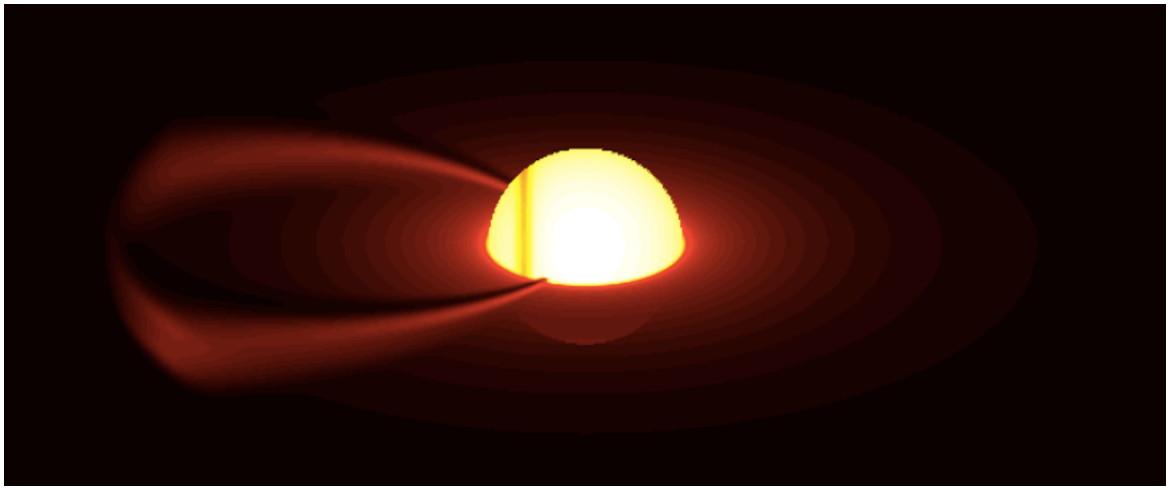
Bright Emissaries

BE STARS AS MESSENGERS OF STAR-DISK PHYSICS

August 11-13th, 2014
London, Ontario, Canada



Western

Western
UNIVERSITY · CANADA

v2.3 August 11, 2014

To the scientific career of Mike Marlborough.

To the memory of Stan Štefl and Olivier Chesneau.

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 6 and the map on page 7 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 Sunday, August 10th, from 7-9pm in the first floor atrium of the PAB. You should find a drink ticket in your registration package. There will also be hors d'oeuvres and a cash bar.

- **Registration:** You can register for the conference at any time during the *Opening Reception* on Sunday and between 8am and 9am on the first full day of the conference.

- **Internet Access:** Western is a member of eduroam (www.eduroam.org). If your institution is also a participant, you should be able to use your home institution login credentials to access our local wireless network. Alternatively, you can request local login credentials, valid for the duration of the conference, at registration.

- **Talks:** All talks are to be held in PAB Room 106. Invited talks are 40 minutes plus 10 minutes of discussion. Contributed talks are 15 minutes plus 5 minutes of discussion. The talk schedule can be found starting on page 8 and talk abstracts, starting on page 12.

  Speakers can use their own computers to present their talks. Alternatively, speakers can send their talk (pdf, powerpoint or keynote) to the LOC (bestars2014@gmail.com), and it will be loaded on a local Mac or PC to be used for the talk.

  $\Rightarrow$ *All speakers are urged to send a pdf of their talk to the LOC prior to the conference. These will be loaded on a local machine to be used as an emergency backup for your presentation.*

- **Poster Sessions:** There are two poster sessions per day. All posters will be displayed in the first floor atrium of the PAB. The maximum allowable size for a poster is 3 feet wide by 4 feet high (91 by 122 cm). Note that this is slightly larger than the A0 standard. The attachment surface is solid so tape is required. The LOC will have an ample supply of materials. Posters must be removed by 6pm 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 38, 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:** Two daily coffee breaks will be held in the first floor atrium of the PAB. Complimentary coffee and snacks will be available. Coffee will also be available in Room 106 during the conference.

- **Banquet:** The conference banquet will be held at 7pm on Tuesday, August 12th, at Windermere Manor, a short 15 minute walk from the Physics & Astronomy Building. The dinner is buffet-style with vegetarian options. Complementary wine will be served. Additional banquet tickets can be purchased upon arrival from the LOC at a price of $65 (CDN) each.

- **Group Photo:** The group photo will be taken during the afternoon coffee break of day one (3:30pm), in front of the PAB. The photo will be posted in the morning of day two for participants to self-identify. Unidentified participants will have names assigned using the RAN2 random-number generator of *Numerical Recipes,* thus eliminating the LOC from any responsibility for errors.

- **Local Organizing Committee:** Your hosts for the Bright Emissaries conference are students and faculty from Western's Physics & Astronomy Department. They will be wearing name tags with red lettering. 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 consists of the following members:

  Ahmed Ahmed, Richard Cyr, Bethany Grzenia, Carol Jones, Parshati Patel, Ethan Rowe, Jessie Silaj, Aaron Sigut, and Henry Leparskas.

  LOC member Aaron Sigut can be reached at 226-377-7071 (cell) for assistance.

  Thanks also to Robbie Halonen who put together the conference poster.

- **Scientific Organizing Committee:** The scientific organizing committee has been responsible for setting the scientific tone of the meeting and selecting speakers. The SOC consists of the following members:

  - **Carol Jones** (Canada, Co-Chair)
  - **Virginia McSwain** (USA)
  - **Thomas Rivinius** (Chile)
  - **Aaron Sigut** (Canada, Co-Chair)
  - **Philippe Stee** (France)
  - **Richard Townsend** (USA)
  - **Chris Tycner** (USA)

- **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. Ontario Hall, the site of on-campus housing, is near the lower left, just below the Sarnia Road label. Ontario Hall to PAB is also a ≈15 minute walk. Note that the corner of Sarnia and Western Road is a busy intersection.

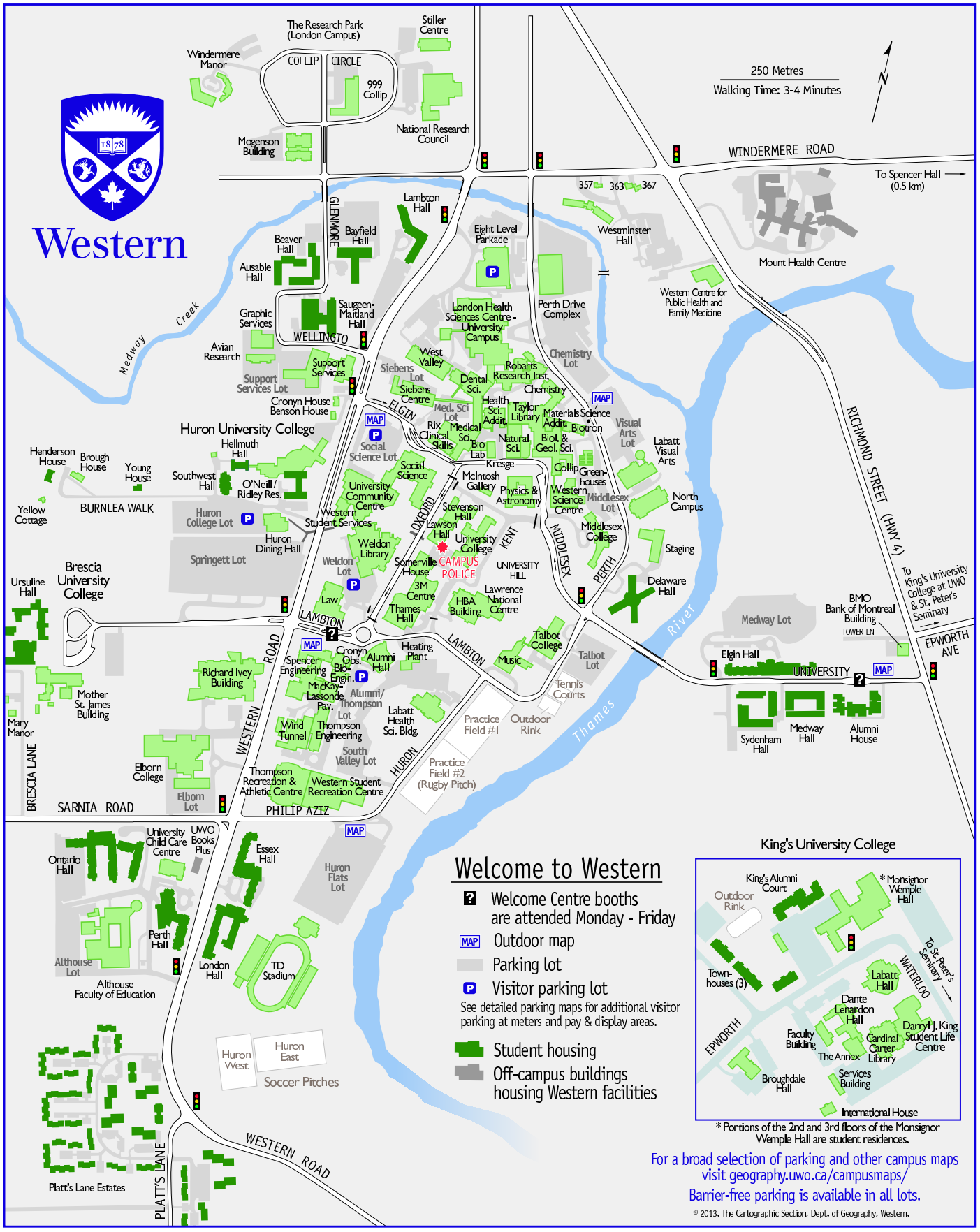
  If you are a runner (or walker), there is an extensive trail system along the east bank of the Thames River, near campus. Contact the LOC for details.

