# CAMILLE CHIU

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## EDUCATION

**Yale University**, New Haven, CT                                        **Expected graduation:** Spring 2026
**Major:** Astrophysics                                                    **Cumulative GPA:** 3.92/4.00

**Current courses (Fall 2025):** Thermodynamics and Statistical Mechanics, Astrostatistics and Data Mining, Painting Basics, Astrophysics Senior Thesis
**Relevant courses:** Fundamentals of Physics I and II; Classical Mechanics; Advanced Physics from Newton to Einstein; Quantum Mechanics and Natural Phenomena; Modern Physical Measurement I and II; Physical Chemistry with Applications in the Physical Sciences II; Linear Algebra; Ordinary and Partial Differential Equations; Probability and Bayesian Statistics; The Anthropology of Outer Space; Research Methods in Astrophysics, Scientific Computing in Astrophysics; Stellar Dynamics, Exoplanets; Critical Data Visualization: History, Theory, and Practice

Graduated from **College Station High School** in May 2021                **HS GPA:** 4.00/4.00

## PUBLICATIONS

- **Chiu C.**, Chandra V., & Rix H.W., in prep. The Stellar Mass-Weighted Orbit and Metallicity Distribution of the Milky Way. *In preparation for submission.*
- **Chiu C.**, Li Y., Huber D., Ong J., van Saders J., & Crawford C., in prep. Constraining Mass Loss Across the Red Giant Branch Using Wide Binaries from Gaia DR3. *In preparation for submission.*
- **Chiu C.**, Geha M., Cerny W., Garling C., Richstein H., & Kallivayalil N., in prep. Kinematics and Star-formation History of Willman 1: A Disrupting Dwarf Galaxy. *In preparation for submission.*
- **Chiu C.** & Strigari L. (2020). Testing the Accuracy of the Tangent Point Method for Determining the Milky Way's Inner Rotation Curve. *Research Notes of the American Astronomical Society*, 4, 165. DOI: 10.3847/2515-5172/abbad8.

## RESEARCH EXPERIENCE

**The Stellar Mass-Weighted Orbit and Metallicity Distribution of the Milky Way**          Summer 2025-present
*Summer Research Intern under the mentorship of Vedant Chandra & Prof. Hans-Walter Rix*          *Heidelberg, Germany*

- We developed a new method for reconstructing the orbit and chemical stellar density distribution of the Milky Way, exploiting the canonical transformation to action-angle space. I applied this method to the precise 6D phase-space and chemical abundance measurements of red giant branch stars from *Gaia* DR3.
- I modeled the *Gaia* selection function, including a rigorous, 3D treatment of interstellar dust. Assuming that every star on a particular orbit is an unbiased sample in orbital phase and stellar mass, we use the selection function to correct for observational incompleteness, effectively "filling in" the missing stars. From this, we can infer the true stellar density of the Milky Way as a function of orbit and metallicity.
- I calculated fundamental structural properties of the Milky Way that have previously been difficult to measure such as the thin/thick disk mass, the global stellar metallicity distribution, and the radial stellar mass profile. This allows us to situate the Milky Way in the context of galactic formation and chemical evolution models as well as the local galaxy population.

**Constraining Mass Loss on the Red Giant Branch Using Wide Binaries**
**and Asteroseismology**                                                  Summer 2024-present
*NSF REU Researcher under the mentorship of Dr. Yaguang Li & Prof. Dan Huber*          *Honolulu, HI*

