

# Alexander (Sasha) Philippov

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## Professional Experience

Assistant Professor, Department of Physics, University of Maryland, from May 2022.

Associate Research Scientist, Center for Computational Astrophysics, Flatiron Institute, September 2018 - May 2022.

Visiting Research Scholar, Astrophysics Department, Princeton University, from September 2018.

NASA Einstein Postdoctoral Fellow, UC Berkeley, Sep 2017-Aug 2018.

## Education

Ph.D. in Astrophysical Sciences, Princeton University, August 2017.

M.A. in Astrophysical Sciences, Princeton University, 2014.

M.S. in Applied Physics & Mathematics with honors, Moscow Institute of Physics and Technology, 2012.

B.S. in Applied Physics & Mathematics with honors, Moscow Institute of Physics and Technology, 2010.

## Honors and Awards

NASA Einstein and TAC postdoctoral fellowship (5 yr), UC Berkeley, 2017

Pappalardo Postdoctoral Fellowship in Physics (3 yr), MIT, 2017, declined

ITC and Menzel Postdoctoral Fellowship (4yr), Harvard University, 2017, declined

Senior Postdoctoral Fellowship (5 yr), Perimeter Institute, 2017, declined

Porter Ogden Jacobus Fellowship, Princeton University, 2016-2017, "Princeton University's top honor for graduate students in their last year, awarded to one Ph.D. student in each of the four divisions (humanities, social sciences, natural sciences and engineering) whose work has exhibited the highest scholarly excellence."

NASA Earth and Space Science Fellowship 2015, Proposal title "Particle Acceleration and Emission Processes in Pulsar Magnetospheres"

Fellowship of the President of Russia 2012

Dynasty Foundation Fellowship 2012

Lebedev Physical Institute Nobel Prize winner V.L. Ginzburg Fellowship 2011

Abramov-Frolov Foundation Fellowship 2008, Spring – 2009, Fall

## Grants

PI, NASA ATP: First-Principles Simulations of Black Hole magnetospheres. Award: \$452,885 from 01/01/21 – 12/31/24

PI, NSF Collaborative Research: WOU-MMA: Extreme Quantum-Electrodynamic and General-Relativistic Plasma Physics. Award: \$360,000 from 07/14/20 – 07/13/23

co-PI, U.S.-Israel Binational Science Foundation grant: Magnetic dissipation and particle acceleration in the process of kink instability in astrophysical jets. Award: \$140,000 from 09/01/19 – 08/31/23

PI, NSF Collaborative Research: WoU-MMA: Electrodynamics of magnetospheric interaction in merging neutron stars binaries. Award: \$219,000 from 09/01/19 – 08/31/22

PI, NSF Collaborative Research: WoU-MMA. Multi-scale and multi-messenger modeling of jets in active galactic nuclei. Award: \$150,000 from 09/01/19 – 08/31/22

France-Berkeley Fund award (travel grant to fund collaborative meetings): Where general relativity, quantum electrodynamics and plasma physics meet: first-principles models of emission from astrophysical black holes. Award: \$20,000, from 01/12/18 – 31/10/19

## Supercomputer time awards

PI, "Simulations of reconnection-powered flares in magnetospheres of magnetars, binary neutron stars and black holes" (2021), Leadership Research Allocation Program at NSF's Frontera, 40 million CPU hours

PI, "Investigating electromagnetic precursors to neutron star merger gravitational wave events" (2020), Leadership Research Allocation Program at NSF's Frontera, 20 million CPU hours

PI, "Kinetic modeling of non-thermal emission from compact object magnetospheres" (2017-2018), NASA HEC, 4.5 million CPU hours

co-PI, "Emission Processes in Pulsar Magnetospheres" (2016-), NASA HEC, approximately 3.5 million CPU hours per year

co-PI, "Global Simulations of Astrophysical Boundary Layers" (2016-2019), NSF XSEDE, approximately 4 million CPU hours per year

co-PI, "Boundary Layer Physics" (2017-2020), NASA HEC, approximately 6 million CPU hours per year

co-PI, "FROMTON – Particle acceleration in pulsars: FROM the Magnetosphere TO the Nebula" (2018-2019), PRACE, France, 24 million CPU hours

