

I have had the fortune of working on multiple research projects spanning across different fields of astrophysics. My undergraduate studies and senior honors thesis on galaxy evolution with Professor Danilo Marchesini led to my first co-author publication. My internship project at NASA Goddard Space Flight Center (GSFC) with Dr. Joshua Schlieder first exposed me to precise stellar characterization and led to two poster presentations. I fell in love with stars through this project and maintained my collaboration with Dr. Schlieder, leading to 4 additional co-author publications, my first talk at an American Astronomical Society (AAS) meeting, and my first first-author peer-reviewed publication. Now, as a Master's student with Dr. Benjamin Montet and Professor Jacob Bean, my research and thesis focuses on exoplanet detections using the *Transiting Exoplanet Survey Satellite (TESS)*. **My unusually broad research experiences have deepened my commitment to observational astrophysics and have left me with the desire to pursue stellar and exoplanet astrophysics at the PhD level.**

Before beginning the PhD program at Columbia University, I will submit another first author publication to a peer-reviewed journal, complete a Master's thesis, give a poster presentation at this winter's AAS meeting, and be an invited speaker at a conference in February.

My primary interest and ideal program of graduate study, which stems from my undergraduate and Master's work, consists of conducting and analyzing observations and large statistical survey studies focusing on exoplanets and stellar hosts. The projects that most appeal to me include follow-up of new exoplanets detected using *TESS* and using both *TESS* and *Gaia* to study planet hosts. I would additionally enjoy projects characterizing stars in the Milky Way to study its previous evolution.

### Research Experience

Upon landing in Chicago the summer before the autumn quarter, I started working with Dr. Benjamin Montet and Professor Jacob Bean. After discussion of several project ideas, I chose my project strategically, with the goal of improving my programming abilities as well as being able to contribute to the astronomy community on a large scale. As a graduate research assistant, I am developing an open-source Python pipeline, `eleanor`<sup>1</sup>, that will produce systematics-corrected light curves for 25 million stars in the *TESS* Full-Frame Images (FFIs) and be publicly available on MAST and ExoFOP-TESS. Upon downloading `eleanor`, users can create their own light curves for fainter objects and create visuals to help better understand their sources. **I will be presenting a poster on `eleanor` at the 233<sup>rd</sup> AAS meeting<sup>2</sup>, was selected to speak about `eleanor` at the AAS *TESS* Special Session, and am an invited speaker on this project at the *TESS* Data Workshop at the Space Telescope Science Institute in February, 2019.** Additionally, I am very excited to be traveling to the Magellan Telescopes in Chile this December to obtain high resolution spectra of interesting systems identified by *TESS*.

As an undergraduate research assistant at Tufts University, I was awarded funding from the Massachusetts Space Grant Consortium to work with my advisor, Professor Danilo Marchesini, on a project in galaxy evolution. My project used publicly available gravitational lensing models in the Hubble Frontier Fields (HFF) cluster pointings to construct catalogs of gravitational lensing magnifications. I am a co-author on the paper accompanying the public release of the HFF-DeepSpace multi-wavelength photometric catalogs of all twelve clusters and parallel HFF pointings.<sup>3</sup> This work, as well as a smaller project on massive ( $> 10^{11} M_{\odot}$ ) galaxy evolution using the UltraVISTA multi-wavelength catalogs culminated into my senior honors thesis, for which I was awarded high honors. Although my passion does not lie in galaxy evolution, my undergraduate experiences left me with strong programming skills and knowledge of how to manage large data sets.

<sup>1</sup><https://github.com/afeinstein20/eleanor>

<sup>2</sup>Poster Number 140.14 on January 7, 2019

<sup>3</sup><http://cosmos.phy.tufts.edu/~danilo/HFF/Home.html>

The summer following my junior year, I interned at NASA GSFC under the guidance of Dr. Joshua Schlieder. My project focused on the characterization of young red dwarfs in the solar neighborhood using spectroscopic data from SpeX, an infrared (0.7-5.3 micron) spectrograph. I wrote a Python program that identified young stars using the strength of gravity-sensitive spectral features as age indicators, because young stars have weaker spectral features due to ongoing contraction. This work resulted in two poster presentations.

