Curriculum Vitae — Zachary P. Vanderbosch

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Research Interests

Time-domain astronomy ••• Evolved planetary systems around white dwarf stars ••• Data mining large surveys ••• Pulsating white dwarf stars ••• Asteroseismology ••• Astronomical pipeline development ••• Astronomical Instrumentation ••• Binary and single star evolution ••• Laboratory astrophysics

Academic Background

California Institute of Technology *2021 – Present*
Postdoctoral Scholar Research Associate in Astronomy

The University of Texas at Austin *2015 – 2021*
Ph.D. Astronomy
Advisors: Don Winget & Mike Montgomery
Thesis: Pulsations and Planetary Debris: Variable White Dwarfs in Time-Domain Surveys

The University of North Carolina at Chapel Hill *2009 – 2013*
B.S. Astrophysics, *cum laude*

Publications

As of 2023 October, I have been involved in 25 peer-reviewed publications with 365 citations in high-impact journals, 5 of which are first and second author publications with 179 citations.

First/Second Author Publications:

** indicates paper written with an undergraduate student I supervised*

1. **Vanderbosch, Z.**, Hermes, J. J., Winget, D. E., et al., *The Pulsating Helium-atmosphere White Dwarfs. I. New DBVs from the Sloan Digital Sky Survey*, 2022, ApJ, 927, 158
2. **Vanderbosch, Z.**, Rappaport, S., Guidry, J. A., et al., *Recurring Planetary Debris Transits and Circumstellar Gas around White Dwarf ZTF J0328−1219*, 2021, ApJ, in press, 917, 41
3. *Sanghi, A., **Vanderbosch, Z.**, & Montgomery, M. H., *Identifying Periodic Variable Stars and Eclipsing Binary Systems with Long-Term Las Cumbres Observatory Photometric Monitoring of ZTF J0139+5245*, 2021, AJ, 162, 133
4. **Vanderbosch, Z.**, Hermes, J. J., Dennihy, E., et al., *A White Dwarf with Transiting Circumstellar Material Far outside the Roche Limit*, 2020, ApJ, 897, 171, Wikipedia
5. *Guidry, J., **Vanderbosch, Z.**, Hermes, J. J., et al., *I Spy Transits and Pulsations: Empirical Variability in White Dwarfs Using Gaia and the Zwicky Transient Facility*, 2021, ApJ, 912, 125

Co-Author Refereed Publications:

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6. Miller, D. R., Caiazzo, I., Heyl, J., ..., **Vanderbosch, Z.**, et al., *An Extremely Massive White Dwarf Escaped From the Hyades Star Cluster*, 2023, accepted in ApJL, arXiv:2310.03204

7. Yamaguchi, N., El-Badry, K., Rodriguez, A. C., ..., **Vanderbosch, Z.**, *Sodium enhancement in evolved cataclysmic variables*, 2023, MNRAS, 524, 740

8. Caiazzo, I., Burdge, K. B., Tremblay, P.-E., ..., **Vanderbosch, Z.**, et al., *A rotating white dwarf shows different compositions on its opposite faces*, 2023, Nature, 620, 61

9. Rodriguez, A. C., Galiullin, I., Gilfanov, M., ..., **Vanderbosch, Z.**, et al., *SRGeJ045359.9+622444: A 55 Minute Period Eclipsing AM Canum Venaticorum Star Discovered from a Joint SRG/eROSITA + ZTF Search*, 2023, ApJ, 954, 63

10. El-Badry, K., Shen, K. J., Chandra, V., ..., **Vanderbosch, Z.**, et al., *The fastest stars in the Galaxy*, 2023, OJAp, 6, 28

11. Burdge, K. B., El-Badry, K., Rappaport, S., ..., **Vanderbosch, Z.**, et al., *Orbital Decay in an Accreting and Eclipsing 13.7 Minute Orbital Period Binary with a Luminous Donor*, 2023, ApJL, 953, 1

12. Rodriguez, A. C., Kulkarni, S. R., Prince, T. A., ..., **Vanderbosch, Z.**, et al., *Discovery of Two Polars from a Crossmatch of ZTF and the SRG/eFEDS X-Ray Catalog*, 2023, ApJ, 945, 141

13. Williams, K. A., Hermes, J. J., **Vanderbosch, Z. P.**, *The Rapid Rotation of the Strongly Magnetic Ultramassive White Dwarf EGGR 156*, 2022, AJ, 164, 131

