


# Siddhartha Gupta

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## Contact Information

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## Personal Details

**Nationality:** Indian    **Gender:** Male    **Languages:** Bengali, English, and Hindi    **Pronouns:** he/him/his

## Academic Training

2019	<b>PhD in Astrophysics</b> , Indian Institute of Science, Bangalore, India
2014	<b>Master of Science in Physics</b> , Indian Institute of Technology (IIT) Kharagpur, India. CGPA: 9.54/10.
2012	<b>Bachelor of Science in Physics</b> , Burdwan Raj College, University of Burdwan, India, Marks: 81.125%

## Research Interests

**Astrophysical plasma:** kinetic theory, cosmic rays, shocks, and the origin of nonthermal energy.

**Galaxy evolution:** star clusters - stellar radiation - stellar wind - supernovae, and cosmic ray feedback.

**Computational physics:** numerical techniques, fluid simulation, and kinetic particle-in-cell simulation.

## Research Experience

2024 Sep – present	Associate Research Scholar, Princeton University, NJ, USA. Advisor: Prof. Anatoly Spitkovsky.
2023 Sep – 2024 Aug	Postdoctoral Research Associate, Princeton University, NJ, USA. Advisor: Prof. Anatoly Spitkovsky.
2019 Dec – 2023 Aug	Postdoctoral Scholar, University of Chicago, IL, USA. Advisor: Prof. Damiano Caprioli.
2014 Aug – 2019 Oct	Doctoral Candidate, Indian Institute of Science (IISc) & Raman Research Institute (RRI), Bangalore, India Thesis: Thermal and Non-thermal Processes in Young Star Clusters. Advisors: Prof. Biman Nath (RRI) & Prof. Prateek Sharma (IISc).
2012 Aug – 2014 Jul	Master Student, Indian Institute of Technology, Kharagpur, India. Thesis: A Modified Newtonian Gravity and Its Applications. Advisor: Prof. Sayan Kar.

## Honors and Awards

2015-2019	Dr. Shyama Prasad Mukherjee Fellowship by the Council of Scientific and Industrial Research by the Government of India for securing <b>All India Rank 3</b> in the National Eligibility Test.
2014	Qualified Joint Entrance Screening Test (JEST), <b>All India Rank 26</b> .
2014	Qualified Graduate Aptitude Test in Engineering (GATE), <b>All India Rank 32</b> .
2014	<b>Institute Silver Medal</b> from IIT Kharagpur for securing <b>1st rank</b> in Master of Science Physics.
2014	<b>Proficiency award</b> from IIT Kharagpur for the <b>Best Project Work</b> in Master of Science Physics.
2012	Qualified IIT - Joint Admission Test for M.Sc (IIT-JAM), <b>All India Rank 62</b> .
2012	<b>Priya Nath Sinha Memorial Medal and Manoranjan Kundu Prize</b> for securing <b>1st rank</b> in Bachelor of Science Physics, from the University of Burdwan, India.
2009-2014	<b>INSPIRE</b> scholarship from the Department of Science and Technology (DST), Government of India, for being in the <b>top 1%</b> of Class 12 examination in the West Bengal Board of Higher Secondary Education.

## Academic Offers (Declined)

- 2023** Postdoctoral position at Australian National University, Australia.  
**2023** Postdoctoral position at Gran Sasso Science Institute, Italy.  
**2019** Postdoctoral position at Ben-Gurion University, Israel.  
**2019** Postdoctoral Fellowship at Max-Planck Princeton Center for Plasma Physics by MPA, Germany.  
**2014** Selected for the OCES programme at the Bhabha Atomic Research Centre.

## Computational Skills

<b>Programming</b>	C (outstanding), C++, python (outstanding), fortran, HTML.
<b>Advanced simulation softwares</b>	PLUTO (magnetohydrodynamic), TRISTAN-MP (electron and proton particle-in-cell), SHOBDO (1D two-fluid cosmic ray hydrodynamic code, developed by me), SHAKTI (particle-in-cell code, C and python based, under development).
<b>Visualization packages</b>	GNU plot, Matplotlib, Mathematica, Origin, MYTH (a plotting interface written by me).

