Alexander Kaurov

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Also known as Sasha, Alexander Aleksandrovich Kaurov.

EXPERIENCE

The Institute for Advanced Study — *postdoc (member)*
Princeton, NJ, 2016 — PRESENT

- **AMIAS fellowship** 2016 — 2017
- **Eric and Wendy Schmidt fellowship** 2017 — 2018
- **William D. Loughlin fellowship** 2018 — 2019
- **IBM Einstein fellowship** 2019 — 2020
- *Paternity leave* 01 — 06/2017

The University of Chicago — *Research Assistant*
Chicago IL, 2012 — 2016

The University of Chicago — *Teaching Assistant*
Chicago IL, 2011 — 2012

- PHSC 12000 The Origin of Universe & How We Know
- PHSC 11900 Introductory astronomy course
- PHSC 13500 Chemistry — The Atmosphere

EDUCATION

The University of Chicago — *Ph.D.*
Chicago IL, 2011 — 2016

Astronomy & Astrophysics. Thesis: "Analytical and numerical modeling of the epoch of cosmic reionization."

- **McCormick Fellowship** 2011 — 2012
  The University of Chicago, Chicago, IL
- **Fermilab Fellowship in Theoretical Physics** 2012 — 2013
  Fermilab, Batavia, IL

St. Petersburg State Polytechnic University — *B.Sc.*
St. Petersburg, Russia, 2007 — 2011

Nuclear astrophysics. Thesis: "Multidimensional numerical simulations of heat transfer in the crusts of neutron stars."

- **Russian Academy of Science fellowship** 2009 — 2011
  Central Astronomical Observatory of the Russian Academy of Sciences at Pulkovo, Russia
- **Ioffe Institute Fellowship** 2009 — 2010
  St. Petersburg State Polytechnic University, Russia

PUBLIC SERVICE

- The National Aeronautics and Space Administration grant review panelist.
- Referee for Monthly Notices of the Royal Astronomical Society.

INTERESTS

Astrophysics, Cosmology, Astronomy.

Science communication.

Science outreach.

SKILLS

Research, data analysis, programming, numerical simulations.

Course and curriculum development, teaching at school and college level.

Academic mentoring.

Application of Virtual and Augmented Reality in science communication and education.

REFERENCES

Education and outreach:

Piet Hut
piet@ias.edu

Academic:

Nickolay Gnedin
gnedin@fnal.gov

Matias Zaldarriaga
matiasz@ias.edu

Hsiao-Wen Chen
hchen@astro.uchicago.edu

Jordi Miralda-Escudé
jmiralda@fqa.ub.edu

LANGUAGES

Russian, English

OUTREACH PROJECTS

Science communication in the virtual worlds

In contrast to traditional printed media and video streaming services, the interactive nature of virtual worlds enables STEM role modeling for young people otherwise lacking the opportunity to meet face-to-face with scientists. Additionally, with no need to travel physically, the virtual planetarium reduces the logistical complications and consequently reduces the cost and environmental impact.

More information: https://www.omniscope.org/outreach

"Powers of Ten" in Virtual Reality

Recreation of the classic idea that first appeared in the book "Comic View" by Kees Boeke and then in a short documentary movie "Powers of Ten" directed by Charles and Ray Eames. The player wears the virtual reality headset and explores the scales of the universe utilizing stereoscopic vision.

More information: https://www.omniscope.org/cosmic-run

Virus VR

This VR experience combines geometric puzzle solving with learning the structure of a virus. The player uses controllers to assemble the capsid of a virus from individual proteins.

More information: https://www.omniscope.org/virus-vr

Cosmology curriculum

The highlight of my outreach activities is the development of the cosmology high-school course that will be adopted for more than 50,000 students per year in Moscow (Russia).

MENTORING

Undergraduate students from St. Petersburg State Polytechnic University that defended their B.Sc. theses under my supervision:

- Evgenii Chaikin (B.Sc., 2017), M.Sc. fellowship at the University of Bonn (Germany), Ph.D. student at Leiden Observatory (Netherlands),
- Nadezhda Tuberozova (B.Sc., 2018), graduate student at the University of Bonn (Germany),
- Ekaterina Leonova (B.Sc., 2019), M.Sc. fellowship at the University of Geneva (Switzerland).

CONTRIBUTION TO SCIENCE

Dark Matter properties from astronomical observations

By observing the distribution and time variability of the astronomical objects it is possible to extract the details of the dark matter properties. Together with collaborators, I am focused on detecting individual highly magnified stars with the gravitational lensing. By studying the brightness variability of these objects on the timescale of a few years, we can estimate how granular is dark matter and whether it is consistent with current theories.

Probing Dark Matter Subhalos in Galaxy Clusters Using Highly Magnified Stars

L Dai, T Venumadhav, **AA Kaurov**, J Miralda-Escudé

The Astrophysical Journal 867 (1), 24, 2018

Highly magnified stars in lensing clusters: new evidence in a galaxy lensed by MACS J0416. 1-2403

AA Kaurov, L Dai, T Venumadhav, J Miralda-Escudé, B Frye

The Astrophysical Journal 880 (1), 58, 2019

Asymmetric Surface Brightness Structure of Lensed Arc in SDSS J1226+ 2152: A Case for Dark Matter Substructure

L Dai, **AA Kaurov**, K Sharon, MK Florian, J Miralda-Escudé, et al.

arXiv preprint arXiv:2001.00261 2020

Early Universe and cosmology

The early epochs of the universe (0.1-1 Billion years after the Big Bang) are not yet probed by the current generation instruments. However, those epochs can be already studied using theoretical modeling. Together with collaborators I am performing numerical simulations utilizing high-performance computing to predict the observations and to figure out how the upcoming data will help us to understand cosmology better.

Implication of the Shape of the EDGES Signal for the 21 cm Power Spectrum

AA Kaurov, T Venumadhav, L Dai, M Zaldarriaga

The Astrophysical Journal Letters 864 (1), L15,2018

Cosmic reionization on computers. ii. reionization history and its back-reaction on early galaxies

NY Gnedin, **AA Kaurov**

The Astrophysical Journal 793 (1), 30, 2014

Recombination clumping factor during cosmic reionization

AA Kaurov, NY Gnedin

The Astrophysical Journal 787 (2), 146, 2014

Physics of Neutron Stars

The neutron stars are rapidly spinning compact stars that are the perfect laboratories to test nuclear physics in extreme environments. Almost the only thing we know about them is that their surface temperature is inhomogeneous, and they have stable hot and cold spots. My interest lies in modeling the distribution and evolution of these spots that ultimately can lead to better understanding of the thermal evolution of the neutron stars and allow us to further test nuclear physics.

Thermal emission of neutron stars with internal heaters

AD Kaminker, **AA Kaurov**, AY Potekhin, DG Yakovlev

Monthly Notices of the Royal Astronomical Society 442 (4), 3484-3494, 2014

Central compact objects in Kes 79 and RCW 103 as 'Hidden' magnetars with crustal activity

SB Popov, **AA Kaurov**, AD Kaminker

Publications of the Astronomical Society of Australia 32, 2015

Neutron stars with outbursts from superfluid crust

AD Kaminker, EA Chaikin, **AA Kaurov**, DG Yakovlev

Journal of Physics Conference Series 932 (1), 2017