Greg Lukens

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Education

The Pennsylvania State University **Aug 2022 – present**
Ph.D. in Astronomy & Astrophysics *State College, PA*

Indiana University **Aug 2018 – May 2022**
Bachelor of Science in Astronomy & Astrophysics *Bloomington, IN*
Bachelor of Science in Physics **GPA**: 3.983
Bachelor of Science in Mathematics *Summa cum Laude*

Research Experience

Large-scale structure **Fall 2022 – present**
Advisor: *Donghui Jeong, Ph.D.* *Penn State University*

- Currently working to develop a technique to more accurately characterize galaxy clustering statistics from wide-angle, full-sky galaxy surveys. This technique incorporates elements of total-angular-momentum (TAM) formalism, which effectively uses spherical Bessel functions and spherical harmonics to fully parameterize density perturbations on a curved sky, and is actively being applied in order to accurately model the angular galaxy power spectrum for NASA's SPHEREx mission with the expressed goal of maximizing the precision on the survey's measurement of primordial non-Gaussianity. Other projects include full-sky modeling of redshift-space distortions including nonlinear effects (e.g. the streaming model), using machine-learning to forward model dark matter halos from initial density fields, and calculating the fully relativistic galaxy density contrast out to second order (and applying it to the three point function).
- **Tentative dissertation title:** *Precision cosmology in full-sky galaxy surveys*

Galaxy gas kinematics **Sept 2018 – Sept 2021**
Advisor: *Liese van Zee, Ph.D.* *Indiana University*

- Used archival radio astronomy (21 cm line) data taken from "nearby" galaxies to analyze the distribution and kinematics of their neutral hydrogen regions. Data reduction was performed using the following programs: Astronomical Image Processicing System (AIPS), Image Reduction and Analysis Facility (IRAF), and the Groningen Image Processing SYstem (GIPSY). End result was the creation of moment maps (distributions, velocities, and velocity dispersion) of the neutral hydrogen regions for each galaxy. In addition, stellar kinematic data was used in combination with the hydrogen kinematics to construct rotation curves, and, consequently, estimate the dark matter composition of each galaxy. This process was performed for Messier 101, NGC 6822, and IC 1613.

Exoplanets **Aug 2020 – May 2022**
Advisor: *Songhu Wang, Ph.D.* *Indiana University*

- Used a combination of archival radial velocity (RV) measurements and new RV data from the Automated Planet Finder (APF) at Lick Observatory to estimate upper-mass limits for putative planets that remain undetected in hot Jupiter systems. The data was reduced using the IDL package EXOFAST and the Python package Allesfitter. In order to obtain the upper-mass limits, an injection-recovery exercise was performed for hypothetical close-in companions in hot Jupiter systems, using the residuals of the systemic RV curves as "jitter" on the companions' radial velocities. This procedure has currently been applied to the following systems: 51 Pegasi, Upsilon Andromedae, HD 149143, HD 187123, HD 209458, and HD 217107.

Neutron lifetime **Fall 2021**
Advisor: *Chen-Yu Lui, Ph.D.* *Indiana University*

- Used two different specially designed "gravity spectrometers" to determine the energy spectrum of the ultracold neutrons (UCN) used in the ongoing UCNτ project, which has produced the most precise measurement of the neutron lifetime to date. This experiment is housed at Los Alamos National Laboratory (LANL) in the Los Alamos Neutron Science CEnter (LANSCE). A comparison of the spectra obtained using the two different shaped spectrometers allows for the quantification of "loss" and detector efficiency effects, which when accounted for, provides a measure of the true neutron energy spectrum.

Teaching Experience

Graduate Teaching Assistant **Fall 2022 - present**
Department of Astronomy *Penn State University*

✓ Nominal duties for all of the following classes: held weekly office hours and graded assignments. Additional responsibilities are specified.

