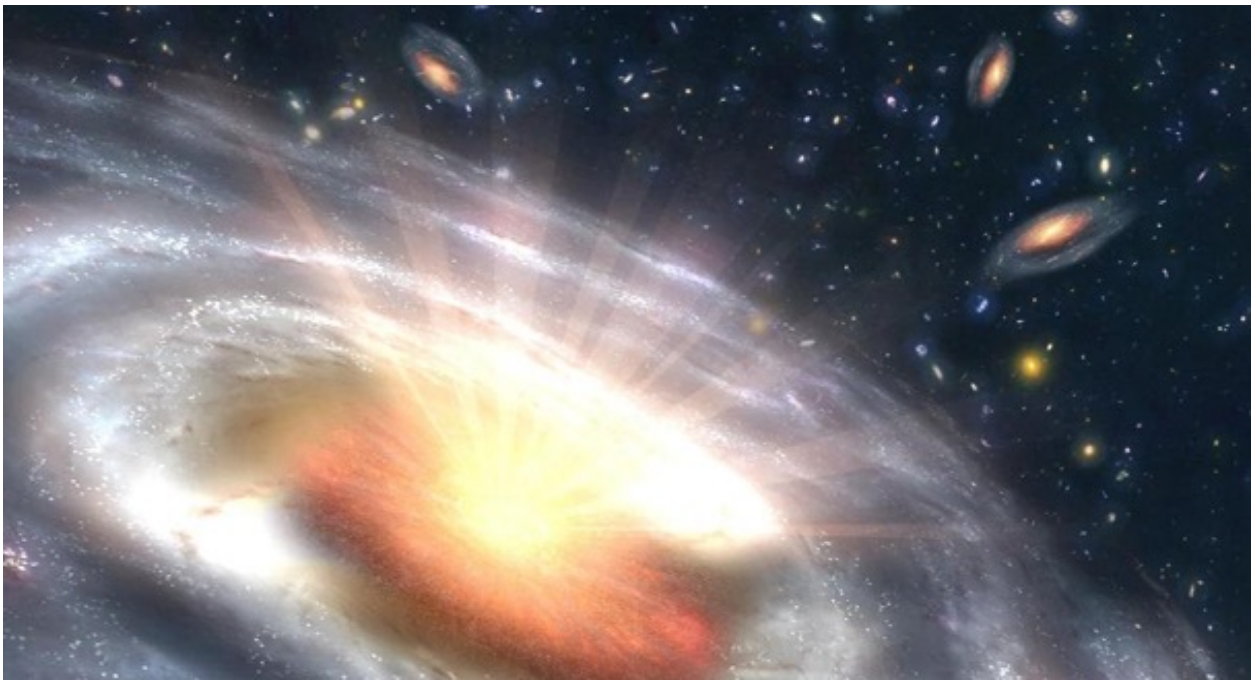
Great Lakes 2016 Quasar Symposium



May 2-4th, 2016

London, Ontario, Canada

Western Science

#glqs2016

Contents

Important Information

- **Location:** All invited and contributed talks will be held in Room 106 of the Physics & Astronomy Building (PAB). See the discussion on page 5 and the map on page 6 for an overview of the Western Campus. The poster sessions and coffee breaks will be held in the first floor atrium of the PAB.

- **Opening Reception:** There is an informal Opening Reception on Monday, May 2nd, from 4:30 to 6:30 pm in the first floor atrium of the PAB.

- **Registration:** You can register for the conference between 11:30 am and 1 pm on the first day of the conference.

- **Internet Access:** We have excellent eduroam access in our building, and so that is available if your home institution is part of the eduroam network. Alternatively, login credentials for the uwosecure-v2 network can be found in the registration package.

- **Talks:** All talks are to be held in PAB Room 106. All contributed talks are 12 minutes plus 3 minutes of discussion. The talk schedule can be found starting on page 7 and talk abstracts, starting on page 11. We will have common Mac and Windows machines with Powerpoint, Keynote (for Mac), and a PDF viewer for displaying slides. Please bring your talk on a memory stick to load during the break prior to your session. We are planning to posts videos of talks. Let us know at registration if you do NOT want to be recorded.

- **Poster Sessions:** There are four poster sessions in total. All posters will be displayed in the first floor atrium of the PAB. The maximum allowable size for a poster is 44" by 44" (110 by 110 cm). Posters must be removed by noon on the final day of the conference.

- **Meals:** There are many meal options available on-campus, although some can be pricey. While there are many restaurants in downtown London, they are viable only for dinner due to travel time. The Local Guide section of this booklet, starting on page 48, contains more information on lunch and dinner restaurant choices, as well as local transit information.

- **The Grad Club:** Of course, many of you are thinking by now "OK, but where is the bar?" Luckily, Western has an excellent watering hole, the Grad Club, in the basement of Middlesex College, a prominent building very near the PAB. Lunch is also an option in the Grad Club.

- **Coffee Breaks:** There will be four coffee breaks in total held in the first floor atrium of the PAB. Complimentary coffee and snacks will be available in Room 101 of PAB.

- **Banquet:** The conference banquet will be held at 6pm on Tuesday, May 3rd, at Windermere Manor, a short 15 minute walk from the Physics & Astronomy Building. The dinner is buffet-style and vegetarian options must be pre-ordered.

- **Group Photo:** The group photo will be taken just before lunch of day two (12:00 pm) with the location TBD.

- **Local Organizing Committee:** Your hosts for the Great Lakes Quasar Symposium are students and faculty from Western's Physics & Astronomy Department. They will be wearing name tags with a red bar on them. Please do not hesitate to approach any of them if you have any questions or concerns as they will be most happy to help you. The LOC members who will be present over the course of the three days are:
  Sarah Gallagher (Co-Chair), Aaron Sigut (Co-Chair), Viraja Khatu, Laura Lenkic, Aycha Tammour, Nathalie Thibert, and Neven Vulic.
  LOC member Sarah Gallagher can be reached at 519-639-0164 (cell) for assistance.

- **Scientific Advisory Committee:** The scientific organizing committee has been responsible for setting the scientific tone of the meeting and selecting speakers. The SAC will be the reporting contacts for any harassment incidents. The SAC will be wearing name tags with a yellow bar and consists of the following members:
  - Sarah Gallagher (Western University)
  - Rajib Ganguly (University of Michigan, Flint)
  - Daryl Haggard (McGill University)
  - Pat Hall (York University)

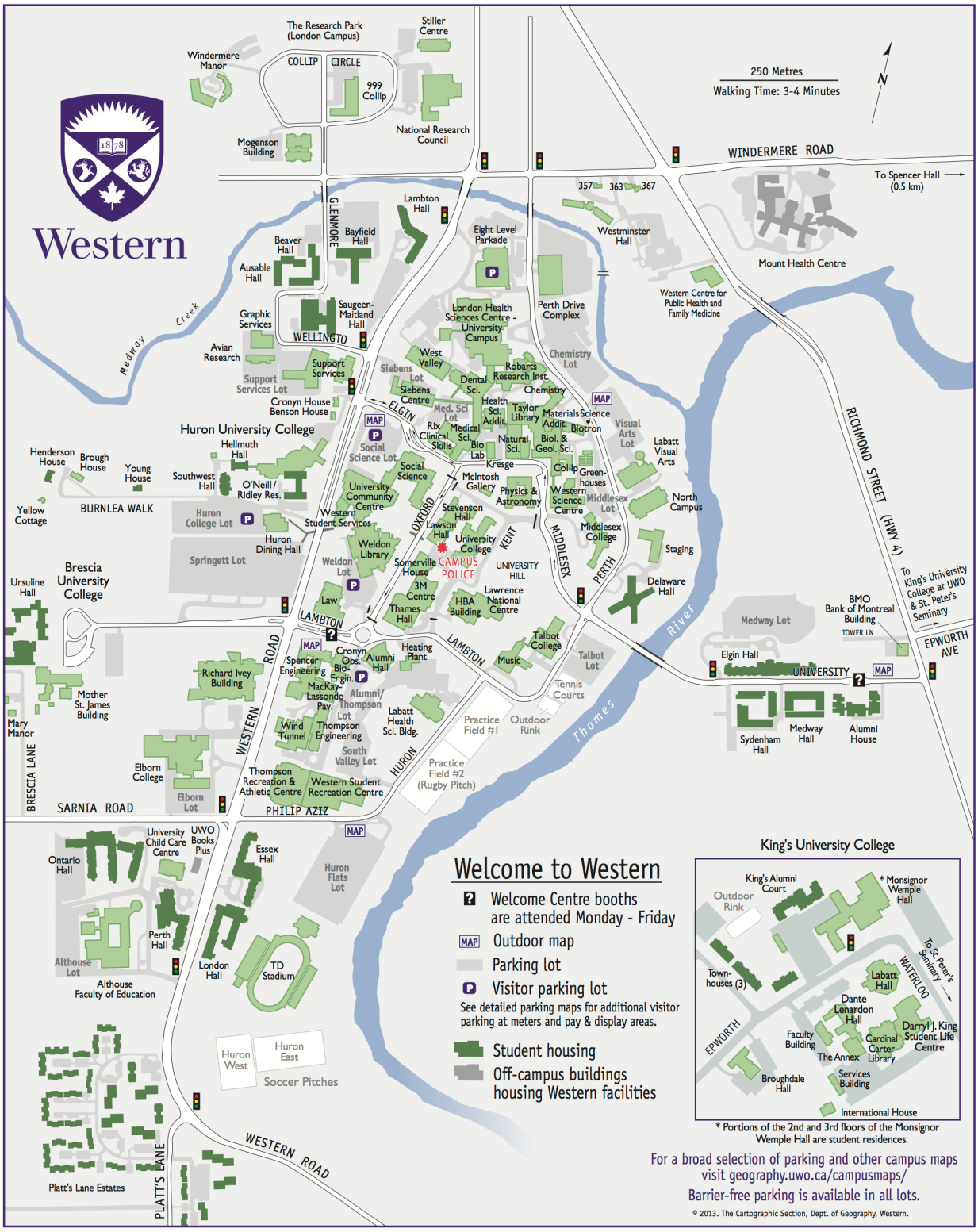
- **Campus Map & Getting Around:** The following page is an overview map of the Western Campus. The Physics & Astronomy Building (PAB) is just to the upper right of the Campus Police (which is marked in red by an asterisk). Windermere Manor, the site of the banquet, is in the upper left, near the purple Western logo. Windermere is a ≈15 minute walk from the PAB.

If you are a runner (or walker), there is an extensive trail system along the east bank of the Thames River, near campus. Contact the LOC for maps.

Downtown London is towards the south east of the map, off the bottom. Bus transit is the most affordable option, with the Richmond 6 bus following along Richmond Street (near the east edge of the map) and the Dundas 2 bus following along Western Road. Bus passes will be provided. PDF transit schedules can be found at www.ltconline.ca/pdfscheds/06ltc.pdf for the Richmond 6 and www.ltconline.ca/pdfscheds/02ltc.pdf for the Dundas 2. There is also a London, Ontario transit app for both iPhone and Android: search for "LTWatch for London Transit" (seller Barum Rho) on the app store for iPhone, and search for "London Transit (myLTC)" (seller Gabriel Castro) on the Google play store. Both are free, but ad supported.

If you prefer to take a cab, the most reliable local company is U-Need-A-Cab (519- 438-2121, www.uneedacablondon.ca). For pick up at the University, order the cab to Western's Natural Sciences Building, which is right across the street from the north exit of the PAB. You should expect to pay approximately $10-$20 for the fare, depending upon traffic conditions.

Finally, you can find a wide range of campus maps at www.geography.uwo.ca/campusmaps/.


