

VADIM SEMENOV

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EDUCATION

The University of Chicago Ph.D. in Astronomy and Astrophysics	2019
Moscow Institute of Physics and Technology B.S. & M.S. in Applied Mathematics and Physics <i>with honors</i>	2013

RESEARCH INTERESTS & EXPERIENCE

STEM Fellow Anthropic	since 07/2026
NASA Hubble and ITC postdoctoral fellow Harvard University <i>ML/AI-aided subgrid models for supersonic turbulence simulations; large-scale cosmological simulations; physics of interstellar medium; early Universe; formation of galactic disks; numerical methods.</i>	since 2019
Research assistant The University of Chicago advisor: A. Kravtsov <i>Galaxy formation simulations; star formation and stellar feedback; cosmic rays; numerical methods</i>	2014 – 2019
Research assistant Lebedev Physical Institute advisor: A. Doroshkevich <i>N-body simulations; large-scale structure of the Universe; properties of dark matter halos</i>	2010 – 2013

PUBLICATIONS

35 papers in total; 14 first-author; 9 led by co-advised students. See the publication list below.
h-index: 20; total citations: >1200 (according to ADS, April 2026)
Links to [ADS library](#), [Google Scholar](#), and [ORCID: 0000-0002-6648-7136](#)

HONORS & AWARDS

Institute for Theory and Computation (ITC) Fellowship Harvard	2022 – 2026
NASA Hubble Fellowship Harvard	2019 – 2022
Schramm Fellowship UChicago	2018 – 2019
Graduate Council Travel Fund Award UChicago	2018
RCC Mind Bytes Award for Visualization in Research RCC, UChicago	2015
McCormick Fellowship UChicago	2013 – 2015
Vitaly Ginzburg Memorial Fellowship Lebedev Physical Institute	2013
Dynasty Foundation Fellowship	2012
Abramov–Frolov Foundation Fellowship MIPT	2008 – 2011

SELECTED TALKS

Invited colloquia and seminars	
Astronomy Colloquium UMass Amherst	04/2026
Astronomy Colloquium UC Berkeley	02/2026
Origins Astronomy Seminar MPA, Garching	07/2025
Astronomy Colloquium University of Hawai'i	02/2025

Astronomy Colloquium Johns Hopkins University	02/2025
Astronomy Colloquium Harvard	01/2025
Astronomy Seminar Tufts University, Boston	11/2024
CITA Seminar CITA, Toronto	09/2023
Astronomy Colloquium University of Michigan	11/2022
ISM Salon CCA Flatiron Institute, NY	10/2022
Ringberg Seminar Series on Star Formation (virtual)	02/2021
Astronomy Colloquium University of Maryland	02/2020
Cosmology Seminar MPA, Garching	01/2019
CCAPP Seminar OSU	11/2018
Galaxies & Cosmology Seminar Harvard	10/2018
TAC Seminar UC Berkeley	09/2018
Lunch Seminar UW Madison	09/2018
Astro Seminar Fermilab	09/2017

Conference Talks * – invited review † – invited talk

†Revisiting the Hubble Sequence Across Cosmic Time Cambridge, UK	04/2026
†Cosmic Turbulence and Magnetic Fields Cargese, France	11/19; 09/23; 09/25
*12 th Sino–German Meeting on Galaxy Formation Chengdu, China	09/2025
*The role of feedback in galaxy formation Potsdam, Germany	07/2025
Deciphering the cosmic code for galaxy formation Puerto Varas, Chile	12/2024
†Celebrating 10 Years of the Illustris Project Gargonza, Italy	10/2024
†Ringberg Workshop on Computational Galaxy Formation	05/16; 03/18; 04/22; 10/24
†Connecting Simulations and Observations in 3D Barossa Valley, Australia	06/2024
*The Feedback-Driven Matter Cycle in Galaxies Heidelberg, Germany	06/2024
GasPisa2024 Pisa, Italy	05/2024
Building Galaxies from Scratch Vienna, Austria	02/2024
Resolving Galaxy Ecosystems Across All Scales Hong Kong, China	12/2023
*The Physics of Star Formation Lyon, France	06/2023
Olympian Symposium – Star formation in the era of JWST Katerini, Greece	06/2023
Star Formation in Different Environments Quy Nhon, Vietnam	08/2022
†A Holistic View of Stellar Feedback and Galaxy Evolution Ascona, Switzerland	07/2022
Midwest Magnetic Fields Meeting UW Madison (virtual)	06/2021
ISM 2021: Structure, characteristic scales, and star formation Beirut (virtual)	05/2021
Universality: Turbulence Across Vast Scales Flatiron Institute, NY	12/2019
Harvard-Heidelberg Star Formation workshop	11/19; 12/22
10-th anniversary of KICC symposium Cambridge, UK	09/2019
The Role of Feedback in Galaxy Formation Potsdam, Germany	09/2018
Santa Cruz Galaxy Workshop UC Santa Cruz	08/15; 08/16; 08/17; 08/18; 07/24; 08/25
The Role of Gas in Galaxy Dynamics Valletta, Malta	10/2017
Carving through the Codes Davos, Switzerland	02/2017