- ***ASTRO 1: Astronomical Universe***
  - Held rooftop observing sessions 4 nights a week.
- ***ASTRO 7N: The Artistic Universe***
  - Provided alternative text to images and animations present in "University of Mars" video game.
- ***ASTRO 292: Astronomy of the Distant Universe***
- ***ASTRO 320: Observational Astronomy Laboratory***
  - Supervised use of 2-foot diameter rooftop telescope for long-term observation projects; twice weekly. Conducted in-laboratory experiments when required.
- ***ASTRO 440: Introduction to Astrophysics***
- ***ASTRO 480: Galaxies and Cosmology***
  - Guest/substitute instructor for three course lectures.
- ***ASTRO 497: Special Topics***
  - Guest/substitute instructor for two course lectures. Created solution set for homework assignments.
- ***ASTRO 545: Cosmology***
  - Guest/substitute instructor for two course lectures.

Undergraduate Tutor **Spring 2020**
Department of Astronomy *Indiana University*

- Assisted students with coursework in intro-level and general astronomy courses.

Outreach

AstroFest **Summer 2023, 2024, 2025**
Volunteer *Penn State University*

- Assisted in holding astronomy-related activities at Penn State's annual AstroFest. These activities included rooftop observing, guided "tours" of the timeline of the universe, astronomy trivia, etc.

Space Tonight **Fall 2020 - Spring 2022**
Editor/Contributor *www.spacetonight.com*

- Main contributor for a start-up website meant for amateur astronomers and those interested in the subject.
- Wrote many articles, most of them pertaining to cosmology and large-scale-structure of the universe.

Astronomy Club **Fall 2018 - Spring 2022**
Member *Indiana University*

- A member of the university astronomy club, which involves attending meetings and participating in outreach events (i.e. Science Fest, Kirkwood Observatory public showings, etc.).

Hallstrom Planetarium **Summer 2017 - Winter 2019**
Volunteer/Assistant *Indian River State College*

- Assisted planetarium director Mr. Jon Bell is providing shows to the general public and local elementary school classes on field trips.
- Learned how to operate the planetarium hardware and software.

Honors & Awards

- Homer F. Braddock Scholarship - *Penn State University* **Fall 2022**
- STARS (Science, Technology And Research Scholars Program) - *Indiana University* **Fall 2018 - May 2022**
- Research Partnership Grant - *IU Hutton Honors College* **Summer 2019**
- Research Grant - *IU Hutton Honors College* **Summer 2020**
- Advanced Summer Research Scholarship - *IU Department of Undergraduate Research* **Summer 2021**
- Wrubel Award - *IU Department of Astronomy* **Spring 2021**
- Founder's Scholar - *Indiana University* **Spring 2019 - May 2022**
- Executive Dean's List - *Indiana University* **Fall 2018 - May 2022**

Selected Workshops and Conferences

COSMO 25 **Fall 2025**
Parallel talk *Carnegie Mellon University*

Neighborhood Workshop **Spring 2025**
Talk *Penn State University*

American Astronomical Society: 245th Meeting **Winter 2025**
Poster *National Harbor, MD*

Seminars and Colloquia

Insitute of Gravitation and the Cosmos: PUG Seminar **Spring 2025**
Penn State University

Lunch Talk **Fall 2024**
Penn State University

Insitute of Gravitation and the Cosmos: PUG Seminar **Spring 2024**
Penn State University

Lunch Talk **Fall 2023**
Penn State University

Lunch Talk **Spring 2022**
Penn State University

Memberships

- Phi Beta Kappa **Spring 2022 - present**
- American Astronomical Society **Spring 2020 - present**

Computational Experience

- **Languages**
  - Python - *Proficient*
  - Julia - *Proficient*
  - C/C++ - *Some experience*
  - IDL - *Some experience*
  - FORTRAN - *Some experience*
- **Software and Packages**
  - Linux - *Proficient*
  - Anaconda - *Proficient*
  - AIPS - *Proficient*
  - IRAF - *Some experience*
  - GIPSY - *Some experience*