Western
250 Metres
Walking Time: 3-4 Minutes
N
WINDERMERE ROAD
To Spencer Hall (0.5 km)
The Research Park (London Campus)
Stiller Centre
Windermere Manor
COLLIP CIRCLE
999 Collip
Mogenson Building
National Research Council
Mount Health Centre
Western Centre for Public Health and Family Medicine
Westminster Hall
357 363 367
Lambton Hall
Eight Level Parkade
Perth Drive Complex
Chemistry Lot
GLENMORE
Bayfield Hall
Beaver Hall
Ausable Hall
Graphic Services
Saugeen-Maitland Hall
WELLINGTO
Medway Creek
Avian Research
Support Services
Support Services Lot
Cronyn House
Benson House
London Health Sciences Centre - University Campus
West Valley
Siebens Lot
Siebens Centre
Dental Sci.
Robarts Research Inst.
Chemistry
Med. Sci Lot
Health Sci. Addit.
Taylor Library
Materials Science
Addit.
Biotron
Visual Arts Lot
Labatt Visual Arts
Rix Clinical Skills
Medical Sci.
Bio Lab
Natural Sci.
Biol. & Geol. Sci.
Kresge
Collip Green-houses
Western Science Centre
Middlesex Lot
North Campus
Middlesex College
Staging
Delaware Hall
ELGIN
Huron University College
Hellmuth Hall
Henderson House
Brough House
Young House
Southwest Hall
O'Neill / Ridley Res.
Yellow Cottage
BURNLEA WALK
Huron College Lot
Huron Dining Hall
Springett Lot
Social Science Lot
Social Science
McIntosh Gallery
Physics & Astronomy
University Community Centre
Western Student Services
Stevenson Hall
Lawson Hall
University College
OXFORD
KENT
MIDDLESEX
PERTH
Weldon Library
Weldon Lot
Somerville House
CAMPUS POLICE
UNIVERSITY HILL
3M Centre
Thames Hall
HBA Building
Lawrence National Centre
Law
LAMBTON
Brescia University College
Ursuline Hall
Mother St. James Building
Mary Manor
BRESCIA LANE
Richard Ivey Building
WESTERN ROAD
Spencer Engineering
Cronyn Obs.
Alumni Hall
Heating Plant
Bio-Engin.
MacKay-Lassonde Pav.
Alumni/ Thompson Lot
Wind Tunnel
Thompson Engineering
Labatt Health Sci. Bldg.
South Valley Lot
Talbot College
Music
Talbot Lot
Tennis Courts
Practice Field #1
Outdoor Rink
Practice Field #2 (Rugby Pitch)
HURON
Thompson Recreation & Athletic Centre
Western Student Recreation Centre
Elborn College
Elborn Lot
SARNIA ROAD
PHILIP AZIZ
Thames River
Medway Lot
BMO Bank of Montreal
TOWER LN
EPWORTH AVE
Elgin Hall
UNIVERSITY
Sydenham Hall
Medway Hall
Alumni House
RICHMOND STREET (HWY 4)
To King's University College at UWO & St. Peter's Seminary
University Child Care Centre
UWO Books Plus
Ontario Hall
Essex Hall
Huron Flats Lot
Perth Hall
Althouse Lot
Althouse Faculty of Education
London Hall
TD Stadium
Huron West
Huron East
Soccer Pitches
Platt's Lane Estates
PLATT'S LANE
WESTERN ROAD
Welcome to Western
Welcome Centre booths are attended Monday - Friday
MAP Outdoor map
Parking lot
P Visitor parking lot
See detailed parking maps for additional visitor parking at meters and pay & display areas.
Student housing
Off-campus buildings housing Western facilities
King's University College
King's Alumni Court
Outdoor Rink
* Monsignor Wemple Hall
Town-houses (3)
To St. Peter's Seminary
WATERLOO
Labatt Hall
Dante Lenardon Hall
Darryl J. King Student Life Centre
Faculty Building
Cardinal Carter Library
The Annex
Broughdale Hall
Services Building
International House
EPWORTH
* Portions of the 2nd and 3rd floors of the Monsignor Wemple Hall are student residences.
For a broad selection of parking and other campus maps visit geography.uwo.ca/campusmaps/
Barrier-free parking is available in all lots.
© 2013. The Cartographic Section, Dept. of Geography, Western.

Keynote Chair: Sarah Gallagher
Afternoon Chair: Niel Brandt

MONDAY, MAY 2		
1:00-1:15 PM	Welcome	
1:15-2:30 PM	KEYNOTE TALK: Karen Leighly	
2:30-3:00 PM	Coffee	
3:00-4:30 PM	ORAL CONTRIBUTIONS	
SESSION I: Black hole masses and accretion disk structure		
Misty Bentz	Georgia State	Black Hole Masses from Reverberation Mapping and Stellar Dynamics
Kelly Denney*	Ohio State	On the Reliability of CIV-based Black Hole Masses: We're Making Progress
Merida Batiste*	Georgia State	Improving Calibration of the MBH - σ·Relation for AGN with the BRAVE Program
Michael Fausnaugh**	Ohio State	Reverberation Mapping of Accretion Disks
Yasaman Yazdi**	Perimeter	Accretion in Radiative Equipartition (AiRE) Disks
Chia-Ying Chiang*	Wayne State	Modeling the Extreme X-ray Spectrum of IRAS 13224-3809
4:30-6:30 PM	Poster Session and Reception	

Morning Chair: Mike Crenshaw
Discussion I Moderator: Sarah Gallagher

TUESDAY, MAY 3		
9:00-10:30 AM	ORAL CONTRIBUTIONS	
SESSION I: Black hole masses and accretion disk structure (continued)		
Daniel Capellupo*	McGill	A New Spectroscopic Look at AGN Accretion Discs and Black Hole Spin
SESSION II: The structure and kinematics of the broad line region		
Anna Pancoast*	Harvard-Smithsonian	Inflow in the Broad Line Region
Knox Long	STScI	Attempts to Reproduce the Rest-Frame UV Spectra of AGN from a Biconical Wind?
Aycha Tammour**	Western	Insights from Unsupervised Clustering Into the Physical Properties Driving Quasar UV Spectral Features
Triana Almeyda**	RIT	Modeling the Dusty Torus Reverberation Response in Active Galactic Nuclei
SESSION III: Absorbing outflows		
Tracey Jane Turner	UMBC	Measuring Light Echoes in NGC 4051
10:30-11:00 AM	Coffee & Posters	
11:00AM-12:00 PM	DISCUSSION I: Brad Peterson & Joe Shields	
12:00-1:30 PM	Lunch	

Afternoon Chairs: Rajib Ganguly, Andy Robinson

1:30-3:00 PM	ORAL CONTRIBUTIONS	
SESSION III: Absorbing outflows (continued)		
Catherine Grier*	Penn State	Broad Absorption Line Variability in Sloan Digital Sky Survey Quasars
Sean McGraw**	Ohio U.	Quasar Outflow Kinematics and Energetics using Absorption Line Variability Studies
Emily Moravec**	Florida	HST and ground-based spectroscopy of quasar outflows: From BALs to mini-BALs
Christopher Culliton**	Penn State	Probing Quasar Winds Using Intrinsic Narrow Absorption Lines
Michael Rodruck**	Penn State	A Search for Variability of Intrinsic Narrow Absorption Line Systems in the Keck/HIRES and VLT/UVES Archives
Nathalie Thibert**	Western	Applying Hierarchical Clustering to Broad Absorption Line Profiles for Quasar Classification
3:00-3:30 PM	Coffee & Posters	
3:30-5:00 PM	ORAL CONTRIBUTIONS	
SESSION III: Absorbing outflows (continued)		
James Reeves	UMBC	Broad Soft X-ray Absorption Lines from the Quasar Wind in PDS 456
Robyn Smith**	Maryland	Further Biases in the Reverberation-Mapped Quasar Sample
SESSION IV: Quasar fueling and feedback		
Nicholas Ross	Edinburgh	The Curious Case of the Disappearing (and Appearing) Quasars
Jessie Runnoe*	Penn State	Now you see them, now you don't: quasars with disappearing central engines
Scott Barrows*	Colorado	Spatially Offset AGN as Tracers of Supermassive Black Hole Growth Amidst Galaxy Mergers
Gerold Busch**	Cologne	Nearby AGN and QSO hosts observed with near-infrared integral-field spectroscopy
6:00 PM	**Banquet at Windermere Manor with guest of honour Dan Weedman**	

Discussion II Moderator: Pat Hall
Morning Session Chair: Jane Turner
Discussion III Moderator: Daryl Haggard

WEDNESDAY, MAY 4		
9:00-9:45 AM	DISCUSSION II: Niel Brandt & Gordon Richards	
9:45-10:15 AM	Coffee & Posters	
10:15-11:30 AM	ORAL CONTRIBUTIONS	
SESSION IV: Quasar fueling and feedback (continued)		
Travis Fischer*	NASA's Goddard	NLR Outflows In QSO2s : Implications for quasar-mode feedback
Rebecca Nevin**	Colorado	Moderate Luminosity AGN Outflows as Probes of Feedback
SESSION V: Quasar demographics and evolution		
Chien-Ting Chen*	Penn State	A NuSTAR selected sample of AGNs in low-mass galaxies
Mallory Molina**	Penn State	Three LINERs Under the Hubble Spectral Microscope
Krista Lynne Smith**	Maryland	Circumnuclear Star Formation and the FIR-Radio Correlation in the BAT AGN Sample
11:30AM-12:15PM	DISCUSSION III: Mike Eracleous & Eilat Glikman	
12:15 PM	**Announcement of Award Winners & Closing**	

*postdoc, **student

Keynote Talk

Karen Leighly, University of Oklahoma

Using Photoionization to Understand Outflows in AGN and Quasars

Many studies of quasars and AGN use the emission and absorption lines in the infrared/optical/UV band, either as direct diagnostics or as probes of the gas physical conditions. These lines are powered by photoionization. In this talk, I will explain how a basic understanding of photoionization in the AGN context can be used to estimate the physical conditions, independent of photoionization modeling. I will illustrate using results from my research.

Contributed Talks

Day One

Session I: Black hole masses and accretion disk structure

Misty Bentz, Georgia State University

Black Hole Masses from Reverberation Mapping and Stellar Dynamics

We have undertaken a program to increase the number of direct comparisons of black hole masses from reverberation mapping and stellar dynamics in nearby active galaxies. Stellar dynamical modeling sets the black hole mass scale for the local Universe while reverberation mapping provides the foundation for black hole mass investigations at cosmological distances, so it is imperative for studies of galaxy and black hole evolution that these mass scales are directly compared. However, direct comparisons of black hole mass measurement techniques are always difficult given the specialized circumstances under which each technique may be applied. In this case, the rarity of bright broad-lined Seyfert galaxies that are also close enough to spatially resolve the black hole sphere of influence will necessarily limit the size of any sample attempting to directly compare reverberation masses with masses from stellar dynamical modeling. Until recently, only two such comparisons have been published. We will present preliminary results for two new galaxies, thereby doubling the available sample, and give an overview of continuing work and future expectations.

Kelly Denney, Ohio State University

On the Reliability of CIV-based Black Hole Masses: We're Making Progress

Being able to reliably determine quasar black hole masses based on the rest-UV CIV emission line has benefits for understanding black hole growth and galaxy evolution in the early universe because this line redshifts into the more easily-accessible visible wavelength regime for $z >\sim 1.5$. However, there has been an unresolved and continuing controversy attached to using CIV as a virial mass indicator due to apparent inconsistencies between masses based on this line and the more robustly-tested Hβ emission line. I will discuss how these inconsistencies largely appear to be due to the lack of understanding of the origin and object diversity in the CIV emission components, how this is connected to the geometry and kinematics of the variable broad line region, and how this in turn affects our ability to use simple line width characterizations as a proxy for the velocity dispersion of the variable CIV-emitting BLR gas. I will then present selected results of several recent projects that have been aimed to improve our understanding of CIV emission as a means to improve the reliability of this emission line as a virial black hole mass indicator.

Merida Batiste, Georgia State University

Improving Calibration of the MBH - σ⋆ Relation for AGN with the BRAVE Program

We present the first results from the BRAVE program. The goal of the BRAVE program is to improve calibration of the MBH - $\sigma_\star$ relation for AGN by improving bulge stellar velocity dispersion ($\sigma_\star$) estimates for the set of reverberation-mapped (RM) AGN with well constrained black hole masses. Accurate calibration of this relation is essential, and a great deal of progress has been made in improving RM black hole mass estimates. However the presence of significant kinematic substructure, such as bars, disk and rings, in the AGN host galaxies is known to contaminate and bias $\sigma_\star$ estimates from both long-slit and single fiber spectroscopy, ultimately limiting the utility of the MBH - $\sigma_\star$ relation. We discuss how the BRAVE program makes use of integral-field spectroscopy to map the line-of-sight velocity distribution across the galaxy, so that dynamically distinct substructure can be identified and more accurate $\sigma_\star$ determinations can be made. We have used the new HexPak IFU at WIYN to observe eight nearby, low-inclination AGN in this sample. We present $\sigma_\star$ estimates from these observations and a preliminary recalibration of the MBH - $\sigma_\star$ relation based on these results.