SUCCESSFUL PROPOSALS

PI, computing time on NASA HECC systems ~1.4M CPU hours	2021 – 2022
<i>Modeling The Turbulent Evolution Of Galaxies Over Cosmic Time</i>	
Co-I, HST Cycle 33, 26 orbits (PI Ava Polzin)	2025
<i>PANCHO: Piloting a Novel Calibration for H2 Observations</i>	

Co-I, ALMA 12m array ~40 hours (PI Eric Koch) 2023
Linking Molecular Cloud Structure to Massive Star Formation: 5000 molecular clouds, filaments, and bubbles across M33

Co-I, VLT MUSE ~20 hours (PI Anna McLeod) 2023
Resolving the environmental dependence of stellar feedback and massive star formation

CO-ADVISING STUDENTS

Sabrina Appel, former PhD student at Rutgers University (now NSF Fellow at AMNH)
Regulation of star formation in MHD simulations of ISM turbulence

Vedant Chandra, PhD student at Harvard
Formation of galactic disks in the TNG50 cosmological simulation

Jiwon Jesse Han, former PhD student at Harvard (now Stanford Science Fellow)
Connection between galactic disk warps and dark matter halos in TNG50

Ralf Konietzka, PhD student at Harvard
Modeling the dispersion measure of Fast Radio Bursts in cosmological simulations

Ava Polzin, PhD student at the University of Chicago
Modeling of molecular hydrogen in galaxy formation simulations

Mark Ugalino, PhD student at the University of Maryland
Comparing methods for modeling magnetic fields in galaxy simulations

Zuzanna Kocjan, PhD student at the University of Maryland
Tracing timescales of the star formation and feedback cycle in galaxy simulations

Rongrong Liu, PhD student at Harvard
Formation of galactic disks in galaxy simulations

Jasmine Palma, Undergraduate student at Harvard
Turbulent properties of intracluster media (senior thesis)

Zion Smith, Undergraduate at North Carolina Agricultural and Technical State University
Modeling the timescales of r-process enrichment (summer internship)

TEACHING EXPERIENCE

Teaching assistant <i>Computational Astrophysics</i> (grad course) UChicago	2016
Teaching assistant <i>Stellar Astronomy and Astrophysics</i> (undergrad course) UChicago	2013
Developed and taught <i>Introduction to Cosmology</i> (undergrad elective) MIPT	2011 – 2012
Taught highschool-level courses and classes Moscow	2007 – 2012

TECHNICAL SKILLS

Programming	C, C++, Python; MPI, OpenMP; git
Scientific computing	High-performance computing on NASA HECC and other clusters; large-scale cosmological galaxy simulations; numerical methods for astrophysics and hydrodynamics
ML/AI development	PyTorch training of custom NN architectures; C++/GPU integration for ML-aided numerical methods; custom skills and harnesses for agentic research workflows

LEADERSHIP & SERVICE

Committees	CfA Seminar organizing committee	2021 – 2024
	ITC Postdoctoral Fellowship Selection Committee	2023 – 2024
	CGM workshop “Multiphase Madness”, CfA	2024
	ITC Colloquium co-organizer	since 2024
Peer reviews	Journals: Nature, ApJ, MNRAS, A&A, LRCA	
	Expert reviewer for NASA FINESST Fellowship	2020 – 2021
	Expert reviewer for NASA HST cycles 32 and 33	2024 – 2025
	Expert reviewer for BSF grants	2023 – 2025

APPEARANCES IN MEDIA

Scientific American	April 2025
“JWST Spots Giant Spiral Galaxy Shockingly Early in Cosmic History”	
Forbes	June 2023
“Our Milky Way Is Somewhat Of An Oddball Galaxy, New Study Confirms”	