## Teaching and Mentorship

Teacher, Correspondence School of Physics and Mathematics (high school level), Moscow Institute of Physics and Technology, 2006-2009

Teaching assistant, Introduction to Plasma Physics (undergraduate level), Moscow Institute of Physics and Technology, Fall 2011-Spring 2012

Teaching assistant, AST205: Planets in the Universe, Princeton University, Fall 2013

Lecturer, Relativistic Plasma Astrophysics, 13th Summer School of Modern Astrophysics, Moscow, Russia, July 2017

Lecturer, Numerical methods in extreme plasma physics and applications in astrophysics, CCA summer school, NY, July 2019

## Talks at conferences

Invited talk at "Physics of Neutron Stars 2022" international conference, Saint-Petersburg, Russia, July 2022

Invited talk at inaugural conference of the Illinois Center for Advanced Studies of the Universe, Illinois, May 2022

Invited talk at "Workshop on Relativistic Plasma Astrophysics", Purdue University, IN, May 2022

Invited talk at Magnetic Reconnection conference, Monterey, May 2022

Invited talk at Weather and Climate on Neutron Stars Workshop, Princeton, April 2022

Invited talk at NANOGrav collaboration meeting, NYC, March 2022

Invited talk at Feebly Interacting Sectors Impact on Cosmology and Astrophysics, Mainz Institute for Theoretical Physics, March 2022

Invited seminar at Princeton's Gravity Initiative, December 2021

Invited colloquium at the University of Wisconsin-Madison, November 2021

Talk at APS DPP, November 2021

Invited talk at MIT PCFS seminar, October 2021

Invited talk at Extremely High Intensity Laser Physics Conference, September 2021

Invited discussion leader at MIAPP workshop on relativistic plasma astrophysics, July 2021

Invited talk at European Astronomical Society meeting, June 2021

Invited colloquium at JSI, University of Maryland, May 2021

Invited colloquium at University of Colorado, Boulder, May 2021

Invited plenary talk at "next-generation EHT" conference, February 2021

Invited talk at Yaroslavl State University, January 2021

Invited talk at MPPC workshop, January 2021

Invited talk at APS DPP mini-conference, November 2020

Invited talk at "Understanding the Most Energetic Cosmic Accelerators: Advances in Theory & Simulation", PCTS, Princeton, October 2020

Invited talk at ICERM's Topical workshop "Mathematical and Computational Approaches for the Einstein Field Equations with Matter Fields", October 2020, Brown University

Invited "Journal of Plasma Physics Frontiers of Plasma Physics Colloquium", July 2020

Invited talk at "Physics of Neutron Stars 2020" international. conference, Saint-Petersburg, Russia, July 2020 (postponed due to COVID-19)

Invited talk at "Magnetic Reconnection International Conference", Alesund, Norway, June 2020 (postponed due to COVID-19)

Invited talk at "Workshop on Relativistic Plasma Astrophysics", Purdue University, IN, May 2020 (postponed due to COVID-19)

Invited talk at ABCD workshop, Leuven, Belgium, April 2020 (cancelled due to COVID-19)

Invited talk at "Singularities in Fluids and Plasmas", PCTS, Princeton, March 2020 (cancelled due to COVID-19)

Invited colloquium at University of Maryland, MD, February 2020

Invited colloquium at University of California, Berkeley, CA, February 2020

Invited panel discussion member at Astrophysics of FRBs, Flatiron Institute, NY, February 2020

Invited talk at High-energy emission of pulsars, Bern, Switzerland, December 2019

Invited talk at GRPIC code workshop, Grenoble, France, November 2019

Invited talk at APS DPP mini-conference, October 2019

Invited talk at 12th Plasma Kinetics Working Meeting, Vienna, Austria, July 2019

Invited talk at Workshop on Neutron Star and Black Hole Magnetospheres, NASA Goddard, DC, June 2019

