

Shivan Khullar

☎ (+1) 416-989-7569 | ✉ khullar@astro.utoronto.ca, shivan.khullar@mail.utoronto.ca, shivankhullar@gmail.com | 🌐 www.astro.utoronto.ca/khullar

Education

University of Toronto

Toronto, Canada

PH.D. (DIRECT ENTRY) IN ASTRONOMY AND ASTROPHYSICS

2019 -

BITS Pilani University

Goa, India

B.E. (HONS.) ELECTRONICS AND INSTRUMENTATION AND MSc. (HONS.) PHYSICS

Aug 2014 - July 2019

Publications

- 'Determining star formation thresholds from observations', **Shivan Khullar**, Mark R. Krumholz, Christoph Federrath, Andrew J. Cunningham, 2019 [ADS Link](#) [arXiv Link](#)
- 'Probing the high-z IGM with the hyperfine transition of $^3\text{He}^+$ ', **Shivan Khullar**, Qingbo Ma, Philipp Busch, Benedetta Ciardi, Marius B. Eide and Koki Kakiichi, 2020 [ADS Link](#) [arXiv Link](#)

Workshops and Conferences

- Canadian Astronomical Society (CASCA), Annual Meeting 2020
Poster - Star Formation Thresholds: Real or Illusory? — **25-28 May 2020**
- International Max Planck Research School on Astrophysics at the Ludwig Maximilians University, Munich
Talk - Star Formation Thresholds: Real and Illusory — **24-28 Feb 2019**

Teaching

Teaching Assistantship

- *Fall 2020* — AST101 The Sun and Its Neighbours — University of Toronto
- *Winter 2020* — AST201 Stars and Galaxies — University of Toronto
- *Fall 2019* — AST101 The Sun and Its Neighbours — University of Toronto
- *Semester I 2017-18* — Electro-Magnetic Theory I — BITS Pilani, Goa
- *Semester II 2017-18* — Mathematical Methods of Physics — BITS Pilani Goa

DUTIES - LEADING TUTORIALS, PLANETARIUM SHOWS, OBSERVING NIGHTS, MARKING PROJECTS AND EXAMS (UoFT);

DESIGNING LECTURE SLIDES, MARKING QUIZZES (BITS).

Undergraduate Research Experience

Determining Star Formation Thresholds from Observations

RSAA, ANU, Canberra, Australia

SUPERVISORS - PROF. MARK KRUMHOLZ AND DR. CHRISTOPH FEDERRATH (RSAA, AUSTRALIAN NATIONAL UNIVERSITY, CANBERRA, AUSTRALIA)

August 2018 - Dec 2018

We created mock observations from simulations of star formation and wrote a pipeline to analyze these mock observations. Using these mock observations, we found that the interpretation of a star formation threshold from certain observational data is misleading and presented a method to find such a threshold (if it exists) from observations.

Gravitational Decoherence

SUPERVISOR - PROF. JOSEPH SAMUEL (RRI, BANGALORE, INDIA)

RRI, Bangalore, India

Jan 2019 - June 2019

I studied the Aharonov-Bohm effect, theory of quantum decoherence, quantum field theory in curved space time, the Unruh effect, and the phenomenon of gravitational decoherence following Samuel (2018). Wrote a Mathematica code to calculate the form factor for a given path configuration of a quantum particle in the double slit experiment.

The $^3\text{He}+$ hyperfine transition line signal at high redshifts

SUPERVISOR - PROF. BENEDETTA CIARDI (MAX PLANCK INSTITUTE FOR ASTROPHYSICS, GARCHING, GERMANY)

MPA, Garching, Germany

June 2018 - July 2018

We used simulations of cosmic reionization and a high-z QSO environment to calculate the differential brightness temperature of the $^3\text{He}+$ 3.46 cm line from these simulations. If detectable, the $^3\text{He}+$ signal could be used to probe the high redshift universe. We analysed whether the $^3\text{He}+$ signal could be found using current or future radio telescopes.

Determining the size distribution of H II regions during Reionization using granulometry

SUPERVISOR - PROF. TIRTHANKAR ROY CHOUDHURY (NCRA-TIFR, PUNE)

NCRA-TIFR, Pune, India

May - June 2017

I wrote a code in Python to implement the granulometry technique on image data from hydro-dynamical simulations of HII bubble growth based on excursion set models. These simulations violated photon number conservation and the granulometry technique would help in pin-pointing the reason for this violation by giving information on the size distribution of HII regions.

Mass Modelling of galaxies using HI 21-cm line observations

SUPERVISOR - DR. NEERAJ GUPTA (IUCAA, PUNE)

IUCAA, Pune, India

May - July 2016

Using observational data from NED, we created moment maps in CASA and then plotted rotation curves of galaxies. The rotation curves were then fitted to the velocity curves obtained using the gas, stellar and dark matter contributions and the dark matter distribution (densities) were obtained.

Awards

International Graduate Student Fellowship for Excellence in Doctoral Studies

DEPARTMENT OF ASTRONOMY AND ASTROPHYSICS, UNIVERSITY OF TORONTO

\$3,000

2020

Department of Astronomy and Astrophysics International Entrance Award

DEPARTMENT OF ASTRONOMY AND ASTROPHYSICS, UNIVERSITY OF TORONTO

\$10,000

2019-2020