Sudeshna Sen | Curriculum Vitae

Personal Details

Nationality : Indian **Gender**: Female

Current affiliation : Assistant Professor, IIT(ISM) Dhanbad

Contact Details

Office address : Academic Complex, 6th Floor, Department of Physics, IIT(ISM) Dhanbad, Dhanbad, Jharkhand, Pin-826004

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Graduation/University Education

Bachelor of Science (B.Sc.) in Physics *2004–2007*

- Name of the University : Jadavpur University, Kolkata, West Bengal, India
- Honors in Physics, Passed in First Class with distinction and 77.4% Marks
  (Subsidiary subjects : Mathematics, Chemistry, Computer Science)

Master of Science (M.Sc.) in Physics (Discontinued) *2007–2008*

- Name of the University : Jadavpur University, Kolkata, West Bengal, India (left to join Integrated PhD scholarship at JNCASR, Bangalore, India)

Master of Science (M.S.) in Materials Science (by Research) *2008–2011*

- Name of the Institute: Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore, Karnataka, India
- Passed with 7.26/8.0 CGPA
  Thesis Title: ***"Theoretical Studies of Transport at the Nanoscale"***
  Thesis Advisor: Prof. N. S. Vidhyadhiraja

Doctoral Thesis (PhD)

Research Scholar *2011–2016*

- Institute: Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore 560064, Karnataka, India
- **Thesis Title:** ***"Emergent phenomena in spatially and energetically inhomogeneous strongly correlated model electron systems"***
- Thesis Advisor: Prof. N. S. Vidhyadhiraja
- Thesis Submitted : March, 2016 Defended: July 2016 Degree Awarded: September 28, 2016

Professional Experience

(I) Assistant Professor *July,2021 – Present*
Department of Physics

- Institute: IIT(ISM) Dhanbad

(I) Postdoctoral Fellow *November, 2018 – June-2021*
(Research Group: Dr. Andrew Mitchell)

- Institute: School of Physics,
  Science Centre North, Belfield, Dublin-4, Ireland

(II) Postdoctoral Fellow *September, 2016 – September, 2018*
(Research Group: Prof. Wei Ku)

- Institute: Tsung-Dao Lee Institute & Shanghai Jiao Tong University,

800 Dongchuan Road, Minhang, Shanghai-200240, China

(III) Research Associate *May, 2016 – September, 2016*
(Research Group: Theoretical Sciences Unit)
- Institute: JNCASR, Jakkur Post, Bangalore-560064, India

Other academic visits

(I) Visiting Scholar *February, 2017*
(Collaborator: Prof. Vladimir Dobrosavljevic)
- Institute: National High Magnetic Field Laboratory, Tallahassee, Florida, USA

(II) Visiting Scholar *December, 2013–August, 2014*
(Collaborator: Prof. Mark Jarrell)
- Institute: Louisiana State University, Baton Rouge, Louisiana, USA

Research Interest

My research interests span the area of condensed matter physics, particularly the field of **strongly correlated electron systems and theoretical nanoscience. I specialise in state-of-the-art many body techniques like diagrammatic perturbation theory, exact diagonalisation, numerical renormalization group and dynamical mean field theory and its extensions.**
Additionally, over the past years, I have broadened my scope of research by delving into the field of **'topological quantum matter' and disordered electron systems**. In general, exact solutions of models of strongly correlated disordered systems are not possible, and one has to resort to advanced computational algorithms in order to investigate the physics of these systems. Driven by this necessity, a major part of my research embarks upon developing complex algorithms using advanced many body methods to understand several complex phenomena like quantum criticality, non-Fermi liquid dynamics and metal insulator transitions in disordered correlated electron systems and quantum interference.
These developments also open up avenues where concepts from **Machine learning** may be utilised to understand many body quantum physics in such systems.
I extensively collaborate with several experts in this area from around the world.

