

PERSONAL DETAILS

<i>Citizenship</i>	India
<i>Affiliation</i>	6 th year PhD student, Department of Astronomy, Yale University
<i>Thesis advisor</i>	Prof. Frank C. van den Bosch
<i>Office address</i>	319, 52 Hillhouse Avenue, New Haven, CT 06511, USA
<i>Email</i>	uddipan.banik@yale.edu, banikuddipan@gmail.com
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<i>Other links</i>	ADS, Google Scholar, ORCID, ResearchGate

EDUCATION

2017-Now Degree expected: May 2023	PhD Astrophysics Dissertation title: “ Pushing the frontiers of gravitational encounters and collisionless dynamics ”	Yale University
2017-2020	M.Phil Astrophysics	Yale University
2017-2020	M.Sc Astrophysics	Yale University
2013-2017	BS Physics Cumulative GPA (CGPA): 9.5/10 Department Rank 1	Indian Institute of Technology Kanpur

RESEARCH INTERESTS

1. Galactic dynamics

- **Perturbation and relaxation of self-gravitating collisionless systems**
- Landau damping, phase-mixing, violent relaxation, chaotic mixing
- **Secular evolution of globular clusters, galaxies and dark matter halos**
- resonant relaxation, dynamical friction
- **Radial migration and angular momentum transport by bars and spiral arms**
- **Gravitational encounters and mergers between galaxies and dark matter halos**
- mass loss, tidal disruption, tidal shocks, revirialization

2. Dark matter

- **Impact of various dark matter models** (WIMP, Fuzzy dark matter, Self-interacting dark matter, QCD axion, etc.) **on structure formation and secular evolution of galaxies**
- **Constraining the nature of dark matter using galactic dynamics**
- dynamical friction in cored vs cuspy host galaxies, diffusion of stellar streams by dark matter substructure

3. Black holes

- **Black hole inspiral and merger**
- gravitational waves, loss-cone dynamics, secular evolution (dynamical friction)
- **Strong gravitational lensing**

4. Cosmology

- **Inflation, cosmological phase-transitions, primordial black holes**
- **Non-linear structure formation**

PUBLICATIONS

First author refereed publications

Published

- **“A Comprehensive Perturbative Formalism for Phase Mixing in Perturbed Disks. I. Phase Spirals in an Infinite, Isothermal Slab”**
(arXiv:2208.05038)
Uddipan Banik, Martin D. Weinberg and Frank C. van den Bosch
The Astrophysical Journal, Volume 935, Number 2, 135, August 23, 2022
- **“Dynamical Friction, Buoyancy and Core-Stalling. I. A Nonperturbative Orbit-based Analysis”**
(arXiv:2112.06944)
Uddipan Banik and Frank C. van den Bosch
The Astrophysical Journal, Volume 926, Number 2, 215, February 25, 2022
- **“A Self-consistent, Time-dependent Treatment of Dynamical Friction: New Insights Regarding Core Stalling and Dynamical Buoyancy”**
(arXiv:2103.05004)
Uddipan Banik and Frank C. van den Bosch
The Astrophysical Journal, Volume 912, Number 1, 43, May 3, 2021
- **“A fully general, non-perturbative treatment of impulsive heating”**
(arXiv:2010.06632)
Uddipan Banik and Frank C. van den Bosch
Monthly Notices of the Royal Astronomical Society, Volume 502, Issue 1, March 2021, Pages 1441–1455
- **“Constraining the mass density of free-floating black holes using razor-thin lensing arcs”**
(arXiv:1811.00637)
Uddipan Banik, Frank C. van den Bosch, Michael Tremmel, Anupreeta More, Giulia Despali, Surhud More, Simona Vegetti and John P McKean
Monthly Notices of the Royal Astronomical Society, Volume 483, Issue 2, February 2019, Pages 1558–1573
- **“Self-gravitating fluid systems and galactic dark matter”**
(arXiv:1606.07875)
Uddipan Banik, Dipanjan Dey, Kaushik Bhattacharya and Tapobrata Sarkar
General Relativity and Gravitation 49, Article number: 116 (2017)

