PATRICK D. ALEO CURRICULUM VITÆ

PH.D. STUDENT IN ASTRONOMY

ADVANCED VISUALIZATION LAB, NCSA

CONTACT

Office: The University of Illinois at Urbana-Champaign
Department of Astronomy
218 Astronomy Building, 1002 W. Green Street, Urbana, IL 61801, USA

Email: paleo2@illinois.edu

Phone: +1 (860) 389 8203

Publications: http://tiny.cc/patrickdaleo

EDUCATION

The University of Illinois at Urbana-Champaign *Aug. 2018 – Present*
Pursuing Ph.D. in Astronomy with Concentration in Computational Science & Engineering

The University of Texas at Austin *Aug. 2014 – Dec. 2017*
Completed B.S. Astronomy, B.S. Physics

APPOINTMENTS

THE UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Ph.D. Student, Astronomy *Aug. 2018 – Present*
Research Assistant, Advanced Visualization Lab, NCSA *Jan. 2019 – Present*
Teaching Assistant, ASTR 121 *Aug. 2018 – Dec. 2018*

THE UNIVERSITY OF TEXAS AT AUSTIN

Scientist Assistant, Astrophysics Theory Group *Feb. 2018 – Jul. 2018*
Undergraduate Research Assistant, Astrophysics *Oct. 2014 – Jan. 2018*
Teaching Assistant/Grader, AST 309C *Jan. 2017 – May 2017*

SELECTED REFEREED PUBLICATIONS

2 Publications · 2 Preprints · 55 Citations · h-index 2 · i10-index 1 *See*: Publications

"*Classifying and Deblending Astronomical Sources with Mask R-CNN Deep Learning*", Colin J. Burke, **Patrick D. Aleo** et al 2019 – arXiv:1908.02748
"*Estra: Clustering Methods for Astrophysical Data Visualization in the Moon-forming Synestia Simulation*", **Patrick D. Aleo** et al 2019 – *In preparation*
"*Blind Nucleosynthetic Source Discovery in Astronomical Elemental Abundance Data*", Miloš Milosavljević, **Patrick D. Aleo**, Natalie R. Hinkel, Haris Vikalo – arXiv:1809.02660
"*On the Iron Abundance Anomaly in K-dwarf and Hyades Stars*", **Aleo, P. D.**, Sobotka, A. C., & Ramírez, I. 2017, ApJ, 846, 24
"*The Dissimilar Chemical Composition of the Planet-Hosting Stars of the XO-2 Binary System*", Ramírez, I., Khanal, S., **Aleo, P.**, et al. 2015, ApJ, 808, 13

RESEARCH EXPERIENCE

Estra: Clustering Methods for Astrophysical Data Visualization: *Jan 2019 – Present*
Developing python pipeline, Estra, to enable scientists in creating their own visualizations in Houdini using results from clustering algorithms for publication, simulation testing, or public outreach. Creating documentation and manuscript to be published to Github and made publicly available for widespread and easy use. Applying clustering algorithms to moon-forming synestia simulation, using cluster IDs to inform color-mapping and creating a simplified shader network to be used on any SPH dataset for realistic, cinematic coloring and rendering.
Publication: In Progress

Star/Galaxy Instance Segmentation with Mask R-CNN Deep Learning: *May 2019 – Present*
Applied a new deep learning technique to detect, classify, and deblend sources in multi-band astronomical images. Trained and evaluated the performance of an artificial neural network built on the Mask R-CNN image processing framework, a general code for efficient object detection, classification, and instance segmentation. After evaluating the performance of our network against simulated ground truth images for star and galaxy classes, we find a purity of 86% at 80% completeness for stars and a purity of 87% at 80% completeness for galaxies in a typical field. We investigate the deblending capability of our code, and find that clean deblends are handled robustly during object masking, even for significantly blended sources. This technique, or extensions using similar network architectures, may be applied to current and future deep imaging surveys such as LSST and WFIRST. Our code, Astro R-CNN, is publicly available at https://github.com/burke86/astro_rcnn. *Publication:* arXiv:1908.02748