Michael Fausnaugh, Ohio State University

Reverberation Mapping of Accretion Disks

I will discuss new reverberation mapping results that allow us to investigate the temperature structure of AGN accretion disks. By measuring time-delays between broad-band continuum light curves, we can determine the size of the disk as a function of wavelength, which allows us to map the disk's temperature profile. I will discuss the recent detection of continuum lags in NGC 5548 reported by the AGN STORM project and the implications of these lags for the accretion disk. I will also present results from a 6-month reverberation mapping campaign that has found evidence for continuum lags in several other AGN. Most of these targets do not have previously published black hole masses, and our measurements of these masses allow us to directly compare the inter-band continuum lags with predictions from standard thin-disk theory.

Yasaman Yazdi, Perimeter Institute/University of Waterloo

Accretion in Radiative Equipartition (AiRE) Disks

Standard accretion disk theory (Shakura & Sunyaev 1973) predicts that the total pressure in disks at typical (sub-)Eddington accretion rates becomes radiation pressure dominated. However, radiation pressure dominated disks are thermally unstable. Since these disks are observed in a steady state, this suggests that our accretion models in the radiation pressure dominated regime (i.e. inner disk) need to be modified. Here we present a modification to the SS model, where radiation pressure is in equipartition with gas pressure in the inner region. We call these disks Accretion in Radiative Equipartition (AiRE) disks. We introduce the basic properties of AiRE disks and show how they modify disk properties such as surface density, central temperature, and spectrum.

Chia-Ying Chiang, Wayne State University

Modeling the Extreme X-ray Spectrum of IRAS 13224-3809

The extreme NLS1 galaxy IRAS 13224-3809 shows significant variability, frequency depended time lags, and strong Fe K line and Fe L features in the long 2011 XMM-Newton observation. In this work we study the spectral properties of IRAS 13224-3809 in detail, and carry out a series of analyses to probe the nature of the source, focusing in particular on the spectral variability exhibited. The RGS spectrum shows no obvious signatures of absorption by partially ionized material ("warm" absorbers). We fit the 0.3-10.0 keV spectra with a model that includes relativistic reflection from the inner accretion disc, a standard power law AGN continuum, and a low-temperature (~0.1 keV) blackbody, which may originate in the accretion disc, either as direct or reprocessed thermal emission. We find that the reflection model explains the time-averaged spectrum well, and we also undertake flux-resolved and time-resolved spectral analyses, which provide evidence of gravitational light-bending effects.

Day Two

Daniel Capellupo, McGill University

A New Spectroscopic Look at AGN Accretion Discs and Black Hole Spin

The physics of active supermassive black holes (SMBHs) is governed by three key parameters: their mass, spin, and accretion rate. We therefore select a unique AGN sample, in a narrow redshift range around z = 1.55, based on both SMBH mass and the Eddington ratio. We have so far observed 39 AGN with the VLT X-shooter instrument, which provides high signal-to-noise spectra covering, at this redshift, the rest wavelength range ~1300 to 9200 A. This allows us to study, in a single spectrum, many more emission lines, as well as a larger portion of the global AGN SED, than almost all previous samples. We also extend our wavelength coverage into the UV with (non-simultaneous) GALEX photometry, and we fit thin accretion disc (AD) spectra to all the SEDs, using a Bayesian technique and the mass accretion rate and BH mass measured directly from the spectra. When fitting only the X-shooter spectra, we can fit 37/39 AGN with the thin AD model, while for the combined X-shooter+GALEX SEDs, we can find satisfactory thin AD fits for 26/38 AGN. For those with satisfactory fits, we obtain constraints on the spin parameter (a*) of the BHs, ranging from -0.6 to nearly maximum spin.

Session II: The structure and kinematics of the broad line region

Anna Pancoast, Harvard-Smithsonian Center for Astrophysics

Inflow in the Broad Line Region

While the broad line region is too small to be spatially resolved for broad emission lines in the optical and UV, we can still probe its structure by using light echoes through the technique of reverberation mapping. A new generation of high-quality reverberation mapping datasets has motivated a direct modeling approach in which the geometry and dynamics of the broad line region can be constrained. I will discuss what we have learned so far from applying a simply parameterized, phenomenological model for the broad line region to high-quality reverberation mapping data, including the Lick AGN Monitoring Project 2008 and OSU reverberation mapping collaboration 2010 datasets. Our results suggest that inflow is prevalent in the H-beta broad line region, with no AGNs (so far) showing a strong preference for outflow.

Knox Long, STScI

Attempts to Reproduce the Rest-Frame UV Spectra of AGN from a Biconical Wind

AGN spectra, particularly those of the so-called broad absorption line AGN, show strong evidence of outflows. However, to determine whether these outflows are massive/energetic enough to affect galaxy evolution, it is clearly important to establish what types of winds are required to produce the observed spectra Here, I describe our efforts to simulate the rest-frame UV spectra of AGN, assuming they contain biconical outflows arising from the disk, using a modern Monte Carlo radiative transfer Python code. We are able to produce synthetic spectra that resemble BALS, assuming plausible values for the wind geometry, smooth outflows, and reasonable mass loss rates, but only for AGN with X-ray luminosities of 10^{43} erg/s or less. Smooth outflows are simply too ionized to produce the UV lines in higher luminosity AGN. However, we also demonstrate that if the wind is clumped, with a filling factor of about 0.01, the same winds in AGN with X-ray luminosities of 10^{45} ergs/s produce rest-frame UV spectra that resemble BALs. The biggest weakness of our models currently is that while we are able to produce broad UV absorption lines (at high inclination), we are currently unable to produce emission lines (at low inclination) with the equivalent widths that are observed.

Aycha Tammour, Western University

Insights from Unsupervised Clustering and Composite Spectral Analysis Into the Physical Properties Driving Quasar UV Spectral Features

Quasar spectra might appear remarkably similar, however subtle systematic differences are well-known and can be linked to the physical processes and conditions in the emitting regions. In this work, we aim to characterize the properties of quasar UV emission and absorption features using large spectroscopic datasets from the Sloan Digital Sky Survey in order to constrain the underlying physics in the inner regions of quasars. To that end, we apply unsupervised clustering analysis (specifically the K-means algorithm) to bin our samples into groups of similar objects in the multi-dimensional parameter space of the equivalent widths, and the red- and blue-half-width at half-maxima of the C IV, C III], and Mg II emission lines, and the parameter space of the equivalent width and the outflow velocities of the CIV trough. We find that our analysis is successfully recovering some of the well-established trends in the UV regime that ultimately point to the disk wind origin of the blueshifted broad lines and the role of the ionizing SED in modulating the winds.

Triana Almeyda, Rochester Institute of Technology

Modeling the Dusty Torus Reverberation Response in Active Galactic Nuclei

The obscuring circum-nuclear dusty torus is a major component of AGN and yet, thus far, its shape, composition, and structure have not been well constrained by observations. A 2.5year monitoring campaign in the mid-infrared and optical bands using the Spitzer Space Telescope and several ground-based telescopes has just been completed, with the aim of using the reverberation mapping technique to determine the "size" of the torus in 12 Type 1 AGN. I have developed a computer simulation that models the response of the dust emission spectrum of the torus to changes in the AGN optical luminosity, in order to extract structural information from the data obtained during the monitoring campaign. Given an input optical light curve, the code computes the integrated emission of a 3D ensemble of dust clouds as a function of time at selected infrared wavelengths, taking into account light travel delays. Here I present models exploring the effects of various geometrical and structural properties, dust cloud orientation, and anisotropy of the illuminating radiation field on the dusty torus response at different wavelengths. I will also show preliminary models of infrared light curves for the Seyfert 1 galaxy, NGC 6418, using the observed optical light curve as the input.

Session III: Absorbing outflows

Tracey Jane Turner, UMBC

Measuring X-ray Light Echos in NGC 4051

NuSTAR X-ray observations of NGC~4051 show lags between flux variations in bands of different X-ray photon energy. The harder band consistently lags the softer band by at least 1000 s, at temporal frequencies ~ 5 x 10^{-5} Hz. In addition, soft-band lags up to 400 s are measured at temporal frequencies ~ 2 x 10^{-4} Hz. Light echos from the inner accretion disk cannot explain the lags in these data, as a sharp soft-band lag is seen in cross-correlations where the softer band is expected to have no contribution from reflection. A stratified clumpy wind with global covering fraction ~50% provides a compelling physical model that satisfies all observational criteria.

Catherine Grier, Penn State University

Broad Absorption Line Variability in Sloan Digital Sky Survey Quasars

I will discuss ongoing work on quasar broad absorption line (BAL) variability in SDSS quasars. The SDSS-III Baryon Oscillation Spectroscopic Survey (BOSS) and SDSS-IV Time Domain Spectroscopic Survey (TDSS) have been obtaining repeat epochs of about 2000 quasars hosting BALs in an effort to investigate quasar winds and BAL variability on multi-year timescales. The ~2000 targets selected for this program were chosen to be optically bright and to have high signal-to-noise spectra with prominent BAL features and have been the subject of a number of previous investigations of BAL variability already. I will discuss the current status of this program, with particular focus on results from the largest systematic investigation of broad absorption line (BAL) acceleration to date. In this study, we use spectra of 140 quasars programs with three epochs of spectra (from SDSSI/II, BOSS, and TDSS) to search for velocity offsets in BALs over timescales of ~2.5-5.5 years in the quasar rest frame. The CIV BALs of two quasars show velocity shifts consistent with the expected signatures of BAL acceleration and the BAL of one quasar shows a velocity-shift signature of deceleration. In all of our acceleration candidates, we see evidence that the magnitude of the acceleration/deceleration is not constant over time; the magnitude of the change in acceleration is difficult to produce with our adopted disk-wind model. We also measure upper limits to acceleration and deceleration for 81 additional BAL troughs and find that the majority of BALs are stable to within about 1.5% of their mean velocities. The lack of widespread acceleration/deceleration could indicate that most BALs are in standing-flow configurations, located at large radii, and/or that BALs are not strongly interacting with ambient material within the host galaxy.

Sean McGraw, Ohio University

Quasar Outflow Kinematics and Energetics using Absorption Line Variability Studies

Quasar outflows are considered plausible candidates for AGN feedback processes and may explain the observed correlations between the central supermassive black hole and its surrounding host. Understanding the role of quasar winds in feedback requires more robust estimates of outflow locations, column densities, and geometries. We place observational constraints on quasar outflows by studying the variability patterns of broad absorption lines (BALs) and mini-BALs in rest frame UV spectra. Our dataset includes multiple-epoch spectra from MDM Observatory on Kitt Peak and from the Sloan Digital Sky Survey data release 7 and 12, and is supplemented with V-band photometry from the Catalina Sky Survey. We detect significant BAL variations over multi-year timescales in 28 of 71 quasars that exhibit the λλ1117,1128 absorption doublet, which is an indicator of high column density gas (i.e. NH > 1022 cm-2). The outflows in our sample are constrained to lie within ~10 pc and 1 kpc of the black hole and exhibit kinetic luminosities between ~10-6 to 1 times Lbol. These results suggest that only some quasar outflows contribute to AGN feedback. Preliminary results on the variability behavior of a sample of 22 mini-BAL quasars will also be presented.