- Mass loss across the red giant branch (RGB) is a key uncertainty in our understanding of stellar evolution. We reviewed scientific literature on asteroseismic techniques and the contradictory results between previous studies of RGB mass loss using globular clusters and those using open clusters.
- I selected a sample of 9 red clump (RC) + subgiant (SG) wide binaries from the El-Badry+2021 catalog using photometric and asteroseismic parameters. I extracted the oscillation frequencies of each RC star from TESS light curves using peakbagging and inferred the stellar properties of each star based on a set of observables.
- I fit the wide binary sample to `MESA` and `GYRE` stellar evolution models using observational, asteroseismic, and coevality constraints in order to estimate the stellar mass loss of the primary RC star in each binary. We use the SG star to anchor the stellar age of the system.
- We conclude that the integrated stellar mass loss determined from our analyses are more consistent with the smaller values ($\leq 0.1\ M_\odot$) estimated from seismic studies of open clusters rather than the larger mass loss values inferred from globular clusters. This method offers a new avenue for exploring RGB mass loss across a wider range of metallicity and stellar mass.

**The Kinematics of Willman 1: A Disrupting Dwarf Galaxy**  Spring 2023-Fall 2025
*Yale Undergraduate Researcher under the mentorship of Prof. Marla Geha*  *New Haven, CT*

- Discovered in 2005 as the first ultra-faint dwarf galaxy found in SDSS, Willman 1 (W1) remains poorly understood. We reviewed scientific literature on W1, ultra-faint dwarf galaxies, and their significance for constraining dark matter, understanding Milky Way dynamics, and testing galactic evolution and cosmological models.
- Using Professor Geha's reduction of Keck/DEIMOS spectroscopy in conjunction with *Gaia* DR3 astrometry and CFHT photometry, I developed an original probabilistic framework to differentiate between Milky Way foreground interloper stars and members of W1. From this sample of member stars, I characterized W1's kinematic, metallicity, and mass segregation profiles, finding an internal velocity dispersion, metallicity spread, and no evidence for mass segregation.
- I performed dynamical analyses to determine the orbital history of W1, including determining its 3D orbit, simulating mock stellar streams, and calculating its tidal radius. These analyses suggest that W1 is most likely being observed at the apocenter of its orbit, implying that W1 has been closer to the Milky Way in the recent past.
- We conclude that evidence points towards W1's classification as a dwarf galaxy that is undergoing tidal disruption. As W1 is not in dynamical equilibrium, we warn that the inferred dynamical mass from its internal kinematics does not accurately reflect the actual mass of the system.

**Mapping the Habitability of the Milky Way with Gaia and Stellar Kinematics**  Fall 2019-Spring 2021
*High school researcher under the mentorship of Katelyn Stringer (PhD candidate at TAMU)*  *College Station, TX*

- We reviewed scientific literature on the Galactic Habitable Zone (GHZ), the regions of the Milky Way that would be most suitable for life, and the effect of various galactic hazards on the potential for life.
- I developed a new model for the GHZ that incorporates stellar kinematics and applied it to stellar data from the Gaia satellite on over 6 million stars, including almost 1,500 confirmed exoplanet systems.
- I performed kinematics analyses by calculating the 3D orbit of each star backwards in time over the last four billion years using the Milky Way's calculated gravitational potential and each star's current 6D phase space.
- We concluded that, in contrast to previous studies, there is a potential for habitable planets in most regions of our galaxy, indicating that accounting for stellar kinematics is an essential piece in our search for life in the Universe.

**Testing the Accuracy of the Tangent Point Method for Determining the Milky Way's**
**Inner Rotation Curve**  Fall 2018-Fall 2020
*High school researcher under the mentorship of Prof. Louis Strigari at TAMU*  *College Station, TX*

- We reviewed scientific literature on galactic rotation curves, which provided one of the first pieces of evidence for the existence of dark matter.
- We formulated hypothesis that the Tangent Point Method (TPM), which has been used since 1954 to calculate the rotation curve of the inner portion of the Milky Way using neutral hydrogen radio telescope data, is inaccurate.
- We designed and executed analyses testing the accuracy of the TPM by comparing the rotation curve derived from the TPM with that derived from direct measurements of the motions of stars from the Gaia satellite.
- We found a statistically significant difference, providing evidence that the TPM is inaccurate and implying that the Milky Way's rotation curve is shallower than previously thought.