REFERENCES

Andrey Kravtsov (PhD advisor)	UChicago kravtsov@uchicago.edu
Charlie Conroy	Harvard cconroy@cfa.harvard.edu
Lars Hernquist	Harvard lhernquist@cfa.harvard.edu
Nick Gnedin	Fermilab gnedin@fnal.gov
Romain Teyssier	Princeton teyssier@princeton.edu

PUBLICATION LIST

h-index: 20; total citations: >1200 (according to ADS, April 2026)

First author (14 total; [ADS link](#))

1. **Semenov** | [ApJ accepted](#) | [arXiv:2602.04950](#) 2026
How Do Disk Galaxies Form?
2. **Semenov**, Conroy, Hernquist | [ApJ 989, 219](#) | [arXiv:2410.09205](#) 2025
From UV-bright Galaxies to Early Disks: the Importance of Turbulent Star Formation in the Early Universe
3. **Semenov**, Conroy, Smith, Puchwein, Hernquist | [ApJ 990, 7](#) | [arXiv:2409.18173](#) 2025
How Early Could the Milky Way’s Disk Form?
4. **Semenov** | [ApJS 281, 37](#) | [arXiv:2410.23339](#) 2025
Capturing Turbulence with Numerical Dissipation: a Simple Dynamical Model for Unresolved Turbulence in Hydrodynamic Simulations
5. **Semenov**, Conroy, Chandra, Hernquist, Nelson | [ApJ 962, 84](#) | [arXiv:2306.09398](#) 2024
Formation of Galactic Disks I: Why did the Milky Way’s Disk Form Unusually Early?
6. **Semenov**, Conroy, Chandra, Hernquist, Nelson | [ApJ 972, 73](#) | [arXiv:2306.13125](#) 2024
Formation of Galactic Disks II: the Physical Drivers of Disk Spin-up
7. **Semenov**, Kravtsov, Diemer | [ApJS 261, 16](#) | [arXiv:2107.14240](#) 2022
Entropy-Conserving Scheme for Modeling Nonthermal Energies in Fluid Dynamics Simulations

8. **Semenov**, Kravtsov, Gnedin | [ApJ 918, 13](#) | [arXiv:2103.13406](#) 2021
Spatial Decorrelation of Young Stars and Dense Gas as a Probe of the Star Formation–Feedback Cycle in Galaxies
9. **Semenov**, Kravtsov, Caprioli | [ApJ 910, 126](#) | [arXiv:2012.01427](#) 2021
Cosmic Ray Diffusion Suppression in Star-Forming Region Inhibits Clump Formation in Gas-Rich Galaxies
10. **Semenov**, Kravtsov, Gnedin | [ApJ 870, 79](#) | [arXiv:1809.07328](#) 2019
What Sets the Slope of the Molecular Kennicutt–Schmidt Relation?
11. **Semenov**, Kravtsov, Gnedin | [ApJ 861, 4](#) | [arXiv:1803.00007](#) 2018
How Galaxies Form Stars: the Connection between Local and Global Star Formation in Galaxy Simulations
12. **Semenov**, Kravtsov, Gnedin | [ApJ 845, 133](#) | [arXiv:1704.04239](#) 2017
The Physical Origin of Long Gas Depletion Times in Galaxies
13. **Semenov**, Kravtsov, Gnedin | [ApJ 826, 200](#) | [arXiv:1512.03101](#) 2016
Nonuniversal Star Formation Efficiency in Turbulent ISM
14. **Semenov** | [Astronomy Reports 57, 485](#) 2013
Statistical Analysis of the Large-Scale Structure of the Universe Using Observational Data and Numerical Modeling

Led by co-advised students (9 total; [ADS link](#))

