

DHRUV MULEY

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EDUCATION AND APPOINTMENTS

MPA Postdoctoral Fellow, Max Planck Institute for Astrophysics, Garching bei München 2025—
Mentor: Prof. dr. Volker Springel

Research Interests numerical hydrodynamics, radiative transfer, exoplanets/protoplanetary disks

Generalizing PLUTO's 3T scheme to include multiple dust species, to better capture dynamical and thermal physics in protoplanetary disks and reproduce observations in the mid-infrared and dust continuum. Also aiming to use the AREPO moving-mesh hydrodynamics code for protoplanetary disk applications.

PhD Astrophysics, Max Planck Institute for Astronomy, Heidelberg (Germany) 2021–2025
Advisor: apl. Prof. dr. Hubert Klahr

Research Interests numerical hydrodynamics, radiative transfer, exoplanets/protoplanetary disks

Developed and used “three-temperature” (3T) radiation hydrodynamics scheme for the PLUTO code, and applied it to simulations of protoplanetary disks. Used the Monte Carlo radiative transport (MCRT) tool RADMC3D to post-process simulations into near-infrared (NIR) and CO-isotopologue line observations.

Research Assistant, University of Victoria (British Columbia) 2020–21
Advisor: Prof. Ruobing Dong

Research Interests numerical hydrodynamics, radiative transfer, protoplanetary disks

B.A. Physics, B.A. Astrophysics, University of California, Berkeley 2016–20
Advisor: Dr. Jeffrey Fung

Research Interests numerical hydrodynamics, protoplanetary disks, galaxy evolution

PUBLICATIONS

9 first-author, 1 second-author, 2 *n*th author (+1 under review) research publications. For an up-to-date publication list, see my ADS library.

13. Sudarshan, Prakruti; Ziampras, Alexandros; Flock, Mario; Pfeil, Thomas; **Muley, Dhruv**; Mattia, Giancarlo; Mignone, Andrea. “Multifluid dust dynamics in PLUTO: Benchmarking dust–gas drag and diffusion against existing implementations,” *The Astrophysical Journal Supplement Series* (2026, under review)
12. **Muley, Dhruv**; Melon Fuksman, Julio David; Sudarshan, Prakruti; Ziampras, Alexandros; Flock, Mario. “Simulating the thermodynamics of gas, radiation, and multispecies dust: Method and applications to protoplanetary disks,” *Astronomy and Astrophysics* (2026, accepted; arXiv:2609.30252)
11. **Muley, Dhruv**; Hühn, León-Alexander; Jiang, Haochang; Melon Fuksman, Julio David. “Spiral excitation in protoplanetary disks through gap-edge illumination: Distinctive kinematic signatures in CO isotopologues,” *Astronomy and Astrophysics*, 706, A239, (2026; arXiv:2511.22527)

10. Melon Fuksman, Julio David; Flock, Mario; Klahr, Hubert; Mattia, Giancarlo; **Muley, Dhruv**. “Multidimensional half-moment multigroup radiative transfer. Improving moment-based thermal models of circumstellar disks,” *Astronomy and Astrophysics*, 701, A97 (2025; arXiv:2408.16461)
9. **Muley, Dhruv**; Melon Fuksman, Julio David; Klahr, Hubert. “Spiral excitation in protoplanetary disks through gap-edge illumination: Three-temperature radiation hydrodynamics and NIR image modeling,” *Astronomy and Astrophysics* (2024; arXiv:2408.16461)
8. **Muley, Dhruv**; Melon Fuksman, Julio David; Klahr, Hubert. “Three-temperature radiation hydrodynamics with PLUTO: Thermal and kinematic signatures of accreting protoplanets,” *Astronomy and Astrophysics*, 687, A213 (2024; arXiv:2405.03375)
7. **Muley, Dhruv**; Melon Fuksman, Julio David; Klahr, Hubert. “Three-temperature radiation hydrodynamics with PLUTO: Tests and applications in the context of protoplanetary disks,” *Astronomy and Astrophysics*, 678, A162 (2023; arXiv:2308.03504)
6. **Muley, Dhruv**; Dong, Ruobing. “CI Tau: A controlled experiment in disk-planet interaction,” *The Astrophysical Journal Letters*, 921, 2 (2021; arXiv:2110.13182)
5. **Muley, Dhruv**; Wheeler, Coral; Hopkins, Philip; Wetzel, Andrew; Emerick, Andrew; Kereš, Dušan. “Progenitor-mass-dependent yields amplify intrinsic scatter in dwarf-galaxy elemental abundance ratios,” *Monthly Notices of the Royal Astronomical Society*, 508, 1 (2021; ArXiv:2008.04901)
4. **Muley, Dhruv**; Dong, Ruobing; Fung, Jeffrey. “Observational signatures of planets in protoplanetary disks: Temperature structures in spiral arms,” *The Astronomical Journal*, 162, 4 (2021; ArXiv:2107.06323)
3. van der Marel, Nienke and 9 others incl. **Dhruv Muley**. “On the diversity of asymmetries in gapped protoplanetary disks,” *The Astronomical Journal*, 161, 33 (2021; arXiv:2010.10568)
2. Fung, Jeffrey; **Muley, Dhruv**. “A staggered semi-analytic method for simulating dust grains subject to gas drag,” *The Astrophysical Journal Supplement Series*, 244, 2 (2019; ArXiv:1909.02006)
1. **Muley, Dhruv**; Fung, Jeffrey; van der Marel, Nienke. “PDS 70: A transition disk sculpted by a single planet,” *The Astrophysical Journal Letters*, 879, 1 (2019; ArXiv:1902.07191)