Invited talk at Horizon collaboration group meeting, Princeton, May 2019

Invited talk at Gravity Initiative lunch, Princeton, April 2019

Invited talk at MPIfR, Bonn, Germany, February 2019

Invited talk at GRAPPA colloquium, University of Amsterdam, Netherlands, February 2019

Invited discussion at Plasma Physics of Neutron Star Mergers, CCA, September 2018

Invited talk at TAPIR seminar, Caltech, CA, May 2018

Invited talk at "Workshop on Relativistic Plasma Astrophysics", Purdue University, IN, May 2018

Invited talk at Tea Time Seminar, Stanford University / KIPAC, March 2018

Invited talk at Astrophysics Seminar, Northwestern University, March 2018

Invited talk at Horizon Collaboration meeting, CCA, NY, January 2018

Invited talk at Cosmic Accelerators Conference, Annapolis, MD, November 2017

Invited talk at Einstein fellows symposium, CfA, MS, October 2017

Invited lectures on Relativistic Plasma Astrophysics at 13th Summer School of Modern Astrophysics, Moscow, Russia, July 2017

Invited talk at "Physics of Neutron Stars 2017" international conference, Saint-Petersburg, Russia, July 2017

Invited talk at "1st JPP Frontiers in Plasma Physics Conference", Abbazia di Spineto, Italy, May 2017

Invited talk at Berkeley TAC seminar, UC Berkeley, CA, November 2016

Talk at "Modelling Pulsar Wind Nebulae" workshop, Sant Hugat, Barcelona, Spain, June 2016

Invited talk at Goddard pulsar workshop, Washington, DC, June 2016

Invited talk at York plasma seminar, York University, UK, April 2016

Invited lunch talk at Jodrell Bank observatory, Manchester, UK, April 2016

Invited talk at CFSA seminar, Warwick University, UK, April 2016

Talk at 6th Fermi symposium, Washington, DC, November 2015

Invited Talk at ITC "Small-Scale" seminar, Harvard University, MS, October 2015

Invited Talk at R. Narayan's group meeting, Harvard University, MS, October 2015

Invited Talk at "Cosmic Rays", Princeton University, NJ, April 2015

Invited Talk at "Max-Planck Princeton plasma center meeting", Princeton University, NJ, March 2015

Talk at "Workshop on Pulsar Physics", Princeton University, NJ, February 2015

Talk at "Workshop on Relativistic Plasma Astrophysics", Purdue University, IN, May 2014

Talk at "Physics of Neutron Stars 2013" international conference, Saint-Petersburg, Russia, July 2014

Talk at 27th Texas Symposium on Relativistic Astrophysics, Dallas, TX, December 2013

Poster at 27th Texas Symposium on Relativistic Astrophysics, Dallas, TX, December 2013

Talk at "High Energy Astrophysics 2013" conference, Moscow, Russia, December 2013

Talk at "High Energy Astrophysics 2012" conference, Moscow, Russia, December 2012

## Scientific and departmental activities

Member of Advisory Board, Journal of Plasma Physics, 2019-2022

Member of the JSI fellowship committee, 2022

Member of the Flatiron research fellowship committee, 2018-2021

SOC member, session on "Probing Energy Extraction from supermassive Black Holes", COSPAR, Australia, 2020 (postponed due to COVID-19)

SOC member, Summer School of Modern Astrophysics, Moscow, Russia, since 2016

SOC member, CCA summer school "Multiscale Modeling of Astrophysical and Space Plasmas", Flatiron Institute, 2019

SOC member, General-Relativistic Particle-In-Cell Methods and Applications to Collisionless accretion on Black Holes, CCA, Flatiron Institute, 2019

SOC and LOC member, Plasma Physics of Neutron Star Mergers, CCA, Flatiron Institute, 2018

SOC member, Summer school of modern astrophysics, Moscow, Russia, from 2017

SOC and LOC member, Workshop on recent progress in modeling of Pulsar Physics, Princeton, February of 2015