## Computational Grant/Allocation

<b>Co-I: 2024 – present</b>	PHY240045 (ACCESS): Kinetic Simulations of High Mach Number Collisionless Shocks: Long-Term Nonlinear Evolution and New Acceleration Mechanisms.
<b>Co-PI: 2020 – 2024</b>	AST180008 (ACCESS): Ab-initio Simulations of Cosmic Ray Acceleration and Transport.
<b>Co-PI: 2021</b>	Special Summer Allocation, at the Midway Cluster, University of Chicago.

## Teaching/Mentoring Experience

<b>Teaching Assistant</b> <b>Aug – Dec 2016</b>	Fundamentals of Astrophysics (undergraduate + graduate course with 90 students). at Indian Institute of Science, Bangalore, India
<b>Undergraduate Student</b> <b>Co-supervisor</b>	Jahnvi Murthy Padukone (Princeton University; June 2025 –), Jake Grodner (Princeton University; January – April 2025), Ivan Jane (University of Michigan, University of Chicago REU programme; June – August 2022),
<b>Graduate Student</b> <b>Co-supervisor</b>	Saikat Das (Indian Institute of Science Bangalore, from April 2024; PhD expected in 2028), jointly with Prof. Prateek Sharma (IISc).

## Synergistic activities

<b>Referee</b>	Astrophysical Journal Letters (ApJL), Astrophysical Journal (ApJ), Monthly Notices of the Royal Astronomical Society (MNRAS), Communications in Computational Physics (CICP).
<b>Membership</b>	Life member of the Astronomical Society of India.
<b>Computational Tool Development</b>	1) Cosmic ray two-fluid MHD module for the PLUTO code; 2) a one-dimensional two-fluid hydrodynamic code: SHOBDO; and 3) electromagnetic particle-in-cell code: SHAKTI.
<b>Conference Organizer</b>	Served as a Local Organizer Committee in “Bubble Big and Small” conference, in June 2018, IISc Bangalore.
<b>Public Outreach</b>	Served as a volunteer at the Open Day events during 2014–2019 at IISc Bangalore.
<b>Other Contributions</b>	Astropasmas seminar organizer in the Dept of Astrophysical Sciences, Princeton University, Volunteering as AstroCoffee host - daily ArXiv paper discussion club at Princeton University.

## Selected Schools and Workshops

- “Synergistic approaches to particle transport in magnetized turbulence: from the laboratory to astrophysics” [15-17th April 2024] at Princeton Center for Theoretical Science, Princeton, USA.
- “Coronal Mass Ejection propagation” [31st January 2024] at 42nd Meeting of Astronomical Society of India, Bangalore, India.

- “GIAN” school [4th-16th December 2017] on “Computational Solution of Hyperbolic PDEs for Scientists, Engineers and Mathematicians” at IIT Delhi, India. Instructors: Prof. Dinshaw Balsara (University of Notre Dame, USA), Prof. Praveen Chandrashekar (TIFR-CAM, Bangalore), Prof. Harish Kumar (IIT Delhi).
- “High-performance computing in Astrophysics” [6th March 2017] at 35th Meeting of Astronomical Society of India, Jaipur, India. Instructors: Prof. Prateek Sharma (IISc, Bangalore), Prof. Mahendra Verma (IIT Kanpur).
- “CLOUDY workshop” [21-26 September 2015] at Inter-University Centre for Astronomy & Astrophysics, Pune India. Instructor: Prof. Gary J. Ferland (University of Kentucky).

