

PUBLICATIONS

Submitted manuscripts

- **“Non-linear dynamo waves in magnetized shear flows: a candidate mechanism for the solar cycle”** (arXiv:2609.30367)
Uddipan Banik
Submitted to *Physical Review E*
- **“A Boltzmann–Poisson theory for violent relaxation in cold dark matter: origin of prompt cusps and NFW halos”**
Uddipan Banik, Scott Tremaine, Frank C. van den Bosch, Sachiet Kapur and Kaushik Bhattacharya
Submitted to *Physical Review D*
- **“Wave interference as the origin of the cyclic magnetorotational dynamo in accretion disks: insights from weakly nonlinear theory and local shearing box simulations”** (arXiv:2605.02996)
Uddipan Banik, Amitava Bhattacharjee and James M. Stone
Submitted to *Physical Review Research*
- **“Non-thermal particle acceleration in multi-species kinetic plasmas: universal power-law distribution functions and temperature inversion in the solar corona”** (arXiv:2601.03344)
Uddipan Banik and Amitava Bhattacharjee
Submitted to *Physics of Plasmas* (special topic: invited papers from the 67th annual meeting of APS-DPP)
- **“Universal power-law distribution functions in an electromagnetic kinetic plasma: implications for the inverted temperature profile in the solar corona”** (arXiv:2508.08361)
Uddipan Banik and Amitava Bhattacharjee
Submitted to *The Astrophysical Journal Letters*

First author refereed publications

- **“Collisionless relaxation to equilibrium distributions in cold dark matter halos: Origin of the Navarro-Frenk-White profile”** (arXiv:2506.02104)
Uddipan Banik and Amitava Bhattacharjee
Physical Review D, 112, 123009, December 3, 2025
- **“Universal non-thermal power-law distribution functions from the self-consistent evolution of collisionless electrostatic plasmas”** (arXiv:2408.07127)
Uddipan Banik, Amitava Bhattacharjee and Wrick Sengupta
The Astrophysical Journal, Volume 977, Number 1, 91, December 5, 2024
Featured in the *Institute Letter*, Spring 2025
- **“Relaxation of weakly collisional plasma: Continuous spectra, discrete eigenmodes, and the decay of echoes”** (arXiv:2402.07992)
Uddipan Banik and Amitava Bhattacharjee
Physical Review E, 110, 045204, October 17, 2024
- **“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”** (arXiv:2303.00034)
Uddipan Banik, Frank C. van den Bosch and Martin D. Weinberg
The Astrophysical Journal, Volume 952, Number 1, 65, July 18, 2023
- **“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)

Co-authored refereed publications

- **“Not all cores are equal: Phase-space origins of dynamical friction, stalling and buoyancy”** ([arXiv:2511.11804](#))
Shashank Dattathri, Frank C. van den Bosch, Uddipan Banik, Martin Weinberg, Priyamvada Natarajan, Zhaozhou Li and Avishai Dekel
The Open Journal of Astrophysics, Volume 9, September 7, 2026
- **“The Dipole Instability in Gravitational N-body Systems: A Natural Explanation for Lopsidedness and Off-Centered Nuclei in Galaxies”** ([arXiv:2505.23905](#))
Shashank Dattathri, Frank C. van den Bosch, Martin D. Weinberg, Uddipan Banik
The Astrophysical Journal, Volume 993, Number 1, 150, Oct 30, 2025
- **“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

Codes

- **“VENUS”**: Vlasov-Einstein NUMerical Solver code in C++ (OpenMP & MPI parallelized, GPU-accelerated), equipped with Einstein-Vlasov, Einstein-Boltzmann, Vlasov-Poisson and Boltzmann-Poisson (CDM and SIDM) modules, for the numerical simulation of non-linear structure formation (virialized halos and black holes) in weakly collisional self-gravitating systems.
- **“Stellar dynamo solvers for AthenaK and Athena++”**: Developed an anelastic MHD solver in AthenaK and Athena++ for stratified, shearing simulations and used it to simulate a solar dynamo with sustained magnetic polarity reversals and meridional circulation resembling solar observations. Developing a fully compressible low-Mach MHD solver in AthenaK for stratified magnetoconvection.
- **“QKIN”**: Quantum KINetic Solver code in C++ (OpenMP & MPI parallelized) for evolving many-body quantum states, with the aim to investigate the relaxation of weakly coupled bosonic and fermionic systems (e.g., degenerate fermions in compact objects, dilute plasmas) towards thermal and non-thermal steady states.
- **“NP-impulse”**: Publicly available code in Python to compute the (non-perturbative) energy transfer and mass loss in impulsive encounters of galaxies and dark matter halos

Publications in preparation

- **“Self-similar profiles in Einstein-Vlasov systems: from virialized halos to black holes”**
Uddipan Banik, Scott Tremaine, Frank C. van den Bosch, Sachiet Kapur and Kaushik Bhattacharya
- **“Numerical solution to the Einstein-Vlasov system in spherically symmetric gravitational collapse”**
Uddipan Banik, Sachiet Kapur, Kaushik Bhattacharya, Frank C. van den Bosch and Scott Tremaine
- **“Numerical solution to the Einstein-Boltzmann problem: core-collapse and black hole formation in self-interacting dark matter”**
Uddipan Banik, Frank C. van den Bosch, Chris Hamilton, Abdelaziz Hussein, Lina Necib, Scott Tremaine, Sachiet Kapur and Kaushik Bhattacharya
- **“A self-consistent quasilinear theory for non-thermal particle acceleration in magnetized plasmas”**
Uddipan Banik, Robert J. Ewart, Alexander A. Schekochihin and Amitava Bhattacharjee
- **“How fast do supermassive black hole binaries form in galaxy mergers?”**
Kavish Sardana, Uddipan Banik, Shashank Dattathri and Frank C. van den Bosch
- **“Dynamical Friction, Buoyancy and Core-Stalling. II. Inspiral vs libration”**
Kavish Sardana, Uddipan Banik, Shashank Dattathri and Frank C. van den Bosch
- **“Self-gravitating response of galactic disks and the Gaia snail”**
Chris Hamilton, Uddipan Banik and Shaunak Modak