Wunch Seminar Organizer, Princeton University, 2013

Referee for Physical Review Letters, Monthly Notices of the Royal Astronomical Society, The Astrophysical Journal, The Astrophysical Journal Letters, Space Science Reviews, Physics Uspekhi, Nature Astronomy, Nature Communications, Science Advances, Journal of Plasma Physics, Galaxies

Invited Reviewer for NASA Earth and Space Science Fellowship (2018, 2021), Israel Science Foundation research grants (2018), NASA ATP program (2019), Max Planck Society Partner group program (2021)

# Publications

- Philippov A.**; Kramer M., Pulsar magnetospheres and their radiation, submitted, invited Annual Review article
- Mahlmann, J., Philippov, A., Levinson, A., Spitkovsky, A., Hakobyan, H., Electromagnetic fireworks: Fast radio bursts from rapid reconnection in the compressed magnetar wind, arXiv:2203.04320, submitted to ApJL
- Yuan, Y., Beloborodov, A., Chen, A., Levin, Y., Most, E.; **Philippov A.**, Magnetar bursts due to Alfvén wave nonlinear breakout, arXiv:2204.08513, submitted to ApJ
- Tolman, Elizabeth A., **Philippov A.**, Timokhin, Andrey N., Electric field screening in pair discharges and generation of pulsar radio emission, arXiv:2202.01303, 2022, submitted to ApJL
- Ripperda B., Liska M., Chatterjee K., Musoke G., **Philippov A.**, Markoff S., Tchekhovskoy A., Younsi Z., Magnetic flares near the event horizon with 3D high-resolution MHD simulations, ApJL, Volume 924, Issue 2, id.L32, 2022
- Vanthieghem A., Mahlmann J., **Philippov A.**, Nakar E., Fiuza F., The role of plasma instabilities in relativistic radiation mediated shocks: stability analysis and particle-in-cell simulations, MNRAS, Volume 511, Issue 2, 2022
- Coleman M., Rafikov R., **Philippov A.**, Boundary Layers of Accretion Disks: Acoustic, Vortex-Driven and Other Modes, MNRAS, Volume 509, Issue 1, 2022
- Coleman M., Rafikov R., **Philippov A.**, Boundary Layers of Accretion Disks: Wave-Driven Transport and Disk Evolution, MNRAS, Volume 512, Issue 2, 2022
- Chernoglazov A.\*, Ripperda B., **Philippov A.**, Dynamic alignment and plasmoid formation in relativistic magnetohydrodynamic turbulence, ApJL, Volume 923, Issue 1, 2021
- Most E., Noronha J., Philippov A., Modeling general-relativistic plasmas with collisionless moments and dissipative two-fluid magnetohydrodynamics, arXiv:2111.05752, 2021
- Skoutnev, V.\*, Most, E., Bhattacharjee, A., **Philippov, A.**, Scaling of Small-Scale Dynamo Properties in the Rayleigh-Taylor Instability, ApJ, Volume 921, Issue 1, id.75, 12 pp., 2021
- TenBarge, J. M.; Ripperda, B.; Chernoglazov, A.\*; Bhattacharjee, A.; Mahlmann, J. F.; Most, E. R.; Juno, J.; Yuan, Y.; **Philippov, A. A.**, Weak Alfvénic turbulence in relativistic plasmas I: asymptotic solutions, Journal of Plasma Physics, Volume 87, Issue 6, 2021
- Ripperda, B.; Mahlmann, J. F.; Chernoglazov, A.\*; TenBarge, J. M.; Most, E. R.; Juno, J.; Yuan, Y.; **Philippov, A.**; Bhattacharjee, A., Weak Alfvénic turbulence in relativistic plasmas II: Current sheets and dissipation, Journal of Plasma Physics, Volume 87, Issue 5, 2022
- Bransgrove A.\*, Ripperda B., **Philippov A.**, Magnetic Hair and Reconnection in Black Hole Magnetospheres, PRL, Volume 127, Issue 5, article id.055101, 2021
- Crinquand B.\*, Cerutti B., Dubus G., Parfrey K., **Philippov A.**, Synthetic gamma-ray lightcurves of Kerr black-hole magnetospheric activity from particle-in-cell simulations, A&A, Volume 650, id.A163, pp.11, 2021
- Yuan Y., Levin Y., Bransgrove A.\*, **Philippov A.**, Alfvén wave mode conversion in pulsar magnetospheres, ApJ, Volume 908, Issue 2, id.176, 12, 2021
- Cerutti B., **Philippov A.**, Dubus G., Dissipation of the striped pulsar wind and non-thermal particle acceleration: 3D PIC simulations, A&A, Volume 642, id.A204, pp.11, 2020
- Bacchini F., Ripperda B., **Philippov A.**, A GCA-coupled particle pusher for simulations of highly magnetized magnetospheres of compact objects, ApJS, Volume 251, Issue 1, id.10, pp. 16, 2020
- Galishnikova A.\*\* , **Philippov A.**, Simulations of the radio polarization of a precessing pulsar PSR J1906+0746, MNRAS, volume 497, Issue 3, pp.2831, 2020
- Ripperda B., Bacchini, F., **Philippov A.**, Magnetic reconnection and hot-spot formation in black-hole accretion disks, ApJ, Volume 900, Issue 2, id.100, 14 pp., 2020
- Crinquand B.\*, Cerutti B., **Philippov A.**, Parfrey K., Dubus G., Multi-dimensional GRPIC simulations of pair discharges around black holes, PRL, volume 124, Issue 14, 145101, 2020
- Most E.\*, **Philippov A.**, Electromagnetic precursors to gravitational wave events: Numerical simulations of flaring in pre-merger binary neutron star magnetospheres, ApJL, volume 893, Issue 1, id.L6, 2020

