

# Dr. James M DerKacy

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## Education

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PhD - **Physics**, University of Oklahoma, Norman

Aug 2015 - July 2022

MS - **Physics**, University of Oklahoma, Norman

Aug 2015 - May 2018

BA - **Physics, Political Science**, *Cum Laude*, North Central College

Sep 2011 - June 2015

## Research Topics & Interests

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Supernovae, Radiative Transfer, Spectroscopy, Ultraviolet, Infrared, Theory, Observational Astronomy

## Collaboration Memberships

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- Mid-InfraRed SuperNovA Collaboration (MIRSNAC)
- Precision Observations of Infant Supernova Explosions (POISE)
- Enhanced Public ESO Spectroscopic Survey of Transient Objects (ePESSTO+)

## Research Experience

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Sept 2022 – Present

**Postdoctoral Associate**

**Virginia Polytechnic Institute and State University**

*Advisor:* Dr. Chris Ashall

*Projects:* NIR/MIR supernovae spectral observations and analysis with JWST, UV studies of SNe Ia with HST, Infant supernovae optical+NIR observations and analysis

Aug 2015 – July 2022

**Graduate Research Assistant**

**University of Oklahoma**

*Advisor:* Dr. Eddie Baron

*Thesis:* Understanding Type Ia Supernova Diversity with PHOENIX

*Projects:* UVOIR SN radiative transfer simulations with PHOENIX, SNe Ia diversity studies, Infant supernovae optical+NIR observations and analysis

June 2014 - Dec 2014

**DOE SULI Intern**

**High Energy Physics, Argonne National Lab**

*Advisor:* Dr. Steve Kuhlmann

*Projects:* Simulations and development of silicon photonic atmospheric OH filters, SNe Ia light curve fitting and analysis

## Grants & Financial Awards

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- 2023
  - HST - **PI**: Cycle 31 AR, *The UV Future is Now: Tapping Hubble's UV Spectral Archive to Drive Current and Future Type Ia Supernova Science*, **\$TBD**
  - JWST - **PI**: Cycle 2/3 GO, *Examining the Heart of Type Ia Supernova 2021aefx with Ultra-Late Time Spectra*, **\$234,452 (Cycle 3 \$TBD)**
  - JWST - **Co-PI**: Cycle 1 DDT, *Dust Our Luck - Measuring Molecule and Dust Formation in M101's Hydrogen Rich SN 2023ixf*, **\$50,000**
  - NASA - **PI**: NExSCI Keck 2023B, *NIR Observations of the JWST Supernova 2022acko*, **\$13,750**
  - NASA - **PI**: NExSCI Keck 2023A, *Combined NIR/MIR Nebular Phase Spectra of Type Ia Supernovae*, **\$14,850**
- 2022
  - STScI Travel Grant - JWST First Science Results Conference, **\$645**

## Talks & Presentations

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- 2023
  - *The First MIRI/MRS Spectra of Type Ia Supernovae Reveal a Dominant Explosion Mechanism*, SuperVirtual 2023, November 2023
  - **(Invited)** *Type Ia Supernova Physics in the JWST Era*, Stony Brook Astronomy Seminar, April 2023
  - **(Invited)** *Type Ia Supernova Physics in the JWST Era*, Brookhaven National Laboratory Particle Physics Seminar, April 2023
- 2022
  - **(Invited)** *Ultraviolet Spectra in Type Ia Supernovae*, Virginia Tech Astronomical Sciences Seminar, November 2022
  - *SN 2021fxy: Mid-Ultraviolet Flux Suppression is a Common Feature of Type Ia Supernovae* (Poster), SuperVirtual Conference, November 2022
  - *SN 2021fxy: A "Cousin" of SN 2017erp with a Strong Ultraviolet Resemblance*, 240th AAS Meeting, June 2022
  - *SN 2021fxy: A "Cousin" of SN 2017erp with a Strong Ultraviolet Resemblance*, Cooks Branch Supernova Workshop, March 2022
- 2021
  - *SN 2021fxy: An Unreddened Cousin of SN 2017erp?* (Poster), SuperVirtual Conference, November 2021
  - **(Invited)** *Ultraviolet Line Identification and Spectral Formation Near Max-light in Type Ia Supernova 2011fe*, University of Kansas Astronomy and Space Physics Seminar, October 2021
  - *SN 2021fxy: A "Shallow-Silicon" Type Ia Supernova Masquerading As A "Core-Normal"*, Apache Point Observatory Science Symposium, July 2021
  - *Probing Spectral Formation of Type Ia Supernovae using PHOENIX*, 237th AAS Meeting, January 2021
- 2020
  - *Ultraviolet Line Identification and Spectral Formation Near Max-light in Type Ia Supernova 2011fe*, CSP Collaboration Workshop, September 2020
  - *Ultraviolet Line Identifications in Near Max Light Spectra of Type Ia Supernova 2011fe* (Poster), 235th AAS Meeting, January 2020
- 2018
  - *Models of Interacting Supernovae: Understanding the Physics and Probing the Circumstellar Environment* (Poster), MidAmerican Regional Astrophysics Conference, April 2018
- 2015
  - *OH Line Suppression Research for Future Near-Infrared Camera Development* (Poster), Rall Symposium for Undergraduate Research, North Central College, May 2015