Emily Moravec, University of Florida - Gainesville

HST and ground-based spectroscopy of quasar outflows: From BALs to mini-BALs

Quasar outflows have been posited as a mechanism that can physically couple the central quasar engine to the evolution of their host galaxies through feedback. The plausibility of this idea depends on the energetics and basic physical properties of the outflows. We selected a sample of 7 quasars that have a range in CIV λ1548,1550 absorption strengths from classic BALs to weaker and narrower "mini-BALs". The redshifts, z ~ 1.8, are high enough to measure CIV from the ground yet still relatively low to minimize Lyα forest contamination in the rest-frame far-UV. We obtained spectra with the HST Cosmic Origins Spectrograph (COS) and several ground-based telescopes to cover rest wavelengths from at least 930 to 1630 Å in every quasar. The combined dataset provides valuable constraints on the outflow ionizations and column densities, while repeated ground-based observations test for variability in CIV which probes the outflow dynamics, structure and locations. The HST spectra reveal OVI absorption in every quasar at a strength at least twice that of CIV. There is evidence for saturation and partial line-of-sight covering in resolved doublets of OVI in 3 mini-BAL quasars and in PVåŹand other lines in the only bona fide BAL in our study. Saturated absorption in the low-abundance PV lines is notable because it requires extreme large optical depths in CIV and other lines plus large total outflow column densities of $\log(N_H) \geq 22.3$ cm^{-2}. The ground-based monitoring reveals line variability in all seven quasars on rest-frame timescales from 0.29 to 1.89 yrs, with half of the quasars exhibiting variations within 1.1 yrs, consistent with previous studies. In one quasar, a distinct new high velocity BAL system emerged on a time frame of ~1.1 year at a velocity of -39000 km/s while the previously known system mini-BAL at -23000 km/s grew much stronger. The CIV variability combined with evidence for saturation indicates that the line changes are caused by changing covering fractions, e.g., clouds crossing our line of sight to the continuum source. If the crossing speeds are roughly Keplarian, the measured variability times indicate outflow locations ~0.4‰??8 pc from the central black hole. The location constraints from variability combined with the minimum N_H estimated in the BAL quasar indicate that this outflow has a minimum kinetic energy luminosity that is ≥ 0.21% of its bolometric output, which is marginally sufficient to be important for feedback to the host galaxies according to published estimates. However, we find a conservative lower limit PVåŹτ_0 ~ 2, but experiments in the line fitting show that the data are consistent with line center optical depths at least ten times larger, which would imply >10 times larger N_H and >10 times larger L_K.

Chris Culliton, Penn State University

Understanding Low-Redshift Quasar Outflows Using Intrinsic NV Absorption Lines

Quasar outflows are important for understanding the accretion and growth processes of the central black hole. Furthermore, outflows potentially have a role in providing feedback to the galaxy, and halting star formation and infall of gas. The geometry and density of these outflows remain unknown, especially as a function of ionization and velocity. Having searched ultraviolet spectra from the Hubble Space Telescope Cosmic Origins Spectrograph archive we have located intrinsic N V absorption systems, with nearly all systems having velocity offsets less than 5000 km/s. We consider the incidence of intrinsic absorbers as a function of quasar properties (optical, radio and X-ray fluxes). We also compare the properties of those quasars in whose spectra we found intrinsic absorption with respect to those in which we did not.

Michael Rodruck, Penn State University

A Search for Variability of Intrinsic Narrow Absorption Line Systems in the Keck/HIRES and VLT/UVES Archives

Nearly 100 quasars have observations obtained at different times with the Keck/HIRES and the VLT/UVES spectrographs at high resolution. The interval between these observations range from months to a decade in the quasar rest frame. Variability is common for broad absorption lines and mini-broad absorption lines that are produced by gas intrinsic to quasars. The variability timescales are useful for deriving gas densities and thus the distances from the central engines. This is important in mapping the quasar surroundings, understanding the accretion disk wind mechanism, and assessing the effect the wind has on the galaxy surroundings. However, the much more common intrinsic narrow absorption line systems, found in as many as half of all quasars, are less likely to vary, and systematic studies with large, high quality datasets have been limited. We report on the results of such a study, exploiting the overlap of targets for observations in the archives of Keck and VLT, and discuss the consequences for interpretation of the origin of intrinsic narrow absorption lines.

Nathalie Thibert, Western University

Applying Hierarchical Clustering to Broad Absorption Line Profiles for Quasar Classification

About 20% of quasars show broad, blue-shifted absorption features in their UV spectra, indicative of an outflowing wind from the accretion disk. The structures of the absorption features are sensitive to the properties (ionization state, velocity profile, and thickness) of the winds. Consequently, the broad absorption line profiles of these objects show great diversity in depth and velocity width. Using a sample of 1,084 broad absorption line quasar spectra from the SDSS DR5, we apply an agglomerative hierarchical clustering algorithm to group spectra by similar CIV absorption line shapes. For each cluster, we compose median spectra and compare the shapes of the CIV broad absorption lines with the properties of prominent, broad emission lines. The link between broad absorption line properties and those of emission lines constrains the structure and dynamics of the outflowing winds.

James Reeves, University of Maryland Baltimore County

Broad Soft X-ray Absorption Lines from the Quasar Wind in PDS 456

High resolution soft X-ray spectroscopy of the prototype, nearby accretion disk wind quasar, PDS 456 will be presented. Here soft X-ray spectra are shown from the large 2013-2014 XMM-Newton campaign, consisting of 5 observations of approximately 100 ks in length, which for the first time revealed the broad, soft X-ray absorption line profiles originating from the quasar wind. The broad absorption and emission line profiles are observed in the RGS grating spectra, at energies near 1 keV and have typical velocity widths of 10000 km/s. The absorption profiles appear highly blueshifted when compared to their most likely line identifications from the photoionization modeling, associated with L-shell iron and He and H-like neon and implying outflow velocities in the range 0.1-0.2c. From comparison with earlier archival data of PDS 456, the absorption lines appear most apparent when the spectrum is more absorbed overall. The most likely scenario is that the soft X-ray absorption profiles are associated with a lower ionization and possibly clumpy phase of the fast accretion disk wind, where the latter is known to be present in this quasar from its well studied iron K absorption profile and where the wind velocity reaches a typical value of 0.3c. Thus PDS 456 is a likely an extreme, higher ionization X-ray analogue of the BAL quasar phenomenon commonly observed in the UV.

Robyn Smith, University of Maryland

Further Biases in the Reverberation-Mapped Quasar Sample?

The accurate determination of supermassive black hole masses is crucial to our understanding of the formation and evolution of galaxies. Virial masses can be determined using reverberation mapping for nearby AGN. At higher redshifts, however, masses are found using single-epoch spectra and empirical scaling relationships based on the reverberation-mapped sample. Previous work has shown that the reverberation-mapped quasars are not representative of the larger quasar population, particularly when considering the presence or absence of a UV/optical accretion disk winds. The ratio of X-ray luminosity to optical luminosity (α_{ox}) is one quantity that can be used as a wind diagnostic. We will present a comparison of α_{ox} values for the reverberation-mapped quasar sample with an updated sample of 1902 SDSS quasars in order to further investigate the extent of biases in the reverberation-mapped sample.

Session IV: Quasar fueling and feedback

Nicholas Ross, University of Edinburgh

The Curious Case of the Disappearing (and Appearing) Quasars

Recently, a new class of Changing-Look quasars (CLQs) has been discovered in SDSS by their repeat spectroscopy in BOSS, where a significant change in the source of ionizing flux has resulted in appearing or disappearing broad emission lines. This "changing-look" behaviour is extremely valuable for understanding the structure of the accretion disc and Broad Line Region. Using a new and efficient selection method based on SDSS and Pan-STARRS1 photometric data, we have performed the first systematic search for CLQs in archival data. Here we present those results, along with the discovery of 5 new CLQs from very recent WHT spectroscopy. This new and ever expanding sample of CLQs potentially suggests a fundamental re-think in the structure and topology of the BLR.

Jesse Runnoe, Penn State University

Now you see them, now you don't: quasars with disappearing central engines

Changing-look quasars are a newly recognized class of high-luminosity active galactic nucleus where we observe dramatic transitions between "quasar-like" and "galaxy-like" spectral states on timescales of a decade or less. Initial investigations of the 12 known changing-look quasars suggest that this behavior results from abrupt changes in the accretion rate, rather than variable obscuration by dust, tidal disruption of stars, or misidentification of a fading supernova. Thus, these objects represent a unique opportunity to study what may be either a previously unappreciated mode or the extreme of normal quasar variability. A substantial sample of these objects will allow us to move beyond the detailed case studies and start to understand the underlying physical mechanisms responsible for these dramatic spectral changes. Several changing-look quasars have been discovered in the Time Domain Spectroscopic Survey (TDSS), and these are likely just the tip of the iceberg. The TDSS offers a promising way of discovering substantial numbers of changing-look quasars because it will revisit several thousand objects with previous spectra from the SDSS, many of which are selected based on substantial photometric variability. I will describe our work on changing-look quasars so far, compare changing-look and regular quasar variability, and discuss prospects for the future with the TDSS and future time-domain surveys.

Scott Barrows, University of Colorado, Boulder

Spatially Offset AGN as Tracers of Supermassive Black Hole Growth amidst Galaxy Mergers

While most galaxies host a nuclear supermassive black hole (SMBH), the dominant mechanisms by which they accrete matter, and thereby grow to their observed masses, are largely uncertain. The apparent correlations between a galaxy's global properties and its central SMBH mass suggest that galaxy mergers may be responsible for their correlated growth. In particular, mergers are known to provide enhanced accretion onto the SMBHs of the progenitor galaxies and might be preferentially associated with high luminosity AGN and dual AGN triggering. Additionally, simulations predict that merger-triggered accretion onto SMBHs becomes more likely at small nuclear separations. To test these scenarios, we have developed a novel method for identifying galaxy mergers hosting AGN by a systematic selection of spatially offset AGN. These systems consist of optically-selected and X-ray detected AGN that are spatially offset from the galactic stellar core of their host galaxy. To select these systems, we cross-matched optical imaging of galaxies with archival Chandra data and employed our own robust astrometric procedure. The offset nature of an AGN is an unambiguous signature of a galaxy merger, and these systems represent an intermediate merger stage with one of the SMBHs actively accreting. With this sample, we find that the offset AGN fraction (fraction of single AGN triggered in a merger) is positively correlated with AGN bolometric luminosity, though at a modest level and less so than a comparative dual AGN fraction. We also find that the offset AGN fraction is inversely correlated with projected nuclear SMBH separation, with this correlation being strongest at the smallest separations resolvable by our method.

Gerold Busch, University of Cologne

Nearby AGN and QSO hosts observed with near-infrared integral-field spectroscopy

Integral-field spectroscopy (IFS) in the near-infrared (NIR) is a powerful tool to study the distribution, kinematics, and excitation mechanisms of gas and stars in the centres of nearby galaxies. With the use of adaptive optics, we can reach a high spatial resolution (~100 mas) that is comparable to the resolution of the groundbreaking sub-mm interferometer ALMA. Only the combination of high-resolution NIR and sub-mm data gives us an unobscured view on the centres of nearby galaxies (Smaji + 12) to study the cold and warm gas reservoirs, inflow and outflow motions, and finally the conditions and impact of star formation in galactic centres in a spatially resolved way (Smaji + 14,15). I will show recent results that we achieved using the NIR-IFS SINFONI at the ESO-VLT. In particular, I will show new NIR data of a set of AGN/starburst host galaxies from the NUGA sample that are scheduled to be observed with ALMA in the sub-mm. All of them show circum-nuclear star formation rings. I will also discuss traces of inflow and outflow motions in the gaseous kinematics. Furthermore, I will show a pilot SINFONI study of a galaxy from the low-luminosity QSO sample (Busch+ 15). These sources do not follow the BH mass - bulge luminosity relations of inactive galaxies (Busch+ 14). With NIR-IFS, we show that this is caused by circum-nuclear star formation. More observations of these sources are currently performed within the Close AGN Reference Survey (CARS). The combination of AGN host galaxy studies at low redshift (highest angular resolution) and intermediate redshift (higher accretion rates) allows inferences to high redshifts and is important in the context of redshift evolution of the AGN - host coevolution.

Day Three

Travis Fischer, NASA's Goddard Space Flight Center

NLR Outflows In QSO2s: Implications for quasar-mode feedback

Previous studies of local (z<.055) Seyfert AGN have revealed massive, radiatively driven gas flows through the Narrow Line Region (NLR), which are thought to play a large role in the co-evolution of galaxy bulge and supermassive black hole masses. An immediate hypothesis would be that the magnitude of these effects would scale with luminosity. However, recent ground-based observations of NLRs in QSO2s present little evidence for these massive outflows in more luminous AGN, questioning the potency of quasar-mode feedback. We present a high-resolution study, using Hubble Space Telescope ACS imaging and STIS long-slit spectroscopy, to measure and model the NLR kinematics of 11 radio-quiet QSO2s and determine whether AGN-driven outflows exist in QSO2s.

