Tirtha Sankar Ray

CONTACT INFORMATION

Indian Institute of Technology Kharagpur
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West Bengal, India - 721302.
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RESEARCH INTERESTS

Particle Physics Beyond the Standard Model, Astro-Particle Physics

PRESENT POSITION

Associate Professor at Department of Physics IIT-Kharagpur, India.

RESEARCH EXPERIENCE

September 2012 to August 2014:
Worked as Post Doctoral Research Fellow in Theoretical Particle Physics at School of Physics, CoEPP, University of Melbourne, Australia.

July 2010 to June 2012:
Worked as Post Doctoral Fellow at Physics Beyond the Standard Model Group, Institut de Physique Théorique, CEA-Saclay, France.

EDUCATION

Ph.D., Physics, September 2010
- University: University of Calcutta, Kolkata, India
- Institute: Saha Institute of Nuclear Physics, Kolkata, India
- Thesis Title: *Beyond the Standard Model: Some Aspects of Supersymmetry and Extra Dimension.*
- Adviser: Prof. Gautam Bhattacharyya

Post M.Sc. Associateship, Physics, 2006
- Specialization: *Particle Physics*
- Institute: Saha Institute of Nuclear Physics, Kolkata, India

M.Sc., Physics, 2005
- Specialization: *Particle Physics*
- University: University of Calcutta, Kolkata

B.Sc., Physics Honours, 2003
- College: Presidency College, University of Calcutta, Kolkata

ISC, 2000
- Don Bosco School Park Circus, Kolkata, CISCE, New Delhi

AWARDS & SCHOLARSHIPS

- Early Career Research Award, SERB, Department of Science and Technology (DST), Govt. of India, March 2019
- Faculty Excellence Award, IIT-Kharagpur, 2018
- Junior Associate of ICTP, Trieste, Italy, 2017-2022
- INSPIRE Faculty Award, INSA, Department of Science and Technology (DST), Govt. of India, February 2014.
- Post Doctoral Research Fellowship, Australian Research Council, 2012-2014.

- CEA-Eurotalents Fellowship, 2011 - 2012.
- Marie Curie Experienced Research Fellowship, 2010 - 2011.
- Shyama Prasad Mukherjee Fellowship by the Council of Scientific and Industrial Research (CSIR), Govt. of India, for pursuing Ph.D. in India for the period 2006 - 2010.
- Lectureship and Junior Research Fellowship awarded by the Council of Scientific and Industrial Research (CSIR), Govt. of India, 2005.
- Satyendra Nath Bose Cash Prize by the University of Calcutta, 2004.
- National Scholarship based on performance in B.Sc. Examinations, for pursuing M.Sc. course, 2003.

Mentoring

- *Post Doctoral*: Dr Ujjal K Dey, Post Doctoral Fellow(NPDF fellow) , 2016-2018 (Present: Faculty IISER, Berhampur) ; Dr Avirup Shaw, Post Doctoral Fellow (NPDF fellow), January 2021-

- *Doctoral*: Tarak Nath Maity (2015 - 2020) (Next: PDF IISc Bengaluru, India;); Sayan Das Gupta (2016 -2022); Sambo Sarkar (Joint with Prof. Somnath Bharadwaj, 2017-); Rohan Pramanik (2018-), Debajit Bose (2019-)

- *Master's*: (2015-2016) Agniva Ghosh (Next: PhD Univerity of Minnesota), Krishna Kulkarni (Next: PhD DESY), Mudit Sinhal (Next: PhD Univerity of Basel); (2016-2017) Poulami Mondal (Next: PhD Calcutta University), Subhadip Sau (Next: PhD IACS, Kolkata); (2017-2018) Sanjib Majumder (Next: PhD IIT, Madras), Deep Ghosh (Next: PhD IACS, Kolkata); (2018-2019) Jangam Viraj Vilas (Next: Industry), Debajit Bose (Next: PhD IIT, Kharagpur); (2019-2020) Subhadip Bouri (Next: PhD IISc, Bangaluru), Arpan Hait (Next: PhD IIT, Kanpur); (2020-2021) Ashok Kumar Sahoo, Kazi Parvez Islam (Next: PhD IIT, Kharagpur); (2021-2022) Aritra Bal, Harsh Mehta, Sourav Sengupta

