

# Hope Boyce

Curriculum Vitae

## EDUCATION

**McGill University / McGill Space Institute**, Montréal, QC, Canada

*Ph.D., Physics*

**Sep 2018 – 2022**

Dissertation: *Observational probes of supermassive black hole environments: from the event horizon to the sphere of influence*

Advisor: **Daryl Haggard**

I present two investigations of Sagittarius A\* (Sgr A\*), the nearest supermassive black hole (SMBH) to us, and a third investigation of the SMBH at the heart of NGC 1387. In the first, coordinated multi-wavelength observations of Sgr A\* are carefully analyzed, cross-correlated, and compared to spectral energy distributions modelling the matter accreting onto the black hole. The second investigation focuses on the multi-wavelength coordination during the 2017 Event Horizon Telescope Campaign to image Sgr A\*. The third investigation probes material out at the edge of the sphere of influence, where kinematic modelling of the molecular gas can accurately estimate the SMBH mass.

*M.Sc., Physics*

**Sep 2016 – Aug 2018**

Thesis: *Monitoring the Closest Supermassive Black Hole: X-ray and Infrared Variability of Sgr A\**

Advisor: **Daryl Haggard, René Doyon**

I reduced over 100 hours of data from the *Spitzer Space Telescope* and *Chandra X-ray Observatory*, resulting in the longest simultaneous X-ray and infrared light curves of Sgr A\* to date. Cross-correlating the light curves constrained the time-lag between simultaneous flares, shedding light on the emission mechanism for the variability.

Coursework: observational techniques in astronomy, astrophysical fluids, general relativity, high energy astrophysics, and cosmochemistry.

**University of Saskatchewan**, Saskatoon, SK, Canada

*B.Sc., Physics (Honours), Specialization in Astronomy*

**Sep 2013 – May 2016**

Coursework: astrophysics, classical mechanics, electricity and magnetism, optics, quantum mechanics, applied mathematics, statistical physics, advanced calculus, computer science, and linear algebra.

## OTHER RESEARCH PROJECTS

**Searching for a Central Black Hole in the Large Magellanic Cloud**

Advisors: **Nora Lützgendorf & Roeland van der Marel**

**2015 – 2017**

I constructed a line-of-sight velocity map of the central square degree of the Large Magellanic Cloud using 784 datacubes from MUSE, the Multi Unit Spectroscopic explorer for the Very Large Telescope. Ran an MCMC to fit custom kinematic models to the central velocity field of the galaxy to constrain the mass (and existence) of a central black hole. (First author publication: [ApJ 846, 14](#))

**Simulating Observations of Distant Galaxies with the IFU designed for the TMT**

Advisor: **Shelley Wright**

**Summer 2014**

During a four month summer research internship at the **Dunlap Institute**, I modelled the detection of high-redshift galaxies with the InfraRed Imaging Spectrograph, an upcoming first-light integral field unit (IFU) designed for the Thirty Meter Telescope (TMT).