15. Kocjan, Diemer, **Semenov**, Bialy, Malamud | [ApJ subm.](#) | [arXiv:2608.28747](#) 2026
Shock-heated Away: The Impact of Radiative Cooling on Gas-Phase Transitions in Supernova Remnants
16. Kocjan, **Semenov** | [ApJ 1007, 46](#) | [arXiv:2602.02657](#) 2026
The Rhythm of the ISM: Tracing the Timescales of Gas Evolution and Star Formation across Galactic Environments
17. Konietzka, Connor, **Semenov**, et al. | [ApJ accepted](#) | [arXiv:2507.07090](#) 2025
Ray-tracing Fast Radio Bursts Through IllustrisTNG: Cosmological Dispersion Measures from Redshift 0 to 5.5
18. Polzin, Kravtsov, **Semenov**, Gnedin | [OJAp 7, 114](#) | [arXiv:2407.11125](#) 2024
On the universality of star formation efficiency in galaxies
19. Chandra, **Semenov**, Rix, Conroy, et al. | [ApJ 972, 112](#) | [arXiv:2310.13050](#) 2024
The Three-Phase Evolution of the Milky Way
20. Polzin, Kravtsov, **Semenov**, Gnedin | [ApJ 966, 172](#) | [arXiv:2310.10712](#) 2024
Modeling Molecular Hydrogen in Low Metallicity Galaxies
21. Han, **Semenov**, Conroy, Hernquist | [ApJL 957, L24](#) | [arXiv:2309.07208](#) 2023
Tilted Dark Halos are Common, Long-Lived, and Can Warp Galactic Disks
22. Appel, Burkhart, **Semenov**, Federrath, Rosen, Tan | [ApJ 954, 93](#) | [arXiv:2301.07723](#) 2023
What Sets the Star Formation Rate of Molecular Clouds? The Density Distribution as a Fingerprint of Compression and Expansion Rates
23. Appel, Burkhart, **Semenov**, Federrath, Rosen | [ApJ 927, 75](#) | [arXiv:2109.13271](#) 2022
The Effects of Magnetic Fields and Outflow Feedback on the Shape and Evolution of the Density PDF in Turbulent Star-Forming Clouds

In collaboration (12 total)

24. Wheeler, Kravtsov, Chiti, Katz, **Semenov** | [OJAp 8, 151](#) | [arXiv:2507.03182](#) 2025
What Sets the Metallicity of Ultra-Faint Dwarfs?
25. Segovia Otero et al. | [MNRAS 538, 2646](#) | [arXiv:2410.08266](#) 2025
Cosmic evolution of the star formation efficiency in Milky Way-like galaxies
26. Robinson, Avestruz, Gnedin, **Semenov** | [OJAp subm.](#) | [arXiv:2412.15324](#) 2024
The effects of different cooling and heating function models on a simulated analog of NGC300
27. Beane, Johnson, **Semenov**, et al. | [ApJ 985, 221](#) | [arXiv:2410.21580](#) 2024
Rising from the Ashes II: The Bar-driven Abundance Bimodality of the Milky Way
28. Aung et al. | [MNRAS 532, 2965](#) | [arXiv:2403.00912](#) 2024
Entrainment of Hot Gas into Cold Streams: The Origin of Excessive Star-formation Rates at Cosmic Noon
29. Jeffreson, **Semenov**, Krumholz | [MNRAS 527, 7093](#) | [arXiv:2301.10251](#) 2024
Clouds of Theseus: long-lived molecular clouds are composed of short-lived H₂ molecules
30. Kiihne, Appel, Burkhart, **Semenov**, Federrath | [ApJ 979, 89](#) | [arXiv:2305.11218](#) 2023
Fitting Probability Distribution Functions in Turbulent Star-Forming Molecular Clouds
31. Shin, Tacchella, Kim, Iyer, **Semenov** | [ApJ 947, 61](#) | [arXiv:2211.01922](#) 2023
Star Formation Variability as a Probe for the Baryon Cycle within Galaxies
32. Bialy, Zucker, Goodman, Foley, Alves, **Semenov**, Benjamin, Leike, Enßlin
[ApJL 919 L5](#) | [arXiv:2109.09763](#) 2021
The Per-Tau Shell: A Giant Star-forming Spherical Shell Revealed by 3D Dust Observations
33. Gnedin, **Semenov**, Kravtsov | [JCoPh 359, 93](#) | [arXiv:1801.03108](#) 2018
Enforcing the Courant–Friedrichs–Lewy Condition in Explicitly Conservative Local Time Stepping Schemes
34. Li, Gnedin, Gnedin, Meng, **Semenov**, Kravtsov | [ApJ 834, 69](#) | [arXiv:1608.03244](#) 2017
Star Cluster Formation in Cosmological Simulations. I. Properties of Young Clusters
35. Kim et al. (AGORA Collaboration) | [ApJ 833, 202](#) | [arXiv:1610.03066](#) 2016
The AGORA High-resolution Galaxy Simulations Comparison Project. II. Isolated Disk Test