14. Zhang, Z., Liu, M. C., Morely, C. V., ..., **Vanderbosch, Z.**, et al., *COol Companions ON Ultrawide orbiTS (COCONUTS). III. A Very Red L6 Benchmark Brown Dwarf around a Young M5 Dwarf*, 2022, ApJ, 935, 15

15. Duan, R. M., Zong, W., Fu, J. N., ..., **Vanderbosch, Z.**, et al., *EPIC 228782059: Asteroseismology of What Could Be the Coolest Pulsating Helium-atmosphere White Dwarf (DBV) Known*, 2021, ApJ, 922, 2

16. Lopez, I. D., Hermes, J. J., Calcaferro, L. M., ..., **Vanderbosch, Z.**, et al., *Discovery, TESS Characterization, and Modeling of Pulsations in the Extremely Low-mass White Dwarf GD 278*, 2021, ApJ, 922, 220

17. Szkody, P., Godon, P., Gänsicke, B. T., ..., **Vanderbosch, Z.**, et al., *The Heating and Pulsations of V386 Serpentis after Its 2019 Dwarf Nova Outburst*, 2021, ApJ, 914, 40

18. Kepler, S. O., Winget, D., **Vanderbosch, Z.**, et al., *The pulsating white dwarf G117−B15A: still the most stable optical clock known*, 2021, ApJ, 906, 7

19. Casewell, S., Belardi, C., Parsons, S., ..., **Vanderbosch, Z.**, et al., *WD1032 + 011, an inflated brown dwarf in an old eclipsing binary with a white dwarf*, 2020, MNRAS, 497, 3571

20. Reding, J., Hermes, J. J., **Vanderbosch, Z.**, et al., *An Isolated White Dwarf with 317 s Rotation and Magnetic Emission*, 2020, ApJ, 894, 19

21. Kilic, M., Rolland, B., Bergeron, P., **Vanderbosch, Z.**, et al., *A magnetic white dwarf with five H α components*, 2019, MNRAS, 489, 3648

22. Bell, K., Pelisoli, I., Kepler, S. O., ..., **Vanderbosch, Z.**, et al., *The McDonald Observatory search for pulsating sdA stars. Asteroseismic support for multiple populations*, 2018, A&A, 617, 6

23. Bell, K., Hermes, J. J., **Vanderbosch, Z.**, et al., *Destroying Aliases from the Ground and Space: Super-Nyquist ZZ Cetis in K2 Long Cadence Data*, 2017, ApJ, 851, 24

24. Bell, K., Gianninas, A., Hermes, J. J., ..., **Vanderbosch, Z.**, et al., *Pruning The ELM Survey: Characterizing Candidate Low-mass White Dwarfs through Photometric Variability*, 2017, ApJ, 835, 180

25. Greiss, S., Hermes, J. J., Gänsicke, B., ..., **Vanderbosch, Z.**, et al., *The search for ZZ Ceti stars in the original Kepler mission*, 2016, ApJ, 457, 2855

Professional Presentations

Talks:

1. *Searching for Planets around White Dwarfs*, 2023 EAS Annual Meeting, Special Session on Planets not orbiting main sequence stars, Krakow, Poland, *2023 July 13*, **invited talk**

2. *Transiting Planetary Debris: An Overview of Search and Characterization Efforts*, KITP White Dwarf Program, Santa Barbara, CA. *2022 November 10*, link to recording

3. *Discovery and Characterization of Transiting Planetary Debris Systems with Gaia and ZTF*, 22nd European Workshop on White Dwarfs, Tuebingen, Germany, *2022 August 16*

4. *Pulsating Helium-Atmosphere WDs: A Hybrid Approach to Finding new DBVs with Gaia + ZTF + TESS*, Spring ZTF Team Meeting, Paris, France, *2022 May 13*

5. *Probing the Time-Domain Universe for Persistently Variable Stars: New Pulsating and Outbursting White Dwarfs from Gaia, ZTF, and SDSS*, Astronomy Seminar at UFRGS, Brazil, *2021 November 10*, **invited talk**, link to recording

6. *White Dwarfs with Transiting Planetary Debris In the Era of Large Time-Domain Surveys*, Online Meetings on Evolved Stars and Systems (O-MESS), *2021 July 14*, link to recording

7. *The Zwicky Transient Facility as a Variable White Dwarf Discovery Tool*, UT Austin Department of Astronomy, *2020 November 11*

