

# Karl JAEHNIG, Ph.D

---

## CONTACT INFORMATION

Vanderbilt University  
Department of Physics & Astronomy  
*Email:* jaehnig.k@gmail.com

## 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”  
233<sup>rd</sup> 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”  
227<sup>th</sup> 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, 233<sup>rd</sup> 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, 47<sup>th</sup> 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