  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. Cash fare is $2.75 with **exact change** required. 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
The Research Park (London Campus)
Stiller Centre
Windermere Manor
COLLIP
CIRCLE
999 Collip
National Research Council
Mogenson Building
WINDERMERE ROAD
To Spencer Hall (0.5 km)
357
363
367
Lambton Hall
GLENMORE
Bayfield Hall
Beaver Hall
Ausable Hall
Eight Level Parkade
Westminster Hall
Mount Health Centre
Western Centre for Public Health and Family Medicine
Perth Drive Complex
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
Chemistry Lot
West Valley
Siebens Lot
Siebens Centre
Dental Sci.
Robarts Research Inst.
Chemistry
Med. Sci Lot
Health Sci. Addit.
Taylor Library
Materials Science Addit.
Biotron
Rix Clinical Skills
Medical Sci.
Bio Lab
Natural Sci.
Biol. & Geol. Sci.
Visual Arts Lot
Labatt Visual Arts
ELGIN
Huron University College
Hellmuth Hall
Social Science Lot
Social Science
Kresge
Collip Greenhouses
Henderson House
Brough House
Young House
Southwest Hall
O'Neill / Ridley Res.
McIntosh Gallery
Physics & Astronomy
Western Science Centre
Middlesex Lot
North Campus
Yellow Cottage
BURNLEA WALK
Huron College Lot
Western Student Services
Huron Dining Hall
University Community Centre
Stevenson Hall
Lawson Hall
University College
OXFORD
KENT
MIDDLESEX
PERTH
Middlesex College
Staging
Springett Lot
Weldon Library
Weldon Lot
Somerville House
CAMPUS POLICE
UNIVERSITY HILL
Brescia University College
Ursuline Hall
3M Centre
Thames Hall
Lawrence National Centre
HBA Building
Delaware Hall
Law
LAMBTON
RICHMOND STREET (HWY 4)
To King's University College at UWO & St. Peter's Seminary
BMO Bank of Montreal Building
TOWER LN
EPWORTH AVE
Medway Lot
Thames River
Elgin Hall
UNIVERSITY
Richard Ivey Building
ROAD
Spencer Engineering
Cronyn Obs.
Bio-Engin.
Alumni Hall
Heating Plant
Talbot College
Music
Talbot Lot
Tennis Courts
MacKay-Lassonde Pav.
Alumni/ Thompson Lot
Mother St. James Building
Mary Manor
WESTERN
Wind Tunnel
Thompson Engineering
Labatt Health Sci. Bldg.
Practice Field #1
Outdoor Rink
Sydenham Hall
Medway Hall
Alumni House
BRESCIA LANE
South Valley Lot
HURON
Practice Field #2 (Rugby Pitch)
Elborn College
Elborn Lot
Thompson Recreation & Athletic Centre
Western Student Recreation Centre
SARNIA ROAD
PHILIP AZIZ
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
Outdoor map
Parking lot
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
*Monsignor Wemple Hall
Outdoor Rink
Town-houses (3)
To St. Peter's Seminary
WATERLOO
Labatt Hall
Dante Lenardon Hall
EPWORTH
Faculty Building
Cardinal Carter Library
Darryl J. King Student Life Centre
The Annex
Broughdale Hall
Services Building
International House
*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.

Bright Emissaries, Day One: Monday, August 11, 2014
Room 106, Physics & Astronomy Building
Session Chairs: Morning (Tycner); Afternoon (Rivinius)

8:00am	8:45am		*Registration*	
8:45am	8:50am		*Welcome*	
8:50am	9:00am		*Dedication*	*To the scientific career of Mike Marlborough*
9:00am	9:50am	I1	**Stan Owocki**	The Broader Relevance of Be Stars for Stellar & Disk Physics
9:50am	10:10am	C1	Thomas Rivinius	The Variable Equatorial Velocity of Achernar
10:10am	10:30am	C2	Diego Castaneda	Modelling Observable Properties of Rapidly Rotating Stars
10:30am	10:50am		*Coffee/Posters*	
10:50am	11:10am	C3	Anahi Granada	Evolution of Intermediate-Mass Rotating Stellar Populations
11:10am	11:30am	C4	Michel Cure	Radiation Driven Wind Solutions and Applications
11:30am	11:50am	C5	Nathaniel Kee	Pulsational Mass Ejection and Radiative Ablation in Be Star Disks
11:50am	12:10pm	C6	Richard Townsend	GYRE: A New Tool for Exploring Be-Star Oscillations
12:10pm	2:00pm		*Lunch*	
2:00pm	2:50pm	I2	**Jon Bjorkman**	Be Disk Growth and Dissipation: Clues to Star-Disk Interactions
2:50pm	3:10pm	C7	Daniel Moser Faes	The Recent Disk Evolution of Achernar
3:10pm	3:30pm	C8	Nicholas Hill	Hyper-Spectral Synthesis of Active OB Stars Using GLaDoS
3:30pm	4:30pm		*Coffee/Posters*	
4:30pm	4:50pm	C9	Anatoly Miroshnichenko	Binaries Among Be Stars: Current Status and Recent Findings
4:50pm	5:10pm	C10	Despina Panoglou	Exploring the Conditions Governing the Mass Transfer in Binaries
5:10pm	5:30pm	C11	Richard Cyr	The Gravitational Effect of Close Binaries on Be Stars

Bright Emissaries, Day Two: Tuesday, August 12, 2014
Room 106, Physics & Astronomy Building
Session Chairs: Morning (Jones); Afternoon (Stee)

8:50am	9:00am		*Dedication*	*To the memory of Stan Štefl*
9:00am	9:50am	I3	**Gail Schaefer**	Properties of Be Star Disks at High Spatial Resolution
9:50am	10:10am	C12	Amber Boyer	Properties of the Be Star Disks in h and χ Persei
10:10am	10:30am	C13	Chien-De Lee	Dust Formation in Be Stars with Large Near-IR Excess
10:30am	10:50am		*Coffee/Posters*	
10:50am	11:10am	C14	Bethany Grzenia	The Disks Around 48 Per and ψ Per
11:10am	11:30am	C15	Jeffrey Fung	Irradiation Instabilty on the Surface of Decretion Disks
11:30am	11:50am	C16	Robert Klement	Detailed Modelling of β CMi
11:50am	12:10pm	C17	Rodrigo Georgetti Vieira	Non-isothermal Effects on Be Disks
12:10pm	2:00pm		*Lunch*	
2:00pm	2:50pm	I4	**Atsuo Okazaki**	Current Status of Our Understanding of Be Disk Physics
2:50pm	3:10pm	C18	Cyril Escolano	2.5D Global Disk Oscillation Models for ζ Tauri
3:10pm	3:30pm	C19	Petr Kurfürst	Hydrodynamic Modelling of Large Circumstellar Disks
3:30pm	4:30pm		*Coffee /Posters*	
4:30pm	4:50pm	C20	John Wisniewski	Disk-Loss and Disk-Renewal Phases in Classical Be Stars
4:50pm	5:10pm	C21	Leandro Rocha Rimulo	A Semiautomatic Pipeline for Be Star Light Curves
5:10pm	5:30pm	C22	Carol Jones	Be Star Disks from a Polarimetric Perspective

Bright Emissaries, Day Three: Wednesday, August 13, 2014
Room 106, Physics & Astronomy Building
Session Chairs: Morning (Sigut); Afternoon (McSwain)

8:50am	9:00am		*Dedication*	*To the memory of Olivier Chesneau*
9:00am	9:50am	I5	(**Christophe Martayan**)[1]	Be Stars Through the Telescope: An Observational Review
9:50am	10:10am	C23	Gkouvelis Leonardos	IPHAS Be Stars of the Northern Galactic Plane
10:10am	10:30am	C24	Warren Reid	Newly Discovered Be Stars in the Large Magellanic Cloud
10:30am	10:50am		*Coffee/Posters*	
10:50am	11:10am	C25	Samer Kanaan	The New Upcoming Be Stars Southern Survey
11:10am	11:30am	C26	Gregg Wade	Magnetic Fields of Be Stars from the MiMeS Project
11:30am	11:50am	C27	Myron Smith	Turning the Tide: The Origin of Hard X-Rays in γ Cas
11:50am	12:10pm	C28	Jesse Golden-Marx	Discovery of the Earliest Type Oe Stars in the SMC
12:10pm	2:00pm		*Lunch*	
2:00pm	2:50pm	I6	**Astrid Lamberts**	Interacting Binaries: Be Stars and High-Energy Astrophysics
2:50pm	3:10pm	C29	Michael Alexander	Fermi Gamma-ray Observations of Be Binary Systems
3:10pm	3:30pm	C30	Mira Grudzinska	On the First Be Star in a Black Hole Binary: MWC 656
3:30pm	3:50pm	C31	Matthew Shultz	The Centrifugal Magnetospheres of Bp Stars
3:50pm	4:10pm	C32	Chris Bard	X-ray Emission of Centrifugal Magnetospheres
4:10pm	4:40pm		*Coffee /Posters*	
4:40pm	4:45pm		*Student Awards*	Best student talk / Best student poster
4:45pm	5:00pm		*Closing*	

