Matthias Yang He, PhD

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Ph.D. in Astronomy & Astrophysics

Research interests: exoplanet discovery – planet populations and architectures – astrostatistics – data analysis

Positions

Postdoctoral Research Associate – University of Notre Dame — **Notre Dame**
Department of Physics and Astronomy — *2022–Present*
Advisor: Prof. Lauren M. Weiss

Education

PhD in Astronomy & Astrophysics – Pennsylvania State University — **University Park**
with minor in Computational Science — *2016–2022*
Advisor: Prof. Eric B. Ford

Honours BSc – University of Toronto — **St. George**
Astronomy & Physics Specialist, with High Distinction — *2012–2016*
Advisor: Prof. Dae-Sik Moon

Research Experience

Scientific Code Reviewer, Department of Astronomy & Astrophysics — **Penn State**
Supervisor: Prof. Eric B. Ford — *Summer 2022*

Graduate Research Assistant, Department of Astronomy & Astrophysics — **Penn State**
Supervisor: Prof. Eric B. Ford, Prof. Darin Ragozzine — *Summer 2017 – Present*

Research Assistant, Canadian Institute for Theoretical Astrophysics (CITA) — **CITA/U of T**
Supervisor: Dr. Cristobal Petrovich — *Summer 2016*

Research Assistant, Department of Astronomy & Astrophysics — **U of T**
Supervisor: Prof. Dae-Sik Moon — *Summer 2015 – 2016*

Research Assistant, Department of Astronomy & Astrophysics — **U of T**
Supervisor: Dr. Amaury Triaud, Prof. Yanqin Wu — *Summer 2015*

Awards and Fellowships

NSERC Postgraduate Scholarship - Doctoral (PGS D) Award – CAD $63K	2018 – 2021
The Royal Astronomical Society of Canada Gold Medal	2016
University Graduate Fellowship – USD $27.5K	2016
Clarence Augustus Chant Fellowship – CAD $10K (declined)	2016
NSERC Summer Undergraduate Research Program Award	2016
University of Toronto Dean's List	2012 – 2016
Woodsworth College Scholarship	2014
John Pounder Scholarship in Astronomy & Astrophysics	2014

Donald MacRae Scholarship in Astronomy & Astrophysics	2013
University of Toronto President's Scholar	2012
Governor General Academic Medal	2012

Grants

NASA ExoPAG Travel Grant – $3000	2019
AAS International Travel Grant (ITG) – $500	2019
Zaccheus Daniel Fellowship – $800	2019
TESS Science Conference I registration fee – $330	2019
Center for Exoplanets and Habitable Worlds (CEHW) Small Grant – $800	2019

Conference and Research Talks

Penn State Dissertation Defense — **Virtual**
Statistical Inference on the Distribution of Exoplanetary Systems: Correlations in Planetary System Architectures — *Feb 15, 2022*

Center for Space and Habitability (CSH) Fellowship Talk — **Virtual**
The Intrinsic Architectures of Planetary Systems: Inter- and Intra-system Correlations — *Feb 2, 2022*

Bay Area Exoplanet Meeting (BAEM39) — **Virtual**
The Intrinsic Architectures of Planetary Systems: Inter- and Intra-system Correlations — *Dec 3, 2021*

UChicago Exoplanet Talk — **Virtual**
The Intrinsic Architectures of Planetary Systems: Inter- and Intra-system Correlations — *Oct 18, 2021*

Chesapeake Bay Area Exoplanet (CHEXO) Meeting — **Virtual**
Friends and Foes: Conditional Occurrence Rates of Exoplanet Companions and Implications for Radial Velocity Follow-up Observations — *May 14, 2021*

PLATO ESP 2020 — **Virtual**
The Intrinsic Architectures of Planetary Systems: Correlations in Periods, Sizes, and Stellar Types from Kepler — *Dec 3, 2020*

Exoplanet Demographics (ExoDem 2020) — **Virtual**
The Intrinsic Architectures of Planetary Systems: Correlations in AMD-Stable Systems — *Nov 11, 2020*

Birmingham Group Meeting (invited) — **Virtual**
The Intrinsic Architectures of Planetary Systems: Correlations in AMD-Stable Systems — *Oct 26, 2020*

Europlanet Science Congress (EPSC 2020) — **Virtual**
The Intrinsic Architectures of Planetary Systems: Correlations in AMD-Stable Systems — *Sep 24, 2020*

Center for Exoplanets and Habitable Worlds (CEHW) Seminar — **Virtual**
The Intrinsic Architectures of Planetary Systems: Correlations in AMD-Stable Systems — *Sep 14, 2020*

Iowa State Journal Club (invited) — **Virtual**
The Intrinsic Architectures of Planetary Systems: Correlations in AMD-Stable Systems — *Aug 17, 2020*

