Subhajit Dandapat

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EDUCATION

Tata Institute of Fundamental Research, Mumbai
Department of Astronomy & Astrophysics
Research Scholar,
Joined on August, 2019 CGPA: 7.9/10.00

Indian Institute of Science Education and Research, Bhopal
BS-MS Dual Degree, Physics
May, 2019 CGPA: 8.89/10.00

IMPORTANT COURSES UNDERTAKEN

TIFR: • Astronomy & Astrophysics I,II • General Theory of Relativity • Computational Physics • Advanced Quantum Mechanics
IISER: • General Theory of Relativity • Cosmology • Quantum Field Theory I,II • Quantum Information Theory • Many Body Quantum Mechanics of Degenerate Gasses • Complex Analysis

RESEARCH INTERESTS

1. Gravitational Wave.
2. Theoretical Astrophysics.
3. General Theory of Relativity.
4. Computational Physics.

CONFERENCE ATTENDED /TALKS

1. "IPTA GWA hackweek on 3P+ comparisons",virtually on zoom, **6-8 March, 2023**; Presented our ongoing efforts on comparing posteriors that arises from various PTA analysis.
2. "Gravitational Wave Orchestra" in-person held on **UCLouvain, Belgium; Sep 8-9,2022**; presented a poster on "**Stochastic gravitational wave background spectrum due to supermassive black hole binaries in precessing eccentric orbits**".
3. "EPTA 2021 Winter meeting" virtually on zoom; Dec 6-8, 2021 and "Astronomy Society of India meeting" in-person held on **IIT Roorkee**; Mar 25-29, 2021. **"Modeling GW burst with linear memory events"** .
4. "EPTA 2021 Summer meeting" virtually on zoom; Apr 21-23, 2021. **"Effect of relativistic pericentre advance on the SGWB due to eccentric SMBH binaries"** .
5. **ICTS Summer School On Gravitational-Wave Astronomy** conducted online during July 05 – 16, 2021.

RESEARCH VISIT

I have visited Prof. Jetzer's group at University of Zürich (`https://www.physik.uzh.ch/en/groups/jetzer.html`) from **15 th July to 30th September, 2022** for LIGO-Virgo-KAGRA (LVK) collaborative work.

PUBLICATIONS

1. Cho, G., **Dandapat, S.** and Gopakumar, A., "Instantaneous third post-Newtonian accurate expressions for the radiated energy and angular momentum during hyperbolic encounters of non-spinning compact objects", published Physical Review D, 2022 (`https://doi.org/10.1103/PhysRevD.105.084018`)
2. Singha, J., Surnis, M. P., Joshi, B.C., . . . , **Dandapat, S.**, and the InPTA Collaboration, 2021, "Evidence for profile changes in PSR J1713+0747 using the uGMRT", MNRASL, 507, L57 (`arXiv:2107.04607`)
3. Nobleson, K., . . . , **Dandapat, S.**, and the InPTA Collaboration, 2021, "Low-frequency wideband timing of InPTA pulsars observed with the uGMRT" (`https://doi.org/10.1093/mnras/stac532`)

4. Joshi, B., ..., **Dandapat, S.**, and the InPTA Collaboration, 2022, "Nanohertz Gravitational Wave Astronomy during the SKA Era: An InPTA perspective", published in JApA. 43, 2, 98. (`https://doi.org/10.1007/s12036-022-09869-w`).
5. Srivastava, A., ..., **Dandapat, S.**, and the InPTA Collaboration, 2023, "Noise analysis in the Indian Pulsar Timing Array Data Release I", (`arXiveprints: 2303.12105`).
6. **Dandapat, S.**, Ebersold, M., Susobhanan, A., Rana, P et al. "Gravitational Waves from Black Hole Encounters: Prospects for Ground and Galaxy-Based Observatories", 2023 submitted Physical Review D. Document: **LIGO-P2300013-v1**.
7. Paladi, A K., ..., **Dandapat, S.**, and the InPTA Collaboration, 2023, "Multi-band Extension of the Wideband Timing Technique", (`arXiveprints:2304.13072`).

