J. LUNA ZAGORAC

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EDUCATION

Yale University, New Haven, CT *August 2016 - Present*
Ph.D. anticipated in August 2022

Colgate University, Hamilton, NY *Aug 2012 - May 2016*
B.A. with Honors in Astronomy/Physics & Anthropology

SKILLS AND QUALIFICATIONS

Programming Languages	Python, C/C++, MATLAB, Chapel, Pascal
Python Packages	Jupyter, MatPlotlib, Numba, NumPy, SciPy, PyFFTW, AstroPy
Software & Tools	LaTeX, Excel, Mathematica, ImageJ
Communication skills	Science & grant writing, outreach, public speaking, data visualization
Languages	English & Serbian (native) French & Italian (proficient), Arabic (conversational) Latin & Middle/Late Egyptian (intermediate)

RESEARCH EXPERIENCE

UltraLight Dark Matter Simulations and Observational Constraints Jan 2019 - Present
Professor Nikhil Padmanabhan & Professor Richard Easther *Yale University*

Developing the ChapelUltra pseudo-spectral solver, optimizing it for HPC use, using it to simulate UltraLight Dark Matter, and assessing candidate feasibility. Projects currently underway include:

- developing calculator for ULDM eigenstates and comparing them with perturbation theory. Publication: Zagorac et al. (2021)
- investigations of the core-halo mass relation and imprints of merger history on ULDM halos
- modelling stellar streams around a ULDM halo using the streakline method
- probing ULDM phenomenology in the presence of baryonic disk potentials

An Astronomical View of Ancient Egyptian Star Clocks Sep 2019 - May 2021
Professor Priya Natarajan & Professor John Coleman Darnell *Yale University*

Developed the code decanO.py to track and analyze the movement of Ancient Egyptian decans in the night sky and compare the results with primary sources. Results were presented at the 2021 Meeting of CT Digital Humanities (CTDH) and the 72nd Annual Meeting of the American Research Center in Egypt (ARCE). This interdisciplinary project was funded by the Franke Program in the Humanities & Natural Sciences at Yale.

Gravitational Signatures of Primordial Black Holes Sep 2017 - Mar 2019
Professor Nikhil Padmanabhan & Professor Richard Easther *Yale University*

Modeled primordial black hole creation mechanisms in the early universe, constrained their 2-body interactions and dynamics, and calculated resultant gravitational wave spectra from mergers for allowed parameter space.
Publication: Zagorac et al. (2019)

Particle Mesh Code for Bi- and Power Spectra Jan 2017 - Aug 2017
Professor Nikhil Padmanabhan *Yale University*

Wrote particle mesh code to calculate the power spectrum and bispectrum from GADGET-2 simulation data in C++. Tested the code by generating a Gaussian random field to run through the code and compared results with analytically calculated power spectra and bispectra for the Gaussian case.

Data Reduction for SMARTS Consortium at Yale Nov 2016 - May 2017
Professor Charles Bailyn *Yale University*

Reduced a backlog of AGN spectra collected by the Yale SMARTS Consortium using Yale's software pipeline. Prepared data for online publication for use by collaborators.

Supermassive WIMP Production in the Early Universe Aug 2015 - May 2016
Professor Patrick Crotty *Colgate University*

Wrote an equation solver in Python, using Numpy and Scipy for analysis and Matplotlib for visualizations. Varied coefficients describing shape of sigmoid inflaton field and calculated resulting DM abundances with assumed particle mass. Presented preliminary results at Syracuse University Undergraduate Research Day. This work constituted my senior honors thesis titled "Constraining WIMPzilla Production in the Inflationary Phase of the Early Universe."

Volunteer Archaeologist at South Asasif Conservation Project Jun - Jul 2015
Dr. Elena Pischikova *Luxor, Egypt*

Supervised team of workers doing excavation; organized, labeled, and stored finds, and documented site progress daily. Used dumpy-level photography and measurements to produce accurate technical drawings of the site. Wrote up extensive field reports for the site director.

Observations and Analysis of 2014 Flare of Blazar 3C454.3 Jun 2014 - Aug 2014
Professor Thomas Balonek *Colgate University*

Observed AGN at Foggy Bottom Observatory at Colgate University on a 16-inch, Newtonian-Cassegrain telescope. Reduced all data using UNIX, IRAF, and Pascal-based software, with analysis focusing on 3C454.3 and its historic flare that summer. Compared our optical data with Yale SMARTS data of the same object to find excellent agreement, as well as radio data from the Submillimeter Array. No correlation between radio and optical flares was found.