Division on Dynamical Astronomy (DDA) – 51st Annual Meeting — **Virtual**
The Intrinsic Architectures of Planetary Systems: — *Aug 3, 2020*
Correlations in AMD-Stable Systems

Exoplanets III (EXO3) – Plenary — **Virtual**
The Intrinsic Architectures of Planetary Systems: — *Jul 29, 2020*
Correlations in Periods, Sizes, and Stellar Types

Chesapeake Bay Area Exoplanet (CHEXO) Meeting — **Virtual**
The Intrinsic Architectures of Planetary Systems: — *Jun 26, 2020*
Intra-system Correlations and Occurrence with Stellar Type

NASA ExoPAG 21 student speaker⋆ — **Honolulu, HI**
Forward Modeling the Architectures of Exoplanetary Systems: — *Jan 4, 2020*
A Clustered Model using Kepler Data
⋆Also served on panel for discussion of Kepler reliability

Lunch Talk – Department of Astronomy & Astrophysics — **Penn State**
Forward Modeling the Architectures of Exoplanetary Systems — *Sep 17, 2019*

Extreme Solar Systems IV (ExSS4) — **Reykjavík, Iceland**
The Intrinsic Distribution of Planetary Systems: — *Aug 20, 2019*
Modeling the Impact of Clustering on Planetary Architectures

Stars and Planets Seminar — **CITA/U of T**
Forward Modeling the Architectures of Exoplanetary Systems: — *Jul 19, 2019*
A Clustered Model using Kepler Data

ERES V — **Cornell**
Modeling the Architectures of Exoplanetary Systems: — *Jun 17, 2019*
A Clustered Model using Kepler Data

SMAC Talk – Department of Statistics — **Penn State**
Forward Modeling of the Kepler Exoplanetary Systems — *Mar 22, 2019*

ERES IV — **Penn State**
Characterizing the Architectures of the Kepler Exoplanetary Systems — *Jun 22, 2018*

Lunch Talk – Department of Astronomy & Astrophysics — **Penn State**
Characterizing the Architectures of the Kepler Exoplanetary Systems — *Jan 16, 2018*

ERES III — **Yale**
Modeling Period and Period Ratio Distributions of Kepler Exoplanetary Systems — *Jun 13, 2017*

Summer Undergraduate Research Program (SURP) — **CITA/U of T**
Stability of Triple Systems — *Jul 7, 2016*

Conference Posters

ERES VII — **Penn State**
De-biasing the Minimum-Mass Extrasolar Nebula — *Aug 1–2, 2022*
The Effect of Missing Planets and the Diversity of Solid Disk Profiles

DDA53 — **Flatiron Institute**
De-biasing the Minimum-Mass Extrasolar Nebula — *Apr 25–28, 2022*
The Effect of Missing Planets and the Diversity of Solid Disk Profiles

TESS Science Conference II — **Virtual (MIT)**
Friends and Foes: The Conditional Occurrence of Planetary Companions — *Aug 2–6, 2021*
to Transiting Exoplanets and their Impact on Radial Velocity Follow-up Observations

SCMA VII — **Virtual (Penn State)**
Friends and Foes: The Conditional Occurrence of Planetary Companions — *Jun 7–10, 2021*
to Transiting Exoplanets and their Impact on Radial Velocity Follow-up Observations

ERES VI — **Virtual (Princeton)**
Friends and Foes: The Conditional Occurrence of Planetary Companions to Transiting Exoplanets and their Impact on Radial Velocity Follow-up Observations — *May 24–26, 2021*

AAS 236 — **Virtual**
The Intrinsic Architectures of Planetary Systems: Inter- and Intra-system Correlations of Planets — *Jun 1–3, 2020*

TESS Science Conference I — **MIT**
Architectures of Exoplanetary Systems: A Forward Model for Planets around Kepler's FGK Stars with Clustered Periods and Sizes — *Jul 29 – Aug 2, 2019*

ICS Symposium — **Penn State**
Characterizing the Architectures of the Kepler Exoplanetary Systems with a Clustered Model — *Apr 1, 2019*

SAMSI ASTRO Transition Workshop — **Durham, North Carolina**
Modeling Period and Period Ratio Distributions of Exoplanetary Systems — *May 9, 2017*

Mentoring

Ryan Wang, 3rd year undergraduate — **U of T**
Physics Mentorship Program — *Oct 2021 – Feb 2022*

Lukas Kerge, high school student — **MIT**
Research Science Institute (research project) — *Jul 2020*

Ashutosh Banjara, 3rd year undergraduate — **U of T**
Physics Mentorship Program — *Sep 2019 – May 2020*

Service and Outreach

Emerging Researchers in Exoplanet Science (ERES) VII — **Penn State**
Organizing committee — *Dec 2021 – Aug 2022*

Summer School in Astrostatistics & Astroinformatics XVII — **Penn State**
Teaching Assistant — *Jun 6–17, 2022*

