the candidates for dramatic variability in profile shapes we have discovered so far, as well as efforts to describe the changes in these broad line profiles in the context of dynamical broad line region changes using physical accretion disk models.

Tonalli: characterizing young and main sequence stars with an asexual genetic algorithm.
Lucía Adame Villanuev

We present the code tonalli (“heat of the sun” in Náhuatl), a python implementation of an asexual GA (Cantó et al. 2009) to solve the optimization problem of finding the best-fit synthetic spectrum for a given APOGEE-2 observed spectrum, thus effectively obtaining the stellar parameters that best characterize the spectrum. The observed spectrum is randomly and efficiently contrasted with an user-selected synthetic spectral library. The search parameter space, which depends on the limits of the synthetic spectral grid, can be constrained further by comparing the GAIA and 2MASS photometry of the star to the photometry from the PARSEC evolutionary models (Bressan et al 2012, Nguyen et al 2022); the photometry best-fit parameters become the input of tonalli. From the minimization of the figure of merit, we derive the metallicity and the alpha-elements abundance, the surface gravity logarithm, the effective temperature, the projected rotational speed, and the radial velocity, with the option to optimize the limb darkening parameter. Our method allowed us to improve the characterization of the young stellar APOGEE-2 spectra, and the framework can be readily translated to combine infrared and optical spectra to characterize the SDSS-V APOGEE and BOSS spectra.

Closing the loop: observing Gaia white dwarfs with SDSS V
Nicola Pietro Gentile Fusillo

Over 95% of all stars in the Galaxy share the same fate: to become a white dwarf. These small, slowly cooling stellar remnants not only encode the stellar formation history of the Milky Way, but are also unique tools with application spanning a wide range of disciplines from stellar evolution to the study of exoplanets, from exotic physics in extreme environments to the origin of type Ia Supernovae. However, white dwarfs are intrinsically faint and sparsely distributed across the entire sky, making them challenging objects to observe. For over 20 years, the white dwarfs serendipitously observed by SDSS constituted the main resource for the large-scale discovery and characterization of these stellar remnants. Even though these observations led to some groundbreaking work, the SDSS white dwarf sample was inevitably “patchy” and plagued by strong biases. The advent of Gaia brought forth a revolution in the field and enabled the creation of an all-sky white dwarf sample virtually complete down to 20th magnitude. But now that Gaia has fulfilled its potential, in order to make full use of this unprecedented resource, we need dedicated, large-scale spectroscopic coverage. Today white dwarfs are no longer just serendipitous targets and SDSS V is the first wide-area spectroscopic survey specifically targeting these stars in both hemispheres. I will give an overview of the critical impact SDSS V spectroscopy will have in the field of white dwarfs, highlighting some key areas of research like: spectral evolution, the origin of magnetic fields, and the study of planetary remnants.

An “Old” Spectroscopic Analysis Learns Some New Tricks
Rachael Beaton (CONFLICT)

At the conclusion of SDSS-IV, the APOGEE Stellar Parameters and Chemical Abundance Pipeline (ASPCAP) still had a few limitations that impacted the ability to use its results for some scientific applications. In this talk, I will summarize progress investigating and finding solutions for two of these limitations: (1) measurement of weak lines, like Ce and Nd (Hayes et al. 2022) and (2) the determination of upper-limits on the measurable abundances for low-metallicity stars (Shetrone et al., in prep.). I will describe our solution to these limitations and the implementation in post-ASPCAP analyses. I will show two of the studies only enabled by this work (1) Ce/Nd ratios that trace the evolution of the r- and s- process within the MW (Hayes et al. in prep) and (2) the metallicity distribution functions at low [Fe/H]. The former provides insight into the overall chemical evolution for neutron capture elements. The latter allows comparisons of the metallicity distributions for 11 dwarf galaxies (Bootes, Draco, Sextans, Carina, Sculptor, Ursa Minor, Fornax, Large Magellanic Cloud, Small Magellanic Cloud, Sagittarius, GES/GSE) with the individual Milky Way components over several orders of magnitude in mass on the same underlying abundance system -- for the first time. I will describe our next steps toward realizing heretofore infeasible results from DR17 and the potential impact to SDSS-V. This presentation argues that there are still many improvements to the traditional ASPCAP analysis that can open up exciting scientific investigations.