[1] *Unfortunately, Christophe is unable to attend. His talk will be presented by Thomas Rivinius and Dietrich Baade.*

Poster Contributions

P1	Alex Carciofi	Be Atlas - A Grid of Be Star Models
P2	Ahmed Ahmed	Nitrogen Abundances in Rapidly Rotating B Stars
P3	Jose Pena	Cluster Membership of Be, Ap and Blue Stragglers in Open Clusters
P4	Catalina Arcos Carvajal	Statistical Study of Be Stars
P5	Karen Bjorkman	Variable Circumstellar Disks of Classical Be Stars within Clusters
P6	Chien-De Lee	Searching for Be Stars in the Open Cluster NGC 663
P7	David Bohlender	Searching For and Monitoring Ae and A Shell Stars at the DAO
P8	Aaron Sigut	The Hα Shell Parameter as a Test of Be Disk Scale Heights
P9	Klara Sejnova	Dynamical Evolution of the Disk of the Be Star 60 Cygni
P10	Bruno Correia Mota	A Multi-technique Study of the Circumstellar Disk of Alpha Arae
P11	Jessie Silaj	The Circumstellar Disk of 48 Librae
P12	Parshati Patel	The Inner Gaseous Disk of the Herbig Be Stars
P13	Ethan Rowe	Modelling CQEs in Be Star Spectra
P14	Yuki Moritani	Photometric & Polarimetric Observations of Be/X-ray and Be/gamma-ray Binaries
P15	Sally Oey	Oe/Be Stars in the RIOTS4 Survey of Field SMC OB Stars
P16	Myron Smith	A Census of the X-ray-active Class, γ Cas Stars
P17	Matthew Shultz	Discovery of Magnetospheric Emission Around the Early B-Type Star ALS 3694
P18	Thomas Rivinius	OHANA: The Observatory Survey at High ANgular Resolution of Active OB Stars
P19	Mohammad Ghoreyshi	Modeling the Full Lightcurve of ω CMA
P20	Larson Folsom	Spectroscopic monitoring of β Canis Minoris in the 21st century

Invited Talks

I1: Stan Owocki, Bartol Research Institute, University of Delaware, USA

The Broader Relevance of Be Stars for Stellar and Disk Physics

As the most rapidly rotating class of non-degenerate stars, Be stars provide an important testbed for understanding the role of rapid, near-critical rotation on stellar structure and evolution, including stellar pulsation, mixing, and possibly a magnetic dynamo and associated stellar activity. Moreover, the characteristic line emission of Be stars provides a direct diagnostic of the gaseous circumstellar disk that is nowadays generally understood to originate from "*decretion*" of material from the rapidly rotating stellar surface. This emission, along with other circumstellar diagnostics, often show extensive variability on time scales ranging from days to decades, providing important, dynamical constraints on the source, sinks, and transport of disk mass associated with phases growth and decay of the emission. Be decretion disks thus represent an important testbed for understanding the viscous diffusion processes that are central to operation of *accretion* disks in broad classes of astrophysical objects, including protostars, mass exchange binaries, and even active galactic nuclei.

I2: Jon Bjorkman, Ritter Observatory, University of Toledo, USA

Be Disk Growth and Dissipation: Clues to the Star-Disk Interaction

In the past few years there has been increasing evidence that the circumstellar disks of Be stars are well-described by the viscous decretion disk model (VDDM). The VDDM is a physical model of the disk fluid dynamics that allows us to predict the time-dependent evolution of the disk structure for a given a mass injection history. When combined with a 3-D NLTE radiative transfer code, we are now able to make accurate predictions of time-dependent observables such as photometric light curves, V/R variations, spectropolarimetry, and spectrointerferometry. Particularly interesting are those Be stars that are in the transition phases of losing or rebuilding their disk. By modelling observables that probe differing regions of these disks, we can begin to investigate how much mass is deposited into the disk during a Be outburst along with its subsequent redistribution within the disk. In this talk I will review what the modelling of these observations is revealing about how the disk is built, how it dissipates, and the clues this provides about the physical interaction between the star and the disk.

I3: **Gail Schaefer**, CHARA / Mount Wilson Observatory, USA

Properties of Be Star Disks at High Spatial Resolution

I will present an observational overview of the properties of Be star disks. The presence of circumstellar gas can be inferred from double-peaked emission line profiles, infrared excesses, and linear polarization. High spatial resolution interferometric observations have confirmed that the gas exists in a flattened disk. The geometry and angular size of the disks at different wavelengths can be used as additional input in determining the density structure of the disks. The combination of spectroscopy and interferometry can be used to study the kinematics of the rotating disks and investigate asymmetries that arise from one-armed density waves in the circumstellar material.

I4: **Atsuo Okazaki**, Hokkai-Gakuen University, Japan

Current Status of Our Understanding of Be Disk Physics

I review the current theoretical understanding of physical processes at work in circumstellar disks of Be stars. In the first part, I overview the viscous decretion disk scenario, which provides a platform on which various phenomena/observational features are studied. I discuss how a disk forms, develops, and dissipates by the effect of viscosity, and present a few applications, such as modelling of light curves and spectra of individual Be stars, a global disk oscillation model for line profile variability, and a truncated disk model for binary Be stars, all of which can be used to constrain the basic disk parameters. Phenomenologically, the viscous decretion disk scenario is thus successful. There are, however, fundamental issues that remain to be solved. They include the mass ejection mechanism from the central star, the origin of disk viscosity, and the interaction with a (clumpy) stellar wind. The study of the radiative effect on the disk dynamics is also important in the context of disk warping and precession. The second part of the talk is devoted to these topics.

I5: **Christophe Martayan**, European Southern Observatory, Chile

Be stars Through the Telescopes: An Observational Review

Last decades a lot of progress was made on the understanding of Be stars, of their physics including the one of their disks. Those improvements came with an increase of the knowledge of the techniques of the instruments and their capability. For instance multi-wavelength and multi-technique observations combined to new models allowed describing better the Be stars and to give some light on their ongoing physical processes. Owing to the new observatory facilities, individual stars were as well observed in other galaxies. Therefore, it became possible to study the extragalactic Be stars, especially in the Magellanic Clouds that serve as test bench. In this review we will browse those aspects, discuss the current limits of our knowledge and present future observational challenges.

I6: Astrid Lamberts, Parker Centre for Gravitation, Univ. of Wisconsin, USA

Interacting Binaries: Be Stars and High-Energy Astrophysics

Advances in X-ray and gamma-ray astronomy have opened a new window on our universe and revealed a wide variety of binaries composed of a compact object and a Be star. In Be X-ray binaries, a neutron star accretes the Be disk and truncates it through tidal interactions. Such systems have important X-ray outbursts, some related to the disk structure. In other systems, strong gamma ray emission is observed. In those systems, the neutron star is not accreting but driving a highly relativistic wind. The wind collision presents similarities to colliding wind binaries composed of massive stars. The high energy emission is coming from particles being accelerated at the relativistic shock. In this talk, I will review the physics of X-ray and gamma-ray binaries, focusing particularly on the recent developments on gamma-ray binaries. I will describe physical mechanisms such as relativistic hydrodynamics, particle acceleration, magnetic fields, tidal forces and non thermal emission. This will highlight how high energy astrophysics can shed a new light on Be star physics.

Contributed Talks

C1: Thomas Rivinius, ESO, Chile
The Variable Equatorial Velocity of Achernar

In the Be star Achernar a variable width of photospheric lines (typically expressed a v sin i) of the order of 35km/s has been found that seems to correlate positively with the emission status of the circumstellar disk. After the first report by Rivinius et al. (2014, A&A, 559L, 4), based on archive data, we have continued to observe Achernar in its current active state, and adapted our modeling techniques to better understand the physical process behind this seeming change of rotational velocity. In this contribution the current status of the analysis will be reported.

C2: Diego Castaneda, Saint Mary's University
Modelling Observable Properties of Rapidly Rotating Stars

Be stars are frequently found to be rapidly rotating. Thus, to fully understand the Be star phenomenon, one must have a reasonable degree of knowledge about the star beneath the disk. Rapid rotation complicates modelling Be stars because fundamental properties like the stellar luminosity and effective temperature require knowledge of the angle of inclination at which the star is observed. Furthermore our knowledge of the structure of rapidly rotating stars is on a less sure foundation than for non-rotating stars. The uncertainties in the inclination and the surface properties of a few rapidly rotating stars have been substantially reduced by interferometric observations over approximately the last decade, and these stars can be used as tests of rotating stellar models, even if those stars themselves may not be Vega, as an MK standard, is historically a very important star because it is used for calibration purposes. However, several studies have suggested that Vega is a rapidly rotating star viewed at a very low inclination angle, raising questions as to how well we really know its properties. Appropriate modelling has been challenging and there is still room for debate over the actual properties of Vega, as opposed to its observed properties. We have previously shown that under certain conditions both the stellar surface properties and the deduced surface properties scale from one model to another with the same surface shape. We used this scaling algorithm with realistic 2D models to compute high-resolution spectral energy distributions and interferometric visibilities to determine the best rotating model fit to Vega. Detailed comparisons between the computed and observed data will be presented.

