Shivan Khullar

Curriculum Vitae

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Employment

Sep 2025 - Present **Flatiron Research Fellow, Center for Computational Astrophysics, Flatiron Institute**, *New York, USA*

Sep 2019 - Apr 2025 **Teaching Assistant**, *University of Toronto*, Toronto, Canada
see Teaching Experience section for details

Jun 2018 - Jul 2018 **Research Intern**, *Max-Planck Institute for Astrophysics*, Garching, Germany
see Undergraduate Research Experience section for details

Jan 2019 - Jun 2019 **Research Intern**, *Raman Research Institute*, Bengaluru, India
see Undergraduate Research Experience section for details

Education

Sep 2019 - Aug 2025 **University of Toronto**, *Toronto, Canada*
Ph.D. Astronomy and Astrophysics
Advisors:
1. Prof. Norman Murray (Professor, Canadian Institute for Theoretical Astrophysics, University of Toronto)
2. Prof. Christopher Matzner (Professor, David A. Dunlap Department of Astronomy and Astrophysics, University of Toronto)
Thesis Title: Star formation across the scales
GPA: 3.99/4.0

Aug 2014 - Aug 2019 **Birla Institute of Technology & Science (BITS) Pilani University**, *Goa, India*
M.Sc. (Hons.) Physics & **B.E. (Hons.) Electronics and Instrumentation**
GPA (Physics degree): 9.38/10

Research Interests

Star formation, turbulence, ISM, stellar feedback, molecular clouds, simulations, numerical methods, reionization of the universe

Publications

Summary:
5 total, 4 first author publications, 1 n-th author publication (125+ **citations)**

- **Shivan Khullar**, Christopher D. Matzner, Norman Murray, Michael Y. Grudić, Dávid Guszejnov, Andrew Wetzel, Philip F. Hopkins, 2024, ApJ, *'Playing with FIRE: A Galactic Feedback-Halting Experiment Challenges Star Formation Rate Theories'*
- **Shivan Khullar**, Christoph Federrath, Mark R. Krumholz, Christopher D. Matzner, 2021,

MNRAS *'The density structure of supersonic self-gravitating turbulence'*

- **Shivan Khullar**, Qingbo Ma, Philipp Busch, Benedetta Ciardi, Marius B. Eide and Koki Kakiichi, 2020, MNRAS *'Probing the high-z IGM with the hyperfine transition of ^{3}He+'*
- **Shivan Khullar**, Mark R. Krumholz, Christoph Federrath, Andrew J. Cunningham, 2019, MNRAS *'Determining star formation thresholds from observations'*
- Riwaj Pokhrel, Robert A. Gutermuth, Mark R. Krumholz, Christoph Federrath, Mark Heyer, **Shivan Khullar**, S. Thomas Megeath, Philip C. Myers, Stella S. R. Offner, Judith L. Pipher, William J. Fischer, Thomas Henning, Joseph L. Hora, 2021, ApJ Letters *'The Single-Cloud Star Formation Relation'*

Honors & Awards

2024 **Jui Lin Yen Award 2024**, *Department of Astronomy and Astrophysics, University of Toronto, for the most notable published work by a graduate student in the department in a given year.*
Award amount: $1,000

2020 **International Graduate Student Fellowship for Excellence in Doctoral Studies**, *Department of Astronomy and Astrophysics, University of Toronto*
Award amount: $3,000

2022 **Mary and Ron Martin International Graduate Fellowship**, *University of Toronto*
Award amount: ∼$9,000

2022 **International Graduate Student Fellowship for Excellence in Doctoral Studies**, *Department of Astronomy and Astrophysics, University of Toronto*
Award amount: $3,000

2021 **International Graduate Student Fellowship for Excellence in Doctoral Studies**, *Department of Astronomy and Astrophysics, University of Toronto*
Award amount: $3,000

2021 **Mary and Ron Martin International Graduate Fellowship**, *University of Toronto*
Award amount: ∼$9,000

2019 - 2021 **Department of Astronomy and Astrophysics International Entrance Award**, *Department of Astronomy and Astrophysics, University of Toronto*
Award amount: $10,000

2021,2023 **Compute time**, *Digital Research Alliance of Canada*
Total award amount: 3 million+ CPU hrs (equivalent to ∼$42,000 in grant funding)

Talks and Conferences

Invited Talks

December 2024 **Galaxy formation group seminar, Lund University**, *Virtual*
Title: From kpc to AU: Star formation across the scales

May 2024 **AstroTours public talk, University of Toronto**, *Toronto, Canada*
Title: And then there was more light: the violent births of stars

March 2024 **TASTY talk, University of Toronto**, *Toronto, Canada*
Title: From kpc to pc: Trying to capture chaos in a single number

November 2022 **Journal club seminar, McMaster University**, *Virtual*
Title: Playing with FIRE: Molecular clouds and star formation in a galactic feedback-halting experiment

October 2021 **Star Formation/ISM Rendezvous, Princeton University**, *Virtual*
Title: Star formation thresholds and the density PDF

October 2020 **Mini-astro workshop**, *Virtual*
Title: The physics of star formation and its simulations

February 2019 **International Max Planck Research School on Astrophysics at the Ludwig Maximilians University, Munich**, *Garching, Germany*, Star Formation Thresholds: Real and Illusory

Contributed Talks

August 2024 **Star Formation Workshop**, *Hamilton, Canada*
Title: The role of stellar feedback in GMC evolution

May 2024 **Globular Clusters and their Tidal Tails**, *Toronto, Canada*
Title: The role of stellar feedback in GMC evolution

