Elena Kopteva

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Appointments

Visiting Research Scientist (Teaching & Research Faculty) — Sep 2022-present
University of Illinois Urbana-Champaign (UIUC), Grainger College of Engineering, Department of Physics; Urbana-Champaign, IL, USA

Visiting Professor — Aug 2019-Aug 2022
Institute of Physics and Research Centre of Theoretical Physics and Astrophysics, Faculty of Philosophy and Science in Opava, Silesian University in Opava, Czech Republic
Series of 3-5 month visits each year and remote collaboration

Assistant Professor — Nov 2016-Aug 2017
Scientific Research Center of Theoretical Physics and Astrophysics, Faculty of Philosophy and Science, Silesian University in Opava, Czech Republic

Visiting Professor — May 2015-Jun 2016
Bogolyubov Laboratory of Theoretical Physics, Joint Institute for Nuclear Research, Dubna, Russia

Associate Professor — Dec 2006-Jul 2015
Theoretical Physics Department, Dnipropetrovsk National University (DNU), Dnipro, Ukraine

Teaching Assistant — Dec 2003-Dec 2006
Physics Department, National Mining University, Dnipro, Ukraine

Patent Expert — Sep 2001-Dec 2003
Center of Technology Commercialization, Dnipro, Ukraine

Education

PhD in Theoretical Physics — May 2006
Theoretical Physics Department, DNU, Dnipro, Ukraine
Thesis: Cosmological and astrophysical models with cosmological constant
Supervisor: Prof. Maria Korkina

Graduate Student — Nov 2000-May 2006
Theoretical Physics Department, DNU, Dnipro, Ukraine

Undergraduate Student — Sep 1995-Jul 2000
Diploma (BSc+MSc equivalent), with honors
Theoretical Physics Department, DNU, Dnipro, Ukraine

Research Focus

- Exact solutions of Einstein's equations
- Black holes in evolving backgrounds and media
- Black hole perturbations, quasinormal modes, superradiance
- Cosmological inhomogeneity and acceleration
- Analytic reference solutions for simulations and data analysis

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Grants and Fellowships

NSF PHY 2409726: Black Hole Probes of Beyond-Standard Model Particles and Fields; Start: 15 Aug 2024; Amount: $240,000; Role: Co-PI

Visiting fellowship: Physical Sciences, Silesian University in Opava, Czech Republic; 2016-2017

NAS of Ukraine: Program "Cosmomicrophysics"; 2007-2013; Role: Member

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Selected Publications

A. Stupka, **E. Kopteva**, M. Saliuk, *I. Bormotova* (2023). Virial theorem for a cloud of stars obtained from the Jeans equations with second correlation moments. *Eur. Phys. J. C* **83**(7), 598. arXiv:2208.07695.

E. Kopteva, *I. Bormotova*, M. Churilova, Z. Stuchlik (2019). Accelerated Expansion of the Universe in the Model with Non-Uniform Pressure. *Astrophys. J.* **887**, 98. arXiv:2001.07382.

E. Kopteva, P. Jaluvkova, *I. Bormotova*, Z. Stuchlik (2018). Exact Solution for a Black Hole Embedded in a Nonstatic Dust-filled Universe. *Astrophys. J.* **866**, 98. arXiv:1810.08613.

M. Korkina, **E. Kopteva** (2012). The generalization of the Tolman-Bondi solution *Astronomical School's Report* **8**, 31-33.

M. Korkina, **E. Kopteva**, W. Kazemir (2008). T-Models and Kantowski-Sachs Models. *Ukrainian Physics Journal* **53**(2), 107-111.

Selected Invited Talks

Jeans equations with account of gravitational field correlations; Institute of Physics Seminar, Silesian University in Opava, Czech Republic (2022)

Luminosity distance within inhomogeneous cosmological models; Institute of Physics Seminar, Silesian University in Opava, Czech Republic (2021)

Quasi-classical neutral particle in extremely charged black hole field; Summer School in Cosmology, ICTP, Trieste, Italy (2010)

Teaching

PHYS 225 (UIUC): Course director, main lecturer. Terms and enrollment: Fall 2023 (119); Fall 2024 (140); Spring 2025 (200, in person + online); Fall 2025 (140)

PHYS 212 (UIUC): Course instructor, second lecturer. Term and enrollment: Spring 2024 (150)

PHYS 211 (UIUC): Discussion coordinator (25 TAs); Discussion TA. Term: Spring 2023