Under review

- **“A Comprehensive Perturbative Formalism for Phase Mixing in Perturbed Disks. II. Phase Spirals in an Inhomogeneous Disk Galaxy with a Non-responsive Dark Matter Halo”**
Uddipan Banik, Frank C. van den Bosch and Martin D. Weinberg
Submitted to *The Astrophysical Journal*

Co-authored refereed publications

- **“Exact results in Floquet coin toss for driven integrable models”**
(arXiv:1705.03662)
Utso Bhattacharya, Somnath Maity, **Uddipan Banik** and Amit Dutta
Physical Review B 97, 184308, May 2018

Publications in preparation

- **“Dynamical Friction, Buoyancy and Core-Stalling. II. Bifurcation of Lagrange Points”**
Uddipan Banik and Frank C. van den Bosch

Published codes

- **“NP-impulse”**: Publicly available code to non-perturbatively compute the energy transfer and mass loss in impulsive encounters of self-gravitating systems

CONFERENCES, SEMINARS AND WORKSHOPS

Conferences, seminars & meetings

Invited Talks

“Pushing the frontiers of gravitational encounters and collisionless dynamics”

- [Cosmology Seminar, Perimeter Institute for Theoretical Physics](#), Waterloo, Ontario, Canada
November 22, 2022
- [Cosmology Seminar, Kavli Institute for Particle Astrophysics and Cosmology \(KIPAC\), Stanford University](#), Stanford, California, USA
October 31, 2022
- [Special Cosmolunch, Hebrew University of Jerusalem](#), Jerusalem, Israel
October 27, 2022
- [Galaxy Evolution Seminar, Department of Physics, University of Oxford](#), Oxford, UK
October 13, 2022
- [Theory Lunch Meeting, Institute for Astronomy, The University of Edinburgh](#), Edinburgh, UK
October 12, 2022
- [Astrophysics Seminar, Observatoire astronomique de Strasbourg](#), Strasbourg, France
October 7, 2022
- [Cosmology Seminar, Max Planck Institute for Astrophysics, Garching](#), Germany
October 4, 2022
- [Kavli Galaxy Evolution Seminar, Institute of Astronomy, University of Cambridge](#), Cambridge, UK
September 30, 2022
- [Astrophysics Seminar, Astrophysics Research Group, University of Surrey](#), Guildford, UK
September 29, 2022
- [Astrophysics Seminar, Department of Astronomy and Astrophysics, Columbia University](#), New York City, New York, USA
September 22, 2022
- [Astrophysics Seminar, Institute for Advanced Study](#), Princeton, New Jersey, USA
September 8, 2022
Click here for my talk.

“A Self-consistent, Time-dependent Treatment of Dynamical Friction: New Insights Regarding Core Stalling and Dynamical Buoyancy”

- [Astrophysics Seminar, Observatoire astronomique de Strasbourg](#), Strasbourg, France
June 18, 2021
- Prof. Wyn Evans’s group meeting, [Institute of Astronomy, University of Cambridge](#), Cambridge, UK
April 23, 2021
- [Special Cosmolunch, Hebrew University of Jerusalem](#), Jerusalem, Israel
March 22, 2021

Talks & Posters

“Pushing the frontiers of gravitational encounters and collisionless dynamics”

- [RandoAstro, Canadian Institute for Theoretical Astrophysics \(CITA\), University of Toronto](#), Toronto, Ontario, Canada
December 1, 2022
- [CCA Dynamics Community Meeting, Center for Computational Astrophysics \(CCA\), Flatiron Institute](#), New York City, New York, USA
November 17, 2022
- Dr. Andrew Benson’s group meeting, [Carnegie Observatories](#), Pasadena, California, USA
October 18, 2022
- [Galaxy Coffee, Max Planck Institute for Astronomy, Heidelberg](#), Germany
October 6, 2022
- [SEGAL \(Secular Evolution of GALaxies\) Collaboration Seminar, Institut d’Astrophysique de Paris](#), Paris, France
September 21, 2022