July 2023 **The Physics of Star Formation: From Stellar Cores to Galactic Scales**, *Lyon, France*
Title: Playing with FIRE: Molecular clouds and star formation in a galactic feedback-halting experiment

July 2022 **A Holistic View of Stellar Feedback and Galaxy Evolution**, *Ascona, Switzerland*
Title: Playing with FIRE: Molecular clouds and star formation in a galactic feedback-halting experiment

Posters/Lightning Talks

June 2024 **Canadian Astronomical Society (CASCA), Annual Meeting**, *Toronto, Canada*
Title: Playing with FIRE: Molecular clouds and star formation in a galactic feedback-halting experiment

Feb 2024 **Turbulence in the Universe**, *KITP, Santa Barbara, USA*
Title: Playing with FIRE: Molecular clouds and star formation in a galactic feedback-halting experiment

June 2022 **International High Performance Computing Summer School**, *Athens, Greece*
Title: Combining multiple scales in star formation simulations

May 2022 **Canadian Astronomical Society (CASCA), Annual Meeting**, *Virtual*
Title: GMCs on FIRE: The impact of feedback on star formation rates, efficiencies, and laws

May 2021 **Canadian Astronomical Society (CASCA), Annual Meeting**, *Virtual*
Title: The density structure of supersonic self-gravitating turbulence

May 2020 **Canadian Astronomical Society (CASCA), Annual Meeting**, *Virtual*
Title: Star Formation Thresholds: Real or Illusory?

Teaching Experience

Teaching Assistant

Winter 2024	**AST 222: Galaxies and Cosmology**, *University of Toronto*
Fall 2023	**AST 221: Stars and Planets**, *University of Toronto*
Summer 2023	**AST 201: Stars and Galaxies**, *University of Toronto*
Summer 2023	**CTA 200H**, *University of Toronto*
Fall 2022	**AST 101: The Sun and Its Neighbours**, *University of Toronto*
Summer 2022	**AST 201: Stars and Galaxies**, *University of Toronto*
Winter 2022	**AST 320: Intro to Astrophysics**, *University of Toronto*
Fall 2021	**AST 325/326: Intro to Practical Astronomy**, *University of Toronto*
Summer 2021	**AST 201: Stars and Galaxies**, *University of Toronto*
Winter 2021	**AST 201: Stars and Galaxies**, *University of Toronto*
Fall 2020	**AST 101: The Sun and Its Neighbours**, *University of Toronto*
Winter 2020	**AST 201: Stars and Galaxies**, *University of Toronto*
Fall 2019	**AST 101: The Sun and Its Neighbours**, *University of Toronto*
Spring 2018	**Mathematical Methods for Physics**, *BITS Pilani, Goa*
Fall 2017	**Electro-Magnetic Theory I**, *BITS Pilani, Goa*

Duties include:

- Leading tutorials, planetarium shows, observing nights, marking projects and exams (AST 101/201, University of Toronto)
- Designing and leading tutorials, grading assignments (AST 221, University of Toronto)
- Designing and leading tutorials, grading lab reports (AST 325/326, University of Toronto)
- Making assignment solutions, holding office hours and grading assignments (AST 320, University of Toronto)
- Designing lecture slides, marking quizzes (BITS Pilani, Goa)

Service

Mentorship

Research mentorship

- Vasilii Pustovoit, graduate student at University of Toronto
- Nan Jiang, incoming graduate student at University of Toronto
- Aryan Jain, undergraduate student at University of Toronto
- Daniel Zhou, undergraduate student at University of Toronto

Peer mentorship

- Phil Van-Lane, graduate student at University of Toronto
- Kanah Smith, undergraduate student at University of Toronto, now PhD student at IST Austria

- Ethen Sun, graduate student at University of Toronto
- Isaac Rosenberg, undergraduate student at University of Toronto

Outreach

- Public talk at UofT GASA's AstroTours, May 2024
- Planetarium shows at UofT GASA's AstroTours
- Various exhibits and refreshments coordination at UofT GASA's AstroTours

Organizational

- Formed and organized a star-formation/ISM focus group at University of Toronto.
- Student representative, CITA visitor committee.
- President, SEDS Celestia (2016-17), astronomy club at BITS-Pilani Goa.
- Member of the Student Faculty Council at the Department of Physics, BITS-Pilani Goa.

Technical Skills

- High Performance Computing - MPI/OpenMP. Used Gadi/Raijin supercomputer at NCI Australia; Niagara supercomputer at SciNet, Compute Canada; Frontera supercomputer at TACC, USA.
- Languages - Python, C, C++, R, Mathematica, Matlab; English, Hindi, Punjabi

Undergraduate Research Experience

Jan 2019 - June 2019 **Gravitational Decoherence**, *Raman Research Institute, Bengaluru, India*
Supervisor - Prof. Joseph Samuel

August 2018 - Dec 2018 **Determining Star Formation Thresholds from Observations**, *RSAA, Australian National University, Canberra, Australia*
Supervisors - Prof. Mark Krumholz and Prof. Christoph Federrath

June 2018 - July 2018 **The ^{3}He+ hyperfine transition line signal at high redshifts**, *Max Planck Institute for Astrophysics, Garching, Germany*
Supervisor - Prof. Benedetta Ciardi

May - June 2017 **Determining the size distribution of H II regions during Reionization using granulometry**, *NCRA-TIFR, Pune, India*
Supervisor - Prof. Tirthankar Roy Choudhury

May - July 2016 **Mass Modelling of galaxies using HI 21-cm line observations**, *IUCAA, Pune, India*
Supervisor - Dr. Neeraj Gupta