## WORKSHOPS, SCHOOLS, & HACKATHONS

**Beyond Interstellar: Extracting Science from Black Hole Images** Keck  
Institute for Space Studies

**Sep 2019**

**SIGNALS Workshop** University of Laval, Québec

**May 2019**

**SITELLE Internship** CFHT, Hawaii

**Nov 2018 - Mar 2019**

**Mauna-Kea Graduate School** CFHT & Gemini Observatory, Hawaii

**May 2018**

**Galaxies & Cosmology CRAQ Summer School** McGill University

**Jun 2018**

**McHacks** McGill University

**Feb 2018**

**McGill Physics Hackathon** McGill University

**Nov 2017**

**Mastering the Instrument Modes of JWST** Madrid, Spain

**Oct 2017**

**Compact Objects CRAQ Summer School** McGill University

**Jun 2016**

**Canada-Norway Student Rocket Program** Andoya Rocket Range, Norway

**Oct 2015**

**Programming Contest – 1st Place Novice Category**, University of Saskatchewan

**Feb 2015**

**Summer Astronomical Instrumentation School** Dunlap Institute, Toronto

**Aug 2014**

TALKS & CONFERENCES	CONTRIBUTED TALK <b>IAU Annual Meeting</b> (VALENCIA, SPAIN)	June 2022
	CONTRIBUTED <b>EHT Meeting</b> (GRANADA, SPAIN)	June 2022
	CONTRIBUTED TALK <b>CASCA Annual Meeting</b> (REMOTE, CANADA)	May 2022
	CONTRIBUTED TALK <b>CRAQ Annual Meeting</b> (QC, CANADA)	May 2022
	CONTRIBUTED TALK <b>Galactic Center Workso</b> p (Yokohama, Japan)	Oct 2019
	CONTRIBUTED TALK <b>MorrisFest</b> (UCLA, USA)	Sep 2019
	CONTRIBUTED TALK <b>CASCA</b> (Montreal, QC, Canada)	Jun 2019
	CONTRIBUTED TALK <b>Women in Physics Canada</b> (Sherbrooke, QC, Canada)	Jul 2018
	CONTRIBUTED TALK <b>CRAQ Annual Meeting</b> (Lac-à-l'Eau-Claire, QC, Canada)	May 2018
	CONTRIBUTED TALK <b>Women in Physics Canada</b> (Waterloo, ON, Canada)	Jul 2017
	CONTRIBUTED TALK <b>CRAQ Annual Meeting</b> (Lac-à-l'Eau-Claire, QC, Canada)	May 2017
	INVITED TALK <b>The Exciting Lives of Galactic Nuclei</b> (Ringberg Castle, Germany)	Mar 2017
	POSTER <b>Canadian Space Exploration Workshop</b> (Montréal, QC, Canada)	Nov 2016
	POSTER <b>CCUWiP</b> (Halifax, NS, Canada)	Jan 2016
TECHNICAL SKILLS	<i>Data Reduction and Analysis:</i> Python, C++, IDL, CASA, NumPy & AstroPy, CIAO	
	<i>Data Visualization:</i> Python/matplotlib, Plotly, IDL, Dashboards	
	<i>Data Mining &amp; Management:</i> MySQL, Python's Django framework, UNIX	
	<i>Observational Astronomy:</i> 50+ hours of experience operating 12-16" optical telescopes. Collected photometric and spectroscopic data of exoplanet transits, supernovae, binary star systems, variable stars, and comets.	
AWARDS & FELLOWSHIPS	<b>2020 FCRF-L'Oréal Canada Award For Women in Science/\$5,000</b>	2021
	<b>Le stage international - FRQNT/\$7,500</b> Oxford & Cardiff Universities	Jan–Apr 2020
	<b>NSERC–CGS D/\$102,000</b> McGill University	2018 – 2021
	<b>Mary Louise Taylor Fellowship/\$13,608</b> McGill University	2017 – 2018
	<b>Mary Louise Taylor Fellowship/\$12,948</b> McGill University	2016 – 2017
	<b>Kaspi &amp; Trottier Graduate Award/\$1,250</b> McGill University	2016 – 2017
	<b>McGill Astrophysics Group Signing Bonus/\$2,500</b> McGill University	Sep 2016
	<b>Summer Internship</b> Space Telescope Science Institute	2016
	<b>Astrophysics Program for Summer Students Fellowship</b> ESA/Leiden University	2015
	<b>NSERC–USRA Summer Researcher</b> University of Toronto	2014
	<b>University of Saskatchewan Transfer Scholarship</b> University of Saskatchewan	Sep 2013
	<b>Coca Cola Award/\$500</b> Lakeland College	Jun 2013
	<b>Saskatchewan Advantage Scholarship</b> Lakeland College	2012 – 2013
	<b>Alexander Rutherford Scholarship/\$2,500</b> Lakeland College	2012 – 2013
TEACHING EXPERIENCE	<b>Teaching Assistant</b> McGill University	2016 – 2021
	Held office hours, led tutorials, guest lectured, and graded assignments and exams for:	
	PHYS 260 – Modern Physics and Relativity (Winter 2019)	
	PHYS 183 – The Milky Way Inside and Out (Winter 2017, and 2018)	
	PHYS 180 – Space Time and Matter (Fall 2016)	
	<b>Teaching Assistant</b> University of Saskatchewan	2014 – 2016
	Created and led tutorials and labs for:	
PUBLIC LECTURES	ASTR 214 – Astronomical Spectroscopy (Fall 2015)	
	ASTR 103 – Descriptive Introduction to Stellar Astronomy (Winter 2015)	
	<b>“Black Hole Mysteries in Our Galactic Neighbourhood”</b> <b>RASC</b> – Saskatoon, SK.	Apr 2016
	<b>“Stellar Studies”</b> <b>RASC</b> – Saskatoon, SK.	Apr 2014
SERVICE, OUTREACH, & VOLUNTEER EXPERIENCE	MEMBER <b>Equity, Diversity, Inclusion Committee</b> , McGill Physics Dept.	2018 – 2022
	LEAD-ORGANIZER <b>Women in Physics Canada</b> , McGill University	Jun 2019
	VOLUNTEER <b>AstroMcGill &amp; Physics Matters</b> , McGill University	2016 – present
	VOLUNTEER <b>Stargazing Live</b> , Oxford University	2020
	CO-ORGANIZER <b>CRAQ Annual Meeting</b> , Lac-à-l'Eau-Claire, Quebec	May 2018
	VP FINANCE EXECUTIVE <b>Physics Students' Society</b> , University of Saskatchewan	2014 – 2016
	OBSERVATORY GUIDE <b>UofS Observatory</b> , University of Saskatchewan	2013 – 2016
	MENTOR <b>Rotary International Exchange Program</b> , Rotary International	2011 – 2012