Research Publications

Online link : Web-link of up-to-date list of publications:
- in arXiv: (`https://arxiv.org/a/sen_s_3.html`
- in Google Scholar:(`https://scholar.google.com/citations?user=N7v_G08AAAAJ&hl=en`

Detailed list : The complete and updated list of academic publications are given here:

1. *"Interplay of molecular symmetry and strong correlations in molecular junctions"*
   Sudeshna Sen, Emma Minarelli, Jonas Rigo, Andrew K Mitchell,
   (In preparation)
2. *"Nature of Mott transition in a Hydrogen lattice"*
   Z J Lang, **Sudeshna Sen**, Kristjan Haule, Wei Ku, Vladimir Dobrosavljevic,
   (In preparation)
3. *"Unraveling continuous Mott metal-insulator transition in a heavy fermion model"*
   Sujan Bhradwaj, Vinayak Kulkarni, **Sudeshna Sen**, N S Vidhyadhiraja,
   (In preparation)
4. *"Generic topological characteristics of the particle-hole asymmetric Mott transition "*,
   Sudeshna Sen, Patrick J. Wong, Andrew K. Mitchell
   (In preparation)
5. *"The Mott transition as a topological phase transition"*
   Sudeshna Sen, Patrick Wong, Andrew Mitchell,
   Phys. Rev. B (Rapid Comm.) **102**, 081110(R) (2020) **Selected as Editors' Suggestion**
6. *"Fragility of the Kondo insulating gap against disorder: relevance to recent puzzles in topological Kondo insulators"*

Sudeshna Sen*, N. S. Vidhyadhiraja, Eduardo Miranda, Vladimir Dobrosavljevic, Wei Ku,
Phys. Rev. Research **2**, 033370 (2020)* Corresponding author

7. *"Emergence of non-Fermi liquid dynamics through non-local correlations in an interacting disordered system"*
Sudeshna Sen, N. S. Vidhyadhiraja, Mark Jarrell,
Phys. Rev. B **98**, 075112 (2018)
8. *"Pressure-induced melting of magnetic order and emergence of new quantum state in α-RuCl3"*
Zhe Wang, Jing Guo, F. F. Tafti, Anthony Hegg, **Sudeshna Sen**, Vladimir A Sidorov, Le Wang, Shu Cai, Wei Yi, Yazhou Zhou, Honghong Wang, Shan Zhang, Ke Yang, Aiguo Li, Xiaodong Li, Yanchun Li, Jing Liu, Youguo Shi, Wei Ku, Qi Wu, Robert J Cava, Liling Sun,
Phys. Rev. B **97**, 245149 (2018) **(Selected as Editors' Suggestion)**
9. *"Local theory for Mott-Anderson localization"*
Sudeshna Sen, Hanna Terletska, Juana Moreno, N. S. Vidhyadhiraja, Mark Jarrell
Phys. Rev. B **94**, 235104 (2016)
10. *"Quantum critical Mott transitions in a bilayer Kondo insulator -metal model system"*
Sudeshna Sen and N. S. Vidhyadhiraja
Phys. Rev. B **93**, 155136 (2016)
11. *"Spectral changes in layered f-electron systems induced by Kondo hole substitution in the boundary layer"*
Sudeshna Sen, Juana Moreno, Mark Jarrell, N. S. Vidhyadhiraja
Phys. Rev. B **91**, 155146 (2015)
12. *"Protocols for Characterising Quantum Transport through Nano-structures"*
Sudeshna Sen and N. S. Vidhyadhiraja
Applied Physics Letters, **101**, 133106 (2012)
13. *"Low Frequency Electrical Noise Thermometry for Micro- and Nano-scale devices"*
R. A. Sayer, J. D. Engerer, **Sudeshna Sen**, N. S. Vidhyadhiraja and T. S. Fisher
ASME International Mechanical Engineering Congress and Exposition (Denver, CO, 2011), pp. IMECE2011-63586

Awards

- Babu Mathru Prasad Scholarship: Best Integrated PhD Student, JNCASR Bangalore, India (2009)
- December, 2010 Awarded *Junior Research Fellowship* and *Eligibility for Lectureship* by *Council of Scientific and Industrial Research (CSIR)*, Government of India (All India rank - 23)
- Poster Award, JNC Research Conference, Kerala, India (30 September 2012 - 2 October 2012)
- Best Poster Award, JNC In-House Symposium, JNCASR, Bangalore, India (2012)
- Department of Science and Technology, Government of India, International Travel Fellowship award (January 2013)
- ICAM Junior Travel Award (2014)

Teaching Experience

- Instructor: Physics of Phase Transformations (Course offered to Graduate students (JRF); IIT(ISM) Dhanbad (Monsoon Semester (2021-2022)
- Instructor: Quantum Mechanics (Course offered to Integrated Mtech Students; IIT(ISM) Dhanbad (Monsoon Semester (2021-2022)
- Instructor: Computation and Simulation Lab (Course offered to MSc Physics students; IIT(ISM) Dhanbad (Monsoon Semester (2021-2022)
- Tutor in Quantum Mechanics (JNCASR, Integrated PhD Course); Instructor: Prof. N. S. Vidhyadhiraja; Semester:August-November -2012
- Guest Lecturer in Advanced Condensed Matter Physics (Graduate Students, SJTU); Instructor: Prof. Wei Ku; Semester:February-June 2017

I am also currently supervising PhD students in the group of Dr. Andrew Mitchell that have resulted in a joint publication and there are similar pending publications.