Blind, Data-based Nucleosynthetic Archetype Discovery: *Apr. 2017 – Present*
Demonstrated the feasibility of simultaneous non-negative matrix factorization and low rank completion on a real world astronomical dataset. Proposed heuristics for parameter selection for blind and robust unmixing of chemical abundance archetypes and minimized the volume of the archetypes' convex hull to promote physical interpretability of the extracted archetypes. Compared the discovered nucleosynthetic archetypes to patterns anticipated from direct astrophysical nucleosynthetic calculations. *Publication:* arXiv:1809.02660

Identifying Critical Line-blended Fe II Lines: *Oct. 2014 – Aug. 2017*
Co-lead a project to investigate the iron over-excitation/abundance discrepancy in cool K-dwarf and Hyades stars. Performed over 15,000 high-resolution stellar spectroscopic measurements to determine [Fe/H] and probed possible factors such as age, photospheric activity, and line-blending effects. Identified six blended Fe II lines which lead to an overabundance of [Fe/H] and verified through calculations of the synthetic spectrum. *Publication:* **Aleo** et al. 2017, ApJ, 846, 24

Chemical Abundances in Planet-Host Stars XO-2:   *Jan. 2015 – Jul. 2015*
Investigated the binary twin stars XO-2N, XO-2S and determined the relative chemical abundances of elements. Found significant differences in the chemical composition of their photospheres and proposed two explanations for the enhanced volatiles and refractories in XO-2N: an early metal depletion scenario and a late accretion scenario. *Publication:* Ramírez, I., Khanal, S., **Aleo, P.**, et al. 2015, ApJ, 808, 13

Searching for Extremely Low Mass Pulsating White Dwarfs: *May 2015 – Dec. 2015*
Observed extremely low mass white dwarfs using the 24" telescope at the Paul and Jane Meyer Observatory to look for pulsations. Led to a research poster presented at the Undergraduate Research Forum at UT Austin.

SCIENTIFIC TALKS & POSTER PRESENTATIONS

HAL Users Group Meeting:
NCSA, "Star/Galaxy Instance Segmentation in Astronomical Images with HAL"   *Jun. 2019*

ASTR 596 AI:
UIUC, "Star/Galaxy Instance Segmentation with Mask R-CNN"   *May 2019*
UIUC, "Predicting Solar Flares with Machine Learning"   *Feb. 2019*

Texas Astronomy Undergraduate Research Symposium (TAURS) Talk:
Baylor University, "On the Iron Abundance Anomaly in K-dwarf Stars"   *Sept. 2016*
Texas A&M University, "Iron and Oxygen Abundance Discrepancies in Cool Dwarf Stars"   *Sept. 2015*

UT Austin Undergraduate Research Forum Poster Presentation:
UT Austin, "On the Iron Abundance Anomaly in K-Dwarf and Hyades Stars"   *Apr. 2017*
UT Austin, "Scouring the Universe for ELMVs: An analysis of J2213 and J0040"   *Apr. 2016*

HONORS, AWARDS & FELLOWSHIPS

Fiddler Endowment Scholar, 2-time recipient	*2019-Present*
University Honors, 5-time recipient	*2014-2017*
$1700, Cox Endowment Undergraduate Excellence and the McDonald Observatory/ Department of Astronomy Board of Visitors Fund	*2016*
$200, Faculty Science and Technology Acquisition and Retention (STARs) Fund	*2016*
$1250, Freshman Research Initiative (FRI) Research Fellowship	*2015*
$500, Astronomy Freshman Prize for Excellence	*2014*

INTERESTS & SKILLS

Areas of Interest: Machine/Deep Learning in Astrophysical Data Visualization and Astronomical Big Data, Data Analytics, Scientific Communication and Public Outreach

Languages & Software: Houdini, Python, LaTeX, IRAF, Mathematica, Git, LabView, Zemax, Fusion360, Microsoft Office Suite, Adobe Premiere Pro, Celtx