Dominika Ďurovčíková

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EDUCATION

Doctor of Philosophy in Physics | Massachusetts Institute of Technology, USA 09/2020 - present

Research advisor: Professor Robert Simcoe, PhD

Research area: High-redshift astrophysics and cosmology

Other research areas: Precision quantum metrology for quantum gravity

Master of Physics (4-year MPhys) | University of Oxford, United Kingdom 10/2016 - 07/2020

Degree classification: First class

Graduate concentration:

- Laser Physics and QIP: laser physics, non-linear and quantum optics, quantum information and computing
- Theoretical Physics: classical and quantum field theory, Landau theory, introduction to stochastic processes

Graduate thesis: Cross-Telescopic Super-Resolution Galaxy Images from Generative Adversarial Networks

International Baccalaureate Diploma | Gymnazium Jur Hronec, Bratislava, Slovak Republic 09/2014 - 06/2016

Score: 42/45

Subjects: Physics HL, Mathematics HL, English B HL, German B SL, Psychology SL, Slovak A SL.

RESEARCH EXPERIENCE

Astrophysics:

PhD student | Quasar Group, MIT Kavli Institute for Astrophysics and Space Research, USA 09/2022 - present

Supervisor: Anna-Christina Eilers, PhD, Professor Robert Simcoe, PhD

Studying quasar proximity zones at redshifts greater than 6 and how they are shaped by cosmic reionization and the properties of the quasars themselves.

Student Researcher | Beecroft Institute of Particle Astrophysics and Cosmology, Oxford, UK 10/2017 - 08/2020

Supervisor: Professor Adrianne Slyz, PhD, Professor Julien Devriendt, PhD

Galaxy super-resolution imaging:

Implemented a super-resolution generative adversarial network to increase the resolution and denoise galaxy images from ground-based telescopes, thus transforming them to Hubble Space Telescope-like quality.

Quasar continua & Epoch of Reionization:

Developed a machine learning based approach to reconstructing high-redshift quasar spectra around Ly-α to study the Epoch of Reionization that improves on the state-of-the-art model by 14%.

Cooling in galaxy formation simulations:

Completed a project on the effect of radiative cooling on galaxy star formation rates in cosmological simulations, comparing the RAMSES and FIRE cooling functions.

Co-Researcher | M.R. Štefánik Observatory, Hlohovec, Slovakia 02/2015 - 10/2016

Supervisor: Karol Petrík, PhD

Co-initiated exoplanetary research at the observatory and investigated the transiting exoplanet TrES-1 b in Lyra through multi-band photometric observations, data reduction in Muniwin, and transit light curve analysis.

Precision and quantum metrology:

Research Assistant | Quantum and Precision Measurements Group, MIT, USA 09/2020 - 08/2022

Supervisor: Professor Vivishek Sudhir, PhD

Theory and design of a new precision force sensor to illuminate the interface between quantum physics and general relativity.

Laidlaw Scholar | LIGO Laboratory, Massachusetts Institute of Technology, Cambridge, MA 07/2018 - 09/2018

Supervisor: Professor Nergis Mavalvala, PhD

Designed and built an opto-electronic control system called the laser intensity stabilisation servo to produce a quantum-noise limited laser beam at 100 Hz - 50 kHz. This system is now used to produce optomechanically squeezed states of light to explore their possible use in future gravitational wave detectors.

Other:

Student Intern | Tearney Laboratory, Massachusetts General Hospital, Boston, MA 07/2019 - 09/2019

Supervisor: Professor Guillermo J. Tearney, MD, PhD

Created a proof of concept of a new version of the micro-optical coherence tomography.

Student Intern | Research Center for Quantum Information, Bratislava, Slovakia 06/2017 - 08/2017
Supervisor: Daniel Nagaj, PhD

Completed a project on the Quantum Approximate Optimization Algorithm (QAOA) and applied the algorithm to the NP-complete problem MAXCUT.

PUBLICATIONS

5. Komori, **Ďurovčíková**, Sudhir, 2022. Quantum theory of feedback cooling of an anelastic macro-mechanical oscillator. PRA, 105(4), p.043520.
4. Bosman, **Ďurovčíková**, Davies, Eilers, 2021. A comparison of quasar emission reconstruction techniques for $z \geq 5.0$ Lyman-α and Lyman-β transmission. MNRAS, 503(2), pp.2077–2096.
3. Reiman, Tamanas, Prochaska, **Ďurovčíková**, 2020. Fully probabilistic quasar continua predictions near Lyman-α with conditional neural spline flows. arXiv: 2006.00615.
2. Katz, **Ďurovčíková**, Kimm, Rosdahl, Blaizot, Haehnelt, Devriendt, Slyz, Ellis, Laporte, 2020. New Methods for Identifying Lyman Continuum Leakers and Reionization-Epoch Analogues. MNRAS, 498(1), pp.164–180.
1. **Ďurovčíková**, Katz, Bosman, Davies, Devriendt, Slyz, 2020. Reionization history constraints from neural network based predictions of high-redshift quasar continua. MNRAS, 493(3), pp.4256–4275.