## AWARDS/FELLOWSHIPS

**National Goldwater Scholarship**  March 2025

**Best Poster Presentation Award** (University of Connecticut Conference for Women in Physics)  January 2025

**Chambliss Astronomy Achievement Student Award** (245th AAS Meeting)  January 2025

**University of Hawai'i Institute for Astronomy REU Fellow** ($7,000)  Summer 2024

**Yale First-Year Summer Research Fellowship in Science & Engineering** ($4,300)  Summer 2023

**International Science and Engineering Fair (ISEF)**

- Finalist, selected as one of six best in fair projects to represent the Austin district  May 2019, 2020, 2021
- Honorable Mention from the National Aeronautics Space Administration (NASA)  May 2019
- 4th place in Astronomy/Physics  May 2021

## CONFERENCES/TALKS

- Expected attendee at the 247th Meeting for the American Astronomical Society in Phoenix, AZ  January 2026
  *Poster: The Stellar Mass-Weighted Orbit and Metallicity Distribution of the Milky Way*

- Yale University Undergraduate Kick-off Event September 2025
  *Talk: The Stellar Mass-Weighted Orbit and Metallicity Distribution of the Milky Way*
- MPIA Milky Way Group Meeting August 2025
  *Talk: The Stellar Mass-Weighted Orbit and Metallicity Distribution of the Milky Way*
- Attendee at APS Conference for Undergraduate Women in Physics at the University of Connecticut January 2025
  *Poster: The Kinematics of Willman 1: A Disrupting Dwarf Galaxy*
- Attendee at the 245th Meeting for the American Astronomical Society in National Harbor, MD January 2025
  *Poster: Constraining Mass Loss on the Red Giant Branch Using Wide Binaries and Asteroseismology*
- Yale University Undergraduate Kick-off Event September 2024
  *Talk: Constraining Mass Loss on the Red Giant Branch Using Wide Binaries and Asteroseismology*
- University of Hawai'i REU Final Presentations August 2024
  *Talk: Constraining Mass Loss on the Red Giant Branch Using Wide Binaries and Asteroseismology*
- Attendee at APS Conference for Undergraduate Women in Physics at CUNY January 2024
  *Poster: Re-assessing Milky Way Dwarf Galaxy Willman 1*
- Invited attendee at Dwarfs in the Local Group and Beyond Regional Conference at the Flatiron CCA July 2023

## OUTREACH

- President the Yale chapter of Women and Gender Minorities in Physics (WiP+) Fall 2025-present
- Yale Astronomy Department AstroSibs Undergraduate Coordinator Spring 2025-present
- Writer for the Yale Scientific Magazine Spring 2025-present
- Regular volunteer for Yale Pathways events (e.g. Girls' Science Investigations) Fall 2022-present
- Independent project: Khroma Spring 2024
  - created a website that guides the user through the creation of astronomical RGB color images from JWST data
- High school tutoring (physics) Spring 2024
- Yale Prison Education Initiative (YPEI) volunteer for the Research Request Network Summer 2023
- Invited speaker at the Austin Astronomical Society, *Talk: Galactic Habitability* August 2020

## SKILLS

- **Data Science/Programming:** advanced Python; intermediate LaTeX, R; basic Mathematica, C++
- **Foreign languages:** French (C1 level, spent gap year between high school and college as an exchange student in France, attending French lycée and living with a host family)
- **Memberships:** Society for Physics Students (2022-present), American Astronomical Society (2024-present)

## OTHER INTERESTS

- **Ballet**, current board member of the Yale Ballet Company
- **Music**, play piano as background music, as an accompanist, and for personal enjoyment; currently teach local elementary schooler piano basics; member of the Yale Handbells Ensemble (former co-president)
- **Reading**, science fiction, philosophy, social sciences (Ted Chiang, Elena Ferrante, Kurt Vonnegut, Albert Camus)