- [Astrophysics Brown Bag Lunch Talk, Kavli Institute for Astrophysics and Space Research, Massachusetts Institute of Technology](#), Cambridge, Massachusetts, USA
September 12, 2022
- [Dissertation Talk: 240th Meeting of the American Astronomical Society](#), Pasadena, California, USA
June 12-16, 2022

“Phase-space spirals as probes of perturbed, out-of-equilibrium disk galaxies”

- [53rd Annual DDA \(Division on Dynamical Astronomy\) Meeting of the American Astronomical Society, Center for Computational Astrophysics, Flatiron Institute](#), New York City, New York, USA
April 25-28, 2022
Click here for my talk.

“Perturbation and phase-mixing in the Milky Way disk: the origin of phase-space spirals”

- [Local Local-Group Group \(L2G2\) Meeting, Center for Computational Astrophysics, Flatiron Institute](#), New York City, New York, USA
November 11, 2021

“A Self-consistent, Time-dependent Treatment of Dynamical Friction: New Insights Regarding Core Stalling and Dynamical Buoyancy”

- [238th Meeting of the American Astronomical Society](#)
June 7-9, 2021

“A fully general, non-perturbative treatment of impulsive heating”

- [237th Meeting of the American Astronomical Society](#)
January 10-15, 2021

“Dynamical friction, core-stalling and merging of Lagrange points”

- [Poster: 2019 Santa Cruz Galaxy Workshop, University of California Santa Cruz](#), Santa Cruz, California, USA
August 5-9, 2019

“Constraining the mass density of free-floating black holes using razor-thin lensing arcs”

- [BLAST \(BLack Holes Across Space & Time\) Workshop, Black Hole Initiative, Harvard University](#), Cambridge, Massachusetts, USA
December 17, 2021
- [Supermassive Black Holes: Environment and Evolution](#) conference, Corfu, Greece
June 19-22, 2019

Workshops & summer schools

- [August 1-7, 2022: N3AS Summer School in Multi-Messenger Astrophysics, University of California Santa Cruz](#), Santa Cruz, California, USA
- [June 28 - August 13, 2021: Applied Galactic Dynamics Summer School, Center for Computational Astrophysics \(CCA\), Flatiron Institute](#), New York City, New York, USA
 - Worked with Prof. Martin D. Weinberg on developing the theory for the perturbative response of disk galaxies and their post-perturbation relaxation/equilibration via phase-mixing (phase-space spirals).
 - Presented my work at the [2021 CCA Big Apple Dynamics School Symposium](#). Click here for my talk.
- [Summer 2016: IUAC Summer Program, Inter-University Accelerator Center \(IUAC\)](#), New Delhi, India
 - Worked on the pulse-shape discrimination and time of flight analysis of neutron and gamma-ray signals from radioactive sources measured with liquid organic scintillation detectors.
- [Summer 2014, Summer 2015: National Initiative on Undergraduate Science \(NIUS\) Program, Homi Bhabha Center for Science Education \(HBCSE\), Tata Institute of Fundamental Research \(TIFR\)](#), Mumbai, India
 - Worked with Dr. Anvesh Mazumdar on the asteroseismology of red giant stars, specifically on constraining the core composition, rotation rates and ages of red giant stars observed by the Kepler space telescope using mixed mode oscillations.