CONFERENCES & TALKS

Talk:	*Theory of ground state cooling of a macroscopic anelastic mechanical oscillator*, Conference on Lasers and Electro-Optics (CLEO), online	05/2022
Talk:	*Intensity interferometry & more quantum optics*, MIT Kavli Institute Journal Club, online	02/2022
Poster:	*Prospects for high-sensitivity continuous force detection with a single trapped ion*, MIT QSEC Annual Research Conference, online	02/2022
Talk:	*On the Unruh effect and its measurement*, MIT Kavli Institute Graduate Lunch, online	04/2021
Workshops:	*Solving Laplace equation; Building a precision force detector*, EWAAB Young Professionals Program, online	03/2021
Video:	*Exploring the Quantum-Gravity Interface through Precision Measurements* Global Young Scientists Summit, online	01/2021
Talk:	*Neural networks for the early Universe*, Summer All Zoom Epoch of Reionization Astronomy Conference (SAZERAC), online	07/2020
Attendee:	APS Virtual Division of Atomic, Molecular and Optical Physics (DAMOP) Meeting	06/2020
Poster:	*Neural networks for the early Universe*, Royal Society-FAPESP Frontiers of Science Meeting, São Paulo	03/2020
Talk:	*Neural networks for the early Universe*, Particle Physics/Astrophysics/Machine learning Seminar, Oxford	02/2020
Attendee:	First Light and Reionisation Epoch Meeting at Royal Astronomical Society, London	02/2020
Poster:	*Developing a motion-weighted micro-optical coherence tomography for in vivo dynamical imaging*, Wellman Scientific Retreat, Boston, MA	09/2019
Poster:	*Developing a motion-weighted micro-optical coherence tomography for in vivo dynamical imaging*, Harvard-MIT Summer Institute for Biomedical Optics Poster Day, Boston, MA	08/2019
Talk:	*Dynamical micro-OCT: principles and challenges*, Harvard-MIT Summer Institute for Biomedical Optics Presentations, Boston, MA	07/2019
Attendee:	FUTURE of Physics at California Institute of Technology, Pasadena, CA	11/2018
Poster:	*Building a laser intensity stabilisation servo (ISS) for the use of optomechanical squeezing in future GW detectors*, Laidlaw Research and Leadership Programme Poster Event, Oxford	10/2018
Talk:	*How to quiet a laser? Laser Intensity Stabilisation Servo for Optomechanical Squeezing Experiment*, MIT Kavli Institute Undergraduate Research Symposium, Cambridge, MA	08/2018
Talk:	*Squeezed States of Light & GW detection*, Presentations at New College, Oxford	02/2018

CERTIFICATES & SCHOLARSHIPS

MIT School of Science Service Fellowship	2022
MIT Physics Graduate Service Award	2021
Bruno Rossi Graduate Fellowship	2020 - 2021
Scholarship of the College of the Blessed Mary of Winchester	2017 - 2020
Harvard-MIT Summer Institute for Biomedical Optics Completion Certificate	2019
Institute of Leadership & Management (ILM) Certificate Level 3	2019
McKinsey&Company Next Generation Women Leaders Award	2019
Laidlaw Research and Leadership Scholarship	2018
Distinction in Physics	2017

TEACHING & COMMUNITY ENGAGEMENT

Lecturer | Discover Summer Academy | discover.sk 08/2020 - present

Designed and taught twice a week-long course on quantum physics to high school students from Slovakia and Czech Republic.

Facilitated team-building and self-reflection sessions in two teams of ∼10 students.

Teaching Assistant | MIT Department of Mechanical Engineering 02/2022 - 05/2022

Co-developed a new course on classical and quantum stochastic processes (course number 2.S982).

Created and marked 7 problem sets, hosted weekly office hours, and marked final presentations.

Vice-President for Admissions | MIT Physics Graduate Student Council 08/2021 - 06/2022

Oversaw and coordinated student initiatives related to admissions to the MIT Physics graduate program.

Collaborated with the Physics Graduate Student Council leadership on improving the student experience at MIT Physics.

Student Leader | MIT Physics Department Graduate Admissions Advisory Council 07/2020 - 06/2022

Co-designed and launched three new student-led resources under the umbrella of PhysGAAP to increase equity in the MIT Physics graduate admissions process.

Prepared and led weekly council meetings with the Admissions Chair and the Academic Programs Office focused on analysing and assessing the current graduate admissions process and improving its equity and inclusivity to applicants from diverse and untraditional backgrounds.

Collaborated with student leaders from other MIT departments to achieve a more uniform change in admissions across MIT.

Co-Founder | EWAAB Nonprofit Organisation | ewaab.org 06/2019 - present

Co-founded EWAAB as an initiative to support confidence in university-level women. We aim to encourage young women to step out of their comfort zone, to provide them with a set of leadership and communication skills to be able to do so, and to connect them to a global network of peers and supporters.

Transformed the original initiative into a 501(c)3 nonprofit organisation currently supported by 9 Trustees.

Co-designed the curriculum of the 2019/20 mentorship program and managed a successful launch of its inaugural year at 8 universities around the world, spanning Canada to Australia, together impacting 27 mentees in 6 countries.

Featured in the Scientific American and SME (the largest Slovak newspaper).

President, STEM Leader, STEM Advisor | Unimak 09/2016 - 09/2020

Led over 80 members of this organisation to spread awareness of the possibilities for young Slovaks and Czechs to study at world leading universities via outreach talks, online media, and advice on issues related to choosing and applying to universities.