SUDIP KUMAR GARAIN

PERSONAL INFO

Date of birth:	15th July, 1984
Nationality:	Indian
Present Affiliation:	Assistant Professor, Department of Physical Sciences
	Indian Institute of Science Education and Research Kolkata (IISER K)
	Mohanpur - 741 246, West Bengal, India
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RESEARCH INTEREST

- Astrophysical Fluid Dynamics – non-relativistic and relativistic MHD
- MonteCarlo method for numerical modeling of radiative processes in astrophysics
- Two-fluid electrodynamics
- Computational electrodynamics
- Turbulence in astrophysical fluid
- Accretion disk around compact objects
- Finite volume methods on structured and unstructured mesh
- Developing highly scalable codes using OpenMP, MPI and CAF

EDUCATION

Integrated-PhD in Physical Sciences   2006 - 2014
at S N Bose National Center for Basic Sciences, India
(M.Sc. in Physics – 2009 and PhD in Physics – 2014)
PhD Thesis Title: *Numerical Simulation of Spectral and Timing Properties of Galactic Black Holes*
PhD Supervisor: Prof. Sandip K Chakrabarti

B.Sc. in Physics (Hons.), Chemistry, Mathematics   2002 - 2005
Burdwan University, India

PAST POSITIONS

Assistant Professor, Physics Department, GITAM University, Visakhapatnam	08/2020 - 04/2022
Post Doc, Korea Astronomy and Space Science Institute (KASI), South Korea	03/2019 - 07/2020
Mentor: Dr. Jinho Kim	
Post Doc, University of Notre Dame, IN, USA	04/2014 - 03/2019
Mentor: Prof. Dinshaw S Balsara	

RESEARCH EXPERIENCE

- Working on developing numerical tools for imaging and polarization calculation for radiative plasma
- Working on developing 3D general relativistic fluid-dynamics simulation framework for studying the dynamics of accretion disk

- Co-developed upto fourth order accurate and highly scalable code to solve ideal MHD equations on geodesic mesh using finite-volume based method

- Co-developed upto fourth order accurate code to solve Maxwell's equation using finite-volume based method

- Co-developed upto fourth order accurate code to solve two-fluid electrodynamics equation using finite-volume based method

- Co-developed very high order accurate Adaptive Order WENO (WENO-AO) scheme for finite-difference and finite-volume methods

- Performed scalability studies for MPI-3 and CoArray Fortran (CAF) codes on large supercomputers for several applications

- Applied relativistic and non-relativistic MHD codes for studying several astrophysical applications such as turbulence, accretion disk etc.

- Co-developed MPI based Monte Carlo code for studying inverse-Compton scattering inside accretion disk around black holes

- Coupled a finite-difference based hydro-dynamics code with Monte Carlo based radiative transfer code for self-consistent radiation-hydrodynamic simulation of accretion disk studies

HIGH-PERFORMANCE COMPUTING EXPERIENCE & TRAINING

- Member of expert user group on HPC provided by IUCAA, Pune to the associates (can use maximum 1024 cores at a time)

- Received computer allocation time of 280,000 node-hour on KISTI Supercomputer in South Korea

- Conducted scalability test for our Geodesic Mesh MHD solver on NCSA BlueWaters using almost upto 80000 cores

- Conducted MHD turbulence simulations on NCSA BlueWaters using almost 65000 cores

- Conducted scalability test and performance comparison of MPI-3 and CoArray Fortran for a few PDE applications on XSEDE-Darter and NCSA BlueWaters using almost upto 65000 cores

- Attended GPU Hackathon   Sep 10-14, 2018
  at National Center for Supercomputing Applications (NCSA), UIUC; implemented openACC into our two-fluid MHD code with help of mentors from PGI.

- Attended XSEDE HPC Monthly Workshop on openMP   Oct 6, 2017
  at University of Notre Dame; lecture and hands on sessions on openMP

- Attended Scaling to Petascale Institute   June 26-30, 2017
  at National Center for Supercomputing Applications (NCSA), UIUC; lecture and hands on sessions on MPI, openMP, GPU, Parallel IO, Visualization.

- Attended Blue Waters Advanced User and yt development workshop   Oct 13-17, 2014
  at National Center for Supercomputing Applications (NCSA), UIUC

TECHNICAL STRENGTHS

Programming Languages	Fortran, C, Python
Parallel Programming	CoArray Fortran, MPI, openMP
Computer Algebra System	Mathematica, Maple, wxMaxima
Visualization and IO	VisIt, Gnuplot, Xmgrace, IDL, HDF5, Silo
Tools	Vim, Gedit, Latex, MS Office, PowerPoint
Operating Systems	Linux, Windows, Mac

FELLOWSHIPS, GRANTS, HONOURS

- IUCAA Associateship from Inter-University Center for Astronomy and Astrophysics, Pune 2021

- Post Doctoral Fellowship from KASI   2019
  for pursuing post-doctoral research in Theoretical Astrophysics Group at KASI, South Korea

- Post Doctoral Research Associateship from University of Notre Dame   2014
  for pursuing post-doctoral research in group of Prof Dinshaw Balsara at Notre Dame Univ, USA

- PBC Postdoctoral Fellowship   2014
  for pursuing post-doctoral research in group of Prof. Tsvi Piran at Hebrew University, Israel
  (declined)

- Post BSc Integrated Research (PBIR) fellowship from S N Bose Center   2006
  for pursuing integrated M.Sc. - Ph.D at S N Bose Center, India

- Travel grant from ITS, SERB, India   2014
  for presenting paper in *Fudan Winter School on Astrophysical Black Holes* held at Shanghai, China

