Hitesh Kishore Das

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Education

PhD in Astrophysics (Ongoing)
PhD Thesis: The dynamics of multiphase gas in astrophysical media International Max Planck Research School on Astrophysics (IMPRS)
Max Planck Institute for Astrophysics (MPA), Garching, Germany
Ludwig Maximilians University (LMU), Munich, Germany
Duration: 2021-Present
Doctoral Advisor: Dr. Max Gronke
Formal supervisor: Prof. Volker Springel

Master of Science
Indian Institute of Science (IISc), Bengaluru, India
Major: Physics
Duration: 2020-2021

Bachelor of Science (Research) Indian Institute of Science (IISc), Bengaluru, India
Major: Physics
Duration: 2016-2020

Senior Secondary (CBSE), 2016 Kendriya Vidyalaya No-4, Bhubaneswar, India
Stream: Science
Date: 21/05/2016

Research Experience

Subgrid model for multiphase gas interactions [FEB 2024 -]

We are developing a subgrid model for survival, destruction and other behaviours of multiphase gas, using the Multifluid AREPO framework.
The project is part of my PhD thesis, supervised by Dr. Max Gronke.

Collaborators: Rainer Weinberger, Dr. Max Gronke
Max Planck Institute for Astrophysics, Garching

Three-phase gas in a turbulent medium [MAY 2024 -]

In this project we are investigating the cold molecular gas in a turbulent medium, where both “warm” and “hot” gas phases are also possible.
This project is led by Zewei “Jason” Wu from UChicago during his DAAD-RISE internship. I was involved as the advisor for his internship, which included writing the research proposal and supervision for the whole duration of internship.

Collaborators: Zewei “Jason” Wu, Dr. Max Gronke
Max Planck Institute for Astrophysics, Garching

Survival, destruction and formation of cold molecular gas [MAY 2023 - AUG 2023]

In this project we are investigating the in-situ formation of cold molecular gas from “warm” gas and its subsequent survival or destruction, in presence turbulence.
Part of the work was done by Atal Agarwal from IIT Roorkee during his DAAD-WISE internship. I was involved

in the intership as a co-supervisor.
The project is also part of my PhD thesis, supervised by Dr. Max Gronke.

Collaborators: Atal Agarwal, Dr. Max Gronke
Max Planck Institute for Astrophysics, Garching

Evolution of thermal instability in 2D and 3D [MAR 2021 -]

In this project we extend our previous work on thermal instability to 2D and 3D systems. We investigate both linear and non-linear evolution of multiphase gas due to radiative cooling.
This project contributed towards my Masters thesis, supervised by Prof. Prateek Sharma.

Collaborator: Dr. Prakriti Pal Choudhury, Prof. Prateek Sharma
Physical Sciences, Indian Institute of Science, Bangalore

Multiphase gas dynamics in Magnetised, turbulent medium [SEP 2021 - JAN 2024]

We studied the different aspects of multiphase gas, like survival, morphology and growth, in a turbulent medium in presence of magnetic fields. We use idealised MHD simulations run using Athena ++ for this study.
This led to a publication on MNRAS Jan 2024 issue. The project is part of my thesis project, supervised by Dr. Max Gronke.

Collaborators: Dr. Max Gronke
Max Planck Institute for Astrophysics, Garching

Role of temperature and metallicity in the evolution of thermal instability [AUG 2019 - APR 2021]

In this project we investigate the role of different parameters like metallicity and temperature in the growth of thermal instability. The project includes setting up and running simulation for study of thermal instabilities using PLUTO.
This work led to some important insights into evolution of large-scale isochoric clouds.

This project contributed towards my Bachelors thesis, supervised by Prof. Prateek Sharma and led to a research paper in collaboration with Dr. Prakriti Pal Choudhury and Prof. Prateek Sharma.