## Selected presentations

<b>June 7, 2025</b>	<i>Contributed Talk</i> , at the Galaxies and related topics, at Raman Research Institute, India (online).
<b>April 1, 2025</b>	<i>Invited Talk</i> , at The Center for Cosmology and AstroParticle Physics, The Ohio State University.
<b>January 22, 2025</b>	<i>Seminar</i> , at Indian Institute of Technology Indore, India.
<b>January 17, 2025</b>	<i>Seminar</i> , at Indian Institute of Astrophysics, Bangalore, India.
<b>January 15, 2025</b>	<i>Seminar</i> , at Indian Institute of Technology Kanpur, India.
<b>January 6, 2025</b>	<i>Seminar</i> , at Indian Institute of Technology Kharagpur, India.
<b>September, 2024</b>	<i>Contributed Talk</i> , at Galaxy Clusters and Radio Relics II at CfA   Harvard and Smithsonian, USA.
<b>February 6, 2024</b>	<i>Seminar</i> , at Inter-University Centre for Astronomy and Astrophysics in Pune, India.
<b>February 2, 2024</b>	<i>Contributed Talk</i> , at the Annual Meeting of “42nd Astronomical Society of India” at Bangalore, India.
<b>January 30, 2024</b>	<i>Seminar</i> , at International Centre for Theoretical Sciences - TIFR, Bangalore, India.
<b>November 28, 2023</b>	<i>Invited Talk</i> , at the “Bahcall Lunch” at the Institute for Advanced Study, Princeton.
<b>November 1, 2023</b>	<i>Contributed Talk</i> , at the “APS Division of Plasma Physics” in Denver, USA.
<b>January 2023</b>	<i>Seminar</i> , at the “Astroplasmas seminar” in Princeton University.
<b>January 2023</b>	<i>Seminar</i> , at the “Theoretical High Energy Astrophysics Group” at Columbia University, New York.
<b>October 2022</b>	<i>Seminar</i> , at Indian Institute of Science, Bangalore, India.
<b>October 2022</b>	<i>Seminar</i> , at Raman Research Institute, Bangalore, India.
<b>September 2022</b>	<i>Invited Talk</i> , at the “Particle Acceleration in Astrophysical Objects (PASTO)” in Italy.
<b>May 3, 2022</b>	<i>Invited Talk</i> , in the “Astrolunch” at the Hebrew University of Jerusalem (Online).
<b>November, 2021</b>	<i>Contributed Talk</i> , at the “63rd Annual Meeting of the APS Division of Plasma Physics” online.
<b>July, 2021</b>	<i>Contributed Talk</i> at the “37th International Cosmic Ray Conference” in Berlin, Germany (online).
<b>April, 2021</b>	<i>Contributed Talk</i> , at the “APS-April meeting” online.
<b>September, 2019</b>	<i>Contributed Talk</i> , at the “From Gas to Stars: The Links between Massive Star and Star Cluster Formation” in York, UK.
<b>January, 2019</b>	<i>Invited Talk</i> , at the Max-Planck Institute for Astrophysics in Garching Germany.
<b>June, 2018</b>	<i>Contributed Talk</i> , at the “4th CRISM” conference at Grenoble, France.
<b>June, 2018</b>	<i>Contributed Talk</i> , at the “Bubble Big and Small” conference at IISc Bangalore, India, in June 2018.
<b>March, 2017</b>	<i>Contributed Talk</i> , at the Annual Meeting of “Astronomical Society of India” (ASI) at Jaipur, India.

## Research Publications

**Journal articles (including 9 lead author papers and 3 significantly contributed author papers)**

**Over 275 citations; i10-index: 11**

15. **Gupta, Siddhartha**; Caprioli, Damiano; Spitkovsky, Anatoly, PRL under review, arXiv:2506.09134, “Speed-dependent threshold for electron injection into diffusive shock acceleration”
14. Diesing, Rebecca; **Gupta, Siddhartha** 2025, ApJ, 980, 167  
“Nonthermal signatures of radiative supernova remnants II: the impact of cosmic rays and magnetic fields”