HONORS & AWARDS

Future Investigator in NASA Earth and Space Science and Technology *May 2020*
NASA Grant for $90,000 *funding two years of doctoral work and independent investigations of ULDM.*

Leigh Page Award for Excellence in Graduate Student Teaching *Nov 2021*
Award for $500 which recognizes broad and valuable contributions to physics education at Yale, science communication, and work fostering a welcoming learning environment for students.

Loyde and William C. G. Ortel Fellowship in Physics *Nov 2020*
Awarded to an outstanding student pursuing a Ph.D. in Physics.

Franke Science & Humanities Interdisciplinary Research Award *Sep 2019*
Yale Fellowship for $3000 funding two years of interdisciplinary work on Egyptian constellations.

Colgate Physics and Astronomy Department Founders Award *Apr 2016*
Awarded periodically to a senior who has demonstrated four years of outstanding progress and development of her understanding of physics or astronomy.

Sigma Pi Sigma Physics Honors Society *Apr 2016*
Honorary membership to Sigma Pi Sigma Honors Society.

Alumni Memorial Scholar at Colgate University *Aug 2012 - May 2016*
Scholars are selected at the time of admission to Colgate for their dedication and interest in scholarship and have the opportunity to apply for grants totaling up to $5,000 to fund independent research.

PUBLICATIONS

4. **Zagorac**, Kendall, Sands, Padmanabhan, and Easther. "Soliton Formation and the Core-Halo Mass Relation for Synthetic ULDM Halos: An Eigenstate Perspective." *In prep, expected late 2021.*

3. **Zagorac**, Sands, Padmanabhan, and Easther. "Schrödinger-Poisson Solitons: Perturbation Theory." (2021). arXiv preprint: 2109.01920.

2. Padmanabhan, Ronaghan, **Zagorac**, and Easther. "Simulating Ultralight Dark Matter with Chapel: An Experience Report." *In SC19 Proceedings* (2019).

1. **Zagorac**, Easther, and Padmanabhan. "GUT-scale primordial black holes: mergers and gravitational waves." Journal of Cosmology and Astroparticle Physics 2019.06 (2019): 052.

PRESENTATIONS

† = Invited Speaker

23. †**Stockholm University** — Jan 2022
UltraLight Dark Matter Dynamics in the Language of Eigenstates — *Virtual*

22. †**Stony Brook University** — Oct 2021
UltraLight Dark Matter Dynamics in the Language of Eigenstates — *Virtual*

21. †**University College London** — Oct 2021
UltraLight Dark Matter Dynamics in the Language of Eigenstates — *Virtual*

20. †**Carnegie Observatories** — Oct 2021
UltraLight Dark Matter Dynamics in the Language of Eigenstates — *Virtual*

19. †**University of Hawaii Institute of Astronomy** — Oct 2021
UltraLight Dark Matter Dynamics in the Language of Eigenstates — *Virtual*

18. †**Northwestern University CIERA Science Happy Hour** — Oct 2021
UltraLight Dark Matter Dynamics in the Language of Eigenstates — *Virtual*

17. †**Newcastle University Cosmology Journal Club** — Sep 2021
Schrödinger-Poisson Solitons: Perturbation Theory. — *Virtual*

16. **Weak Interaction Discussion Group at Yale** — May 2021
Linear Approximations to UltraLight Dark Matter Stationary States — *Virtual*

15. **American Research Center in Egypt Annual Meeting** — Apr 2021
In Search of Lost Time: An Astronomical View of Ancient Egyptian Star Clocks — *Virtual*

14. **Aspen Winter Conference, A Rainbow of Dark Sectors** — Mar 2021
UltraLight Dark Matter & Its Eigenstates — *Virtual*

13. †**Yale Institute of Sacred Music** — Mar 2021
Cosmogonies, Cosmologies, & Time — *Virtual*

12. †**Connecticut Digital Humanities** — Feb 2021
In Search of Lost Time: An Astronomical View of Ancient Egyptian Star Clocks — *Virtual*

11. †**Bay Area Science Festival Science Cafe Mini-Talks in Astronomy** — Oct 2020
Cosmic Archaeology, or: How Do We Know the Things We Know? — *Virtual*

10. **236th Meeting of the American Astronomical Society** — Jun 2020
Parametrizing UltraLight Dark Matter Haloes Through Binary Soliton Core Mergers — *Virtual*

9. †**Center for Computational Astrophysics** — May 2020
Parametrizing UltraLight Dark Matter Haloes Through Binary Soliton Core Mergers — *Virtual*

8. **Weak Interaction Discussion Group at Yale** May 2020
Parametrizing UltraLight Dark Matter Haloes Through Binary Soliton Core Mergers *Virtual*

7. **235th Meeting of the American Astronomical Society** Jan 2020
A Light in the Dark: Ultra Light Dark Matter in Theory and Simulation *Hawaii Convention Center*

