

Dedications

This thesis is dedicated to

Mrs. Manju Dutta (Maa)

Late. Utpal Dutta (Baba)

Ms. Sunali Dutta (Neha)

&

my whole family

**People whose joy for my
achievement of a Ph.D. surpasses
even my own**

Declaration

*I, Mr. Subham Dutta (Roll No: PHP20105 and Registration No. TZ200484 of 2019, Department of Physics, School of Sciences, Tezpur University) hereby declare that the thesis entitled, "**Plasma fireball instabilities**", submitted in the partial fulfilment of the requirements for the award of degree of **Doctor of Philosophy (Ph.D.)**, is a genuine record of original research investigations by me during my academic journey period.*

Any part of texts, figures and results by other researchers in any form, which are properly used in a dignified way herein, are suitably, and honestly cited in order to give the main credits to the originators and pioneers.

I also hereby declare that the works compiling this thesis have not been submitted anywhere in part, or in full, for the award of any other degree, diploma, or recognition from any other academic institution or organisation.

Date: 11-06-2025

Place: Tezpur



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Certificate

*This is to certify that the proposed thesis entitled, “Plasma fireball instabilities”, submitted to the School of Sciences, Tezpur University, in partial fulfilment of the requirements for the award of degree of **Doctor of Philosophy (Ph.D.)** in physics is a genuine record of original research investigations carried out by **Mr. Subham Dutta** under my constant supervision and guidance.*

All the cooperation, support and help received by him throughout this academic journey from various sources have been thankfully acknowledged.

It is further stated that no part of the contents compiled in this thesis has been submitted elsewhere for the award of any other degree, diploma, or recognition.

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Subham Dutta

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ACADEMIC PROGRAMS PARTICIPATED

A. Seminars/Conferences

1. Chandra's Contribution in Plasma Astrophysics (CCPA), Jawaharlal Nehru University, New Delhi, India, 2021.
2. National Conference on Physical Sciences (NCPS), DHSK College and Manipur University, Dibrugarh, Assam, India, 2022.
3. Plasma Theory and Simulation (PTS), Jawaharlal Nehru University, New Delhi, India, 2023.
4. Symposium on Physics: Advances on Research and Knowledge (SPARK), North Lakhimpur College, Assam, India, 787031, 2023.

LIST OF RESEARCH PUBLICATIONS

A. International and National Refereed Journal of Scientific Repute

1. **Dutta, S.**, and Karmakar, P. K. “Fireball sheath instability”, *Journal of Astrophysics and Astronomy*, 43(64), 1-8, 2022. (UGC-Care listed)
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2. **Dutta, S.**, and Karmakar, P. K. “A multi-order nonlinear meta-analysis of bifluidic fireball sheath fluctuation”, *Waves in Random and Complex Media*, 1–27, 2023.
DOI: <https://doi.org/10.1080/17455030.2023.2178826>
3. **Dutta, S.**, and Karmakar, P. K. “Sheath plasma instability in inverted fireballs”, *Chaos, Solitons and Fractals*, 186(115259), 2024. (UGC-Care listed)
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4. **Dutta, S.**, Gruenwald, J., and Karmakar, P. K. “Analytic model for sheath plasma resonance in inverted fireballs”, *Results in Physics*, 2025. (Communicated)
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5. **Dutta, S.**, and Karmakar, P. K. “An electric circuital analysis of laboratory plasma sheath fluctuations and propagations”, *Scientific Reports*, 2025. (Under review)
6. **Dutta, S.**, Atteya, A., and Karmakar, P. K. “Plasma fireball sheath dynamics: A brief review and meta-analysis”, *Discover Space*, 2025. (Communicated)
7. Karmakar, P. K., **Dutta, S.**, and Deka U. “A brief review on plasma sheath stability: Circuital description, implication, and application”, *European Physical Journal Plus*, 2025. (Under review)

B. Conference Proceeding

1. **Dutta, S.**, and Karmakar, P. K. “A brief overview of diverse plasma fireballs and their dominant instabilities”, *Journal of Physics: Conference series*, 2957(012018), 2025.

C. Book chapter

1. **Dutta, S.**, and Karmakar, P. K. “Fusion: A pathway to energy sufficiency in future”, *Emerging Trends in Basic and Applied Sciences*, Purbayon Publication, Guwahati, Assam, India, ISBN: 978-93-5860-107-7, 2024.