**Philippov A.**, Timokhin A., Spitkovsky A., On the origin of pulsar radio emission, PRL, volume 124, Issue 24, 245101, 2020

Davelaar J.\*, **Philippov A.**, Bromberg O., Singh C., Particle acceleration in Kink-unstable jets, ApJL, volume 896, id.L31, 2020

Bromberg O., Singh C., Davelaar J.\*, **Philippov A.**, Kink instability: evolution and energy dissipation in Relativistic Force-Free Non-Rotating Jets, ApJ, volume 884, Issue 1, article id. 39, 2019

**Philippov A.**, Uzdensky D., Spitkovsky A., Cerutti B., Pulsar Radio Emission Mechanism: Radio Nanoshots as a Low Frequency Afterglow of Relativistic Magnetic Reconnection, ApJL, volume 876, Issue 1, article id. L6, 2019

Hakobyan H.\*, **Philippov A.**, Spitkovsky A., Effects of synchrotron cooling and pair production on collisionless relativistic reconnection, ApJ, Volume 877, Issue 1, article id. 53, 2019

Werner G., **Philippov A.**, Uzdensky D., Particle acceleration in relativistic magnetic reconnection with strong inverse-Compton cooling in pair plasmas, MNRAS Letters, volume 482, Issue 1, p. L60-L64, 2019

Parfrey K., **Philippov A.**, Cerutti B., First-Principles Plasma Simulations of Black-Hole Jet Launching, PRL, volume 122, Issue 19, 035101, 2019

**Philippov A.**, Spitkovsky A., Ab-Initio Pulsar Magnetosphere: Particle acceleration in Oblique Rotators and High-energy Emission Modeling, ApJ, Volume 855, Issue 2, article id. 94, 2018.

Cerutti B., **Philippov A.**, Dissipation of the striped pulsar wind, A&A, Volume 607, id. A134, 2017.

Hakobyan H.\*\* , Beskin V. S., **Philippov A.**, On the mean profiles of radio pulsars II: Reconstruction of complex pulsar light-curves and other new propagation effects, MNRAS, 469, Issue 3, p. 2704-2719, 2017.