6. **Great Lakes Cosmology Workshop** Aug 2019
Pseudo-Spectral Solvers for Fuzzy Dark Matter *Rochester Institute of Technology*

5. **Tri-Institute Summer School on Elementary Particles** Jul 2018
Gravitational Wave Spectrum of Ultralight Primordial Black Holes *Perimeter Institute*

4. **Colgate University Honors Thesis Defense** Apr 2016
Saving Tokyo: Constraining WIMPzilla Production in the Early Universe *Colgate University*

3. **Syracuse University Undergraduate Research Day** Dec 2015
Constraining WIMPzilla Production in the Early Universe *Syracuse University*

2. **Keck Northeastern Astronomy Consortium** Nov 2014
The Optical and Radio Variability of the Blazar 3C 454.3 *Swarthmore College*

1. **Colgate Physics & Astronomy Welcome Seminar** Sep 2014
The Variability of Blazar 3C 454.3 *Colgate University*

TEACHING EXPERIENCE

Curriculum Development & Lecturing Summer 2019 - 2021
Yale Bootcamp on Physics Fundamentals

Co-developed a curriculum for 20 hours of Classical Mechanics instruction, met weekly with staff supervisor to polish lectures and example problems. Delivered 10 hours of lecture at the Bootcamp. Developed a Mathematica tutorial for incoming graduate students. Re-vamped the curriculum and moved it online for Summer 2020 and Summer 2021.

Head Teaching Fellow Positions Aug 2017 - May 2018
PHYS170/171 - University Physics for the Life Sciences

Organized other teaching fellows, staffed weekly help sessions and office hours, held review sessions on material before exams, graded weekly homework, proctored and graded exams.

Teaching Fellow Positions Fall 2016 - Fall 2020

PHYS/ASTR600 - Cosmology *Fall 2020*
PHYS442 - Introduction to Nuclear and Elementary Particle Physics *Spring 2020*
PHYS410 - Classical Mechanics *Fall 2019*
ASTR343 - Gravity, Astrophysics, and Cosmology *Spring 2019*
PHYS165/166 - General Physics Laboratory *Fall 2016 - Spring 2017*

SCIENCE COMMUNICATION

Popular Science Presentations

Bay Area Science Festival "Astro Coffee" Presenter: *Cosmic Archaeology* — *Oct 2020*
"Ask a Scientist" Webinar Presenter: *Dark Matter* — *May 2020*
"Astronomy on Tap" Presenter: *Cosmic Archaeology* — *Aug 2019*
"3 Minute Thesis" Yale Finalist: *How Small Black Holes Teach Us about the Big Bang* — *Apr 2019*

Writing

Astrobites Media Intern at AAS238 — *Jun 2021*
Astrobites Contributing Author (>15 articles and interviews) — *Dec 2019 - Present*
ComSciCon at AIP Participant — *Sep 2019*

SERVICE & LEADERSHIP

University Positions

Yale Digital Humanities Lab Consultant — *Sep 2020 - Present*
McDougal Graduate Student Life Fellow at Yale — *Aug 2018 - May 2019*
Graduate Affiliate, Pauli Murray College at Yale — *Fall 2017 - Present*

Committee Work

Astrobites Diversity, Equity, and Inclusion Committee Member — *Mar 2020 - Present*
Physics Climate and Diversity Committee Member — *Jan 2018 - May 2020*

Conference & Seminar Organization

Co-organizer: Black in Physics Week at Yale Event Series — 2020
Volunteer: Conference for Undergraduate Women in Physics — 2019-2020
Co-organizer: Equity in the Job Search Symposium — 2018-2019

Outreach Volunteering

Astronomy Ambassador, American Astronomical Society — *Jan 2020 - Present*
Volunteer, Yale Pathways to Science — *Fall 2018 - Spring 2019*
Activity Leader, CT Students Exploring Engineering Day — *Spring 2018*
Activity Leader, Girls Science Investigations — *Sep 2016 - Present*

MENTORSHIP

Undergraduates Researchers Supervised

Claire Recamier, junior at Yale: — *Jun 2021 - Present*
Stellar Streams in UltraLight Dark Matter Halos

Isabel Sands, now Ph.D. student at Caltech: — *Jan 2020 - Jun 2021*
Constructing a Binary Soliton Merger Library
Linear Approximations to UltraLight Dark Matter Stationary States

Formalized Mentoring Activities

SU(5) Group Mentor — *Fall 2020*
Científico Latino Graduate Student Mentoring Initiative (GSMI) Mentor — *Fall 2019*
Women in Science at Yale (WISAY) Mentor — *2016-2019*