Schools/Conferences attended

- JNCASR/SISSA/IBM School on First Principles Simulations, 2010.
- International Condensed Matter Programme, ICTS, IISc (Bangalore), India (Dec- 2011).
- Nonequilibrium Winter School, ICTS, IISER (Kolkata), India (2011-2012).

- JNC Research Conference, Kerala, India (30 September 2012 - 2 October 2012)
- 5th MaNEP Winter School, Switzerland (13 January 2013 - 18 January 2013)
- DMFT at 25: Infinite Dimensions, Julich, Germany, 2014
- JNCASR-Purdue University Workshop on Nanomaterials for Energy (2014)
- LA-SiGMA symposium, Louisiana State University, Baton Rouge (2014)
- XXVII IUPAP Conference on Computational Physics (December, 2015)
- 7th Workshop on Quantum many Body computation, UCAS, Beijing (May, 2017)
- DPG Spring Conference, Regensburg (31st March to 5th April, 2019)
- Annual March Meeting 2021,(Online) March, 2021

Talks/Posters presented

- APS March Meeting 2021, 'Virtual Session'
  Title: Theory of a benzene transistor: Symmetry and interactions (Virtual Presentation)
- DIAS Seminar, Dublin Institute for Advanced Studies, Dublin (2020)
  Title: Interplay of molecular symmetry and strong correlations in molecular junctions (Virtual Presentation)
- APS March Meeting 2020, 'Virtual Session'
  Title: Interplay of molecular symmetry and strong correlations in molecular junctions
- Workshop on "2D electronic systems in magnetic field at IISER Kolkata, December, 2019,
  Title: "The Mott transition as a topological phase transition"
- 7th Workshop on Quantum many Body computation, UCAS, Beijing (May, 2017)
  Title: Emergence of non-Fermi liquid dynamics due to non-local correlations in an interacting disordered electronic system
- Harish Chandra Research Institute, Allhabad, India
  Title: Emergence of non-Fermi liquid dynamics through non-local correlations in an interacting disordered system (2016)
- ICTS Bangalore, India
  Title: Quantum critical Mott transitions in a bilayer Kondo insulator -metal model system (2016)
- XXVII IUPAP Conference on Computational Physics (December, 2015)
  Title: Interaction versus disorder: a new computational approach
- DMFT at 25: Infinite Dimensions, Julich, Germany, 2014
  Title: Spectral changes in layered f-electron systems induced by Kondo hole substitution in the boundary-layer
- JNCASR-Purdue University Workshop on Nanomaterials for Energy (2014)
  Title: Spectral changes in layered f-electron systems induced by Kondo hole substitution in the boundary-layer
- LA-SiGMA symposium, Louisiana State University, Baton Rouge (2014)
  Title: Spectral changes in layered f-electron systems induced by Kondo hole substitution in the boundary-layer
- Nonequilibrium Winter School, ICTS, India (9 Dec 2011 - 22 Jan 2012)
  Title: Correlated Electron Ion Dynamics in Current Carrying Nanojunctions
- JNC Research Conference, Kerala, India (30 September 2012 - 2 October 2012)
  Title: Protocols for characterising quantum transport through nano-structures

Academic References

- **Prof. N. S. Vidhyadhiraja** (Thesis Advisor)
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  Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore-560064, India
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- **Dr. Andrew Mitchell**
  Assistant Professor of Theoretical Physics
  University College Dublin (UCD),School of Physics, UCD Science Centre North, Belfield, Dublin 4, Ireland
  Email: andrew.mitchell@ucd.ie
  Phone:+353 (0) 1716 2520

- **Prof. Vladimir Dobrosavljevic**
  Director, Condensed Matter Science-Theory, NHMFL; Professor of Physics, FSU
  1800 E. Paul Dirac Dr. Tallahassee , FL 32310-3706
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- **Prof. Eduardo Miranda**
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  CEP 13083-859 - Campinas - SP - Brazil
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- **Prof. Mark Jarrell (deceased)**
  Department of Physics and Astronomy,
  Louisiana State University,
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