RECENT RESEARCH WORKS

- Modelling Hyperbolic Gravitational Wave Burst Events with Linear Memory
  - We are developing an `Enterprise` compatible Python routine that provides ready-to-use PTA responses to GWs from Supermassive Black Hole Binary (SMBHB) in general relativistic hyperbolic orbits in the 3.5 post-Newtonian description. Further, we explain how we can adapt our approach to search for Burst with Memory events in the LIGO-Virgo-Kagra data sets.
- Tail effects in the third post-Newtonian (**3PN**) gravitational wave energy and Angular momentum flux during Hyperbolic Encounters of Black Hole Binaries.
- Incorporating the effect of pericenter advance on to the ready-to-use Characeristic strain expression for the eccentric GWB.
  - Chen, Sesana and Del Pozzo (CSD) provided an efficient approach to obtain the characteristic spectrum of gravitational wave background (GWB) from a population of eccentric massive black hole binaries (MBHBs) (`arXiv: 1612.00455`). Currently I am involved in a project that explores the effects of pericenter advance on CSD's characteristic strain spectrum.
- Incorporating Black Hole Spin-Spin Interaction Effects on to Frequency Domain Inspiral Templates for Black Hole Binaries in Eccentric Orbits.
  - This project computes ingredients, required to construct in-spiral templates that model GWs from spinning black hole binaries in eccentric orbits in the post-Newtonian (PN) approximation. Specifically, we compute effects of dominant order general relativistic spin-spin contributions to frequency evolution of orbital eccentricity and Fourier phases. These contributions enter at the 2PN order and our analytic computations incorporate only the next -to-leading-order eccentricity corrections.

MASTER'S THESIS

- **Duration:** May, 2018 - May, 2019.
- **Title:** Chiral Anomalies In Quantum Field Theory
- **Advisors**:
  Dr. Nabamita Banerjee, IISER Bhopal
  Dr. Suvankar Dutta, IISER Bhopal
- I worked on Chiral anomalies in QFT, particularly with pion to two-photons decay process. Such anomalies tend to appear in the QFT process from the non-invariance of the fermionic measure in the functional integral under chiral transformation in background Gauge condition. Chiral anomalies can also be understood by three point correlator containing two vector and one axial current.I used different types of regularization-dimensional, pauli-villars and point splitting regularization to explicitly reproduce the anomaly term. I have also analyzed another different type of anomaly which comes from the 3 point correlator

containing three left or right handed (chiral) current which leads to chiral current non-conservation.

INTERNSHIPS

- Summer Project (2017): **"Path integrals in Quantum Mechanics"**, at 'Indian Institute Of Science Education and Research Bhopal', under Dr. Suhas Gangadharaiah.
  In this project I learned the basics of the path integral formulation in quantum mechanics. Over the course of the project, I explored this method in further detail and applied it in the context of free particle and quantum harmonic oscillator.
- Summer Project (2016): **"Steiner Trees and Spanning Trees Configurations in Multi-pin Soap Film"**, at 'Indian Institute Of Technology Kharagpur', under Dr. Sugata Pratik Khastagir.
  The goal of this project was to understand about Plateau's problem of minimal surfaces for a given boundary. I learned about the Steiner minimal trees, which are stationary states for a given boundary corresponding to local minima of energy which appears in soap films connecting multiple pins between two parallel plates. Throughout the project, I have calculated the length of each Steiner and spanning tree configurations in both 3 and 5 pin soap films and obtained a generalized formula to calculate the length of trees for both three and five pin configuration.

SKILLS

- **Software Skills:**
  - Python, C, Mathematica and Maple.
  - TEMPO2, Enterprise (Pulsar timing analysis package).
- **Theoretical Skills:**
  - **Theoretical modelling and building templates for Gravitational Wave sources.**
  - Feynman Amplitudes/Scatting Matrix Calculations and their regularization/ Renormalization.

REFERENCES

1. Dr. Achamveedu Gopakumar
   Professor, Department of Astronomy & Astrophysics
   Tata Institute of Fundamental Research, Mumbai
   Email: gopu.tifr@gmail.com
2. Dr. Suvankar Dutta
   Associate Professor, Department of Physics
   Indian Institute of Science Education and Research, Bhopal
   Email: suvankar.hri@gmail.com
3. Dr. Nabamita Banerjee
   Assistant Professor, Department of Physics
   Indian Institute of Science Education and Research, Bhopal
   Email: nabamita.hri@gmail.com