- 2014 | • *OH Line Suppression Research for Future Near-Infrared Camera Development*, 24th Annual Argonne Undergraduate Research Symposium, Argonne National Lab, October 2014

## Awarded Telescope Time

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HST Cycle 31	<ul style="list-style-type: none"> <li>• <b>P.I.</b> - HST Archival Research, <i>The UV Future is Now: Tapping Hubble’s UV Spectral Archive to Drive Current and Future Type Ia Supernova Science</i>, HST-AR-17555</li> <li>• Co-I - 10 orbits, HST/WFC3, <i>Elevating the Scientific Output of JWST by using HST to Examine the Heart of Type Ia Supernova 2021aefx</i>, HST-GO-17429</li> </ul>
JWST GO Cycle 2/3	<ul style="list-style-type: none"> <li>• <b>P.I.</b> - 19.75 hours, JWST/NIRSpec+MIRI, <i>Examining the Heart of Type Ia Supernova 2021aefx with Ultra-Late Time Spectra</i>, JWST-GO-3726</li> <li>• Co-I - 16.58 hours, <i>Probing Early Dust Formation in the Universe via Stripped-Envelope Supernovae</i>, JWST-GO-4217</li> </ul>
JWST DDT Cycle 1/2	<ul style="list-style-type: none"> <li>• <b>Co-P.I.</b> - 7.78 hours, JWST/NIRSpec+MIRI, <i>Dust Our Luck - Measuring Molecule and Dust Formation in M101’s Hydrogen-rich SN 2023ixf</i>, JWST-DD-4522 and JWST-DD-4575</li> <li>• Co-I - 6.2 hours, <i>Near- and Mid-IR Observations to Probe Dust Formation in the Remarkably Nearby Stripped-Envelope Supernova 2023dbc</i>, JWST-DD-4436 and JWST-DD-4520</li> </ul>
JWST GO Cycle 1	<ul style="list-style-type: none"> <li>• Co-I - 21.2 hours, JWST/MIRI, <i>MIR Spectroscopy of Type Ia Supernovae: The Key to Unlocking their Explosions and Element Production</i>, JWST-GO-2114</li> <li>• Co-I - 22.5 hours, JWST/NIRSpec+MIRI, <i>Dust, Mass Loss and Explosions of Massive Stars in the MIR</i>, JWST-GO-2122</li> </ul>
WMKO/NASA NExSci	<ul style="list-style-type: none"> <li>• <b>P.I.</b> - 2 half-nights, Keck-II/NIRES, <i>NIR Observations of the JWST Supernova 2022acko</i>, 2023B</li> <li>• <b>P.I.</b> - 2 half-nights, Keck-II/NIRES, <i>Combined NIR/MIR Nebular Phase Spectra of Type Ia Supernovae</i>, 2023A</li> </ul>
Apache Point Observatory	<ul style="list-style-type: none"> <li>• <b>P.I.</b> - 34 half-nights, ARC 3.5-m/DIS/KOSMOS/TripleSpec, <i>Spectroscopic Follow-up of POISE Objects</i>, 2020Q1 - 2023Q2</li> <li>• <b>P.I.</b> - 17 half-nights, ARC 3.5-m/DIS, <i>Nebular Phase Spectra for a Well-defined Sample of Nearby Supernovae</i>, 2017Q3 - 2019Q4</li> </ul>

Co-investigator on numerous other successful observing proposals with time awarded at Las Campanas Observatory including the Magellan telescopes, Gemini telescopes, and Las Cumbres Global Telescope Network.