C3: Anahi Granada, Geneva Observatory, Switzerland
Evolution of Intermediate-Mass Rotating Stellar Populations: rotational properties, surface abundances and their link to the Be-phenomenon

Stellar rotation plays a relevant role in the evolution of stars: not only it modifies their mass, angular momentum and energy content, but also affects their lifetimes, their surface chemical enrichment, their circumstellar environment, as well as the final fate of the star. Therefore, rotation leaves an imprint on stars that deeply affects the observed characteristics of stellar clusters and galaxies. In particular, the range of intermediate mass stars, corresponding to B-type stars, has proved to be a unique laboratory to study the physics of stellar rotation and its impact on environments of different age and metallicity. We have computed through the last few years grids of stellar evolution models for masses between 1.7 and 15 solar masses with different metallicities and rotational rates at the Zero Age Main Sequence (ZAMS). By using these grids and our new Geneva Population Synthesis Code (SYCLIST) we produce synthetic stellar populations, fully accounting for stellar rotation effects, and study their evolution in time. By assuming initial mass and rotational velocity distributions at the ZAMS, we show how the fraction of rapidly-rotating stars and of surface-enriched stars evolve with time. We compare our theoretical results with observed rotating populations, in particular with that of single Be stars.

C4: Michel Cure, Universidad de Valparaiso, Chile
Radiation driven wind solutions and applications

The standard modified-CAK equation of motion is a very non-linear differential equation that posses many singular points and therefore many solutions. Besides the standard Solution (Friend & Abbott 1986) we have found other 3 physical solutions: i) when the rotational velocity is higher than 3/4 of the critical rotational speed; ii) when thoughout, the wind is a higher ionisation change; and iii) when the k line force parameter is high (k is the fraction of the total stellar flux which would be blocked already in the photosphere if all lines were optically thick). We also show some applications of these solutions, e.g, the wind of a B[e] supergiant, the oblate wind of a Be star and the wind of BA supergiants. Furthermore we will show some spectra obtained with FASTWIND where we have used as input our hydrodynamical new solutions.

C5: Nathaniel Dylan Kee, University of Delaware, USA
Pulsational mass ejection and radiative ablation in Be star decretion disks

Despite extensive observations of Be stars and their circumstellar environments, the origins and variations of Classical Be decretion disks are still not fully understood. This talk will discuss dynamical simulations of a Pulsationally Driven Orbital Mass Ejection (PDOME) model, which builds such disks through a combination of non-radial pulsation modes and rapid rotation. It will also examine the role of radiative ablation in the decay of the inner disk during epochs of weak or no mass ejection, with emphasis on the conditions for which this can enhance the usual decay by viscous diffusion.

C6: Richard Townsend, Univeristy of Wisconsin-Madisen
The GYRE Code: A New Tool for Exploring Be-Star Oscillations

In recent decades a consensus has emerged that non-radial oscillations are a ubiquitous feature of Be stars. In this presentation I'll describe my new GYRE code, which can be used to explore these oscillations in detail and investigate putative links with the still-elusive Be-disk formation mechanism. Given an input stellar model produced by an evolutionary code (e.g., MESA), GYRE calculates the oscillation eigenfrequency spectrum and corresponding eigenfunctions. The code is straightforward to use, but is nevertheless very powerful due to new solution algorithms which are accurate, robust and computationally efficient. The effects of non-adiabatic processes are included, allowing determination of the stability/instability of different types of oscillation mode, and a number of different prescriptions are provided for modeling the impact of rapid rotation. GYRE is freely available under an open-source license, and supports a growing community of users.

C7: Daniel Moser Faes, IAG-USP and OCA-UNS, Brazil/France
The Recent Disk Evolution of Achernar

Be stars are known to be fast rotators. At high rotation rates a profound modification of the radiation field reaching the circumstellar environment is expected. Here we discuss the effects of rotation on the structure of Be star disks based on the Viscous Decretion Disk (VDD) model. The new active phase of the Be star Achernar (2013-present) is used as an example of these effects on observables, such as interferometry, spectroscopy and polarimetry. Achernar's recent outburst offers us a rare opportunity to evaluate the process governing the circumstellar material in the close vicinity of the stellar photosphere.

C8: Nicholas Hill, University of Wisconsin-Madison, USA
Hyper-Spectral Synthesis of Active OB Stars using the GLaDoS Code

In recent years there has been considerable interest in using graphics processing units (GPUs) to perform scientific computations that have traditionally been handled by central processing units (CPUs). However, there is one area where the scientific potential of GPUs has been overlooked — computer graphics, the task they were originally designed for. Here we introduce GLaDoS, a hyper-spectral code which leverages the graphics capabilities of GPUs to synthesize spatially and spectrally resolved images of complex stellar systems. We demonstrate how GLaDoS can be applied to calculate observables for three different classes of active OB stars: rapidly rotating stars, non-radially pulsating stars, and close binary stars with surface flows driven by irradiation.

C9: Anatoly Miroshnichenko, University of North Carolina, USA
Binaries among Be stars: Current status and recent findings

Binarity as an explanation of some observed properties of Be stars, such as the fast rotation and the presence of circumstellar disks, was suggested nearly 40 years ago. Although not well accepted initially because of the lack of supporting data, this hypothesis gained solid grounds with the advent of high resolution spectroscopy. Many bright Be stars have been recognized as primary components of binary systems over the last two decades. I will review the current binary statistics among Be stars, discuss methods of detecting binaries, and briefly present recent results on newly found binary systems.

C10: Despina Panoglou, IAG/USP, Brasil
Exploring the Conditions Governing the Mass Transfer in Binary Systems

Be stars are often members of binary systems, with their decretion disk in the role of the mass repository from which matter is accreted to the companion star, be it a compact object emitting X-rays or a hot subdwarf O star that emits in the UV range. In the past, a smooth particle hydrodynamics model has been used to explore the effect of the value of viscosity, assuming that the disk is isothermal and the two stars have co-planar and aligned orbits. In this work we are going to use the same smooth particle hydrodynamics model, in order to explore the evolution of the system more thoroughly, not only expanding to further ranges of the parameter space, but also in cases of counter-aligned and misaligned orbits. In selected snapshots of the evolution of the system we are going to calculate the thermal profile of the disk and produce the observables with an external three-dimensional radiation transfer model. With those tools, we expect to reproduce the phase perturbations observed in Be stars, as well as examine the conditions that provoke the variations in the morphology of their decretion disks, and the evolution of binary systems in general.

C11: Richard Cyr, Western University, Canada
A study of the gravitational effect of a close binary companion on the dynamics of Be star disks.

The study of the gas structure and dynamics of Be star disks is critical to our understanding of the Be star phenomenon. The central star is the major force driving the evolution of these disks. However other external forces, for example the presence of a binary companion, can also affect the formation of the disk. My current work involves studying the gravitational effects due to a low-mass companion on the structure and dynamics of these disks and the resulting signatures on the observables. In this talk I will highlight my preliminary results due to these binary companions on typical Be star disks.

C12: Amber Boyer, Kutztown University
Physical Properties of the Be Star Disks in h and χ Persei

We present new results in our on-going analysis of the B-type and Be star populations of the double open clusters h and χ Persei. As these clusters are rich is massive B-type and Be stars, they present an optimal location for studying the physical properties and variability of these disk structures. In previous analysis we have established physical properties, including $v \sin i$, $T_{\rm eff}$, $\log g_{\rm polar}$, $M_{\rm star}$, and $R_{\rm star}$, for each B-type and Be star in our sample. In this work we continue our study of the cluster Be stars by examining the disk spectral energy distributions (SEDs) via observations from WEBDA, 2MASS, Spitzer, AKARI, and WISE. We also present multiple observations of Hα taken between 2009-2012 with the KPNO Coude Feed, KPNO 2.1m, and WIRO telescopes. We use the Hα equivalent width model of Grundstrom & Gies and the infrared flux model of Touhami et al. to constrain the disk masses, radii, and densities for our Be star sample. Our results show a systematic, order of magnitude discrepancy between the disk densities predicted by the Grundstrom & Gies models, and those which appear to match with the observed infrared flux excess.

