Austin Hinkel

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Research Interests: Galactic Structure, Galactic Archaeology, Physics & Astronomy Education/Outreach

Ph.D. Physics | Galactic Archaeology, Astrophysics, Data Science

Education

2016 - 2021 Ph.D., M.S. in Physics — **University of Kentucky**
Dissertation: "Axial Symmetry Tests of Milky Way Disk Stars Probe the Galaxy's Matter Distribution", GPA: 3.94

2015 - 2015 — **Danish Institute for Study Abroad**
Summer study abroad program in geopolitics and history

2012 - 2016 B.S. in Physics, minor in Mathematics — **University of Kentucky**
Honors Program, summa cum laude, GPA: 4.00

Appointments

2021 - 2023 Visiting Assistant Professor — **Colorado College**
2016 - 2021 Teaching and Research Assistant — **University of Kentucky**

Courses Taught

Introductory Astronomy - Lecture — Fall 2022
Sole lecture instructor for 34 students. Designed course around lecture tutorial worksheets, Think-Pair-Share activities, and other active learning techniques I learned at the AAPT's New Faculty Workshop.

Introductory Physics for the Physical Sciences II - Lab — Fall 2022
Sole laboratory instructor for around 35 students.

Astronomy and Data Analysis with the Gaia Space Telescope - Lecture — Spring 2022
Sole lecture instructor for 7 upper-level students. Facilitated the use of real astronomy data for students to learn programming, databases, data analysis techniques, and astrophysics. Designed course around mini-tutorials, mini-lectures, and more involved labs and projects.

Introductory Physics for the Life Sciences I - Lecture — Spring 2022
Sole lecture instructor for around 20 students. Designed course around lecture tutorial worksheets.

Introductory Physics for the Physical Sciences II - Lab — Spring 2022
Sole laboratory instructor for around 10 students.

Introductory Physics for the Life Sciences II - Lecture — Fall 2021
Sole lecture instructor for around 20 students. Designed course around lecture tutorial worksheets.

Introductory Physics for the Life Sciences I - Lab — Fall 2021
Sole laboratory instructor for around 20 students.

Introductory Physics for the Physical Sciences I - Lab — Fall 2021
Sole laboratory instructor for around 10 students.

Publications

Peer-Reviewed Journal Articles

1. Hinkel, Austin, Susan Gardner, and Brian Yanny (2022). "Two-Point Correlation Function Studies for the Milky Way: Discovery of Spatial Clustering from Disk Excitations and Substructure". In: *The Astrophysical Journal* (Submitted).

2. Gardner, Susan, Austin Hinkel, and Brian Yanny (2020). "Applying Noether's theorem to matter in the Milky Way: evidence for external perturbations and non-steady-state effects from Gaia Data Release 2". In: *The Astrophysical Journal* 890.2, p. 110.

3. Hinkel, Austin, Susan Gardner, and Brian Yanny (2020b). "Axial Asymmetry Studies in Gaia Data Release 2 Yield the Pattern Speed of the Galactic Bar". In: *The Astrophysical Journal Letters* 899.1, p. L14.
4. — (2020c). "Probing Axial Symmetry Breaking in the Galaxy with Gaia Data Release 2". In: *The Astrophysical Journal* 893.2, p. 105.

Journal Articles In Preparation

1. Hinkel, Austin (2022). "The Brocard-Ramanujan Problem and an Unexpected Connection to Primitive Pythagorean Triples". In: *Mathematics Magazine*.

Theses

1. Hinkel, Austin (2021). "Axial Symmetry Tests of Milky Way Disk Stars Probe the Galaxy's Matter Distribution". In: *Theses & Dissertations*.
2. — (2016). "Modeling Extrasolar Trojan Asteroids in Gravitational Potentials of Migrating Jovian-like Planets to Inform Future Observations". In: *Theses & Dissertations*.

Conference Proceedings, Posters, & Outreach

Conference Proceedings

1. Hinkel, Austin, Susan Gardner, and Brian Yanny (2021a). "Axial Symmetry Tests of Milky Way Disk Stars Probe the Galaxy's Matter Distribution". In: 237th Meeting of the AAS.
2. — (2021b). "Axial Symmetry Tests of Milky Way Disk Stars Probe the Galaxy's Matter Distribution". In: APS April Meeting.
3. — (2020a). "Applying Noether's Theorem to Matter in the Milky Way: Axisymmetry Tests with Gaia Data Release 2 Reveal External Perturbations and Non-Steady-State Effects". In: vol. 65. APS April Meeting.