## Supervised Students & Outcomes

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Co-Supervised Graduate Students	<ul style="list-style-type: none"> <li>• Cassie Stevens, Virginia Tech, Sept. 2022 - Present</li> <li>• Behnaz Khaghani, Virginia Tech, May 2023 - Present</li> <li>• Cameron Pfeffer, Virginia Tech, June 2023 - Present</li> </ul>
Undergraduates	<ul style="list-style-type: none"> <li>• Derek Budd, Virginia Tech, Sept 2022 - Present; Graduated</li> <li>• Zach Yarbrough, University of Oklahoma, Feb 2021 - May 2022; Graduate Student, LSU</li> <li>• Sara Paugh, University of Oklahoma, May 2021 - May 2022; Graduate Student, Miss St.</li> </ul>

## Teaching Experience

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### Virginia Polytechnic Institute and State University

Guest Lecturer | PHYS 1055 - Introduction to Astronomy

### University of Oklahoma

Spring 2021 | ASTR 5453 - Extragalactic Astronomy & Cosmology, Grader  
ASTR 5900 - Numerical Methods, Grader

Fall 2020 | ASTR 3103 - Stars, Grader

Spring 2017 | PHYS 2524 - Gen. Physics for Life Sciences, Graduate TA

Fall 2016 | ASTR 1514 - General Astronomy, Laboratory Instructor

Summer 2016 | PHYS 2514 - Gen. Physics for Engineers, Graduate TA

Spring 2016 | ASTR 1514 - General Astronomy, Laboratory Instructor

Fall 2015 | ASTR 1514 - General Astronomy, Laboratory Instructor

### North Central College

Winter 2013 | PHY 142 - Physics II, Laboratory TA

Fall 2012 | PHY 141 - Physics I, Laboratory TA

## Community Outreach & Department Service

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### Virginia Tech Astro Journal Club

*Role: Organizer, Oct. 2022 - Present*

Organize weekly journal club discussions for astronomers of recent, high impact, and noteworthy works cultivated from new publications and arXiv postings.

### Summer REU Mentor, University of Oklahoma

*Summer 2021*

Co-advised undergraduate REU student Sara Paugh on her work with SN 2021fxy. Responsibilities included assisting Sara in learning several analysis codes, such as SYNOW and MISFITS.

### Graduate Physics Student Interdependence (GPSI), University of Oklahoma

*Roles: President, 2019 - 2020, Vice President, 2017 - 2019*

GPSI is the OU Physics & Astronomy department's graduate student advocacy group. Its goals are to promote the success of graduate students within the departments, increase the department sense of community, and facilitate communication between the graduate students and faculty.

### Lunar Sooners, University of Oklahoma

*Roles: Engineer, 2016 - 2017, Member 2015 - 2022*

Lunar Sooners is a graduate student-led outreach arm of the OU Astronomy group. Lunar Sooners mission is to share the joy of astronomy with the greater Oklahoma community, with a particular focus on outreach to under-represented communities through public star parties, interactive demonstrations, and portable planetarium shows.

## References

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Dr. Chris Ashall  
Department of Physics  
Virginia Polytechnic Institute & State University  
cashall@vt.edu

Dr. Eddie Baron  
Planetary Science Institute  
ebaron@psi.edu

Dr. Peter J. Brown  
Mitchell Institute for Fundamental Physics & Astronomy  
Texas A&M University  
pbrown@physics.tamu.edu

## Refereed Publications

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**Summary:** 6 First Author & Significant Contribution Papers, 28 Papers Overall, ADS Library