Teaching

- Astrophysics: Spring 2022
- Advanced Classical Mechanics at IIT Kharagpur: Autumn 2020, Autumn 2021
- Cosmology at IIT Kharagpur: Spring 2019, Spring 2020, Spring 2021
- Physics 1at IIT Kharagpur: Autumn 2018*, Autumn 2019
- High Energy Physics at IIT Kharagpur: Spring 2015, Spring 2016*, Spring 2017, Spring 2018
- Advanced Electrodynamics at IIT Kharagpur: Autumn 2015, Autumn 2016* , Autumn 2017
- Nuclear and Particle Physics Lab at IIT Kharagpur: Spring 2015, Spring 2016, Spring 2017, Autumn 2017, Spring 2018, Spring 2019, Autumn 2020
- 1st Year General BTech Lab, IIT Kharagpur: Autumn 2016, Spring 2021
- Thermal Physics and General Properties of Matter Lab at IIT Kharagpur: Autumn 2015
- Guest Lecturer for Group Theory Course at SERC Preparatory School at IISER-Bhopal, 2015
- Guest Lecturer for Radiative Corrections in the Standard Model and New Physics Course at SERC Main School at Kalyani University, 2017
- Lectures on Electroweak Symmetry Breaking and Vacuum Stability at SANGAM@HRI 2018
- Lectures on Electroweak Effective Theory at XXXII SERB THEP Main School, IISER-Pune, Pune, November 25 - December 15, 2018

(∗: Among Top Student Feed Back at Institute)

Projects

- Project Title: *Neutral Natural Extensions of the Standard Model at LHC and Beyond*
  Principal Investigator: *Tirtha Sankar Ray*
  Sponsoring Agent: *ECRA, DST, Govt. of India*
  Tenure: *March, 2019- March, 2022*
  Grant amount: *Rs. 0.9 million*
- Project Title: *Electroweak Symmetry Breaking in the Era of Precision Higgs Physics*
  Principal Investigator: *Tirtha Sankar Ray*
  Sponsoring Agent: *INSPIRE Faculty Scheme, DST, Govt. of India*
  Tenure: *August, 2014- August, 2020*
  Grant amount: *Rs. 3.5 million (7 lakh/annum)*
- Project Title: *Electroweak Symmetry Breaking via Strong Dynamics at LHC@14*
  Principal Investigator: *Tirtha Sankar Ray*
  Sponsoring Agent: *ISIRD, IIT Kharagpur, India*
  Tenure: *August, 2015- August, 2018*
  Grant amount: *Rs. 1.63 million*

Publications:

1. Radiative correction to the lightest neutral Higgs mass in warped supersymmetry; Gautam Bhattacharyya, Swarup Kumar Majee and Tirtha Sankar Ray, Phys.Rev.D78 (2008) 071701 (rapid communication), arXiv:0806.3672 [hep-ph].

2. Probing warped extra dimension via $gg \to h$ and $h \to \gamma\gamma$ at LHC; Gautam Bhattacharyya and Tirtha Sankar Ray, Phys.Lett.B675 (2009) 222-225, arXiv:0902.1893 [hep-ph].

3. A phenomenological study of 5d supersymmetry; Gautam Bhattacharyya and Tirtha Sankar Ray, JHEP 1005 (2010) 040, arXiv:1003.1276 [hep-ph].

4. On the possibility of generating leading order gaugino masses in direct gauge mediation scenario; Tirtha Sankar Ray, Phys.Rev.D85 (2012) 035003, arXiv:1111.4266 [hep-ph].

5. Gluino, Wino and Higgsino-like Particles without Supersymmetry; Tirtha Sankar Ray, Hiroshi De Sandes and Carlos A. Savoy, Phys.Lett.B712 (2012) 401-406, arXiv:1112.6180 [hep-ph].

6. Naturally split supersymmetry; Gautam Bhattacharyya and Tirtha Sankar Ray, JHEP 1205 (2012) 022, arXiv:1201.1131 [hep-ph].

7. On Composite Two Higgs Doublet Models; Enrico Bertuzzo, Tirtha Sankar Ray, Hiroshi de Sandes and Carlos A. Savoy, JHEP 1305(2013)153, arXiv:1206.2623 [hep-ph].

8. Pushing the SUSY Higgs mass towards 125 GeV with a color adjoint; Gautam Bhattacharyya and Tirtha Sankar Ray, Phys.Rev.D87 (2013) 015017, arXiv:1210.0594 [hep-ph].

9. Burgeoning the Higgs mass to 125 GeV through messenger-matter interactions in GMSB models; Pritibhajan Byakti and Tirtha Sankar Ray, JHEP 1305 (2013) 055, arXiv:1301.7605 [hep-ph].

10. Constraining minimal and non-minimal UED models with Higgs couplings; Ujjal Kumar Dey and Tirtha Sankar Ray, Phys.Rev.D88 (2013) 056016, arXiv:1305.1016 [hep-ph].