- Financial support from European Space Astronomy Center   2013
  for presenting paper in *Spectral/timing properties of accreting objects: from X-ray binaries to AGN* held at Madrid, Spain

- MG13-IUPAP grant from Marcell Grossman meeting organizers   2012
  for presenting paper in MG-13 meeting held at Stockholm, Sweden

- Travel award from South Asian Physics Foundation   2010
  for presenting research works at *International Conference on Accretion and Outflow in Black Hole Systems* in Kathmandu, Nepal

REVIEWER EXPERIENCE

Reviewer for:	Journal of Computational Physics, Computers and Fluids, Journal of Scientific Computing, Computer Physics Communications, Advances in Aerodynamics, Universe

PRESENTATIONS

1. *Invited* seminar titled "Numerical Experiment using Computational Magnetohydrodynamics" at **CESSI, IISER-Kolkata** in Kolkata, **India**, 10 June, 2021

2. *Invited* seminar titled "Numerical Experiment for Astrophysical Flows" at **IISER-Mohali** in Chandigarh, **India**, 22 May, 2021

3. *Invited* seminar titled "Numerical Studies of Accretion Process onto Black Holes" at **NISER** in Bhubneswar, **India**, 2 July, 2020

4. *Invited* seminar titled "Development of Numerical Tools for a few Physics and Astrophysics Applications" at **IIT-Bhilai** in Bhilai, **India**, 24 September, 2019

5. *Invited* seminar titled "Numerical Studies of sub-Keplerian Accretion Disk around Black Holes" at **NITTTR** in Kolkata, **India**, 14 June, 2019

6. *Invited* "6th seminar on Gravitational Wave and Numerical Relativity" titled "Numerical Studies of sub-Keplerian Accretion Disk onto Black Holes" organized by **Korea Institute of Science and Technology Information** in Daejeon, **Korea**, 3 May, 2019

7. *Invited* seminar titled "Numerical Studies of sub-Keplerian Accretion Disk around Black Holes" at **IISER Pune** in Pune, **India**, 27 Jan, 2019

8. *Invited* seminar titled "Geodesic Mesh MHD – A New Paradigm for Computational Astrophysics and Space Physics Applied to Spherical Systems" at **IISc** in Bangalore, **India**, 22 Jan, 2019

9. *Invited* seminar titled "Numerical Studies of sub-Keplerian Accretion Disk around Black Holes" at **IIT Kanpur** in Kanpur, **India**, 17 Jan, 2019

10. *Notre Dame astro* seminar titled "Numerical Studies of sub-Keplerian Accretion Disk around Black Holes" at **Physics Department, NDU** in Notre Dame, **USA**, 9 Oct, 2018

11. *Oral* presentation titled "General Relativistic Numerical Simulation of sub-Keplerian Transonic Accretion Flows onto Black Holes" in 42nd **COSPAR Meeting** in Pasadena, **USA**, 14–22 July, 2018

12. *Poster* presentation titled "A High Order Relativistic Two-Fluid Electrodynamic Scheme And Application to Fast Reconnection Study" in **International School of Computational Astrophysics** at Les Houches, **France**, 16–27 May, 2016

13. *Oral* presentation titled "Numerical Simulation of Spectral and Timing Properties of Galactic Black Holes" in **Fudan Winter School on Astrophysical Black Holes** at Shanghai, **China**, 10–15 September, 2014

14. *Poster* presentation titled "Effects of Compton Cooling on the Outflow in a Two Component Accretion Flow around a Black Hole: Results of Coupled Monte Carlo-TVD Simulation" in **Spectral/Timing Properties of Accreting Objects** at ESAC in ESA, Madrid, **Spain**, 3–5 April, 2013

15. *Oral* presentation titled "Numerical Simulation of Spectral and Timing Properties of a Two Component Accretion Flow around a Black Hole" in **Recent Trends in the Study of Compact Objects: Theory and Observations** at IIT-Guwahati, Guwahati, **India**, 11–13 March, 2013

16. *Oral* presentation titled "Effects of Compton Cooling on Hydrodynamic and Spectral Properties of a Two Component Accretion Flow around a Black Hole" in 39th **COSPAR Meeting** in Mysore, **India**, 14–22 July, 2012

17. *Oral* presentation titled "Effects of Compton Cooling on the Outflow in a Two Component Accretion Flow around a Black Hole: Results of Coupled Monte Carlo-TVD Simulation" in 13th **Marcel Grossmann Meeting** in Stockholm, **Sweden**, 1–7 July, 2012

COLLABORATORS AND REFEREES

1. Dinshaw S. Balsara, Professor,
   Department of Physics,
   University of Notre Dame,
   225 Nieuwland Science Hall,
   Notre Dame, IN 46556, USA.

2. Jinho Kim, Senior Research Leader & Associate Professor,
   Korea Astronomy and Space Science Institute,
   Daedeokdae-ro 776, Yuseong-gu,
   Daejeon, 34055 Republic of Korea.

3. Sandip K. Chakrabarti, Distinguished Professor, (PhD Advisor)
   Indian Center for Space Physics,
   43 Garia Station Road, Kolkata - 700084

4. Allen Taflove, Professor,
   Electrical Engineering and Computer Science,
   Northwestern University,
   Evanston, IL 60208, USA.

5. Vladimir Florinski, Associate Professor,
   Space Science Department,
   University of Alabama in Huntsville,
   301 Sparkman Drive,
   Cramer Research Hall, Room 2039,
   Huntsville, AL 35899, USA

6. Arnab Rai Choudhuri, Professor,
   Department of Physics,
   Indian Institute of Science,
   Bangalore, 560012, India.