

Karl JAEHNIG, Ph.D

CONTACT INFORMATION

Vanderbilt University
Department of Physics & Astronomy
Email:

EDUCATION

Vanderbilt University, Nashville, Tennessee, USA
Ph.D, Astrophysics, Sept 2017 – August 2023
Thesis: “Characterizing Open Clusters and Spectroscopic Eclipsing Binaries with Machine Learning Frameworks”
Thesis Advisor: Dr. Kelly Holley-Bockelmann

Fisk University, Nashville, Tennessee, USA
M.A., Physics, Aug 2015 – Aug 2017
Thesis: “Evidence for a decreasing spectroscopic binary fraction within the IN-SYNC sample.”
Thesis Advisor: Dr. Keivan G. Stassun

University of Florida, Gainesville, Florida, USA
B.S., Major: Astronomy – December 2011

RESEARCH EXPERIENCE

Flatiron Institute - Data Research Analyst (Aug 2021 – Jan 2022)

- Construct Bayesian framework to infer binary dynamical parameters
 - Jointly modeled binaries with two different sets of time-series data
 - Uses Hamiltonian Monte Carlo for robust sampling performance
 - Framework designed for scalability and parallelization

Vanderbilt University - PhD Candidate (May 2018 –)

- Research various clustering algorithms to find co-moving stellar populations
 - Employed extreme deconvolution GMMs to achieve higher sensitivity in detecting members
 - Information theory was used to automate star cluster identification
 - 98.1% recovery rate, 11 previously unknown star clusters found

Vanderbilt University - Graduate Teacher (Aug 2017 – Apr 2019)

- Teaching assistant for class of ~250 students
- Investigated radius inflation in low-mass stars in star clusters
 - Found observed radius inflation is correlated with theoretical models of convection
- Explored blue straggler formation in star clusters with N-body simulations
 - Multi-scale dynamical interactions between cluster and binaries included
 - Stellar evolution models also integrated into simulations

Vanderbilt University - Graduate Researcher (Aug 2015 – Aug 2017)

- Investigated inferred binary fractions evolution using Bayesian Inference
 - Discovered possible binaries in young nebulous clouds through analysis of RV variations
 - Assessed observational sensitivity with synthetic Monte Carlo Observations
 - Found evidence binary fraction $\propto \text{age}^{-1}$ in young star forming regions

University of Florida - Post-Baccalaureate Researcher (Aug 2013 – Jul 2015)

- Developed statistical metric, *Angular Dispersion Parameter* (ADP) to quantify sub-structure
 - Applied ADP to Orion Nebula Cluster and older star clusters to study systematics
 - Characterized physical sub-structure of 20 young star forming regions

RESEARCH
INTERESTS

- Construction and design of machine learning pipelines for Bayesian inference
- Using ML to determine star cluster membership with astrometric/photometric data
- Using advanced visualization techniques (e.g. Plotly, Glueviz) to summarize ML results
- Developing python software to facilitate teaching/learning in astronomy

PUBLICATIONS:
REFEREED

1. **Jaehnig, Karl O.**, Adrian Price-Whelan, Dan Foreman-Mackey, and Trevor David, A joint LC-RV probabilistic model for spectroscopic eclipsing binary orbital parameter estimation, 2022, **Submitted**
2. **Jaehnig, Karl O.**, Bird, Jon, and Holley-Bockelmann, Kelly, Membership lists for 431 open clusters in Gaia DR2 using extreme deconvolution gaussian mixture models, 2021, 19 pages, ApJ, 923, 129
3. **Jaehnig, Karl O.**, Somers, Garrett, and Stassun, Keivan G., Radius Inflation at Low Rossby Number in the Hyades Cluster, 2019, 12 pages, ApJ, 879, 39
4. **Jaehnig, Karl O.**, Bird, Jonathan C., Stassun, Keivan G., Da Rio, Nicola, Tan, Jonathan C., Cotaar, Michiel, and Somers, Garrett, IN-SYNC. VII. Evidence for a Decreasing Spectroscopic Binary Fraction (from 1 to 100 Myr) within the IN-SYNC Sample, 2017, 18 pages, ApJ, 851, 14
5. **Jaehnig, Karl O.**, Da Rio, Nicola, and Tan, Jonathan C., The Structural Evolution of Forming and Early Stage Star clusters, 2015, 7 pages, ApJ, 798, 126
6. Da Rio, Nicola, Tan, Jonathan C., and **Jaehnig, Karl O.**, The Structure, Dynamics, and Star Formation Rate of the Orion Nebula Cluster, 2014, 16 pages, ApJ, 795, 55

PRESENTED
TALKS

- Jan 2019* “Radius Inflation in the Hyades Cluster”
233rd American Astronomical Society Meeting, ID 420.06, Seattle, Washington State
- Jan 2016* “Binaries at Birth: Stellar Multiplicity in Embedded Clusters from Radial Velocity Variations in the INSYNC Survey”
227th American Astronomical Society Meeting, ID 404.02, Kissimmee, Florida

CONFERENCE
POSTERS &
ABSTRACTS

- “An Analysis of Bulk Cluster Rotation Signatures Present Within Open Clusters Using Gaia DR2 Data”
Jaehnig, Karl O., Holley-Bockelmann, Kelly
2019, 233rd American Astronomical Society Meeting, ID 266.04, Seattle, Washington State
- “Binaries at Birth: Stellar Multiplicity in Embedded Clusters from Radial Velocity Variations in the INSYNC Survey”
Jaehnig, Karl O., Bird, Jonathan, Stassun, Keivan G., and the INSYNC Survey Team
2016, Statistical Challenges in Modern Astronomy VI, Pittsburgh , PA
- “The Structural Evolution of Forming and Early Stage Star clusters”
Jaehnig, Karl O., Da Rio, Nicola, and Tan, Jonathan C.
2016, 47th Division of Dynamical Astronomy Meeting, Nashville, Tennessee

PROFESSIONAL
WORKSHOPS

- April 2018* Modest 18a Workshop, Leiden University, Netherlands
- Jan 2017* Graduate Student Professional Development Workshop, Vanderbilt University
- June 2016* Summer School in Statistics for Astronomers XII, Penn State University, State College

May 2016 Astro-Statistics Workshop, Vanderbilt University

PROFESSIONAL AND
ACADEMIC
AFFILIATIONS

- Sigma Xi Scientific Research Honor Society: 2016–2019
- Division of Dynamical Astronomy (DDA): 2016–2020
- American Astronomical Society (AAS): 2015–present

SCHOLARSHIPS,
FELLOWSHIPS, &
COMPETITIVE
AWARDS

- CCA Pre-Doctoral Fellow: 2021–2022
- LSSTC Data Science Fellowship: 2018–2021
- Fisk-Vanderbilt Master’s to Ph.D Program Bridge Fellow: 2017–2023