Rebecca Nevin, University of Colorado, Boulder

Moderate Luminosity AGN Outflows as Probes of Feedback

While powerful quasar-driven outflows are commonly invoked as a means of shutting down star formation in galaxies, the impact of moderate luminosity AGN outflows on their host galaxies is still unclear. I will present a novel spectroscopic selection technique for moderate luminosity AGN outflows using double-peaked narrow emission lines. We observe a sample of 65 such outflows with optical longslit spectroscopy, which we use to analytically model the outflows and extract their energetics. By comparing the kinetic luminosities of the biconical outflows to the bolometric luminosities, we find that a significant fraction (~75%) of the outflows are energetic enough to drive a two-staged feedback that can shut down star formation in their host galaxies. This suggests that moderate luminosity AGN outflows, which are much more common than quasar outflows, play an important role in the regulation of star formation in galaxies.

Session V: Quasar demographics and evolution

Chien-Ting Chen, Penn State University

A NuSTAR selected sample of AGNs in low-mass galaxies

We present a sample of 11 low-mass galaxies selected from the ~5 deg^2 NuSTAR Serendipitous Survey, with a median absolute magnitude of M_r = -19.94 mag, z < 0.3, and significant NuSTAR detections at 3-24 keV. With the greatly improved hard X-ray sensitivity of NuSTAR, this is the first hard X-ray selected low-mass AGN sample with an X-ray luminosity distribution comparable to those of broad-line IMBH host galaxies selected from large optical spectroscopic surveys. We find that 30 (+16,-9)% of the galaxies in our sample do not show AGN-like emission lines in their optical spectra, implying that a fraction of low-mass galaxies might harbor accreting intermediate mass black holes (IMBHs, $M_{BH} \sim 10^5$ - 10^6 $M_\odot$) that are missed by spectroscopic surveys in the optical wavelengths. While the X-ray stacking analysis of higher redshift dwarf galaxies has suggested the presence of a population of IMBHs hosted by dust-obscured galaxies, the ancillary soft X-ray observations of our sample do not support this picture. In fact, when combining the dwarf galaxies ($M_{star} < 3x10^9$ $M_\odot$) from our NuSTAR sample with the dwarf galaxies from the previous generation Swift/BAT surveys, we find that the X-ray obscured fraction ($N_H>10^{22}$ cm^{-2}) is only 0.3(+0.15, -0.10), which is much smaller than the >0.8 obscured fraction inferred from the studies of more luminous AGNs. While the hard X-ray selected low-mass AGN sample size is still extremely limited, our result shows that the sensitive NuSTAR observations are capable of probing the faint hard X-ray emission originated from the nuclei of low-mass galaxies out to z~3, thus providing a key step towards understanding the AGN demographics in low-mass galaxies.

Mallory Molina, Penn State University

Three LINERs Under the Hubble Spectral Microscope

The majority of low-ionization nuclear emission regions (LINERs) harbor supermassive black holes (SMBHs) with very low accretion rates. Since SMBHs spend most of their lifetimes in these low accretion-rate states, understanding LINERs is important for understanding active galactic nuclei (AGN) in the context of galaxy evolution. On scales of ~100 pc, the energy budget of LINERs appears to be deficient when the only source of power considered is the AGN. Thus, other energy sources are likely to contribute to the excitation of the emission-line gas. To probe these sources, we observed three nearby, bright, and representative LINERs with the Space Telescope Imaging Spectrograph (STIS) on the Hubble Space Telescope (HST). We specifically looked at the 0.1-1 arcsecond scale (corresponding to ~5-50 pc) to find what these energy sources are and how far from the nucleus they take over the excitation of the gas. After subtracting both the unresolved nuclear light and the spatially-extended starlight, we measured a number of diagnostic emission line ratios. We find that within 10 pc, the observed line ratios of [O III]/[O II] vs [O IIII]/H-beta are consistent with AGN photoionization. The line ratios of [N II]/H-alpha vs [O III]/H-beta show that at larger distances, the excitation mechanism is most likely consistent with hot stars or shocks. Shocks are particularly appealing in the case of NGC 4278, which harbors a Gigahertz-Peaked radio source with small jets detected by the VLBA. If hot stars are the primary excitation mechanism, these are most likely post-AGB stars (from the old stellar population). We conclude from these representative cases that the characteristic LINER emission-line spectrum does not result from a single excitation mechanism, but rather from a combination of different mechanisms within the central 100 pc of each object that varies from object to object.

Krista Lynne Smith, University of Maryland

Circumnuclear Star Formation and the FIR-Radio Correlation in the BAT AGN Sample

It has long been an assumption that active galaxies would obey the same far-infrared (FIR) - radio correlation established for normal galaxies. This assumption has been used by numerous high-z studies, but has recently come into doubt for two main reasons: the revelation that the AGN itself may contribute non-negligibly to the FIR emission, and the possibility of different radio emission physics in the vicinity of the active nucleus than in isolated HII regions. Studies have attempted to decompose the FIR spectral energy distributions to remove the AGN contribution and then calculate the SFR. It would then be ideal to compare this to another, independent measure of SFR. So far, radio observations of large samples of AGN have been too low-resolution to truly map the nuclear regions. We have conducted a high-resultion (0.3-1") JVLA survey of an unbiased sample of nearby, hard X-ray selected AGN in order to spatially decompose the extended star formation emission from the central compact source. We present these maps of the nuclear regions of 41 AGN from the Swift-BAT sample. The objects exhibit a wide range of circumnuclear radio morphologies, including mini-jets and star-forming rings. When the central compact source is removed, the extended emission does indeed conform to the FIR-radio correlation. A subset of the objects also remain compact in our 1" and 0.3" observations, implying very high star formation surface densities which may be capable of driving significant winds.

Poster List

P1, Nabeel Ahmed**, York University, A Sample of Disappearing Broad Absorption Line Quasars and Red Shifted Broad Absorption Line Quasars

P2, Anirban Bhattacharjee, Sul Ross State University, Reverberation mapping of two radio-loud quasars: 3C 382 and PG 2209+184

P3, Niel Brandt, Penn State University, Exceptional X-ray Weak Quasars and Their Implications for Accretion Flows, Winds, and Broad Line Regions

P4, Laura Chajet**, York University, Line-Width Distribution of MHD Disc Winds in AGN

P5, Michael Crenshaw, Georgia State University, Kinematics of the Ionized and Molecular Gas in the Narrow-Line Regions of Nearby AGN with Gemini NIFS

P6, Chris Culliton**, Penn State University, Understanding Low-Redshift Quasar Outflows Using Intrinsic NV Absorption Lines

P7, Mike Eracleous, Penn State University, Can emission line profiles from perturbed accretion disks mimic those from the broad line region of a black hole in a supermassive binary?

P8, Mike Eracleous, Penn State University, The Impact of Profile Variability in Searches for Supermassive Black Hole Binaries

P9, Mike Eracleous, Penn State University, The Time Domain Spectroscopic Survey

P10, Mike Eracleous, Penn State University, The Ultraviolet Spectra of Active Galaxies With Double-Peaked Balmer Emission Lines

P11, Rajib Ganguly, University of Michigan-Flint, Quasars Outflows As A Function of Physical Property

P12, Eilat Glikman, Middleburg College, Luminous WISE-selected Red and Obscured Quasars in Stripe 82

P13, Catherine Grier*, Penn State University, The Sloan Digital Sky Survey Reverberation Mapping Project: Quasar Reverberation Mapping Studies

P14, Daryl Haggard, McGill University, Interpreting Sgr A*'s Most Luminous X-ray Flares

P15, Patrick Hall, York University, Blind Source Separation and SDSS DR12 Quasar Spectra

P16, Patrick Hall, York University, Visualizing Variable Quasar Outflows

P17, Viraja Khatu**, Western University, Extremely High Velocity Outflows in low-redshift Active Galactic Nuclei

P18, Viraja Khatu**, Western University, Investigating the rare He I* transition in the optical spectra of mini-broad absorption line quasars

P19, Camilo Machuca**, Georgia State University, Modeling the Host Disk Kinematics of the Seyfert 2 Galaxy Mrk 573 with Long-Slit and Integral Field Spectroscopy

P20, Crystal Pope**, Georgia State University, The Effect of Special Reduction Procedures of IFU Observations from Gemini-NIFS on Dynamical Measurements of Nearby AGN

P21, Mitchell Revalski**, Georgia State University, Characterizing the Narrow Line Region Outflows in Markarian 573

P22, Andy Robinson, Rochester Institute of Technology, Torus reverberation mapping: a “changing look” AGN caught in the act

P23, Michael Rodruck**, Penn State University, A Search for Variability of Intrinsic Narrow Absorption Line Systems in the Keck/HIRES and VLT/UVES Archives

P24, Jesse Runnoe*, Penn State University, New results from the ongoing hunt for supermassive black hole binaries

P25, Amanda Schilling**, University of Arkansas, The black hole mass/pitch angle relation of AGN in spiral galaxies

P26, Keziah Sheldon**, Drexel University, Emission Line Correlations as Diagnostics of Quasar Winds

P27, Krista Lynne Smith**, University of Maryland, KSwAGS: Finding AGN in the Kepler and K2 Fields with Swift

P28, Robert Stone**, Drexel University, Broad and Narrow Intrinsic Absorption in Quasars as it Relates to Outflows, Orientation, and Radio Properties

P29, Donald Terndrup, Ohio State University, SimBAL: A Spectral Synthesis Approach to Analyzing Broad Absorption Line Quasar Spectra

P30, Tim Waters**, University of Nevada, Las Vegas, On the efficient acceleration of broad line region clouds

Contributed Posters

Nabeel Ahmed, York University

A Sample of Disappearing Broad Absorption Line Quasars and Red Shifted Broad Absorption Line Quasars

We have identified, using the Sloan Digital Sky Survey, a sample of disappearing (BAL) quasars where the BALs were seen to disappear between different spectroscopic epochs. One proposed model for this variability is a significant increase in ionizing radiation reaching the BAL outflow. The extra ionizing radiation will ionize C IV to C V, for example, resulting in a decrease in observed C IV absorption. We have obtained Gemini spectroscopy to observe the UV-emitting regions of these BAL quasars simultaneous with Chandra observations that can tell us how much X-ray absorbing gas is along our line of sight. We will search for a correlation between BAL disappearance, BAL variability, and X-ray absorbing gas along our line of sight. We have also found a sample of BALs that are redshifted in the quasar rest frame. This sample can give new insight on our understanding of BAL Quasars and winds as they are very rare, with only 1 in 1000 BALs being redshifted. Although not very well understood yet, some possible explanations are rotationally dominated outflows or gas infalling to small radii. We have ongoing Chandra observations that are testing these models by assessing if heavy X-ray absorption lies along our line of sight. We will present Gemini spectroscopy of these two samples of quasars and preliminary results on any rest-frame UV spectral changes accompanying the X-ray observations.

Anirban Bhattacharjee, Sul Ross State University

Reverberation mapping of two radio-loud quasars: 3C 382 and PG 2209+184

We present results of a reverberation mapping (RM) campaign on two radio-loud quasars, 3C 382 and PG 2209+184, using the Wyoming Infrared Observatory (WIRO). For 3C 382 we determine a Hβ time lag of $\tau = 47.2^{+16.8}_{-30.4}$ days, with a RMS line dispersion of 2317±195 km/s and a corresponding mass of $2.12^{+0.92}_{-1.46} \times 10^8 M_{sun}$. For PG 2209+184, we determine a Hβ time lag of $\tau = 38.9^{+11.9}_{-21}$ days, with a RMS line dispersion of 2114±121 km/s, and a corresponding mass of $1.45^{+0.58}_{-0.87} \times 10^8 M_{sun}$. These two objects are consistent with the radius-luminosity relationship for Hβ and bring the total of radio-loud quasars reverberation mapped to seven. Radio-loud quasars bring the potential of investigating orientation biases in quasar black hole mass determination.

Niel Brandt, Penn State University

Exceptional X-ray Weak Quasars and Their Implications for Accretion Flows, Winds, and Broad Line Regions

Actively accreting supermassive black holes (SMBHs) are found, nearly universally, to create luminous X-ray emission. However, there are apparent X-ray weak exceptions to this rule that are now providing novel insights, including many weak-line quasars (WLQs). We have been systematically studying such X-ray

weak quasars with Chandra observations and near-infrared spectroscopy, and I will report results on their remarkable properties and describe implications for models of the accretion disk/corona, quasar winds, and emission-line formation. We have found evidence that many of these WLQs have geometrically thick inner accretion disks, likely due to high Eddington ratios, that shield the high-ionization broad line region from the relevant ionizing continuum. This basic model can explain, in a unified manner, the weak lines and diverse X-ray properties of WLQs. Such shielding may, more generally, play a significant role in shaping the broad distributions of quasar emission-line equivalent widths and blueshifts. An expectation of our model is that WLQs should be more common at high redshift, and they may serve as a signature of rapid SMBH growth at early cosmic times. I will end by discussing some promising ongoing studies that are extending these ideas.