11. Radiative corrections to the composite Higgs mass from a gluon partner; James Barnard, Tony Gherghetta, Anibal Medina, and Tirtha Sankar Ray, JHEP 1310 (2013) 055, arXiv:1307.4778 [hep-ph].

12. Minimal supersymmetry confronts R_b, $A_{\rm FB}^b$ and m_h; Gautam Bhattacharyya, Anirban Kundu and Tirtha Sankar Ray J.Phys.G:Nucl.Part.Phys. 41 (2014) 035002, arXiv:1306.0344 [hep-ph].

13. Radion/dilaton-Higgs mixing phenomenology in light of the LHC; Peter Cox, Anibal Medina, Tirtha Sankar Ray and Andrew Spray, JHEP 1402 (2014) 032, arXiv:1311.3663 [hep-ph].

14. UV descriptions of composite Higgs models without elementary scalars; James Barnard, Tony Gherghetta and Tirtha Sankar Ray, JHEP 1402 (2014) 002, arXiv:1311.6562 [hep-ph].

15. The Higgsino-Singlino World at the Large Hadron Collider ; Jong Soo Kim and Tirtha Sankar Ray, Eur.Phys.J. C, 75 (2015) 2, 40, arXiv:1405.3700 [hep-ph].

16. The Unnatural Composite Higgs; James Barnard, Tony Gherghetta, Tirtha Sankar Ray and Andrew Spray, JHEP 1501 (2015) 067, arXiv:1409.7391 [hep-ph]

17. Same sign di-lepton candles of the composite gluons; Aleksandr Azatov, Debtosh Chowdhury, Diptimoy Ghosh and Tirtha Sankar Ray, JHEP 1508 (2015) 140, arXiv:1505.01506 [hep-ph].

18. Higgs Couplings in Warped Extra Dimensional Models with Brane Kinetic Terms; Ujjal Kumar Dey and Tirtha Sankar Ray, PRD(rapid communication) 93 (2016) 011901(R) , arXiv:1507.04357 [hep-ph].

19. Novel Collider and Dark Matter Phenomenology of a Top-philic Z; Peter Cox, Anibal D. Medina, Tirtha Sankar Ray, Andrew Spray , JHEP 1606 (2016) 110 , arXiv:1512.00471 [hep-ph].

20. Implications of diphoton searches for a Radion in the Bulk-Higgs Scenario; Peter Cox, Anibal D. Medina, Tirtha Sankar Ray, Andrew Spray , Int. J. Mod. Phys. A 32 (2017) 1750020, arXiv:1512.05618 [hep-ph].

21. Light Dark Matter through Assisted Annihilation; Ujjal Kumar Dey, Tarak Nath Maity and Tirtha Sankar Ray, JCAP 03(2017)045, arXiv:1612.09074 [hep-ph].

22. Improving Fine-tuning in Composite Higgs Models; Avik Banerjee, Gautam Bhattacharyya, Tirtha Sankar Ray, Phys. Rev. D **96** (2017) no.3, 035040, arXiv:1703.08011 [hep-ph].

23. Dark Energy from pNGB Mediated Dirac Neutrino Condensate ; Ujjal Kumar Dey, Tirtha Sankar Ray, Utpal Sarkar, Nucl.Phys. B928 (2018) 258-267, arXiv:1705.08484 [hep-ph].

24. Mitigating Direct Detection Bounds in Non-minimal Higgs Portal Scalar Dark Matter Models ; Subhaditya Bhattacharya, Purusottam Ghosh, Tarak Nath Maity, Tirtha Sankar Ray, JHEP 1710 (2017) 088, arXiv:1706.04699 [hep-ph] .

25. Constraining Composite Higgs Models using LHC data; Avik Banerjee, Gautam Bhattacharyya, Nilanjana Kumar, Tirtha Sankar Ray, JHEP 03(2018)062, arXiv:1712.07494 [hep-ph].

26. Status of Flavour Maximal Non-minimal Universal Extra Dimension; Sayan Dasgupta, Ujjal Kumar Dey, Tapoja Jha, Tirtha Sankar Ray, Phys.Rev. D98 (2018) no.5, 055006 , arXiv:1801.09722 [hep-ph].

27. Clockworked VEVs and Neutrino Mass; A. Banerjee, S. Ghosh and T. S. Ray, JHEP 1811 (2018) 075, arXiv:1808.04010 [hep-ph].

28. Boosting Assisted Annihilation for a Cosmologically Safe MeV Scale Dark Matter; U. K. Dey, T. N. Maity and T. S. Ray, Phys. Rev. D **99**, no. 9, 095025 (2019), arXiv:1812.11418 [hep-ph].