PHYS 497 (UIUC): Individual Study (Undergraduate). Ongoing

DNU courses: General Physics; Gravitation and Cosmology; Nonlinear Dynamics; Fundamentals of Physics and CS; Physical Principles of IT and CS; Nuclear and Atomic Physics Lab

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Supervision

PhD

D. Garzon (UIUC) - Superradiance in cosmological spacetimes, 2023-present (co-supervisor)
I. Bormotova (Silesian University in Opava) - Inhomogeneous spherically symmetric solutions of Einstein's equations and their implications for cosmology and astrophysics, 2017-present (supervisor)
P. Jaluvkova (Silesian University in Opava) - Black holes in cosmological backgrounds, 2015-2018 (supervisor)

Undergrad

Z. Zeng (UIUC) - Conformally flat metric for a generalized Schwarzschild-like solution (PHYS 497 Spring 2025; Undergraduate research Summer-Fall 2025) (supervisor). *Award: Ralph O. Simmons Undergraduate Research Scholarship (Spring 2025)*
Yi Zhang (UIUC) - Horizon structure of a charged black hole with domain walls; QNMs for charged-scalar scattering (PHYS 497 Spring 2024; Summer-Fall 2024) (supervisor). *Outcome: admitted to UIUC Physics graduate program (Spring 2025)*
S. Gupta (UIUC) - Shadows of cosmological black holes I-II (Summer 2023; Summer 2024) (supervisor). *Award: Lorella M. Jones Summer Research Award (Summer 2023)*
DNU - Supervisor of three diploma theses in cosmology, 2012-2014

HS/Outreach

WYSE Young Scholars - Simulations of black hole collisions on supercomputers (two cohorts; four students), Summer 2024-2025 (mentor)

Service

Co-organizer of Astrophysics, Gravitation, and Cosmology Seminar, Department of Physics, UIUC (2024-2026)

Co-organizer and chair of Interdisciplinary Seminar for Natural Sciences, DNU, Dnipro, Ukraine (2006-2008)

Co-organizer of Seminar on Theoretical Physics, National Mining University, Dnipro, Ukraine (2003-2006)

Affiliations and Memberships

- Witek Gravity Group
- Illinois Center for Advanced Studies of the Universe (ICASU), UIUC
- LISA Consortium, Associate Member (2023-present)
- American Physical Society (APS), DGRAV Division (2024-present)

Outreach and Broader Impact

- Member, Scholars at Risk (SAR) network (2023-present)
- Mentor, WYSE Young Scholars Research Program (Summer 2024; Summer 2025)
- Series of invited lectures on cosmology for PHYS 403, UIUC (2023-2025)
- Public talk for the Society of Physics Students, UIUC: The Human Side of Physics (Spring 2025)
- Invited lecture at OLLI, UIUC: Carrying Two Realities (Spring 2025)
- Community engagement talk for the Illinois Club Cosmopolitan Group: My Family and War (Winter 2024)
- Illinois Global Institute Speaker Series: Family and War (2023)

Computational and Programming

Primary: Mathematica, LaTeX

Working knowledge: Python (read/modify scripts; numerical analysis and visualization)

Additional training: Center for AI Innovation, NCSA-UIUC - *AI Training Seminar Series* (Fall 2025); Topics included AutoEncoders/VAEs, GANs, CycleGANs, and Diffusion Models in PyTorch; Electronic badge awarded

Legacy: Pascal; BASIC; VB.NET

Miscellaneous

Languages: English (fluent); Czech (advanced); Ukrainian (native); Russian (native)

Other skills: U.S. Driver's license; Patents and intellectual property expertise; Visual design and scientific illustration (formal training in painting; portfolio on website); literature and poetry (three published books)

Poetry Books

E. M. Kopteva. *All Ways* (Vse dorogi, in Russian). Moscow, 2016. 408 pp.
E. M. Kopteva. *White Beasts* (Belye zveri, in Russian). Dnipropetrovsk University Press, 2002. 27 pp. ISBN 966-551-100-9.
E. M. Kopteva. *Tales* (in Russian). Miniature Poetry Library "Chetverg", St. Petersburg, 2000. 16 pp.

Publication List

In the publications listed, the order of authors reflects the relative contribution, with the first author being the primary contributor. My supervised students are highlighted in italics.

A. Stupka, **E. Kopteva**, M. Saliuk, *I. Bormotova* (2023). Virial theorem for a cloud of stars obtained from the Jeans equations with second correlation moments. *Eur. Phys. J. C* **83**(7), 598. arXiv:2208.07695.