8. *Planetary Debris around White Dwarfs in the Zwicky Transient Facility*, Celebrating ZTF-I & Soft Launch of ZTF-II, Caltech, USA, *2020 October 23*, **invited talk**, link to recording

9. *A ground-based detection of a DBV outburst*, IAU Symposium 357: White Dwarfs as probes of fundamental physics and tracers of planetary, stellar, & galactic evolution, Hilo, Hawaii, USA, *2019 October 21–25*

10. *Variable Stars in ZTF and a Second Case of Transiting Debris around a White Dwarf*, UT Austin Department of Astronomy, *2019 October 3*

11. *Observing Outbursting White Dwarfs in the post-Kepler Era*, TASC5/KASC12 Workshop, MIT/Cambridge, USA, *2019 July 22–26*

12. *A Ground-based Detection of an Outbursting White Dwarf*, UT Austin Department of Astronomy, *2019 April 17*

13. *The Empirical Limits of the DB(A) Instability Strip*, 21st European White Dwarf Workshop, UT Austin, *2018 July 23–27*, link to recording

14. *Redefining the Helium White Dwarf Pulsation Instability Strip with High-Speed Photometry, Uniform Spectroscopy, and Sandia Experiments*, UT Austin Department of Astronomy, *2018 March 21*

Posters:

15. *A Multi-Instrument Approach to Discovery and Characterization of Planetary Debris around White Dwarfs*, Palomar Science Meeting, Pasadena, CA, *2023 June 1–3*, PDF
16. *ZTF J0139+5245: A Second Case of Transiting Circumstellar Debris around a White Dwarf*, IAU Symposium 357: White Dwarfs as probes of fundamental physics and tracers of planetary, stellar, & galactic evolution, Hilo, Hawaii, USA, *2019 October 21–25*, PDF
17. *Empirical Constraints on the DB White Dwarf Instability Strip*, Sandia National Labs: Z Fundamental Science Workshop, Albuquerque, New Mexico, USA, 2019 August 11–14, PDF
18. *The First Ground-Based Detection of an Outburst in a K2 Pulsating Helium Atmosphere White Dwarf*, Kepler and K2 SciCon V, Glendale, California, USA, *2019 March 4–8*, PDF
19. *Asteroseismology of Pulsating Helium Atmosphere White Dwarfs using K2*, TASC4/KASC11 Workshop: First Light in a New Era of Astrophysics, Aarhus University, Denmark, *2018 July 8–13*, PDF
20. *V471 Tauri: Examining Eclipse Timing Variations with Two Independent Clocks*, 20th European White Dwarf Workshop, University of Warwick, UK, *2016 July 25–29*, PDF

Awarded Telescope Time

* *indicates time that includes currently active allocations*

Keck-I, LRIS Spectrograph	*4 nights as PI — Observed 4 Nights*
Keck-I, HIRES Spectrograph	*2 nights as PI — Observed 2 Nights*
Keck-II, ESI Spectrograph	*1 night as PI — Observed 1 Night*
Palomar 200-in, CHIMERA Photometer	*8 nights as PI — Observed 8 Nights*
Palomar 200-in, WIRC Near-IR Photometer	*1 night as PI — Observed 1 Night*
Palomar 200-in, DBSP Spectrograph	*5 nights as PI — Observed 5 Nights*
McDonald 2.1-m, ProEM Photometer	*241/128 nights as PI/Co-PI — Observed 216 Nights*
McDonald 2.7-m, Tull Spectrograph	*23 nights as PI — Observed 21 Nights*
McDonald 2.7-m, Coude Guide Photometer	*4 nights as PI — Observed 4 Nights*
HET 10-m, LRS2 Spectrograph	*79/10 hours as PI/Co-I — Used 49/6 hours*
LCOGT 1.0-m Network, Sinistro Imager	*110 hours as PI — Used 91.6 hours*
LCOGT 0.4-m Network, SBIG Imager	*5 hours as PI — Used 4.6 hours*
Gemini North 8.1-m, GMOS Spectrograph	*3.2 hours Fast Turnaround Time as PI*

Science, Project, & Team Management

ZTF Science Working Group Co-Lead, *Caltech* *May 2022 – present*

Serving as co-lead of the Zwicky Transient Facility (ZTF) Galactic stellar variable science working group, organizing and leading bi-weekly science and ZTF operations update meetings for an international group of ≈30 members. For semi-annual ZTF collaboration team meetings (three to-date), organize and present new working group science results, solicit individual science presentations from working group members, and lead working group discussion sessions for the planning and advancement of group-wide efforts, such as ZTF legacy data products/papers and new partnership survey modes. Recently contributed to an NSF proposal for the completion of a unique ZTF survey during the first year of Rubin-LSST observations, providing crucial text/figures for stellar variable science cases that uniquely benefit from ZTF-Rubin overlap.