Laura Chajet, York University

Line-Width Distribution of MHD Disc Winds in AGN

We study AGN broad emission line profiles with a model that combines an improved version of the accretion disc wind model of Murray & Chiang (1997) with the magnetohydrodynamic (MHD) driving of Emmering et al. (1992). The dynamics of these self-similar MHD outflows is characterized by two parameters, that we chose to be the dimensionless angular momentum and the wind-launching angle with respect to the disc plane. For a range of central object masses and luminosities we constructed series of Civ line profiles parametrized by the wind-launching and viewing angles, while keeping the dimensionless angular momentum fixed. We compared the dispersions in our model line-width distributions to observational upper limit on that dispersion, that translates into constraints on the geometry of the torus that is part of the standard model describing the AGN phenomenon. We found that the half-opening angle of the putative obscuring structure strongly depends both on the accretion rate and the mass of the central object alone. Additional series of model runs with different values of the dimensionless angular momentum suggest, on the other hand, that the profile line-widths and corresponding dispersions depend only mildly on this parameter.

Michael Crenshaw, Georgia State University

Kinematics of the Ionized and Molecular Gas in the Narrow-Line Regions of Nearby AGN with Gemini NIFS

We present a study of the kinematics of ionized and molecular gas in the circumnuclear regions of nearby active galactic nuclei (AGN) based on observations with the Near-Infrared Field Spectrograph (NIFS) on the Gemini North 8-meter telescope. We compare the NIFS observations with those from the Hubble Space Telescope and ground-based long slit spectra of the host galaxies using the Apache-Point Observatory 3.5-meter telescope to investigate the geometries of feeding and feedback in nearby AGN. The IFU observations show a mixture of infall, outflow, and rotation in their NLRs. Disentangling these kinematics in a large sample of AGN will allow us to resolve the mechanisms of feeding and feedback around the supermassive black holes and determine accurate mass outflow rates and kinetic powers that AGN deliver to their environments.

Chris Culliton, Penn State University

Understanding Low-Redshift Quasar Outflows Using Intrinsic NV Absorption Lines

Quasar outflows are important for understanding the accretion and growth processes of the central black hole. Furthermore, outflows potentially have a role in providing feedback to the galaxy, and halting star formation and infall of gas. The geometry and density of these outflows remain unknown, especially as a function of ionization and velocity. Having searched ultraviolet spectra from the Hubble Space Telescope Cosmic Origins Spectrograph archive we have located intrinsic N V absorption systems, with nearly all systems having velocity offsets less than 5000 km/s. We consider the incidence of intrinsic absorbers as a function of quasar properties (optical, radio and X-ray fluxes). We also compare the properties of those quasars in whose spectra we found intrinsic absorption with respect to those in which we did not.

Mike Eracleous, Penn State University

Can emission line profiles from perturbed accretion disks mimic those from the broad line region of a black hole in a supermassive binary?

Both observations and simulations from the last decade suggest a link between the evolution of galaxies and their central supermassive black holes. An important ingredient in these evolutionary models is galactic interaction and mergers. Consequently, we expect to see dual active galactic nuclei at the early stages of an interaction and close, bound binary black holes after the parent galaxies have merged. While binary active galactic nuclei have been detected at large separations, it has proven difficult to detect close, bound binaries. Our team has been carrying out an observing campaign to find binary black holes with sub-parsec separations. Thus, we have been studying a sample of 88 quasars from the Sloan Digital Sky Survey whose broad Hβ lines are offset from their nominal wavelength by a few thousand km/s. These offsets suggest orbital motion of one of the black holes and the gas that is bound to it. In this work, we play devil's advocate by exploring an alternative interpretation of the broad emission lines. We ask whether lines formed in a perturbed, non-axisymmetric disks can have profiles similar to those observed. Two categories of non-axisymmetric disks are explored - one with a prominent spiral arm and one that is elliptical. To make the model as general as possible, the radial emissivity of the disk was allowed to have a broken power-law profile. For certain combinations of model parameters, these models can match the observed profile shapes. A subset of these models predict radial velocity variations of the line peaks that resemble those we would expect to see in a binary system on an observable time scale. However, the predominant, observed statistical trend between the Pearson Skewness and the peak position is not reproduced; instead, other trends are predicted by the models that we do not observe.

Mike Eracleous, Penn State University

The Impact of Profile Variability in Searches for Supermassive Black Hole Binaries

Modern galaxy evolution scenarios suggest that supermassive black hole binaries (SBHBs) are an inevitable result of merging galaxies that host black holes in their centers. Though candidates of wide-

separation dual active galactic nuclei have been detected, there is no reliable evidence for the expected close, bound binaries at separations of one parsec or less. We are searching for close SBHBs among z<0.7 SDSS quasars with offset broad emission lines. Specifically, we test the idea that, if one of the black holes is active, the orbital motion within the binary will cause its broad emission lines to exhibit periodic radial velocity shifts. Among the most significant caveats to this approach is that the variability of the broad Hβ profile may mimic radial velocity changes. Cases where the flux increases in one side of the line profile and decreases in the other are of particular concern. In order to test the extent of this problem, we introduce simulated profile variability into the observed spectra of the binary candidates and then make radial velocity measurements on the Hβ lines. We will present the results of this simulation to assess how often we will measure false radial velocity shifts as a result of changes in the shape of the broad Hβ profile.

Mike Eracleous, Penn State University

The Ultraviolet Spectra of Active Galaxies With Double-Peaked Balmer Emission Lines

We present the UV spectra of eight nearby AGNs with broad, double-peaked Balmer emission lines in their optical spectra. We find that the Mg II UV lines have similar widths and profiles as the optical Balmer lines but the higher-ionization UV lines as well as Lyα have single peaked and relatively "cuspy" profiles. We find that the Lyα/Hα ratio in double-peaked emitters increases with Eddington ratio; it ranges from less than unity for the objects with the lowest Eddington ratios to a few for objects with Eddington ratios of order a few tenths. We quantify the profile shapes by means of the ratio of widths at half maximum and quarter maximum, which is a proxy for the kurtosis. We find that the kurtosis of the UV lines of double-peaked emitters is substantially lower than that of the same lines of ordinary quasars (i.e., the UV lines of double-peaked emitters are less "cuspy"). We interpret these observational results in the context of a picture where the broad-line region is an accretion disk and its associated wind. We suggest that the relative strengths and profiles shapes of double-peaked emitters correspond to a wind with a small optical depth and small emission measure, which is a consequence of a low Eddington ratio.

Mike Eracleous, Penn State University

The Time Domain Spectroscopic Survey

The Time-Domain Spectroscopic Survey (TDSS) is a subproject of the SDSS-IV eBOSS project, aimed at identifying variable objects and following up additional, interesting objects. At the end of the 4–6 years of the eBOSS survey, the TDSS will have yielded 200,000 spectra of variables (90% initial spectra) at 17 < i < 21. Approximately half of these variables are expected to be quasars, observed spectroscopically for the first time. The survey is also devoting 10% of its fibers to obtain additional spectra of interesting classes of objects that have previous spectra from SDSS I–III or other programs (these are the Few-Epoch Spectroscopy, or FES, programs). This allows the study of the variability of these classes through large samples (~1000 targets each) that could not be easily observed otherwise. We will describe the design of the survey and summarize the goals of the FES programs. will also describe the results from a pilot survey, carried out in spring 2014 as part of SDSS-III/SEQUELS and covering ~320 square degrees of the sky, that give us a preview of what TDSS will bring. For example, we find that, variability selection

complements color selection by selecting redder quasars. Moreover variability selection yields larger fractions of blazars and BAL quasars than color election alone.

Rajib Ganguly, University of Michigan-Flint

Quasars Outflows As A Function of Physical Property

Accretion onto supermassive black holes that lie at the heart of galaxies is now recognized as a vital phase in describing galaxy evolution, growth, and star formation efficiency. Such a system is called a quasar, of which roughly 60% are observed to have gas flowing outward with a variety of velocities and velocity dispersions. The most extreme observed form of these outflows appears in the ultraviolet spectrum of 15-20% of objects. As a follow up to a previous study, we have identified a sample of nearly 11000 z=1.7-2 quasars using archived data from the Sloan Digital Sky Survey (Data Release 7), of which roughly 4400 appear to show outflows. The specific redshift range is chosen to feature both the Mg II 2800 emission line as well as wavelengths extending to nearly 20,000 km/s blueward of the C IV 1549 emission line. Our goals for this study are: (1) To measure the properties of the outflows detected in absorption (velocity, velocity dispersion, equivalent width, ionization); (2) To temper our visual inspection schemes with a more automated, measurement-driven scheme; (3) To characterize the incidence of outflows as a function of quasar physical property (black hole mass, accretion rate, etc.); and (4) To investigate in an empirical way the complex dependencies between the properties of the outflow, and the physical properties of the system.

Eilat Glikman, Middleburg College

Luminous WISE-selected Red and Obscured Quasars in Stripe 82

Studies of luminous dust-reddened quasars suggest that they represent a phase in merger-driven quasar/galaxy co-evolution where these reddened quasars are shedding their dusty environment prior to becoming a "normal"' blue quasar. Most red quasar samples have been selected by requiring a radio detection, to avoid contamination from Galactic stars. However, the radio requirement restricts those sample to a small fraction of the overall quasar population of radio-detected objects. The Wide-Field Infrared Survey Explorer (WISE) All-sky Survey enables the selection of reddened and obscured regardless of their radio properties. Here we present a pilot survey for heavily obscured luminous quasars using infrared selection from WISE colors in the SDSS Stripe 82. We concentrated on objects with both bright WISE 22 micron fluxes and 2MASS magnitudes that lack spectra in SDSS to identify the brightest (mostly high luminosity) sources that complement the fainter objects in Spitzer-selected samples. Our relatively liberal color selection produced a candidate list of 15 red quasars. We obtained optical and/or near-infrared spectra for all the sources. We construct an appropriate comparison sample and explore the nature of the most luminous obscured quasars population and how it depends on redshift, luminosity and radio-loudness.

Catherine Grier, Penn State University

The Sloan Digital Sky Survey Reverberation Mapping Project: Quasar Reverberation Mapping Studies

The Sloan Digital Sky Survey Reverberation Mapping Project (SDSS-RM) has completed its first two years of spectroscopic observations of a sample of ~850 quasars with the SDSS-III BOSS spectrograph and is continuing to obtain spectra in 2016. From January-July 2014 and 2015, more than 40 epochs of spectroscopy were obtained for this quasar sample, and supporting photometric observations were carried out at the Canada-France-Hawaii Telescope and the Steward Observatory Bok telescope. In addition, the SDSS-RM field overlaps with the Pan-STARRS 1 Medium Deep Field MD07, so we have photometric data for three years prior to the SDSS-RM observations, which considerably extends the time delay sensitivity of the campaign. Preliminary reverberation mapping results were presented by Shen et al. (2015) and the program has also yielded ancillary science results in regimes such as broad absorption line variability, quasar ensemble variability characteristics, quasar emission line studies, and host galaxy properties. I will discuss the current status of the SDSS-RM program and report preliminary reverberation mapping results from the wider 850-quasar sample using the full set of photometric and spectroscopic data from 2014.

Daryl Haggard, McGill University

Interpreting Sgr A's Most Luminous X-ray Flares*

During ambitious X-ray and radio monitoring campaigns with Chandra, XMM, Swift, and the VLA, we have detected the brightest-ever X-ray flares from Sgr A*. These flares likely probe the physical processes and accretion flow near the black hole's event horizon. Yet, despite years of observational and theoretical study, we do not have a complete, unique model to explain these high-energy flares, or their relationship to variability at other wavelengths. Viable models range from the tidal disruption of asteroids to gravitational lensing to magnetic reconnection, motivating observers to place tighter constraints on the timing and multiwavelength properties of these outbursts. X-ray flares may also help us relate Sgr A* to weakly accreting black holes across the mass spectrum. I will discuss the possible origins and continuing mysteries surrounding Sgr A*'s high-energy flares, describe future monitoring campaigns, and give a brief update on the Sgr A*/G2 interaction.

