

PHILLIP A. CARGILE

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Education

Ph.D., PHYSICS, VANDERBILT UNIVERSITY MAY 2010
Thesis: *Testing the Chronometric Accuracy of Stellar Evolution Models Using Young Stars in Open Clusters*
Advisors: Keivan G. Stassun & David J. James
M.S., PHYSICS, VANDERBILT UNIVERSITY MAY 2008
B.S., ASTRONOMY, UNIVERSITY OF TEXAS AT AUSTIN MAY 2004
B.S., PHYSICS, UNIVERSITY OF TEXAS AT AUSTIN MAY 2004

Professional Appointments

RESEARCH SCIENTIST, HARVARD UNIVERSITY 2017–PRESENT
POSTDOCTORAL RESEARCHER, HARVARD UNIVERSITY 2014–2017
POSTDOCTORAL FELLOW, VANDERBILT UNIVERSITY 2010–2014

Research Interests

Connecting observations of starlight to fundamental models of stellar structure and evolution:

- Improving the accuracy of *ab initio* stellar-atmosphere and radiative-transfer models.
- Accelerating predictions of stellar spectra and other observables with machine learning.
- Industrial-scale inference of stellar properties with Bayesian and gradient-based methods.
- Characterizing stars and stellar populations to create benchmarks for physical models.

Scientific Surveys & Collaborations

VIA SURVEY:

Data processing and analysis lead for the survey, including spectral calibration and extraction and stellar-parameter inference. Developing novel extraction methods that combine established spectroscopic techniques with approaches from computer vision.

H3 SPECTROSCOPIC SURVEY:

Core team member across survey planning, target selection, observations, data archiving, processing, and operation of the MINESweeper stellar-parameter pipeline on Harvard's FASRC computing cluster.

SDSS-V MILKY WAY MAPPER:

Collaborator using stellar-inference pipelines to map distant, metal-poor Milky Way populations with SDSS spectroscopy, photometry, and Gaia astrometry.

JWST ADVANCED DEEP EXTRAGALACTIC SURVEY (JADES):

*Collaborated with the NIRC*am* imaging team to process, register, and stack JADES and complementary observations of GOODS-North and GOODS-South. This work contributed to the JADES Origins Field (JOF), the deepest JWST imaging yet achieved, and to searches that identified the highest-redshift galaxies known at the time.*

MAPPING THE DUSTY UNIVERSE – ROMAN & SPHEREx:

Collaborator on the Roman Galactic Plane Survey and SPHEREx, providing stellar modeling of Roman and SPHEREx photometry to infer stellar properties and construct detailed maps of interstellar dust.

Software Development

MINESWEEPER AND UBERMS:

Creator and lead developer of MINESweeper, which jointly models spectra, photometry, stellar-evolution tracks, and astrometric priors to infer stellar properties with full posterior uncertainty. Developing uberMS around automatic differentiation, NUTS, and variational inference for substantially faster analysis.

THE PAYNE:

*Co-developed neural-network emulators of *ab initio* stellar spectra with Yuan-Sen Ting. The PyTorch-based framework compresses high-dimensional physical model grids for fast, differentiable, uncertainty-aware inference.*

Radiative Transfer & Spectral Modeling

FITTING ALL THE LINES AND THE CWC GRID:
Lead optimization of atomic and molecular line parameters against benchmark spectra, currently fitting approximately 140,000 optical lines. Building the Korg-based CWC grid of consistently calibrated synthetic stellar spectra.

SPECTRAL-SYNTHESIS DEVELOPMENT:
Develop and modernize radiative-transfer workflows spanning Korg, SYNTHE, and ATLAS12, integrating new physics, updated atomic and molecular data, and new calibration techniques.

Teaching Experience

AUTODIFFERENTIATION, PYTORCH, AND JAX
NASA Cosmic Origins AI/ML Science and Technology Interest Group Lecture Series — December 2025

ACCELERATED COMPUTATION WITH AUTOMATIC DIFFERENTIATION: AD/PYTORCH/JAX
AstroAI Workshop, Center for Astrophysics | Harvard & Smithsonian — June 2026

TEACHING ASSISTANT, VANDERBILT UNIVERSITY 2007–2008
Instructor for observational-based astronomy laboratory for science and non-science majors.

Technical Expertise

SCIENTIFIC DOMAIN KNOWLEDGE: stellar atmospheres and evolution, radiative transfer, spectroscopy, stellar populations, and Galactic archaeology.

SCIENTIFIC COMPUTING & ML/AI: Python, Fortran, Julia; PyTorch, JAX, NumPy/SciPy; neural emulation; generative distribution modeling with normalizing flows, flow matching, and diffusion; autodiff; GPU/HPC workflows.

PROBABILISTIC MODELING: Bayesian inference, nested sampling, Hamiltonian Monte Carlo, NUTS, variational inference, hierarchical models, and posterior diagnostics.

Students Supervised

ALISHA KUNDERT, VANDERBILT UNIVERSITY 2010–2012

AARON JUAREZ, FISK UNIVERSITY, 2012–2014

MARIALIS ROSARIO-FRANCO, VANDERBILT UNIVERSITY, 2012–2015

KESHAWN IVORY, HARVARD UNIVERSITY, 2015

PRISCILLA HOLGUIN LUNA, HARVARD UNIVERSITY, 2018–2019

Long-term research mentor and technical collaborator with graduate and early-career researchers in the Conroy group and survey collaborations.