TALKS AND CONFERENCES

8. “3T radiation hydrodynamics with PLUTO: A powerful tool to investigate protoplanetary disks”
Talk at University of Arizona Steward Observatory (Tucson, AZ, USA) September 10, 2024
Talk at Princeton University (Princeton, NJ, USA) October 29, 2024
7. “Can gap-edge illumination excite spirals in protoplanetary disks?”
Talk at Leiden Observatory Lunch (Leiden, NL) April 12, 2024
Poster at Exoplanets 5 (Leiden, NL) June 18, 2024
Poster at New Heights in Planet Formation (Garching, DE) July 17-19, 2024
Talk at Minor Bodies of the Solar System (Ringberg, DE) December 20, 2024
6. “Thermal and kinematic signatures of accreting protoplanets”
Talk at PLUTO Symposium (Torino, IT) September 25, 2024
Talk at Columbia University (New York, NY, USA) October 24, 2024
Poster at MHD Flows in Young Circumstellar Disks (Ringberg, DE) November 2-4, 2023
5. “Three-temperature radiative transfer for the PLUTO hydrodynamical code”
Talk at Disks and Planets across ESO Facilities (Garching, DE) November 29, 2022
Talk at SPP 1992 meeting (München, DE) March 15, 2023

4. “Observational signatures of planet formation: temperature structures from spiral arms”
Poster at CASCA 2021 AGM (virtual) May 8, 2021
Talk at “The formation of the Solar System” (Ringberg, DE) October 8, 2021

3. “Wide, deep cavities in gas and dust: simulations versus observations” December 7-11, 2020
Talk at Five years after HL Tau: a new era in planet formation (virtual)

2. “PDS 70: A laboratory for disk-planet interaction” November 22, 2019
Talk at Bay Area Planetary Science Meeting (Stanford)

1. “PDS 70: A transition disk sculpted by a single planet” February 14, 2019
Talk at Astronomy Thursday Lunch (UC Berkeley)

TECHNICAL SKILLS

Advanced	Python, C/C++, Unix
Intermediate	CUDA, Java, Mathematica, L ^A T _E X
Basic	Fortran 90, HTML, JavaScript, Photoshop, MPI

OUTREACH

Presenter , Explore Science Festival (Mannheim, Germany)	2024
Helped present (on 15 June 2024) a model illustrating transmission spectroscopy of exoplanet atmospheres, and a rotating water tank demonstrating the baroclinic instability, at the Explore Science week-long public festival.	
Presenter , Open Day (MPIA, Heidelberg, Germany)	2023
Modified the video game <i>Protoplanet Express</i> to include an additional, explorable 3D disk model (TW Hya), and helped with German translation. Presented game to many visitors from the general public, as one exhibit at MPIA's Tag der Offenen Tür (Open House Day, 14 October 2023).	
Mentor , SPLASH, University of California, Berkeley	2020
Gave an "Introduction to Theoretical Astrophysics" seminar class to high-school students in the San Francisco Bay Area, emphasizing order-of-magnitude reasoning skills.	
Mentor , Be a Scientist program, Martin Luther King Jr. Middle School, Berkeley	2018
Worked with students in Berkeley aged 11-14 to develop scientifically testable hypotheses, devise and conduct experiments, and analyze results.	

TEMPORARY APPOINTMENTS

Undergraduate Researcher , University of California, Berkeley Advisor: Dr. Sivan Ginzburg Developed scaling relations for planetary gap depths and migration rates.	2020
SURF Fellow , California Institute of Technology Advisor: Dr. Coral Wheeler, Prof. Philip F. Hopkins As part of a Caltech summer project in 2019 (for which the fellowship amount was \$6350), implemented progenitor-dependent yields and event rates for supernovae and stellar winds, from the NuGrid suite, into the GIZMO hydrodynamics code. Subsequently ran simulations to measure the resulting changes in metal abundances in dwarf galaxies, resulting in a publication.	2019-20
Affiliate , Lawrence Berkeley National Laboratory Advisor: Dr. Carlton Pennypacker	2017–18
Undergraduate Researcher , Columbia University (remote) Advisor: Prof. David Kipping	2016

TEACHING

Undergraduate Student Instructor , Physics 5BL, University of California, Berkeley Instructor: Dr. Gurpreet Kaur Helped students conduct experiments and graded lab reports for 25 students in Physics 5BL, Berkeley's laboratory course for first-year physics majors focusing on springs and waves.	2020
Reader , Physics 137B, University of California, Berkeley Instructor: Prof. Michael Crommie Graded roughly 60 homework assignments biweekly for Physics 137B, the second semester of upper division quantum mechanics at Berkeley, during Spring 2019.	2019
Undergraduate Student Instructor , Astronomy C10, University of California, Berkeley Instructor: Prof. Alex Filippenko Ran weekly discussion sections, devised worksheets and study materials, and graded exams for approximately 60 students in Astronomy C10, UC Berkeley's survey course on astronomy for non-majors, during the Fall 2018 semester.	2018
Reader , Astronomy C10, University of California, Berkeley Instructor: Prof. Alex Filippenko Graded roughly 100 homework assignments per week for Astronomy C10.	2017

LANGUAGES

English	Fluent; professional working proficiency
Spanish	Intermediate
German	Intermediate
Marathi	Basic