Quarter Century Sky Project Member, *Caltech* *August 2022 – present*
Member of a collaborative effort to uniformly process photometry from multiple Caltech-led optical surveys to create a database of light curves spanning more than 20 years, the Quarter Century Sky (QCS) project. Organize and lead weekly update meetings with 5–10 people, including the project PIs, the database backend/frontend developer, and an image calibration expert. Responsible for the development and operation of a custom forced photometry pipeline applied to ZTF difference images to produce enhanced ZTF light curves stored in HDF5 file format, and reporting on pipeline status during weekly meetings. Also developing methods for comparing light curve quality from four different pipelines to determine the optimal pipeline choice for QCS. Also made significant contributions to the scientific and technical justifications of two NSF proposals for QCS funding.

Caltech Stellar Variables Group Member, *Caltech* *October 2021 – present*
Member of a highly collaborative group at Caltech including ≈15 postdocs, students, and faculty that share observational, technical, and scientific resources. Contribute to the proposing, planning, and execution of observations at Palomar and Keck observatories, typically observing 2–3 nights per month in service of other group member's programs. Develop documentation and tutorials related to instrument operation and data reduction/analysis, and collaborate on scientific publications. Also develop software tools for our group, and the Caltech astronomy department in general, providing programmatic access of spectroscopic survey products from SDSS-V and DESI and cross-matching with ZTF light curves and other external catalogs.

Teaching and Advising

Research Advisor: *Sam Whitebook, Caltech* *September 2023 – present*
Advising a post-baccalaureate student who is developing a novel method to identify white dwarfs with stable pulsations using Zwicky Transient Facility and TESS photometry. He plans to submit his results to a peer-reviewed journal this year. *Caltech*

SURF Research Mentor: *Soumyadeep Bhattacharjee, Caltech* *2022 – present*
Co-advised an undergraduate student during the Caltech Summer Undergraduate Research Fellowship (SURF) program who used Zwicky Transient Facility data to identify light curve statistical metrics that distinguish white dwarf stars with planetary debris transits from other variable white dwarfs. He plans to submit his results to a peer-reviewed journal this year. *Caltech*

Research Advisor: *Joseph Guidry, UT Undergraduate* *2019 – 2021*
Co-advised an undergraduate student in two research projects, one leading to a poster presented at the TASC5/KASC12 workshop, and another leading to the student's first first-author refereed publication (Guidry et al. 2021, currently with 61 citations!). *UT Austin*

Research Advisor: *Aniket Sanghi, UT Undergraduate* *2020 – 2021*
Advised an undergraduate student in a research project utilizing archival LCOGT images to identify variable stars. This project resulted in the student's first first-author refereed publication (Sanghi et al. 2021). *UT Austin*

Research Mentor: *Freshman Research Initiative* *2018 – 2021*
TA and mentor engaging undergraduate students in genuine research experiences. *UT Austin*

PDP Participant: *ISEE Professional Development Program* *2018*
Actively developed inquiry-based learning activities through the Institute for Scientist & Engineer Educators (ISEE) Professional Development Program, culminating in the design and execution of a 3-class inquiry activity for a 30-student undergraduate research methods course. Co-authored an ISEE journal article describing our program and outcomes (ISEE Article) *UT Austin, UC Santa Cruz*

Teaching Assistant: *AST-309N, Lives and Deaths of Stars* *Fall 2017*
TA for an introductory Astronomy class for non-STEM majors. *UT Austin*

Teaching Assistant: *AST-321, The Future of Humanity* *Fall 2016*
TA for a discussion and writing intensive course for both STEM/non-STEM majors. *UT Austin*

Undergraduate Teaching Assistant: *ASTR-101L, Intro Astronomy Lab* *Spring 2011, 2012, 2013*
Assistant to graduate TA in interactive Astronomy labs. *UNC Chapel Hill*

Instrumentation

ProEM Filter Wheel Upgrade: Designed, assembled, and commissioned a new software-integrated filter wheel, allowing for multi-color photometry with the ProEM photometer on the McDonald 2.1-m telescope. *UT Austin* *2016 – 2017*