Additionally, Dr. Schlieder and I completed four half nights of observing with the NASA Infrared Telescope Facility. The observed targets were included on a paper studying low-mass stellar systems observed by the *Kepler/K2* mission and lead to the confirmation of the third-known exoplanet in the Hyades cluster. I received funding to present a talk on this discovery at the 231<sup>st</sup> AAS meeting. Dr. Schlieder and I have continued to collaborate, most recently confirming the existence of a temperate super-Earth ( $1.9 R_{\oplus}$ ) identified by citizen scientists on the Zooniverse platform. **I am the first author on this peer-reviewed paper, along with all citizen scientists who identified this planet.**

My Physics GRE score is old, taken a year ago, and does not demonstrate my ability to understand and succeed in physics & astronomy, as demonstrated by my available graduate course grades at the University of Chicago and undergraduate major GPA (3.71/4.0) and research experiences. As a Master's student at the University of Chicago, I am challenging myself and broadening my knowledge by enrolling in graduate-level astronomy, physics, and geophysical sciences courses. I chose to pursue my Master's degree here because of the rigor of the courses, deepening my knowledge of the subjects, and the flexibility of the 8 courses required by the program. By enrolling in courses across several departments, I hope to obtain a competitive foundation of stellar and planetary systems.

### Future Goals

I believe my research interests align well with Professor Melissa Ness, Professor Ruth Angus, and Professor Rebecca Oppenheimer. I believe Professor Ness' interest in the chemical classification and modeling of stellar spectra compliments mine. My previous research in determining the stellar ages of low-mass stars drives my interest in further working with stellar spectra. Additionally, I am interested in probing other methods of characterizing stellar populations, such as with measuring rotation periods of stars observed with *Kepler* and *TESS*. *TESS* is observing stars all across the sky on the order of a month to a year. The prospects of having long time-domain photometry to accurately measure rotation periods is particularly exciting to me. The light curves I produce as a result of my Masters' thesis at the University of Chicago will prove incredibly useful for this project. I hope to expand this project into studying stellar activity as a function of age as well. After measuring rotation periods, I hope to confirm stellar ages using spectrographs on the MDM Observatory, implementing my previous methods of measuring spectral feature strength and equivalent widths. In addition to probing individual stars, I am excited to further understand Milky Way structure under Professor Ness' guidance. There is so much archival data due to the increase in large surveys over the past decade. I am excited to explore the rich science that is still unexplored with the *Gaia* and APOGEE surveys to specifically understand the chemical composition of stellar populations in the Milky Way. I am excited by the prospects of exploring multiple data-driven projects under Professor Ness' advising.

In addition to academics, I am committed to public outreach efforts, starting my junior year of undergraduate studies and continuing to today. As event coordinate and later president of the Tufts branch of the Society of Physics Students, I organized outreach events such as star parties, solar observing, and liquid nitrogen ice cream. The summer before my Master's program began, I was an aide in an after-school program, which combined science and art, at the Hyde Park Neighborhood Club. Throughout the academic year, I continue with these efforts as a volunteer scientist for both the Letters to a Pre-Scientist organization (through which I have a 6<sup>th</sup> grade pen-pal in California) and the Skype a Scientist organization. **I am always looking for new**

**and exciting ways to reach young children and get them invested in STEM subjects, and specifically showing young girls that if I can pursue STEM, so can they.**

I am especially eager to continue these efforts at Columbia University, specifically bringing telescopes to the sidewalks of NYC and amaze residents with all they can see from the city, regardless of light pollution. I hope to become involved in the organization of local Astronomy on Tap events with speakers from Columbia's and surrounding institution's faculty members and graduate students. As an organizer, I want to host special nights for senior undergraduates and underrepresented members of the field to come and talk about their work. In addition to the many outreach efforts Columbia Astronomy has, I also hope to bring Soapbox Science to NYC. Soapbox Science is a novel approach to promote women scientists in all fields. My hope is to organize events in heavily trafficked areas, such as Central Park and Union Square, and spread science and promote diversity across all fields of STEM.

I would be honored to continue my education at Columbia University. I feel my undergraduate and Master's experiences make me a qualified candidate for this position. I aspire to probe and uncover exciting new astrophysics that will better enhance our understanding of stellar and planetary systems. A PhD in Astronomy from Columbia University will help me towards my ultimate goal of being a professional astronomer and devoting my career to scientific discovery. I hope to have the opportunity to adapt my skills and challenge myself under the guidance of the faculty at Columbia University.

Thank you for your consideration.