C13: Chien-De Lee, Graduate Institute of Astronomy, National Central University, Taiwan
Dust Formation in Be Stars with Large Near-Infrared Excess

We report on scrutiny of a class of Be stars which have prominent infrared excess emission, yet are away from any star-forming regions. Most of these stars show forbidden lines in the spectra and are among the strongest Balmer emitters. Their infrared excess, with near-infrared colors J-H and H-Ks both greater than 0.7 mag, and extending to mid- or even far-infrared wavelengths, cannot be explained by free-free emission alone, and must be accounted for by dust thermal emission. The gas emission activity is found to correlate with dust emission: (1) stars with Balmer lines (at least to Hγ) all in emission tend to have the largest infrared excess, (2) stars with only Hα in emission have moderate infrared excess, and (3) those with little emission activity have the least amounts of infrared excess. A comprehensive "neighborhood census" excludes the possibility of their pre-main sequence status, so these Be stars must have evolved beyond the pre-main sequence stage, perhaps near the terminal main sequence, and condense dust in situ in their expanding envelopes. The freshly made grains could be very small in size, and distributed in a compact disk configuration, in contrast to the case in pre-main sequence Herbig Ae/Be stars that inherit dust grains grown since in parental molecular clouds. This class of main sequence stars hence serves as an additional source of cosmic dust production to the usual post-main sequence stars.

C14: Bethany Grzenia, Western University, Canada
Investigating the Disks Surrounding B-emission Stars 48 Persei and ψ Persei

The Be stars 48 Persei and ψ Persei are thought to have mid-B spectral types but respectively their disks are viewed as nearly pole-on, and nearly edge-on. The two stars were investigated in 2011 by Delaa et al., using the VEGA/CHARA interferometer in the Hα emitting region. This study uses a much more extensive set of observations taken at NPOI along with contemporaneous Hα spectroscopy for both stars. The large data set will provide tight constraints for probing the disk systems using the radiative transfer codes BEDISK and BERAY. Detailed models produced in this study will be compared with the findings of the previous study.

C15: Jeffrey Fung, The University of Toronto, Canada
Irradiation Instability on the Surface of Decretion Disks

An instability can potentially operate in highly irradiated disks where the disk sharply transitions from being radially transparent to opaque. We term this instability the 'irradiation instability', or IRI. We have previously demonstrated that the inner edges of accretion disks can undergo IRI and develop highly asymmetric structures. In this talk I will review the mechanism that drives IRI, and discuss the possibility of IRI acting on the surface of highly irradiated decretion disks, such as those around Be stars.

C16: Robert Klement, Charles University in Prague, Czech Republic
Detailed modeling of β CMi: a multi-technique test of the viscous decretion disk scenario

The close and bright B8Ve star β CMi represents a perfect laboratory to study the detailed structure of a stable, unperturbed disk which is not truncated by a close binary companion. The NLTE Monte Carlo radiative transfer code HDUST is used to model the SED from UV up to cm wavelengths along with visual spectroscopy, polarimetry and near-IR interferometry. Special focus is put on testing the viscous decretion disk (VDD) scenario in the outer parts of the disk, which are observed in the far-IR and radio wavelengths. With the available data we are able to put constrains on the physical extent of the disk for the first time.

C17: Rodrigo Georgetti Vieira, University of Sao Paulo, Brazil
Non-isothermal effects on Be disks: observations finally meet theory

The Be phenomenon is characterized by the ejection of gaseous material from early type stars close to critical rotation. This episode of mass ejection originates a decretion disk, which rapidly acquires a quasi-keplerian kinematics structure due to the viscous diffusion process. The importance of non-isothermal effects on decretion disk models has been vastly demonstrated by several authors. However, no conclusive observational evidence of non-isothermal effects has been presented to date. We present a theoretical study of observational signatures of non-isothermality. Such signatures represent second order effects on the disk observables, and may lead to a first indirect detection of a non-isothermal structure. The disk observables were calculated with HDUST, a 3-D NLTE radiative transfer code capable of producing self-consistent models. Our theoretical results show the non-isothermal imprints on infrared excess and interferometric visibilities. These results are then compared to MIDI@VLTI data for β CMi and α Col.

C18: Cyril Escolano, IAG, Brazil
2.5D global disk oscillation models applied to the shell Be star Zeta Tauri

Zeta Tauri is a famous shell Be star. Thanks to its ideal position in the sky, it is observable from both northern and southern hemispheres, providing a rich data set. Its various observed peculiarities make Zeta Tauri a perfect laboratory for getting insight the physics of Be stars and testing theoretical models. Its most important feature are the so-called V/R variations, i.e., the quasi-cyclic variation of the ratio between violet and red peak intensities in HI lines observed in emission. These variations are the manifestation of a global disk oscillation, provoking important modifications of the density and velocity structures inside the disk. The shell nature of Zeta Tauri has - surprisingly - never been considered in a quantitative way before. In the simple case of an axisymmetric Keplerian disk, shell line profiles should be time-invariant. In reality, they are highly variable along the V/R cycle of Zeta Tauri, confirming the existence of non-circular motions inside the disk, as predicted by the global disk oscillation scenario. We shall present the results of a detailed spectroscopic analysis of Zeta Tauri, focusing on hydrogen Balmer lines. In a first step, the variations of their characteristics along the V/R cycle were quantified. In a second step, a combination of two different codes was used in order to model the observed variations; the opportunity to (i) check whether the density and velocity structures predicted by our models are correct; (ii) test a brand new "2.5D" disk oscillation formalism.

C19: Petr Kurfürst, Masaryk University, Brno, Czech Republic
Hydrodynamic modelling of large circumstellar disks

Massive stars may during their evolution reach the phase of critical rotation when further increase in rotational speed is no longer possible. Direct centrifugal ejection from a critically or near-critically rotating surface forms the gaseous equatorial decretion disk. Anomalous viscosity provides the efficient mechanism for transporting the angular momentum outwards. Near a star the disks are Keplerian, and it is expected that far from the star the disks become angular-momentum conserving, although this transitional feature is not very well understood theoretically nor it is observationally confirmed. We developed the numerical code for time-dependent hydrodynamical modelling including full Navier-Stokes shear viscosity calculation. We study the main physical characteristics, i. e. the density, the radial and rotational velocity as well as the mass and angular momentum loss rate. We examine their behaviour according to the variably parameterized distribution of temperature and viscosity up to the distance of several thousands stellar radii, where we may expect the disk equatorial density drops to some average interstellar medium density. Since the profile of the disk viscosity is not quite certain, we investigate the cases with various viscosity parameters for constant and also non-constant radial viscosity distribution. The sonic point distance strongly depends on temperature profile and is almost independent of viscosity. The rotational velocity at large radii rapidly drops accordingly to both temperature and viscosity distribution. The total amount of disk angular momentum increases with decreasing profiles of temperature and viscosity. Using our 2D code, we calculate the self-consistent distribution of temperature and density in the inner part of the disk for various mass-loss rates and various viscosity parameters assuming thermal and radiative equilibrium. The rate of viscous heat generation is calculated, and for the irradiative flux we account for the geometry of the critically oblated stellar body, including the effects of gravity and limb darkening.

C20: John Wisniewski, University of Oklahoma, USA
Disk-Loss and Disk-Renewal Phases in Classical Be Stars

Recent observational and theoretical studies of classical Be stars have established the utility of polarization color diagrams (PCD) in helping to constrain the time-dependent mass decretion rates of these systems. We discuss our observational study of this phenomenon, and report the detailed analysis of a long-term (1989-2004) spectropolarimetric survey of 11 classical Be stars, including systems exhibiting evidence of partial disk-loss/disk-growth episodes as well as systems exhibiting long-term stable disks. We discuss the evolution of these systems in PCD-space, and compare our results to the behavior predicted by theory. We also discuss the potential detection of polarimetric variability attributable to one-armed density structure in a Be disk, and our efforts to characterize the base densities and alpha parameters of our disk sample.

C21: Leandro Rocha Rimulo, Instituto de Astronomia, USP, Brazil
A Semiautomatic Pipeline for Investigating Light Curves of Be Stars

Observational and theoretical studies from the last decade have shown that the Viscous Decretion Disk (VDD) scenario is the only viable model for explaining Be circumstellar disks. In the alpha-disk model applied to the VDD scenario, the "viscosity parameter" carries the physics of the turbulent viscosity, and it is a very poorly determined parameter for Be disks. A statistically significant determination of this parameter for several Be stars is of great interest in understanding the physics of turbulent disks. The viscosity parameter has an hydrodynamical timescaling effect: the greater it is, the shorter the disk takes to build-up or dissipate. The viscosity parameter is, therefore, imprinted in the timescale of the variations in the light curves of Be stars. Thousands of light curves of Be stars, with known distance and reddening, from photometric surveys (e.g., OGLE, MACHO and EROS) are available.

C22: Carol Jones, Western University
Be Star Disks from a Polarimetric Perspective

The intrinsic linearly polarized light arising from electron scattering of stellar radiation in a non-spherically symmetric distribution of gas is a characterizing feature of classical Be stars. The distinct spectropolarimetric signature provides a means for directly probing the physical and geometric properties of the gaseous material enveloping these rapidly-rotating massive stars. Using a Monte Carlo radiative transfer computation and a self-consistent radiative equilibrium solution for the circumstellar gas, we explore the role of this observable property in investigating the dynamical nature of classical Be star disks. In particular, we focus on the spectropolarimetric potential for providing diagnostics of mass-loss events and for tracing the evolution of the gas in a circumstellar disk. This context for interpreting the observed linear polarization signature can play an important role in identifying the physical process(es) which govern the formation and dissipation.