Syzygy Optics VPH Gratings: Lab assistant manufacturing and developing production methods for volume phase holographic (VPH) diffraction gratings, primarily for astronomical purposes. *UNC Chapel Hill* *2014 - 2015*

Goodman Spectrograph Camera Shutter Upgrade: Designed a new camera shutter incorporating a GPS-linked Hall-effect sensor to provide accurate shutter open and close times for astronomical imaging. Traveled to the SOAR telescope in Chile to install the new shutter on the Goodman Spectrograph. *UNC Chapel Hill* *2011 – 2012*

Open Source Code, Tutorials, and Documentation

`phot2lc`: An open-source Python package for efficient and interactive extraction of time-series photometry light curves, compatible with the outputs from multiple photometry pipelines (`ccd_hsp`, ULTRACAM, HiPERCAM, MAESTRO) and data acquired from multiple facilities (McDonald 2.1-m, Palomar 200-in, Perkins 1.8-m, Kitt Peak 2.1-m). [Source, Docs, Zenodo]

`ZTF_Tools`: Open-source tools for visualizing and analyzing Zwicky Transient Facility (ZTF) light curve data. Main features are a tutorial notebook (`ztf_quicklook`) for single-source light curve retrieval and periodicity analysis, and code (`bokeh_web_plot`) demostrating how to produce a website-embeddable interactive Bokeh plot. [Source]

`LCO_Phot`: Open-source tools for performing aperture photometry on Los Cumbres Observatory (LCO) 1.0-m telescope images and calibrating to the Pan-STARRS1 magnitude system. [Source]

`Proto-Plotter`: An interactive educational tool developed using Python and TKinter for performing by-eye fits of blackbody functions to the spectral energy distributions of proto-planetary systems. We used this tool in multiple inquiry-based learning activities as part of the ISEE Professional Development Program. [Source, ISEE Article]

Service and Outreach

Caltech Optical Observatories TAC *Fall 2022*
Served on the Caltech Optical Observatories Time Allocation Committee (TAC), reading and providing critical assessments and ratings for more than 60 multi-disciplinary proposals aimed at using a large variety of near-IR to optical instruments on the Palomar 200-in and Keck 10-m telescopes. *Caltech*

Caltech Summer Research Connections (SRC) *Summer 2022,2023*
Served as a research mentor in SRC, a six-week summer program aimed at engaging local high school students in authentic STEM research experiences at Caltech. Worked with groups of five (2022) and two (2023) students, designing weekly presentations and research assignments related to the discovery and characterization of near-Earth objects (NEOs) using the Zwicky Transient Facility. *Caltech*

McDonald 2.1-m Telescope Tours *2017 – 2021*
Provided one-of-a-kind 2.1-m telescope tours and demonstrations to McDonald Observatory visitors and distinguished guests. *Fort Davis, TX*

FRI Science Sprint *October 2018*
Designed and facilitated a 1-day inquiry-based science sprint for 10–15 multi-disciplinary undergraduate students in the Freshman Research Initiative (FRI) program. *UT Austin*

Texas Lutheran University *April 2018*
Presentation on observational astronomy and laboratory astrophysics for 25 undergraduates in the society of physics students at Texas Lutheran University. *Seguin, TX*

Westminster Retirement Community *July 2017*
Public presentation on white dwarfs and observational astronomy to 60+ members of an Austin retirement community. *Austin, TX*

TAURUS Seminar *July 2016*
Presentation on observational astronomy to students in the Texas Astronomy Undergraduate Research experience for Under-represented Students (TAURUS) program. *Austin, TX*

Girl Day at UT *Spring 2016*
Volunteered with the preparation of materials and activities for Girl Day, attended by over 8,000 elementary and middle school students. *Austin, TX*

Astronomy on Tap ATX *2015 – 2016*
Volunteered at monthly Astronomy on Tap events which regularly host more than 200 attendees. *Austin, TX*

Skills

Computer Languages:	Python, JavaScript, SQL/ADQL, bash/shell, LaTeX, C, C#, R, git, markdown, reStructuredText, HTML
Software:	TOPCAT, Github, IRAF, Period04, WQED, MOOG, iSpec, MS Office, Google Suite, Autodesk Inventor & Fusion 360, Zemax
Instrumentation:	Precision mill and lathe operation, soldering, PCB design, ray tracing & optics manufacturing