TEACHING, MENTORING & OUTREACH

- **2017-20:** Acted as **Teaching Fellow** in the courses, **ASTR130 (Origin & Search For Life In The Universe)** taught in Fall 2017 and Fall 2018 and **ASTR170 (Introduction to Cosmology)** taught in Spring 2018 and Spring 2020 at **Yale University**.
 - Took tutorial sessions and did one-on-one mentoring of undergraduate students.
 - Prepared assignment questions and graded assignments and examinations.
- **2022:** **Mentored Astronomy undergraduate students** as part of the **Astro Sibbs Undergraduate Mentorship Program** at the **Department of Astronomy, Yale University**.
- **2017:** Acted as an **Academic Resource Person** in the **Orientation cum Selection Camp** at the **Homi Bhabha Center for Science Education (HBCSE), Tata Institute of Fundamental Research (TIFR)**, Mumbai, India for the **48th International Physics Olympiad**.
 - Designed practice and examination questions.
 - Did one-on-one mentoring of high school students.
- **2014-15:** Acted as **Academic Mentor** at the **Counselling Service, Indian Institute of Technology (IIT) Kanpur**, Kanpur, India.
 - Took tutorial and remedial sessions for undergraduate level Physics courses like PHY102 (Introductory Classical Mechanics), PHY103 (Classical Electrodynamics), PSO201 (Quantum Physics), etc.
- **2014-15:** Taught Physics and Mathematics to high school students from marginalized backgrounds in and around the campus of IIT Kanpur as part of **voluntary service** at **Prayas** ('Initiative'), an endeavour of the **Presidential Council, Students' Gymkhana, IIT Kanpur**.

TECHNICAL SKILLS

- **Computer programming:** Proficient in PYTHON, C and C++. Working knowledge of MATHEMATICA, MATLAB, Bash shell script, AWK. Acquainted with HTML.
- **Software:** Proficient in Git, developing codes with documentation.

MAJOR POSITIONS OF RESPONSIBILITY

Academic Service

- Reviewer for Monthly Notices of the Royal Astronomical Society since Feb 2022

Organizational

- Acted as Board-member and Cultural Secretary of SAGA, the South Asian Graduate and Professional Association at Yale University from 2018 till 2021. The organization is dedicated to propagating awareness about South Asian culture and socio-political issues through lectures, panel discussions and other interactive social events.
- Acted as house captain in high school from 2009 till 2011.

AWARDS, FELLOWSHIPS AND SPECIAL ACHIEVEMENTS

- Awarded the *Tinsley award* for the best graduate student paper in the Department of Astronomy at Yale University for the year 2021 (announced on December 8, 2022).
- Awarded the *General Proficiency Medal* for the best academic performance and securing Department Rank 1 among all graduating students of 2017 batch in the Department of Physics, Indian Institute of Technology (IIT) Kanpur.
- Awarded the *Academic Excellence Awards* for outstanding academic performance in BS Physics in the years 2014-15 and 2015-16 at IIT Kanpur.
- Awarded the *Innovation in Science Pursuit for Inspired Research (INSPIRE) Fellowship* by the Department of Science and Technology, Government of India over all 4 years of the BS Program in Physics at IIT Kanpur for outstanding performance in 12th standard and JEE Advanced (engineering entrance examination for the Indian Institutes of Technology) examinations.
- Acted as a member of the Academic Team at the 10th International Olympiad on Astronomy and Astrophysics, Bhuvaneshwar, India, 2016.
- Acted as a member of the Academic Team at the 46th International Physics Olympiad, Mumbai, India, 2015.

EXTRACURRICULAR ACTIVITIES

- Proficient in Hindustani Classical Music (North Indian). Performed onstage at classical music concerts. Performed onstage at musical events such as Musical Extravaganza, Galaxy college festival and Antaragni inter-college festival as member of the Music Club, IIT Kanpur.
- Proficient in chess. Participated in chess tournaments.
- Written essays on philosophy and social issues.
- Performed military drills as part of the National Cadet Corps (NCC), the youth wing of the Indian Armed Forces, at IIT Kanpur.

PEOPLE FAMILIAR WITH RESEARCH

Recommendation letter writers

- **Frank C. van den Bosch**
Department of Astronomy, Yale University, PO. Box 208101, New Haven, CT 06520, USA
Email: frank.vandenbosch@yale.edu
- **Martin D. Weinberg**
Department of Astronomy, University of Massachusetts at Amherst, 710 N. Pleasant St., Amherst, MA 01003, USA
Email: mdw@umass.edu
- **Kathryn V. Johnston**
Department of Astronomy and Astrophysics, Columbia University, New York, NY 10027, USA
Email: kvj@astro.columbia.edu
- **Elena D'Onghia**
Department of Astronomy, University of Wisconsin-Madison, 475 North Charter Street, Madison, WI 53706, USA
Email: edonghia@astro.wisc.edu