C23: Gkouvelis Leonardos, University of Valencia, Spain
IPHAS Be Stars of the Northern galactic Plane on the BCD Classification System

We present an automatic spectral classification program, based on the Barbier-Chalonge-Divan (BCD) system. Our goal is to investigate the Galactic arms structure between $5^o < b < 5^o$ and $29^o < l < 215^o$ using the CBe stars of the INT Photometric H Survey of the northern Galactic plane (IPHAS) (Drew et al. 2005) as tracers. IPHAS has been going on since 2003 and the bright and clear emission line stars had been followed up spectroscopicaly by the FLWO 60" telescope and its FAST spectrograph from 2005 up to 2012, covering a population of 2627 objects. We present the analysis of the Be stars survey and the Galactic structure based on the CBe stars populations as tracers.

C24: Warren Reid, Macquarie University, Australia
Newly discovered Be stars in the Large Magellanic Cloud

The Large Magellanic Cloud (LMC) is a unique laboratory in which to study the peculiar characteristics of massive and luminous emission-line stars. In order to study the Balmer emission we have measured the Equivalent Width (EW) and Full Width Half Maximum (FWHM) of the Hα emission-lines for Be stars in the LMC. In addition, we measured the H-alpha fluxes from medium resolution spectroscopy of 518 of our recently discovered Be stars within the survey area. Velocities accurate to 4 km s^{-1} have been found for all the Be stars using both the weighted emission-line and cross-correlation techniques on our higher dispersion spectroscopic data. These velocities are used to search for kinematical substructures in the LMC disk, create a 3D kinematic map of the LMC for comparison with the HI disk, assist studies of age-metallicity dispersion and distribution, potentially find stellar associations and streams, and compare medium to old age populations such as planetary nebulae. We show the projected distribution of emission-line stars across the survey field of the LMC. By subtracting any ambient sky and any nebula contamination, we present the first luminosity function for these stars in the LMC. We report on the 130 or 22% of B stars which are type B[e], characterised by the presence of forbidden emission lines such as SII, NII and OII. We then assess the emission by comparing BVI photometry from SuperCOSMOS and OGLE-II data where available. We discuss the stellar photometry, its reliability and problems associated with variability.

C25: Samer Kanaan, Universidad de Valparaiso, Chile
The New Upcoming Be Stars Southern Survey

We present a new Be Stars Observation Survey in the southern hemisphere (BeSOS). the lack of spectroscopic follow up in the case of Be stars has limited the studies to a few variable Be stars, the aim of this catalogue is to observe in the visible range ($R = 20000$) at least 200 Be stars ($V < 6$) with a close follow up in order to constrain and study the variability. This catalogue will be the base of a statistical study on the 200 Be stars such as the distribution of vsini, variability, disk size. Furthermore, with our collaborators we will combine these observations with interferometric observations in order to constrain the size, inclination on part of the sample. Moreover we are planning to install in Chile a 50 cm telescope with a 20000 echelle spectrograph completely dedicated to the study of massive stars especially Be stars.

C26: Gregg Wade, RMC, Canada
Magnetic Fields of Classical Be stars From the MiMeS Project

(G.A. Wade, C. Neiner, J. Grunhut, E. Alecian, S. Owocki, V. Petit, T. Rivinius, R. Townsend and the MiMeS Collaboration)

In the context of the MiMeS survey of magnetism in massive stars, nearly 100 classical Be stars were observed in circular polarization with the aim of detecting magnetic fields at their surfaces. No direct evidence of such fields is found, in contrast to the significant rate of detection in non-Be stars. In this talk I will describe the sample properties, the detection methodology and the data quality. I will review the characteristics and robustness of this null result, and discuss its implications.

C27: Myron Smith, National Optical Astronomy Observatory, United States
Turning the Tide? New evidence for the origin of hard X-rays in gamma Cas

γ Cas is the prototype of a group of at least 12 noninteracting classical Be stars characterized by X-ray emission. Altogether, they probably contribute most of the hard X-rays emitted by massive stars in the Galaxy. The X-rays are variable on timescales from seconds to years, including ubiquitous "flares" with timescales of several seconds or less. X-ray spectra indicate multicomponent optically thin thermal emission, with the dominant one having a kT of at least 12-25 keV. The origin of the X-rays has been a subject of spirited debate. A number of optical/X-ray correlations have been found between broadband flux and spectroscopic line diagnostics. Monitoring over 17 seasons ($\approx$ 3262 observations) of gamma Cas with the Automated Photometric telescope indicates that the star's disk undergoes 3% variability cycles of 50-90 days. Also, we used the XMM-Newton satellite to monitor the star's X-rays during an optical outburst during 2010-2011. During this event the star/disk complex brightened and reddened while the soft X-ray flux attenuated due to an increased column density toward the of hard X-ray emission source(s). These discoveries indicate that the X-ray emission originates close to the outbursting Be star. We find also that the star exhibits a rotational modulation feature (P_{rot} = 1.215 days) which weakens between 2003 and 2005. This indicates that the putative magnetic surface structure responsible for the light modulation nearly disappeared during this period and could be the reason why recent spectropolarimetric observations did not detect a field.

C28: Jesse Golden-Marx, University of Michigan, USA
Discovery of the Earliest Type Oe Stars in the Small Magellanic Cloud

No classical Oe/Be stars earlier than type O7.5e have been identified to date in the Milky Way (MW). This is consistent with the decretion disk model because strong stellar winds cause early-type O stars to lose angular momentum, thereby preventing them from rotating fast enough to spin out decretion disks. However, metal-poor O stars have weaker stellar winds, thus allowing the stars to retain angular momentum. Therefore, low-metallicity environments should promote the formation of Oe stars, including those of earlier spectral types than observed at high metallicity. Using the RIOTS4 survey, a spatially complete sample of Small Magellanic Cloud (SMC) field OB stars, we identify 29 SMC field Oe stars, which account for 24% of SMC field O stars. This fraction is significantly higher than in the MW, where $< 10\%$ of O stars appear to display the Be phenomenon. We also present 7 Oe stars of spectral type ranging from O5e to O7e, all earlier spectral types than the earliest

C29: Michael Alexander, Lehigh University
Fermi Gamma-ray Observations of Be Binary Systems

We present a Fermi analysis of the gamma-ray source AGL 2241+4454, which is thought to coincide with the Be binary HD 215227 (MWC 656). AGL 2241+4454 was detected in a single flare in 2010 and was subsequently shown to coincide with the Be binary system, HD 215227 (MWC 656). In light of the discovery of HD 215227 as the first Be-black hole binary system, we reanalyzed the Fermi data using more than 6.5 years worth of data. We place new upper limits on the gamma-ray emission from this source and disucss it in context of another known black hole binary, Cyg X-1.

C30: Mira Grudzinska, University of Warsaw, Poland
On the first Be star in a black hole binary MWC 656

The first Be binary with a black hole has been just recently discovered by Casares et al. (2014). The formation of MWC 656 involves a common envelope phase and a supernova explosion. Since, it is not expected that B star can get any significant accretion/spin up in the common envelope, our findings support the idea that stars are born as Be objects rather than created by binary evolution. We predict several tens of Be BH binaries to currently reside in the Galactic disk, but there is only a very small chance to observe a system with parameters resembling MWC 656. If MWC 656 is representative of intrinsic Galactic Be BH binary population, it may indicate that standard evolutionary theory needs to be revised. This would pose another evolutionary problem in understanding BH binaries, with BH transient formation issue being the prime example. The future evolution of MWC 656 with a 5 Msun black hole and with a $\approx$ 10-16 Msun main sequence companion may lead to the formation of a coalescing BH-NS system. The estimated Advanced LIGO/Virgo detection rate of such systems is 0.1/yr, alas with large uncertainties ± 0.1/yr. This empirical estimate is a lower limit as it is obtained with only one particular evolutionary scenario, this of MWC 656 binary. This is only a third such estimate available, and it lends additional support to the existence of so far undetected BH-NS binaries.

C31: Matthew Shultz, European Southern Observatory/Queen's University, Chile/Canada
The Centrifugal Magnetospheres of Bp Stars: Results from a Population Study

Rapidly rotating early-type Bp stars with strong magnetic fields typically display emission in wind-sensitive spectral lines originating in the rotationally-supported plasma of their corotating 'centrifugal magnetospheres' (CMs). While the gross properties and variability patterns of this emission are well-described by the leading Rigidly Rotating Magnetosphere (RRM) model, there are mysteries the RRM model is currently unable to explain. In particular, there exist numerous stars predicted to possess CMs, but which show no sign of them in optical wind-lines; meanwhile, amongst stars with CMs detectable in optical spectra, the distribution of plasma is less extended than predicted by RRM. Both of these discrepancies are likely related to a mass-leakage mechanism as-yet unaccounted for in the steady-state RRM model. Is mass-balancing accomplished via a gradual process (e.g., ambipolar diffusion), or via violent, sporadic events (i.e. centrifugal reconnection)? We report the latest results of a population study encompassing all known magnetic Bp stars (both those with and without optical emission lines) for which high-precision spectropolarimetry is available. The aim of this study is to clarify the magnetic, rotational and stellar properties of the sample stars, and to investigate their circumstellar structures in detail, in order to provide a firm empirical basis with which to confront the predictions of the RRM model and investigate the viability of different magnetospheric leakage mechanisms.