29. Resonant Assisted Annihilation, T. N. Maity and T. S. Ray, JCAP **1911**, 033 (2019), arXiv:1907.08262 [hep-ph].

30. Exchange driven freeze out of dark matter, T. N. Maity and T. S. Ray, Phys. Rev. D **101**, no. 10, 103013 (2020), arXiv:1908.10343 [hep-ph].

31. Impact of a colored vector resonance on the collider constraints for top-like top partner, S. Dasgupta, S. K. Rai and T. S. Ray, Phys. Rev. D **102**, 115014 (2020), arXiv:1912.13022 [hep-ph].

32. Prospects of Migdal Effect in the Explanation of XENON1T Electron Recoil Excess, U. K. Dey, T. N. Maity and T. S. Ray, Phys. Lett. B **811**, 135900 (2020), arXiv:2006.12529 [hep-ph].

33. Halo uncertainties in electron recoil events at direct detection experiments, T. N. Maity, T. S. Ray and S. Sarkar, Eur. Phys. J. C **81** (2021) no.11, 1005, arXiv:2011.12896 [hep-ph].

34. Probing composite Higgs boson substructure at the HL-LHC, A. Banerjee, S. Dasgupta and T. S. Ray, Phys. Rev. D **104** (2021) no.9, 095021, arXiv:2105.01093 [hep-ph].

35. Neutrinos from captured dark matter annihilation in a galactic population of neutron stars, D. Bose, T. N. Maity and T. S. Ray, JCAP **05** (2022) no.05, 001, arXiv:2108.12420 [hep-ph].

36. Broad toplike vector quarks at LHC and HL-LHC, S. Dasgupta, R. Pramanick and T. S. Ray, Phys. Rev. D **105** (2022) no.3, 035032, arXiv:2112.03742 [hep-ph].

37. Solar constraints on captured electrophilic dark matter, D. Bose, T. N. Maity and T. S. Ray, arXiv:2112.08286 [hep-ph].

38. Reappraisal of the minimal flavoured Z' scenario, T. S. Ray and A. Shaw, arXiv:2202.04430 [hep-ph].

39. Constraints on dark matter self-interaction from galactic core size, T. S. Ray, S. Sarkar and A. K. Shaw, arXiv:2202.12247 [astro-ph.GA].

Citation Average: 26.8 [Published Papers], $h-$ Index: 16

PhD Thesis and Proceedings

- Beyond the Standard Model: Some Aspects of Supersymmetry and Extra Dimension; Tirtha Sankar Ray, arXiv:1103.5939 [hep-ph].

- Electroweak symmetry breaking via Strong dynamics in the Precision Higgs Era: Extra Dimension and Composite Higgs; Tirtha Sankar Ray, Springer Proc.Phys. 174 (2016) 661-669.