Collaborator: Dr. Prakriti Pal Choudhury, Prof. Prateek Sharma
Physical Sciences, Indian Institute of Science, Bangalore

Computational Studies of Systems of Self-driven Particles [8 MAY 2019 – 12 JUL 2019]

This project aimed at investigating the underlying physical origin of this "phase transition" via the development of appropriate computational models. The project goals included:
- Molecular dynamics code development (in LAMMPS), adapting existing code in the research group
- Reproduction of literature data

Under supervision of: Assoc. Prof. Massimo Pica Ciamarra
School of Physical & Mathematical Sciences, Nanyang Technological University, Singapore

Electrostatics of Spherical Topological Insulators [1 MAY 2018 – 30 JUN 2018]

Theoretical derivation of electric and magnetic scalar potentials for different cases of electric and magnetic fields near a spherical Topological insulator.

Under supervision of: Assoc. Prof. Subroto Mukerjee
Physical Sciences, Indian Institute of Science, Bangalore

Analysis of data from CERN 2010 open data and simulation of top pair production [1 MAY 2017 – 31 JUL 2017]

It consisted of accessing CERN 2010 open data using CernVM and analysing the data using C++ and Python code incorporating ROOT to plot Dimuon spectra, Trimuon spectra and other related plots.
High-energy particle physics event simulations of top pair production were done using Pythia 8.2 and Madgraph 5.

Under supervision of: Asst. Prof. Jyothsna Rani Komaragiri
Centre for High Energy Physics, Indian Institute of Science, Bangalore

Publications

- Magnetic Fields in Multiphase Turbulence: Impacts on Dynamics and Structure

Hitesh Kishore Das, Max Gronke Monthly Notices of the Royal Astronomical Society, Volume 527, Issue 1, January 2024, Pages 991–1013, doi.org/10.1093/mnras/stad3125
arXiv: 2307.06411

- Shatter or not: role of temperature and metallicity in the evolution of thermal instability

Hitesh Kishore Das, Prakriti Pal Choudhury, Prateek Sharma
Journal: Monthly Notices of the Royal Astronomical Society, Volume 502, Issue 4, April 2021, Pages 4935–4952, doi.org/10.1093/mnras/stab382
arXiv: 2009.11317

Conferences and Seminars

- **Talk** at Lars Hernquist group meeting at **Center for Astrophyiscs**, Harvard University on August 23, 2024.
- **Multiphase Madness: Resolving the CGM in Theory and Observations** (August 21-23, 2023). Gave a **talk** in-person at Center for Astrophysics, Harvard University, Cambridge.
- **Talk** at Computational Structure and Galaxy formation group meeting at **MIT Kavli Institute for Astrophyiscs** on August 19, 2024.
- **Talk** in GalRead at Peyton Hall, **Princeton University**, on August 16, 2024.
- **Team meeting for "Observe Local Think Global: What Solar Observations can teach us about Multiphase Plasmas across Astrophysical Scales"**
  (May 13-17, 2024)
  Presented my work. In-person at ISSI, Bern, Switzerland
- **Talk** in **Cosmology section meeting** at AIP, Potsdam, on May 8, 2024.
- **Annual Astronomical Society of India (ASI) meeting** 2024 (Jan 30-Feb 4, 2024).
  Presented a **poster** at IISc, Bangalore, India.
- **2023 IAP colloquium: New simulations for new problems in galaxy formation** (December 11-15, 2023). Gave a **talk** in-person at IAP, Paris, France.
- **MIST2023 : Cosmic turbulence and Magnetic fields** (September 24 - October 1, 2023) Gave a **talk** in-person at Cargese, Corsica, France.
- **Modelling of Multiphase Astrophysical Media** (May 30-June 2, 2023)
  Presented a ~15 min talk about my work. In-person at Aspenstein Castle, near Lake Kochel, Germany
- **MPA weekly Institute Seminar** (May 15, 2023)
  Presented a ~45 min talk about my work. In-person at MPA, Garching, Germany
- **52nd Saas-Fee winter School on "The Circum-Galactic Medium across cosmic time: an observational and modelling challenge"**
  (March 19-24, 2023)
  Presented a poster about my work. In-person at Les Diablerets, Switzerland
- **Team meeting for "Observe Local Think Global: What Solar Observations can teach us about Multiphase Plasmas across Astrophysical Scales"**
  (March 13-17, 2023)
  Presented an introduction for simulations in ICM/CGM, and my work. In-person at ISSI, Bern, Switzerland
- **The Multiphase Circumgalactic Medium** (February 26- March 3, 2023)
  Presented a ~15 min talk about my work. In-person at Ringberg Castle, Germany