Patrick Hall, York University

Blind Source Separation and SDSS DR12 Quasar Spectra

To study absorption in quasars, it would be advantageous to be able to accurately reconstruct unabsorbed, noise-suppressed quasar spectra. Fortunately, quasar spectra can be considered as a sum of a few emission components affected by wavelength-dependent dust extinction and narrow and broad absorption. And given a large set of quasar spectra, those emission components can be inferred statistically, using various Blind Source Separation methods. We have extended the method of Heteroscedastic Matrix Factorization (HMF; Tsalmantza & Hogg 2012), which is similar to error-weighted Principal Component Analysis, and have used it to attempt to statistically infer, for the first time, each quasar's dust extinction as well as its intrinsic spectrum. We have been foiled so far by degeneracies between inferred parameters, but will

discuss ideas for future progress, our fits to all quasar spectra from the latest release of the SDSS (which we will make available to the community), and a few interesting quasars discovered in our study.

Patrick Hall, York University

Visualizing Variable Quasar Outflows

I will discuss what the variability of Broad Absorption Line (BAL) troughs in quasars implies for the structure of quasar outflows. Multiple-epoch studies of newly-appeared and other strongly-variable BAL troughs (at up to 60,000 km/s) show that significant variability can occur down to timescales of days, and extreme variability on timescales of months. Two-epoch studies of hundreds of BAL quasars show that troughs widely separated in velocity tend to vary together, and I'll discuss new results on how that correlation changes with velocity separation. Both ionizing flux variability and coordinated motion across the line of sight can cause trough variability, so how can observations constrain those models? I will present some visualizations of simple quasar outflow models as a first step toward examining what observations might be telling us about the structure of quasar outflows.

Viraja Khatu, Western University

Extremely High Velocity Outflows in low-redshift Active Galactic Nuclei

In Active Galactic Nuclei (AGN), there are winds of gas, also called outflows, which move away from the center of AGN. Since outflows appear from the inner region of an AGN, their study can help us understand the nature of AGN. It can also allow us to describe the driving mechanism and possible effects of outflows on their host galaxies as well as their surrounding intergalactic medium. Past research on extremely high-velocity AGN outflows ($v \geq 25{,}000$ km/s) has focused mainly on the AGN at $z \geq 2$. We present the first survey of extremely high-velocity outflow AGN at $0 < z < 0.2$. We analyzed low and medium resolution spectra of 27 AGN from the Hubble Space Telescope (HST) data archive taken with the Cosmic Origins Spectrograph to search for CIV λλ1548,1550 broad absorption-line features at extremely high velocities. The results show no evidence for CIV extremely high-velocity outflows in the selected AGN sample.

Viraja Khatu, Western University

Investigating the rare He I transition in the optical spectra of mini-broad absorption line quasars*

The accretion of matter onto the central supermassive black hole in a quasar radiates tremendous amount of energy, and a fraction of that accelerates energetic outflows away from the central engine. These outflows can travel to great distances within or beyond their host galaxies and hence, can influence galaxy evolution in general. However, the geometry and effects of quasar outflows on their host galaxies as well as their neighbouring environment are poorly understood. Therefore, studying quasar outflow properties such as their absorption-line widths, covering fraction, and column densities is important and is effectively done by analyzing the broad and blue-shifted absorption-line features in the spectra of broad absorption line quasars, which make up nearly 20% of quasars. We will investigate the structure of the He I* λ3888

absorption line in the optical spectra of ten mini-broad absorption line (mini-BAL) quasars at redshifts 0.5 < z < 0.6 that were identified from the Sloan Digital Sky Survey Data Release 7 and observed at the 4-m Mayall telescope at the Kitt Peak National Observatory to determine the column densities of their outflows and the mass outflow rates. He I* transitions are rarely observed in the universe and so, are known to be sensitive tracers of the large amounts of gas in thick outflows along the line of sight. Comparing our results with previous studies on the X-ray and near-infrared spectra of mini-BAL quasars will allow us to put constraints on the physical properties and geometry of their outflows.

Camilo Machuca, Georgia State University

Modeling the Host Disk Kinematics of the Seyfert 2 Galaxy Mrk 573 with Long-Slit and Integral Field Spectroscopy

In order to further our understanding of the relationship at various distances between active galactic nuclei (AGN) and their host galaxy, we present this case study on Mrk 573 based on observations with the Dual Imaging Spectrograph (DIS) on the ARC 3.5-meter telescope and the Near-Infrared-Field Spectrograph (NIFS) on the Gemini North 8-meter telescope. We have previously shown that the narrow-line region kinematics of some AGN can be used to fit a biconical outflow model, but for most AGN (including Mrk 573) the kinematics are too convolved with galactic rotation to be modeled precisely. In this work, we present our progress towards disentangling the kinematics through analysis of ionized gas (Hė± and [O III], in DIS) and absorption features (CO, in NIFS). We continue by modeling the results using DiskFit, a publicly available code that fits disk rotation.

Crystal Pope, Georgia State University

The Effect of Special Reduction Procedures of IFU Observations from Gemini-NIFS on Dynamical Measurements of Nearby AGN

We present a preliminary analysis of the inflows and outflows in the narrow-line regions of nearby (z < 0.1) AGN using observations from the Gemini-North telescope's Near-infrared Integral Field Spectrograph (NIFS). In addition to the standard reduction procedure for NIFS data cubes, these observations were treated for multiple sources of noise and artifacts introduced by the atmosphere, the use of adaptive optics, and the NIFS instrument. This procedure included the following steps: correction of the differential atmospheric refraction, spatial resampling, low-pass Butterworth spatial filtering, the Richardson-Lucy deconvolution, and the removal of an "instrumental fingerprint". We compare kinematic measurements from NIFS data cubes with and without the additional correction procedures to determine the effect of this data treatment on our scientific results.

Mitchell Revalski, Georgia State University

Characterizing the Narrow Line Region Outflows in Markarian 573

We present our current progress in determining the mass outflow rate as a function of distance from the nucleus in the narrow line region (NLR) of Markarian 573. Active Galactic Nuclei (AGN) are known to

exhibit mass outflows that drive gas away from the centrally accreting super massive black hole (SMBH). This gas propagates into the circumnuclear environment and may be an important regulator of the SMBH growth rate and its coevolution with the host bulge. Recent work by Crenshaw et al. determined that the mass outflow rate in the NLR of NGC 4151 is much larger than if all of the mass were only originating from the centermost regions. This is indicative of mass loading whereby the outflow accelerates gas in situ as it travels away from the nucleus. We are utilizing archival spectra taken with the Space Telescope Imaging Spectrograph (STIS) on board the Hubble Space Telescope (HST) to calculate the mass outflow rates for 10 Seyfert AGN. Ultimately, we want to determine if there are correlations between the outflows and host properties such as SMBH mass and Eddington ratio. To find the mass of the outflowing gas we will analyze the emission line spectra and create photoionization models using the Cloudy software. In conjunction with kinematic models from Fischer et al. we will calculate the mass outflow rates and kinetic luminosities as a function of distance from the nucleus. These measurements will allow us to determine the importance of NLR outflows in regulating AGN feedback through direct comparison of observations with theoretical feedback models.

Andy Robinson, Rochester Institute of Technology

Torus reverberation mapping: a "changing look" AGN caught in the act

"Changing Look" AGN are a rare but interesting group that have undergone dramatic changes in spectral type, in which the spectrum typically changes from Seyfert Type 1 to Type 2, or vice versa. These transitions may provide insights into accretion processes or the dynamics and distribution of absorbing material around the nucleus. We report the discovery of a new example, NGC 6418, which was observed to change state during a ~2.5 year infrared and optical monitoring campaign with the Spitzer Space Telescope. Early in 2013, the infrared luminosity of NGC6418 increased by a factor ~2 at 3.6 and 4.5 microns, following a similar increase in optical luminosity. This increase took place over a period of 100 - 150 days and appears to have been accompanied by a significant strengthening of the broad lines and AGN continuum, and a decrease in reddening. The optical-infrared reverberation lag also increased, from 37 days at 3.6 microns prior to the continuum increase, to 52 days afterwards, implying a corresponding increase in the dust sublimation radius. The transition in NGC 6418 appears to have involved both an increase in the intrinsic luminosity of the AGN and a decrease in obscuration, probably because of dust sublimation.

Michael Rodruck, Penn State University

A Search for Variability of Intrinsic Narrow Absorption Line Systems in the Keck/HIRES and VLT/UVES Archives

Abstract: Nearly 100 quasars have observations obtained at different times with the Keck/HIRES and the VLT/UVES spectrographs at high resolution. The interval between these observations range from months to a decade in the quasar rest frame. Variability is common for broad absorption lines and mini-broad absorption lines that are produced by gas intrinsic to quasars. The variability timescales are useful for deriving gas densities and thus the distances from the central engines. This is important in mapping

the quasar surroundings, understanding the accretion disk wind mechanism, and assessing the effect the wind has on the galaxy surroundings. However, the much more common intrinsic narrow absorption line systems, found in as many as half of all quasars, are less likely to vary, and systematic studies with large, high quality datasets have been limited. We report on the results of such a study, exploiting the overlap of targets for observations in the archives of Keck and VLT, and discuss the consequences for interpretation of the origin of intrinsic narrow absorption lines.

Jesse Runnoe, Penn State University

New results from the ongoing hunt for supermassive black hole binaries

Supermassive black hole binaries seem to be an inevitable product of the prevailing galaxy evolution scenarios where most massive galaxies play host to a central black hole and undergo a history of mergers and accretion over the course of cosmic time. The early stages of this process have been observed in the form of interacting galaxy pairs as well as kilo-parsec separation dual active galactic nuclei, but detections of the close, bound binaries that are expected to follow have proven elusive. With this motivation, we have been conducting a systematic observational search for sub-parsec separation supermassive black hole binaries. Specifically, we test the hypothesis that the secondary black hole in the system is active and the resulting broad emission lines will be doppler shifted due to its orbital motion in the binary (analogous to a single-line spectroscopic binary star). Our sample includes 88 binary candidates selected from $z < 0.7$ Sloan Digital Sky Survey quasars based on substantial offsets (>1000 km/s) of their broad H-beta emission lines relative to their systemic redshifts. I will present an update on the primary observational test to constrain the nature of the binary candidates; spectroscopic monitoring to look for signs of periodic variations in the radial velocity curves. We find 8/88 velocity variable candidates and 12/88 candidates whose broad H-beta lines have not varied over the course of our observations. The minimum periods that are consistent with these radial velocity curves can place lower limits on the total binary masses. We find that the minimum masses are not restrictive, but the periods are predictive. Continued spectroscopic monitoring is essential in order to make the limits on the masses more stringent.

Amanda Schilling, University of Arkansas

The black hole mass/pitch angle relation of AGN in spiral galaxies

A relationship between the mass of supermassive black holes, M, at the center of galaxies and the pitch angle, P, a measure of tightness of spiral arms, was recently reported by Berrier, J.C., et al., (2013, ApJ, 769, 132) for late type galaxies. The relationship established for a local sample, shows that spiral galaxies with tighter pitch angles contain higher mass black holes. In this work, we explore the M-P relation for a sample of 148 moderate to high redshift ($0.04<z<2.0$) spiral galaxies that host AGN. Nineteen spiral galaxies were selected from the SDSS-I/II and SDSS-III quasar catalogs and 129 objects from the Galaxy Zoo: Hubble (GZH) dataset. The GZH galaxies were matched in the SIMBAD database to AGN which have some spectroscopic observation. The broad CIV, H, and MgII emission lines were used with the broad-line mass scaling relations to estimate M for the Type 1 AGN. [OIII]5007√Ö and [OII]3727√Ö line widths were used as a proxy for in the M- relation for Type 2 objects. Pitch angles were measured

using a 2DFFT technique (Davis, B.L., et al., 2012, ApJS, 199, 33). The M-P relation for the higher redshift AGN sample again shows that tighter pitch angles correlate to higher mass black holes, however, with a shallower slope. We discuss this result as possible evolution in the M-P relation or as a means to explore other properties of the disk galaxies and the co-evolution of AGN and the host galaxy.

