MINGHAN CHEN, PH.D.

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EDUCATION

University of California, Santa Barbara Sept 2018 - Sept 2024
Ph.D. in Physics

University of California, Santa Barbara Sept 2018 - Feb 2021
Master's in Physics

Carnegie Mellon University Sept 2014 - May 2018
B.Sc. Physics, GPA 3.97/4.00

RESEARCH EXPERIENCE

Exoplanet Imaging and Characterization Research Group, UCSB Sept 2018 - Present
Staff Research Associate *Santa Barbara, CA*

- Currently leading the data analysis and modeling of a high dimensional spectral imaging dataset from the Subaru Telescope, leveraging **the open-source Python pipeline I developed during my Ph.D. to perform regression and modeling**.
- Developed a novel data processing algorithm for the beam-steering mode of the Subaru Telescope to achieve a **measurement precision of** ~ 0.1 **pixel, a factor of** ~ 10 **better than standard pipeline**.
- Optimized the forward modeling and signal extraction of the imaging data and **improved precision by** $\sim 30\%$**, signal-to-noise ratio (SNR) by** $\sim 50\%$**, and reduced bias by a factor of 2**.

Doctoral Researcher *Santa Barbara, CA*

- Led the development of the CHARIS-pyKLIP Post-Processing Pipeline using **Bitbucket and Git workflow**. It is an **open-source Python data processing pipeline** for the **259-million-dollar Subaru Telescope** in Hawaii. The pipeline achieves a spatial measurement **precision of** $\sim 0.5\%$ and a contrast higher than **one million**.
- Implemented **asynchronous parallel processing** for the pipeline, which can perform data cleaning, regression, and signal modeling on gigabytes of high dimensional data in minutes.
- Designed and developed algorithms for image registration, calibration, and distortion correction for the pipeline. Achieved a detector scale calibration **precision of** $\sim$ **1%**.
- Implemented a novel Expectation Maximization Principal Component Analysis (EM-PCA) algorithm for the pipeline that achieves **zero self-contamination** of the image signal, **improving the signal-to-noise ratio (SNR) by** $20\% - 50\%$ **in data-constrained environments**.
- Developed a **maximum likelihood algorithm** to fit for accurate positions of blended sources to **1%**. Performed **time-series and periodogram analyses on 11 years of flux data under sparse sampling conditions** and achieved the strongest evidence for the null hypothesis. Applied **Markov-Chain Monte Carlo** to fit the orbit of a planetary system, which produced **the most precise mass measurements ever (**$\sim$ **0.5% precision)** at the time of publication for all imaged brown dwarfs.

The McWilliams Center for Cosmology & Astrophysics, CMU Oct 2015 - Apr 2018
Student Researcher *Pittsburgh, PA*

- Trained and tested a **computer vision deep learning model** on a simulation database, queried using **SQL**, and applied it on a real galaxy cluster to yield a precise mass ($\sim$ **1%**) **published in Nature Astronomy**.

Geneva Observatory Jun 2017 - Aug 2017
Research Intern at École Polytechnique Fédérale de Lausanne (EPFL) *Lausanne, Switzerland*

- Worked with **sparse signal processing** and improved an algorithm that used **wavelet transformations** to distinguish different colored components in multi-band images.

TEACHING AND MENTORING EXPERIENCE

Doctoral Teaching Assistant Sept 2018 - June 2019, Mar - Jun 2023, Jan - Mar 2024
University of California, Santa Barbara *Santa Barbara, CA*

- Led undergraduate-level classical mechanics physics lab sessions, 6 hours / week for two academic quarters. Taught physics concepts, experimental principles and procedures.
- Led undergraduate-level scientific programming sessions, 4 hours / week for three academic quarters. Designed session problems that incorporate applications of the scientific method and programming on physics problems.
- Experimented with the incorporation of AI-assisted programming into the scientific programming course to facilitate more efficient learning. Designed and implemented policies to ensure academic integrity while allowing students to benefit from AI assistance.
- Wrote step-by-step homework solutions. Graded homework and lab reports, and provided personalized feedback.
- Held weekly office hours to assist students with their learning and projects.

Physics Graduate Mentoring Program Mentor Sept 2021- Jun 2022
University of California, Santa Barbara *Santa Barbara, CA*

- Mentored new graduate students in navigating department resources, setting goals and planning for the Ph.D. program.

Peer Tutor and Teaching Assistant Sept 2015 - May 2016
Carnegie Mellon University *Pittsburgh, PA*

- Conducted one-on-one and group tutoring sessions weekly on undergraduate-level physics and mathematics.
- Level 2 CRLA certified tutor, over 100 hours of tutoring completed.

SKILLS

Languages	Python (pandas, scipy, numpy; object-oriented), SQL, C
Tools	Git, Emacs, Linux, Azure, Jupyter, Bitbucket, Mathematica, LaTeX, Docker
Skills	Signal processing, Machine Learning, Bayesian Inference, MCMC, Statistical Modeling PCA, A/B testing

SELECTED PUBLICATIONS

- Precise Dynamical Masses of ε Indi Ba and Bb: Evidence of Slowed Cooling at the L/T Transition
  Minghan Chen & Yiting Li et al. The Astronomical Journal, 163 288, 2022
- Post-processing CHARIS integral field spectrograph data with pyKLIP
  Minghan Chen et al. RAS Techniques and Instruments, Volume 2, Issue 1, 2023
- Multiband polarimetric imaging of HD 34700 with SCExAO/CHARIS
  Minghan Chen et al. Submitted to Monthly Notices of the Royal Astronomical Society, 2024
- The dynamical mass of the Coma cluster from deep learning
  Matt Ho et al. Nature Astronomy, 936-941, 2022
- Improved Dynamical Masses for Six Brown Dwarf Companions Using Hipparcos and Gaia EDR3
  Mirek Brandt et al. The Astronomical Journal, 162 301, 2021
- Astrometric Accelerations as Dynamical Beacons: Discovery and Characterization of HIP 21152 B, the First T-dwarf Companion in the Hyades
  Kyle Franson et al. The Astronomical Journal, 165 39, 2023
- Surveying Nearby Brown Dwarfs with HGCA: Direct Imaging Discovery of a Faint, High-Mass Brown Dwarf Orbiting HD 176535 A
  Yiting Li et al. Monthly Notices of the Royal Astronomical Society, Volume 522, Issue 4, 2023
- Dynamical masses and ages of Sirius-like systems
  Hengyue Zhang et al. Monthly Notices of the Royal Astronomical Society, Volume 524, Issue 1, 2023

PRESENTATIONS

- Colloquium talk at National Autonomous University of Mexico (UNAM): Characterizing Exoplanets and Brown Dwarfs with High Contrast Imaging. Nov 2023

HONORS AND AWARDS

Carnegie Mellon University, Dean's List High Honors 2018

LEADERSHIP

Osterbrock Sierra Conference
Lead Organizer Feb 2020 - Sept 2021

- Organized an astrophysics graduate student conference that included 8 University of California campuses.
- Drafted conference proposal and secured conference funding from the Osterbrock Leadership Program.
- Worked with delegates from all campuses to book conference venue, coordinate transportation, and plan conference activities.