Gralla S., Lupsasca A., **Philippov A.**, Inclined Pulsar Magnetospheres in General Relativity: Polar Caps for the Dipole, Quadrupole and Beyond, ApJ, Volume 851, Issue 2, article id. 137, 2017.

**Philippov A.**, Rafikov R., Radial Transport and Meridional Circulation in Accretion Disks, ApJ, volume 837, Issue 2, article id. 101, 2017.

Cerutti B., Mortier J.\* , **Philippov A.**, Polarized synchrotron emission from the wind equatorial current sheet in gamma-ray pulsars, MNRAS Letters, vol. 463, issue 1, p. L89-L93, 2016.

Gralla S., Lupsasca A., **Philippov A.**, Pulsar Magnetospheres: Beyond the Flat Spacetime Dipole, ApJ, volume 833, Issue 2, article id. 258, 2016 (alphabetic author order).

Cerutti B., **Philippov A.**, Spitkovsky A., Modeling high-energy pulsar lightcurves from first principles, MNRAS, volume 457, issue 3, p. 2401-2414, 2016.

Tchekhovskoy A., **Philippov A.**, Spitkovsky A., Three-dimensional analytical description of magnetized winds from oblique pulsars, MNRAS, volume 457, issue 3, 2016.

**Philippov A.**, Rafikov R., Stone J.M., Spreading Layers in Accreting Objects: Role of Acoustic Waves For Angular Momentum Transport, Mixing and Thermodynamics, ApJ, volume 817, issue 1, article id. 62, 2016.

**Philippov A.**, Cerutti B., Spitkovsky A., Tchekhovskoy A., Ab-Initio Pulsar Magnetosphere: The Role of General Relativity, ApJ Letters, volume 815, issue 2, L19, 2015.

Arzamasskiy L.\*\* , **Philippov A.**, Tchekhovskoy A., Time evolution of the non-spherical pulsar, MNRAS, volume 453, issue 4, p. 3540-3553, 2015.

**Philippov A.**, Spitkovsky A., Cerutti B., Ab-Initio Pulsar Magnetosphere: Three-dimensional Particle-in-cell Simulations of Oblique Pulsars, ApJ Letters, volume 801, issue 1, L19, 2015.

Cerutti B., **Philippov A.**, Parfrey K., Spitkovsky A., Particle acceleration in axisymmetric pulsar current sheets, MNRAS, volume 448, issue 1, p. 606-619, 2015

**Philippov A.**, Spitkovsky A., Ab-Initio Pulsar Magnetosphere: Three-dimensional Particle-in-cell Simulations of Axisymmetric Pulsars, ApJ Letters, volume 785, issue 2, L33, 2014.

**Philippov A.**, Tchekhovskoy A., Li J. G., Time evolution of pulsar obliquity angle from 3D simulations of magnetospheres, MNRAS, volume 441, issue 3, 2014.

**Philippov A.A.**, Rafikov R.R., Analysis of Spin-Orbit Misalignment in Eclipsing Binary DI Herculis, ApJ, vol. 768, issue 2, article id. 112, 2013

Beskin V.S., Istomin Ya.N., **Philippov A.A.**, Radiopulsars – search for the truth, review paper, Physics Uspekhi, 56, 2, 2013.

Istomin Ya.N., **Philippov A.A.**, Beskin V.S., On the collective curvature radiation, MNRAS, vol. 422, issue 1, p. 232-240, 2012.

Beskin V.S., **Philippov A.A.**, On the mean profiles of radio pulsars – I. Theory of propagation effects, MNRAS, vol. 425, issue 2, pp. 814-840, 2012.

Krylenko Yu. V., Mikhailov Yu. A., Orekhov A. S., Sklizkov G. V., **Philippov A. A.**, Dependence of the temperature of stochastically heated electrons on the flux density of pulsed laser radiation on a target, in russian, Bulletin of the Lebedev Physics Institute, vol. 37, issue 10, p. 324-329, 2010.

\* marks PhD students I supervised, \*\* marks undergraduate students I supervised.

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