Iron abundance in the Orion star-forming complex
Ricardo López-Valdivia

In this talk, I will present an ongoing project on determining the chemical abundance of young stars with DR17. As a first approach, we selected a sample of nearly 200 fiducial members of the Orion Complex.

Milky Way Stars as Probes of Heavy-Element Enrichment
Shivani Shah

The 5 million stars that the SDSS-V Milky Way Mapper program is designed to study, will be probed for signatures of mostly light elements, up to the iron-peak, to understand the enrichment history of the Milky Way (MW). However, our understanding of the MW’s chemical enrichment will remain incomplete without the study of heavier elements, formed via neutron-capture processes. In this talk, I will show how the combined power of optical and UV spectroscopy can be used to obtain chemical abundances from the lightest (Li; $Z = 3$) to the heaviest (U; $Z = 92$) elements, enabling constraints on a variety of enrichment sources, including the rapid-neutron capture process. In addition to constraining the yields of the enrichment events, I will show how the abundances of some of the heaviest elements (e.g., U and Th) can be improved and then used to constrain the timestamp of these enrichment events using radioactive-decay dating and independent of stellar evolution models. Finally, I will discuss how such investigations of a broader range of elements can be achieved within the MWM program and by building upon it to piece together a comprehensive picture of the Galactic chemical enrichment.

Poster Presentations

In Colour
Anne-Marie Weijmans

A small observatory in St Andrews has stood unused for many years, its telescope long since removed. Once home to a twin photometric telescope, the building is now being brought back into dramatic use through a new art installation in the summer of 2023. Tim Fitzpatrick has been exploring the use of emission line spectra and colour in his work as SDSS artist in residence, and this installation is his latest work.

Comparing broad MgII and Hbeta emission line profiles in SDSS quasars.
Sofia Golla

The project involves looking and comparing double-peaked broad MgII and Hbeta emission line profiles in quasars spectra from the SDSS database.

Simulating Disky Broad-Line Region Reverberation
Mary Ogborn

Variability studies of the broad emission lines of AGN show stochastic radial velocity variations, 'jitter', on timescales of weeks to months. This jitter may be intrinsic as the broad-line emitting region (BLR) reverberates from the variable AGN continuum. This jitter is the primary source of confusion in the search for supermassive black holes binaries (SBHBs) as it makes orbital motion difficult to discern. Therefore, it is important to determine the cause of the jitter in order to incorporate it in future searches for SBHBs. This project will produce computational tools that can take in various continuum light curves, utilize a specific BLR geometry and relativistic effects, and produce synthetic emission line profiles. These profiles will then be used to measure jitter and characterize its properties. The computational tools developed will also be applicable to case studies of quasars observed under the Black Hole Mapper's reverberation mapping program.

Characterizing the kinematics and chemical properties of outer disk substructures:
Chervin Laporte

Gaia eDR3 has uncovered a clearer picture of the outer disc through the identification of kinematically coherent substructures. A number of them were already known (e.g. ACS, EBS) however a few new ones and some extensions to prior known overdensities (e.g. TriAnd) have been uncovered. These structures can potentially be used to probe the MW's past interaction history and study chemical composition (enrichment history) and radial migration in the outer disc. In this project, we aim to further characterize them using chemical information provided from APOGEE and BOSS in SDSS-V on top of kinematic information provided from Gaia DR3. We already have preliminary results with APOGEE DR17 and will give updates using IPL-1.