- **Lyman-X Day: ORIGINS workshop** (October 5, 2022)
  Attended in-person at European Southern Observatory (ESO), Garching
- **The National Astronomy Meeting (NAM) 2022** (July 11-15, 2022)
  Attended virtually and submitted a poster for the parallel session "Non-equilibrium thermodynamics across scales: from the solar corona to the intracluster medium".
- **Gas Flows around Galaxies: ORIGINS workshop** (May 24, 2022)
  Presented my work in-person at MPA, Garching
- **Presision Presidency Physics Summit** (September 11-13, 2020)
  Organized by Presidency University, Kolkata
  Presented work done on Thermal Instability as a talk in the Undergraduate Symposium.
- **On the Origin, Nature, and Mixing of Multiphase Gas in Astrophysics** KITP online conference (October 15-16, 2020)
  Attended the conference virtually
- **IAP online Colloquium on Intracluster Medium/Circumgalactic medium** (June 22-26, 2020)
  Attended the conference virtually

Mentoring

- Fully **Supervised** the DAAD-RISE intership of Zewei "Jason" Wu (UChicago) at MPA, Garching between May - August 2024
- **Co-supervised** the DAAD-WISE intership of Atal Agarwal (IIT Roorkee) at MPA, Garching between May-August 2023

Extra-curricular Experience

- **External PhD representative** at MPA
- **13th IMPRS Symposium**
  Was involved in organising the 13th IMPRS Symposium as the Chair of the Local Organising Committee.
- **Undergraduate Physics Club**
  Delivered a talk on "Special Relativity and Minkowski Diagrams".
- **Indian Instiute of Science Open Day**
  Constructed and demonstrated an experiment about Bernard cells, convection and convection cells in Sun. Also, demonstrated an experiment about Polarization of light.
- **Institute Fest - "Pravega"**
  Involved in planning and conducting events by Physics club for Pravega - 2016 and Pravega - 2017.

Awards and Fellowships

- **Kishore Vaigyanik Protsahan Yojana** (KVPY) Fellowship}
  Funded by: Department of Science and Technology, Government of India
  Stream: SX
  Duration: 2016-2021
- **National Cyber Olympiad** 2014-15
  National Rank: 1 (in 11th grade)
  Organised by: Science Olympiad Foundation
- **National Standard Examination in Astronomy** , 2015
  Got certificate for being in top 10% of the examination centre.
  Organised by: Indian Association of Physics Teachers (IAPT)

Skills

Compiled languages: C, C++
Hydrodynamic Simulation: AREPO, Athena++ , PLUTO

Interpreted languages: Python, Matlab, Mathematica
Others: LaTeX, ROOT, Bash scripting, High Performance Computing, LAMMPS, Madgraph 5, Pythia

Language proficiency

- English (Proficient)
- Hindi (Proficient)
- Odia (Native)
- German (Beginner A1)

Worked with:

Dr. Max Gronke

Max Planck Institute for Astrophysics, Garching, Germany
Email: maxbg[AT]mpa-garching.mpg.de
Website: max.lyman-alpha.com

Prof. Prateek Sharma

Physical Sciences
Indian Institute of Science, Bangalore, India
Email: prateek[AT]iisc.ac.in
Website: www.physics.iisc.ernet.in/~prateek

Dr. Rainer Weinberger

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Website: rainerweinberger.com

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Asst. Prof. Jyothsna Rani Komaragiri

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Indian Institute of Science, Bangalore, India
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