MEDIA COVERAGE	<p>McGill News <i>“Astronomers reveal first image of the black hole at the heart of our galaxy”</i> (May 2022)</p> <p>My Lloydminster Now <i>“Students receive out-of-this-world education”</i> (Jan 2019)</p> <p>U of S Alumni News <i>“Astronomy graduates’ research is out of this world”</i> (Oct 2017)</p> <p>620 CKRM The Source <i>“U of S Student Astronomy grad published in top research article”</i> (Sep 2017)</p> <p>Lloydminster Meridian Booster <i>“Shooting beyond the stars”</i> (Sep 2017)</p> <p>GX94 Radio <i>“U of S Astronomy Graduate Chosen as Lead Author of Research Article”</i> (Sep 2017)</p> <p>paNOW Radio <i>“Rare comet to shine bright over Sask. Wednesday night”</i> (Jan 2015)</p>
SUCCESSFUL PROPOSALS	<p><b>PI</b>, <i>Canada France Hawaii Telescope</i>, Semester 2020B, #C025, 28 hrs, <i>What causes star formation suppression in galaxy bulges?</i></p> <p>Co-I, <i>Chandra</i>, Cycle 21, ID #21700401, 162 ks, <i>Event Horizon Dynamics: Joint Chandra/EHT Imaging of Sgr A* and M87</i> (PI: Daryl Haggard)</p> <p>Co-I, <i>Spitzer</i>, Cycle 14, ID #14026, 49.6 hours, <i>The Vital Infrared to X-ray Link in the Sgr A* Accretion Flow</i> (PI: Steven Willner)</p> <p>Co-I, <i>Chandra</i>, Cycle 20, ID # 20700293, 162 ks, <i>Event Horizon Dynamics: Joint Chandra/EHT Imaging of Sgr A* and M87</i> (PI: Daryl Haggard)</p>
SELECTED PUBLICATIONS	<p>[9] FIRST SAGITTARIUS A* EVENT HORIZON TELESCOPE RESULTS. II. EHT AND MULTIWAVELENGTH OBSERVATIONS, DATA PROCESSING, AND CALIBRATION Event Horizon Telescope Collaboration including <b>H. Boyce</b> 2022, <a href="#">ApJ 930L, 13E</a></p> <p>[8] FIRST SAGITTARIUS A* EVENT HORIZON TELESCOPE RESULTS. I. THE SHADOW OF THE SUPERMASSIVE BLACK HOLE IN THE CENTER OF THE MILKY WAY Event Horizon Telescope Collaboration including <b>H. Boyce</b> 2022, <a href="#">ApJ 930L, 12E</a></p> <p>[7] MULTIWAVELENGTH VARIABILITY OF SAGITTARIUS A* IN 2019 JULY <b>H. Boyce</b>, D. Haggard, G. Witzel, et. al. 2022, <a href="#">ApJ 931, 7B</a></p> <p>[6] CONSTRAINING PARTICLE ACCELERATION IN SGR A? WITH SIMULTANEOUS GRAVITY, SPITZER, NUSTAR, AND CHANDRA OBSERVATIONS GRAVITY collaboration et al. including <b>H. Boyce</b> 2021, <a href="#">A&amp;A 654, 22G</a></p> <p>[5] RAPID VARIABILITY OF SGR A* ACROSS THE ELECTROMAGNETIC SPECTRUM G. Witzel, et al. including <b>H. Boyce</b> 2021, <a href="#">ApJ 917, 73W</a></p> <p>[4] A DEEP CFHT OPTICAL SEARCH FOR A COUNTERPART TO THE POSSIBLE NEUTRON STAR – BLACK HOLE MERGER GW190814 N. Vieira, D. Haggard, et al. including <b>H. Boyce</b> 2019, <a href="#">ApJ 895, 96V</a></p> <p>[3] SIMULTANEOUS X-RAY AND INFRARED OBSERVATIONS OF SAGITTARIUS A*’S VARIABILITY <b>H. Boyce</b>, D. Haggard, et. al. 2019, <a href="#">ApJ 871, 161</a></p> <p>[2] AN UPPER LIMIT ON THE MASS OF A CENTRAL BLACK HOLE IN THE LARGE MAGELLANIC CLOUD FROM THE STELLAR ROTATION FIELD <b>H. Boyce</b>, N. Lützgendorf, R. P. van der Marel, et. al. 2017, <a href="#">ApJ 846, 14</a></p> <p>[1] THE INFRARED IMAGING SPECTROGRAPH (IRIS) FOR TMT: OVERVIEW OF INNOVATIVE SCIENCE PROGRAMS S. Wright, et. al. including <b>H. Boyce</b> 2014, SPIE 91479S</p>