The Astrophysical Journal Letters (ApJL) — **AAS Journals**
Referee — *Apr 2021 – Present*

CEHW Journal Club — **Penn State**
Organized weekly journal club meetings to discuss recent papers — *Sep 2019 – Aug 2020*

AstroNight — **Penn State**
Volunteer — *Oct 12, 2019*

Penn State Inservice Workshops in Astronomy (PSIWA) — **Penn State**
Computers and the Universe — *Jun 21, 2017, Jul 17, 2018*
Presented and led day-long workshops for high school teachers on computer generated fractals using my own code

AstroFest — **Penn State**
Volunteer — *Jul 12–15, 2017, Jul 11–14, 2018*

Programming and Technical Skills

Advanced: Python, Julia, LaTeX, GitHub, Git

Intermediate: Keynote, ssh, C++

Basic: R, DS9, bash

Publications

Refereed papers

Debiasing the Minimum-Mass Extrasolar Nebula: On the Diversity of Solid Disk Profiles

Matthias Y. He, Eric B. Ford, 2022, submitted to AJ

Developing a Drift Rate Distribution for Technosignature Searches of Exoplanets

Megan G. Li, Sofia Z. Sheikh, Christian Gilbertson, **Matthias Y. He**, Howard Isaacson, Steve Croft, Evan L. Sneed, 2022, submitted to AJ

Edge-of-the-Multis: Evidence for a Transition in the Outer Architectures of Compact Multiplanet Systems

Sarah C. Millholland, **Matthias Y. He**, Jon K. Zink, 2022, AJ, 164, 72-87

Friends and Foes: Conditional Occurrence Rates of Exoplanet Companions and their Impact on Radial Velocity Follow-up Surveys

Matthias Y. He, Eric B. Ford, Darin Ragozzine, 2021, AJ, 162, 216-238

Evidence for a Non-Dichotomous Solution to the Kepler Dichotomy: Mutual Inclinations of Kepler Planetary Systems from Transit Duration Variations

Sarah C. Millholland, **Matthias Y. He**, Eric B. Ford, Darin Ragozzine, Daniel Fabrycky, Joshua N. Winn, 2021, AJ, in press

Architectures of Exoplanetary Systems. III: Eccentricity and Mutual Inclination Distributions of AMD-stable Planetary Systems

Matthias Y. He, Eric B. Ford, Darin Ragozzine, Daniel Carrera, 2020b, AJ, 160, 276-314

Architectures of Exoplanetary Systems. II: An Increase in Inner Planetary System Occurrence Toward Later Spectral Types for Kepler's FGK Dwarfs

Matthias Y. He, Eric B. Ford, Darin Ragozzine, 2020a, AJ, 161, 16-40

Architectures of Exoplanetary Systems. I: A Clustered Forward Model for Exoplanetary Systems around Kepler's FGK Stars

Matthias Y. He, Eric B. Ford, Darin Ragozzine, 2019, MNRAS, 490, 4575-4605

On the stability and collisions in triple stellar systems

Matthias Y. He, Cristobal Petrovich, 2018, MNRAS, 474, 20-31

First limits on the occurrence rate of short-period planets orbiting brown dwarfs

Matthias Y. He, Amaury H.M.J. Triaud, Michaël Gillon, 2017, MNRAS, 464, 2687-2697

KMTNet Supernova Program Variable Objects I. NGC 2784 Field

Matthias Y. He, Dae-Sik Moon, Hilding Neilson, Jae-Joon Lee, Sang Chul Kim, Mina Pak, Hong Soo Park, Dong-Jin Kim, Yongseok Lee, Seung-Lee Kim, Chung-Uk Lee, 2016, JKAS, 49, 209-233

Conference proceedings

Supernova and optical transient observations using the three wide-field telescope array of the KMTNet

Dae-Sik Moon, Sang Chul Kim, Jae-Joon Lee, Mina Pak, Hong Soo Park, **Matthias Y. He**, John Antoniadis, Yuan Qi Ni, Chung-Uk Lee, Seung-Lee Kim, Byeong-Gon Park, Dong-Jin Kim, Sang-Mok Cha, Yongseok Lee, Santiago Gonzalez, 2016, Proc. SPIE 9906

Software

SysSimExClusters: `https://github.com/ExoJulia/SysSimExClusters`

- Code for simulating planet catalogs from the "Clustered" models that are fit to the *Kepler* data
- Provides a branch for each of the three "Architectures of Exoplanetary Systems" papers (I, II, & III)
- Provides an online folder with a large collection of pre-simulated (physical and *Kepler*–observed) planet catalogs for download

ExoplanetsSysSim: `https://github.com/ExoJulia/ExoplanetsSysSim.jl`

- Core *SysSim* code
- Contributed to various elements to make it work with SysSimExClusters