

Yi Guo

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EDUCATION

University of California, San Diego

Ph.D. Physics

Physics Excellence Award

La Jolla, CA
Sep 2018 – Expected Jun 2023

University of California, Santa Barbara

B.S. Physics

Academic Honors, Worster Fellowship

Isla Vista, CA

B.S. Mathematics

Sep 2014 – Jun 2018

SKILLS

Languages and Tools Python, C/C++, Fortran, Mathematica, Matlab, Markdown, L^AT_EX, Git, Docker

Web Development Javascript, HTML, CSS, MySQL, React, React Native, Firebase

Numerical Research Data Visualization, Parallel Computing, Monte Carlo Simulation,
Non-linear Regression, Classification

Miscellaneous Photography, Video Editing, Image Processing

ACADEMIC RESEARCH

University of California San Diego

Research Assistant

La Jolla, CA
Dec 2019 – Present

- Numerically forecasted the sensitivities of future CMB/LSS surveys, in terms of the primordial non-Gaussianities and the cosmological parameters, with the Fisher matrix method. Innovations including taking the SZ effect into consideration, and adopting the multi-tracer scale dependent bias, which greatly reduces the uncertainties. Codes were written in **Jupyter notebooks**. Figures were plotted with **Matplotlib** and **Plotly**.
- Calculated the constraints on the coupling strength between axions and standard model fermions, using tree level quantum field theory and modern cosmology. By far the most accurate results, for doing the calculation exactly without approximations. To tackle the five dimensional integral, **Mathematica** was used to get the analytic result of one dimension, leaving the rest four done numerically. **Numba** was used to speed up the already parallel **Python** code by another 100X. Work published on JCAP.
- Calculated the CMB anisotropy phase shift in a neutrino dominated universe. [Pang Bai] (Existing literature only focused on the photon dominated universe and expressed the phase shift as an expansion of the neutrino proportion, which should be trusted only when the neutrino proportion was small. On the contrary, I calculated in the neutrino dominated situation, and expressed the phase shift as an expansion of the photon proportion. It turned out that the approximation in current literature was only off by 5%, so the work was not published.) Computation done with **Mathematica** and **Python**.

University of California Santa Barbara

Student Researcher

Isla Vista, CA
Sep 2015 – Jun 2017

- Measured the gas kinematics and thermal behaviors of 28 galaxy mergers of redshift 0.1 with the package I developed. Found that most of them (25) are blowing gas away, and only few (3) are inhaling, confirming theoretical predictions. Presented on UCSB undergraduate symposium and Worster Symposium.
- Measured the photometry of 52 galaxy mergers from raw data. Learnt how to reduce all kinds of noise for telescope images. Overcame the difficulty of learning IRAF, an old package with few or obsolete documentation, by inferring syntax from bash, tcsh, C, etc. Reduced the work of repeating the same procedure hundreds of times by writing **C** programs and **shell** scripts to auto-locate the targets and run the measurement scripts automatically.

WORK EXPERIENCE

University of California San Diego

Teaching Assistant

La Jolla, CA

Oct 2018 – Present

Notable courses:

- TA of Computational Physics I: Probabilistic Models and Simulations.
Simulated galaxy collisions with 1 million particles, exported into videos.
Taught N-body simulation algorithms from $O(N^2)$ to $O(N)$ to students.
- TA of Computational Physics II: PDE and Matrix Models.
Simulated various quantum experiments on classical computers using the path integral formulation.
- Lectured on data visualization and matrix operations using **Jupyter notebook**.
- Reviewed as “Excellent” by the instructor.

SOFTWARE DEVELOPMENT PROJECTS

Web Application – Personal Task Management System

Apr 2022 – May 2022

- Developed a Progressive Web App for personalized task tracking purpose. Works on Web/Mobile/Desktop.
- Using **Firestore**, a no-SQL database, to store user data and built the login system with OAuth2.
- Designed and built the frontend with **React** and **Material UI** to allow users interact with tasks.
- Users can take notes, set start time, deadline, repetition, prerequisites, and priority for individual tasks. System settings includes account, theme(light/dark), language(EN/CN).
- Adding new features such as the calender, the wallet.

Scientific Calculation – Package for Astronomical Spectrum Analysis

Sep 2015 – Jun 2016

- Developed a package for rapid galactic spectrum analysis.
- Incorporated the best of two worlds: **Fortran** for performance hungry computation and **Python** for user interface and data visualization. Used **F2PY** as the bridge between these two languages.
- Utilizing Levenberg-Marquardt algorithm for non-linear fitting, Markov chain Monte Carlo for error estimation, and with handy automation from the user interface, it helped speed up traditional spectrum fitting by more than 10X.
- Well documented with user manual.

PROJECTS THAT I BELIEVE IS NOT WORTH TALKING BUT ANYWAY

Network – Personal Cluster

- Built a small cluster consisting of a macbook master and 3 PC workers, 74 threads in total. Connected via either OpenMP or Ray.
- Networked by a soft router running Pfsense, with customized NAT and rules, connecting machines with LAN and virtual machines with OpenVPN.

Tool – Bilibili Live Stream Recorder

- Built a live stream recorder for bilibili.com using Python package urllib2. Ran on a remote server 24/7 and pushes email notifications on disk full.

PUBLICATIONS

D. Green, **Y. Guo** and B. Wallisch, “Cosmological implications of axion-matter couplings,” In: *JCAP* 02.02, p. 019 (2022) DOI: [10.1088/1475-7516/2022/02/019](https://doi.org/10.1088/1475-7516/2022/02/019) arXiv: [2109.12088](https://arxiv.org/abs/2109.12088) [astro-ph.CO].