I. Bormotova, **E. Kopteva**, Z. Stuchlik (2021). Geodesic Structure of the Accelerated Stephani Universe. *Symmetry* **13**(6), 1001. arXiv:2103.08999.

I. Bormotova, **E. Kopteva**, M. Churilova, Z. Stuchlik (2020). Accelerated expansion of the universe from the perspective of inhomogeneous cosmology. *Int. J. Mod. Phys. A*. arXiv:2002.00454.

E. Kopteva, *I. Bormotova*, M. Churilova, Z. Stuchlik (2019). Accelerated Expansion of the Universe in the Model with Non-Uniform Pressure. *Astrophys. J.* **887**, 98. arXiv:2001.07382.

E. Kopteva, *P. Jaluvkova*, *I. Bormotova*, Z. Stuchlik (2018). Exact Solution for a Black Hole Embedded in a Nonstatic Dust-filled Universe. *Astrophys. J.* **866**, 98. arXiv:1810.08613.

P. Jaluvkova, **E. Kopteva**, Z. Stuchlik (2017). The model of the black hole enclosed in dust: the flat space case. *Gen. Rel. Grav.* **49**:80. arXiv:1602.01266.

I. Bormotova, **E. Kopteva** (2016). Geodesic motion of test particles in Korkina-Grigoryev metric. arXiv:1611.07398.

E. Kopteva, *P. Jaluvkova*, Z. Stuchlik (2016). The generalized Lemaitre-Tolman-Bondi solutions with nonzero pressure in modeling the cosmological black holes. arXiv:1611.06182.

I. Bormotova, **E. Kopteva** (2016). Friedmann Cosmological Models with Various Equations of State of Matter. *Ukrainian Journal of Physics.* 61. 843-849. 10.15407/ujpe61.09.0843.

M. Korkina, O. Iegurnov, **E. Kopteva** (2016). Stephani cosmological models with accelerated expansion. *Russ. Phys. J.* **59**(3), 328-334.

M. Korkina, O. Iegurnov, **E. Kopteva** (2015). Inhomogeneous Cosmological Models Based on the Stephani Solution. *Bulletin of Dnipropetrovsk National University, Physics and Radioelectronics* **23**(22).

E. Kopteva, *A. Hradyskyi* (2014). Energy Density and Pressure of the Stephani's Universe with Radiation and Negative Spatial Curvature. *Astronomical School's Report* **10**(1), 62-65.

E. Kopteva, *A. Hradyskyi* (2014). Special case for shiftless cosmological model with radiation under negative space curvature. *Bulletin of Dnipropetrovsk National University, Rocket and Space Technology* **22**(4), issue 18, part 2, 52-57.

M. Korkina, **E. Kopteva**, S. Grigori'ev (2013). Coordinates and reference systems. In: Proceedings of the International conference "Training theory and technique in reading courses of mathematics, physics and informatics" **11**(2).

M. Korkina, **E. Kopteva** (2012). The generalization of the Tolman-Bondi solution *Astronomical School's Report* **8**, 31-33.

M. Korkina, **E. Kopteva** (2012). The mass function method for obtaining exact solutions in General Relativity. *Space, Time and Fundamental Interactions* **1**, 38-47. arXiv:1604.08247.

M. Korkina, **E. Kopteva** (2008). Cosmological model with effective state equation. *Bulletin of Dnipropetrovsk National University, Physics and Radioelectronics*.

M. Korkina, **E. Kopteva**, W. Kazemir (2008). T-Models and Kantowski-Sachs Models. *Ukrainian Physics Journal* **53**(2), 107-111.

M. Korkina, **E. Kopteva**, O. Orlyansky (2005). The Friedmann Models with the Pressure and the Cosmological Constant. *Ukrainian Physics Journal* **50**(1), 11-15.

E. Kopteva (2004). The Homogeneous and Isotropic Universe with Domain Walls. *Bulletin of Dnipropetrovsk National University, Physics and Radioelectronics* **12**, 161-163.

Textbooks, Manuals, Workbooks

M. P. Korkina, E. M. Kopteva (2012) *The Mass Function Method*. Workbook for cosmology. Dnipropetrovsk National University Press.

E. M. Kopteva, Ye. A. Yakunin, A. V. Chernay (2005) *Studying the Magnetoelasticity Effect*. Workbook for general physics course, solid state physics section. National Mining University Press.

E. M. Kopteva, Ye. A. Yakunin, A. V. Chernay, A. V. Podlyatskaya (2005) *Studying the temperature dependence of resistance of the semiconductor and finding its forbidden band*. Workbook for general physics course, solid state physics section. National Mining University Press.