The Open Cluster Chemical Abundances and Mapping Survey Follow-up: Tracing the Neutron-Capture Enrichment of the Milky Way
Natalie Myers

Open clusters are powerful tools for tracing the dynamic and chemical evolution of the Milky Way. However, in order to adequately and precisely constrain these evolutionary characteristics, we need to build a comprehensive, large, and uniform sample of open clusters to sample a large swath of the Galaxy. This is the goal of the

SDSS/APOGEE-based Open Cluster Chemical Abundances and Mapping (OCCAM) survey: to identify and analyze a large sample of open clusters with a wide range of elemental abundances from SDSS/APOGEE. While APOGEE is able to provide a plethora of abundances for elements available in the infrared, it lacks reliable neutron capture abundances, which can be used to trace enrichment from AGB, Type 1a SN, as well as neutron star mergers. Here, I present the current status, observations and analysis, of the neutron capture follow-up as part of the OCCAM project.

The Open Cluster Chemical Abundance and Mapping (OCCAM) survey: Cross-calibration of APOGEE to MWM/ASTRA
Jonah Otto

To extend the Open Cluster Chemical Abundance and Mapping (OCCAM) survey, we will utilize recent blind searches for open clusters from Gaia DR3 data combined with MWM/Astra radial velocities and abundances. However, for the OCCAM dataset to be trustworthy, we need to provide a reliable and uniform calibration for the SDSS-V stars. Here, we present initial comparisons between DR17 abundances and the astra ASPCAP pipeline using OCCAM identified clusters and member stars. We also explore the other Astra pipelines to determine which, if any, allow a consistent analysis for cluster stars across a wide range of temperatures and evolutionary states. These calibrations are essential to building the final OCCAM SDSS-V catalog of open clusters, which will increase the number of clusters from previous OCCAM samples by an order of magnitude and will be used to investigate the Galactic abundance gradient.

Only the Special Survive: Star Cluster Disruption in Galaxy Simulations
Alessa Ibrahim

There is currently a mismatch between the chemical properties of a typical star and those within star clusters across the Milky Way galaxy. Studying star clusters allows us to trace essential information throughout the rich history of our Galaxy, as we can measure their age and their chemical composition independently. While some clusters interact with their environment, causing them to dissolve, other clusters remain bound for billions of years. In order to investigate these disruption events, we will study the evolution of star clusters throughout cosmic time via simulations. We use a zoom-in cosmological simulation: Feedback In Realistic Environment (FIRE), which enables us to investigate why clusters move from their original place of formation and how far they go. Additionally, FIRE allows us to trace star clusters through their different stages of their evolution, and study how they survive as they interact with other components of the galaxy. In this work, we investigate the Galactic chemical gradient mismatch between clusters and field stars in the Milky Way, as we compare the FIRE simulations to the observed SDSS/OCCAM star clusters.

The IRX-Beta Relationship in Star Forming Regions
Laura Duffy

The effect of dust attenuation on a galaxy's light depends on a number of physical properties, such as geometry and dust composition, both of which can vary across the faces of galaxies. To investigate this variation, we continue analysis on star-forming regions in 29 galaxies studied by Molina et al (2020) in a previous work. We analyze these regions using Swift/UVOT and WISE images, as well as SDSS/MaNGA emission line maps to constrain the relationship between the infrared excess (IRX) and the UV spectral index, beta, for each star forming region. This relationship can be used to constrain which dust attenuation law is appropriate for the region. We find that the value of D(4000) for a region is correlated with both IRX and beta, and that the gas-phase metallicity is strongly correlated with the IRX. This correlation between metallicity and IRX suggests that regardless of aperture, metal rich regions have steeper attenuation curves. We also find that integrated galactic light follows nearly the same IRX-beta relationship as that found for kiloparsec-sized star forming regions. This similarity may suggest that the attenuation law followed by the galaxy is essentially the same as that followed by the regions, although the relatively large size of our star forming regions complicates this interpretation because optical opacity and attenuation curves have been observed to vary within individual galaxies. The SDSS-V Local Volume Mapper (LVM) may be used to confirm this relationship on much smaller spatial scales.