- 2023
1. **DerKacy, J. M.**, Ashall, C., Hoeflich, P. et al. 2023, *JWST MIRI/MRS Observations and Spectral Models of the Underluminous Type Ia Supernova 2022xkq*, ApJ, accepted, arXiv:2310.09153.
  2. **DerKacy, J. M.**, Paugh, S., Baron, E., et al. 2023, *SN 2021fxy: Mid-Ultraviolet Flux Suppression is a Common Feature of Type Ia Supernovae*, MNRAS, 522, 3481, doi:10.1093/mnras/stad1171.
  3. **DerKacy, J. M.**, Ashall, C., Hoeflich, P., Baron, E., ... et al., 2023, *JWST Low-Resolution MIRI Spectral Observations of SN 2021aefx: High-density Burning in a Type Ia Supernova*, ApJL, 945, L2 doi:10.3847/2041-8213/acb8a8.
  4. Yarbrough, Z., Baron, E., **DerKacy, J. M.**, et al., 2023, *Direct Analysis of the Broad-Line SN 2019ein: Connection with the Core-Normal SN 2011fe*, MNRAS, 521, 3873, doi:10.1093/mnras/stad758.
  5. Shahbandeh, M., Ashall, C., Hoeflich, P., ... **DerKacy, J. M.** et al., 2023 *JWST NIRSpec+MIRI Observations of SN 2022acko: A Nearby Type IIP Supernova*, ApJL, submitted.
  6. Mayker Chen, N., Tucker, M. , Hoyer, N., ... **DerKacy, James M.**, et al., 2023 *Serendipitous Nebular-phase JWST Imaging of SN Ia 2021aefx: Testing the Confinement of  $^{56}\text{Co}$  Decay Energy*, ApJL, 944, L28, doi:10.3847/2041-8213/acb6d8.
  7. Pearson, J., Sand, D. J., Lundqvist, P., ... **DerKacy, J. M.** et al., 2023, *Strong Carbon Features and a Red Early Color in the Underluminous Type Ia SN 2022xkq*, ApJ, accepted. arXiv:2309.10054.
  8. Kwok, L., Siebert, M., Johansson, J., ... and **DerKacy, J. M.**, et al., 2023, *Ground-based and JWST Observations of SN 2022pul: II. Evidence from Nebular Spectroscopy for a Violent Merger in a Peculiar Type-Ia Supernova*, ApJ, submitted, arXiv:2308.12450.
  9. Siebert, M., Kwok, L., Johansson, J., ... and **DerKacy, J. M.**, et al., 2023, *Ground-based and JWST Observations of SN 2022pul: I. Unusual Signatures of Carbon, Oxygen, and Circumstellar Interaction in a Peculiar Type Ia Supernova*, ApJ, accepted, arXiv:2308.12449.
  10. Bostroem, K. A., Dessart, L., Hillier, D. J., ... and **DerKacy, J. M.**, et al., 2023, *SN 2022acko: The First Early Far-ultraviolet Spectra of a Type IIP Supernova*, ApJL, 953, L18, doi:10.3847/2041-8213/ace31c.
  11. Kwok, L., Jha, S., Temim, T., ... and **DerKacy, J. M.**, et al., 2023, *A JWST Near- and Mid-Infrared Nebular Spectrum of the Type Ia Supernova 2021aefx*, ApJL, 944, L3, doi:10.3847/2041-8213/acb4ec.
  12. Dwomoh, A. M., Peterson, E. R., Scolnic, D., ... **DerKacy, J. M.**, et al., 2023, *Evaluating the Consistency of Cosmological Distances Using Supernova Siblings in the Near-Infrared*, ApJ, submitted, arXiv:2311.06178.