Community Involvement

CO-FOUNDER AND EXECUTIVE COMMITTEE MEMBER — ASTROAI

INVITED REVIEWER — APJ, AJ, A&A, AND NATURE

INVITED REVIEW PANELIST — NSF AND NASA

PYTHON “BOOTCAMP” INSTRUCTOR — SAO LATINO INITIATIVE PROGRAM 2019–2021

“SPEAK TO A SCIENTIST” AFTER-SCHOOL PROGRAM, Shady Hill School, Cambridge, MA, 2016–2018

VOLUNTEER SPEAKER — DYER OBSERVATORY 2005–2014

RESEARCH ADVISER — FISK–VANDERBILT BRIDGE PROGRAM 2005–2014

Selected Funding

THE H3 SPECTROSCOPIC SURVEY AND THE ORIGIN OF THE GALAXY
National Science Foundation AAG — PI: Conroy — Aug 2021–2024

TRIANGULATING ON THE AGES OF STARS: USING OPEN CLUSTERS TO CALIBRATE STELLAR CHRONOMETERS FROM MYR TO GYR AGES
National Science Foundation AAG — PI: Cargile — Aug 2011–2016

Manuscript in Preparation

1. **Cargile, P. A.**, et al., *Fitting All the Lines: Empirical Calibration of $\sim 140,000$ Atomic and Molecular Lines for Stellar Spectral Modeling*, in preparation.
2. **Cargile, P. A.**, et al., *uberMS: Fast, Differentiable, Bayesian Inference of Stellar Parameters from Spectrophotometric Data*, in preparation.
3. **Cargile, P. A.**, et al., *The Ill-posed Inverse Problem of Spectral Extraction: Merging Spectroperfectionism with Computer Vision*, in preparation.

First Author Publications

1. **Cargile, P. A.**, Conroy, C., Johnson, B. D., et al., *MINESweeper: Spectrophotometric Modeling of Stars in the Gaia Era*, 2020, ApJ, 900, 28.
2. **Cargile, P. A.**, James, D. J., Pepper, J., et al., *Evaluating Gyrochronology on the Zero-age-main-sequence: Rotation Periods in the Southern Open Cluster Blanco 1 from the KELT-South Survey*, 2014, ApJ, 782, 29.
3. **Cargile, P. A.**, James, D. J., Jeffries, R. D., *Identification of the Lithium Depletion Boundary and Age of the Southern Open Cluster Blanco 1*, 2010, ApJ, 725L, 111.
4. **Cargile, P. A.**, James, D. J., *Employing a New BVI_C Photometric Survey of IC 4665 to Investigate the Age of This Young Open Cluster*, 2010, AJ, 140, 677.
5. **Cargile, P. A.**, James, D. J., Platais, I., *A New X-Ray Analysis of the Open Cluster Blanco 1 Using Wide-Field BVI_C Photometric and Proper Motion Surveys*, 2009, AJ, 137, 3230.
6. **Cargile, P. A.**, Stassun, K. G., Mathieu, R. D., et al., *Discovery of Par 1802 as a Low-Mass, Pre-Main-Sequence Eclipsing Binary in the Orion Star-Forming Region*, 2008, ApJ, 674, 329.

Selected Recent and Key Publications

1. Ting, Y.-S., Wadekar, D., **Cargile, P. A.**, et al., *Deep Learning for Astrophysics: An Open Textbook from the NASA Cosmic Origins AI/ML Science and Technology Interest Group*, 2026, RNAAS, 10, 202.
2. Chandra, V., **Cargile, P. A.**, et al., *Mapping the Distant and Metal-poor Milky Way with SDSS-V*, 2026, ApJ.
3. Ying, J., Chaboyer, B., **Cargile, P. A.**, et al., *Dartmouth Stellar Evolution Emulator (DSEE). 1. Generative Stellar Evolution Model Database*, 2026, ApJ.
4. Pass, E. K., **Cargile, P. A.**, et al., *Metallicities from High-resolution TRES Spectra with uberMS: Performance Benchmarks and Literature Comparison*, 2025, ApJS.
5. Speagle, J. S., et al., including **Cargile, P. A.**, *Mapping the Milky Way in 5D with 170 Million Stars*, 2024, ApJ.
6. Chandra, V., et al., including **Cargile, P. A.**, *Discovery of the Magellanic Stellar Stream Out to 100 kpc*, 2023, ApJ.
7. Ting, Y.-S., Conroy, C., Rix, H.-W., **Cargile, P. A.**, *The Payne: Self-consistent ab initio Fitting of Stellar Spectra*, 2019, ApJ, 879, 69.
8. Conroy, C., Bonaca, A., **Cargile, P. A.**, et al., *Mapping the Stellar Halo with the H3 Spectroscopic Survey*, 2019, ApJ, 883, 107.
9. Stassun, K. G., Mathieu, R. D., **Cargile, P. A.**, et al., *Surprising Dissimilarities in a Newly Formed Pair of “Identical Twin” Stars*, 2008, Nature, 453, 1079.