Invited Talks

1. Hinkel, Austin, Susan Gardner, and Brian Yanny (2021c). "Two-Point Correlation Function Studies in the Milky Way: Spatial Clustering from Disk Excitations and Substructure". In: Ohio State University Little Galaxies Journal Club.

Poster Talks (Non-Presenting Coauthor)

1. Yin, Ziyuan and Austin Hinkel (2022). "A Wave-Corrected Assessment of the Milky Way's Vertical Structure Near the Solar Neighborhood". In: Colorado College Student Summer Research Symposium.

Outreach Talks

1. Hinkel, Austin (2020a). "Okay, the Climate's Changing... What Can We Do About It?" In: West Sixth Suds and Science Public Lecture Series.
2. — (2020b). "Swing Sets, Stars, and the Secrets of the Universe". In: U. of Kentucky Virtual Three Minute Thesis Competition (Finalist).
3. — (2019). "The Leftovers of Solar System Formation". In: Kentucky Sky Talk Public Lecture Series.

Honors, Grants, & Awards

Colorado College Faculty-Student Collaborative Research Grant Spring 2021
Colorado College Divisional Research & Development Grant Spring 2021
Universities Research Association Visiting Scholars Program grant winner (3X) 2018-2021
U. Kentucky College of Arts & Sciences Dean's Competitive Fellowship Fall 2020
GAANN Fellow, U.S. Dept. of Education for study at the U. Kentucky Fall 2018
American Physical Society Five Sigma Physicist Award 2016
U. Kentucky Dept. of Physics & Astronomy Outstanding Senior 2016
U. Kentucky Dept. of Physics & Astronomy Outstanding Junior 2015
U. Kentucky Presidential Scholarship 2012-2016
U. Kentucky Department of Physics & Astronomy Scholarship 2014-2016
Sigma Pi Sigma Physics Honor Society inductee 2015
Kentucky Educational Excellence Scholarship 2012-2016
U. Kentucky Dean's List 2012-2016
Kentucky Governor's Scholar 2011

Other Projects, Interdisciplinary Work, & Activities

Two-Point Correlation Studies of the Milky Way – Building on our previous work with the Two-Point Correlation Function (2PCF), my collaborators and I are working to develop an accurate model of the local Milky Way to allow for a traditional 2PCF analysis of the halo. By constraining the power spectrum of dark matter, our work may help to discriminate between particle physics models of dark matter.

Fall Risk Identification Project – Interdepartmental collaborator on a Human Biology and Kinesiology research project wherein I designed and implemented a data reduction and processing pipeline, filtered Fourier Transform data, and developed a moving-window analysis to automatically identify particular data collection outliers inherent in the experimental setup. I also formulated a novel metric to highlight a particular type of human movement of interest. The metric was ultimately able to predict fall risk in elderly patients with very high accuracy.

Energy Savings Advisor Software and Sensor System – Provisional patent filed in 2021 for a software-enabled hardware solution intended to lower energy usage of the built environment through thermodynamics calculations, building envelope monitoring, and consumer engagement.

Commission for Environmental Cooperation Youth Innovation Challenge Semi-Finalist – Semi-finalist in the Commission for Environmental Cooperation's Youth Innovation Challenge for the invention above.

United Nation Sustainable Development Goals for Intro Physics – A colleague and I are in the very early stages of developing a physics education research study monitoring student motivation, engagement, retention, and learning outcomes when concepts in introductory physics classes are designed to illustrate how physics is relevant to students' lives.

Adapting 2PCF Clustering Code to Health Equity Research – I am in the early stages of adapting my Two-Point Correlation Function studies to a more general clustering algorithm capable of picking out clusters from limited data sets. The goal is to open-source this software to help researchers pick out additional trends in clinical data which are all too often dominated by white males.

Leadership Activities, Professional Development, & Service

American Association of Physics Teachers New Faculty Workshop — July 2022
Student Sustainability Council Representative at U. Kentucky — 2020-2021
Graduate Student Congress Leadership Team: Sustainability Advocate at U. Kentucky — 2020-2021

Professional Memberships

American Physical Society – Member, District Advocate, & 5-sigma Physicist
American Astronomical Society – Member
American Association for the Advancement of Science – Member
American Association of Physics Teachers – New Faculty Workshop Participant
Union of Concerned Scientists – Science Network Member

Selected Press Coverage

Astronomy Class – Teaching coverage
Milky Way Structures – Research coverage