Keziah Sheldon, Drexel University

Emission Line Correlations as Diagnostics of Quasar Winds

We investigate correlations between UV and optical emission line properties for a sample of z~0.5 SDSS quasars that have been observed by HST. The sample is designed to be comparable in luminosity to the existing "reverberation mapping (RM)" sample, but less biased in terms of their "eigenvector 1" properties. We seek to understand what the constraints of accretion disk winds are. Further, we hope to identify a local sample of wind-dominated quasars that are comparable to the RM sample that can be used to establish better black hole mass scaling relations for wind-dominated quasars at high redshift.

Krista Lynne Smith, University of Maryland

KSwAGS: Finding AGN in the Kepler and K2 Fields with Swift

We present the first phase of the Kepler-Swift Active Galaxies and Stars survey (KSwAGS), a simultaneous X-ray and UV survey of 6 square degrees of the Kepler field. Kepler/K2 is the most precise photometer of our time, producing light curves of AGN capable of probing accretion physics. The survey detected 93 unique X-ray sources in the original Kepler field with signal-to-noise ratio > 3 with Swift XRT, of which 60 have UV counterparts. The survey produces a mixture of stellar sources and AGN. We have obtained optical spectra for the large majority of these targets, providing necessary parameters for study of the light curves in an astrophysical context; for example, surface gravities and rotation velocities for stars, and black hole mass and accretion rate estimates for AGN. Our survey provides the first X-ray and UV data for a number of known variable stellar sources, as well as a large number of new X-ray detections in this well-studied portion of the sky. The KSwAGS survey is currently ongoing in the K2 ecliptic plane fields, and provides a wide array of X-ray selected targets for photometric study with archival Kepler light curves and new data from K2.

Robert Stone, Drexel University

Broad and Narrow Intrinsic Absorption in Quasars as it Relates to Outflows, Orientation, and Radio Properties

We investigate the nature of quasar outflows in the form of both broad and narrow absorption lines using data taken as part of the Sloan Digital Sky Survey (SDSS). We look for correlations of these outflows with the radio properties of the quasars, which can potentially reveal a physical connection between the quasar's accretion physics and its outflows. We also investigate how relaxing the traditional criteria for defining both radio loud and broad absorption line quasars impacts our understanding of these classes and quasars in general. We seek to demonstrate that not all BALQSOs are exactly the same; separating

the extreme cases and discovering where they lie on the continuum of quasar properties could help in determining the physics underlying all quasars. Our ultimate goal is to understand how outflows from quasars change as a function of line-of-sight orientation, mass, accretion, and spin of the black holes that fuel them.

Donald Terndrup, Ohio State University

SimBAL: A Spectral Synthesis Approach to Analyzing Broad Absorption Line Quasar Spectra

Broad Absorption Line quasars (BALQSOs) show blueshifted absorption lines in their restframe spectra, indicating powerful winds emerging from the central engine. These winds are essential part of quasars: they can carry away angular momentum and thus facilitate accretion through a disk, they can distribute chemically-enriched gas through the intergalactic medium, and they may inject kinetic energy to the host galaxy, influencing its evolution. The traditional method of analyzing BALQSO spectra involves measuring myriad individual lines, computing the inferred ionic column densities, and comparing with the output of photon ionization models. This method is inefficient, does not handle line blending well, and usually fails to fully explore the space of model parameters. We introduce SimBAL, a spectral synthesis fitting method for BALQSOs, which compares synthetic spectra created from photoionization models with observed spectra using Bayesian model calibration. We illustrate its application to the UV-through infrared spectrum of the low-redshift BALQSO SDSS J0850+4451, and discuss how various regions of the spectrum constrain our knowledge of the ionization state, column density, and velocity structure in the quasar wind.

Tim Waters, University of Nevada, Las Vegas

On the efficient acceleration of broad line region clouds

In the broad line region of AGN, acceleration occurs naturally when a cloud condenses out of the hot confining medium due to the increase in line opacity as the cloud cools. However, acceleration by radiation pressure is not very efficient when the flux is time-independent, unless the flow is one-dimensional. Here we explore how acceleration is affected by a time-varying flux, as AGN are known to be highly variable. If the period of flux oscillations is longer than the thermal timescale, we expect the gas to cool during the low flux state, and therefore line opacity should quickly increase. The cloud will receive a small kick due to the increased radiation force. We perform hydrodynamical simulations using Athena to confirm this effect and quantify its importance. We find that despite the flow becoming turbulent in 2D due to hydrodynamic instabilities, a 20% modulation of the flux leads to a net increase in acceleration --- by more than a factor of 2 --- in both 1D and 2D. We show that this is sufficient to produce the observed line widths, although we only consider optically thin clouds.

Discussion Notes

Discussion Notes

Local Guide

- **In Case of Emergency:** The Western University Campus Police can be reached for emergencies at 911 from any University phone. Non-emergencies should use 519-661-3300.

  The two closest hospitals are University Hospital, located on the Western Campus at 339 Windermere Road (519-663-2966), and St. Joseph's Hospital, located at 268 Grosvenor Street (519-646-6100). St. Joseph's hosts an Urgent Care Centre, and minor injuries, up to and including cuts and broken limbs, are best handled there. However, the Urgent Care Centre is only open Monday to Friday from 8am to 6pm and Saturday and Sunday from 8am to 4pm.

- **ATM/Bank/Pharmacy:** There is an ATM (Royal Bank of Canada) just inside the entrance of the Natural Sciences Building. The closest bank is a TD-Canada Trust, located at the main University Gates at 1137 Richmond Street (the south west corner of Richmond and University Drive). There is a drugstore and pharmacy in the basement of the UCC Student Centre, across from the Western Bookstore.

- **Currency Exchange:** The closest is Continental Currency Exchange inside the Masonville Place Mall at 1680 Richmond Street (519-850-0111). You need to take the Wellington 13 bus to reach Masonville Mall.

- **Lunch Options:** The length of the lunch break likely precludes a trip to downtown London. On-campus and close to campus options are:

  1. *The Grad Club*: Located in the basement of Middlesex College (across the street from PAB, to the east– it's the building with the clock tower), the Grad Club offers drinks and cafeteria-style food. If your idea of lunch is a beer and a burger, look no further. $5-$10 for lunch.

  2. *The Wave*: Located on the second floor of the UCC Student Centre, the Wave (519-661-3007) is a traditional restaurant with menu options ranging from burgers and salads to wraps and pasta. The Wave is only open for lunch during the summer, 11am-2pm, Monday through Friday. You can find a complete menu at www.usc.uwo.ca/wave/ . $10-$15 for lunch.

  3. *Green Leaf Cafe*: Located on the second floor of Somerville House, the Green Leaf Cafe (519-661-4080) features different weekly and daily meals. Reservations are required and can be done at www.greenleafcafe.uwo.ca/ . $12 for buffet.

3. *Barakat Restaurant*: Located at 1149 Western Road, Barakat is just around the corner from Ontario Hall, Western's on-campus accommodation. Barakat specializes in Mediterranean Cuisine. You can find an on-line menu at www.barakatrestaurant.com . $8-$15 for lunch.

4. *Other Options*: The Natural Sciences Building, across the street from the north exit of the PAB, houses both a Tim Horton's and Einstein's Cafe. "Tims" offers sandwiches, soup, and coffee. Einstein's offers take-away wraps and salads including vegetarian options.

5. *Grocery Store*: The basement of the UCC Student Centre hosts a small green-grocer, Grocery Checkout.

- **Dining Options:** Unfortunately, there are not many restaurants within an easy walk from campus; therefore, a bus or taxi ride will be necessary. Almost all of the restaurants listed here are on the Richmond 6 (or 6A) bus route, with the exceptions of "Quynh Nhi" and "Zen Gardens" (use the Dundas 2) and the Masonville Place restaurants (use the Wellington 13). You can catch both the Richmond 6 and Dundas 2 from in front of the Natural Sciences Building. The stop for the Wellington 13 is in front of Delaware Hall on Perth Drive, down the hill and behind Middlesex College. Be sure to stand directly in front of Delaware Hall to catch the northbound Wellington 13 as the stop on the opposite side of the street, directly behind Middlesex College, is the southbound bus. The complimentary bus pass included with your registration is valid for the dates of the conference; otherwise the bus fare is $2.75, exact change only.

  The best cab option is U-Need-A-Cab (519-438-2121). You should expect a fare of between $10 and $20, depending on traffic.

  If you like an unstructured approach to dinner, a good plan is to take the Richmond 6 (or 6A) from Natural Sciences downtown to "Richmond Row," an area of downtown London on Richmond Street between Oxford and Pall Mall. Watch for the intersection of Richmond & Oxford and then wait to pull the stop signal until you cross the railway tracks just a little further south (yes, there are still level railway crossings in London). Continuing to walk south on either side of the street, you will pass a wide variety of restaurants and bars. Pubs include Molly Bloom's, The CPR/Ceeps, and the Kilted Loon/Barking Frog.

  Finally, here is a short list of specific dining options. Note that "Veg Out" is vegan, and "Zen Gardens" is vegetarian.

1. Aroma Restaurant
   717 Richmond Street, Unit 1
   519-435-0616
   Portuguese and continental food, in a beautiful indoor courtyard atmosphere. Includes seafood specialities and Paella.
   Dinner entrees: $20-$35
   fginternationalcorp.com

2. Black Trumpet
   523 Richmond Street
   519-850-1500
   Includes a courtyard. Intimate, very elegant, and pricey. Has good continental and international food.
   Dinner entrees: $30-$40
   www.blacktrumpet.ca

3. Covent Garden Market
   130 King Street
   519-439-4281
   A large indoor market with many shops and restaurants, including Waldo's Bistro on King and Tanakaya (Japanese).
   Prices vary.
   www.coventmarket.com

4. Thaifoon
   120 Dundas Street
   519-850-1222
   Classic Thai food like noodle stir-fries and curries, with cocktails.
   Dinner entrees: $15-$20
   http://www.thaifoonrestaurant.com/

5. David's Bistro
   432 Richmond Street
   519-667-0535
   Upscale bistro, with excellent food preparation.
   Dinner entrees: $20-$30.
   www.davidsbistro.ca

6. Dragonfly Bistro
   715 Richmond Street
   519-432-2191
   Dutch and Indonesian food.
   Dinner entrees: $20-$30.
   www.dragonflybistro.ca

7. Masonville Place
   Corner of Richmond Street and Fanshawe Park Road
   The Mall includes a food court and Milestones Restaurant. Shopping centres adjacent to the mall also contain many chain restaurants. Paul N Yu (Chinese) and Kelsey's are to the east;

north side of Fanshawe Park Rd includes East Side Mario's, Jack Astor's, and Swiss Chalet; west side of Richmond Street has Tony Roma's, and Richie's.
Milestones (www.milestonesrestaurants.com) is an upscale continental restaurant.
Note that you would need to take the northbound Wellington 13 from in front of Delaware Hall to reach Masonville Place.

8. Black George
   349 Talbot St
   519-672-5862
   Eastern European cuisine & cocktails are presented with modern flair in sophisticated surroundings.
   Dinner entrees: $12-$25
   http://www.blackgeorge.ca/

9. The Raja
   428 Clarence Street
   519-601-7252
   Indian fine dining experience in a luxurious setting. Specialities Include Tandoori Chicken (on sizzling platter), Fish Tikka, and Bengal Duck.
   Dinner entrees: $15-$25
   www.rajafinedining.ca

10. Spageddy Eddy's
    428 Richmond St
    519-645-3002
    Rustic standby decorated with quirky memorabilia & serving hefty plates of pasta dishes.
    Dinner entrees: $10-$20
    http://www.spageddyeddys.ca/

11. Veg Out
    646 Richmond Street
    519-850-8688
    Vegan Restaurant.
    Dinner entrees: $15-$20
    www.vegoutrestaurant.com

12. Zen Gardens
    344 Dundas Street
    519-433-6688
    Purely vegetarian restaurant, with Chinese, Thai, and Japanese dishes. Highest quality vegetarian food selection in London. Note that you should take the Dundas 2 bus from the Natural Sciences Building for a direct route.
    Dinner entrees: $10-$15
    www.zen-garden.ca

13. Milos' Craft Beer Emporium
    420 Talbot Street North
    519-601-4447

Excellent beer selection and fresh, delicious, local food. Definitely a pub atmosphere - very loud.
Dinner entrees: $13-$25
www.pubmilos.com

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