- 2023 | 13. Ertini, K., Folatelli, G., ... **DerKacy, J.M.**, et al., 2023, *SN 2021gno: A Calcium-rich Transient with Double-peaked Light Curves*, MNRAS, 526, 279, doi:10.1093/mnras/stad2705.
14. Desai, D.D, Ashall, C., Shappee, B.J., ... **DerKacy, J. M.**, et al. 2023, *Fast and Not-so-Furious: A Case Study of the Fast and Faint Type IIb SN 2021bxu (ATLAS21dov)*, MNRAS, 524, 767, doi:10.1093/mnras/stad1932.
15. Xiang, D., Wang, X., Zhang, X. ... and **DerKacy, J. M.**, et al. 2023, *SN 2018hna: Adding a Piece to the Puzzle of the Explosions of Blue Supergiants*, MNRAS, 520, 2965, doi:10.1093/mnras/stad340.
- 2022 | 16. Ashall, C., Lu, J., Shappee, B.J, ... **DerKacy, J.**, et al., 2022, *A Speed Bump: SN 2021aefx Shows that Doppler Shift Alone can Explain Early-Excess Blue Flux in Some Type Ia Supernovae*, ApJL, 932, L2 doi:10.3847/2041-8213/ac7235
17. Zhang, X., Wang, X., Sai, H., ... **DerKacy, James M.**, et al., 2022, *SN 2019va: A Type IIP Supernova with an Unusually Large Contribution of Nickel-56 Decay to the Plateau-Phase Light Curve*, MNRAS, 513, 4556 doi:10.1093/mnras/stac1166
18. Zhang, X., Wang, X., Sai, H., ... **DerKacy, J. M.**, et al., 2022, *SN 2018hfm : A Low-Energy Type II Supernova with Prominent Signatures of Circumstellar Interaction and Dust Formation*, MNRAS, 509, 2013. doi:10.1093/mnras/stab3007
- 2021 | 19. Zeng, X., Wang, X. F., Esamdin, A., ... **DerKacy, James M.**, et al. 2021, *SN 2017hpa: A Nearby Carbon-rich Type Ia Supernova with a Large Velocity Gradient* ApJ, 909, 176, doi:10.3847/1538-4357/abdeb9
- 2020 | 20. **DerKacy, J. M.**, Baron, E., Branch, D., et al. 2020, *Ultraviolet Line Identifications and Spectral Formation Near Max Light in Type Ia Supernova 2011fe*, ApJ, 901, 86, doi:10.3847/1538-4357/abae67
21. Zhang, J., Wang, X., Vinko, J., ... **DerKacy, James M.**, et al. 2020, *SN 2018zd: An Unusual Stellar Explosion as Part of the Diverse Type II Supernova Landscape*, MNRAS, 498, 84Z, doi:10.1093/mnras/staa2273
22. Lin, W. L., Wang, X. F., Li, W. X., ... **DerKacy, J. M.**, et al. 2020, *SN 2018hti: A Nearby Superluminous Supernova Discovered in a Metal-poor Galaxy*, MNRAS, 497, 318L, doi:10.1093/mnras/staa1918
23. Jacobson-Galán, W. V., Margutti, R., Kilpatrick, C. D., ... **DerKacy, James M.**, et al. 2020, *SN 2019ehk: A Double-peaked Ca-rich Transient with Luminous X-Ray Emission and Shock-ionized Spectral Features*, ApJ, 898, 166, doi:10.3847/1538-4357/ab9e66
24. Bostroem, K. A., Valenti, S., Sand, D. J., ... **DerKacy, J. M.**, et al. 2020, *Discovery and Rapid Follow-up Observations of the Unusual Type II SN 2018ivc in NGC 1068*, ApJ, 895, 31, doi:10.3847/1538-4357/ab8945.
- 2019 | 25. Xiang, D., Wang, X., Mo, J. ... **DerKacy, James M.**, et al. 2019, *Observations of SN 2017ein Reveal Shock Breakout Emission and a Massive Progenitor Star for a Type Ic Supernova*, ApJ, 871, 176, doi:10.3847/1538-4357/aaf8bo
26. Dimitriadis, G., Foley, R. J., Rest, A., ... **DerKacy, J. M.** et al. 2019, *K2 Observations of SN 2018oh Reveal a Two-component Rising Light Curve for a Type Ia Supernova*, ApJ, 870, L1, doi:10.3847/2041-8213/aaedbo
27. Shappee, B. J., Holoien, T. W.-S., Drout, M. R. ... **DerKacy, J. M.**, et al. 2019, *Seeing Double: ASASSN-18bt Exhibits a Two-component Rise in the Early-time K2 Light Curve*, ApJ, 870, 13, doi:10.3847/1538-4357/aaec79
28. Li, W., Wang, X., Vinkó, J., ... **DerKacy, J. M.**, et al. 2019, *Photometric and Spectroscopic Properties of Type Ia Supernova 2018oh with Early Excess Emission from the Kepler 2 Observations*, ApJ, 870, 12, doi:10.3847/1538-4357/aaec74