C32: Christopher Bard, University of Wisconsin-Madison
X-ray Emission of Centrifugal Magnetospheres

In the subset of massive OB stars with strong global magnetic fields, X-rays arise from magnetically confined wind shocks (Babel and Montmerle 1997) resulting from the trapping and channeling of the stellar wind along magnetic field lines. However, it is not yet clear what the effect of stellar rotation and mass-loss rate is on these wind shocks and resulting X-rays. Here, I present results from a grid of Rigid-Field Hydrodynamic simulations (RFHD; Townsend et al. 2007) of a B-star centrifugal magnetosphere with an eye towards quantifying the effect of stellar rotation and mass-loss rates on the level of X-ray emission. These X-ray results are used to create a diagnostic for magnetosphere X-ray emission.

Contributed Posters

P1: Alex Carciofi, IAG/USP, Brazil
Be Atlas - A Grid of Be Star Models

In recent years, the viscous decretion disk (VDD) model appeared as the paradigm for explaining the formation and structure of Be star disks. From the earlier models of individual stars, that used a simple implementation of the VDD consisting of an isothermal disk in steady state, the theory evolved to include second order effects (e.g. non-isothermality) and the temporal evolution of disk subject to non-constant mass injection rates.

Observational tests, so far, mostly involved studies of a few individual stars using different computer tools and slightly variations of the VDD model to fit Be star observables. Despite the scarcity of direct verification, abundant circumstantial evidence in support of VDD scenario does exist. However, a statistically significant assessment of the universality of the VDD scenario for Be stars still remains to be done.

In this contribution we report on an effort of build a large model grid for Be stars, the Be Atlas project. The Atlas will serve basically two main purposes. 1) Since the grid will cover the entire range of B spectral subtypes and will include very realistic and diverse disk models, it will allow for the creation of physically realistic synthetic population of Be stars for several different observables (photometric bands, spectral lines, linear polarization, interferometry, etc.). This synthetic population will then be confronted to observations of large numbers of Be stars; 2) The grid will provide a very useful starting point for modeling individual stars.

P2: Ahmed Ahmed, Western University, Canada
Nitrogen Abundances in Rapidly Rotating B and Be Stars

New non-LTE calculations for N II are presented for main sequence B stars ($T_{\rm eff} = 10,000 \rightarrow 31,000\,{\rm K}$, $\log g = 3.5 \rightarrow 4.5$). Equivalent widths <u>*with error bars*</u> are given for $\lambda\,3995$ Å and several other optical lines commonly used in nitrogen abundance determinations. Errors for the equivalent widths are evaluated using Monte Carlo simulation based on the underlying accuracy of the atomic data. The influence of gravitational darkening on the N II equivalent widths is also discussed.

P3: Jose H. Pena, Instituto de Astronomia, UNAM, Mexico
Cluster Membership of Be, Ap and Blue Stragglers in Open Clusters

Distances to stars which have photometric measurements in the Strömgren system can be determined from the calibrations of Shobbrook (1984) and Nissen (1988) if the stars are of a spectral class earlier than F. In the last few years we have measured and analyzed in uvby-beta photometry some stars in the direction of selected open clusters. Taking the entire sample of distances in the direction of a given cluster, the distance to the cluster is assigned from a distance histogram for those stars which are within one sigma from the mean. Once membership has been determined for the cluster, some bulk characteristics can be determined, such as distance and reddening and, from the hottest stars, the temperatures which provide, through the calibrations of Meynet, Mermilliod and Maeder (1993) the age of the cluster. Webda (Paunzen, Sttz, and Janik, 2013) compiles, among several characteristics, those stars that belong to either one of the following three categories: Be, Ap and Blue Stragglers . With measurements in Strömgren photometry we can determine if specific stars belong to the chosen cluster or not. A sample of 16 open clusters has been considered. In those clusters, 47 Be stars, 25 Ap stars and 16 Blue Stragglers have been examined.

P4: Catalina Arcos Carvajal, Universidad de Valparaiso, Chile
A Statistical study of Be stars

What causes B stars to become Be stars is not yet well understood. Most of these stars shown variations on its lines that are associated to radial pulsations or binary star. To make a detailed study, it is necessary to perform statistical studies on the spectra of a large number of Be stars obtained over a long period of time. For that reason, we are building a catalog of 286 Be stars (V<8) of southern hemisphere. At moment, we count with 48 echelle spectrum and we intend to study the variability, rotational velocity, size and configuration of the disk, and quantify the mass loss rate of Be stars. This will help us to improve massive stars evolution models and have a better understanding of the Be phenomenon.

P5: Karen Bjorkman, University of Toledo, USA
Variable Circumstellar Disks of "Classical" Be Stars within Clusters
(Karen Bjorkman & Cody Gerhartz, University of Toledo)

Circumstellar disks are common among many stars, all spectral types, and at different stages of their lifetimes. Among the near-main sequence Classical Be stars, there is growing evidence that these disks can form, dissipate, and reform, on timescales that are differ from case to case. Using data obtained with the LMI instrument at the Discovery Channel Telescope and additional data from the Ritter Observatory, we are undertaking a long-term monitoring project for a set of galactic star clusters known to contain Be stars. Our goal is to develop a more statistically significant sample of variable circumstellar disk systems over multiple time-scales. With a robust multi-epoch study we can determine the relative fraction of Be stars that exhibit disk-loss or disk-renewal phases, and investigate the range of timescales over which these events occur. A larger sample will enable us to reach a better understanding of the prevalence and nature of these disk events.

P6: Chien-De Lee, National Central University, Taiwan
Searching for Be Stars in the Open Cluster NGC 663

We present Be star candidates in an open cluster NGC 663, identified by Hα imaging photometry with the Palomar Transient Factory Survey, as a pilot program to investigate how the Be star phenomena, the emission spectra, extended circumstellar envelopes, and fast rotation, correlate with massive stellar evolution. Stellar membership of the candidates was verified by 2MASS magnitudes and colors and by PPMXL proper motions. We discover 4 new Be stars and exclude one known Be star from being a member due to its inconsistent proper motions. The fraction of Be stars to member stars [N(Be)/N(Be+MS)] in NGC 663 is 3.4%. The spectral type of the 34 Be stars in NGC 663 shows bimodal peaks at B0B2 and B5B7, which is consistent with the statistics in most star clusters. Additionally, we also discover 23 emission-line stars of different types, including non-member Be stars, dwarfs, or giants.

P7: David Bohlender, NRC Herzberg Astronomy and Astrophysics, Canada
Searching for and Monitoring Ae and A Shell Stars at the Dominion Astrophysical Observatory

To demonstrate the continued utility of the venerable DAO 1.8-m Plaskett telescope to carry out large spectroscopic observing programs, we have obtained high S/N, moderate-resolution spectra of the Hα profile of ≈ 400 A-type stars north of $\delta = 20^o$ and with vsini ≥ 150 km s^{-1}. These data have been used to estimate the incidence of circumstellar shell and emission line features in rapidly rotating A stars. Hα shell or emission features are observed in more than 60 stars, or $\approx$ 15% of the survey sample, and approximately 30 of these are bright, previously unreported shell or emission line stars. As has been observed for the classical Be stars, the frequency of shell or emission features in A-type stars decreases towards late-A spectral types and also with decreasing vsini.

P8: Aaron Sigut, Western University, Canada
The Hα Shell Parameter as a Probe of Be Disk Scale Heights

The Hα shell parameter (defined as the ratio of the peak emission in Hα divided by the line centre flux) in excess of 1.5 has been proposed by Hanuschik (1996) as the definition of a Be shell star. Such systems occur only for high inclinations of the star's rotation axis to the observer's line of sight, and such geometry can be used to probe the thickness of the Be star's circumstellar disk. In this work, the cumulative distribution of the Hα shell parameter in a sample of Be stars is formulated as a test of the scale height of the disk. Comparison with Hanuschik's observed distribution of 114 shell parameters suggests that Be star disks are remarkably thin.

P9: Klara Sejnova, Masaryk University in Brno, Czech Republic
Dynamical evolution of the disk of the Be star 60 Cygni

Be stars are still big unknown in the respect of origin and geometry of circumstellar disk around a star. We present here modified version of program Shellspec which is designed to solve a simple radiative transfer along the line of sight in 3D moving media. We used this program for the model: star with a disk (simplified model for Be stars) and applied this model to study a certain star. We present here results for Be star 60 Cygni and its disk evolution (evolution of the radius, opening angle, etc.) between years 2003 and 2011.

P10: Bruno Correia Mota, Instituto de Astronomia Geofisica e Ciencias Atmosfericas da Universidade de Sao Paulo, Brazil
A Multi-technique Study of the Circumstellar Disk of Alpha Arae

Classical Be stars are known by their rapid rotation and non-radial pulsation. They are the only Main Sequence stars that exhibit decretion circumstellar disks formed and ruled by processes not completely understood. The physical properties of the disk can be studied by modeling its structure and solving the radiative transfer from the stellar light. In this point, the production of synthetic observables arises as a tool to investigate the important physical quantities of the system. Among the proposed models to the disk formation, the Viscous Decretion Disk (VDD) model becomes the current paradigm, correctly describing a large set of evidences that implies viscosity is the responsible mechanism for the dynamics of the circumstellar disk. We aim to perform an holistic analysis of the circumstellar disk of one of the most observed Be stars, alpha Arae based on the VDD paradigm. Its importance reside in the fact that the VDD model was tested in detail just for another star (zeta Tauri) and the universality of the VDD must be evaluated. Initially, we summarized the literature data available together with the polarimetric data from our group. These allow us to caracterize the variability of alpha Arae, from which we can estimate the physical properties of the system and perform the initial models to be presented.