13. Lichko, Emily; Caprioli, Damiano; Schroer, Benedikt; **Gupta, Siddhartha**; 2025, ApJ, 980, 240  
*"Understanding streaming instabilities in the limit of high cosmic-ray current density"*
12. **Gupta, Siddhartha**; Caprioli, Damiano; & Spitkovsky, Anatoly 2024, ApJ, 976 10  
*"Electron acceleration at quasi-parallel non-relativistic shocks: a 1D kinetic survey"*
11. **Gupta, Siddhartha**; Caprioli, Damiano; & Spitkovsky, Anatoly 2024, ApJ, 968, 17  
*"Return currents in collisionless shocks"*; featured in ApJ YouTube (<https://youtu.be/OEdYnshvKPQ>).
10. Zacharegkas, Georgios; Caprioli, Damiano; Haggerty, Colby; **Gupta, Siddhartha**; Schroer, Benedikt 2024, ApJ, 967, 71,  
*"Modeling the saturation of the Bell instability using hybrid simulations"*
9. Diesing, Rebecca; Metzger, Brian D.; Aydi, Elias; Chomiuk, Laura; Vurm, Indrek; **Gupta, Siddhartha**; and Caprioli, Damiano 2023, ApJ, 947, 70  
*"Evidence for multiple shocks from the  $\gamma$ -ray emission of RS Ophiuchi"*
8. Bhadra, Sourav; **Gupta, Siddhartha**; Nath, Biman B.; Sharma, Prateek 2022, MNRAS, 510, 5579  
*"Cosmic rays from massive star clusters: a close look at Westerlund 1"*
7. **Gupta, Siddhartha**; Caprioli, Damiano, & Haggerty, Colby 2021, ApJ, 923, 208  
*"Lepton-driven nonresonant streaming instability"*
6. **Gupta, Siddhartha**; Sharma, Prateek & Mignone, Andrea 2021, MNRAS, 502, 2733  
*"A numerical approach to the non-uniqueness problem of cosmic ray two-fluid equations at shocks"*
5. Jana, Ranita; **Gupta, Siddhartha**; Nath, Biman B 2020, MNRAS, 497, 2623  
*"Role of cosmic rays in the early stages of galactic outflows"*
4. **Gupta, Siddhartha**; Nath, Biman B.; Sharma, Prateek & Eichler, David 2020 MNRAS 493, 3159  
*"Realistic modeling of wind and supernovae shocks in star clusters: addressing 22Ne/20Ne and other problems in Galactic cosmic rays"*
3. **Gupta, Siddhartha**; Nath, Biman B. & Sharma, Prateek 2018 MNRAS 479, 5220  
*"Constraining cosmic ray acceleration in young star clusters using multi-wavelength observations"*
2. **Gupta, Siddhartha**; Nath, Biman B.; Sharma, Prateek & Eichler, David 2018 MNRAS 473, 1537  
*"Lack of thermal energy in superbubbles: hint of cosmic rays?"*
1. **Gupta, Siddhartha**; Nath, Biman B.; Sharma, Prateek & Shchekinov, Yuri 2016 MNRAS, 462, 4532  
*"How radiation affects superbubbles: through momentum injection in early phase and photo-heating thereafter"*

#### Conference Proceedings

3. **Gupta, Siddhartha**; Caprioli, Damiano; & Spitkovsky, Anatoly 2023, PoS ICRC2023, 396  
*"What regulates electron injection in diffusive shock acceleration?"*
2. Caprioli, Damiano; Zacharegkas, Georgios; Haggerty, Colby C; **Gupta, Siddhartha**; & Schroer, Benedikt 2023, PoS ICRC2023  
*"The saturation of the Bell instability and its implications for cosmic ray acceleration and transport"*
1. **Gupta, Siddhartha**; Caprioli, Damiano; & Haggerty, Colby 2021, PoS ICRC2021, 484  
*"Nonresonant streaming instability driven by leptons"*

#### In preparation

2. Saikat, Das; **Gupta, Siddhartha**; Prateek Sharma  
*"Impact of cosmic ray distribution on the growth and saturation of cosmic ray streaming instabilities"*
1. **Gupta, Siddhartha**; Sharma, Prateek; Mignone, Andrea  
*"A cosmic ray magnetohydrodynamic module for the PLUTO code".*