Utilizing the Accuracy of TESS Asteroseismology for the Advancement of Stellar Archeology
Artemis Theano Theodoridis

In the study of galactic archeology, the lack of reliable stellar ages often impairs the capability to accurately explain the evolution of our galaxy. To date, NASA's Kepler mission has been considered the gold standard for the most precise asteroseismic ages, despite data only being available for a small portion of the sky. With TESS's all-sky photometry now available, we can expand the calibration sample if we can prove that TESS has a similar accuracy and precision to Kepler. To do so, we have compared TESS to APOGEE DR17, which was calibrated to Kepler, and discovered that the asteroseismic and spectroscopic surface gravities agree to better than 5% for 90% of stars. However, we find that the errors were underestimated by a factor of ~2. With this information, we use asteroseismic scaling relations to infer masses and surface gravities for ~15,000 red giants. We conclude that current TESS seismic results can already be used for galactic archaeology, and future results with Milky Way Mapper will likely be highly transformational to our understanding.

A Great Payne to Include NLTE Effects: Fitting APOGEE spectra for stellar parameters
Pierre Thibodeaux

The Galactic Genesis program of the Milky Way Mapper aims to better characterize the structure and history of the Milky Way by obtaining near-infrared APOGEE spectra of over 4 million stars in the Milky Way, focusing on red giant stars. ASPCAP is used to determine stellar parameters and chemical abundances by fitting observed spectra with precomputed synthetic spectra. However, the spectroscopically inferred effective temperature and surface gravity deviate from photometric temperatures and asteroseismic surface gravities, which are currently corrected with empirical relations. One possible reason for this discrepancy is that ASPCAP's spectra are calculated under the assumption of Local Thermodynamic Equilibrium (LTE), which especially breaks down in the atmospheres of cooler and more metal poor red giant stars. Models which include non-LTE (NLTE) effects may allow us to obtain accurate parameters without calibration. To investigate the impact of NLTE, we used an updated version of Turbospectrum to synthesize a grid of spectra in LTE and NLTE over a range of effective temperatures, surface gravities, and metallicities. To enable rapid fitting of the APOGEE spectra, we train neural network emulators of the spectral grids and simultaneously determine the stellar parameters and chemical abundances of stars (The Payne). We then investigate whether or not NLTE effects reduce the need for calibrating stellar parameters with APOGEE DR17.

Investigation of Continuum Lag Dependence on Broad-Line Contamination and Quasar Properties
Hugh Sharp

This work studies the relationship between accretion-disk size and quasar properties, using a sample of 95 quasars with measured measured lags between g and i bands from the SDSS-RM project. This quasar sample is particularly interesting, evenly depicting disk lags that are longer and shorter than predicted by the SS73 model, requiring satisfying explanation for both cases. While our quasars only have singular lag measurements, we explore the wavelength dependent effects of diffuse Broad Line Region (BLR) contamination through our samples broad redshift range, paired with rms flux spectra of each object. We do not find significant evidence of variable diffuse Fe II and Balmer nebular emission via rms spectra, and Anderson-Darling tests of quasars in different populations of redshift. Similar to other studies, we do find that quasars with larger-than-expected continuum lags have lower 3000 Angstrom luminosity, but additionally have lower X-Ray luminosity and black hole mass. Our low luminosity quasars would be more effected by diffuse Balmer contamination in the ``driving'' g-band lightcurve, leading us to believe these anti-correlations aren't the result of increased diffuse continuum strength depicted by the Baldwin effect. These anti-correlation likely favor accretion disk models depicting disk fluctuations on thermal timescales proportional to square root luminosity. Future analysis on multi-band continuum-rm surveys with large diverse quasar samples will be required in order to determine how predominant the effects of diffuse BLR contamination is, specifically past the influence of the Balmer Jump alone.

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