P11: Jessie Silaj, Western University, Canada
The Circumstellar Disk of 48 Librae

48 Librae is a well-known Be shell star that exhibits spectacular cyclic V/R asymmetries in its Balmer emission lines. We use high resolution spectroscopic data of the lower Balmer lines to determine the length of the most recent V/R cycle, and well as quantify the phase lags that occur between the various members of the series owing to the fact that they originate from different locations in the disk. The global disk oscillation model is employed to reproduce the temporal evolution of the V/R variations.

P12: Parshati Patel, Western University, Canada
The Inner Gaseous Disk of Herbig Be Stars

The structure of the inner gaseous disk of Herbig Be stars (pre-main sequence, massive stars with circumstellar disks where dust is thought to evaporate due to high temperature) is poorly understood. Using the circumstellar disk codes BEDISK and BERAY, and observational spectra (3700 to $10,500$ Å) from the ESPaDOnS instrument on CFHT, we attempt to constrain the physical properties of this inner gaseous region. The synthetic line profiles of hydrogen and ionized metals, along with the observed line profiles, will help understand the geometry and kinematics of the gaseous disk.

P13: Ethan Rowe, Western University, Canada
Modelling CQEs in Be Star Spectra

Central reversals, or emission peaks, in the cores of helium and metal lines are common features of Be shell stars. Such features are usually referred to as central quasi-emission features (CQEs) as they are formed naturally via the absorption of central star's light by a circumstellar disk in Keplerian rotation. We revisit the original analysis of Hanuschik (1995), and extend his model to gauge the sensitivity of CQEs features to the gravitational darkening of the central star and the thickness of the circumstellar disk.

P14: Yuki Moritani, Hiroshima University, Japan
Photometric and polarimetric observations of several Be/X-ray and Be/gamma-ray binaries

Be/X-ray and Be/gamma-ray binaries are systems comprised of a Be star and a compact object. In these systems, Be disks have important roles in their high-energy activities through the interaction with the compact object. With highly eccentric orbits, the interaction depends on the orbital phase in Be/X and Be/gamma-ray binaries, where X-ray outbursts occurs. Besides, such interaction causes photometric variabilities in optical bands, reflecting the change of the disk structure (e.g. Zamanov et al. 2013, A&A, 559,87; LS I +61 303). In order to search photometric and polatimetric variabilities in Be/X-ray and Be/gamma-ray binaries, we have monitored several systems with the polarimeter for Hiroshima 1.5m Kanata telescope. Our two-year monitor found that all programmed systems show photometric modulations, whereas only some systems show polatimatric modulations.

P15: Sally Oey, University of Michigan, USA
Oe/Be Stars in the RIOTS4 Survey of Field SMC OB Stars

The Runaways and Isolated O-Type Star Spectroscopic Survey of the SMC (RIOTS4) is a spatially complete survey of Small Magellanic Cloud (SMC) field OB stars that were identified by UBR photometry. The photometric criteria enhanced selection of Oe/Be stars, yielding a complete sample of these field stars in the metal-poor SMC down to about spectral type B1e. We present some preliminary statistics for the frequencies of these Oe/Be stars, comparing with Galactic populations and cluster populations. We also examine their cross-identification with Spitzer and XMM sources.

P16: Myron Smith, National Optical Astronomy Observatory, USA
A census of the X-ray-active class, gamma Cas stars

Abstract: The fundamental properties of 12 known Galactic "gamma Cas stars" are reviewed. This sample, now extending to 6-7 kpc from the Sun, is by now is sufficient to assess the basic properties of these stars as a group. Such properties are their rotation rates, spectral types, luminosities, L_x's, and temperatures characterizing their dominant X-ray emission components can now be assessed in order to constrain the still unknown process(es) responsible for the variable and hard X-ray emission from these stars. For example, fundamental to the resolution of the origin of these emissions is the role of binarity. So far only gamma Cas itself is known to be in a binary though it is likely that at least three stars others are blue stragglers. The character (strength and double-lobeness) of the Halpha emission, relative to other early-B type classical Be stars, also offers information concerning interactions of the Be disk with the central star as well as the obliquity of the system as viewed from the Sun.

P17: Matthew Shultz, European Southern Observatory-Queen's University-Royal Military College, Canada
Discovery of Magnetospheric Emission Around the Magnetic Early B-Type Star ALS 3694

We have acquired new ESPaDOnS observations of the magnetic B-type star ALS 3694, in which we detect variable H Balmer line emission consistent with the presence of a centrifugal magnetosphere (CM). Stars with CMs detectable in H line emission are quite rare, representing less than 3of the population of early B-type stars, with only 12 previously known, confirmed members of this class. Thus, ALS 3694 represents a valuable addition to this small, but rapidly growing sub-population. We present constraints on the rotational and magnetic properties of ALS 3694 based on line profile modelling and magnetometry, and interpret these in the context of the Rigidly Rotating Magnetosphere model.

P18: Thomas Rivinius, ESO, Chile
OHANA - the Observatory survey at High ANgular resolution of Active OB stars

OHANA is an interferometric snapshot survey of the gaseous circumstellar environments of hot stars, carried out by the VLTI group at the Paranal observatory. It aims to characterize the mass-loss dynamics (winds/disks) at unexplored spatial scales for many stars. The survey employs the unique combination of AMBER high spectral resolution with the unmatched spatial resolution provided by the VLTI. Because of the spatially unresolved central OBA-type star, with roughly neutral colour terms, their gaseous environments are among the easiest objects to be observed with AMBER, yet the extent and kinematics of the line emission regions are of high astrophysical interest. The raw data has become public immediately, an here we report on the results of the final reduction, which we will make available as well as soon as quality tests have been passed. The survey targets included bright 12 Be stars, ranging from equator-on to pole-on stars. Nearly 100 observations were obtained. They all show the typical rotating disk kinematic features, sometimes with asymmetries, and the largest disks are fully resolved at the longest baselines. This poster is to advertise the data and to encourage all interested researches to make use of it in their studies.

P19: Mohammad Ghoreyshi, University of Sau Paulo, Brazil
Modeling the Full Lightcurve of ω CMA

We have used the radiative transfer code HDUST to analyze and interpret the long-term photometric monitored Be star ω CMa, considering four complete cycles including several disk formation and dissipation phases. This is the first time in which a full lightcurve of a Be star was investigated and modeled including both disk build-up and dissipation phases. Based on the quite good fit of the observed data we were able to derive the history of stellar mass decretion rates (including small and short-term changes) during the disk formation and dissipation phases in all four cycles. Even though we report on preliminary results, we present evidence that suggests that the viscosity parameter may not be constant from cycle to cycle.

P20: Larkin D. Folsom, University of North Carolina at Greensboro, USA
Spectroscopic monitoring of Beta Canis Minoris in the 21st century

We report the results of high-resolution spectroscopic observations obtained in 2000-2014. The goals of the program were to search for signs of binarity, which was suspected in several studies long ago but not confirmed by more recent data. We have measured parameters of several emission and absorption lines and studied their trends on different time scales. Implications for the circumstellar disk properties and the system binarity are discussed.

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, cafeteria-style food, and an outdoor barbeque. If your idea of lunch is a beer and a burger, look no further.
  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/ .
  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 .
  4. *Other Options*: The Natural Sciences Building, across the street from the north exit of the PAB, houses both a *Tim Horton's* and a *Starbucks*. "*Tims*" offers sandwiches, soup, and coffee. *Starbucks* offers take-away wraps and salads. *Starbucks* is your best option for a quick vegetarian snack.
  5. *Grocery Store:* The basement of the UCC Student Centre hosts a small greengrocers, *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. Remember that 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. **Curry Garden**

   374 Richmond Street
   519-850-5678
   Tasty Indian cooking. Very good vegetarian dishes, including Saag Paneer and Mixed Vegetable Bhaji. Non-veg specialities include Chicken Dupiaza, Lamb Pasanda, and Butter Chicken. Dinner entrees: $10-$15
   www.currygardenrestaurant.ca

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, Richie's, and Crave.
   Milestones (www.milestonesrestaurants.com) and Crave (craverestaurant.ca) are two upscale continental restaurants.
   Note that you would need to take the *northbound* Wellington 13 from in front of Delaware Hall to reach Masonville Place.

8. **Quynh Nhi**
   55A Wharncliffe Road
   519-850-8878
   Excellent Vietnamese food, although premises adjacent to an autobody shop! Not licensed. Take the Dundas 2 and get off at Riverside.
   Dinner entrees: $11-$15
   www.quynhnhi.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. **Veg Out**
    646 Richmond Street
    519-850-8688
    Vegan Restaurant.
    Dinner entrees: $15-$20
    www.vegoutrestaurant.com

11. **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