

# Shivan Khullar

## Curriculum Vitae

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🌐 [shivankhullar.github.io](https://shivankhullar.github.io)

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### Education

- 2019-2025 **University of Toronto, Toronto, Canada**  
(expected) **Ph.D. (Direct-Entry) Astronomy and Astrophysics**  
Advisors: Prof. Norman Murray and Prof. Chris Matzner  
GPA: 3.99/4.0
- 2014-2019 **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

### Publications

#### Summary:

5 total, 4 first author publications, 1 n-th author publication (100+ 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  $^3\text{He}^+$ ’*
- **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 (~\$42,000)

## 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?

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## 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*

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

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

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

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

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