Talks, Conferences, Visits and Schools

- Associate visit to ICTP, Trieste, Italy, 11th November - 23rd December, 2021.
- Virtual Talk at The XXVIII International Conference on Supersymmetry and Unification of Fundamental Interactions (SUSY 2021), 23-28 August, 2021 ♠
- Virtual Talk at ICTP Phenomenology Group, HECAP, ICTP, Trieste, Italy, 3rd November, 2020 ★
- Zooming in on Axions in the Early Universe, CERN Virtual Workshop, 20-26 June, 2020
- The Workshop on High Energy Physics Phenomenology (WHEPP) XVI, IIT Guwahati, India, 1st December-10th December, 2019 (Working Group-1 Co-ordinator)
- Fundamental Composite Dynamics: Opportunities for Future Colliders and Cosmology, MIPT, Johannes Gutenberg University, Mainz, Germany,26th August-7th September, 2019 ★
- Dark Matter Identification: Connecting Theory and Signature Space, MIPT, Johannes Gutenberg University, Mainz, Germany, 8th-12th April, 2019.
- Seminar at SINP Kolkata, 11th June, 2018 ★
- SANGAM@HRI - 2018, HRI Allahabad, 5th-9th March, 2018 ★
- Workshop on Top Quark Physics at Present and Future Collider, 27th-30th January, 2018 ★
- Associate visit to ICTP, Trieste, Italy, 15th May - 16th June, 2017.
- Visit to HRI,Allahabad, 11th-14th March, 2017★
- From Strings to LHC - IV, Chalsa, India. 05th-11th March, 2017★
- Looking for BSM Physics, Indian Institute of Science, Bangaluru, 19th-22nd December, 2016 ★
- Higgs Tasting Workshop 2016, Centro de Ciencias de Benasque Pedro Pascual, Benasque, Spain, 15th - 21st May , 2016♠.
- Indo-French Kick Off Meeting, Indian Institute of Science, Bangalore and 750 GeV Excess @LHC under scrutiny at ICTS-TIFR, , Bangaluru 2nd -6th May, 2016★.
- WHEPP at IIT-Kanpur, India 4th-13th December, 2015★.
- Invited talk at TPP, SISSA, Trieste 20th May, 2015★.
- Visit the HECAP, ICTP, Trieste, 17th May - 18th June, 2015.
- LHCDM-2015: Three Week Workshop on LHC and Dark Matter (LHCDM) IACS, Kolkata, India, 23rd-28th February, 2015★.
- XXI DAE-BRNS High Energy Physics Symposium 2014, IIT Guwahati, India, 8th-12th December, 2014★.
- Visit to University of Calcutta, India, 14th August - 7th September, 2014 as INSPIRE Faculty.
- PLANCK 2014, Paris, France, 26th May-30th May, 2014♠.
- Visit to the William I Fine Theoretical Physics Institute, University of Minnesota, Minneapolis, USA, 19th April-25th May, 2014.
- After the Discovery: Hunting for a Non-Standard Higgs Sector, Centro de Ciencias de Benasque Pedro Pascual, Benasque, Spain, 6th April - 18th April, 2014.
- CoEPP Annual Workshop 2014, Wollongong, NSW, Australia, 18th February - 21st February 2014♣.
- Mini Workshop on SUSY, CoEPP, Adelaide Node, University of Adelaide, 11th November-13th November 2013♠.
- CoEPP Tropical Workshop, Cairns Colonial Club Resort, Cairns, Australia, 7th July - 12th July 2013♣.
- Visit to IPhT, CEA-Saclay, France, 16th June- 29th June 2013★.
- Visit to Theory Division, CERN, Geneva, 2nd June-16th June, 2013.
- Visit to CoEPP, Adelaide Node, University of Adelaide, 3rd December - 4th December, 2012★.
- Visit to Indian Institute of Science, Bangalore, India, 14th August-17th August, 2012★.

- Visit to Harish-Chandra Research Institute, Allahabad, India, 6th August-9th August, 2012★.
- Visit to University of Calcutta, Kolkata, India, 2nd July-29th Sept, 2012.
- Visit to Fakultät für Physik, Technische Universität Dortmund, Dortmund, Germany, 11th June-16th June, 2012★.
- PLANCK 2012, Warsaw, Poland, 28th May-1st June, 2012♠.
- GDR Terascale@Clermont-Ferrand, France, 23rd April - 25th April, 2012♠.
- Visit to Jozef Stefan Institute, Ljubljana, Slovenia, 24th January-27th January, 2012★.
- Visit to Theory Division, CERN, Geneva, 21st November-29th November, 2011.
- Summer School of ITN on Unification in the LHC Era at Corfu Summer Institute, Corfu, Greece, 4th September - 11th September, 2011.
- Workshop on Implications of LHC Results for TeV-scale Physics at CERN, Geneva, 29th August - 2nd September, 2011.
- Visit to Fermilab, Illinois, USA, 21st June - 1st July, 2011.
- PLANCK 2011 Meeting at Instituto Superior Técnito, Lisbon, Portugal, 30th May - 3rd June, 2011 on "Physics Beyond the Standard Model".
- Cargèse Summer School, at the Institute for Scientific Studies in Cargèse, Corsica, France, 19th July - 31st July 2010.
- Workshop on High Energy Physics Phenomenology (WHEPP XI) at Physical Research Laboratory, Ahmedabad, India, 2nd January - 12th January, 2010.
- Conference at Department of Physics, University of Calcutta, Kolkata, India, December 2009 on "LHC and New Frontiers of Particle Physics".
- Topical meeting at IACS, Kolkata, India, January 2009 on "Beyond the Standard Model Physics at the LHC", organized by Dept. of Theoretical Physics, IACS in collaboration with RECAPP, HRI.
- Visit to Harish-Chandra Research Institute, Allahabad, India, 18th July - 16th August, 2007.
- Summer School on Particle Physics at Trieste, Italy, June 2007, organized by ICTP.
- SERC Schools organized by Dept. of Science and Technology, Govt. of India: (i) Preparatory School at IISc, Bangalore, October 2006, (ii) Main School at Hyderabad Central University, January 2007, (iii) Main School at IIT, Mumbai, February 2008.

(♠: Contributed talks; ♣: Plenary talks; ★: Invited talks)