# MichałBejger

## Scientific areas

Data analysis and detection of gravitational waves, machine learning, dense matter equation of state, numerical simulations of relativistic compact objects, high-performance computing

## Contact

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## Languages (CERF scale)

English (C2), German (B2), Italian (A2)

## Bibliometry

(7 April 2025)
Citations: 87574
h: 96
SAO/NASA ADS

## Education

| | | |
|---|---|---|
| 2013 | **Habilitation** *"Astrophysical parameters of neutron stars as tests of the dense matter properties"* (25.10.2013) | Nicolaus Copernicus Astronomical Center, PAS |
| 2001–2005 | **PhD** in physics (astrophysics) *"Neutron stars dynamics and the equation of state of dense matter"*. Supervisor: Paweł Haensel (16.06.2005; with distinction from the NCAC Scientific Council). | Nicolaus Copernicus Astronomical Center, PAS |
| 1996–2001 | **Master** of Science | Warsaw University, Faculty of Physics |

## Positions

| | | |
|---|---|---|
| 2021–present | **Associate professor** | Istituto Nazionale di Fisica Nucleare, Ferrara, Italy |
| 2014–present | **Associate professor** | Nicolaus Copernicus Astronomical Center, PAS, Warsaw, Poland |
| 2018–2019 | **Researcher** | AstroParticule et Cosmologie (APC), CNRS, Paris, France |
| 2008–2014 | **Assistant professor** | Nicolaus Copernicus Astronomical Center, PAS, Warsaw, Poland |
| 2007–2008 | **Post-doc** | Nicolaus Copernicus Astronomical Center, PAS, Warsaw, Poland |
| 2006-2007 | **Marie Currie Fellow post-doc** | Observatoire de Paris, LUTH, Paris-Meudon, France |

## Fellowships and awards

| | |
|---|---|
| 10.10.2016 | W. Rubinowicz Science Prize from Polish Physical Society for the discovery of gravitational waves |
| 04.05.2016 | Gruber Cosmology Prize, Gruber Prize foundation, for the discovery of gravitational waves |
| 02.05.2016 | Special Breakthrough Prize in fundamental physics for the authors of the first direct detection of gravitational waves |
| 15.03.2016 | Nicolaus Copernicus Medal of the Polish Academy of Sciences (for members of the Virgo-POLGRAW team) |
| 09–11.2015 | DAAD Research Stay for University Academics and Scientists (Steinbuch Centre for Computing, Karlsruhe Institute of Technology, Germany) |
| 04.2008–03.2011 | Marie Curie Re-integration Fellowship (NCAC, Warsaw, Poland) |
| 03.2006–08.2007 | Marie Curie Intra-European Fellowship (LUTH, Paris, France) |

## Peer review service

AAS & APS journals (ApJ, ApJ, Phys. Rev. D, Phys. Rev. Lett.), MNRAS, A&A, EPJA, MLST, General Relativity and Gravitation, NWA

## Institutional responsibilities

2014–2018: Proceedings of the Polish Astronomical Society editor

2009–2021: Member of the Scientific Council, NCAC

2008–2012: Institute Journal Club host, NCAC

# Invited talks

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|---|---|
| 21.02.2025 | PAIP Warsaw 2025, "LIGO-Virgo-KAGRA gravitational-wave sources and observational results" |
| 09.01.2025 | TMEX Vietnam 2025, "LIGO-Virgo-KAGRA gravitational-wave sources and observational results" |
| 16.09.2024 | GEMMA2, Rome, Italy, "LIGO-Virgo-KAGRA gravitational-wave sources and observational results" |
| 09.01.2023 | TMEX Vietnam 2023, "Dense-matter equation of state from GW observations" |
| 24-10-2022 | From holography to machine learning, Helsinki Finland, "Machine learning methods in gravitational wave astrophysics" |
| 05-10-2022 | 3rd Gravi-Gamma Workshop, Volterra Italy, "Continuous GWs from known and unknown sources: O3 observations and beyond" |
| 23.11.2021 | Cortona TNPI2021, "Unraveling the character of possible dense-matter state transition from neutron stars observations", Pisa Italy (online) |
| 07.07.2021 | Marcel Grossman MG16, "Search for gravitational waves from r-mode oscillations in PSR J0537–6910", on behalf of the LIGO-Virgo-KAGRA Collaboration and NICER Team, (online) |
| 25.04.2019 | PHAROS 2019, "GW170817: lessons from the observations of a binary neutron star merger", Platja d'Aro, Spain |
| 25.02.2019 | GWEOS workshop, "Isolated NS: results and perspectives", Pisa, Italy |

# Leader roles in research grants

| | |
|---|---|
| 2021–present | LIGO-Virgo-KAGRA Collaboration data analysis (Continuous Waves) working group co-chair |
| 2021–present | Einstein Telescope Observation Science Board division 9 coordinator |
| 2024-2026 | Local PI at NCAC in "Virgo-PL: Polish contribution to Virgo gravitational-wave observatory", Ministry of Science and Higher Education project (2023/WK/13 (anex 2024/WK/03)) |
| 2024-2028 | Local PI at NCAC in "Science with Gravitational Waves in the Era of LIGO-Virgo-KAGRA Discoveries" OPUS project, funding NCN (2023/49/B/ST9/02777) |
| 2023-2025 | Local PI (INFN Ferrara) in "Model discovery in the complex parameter space of unmodeled gravitational waveform reconstructions", funding MUR, PRIN 202275HT58 |
| 2022-2026 | PI at NCAC in "Calm before the storm: rethinking the gravitational-wave analysis toolbox in the face of future challenges" OPUS project, funding NCN (2021/43/B/ST9/01714) |
| 2018-2023 | Management Committee Member and Work Group Leader in the COST Action "A network for Gravitational Waves, Geophysics and Machine Learning", funding: EU Horizon2020 (COST Action CA17137) |
| 2018–2022 | PI at NCAC in "Gravitational-wave astronomy: participation of the Polgraw group in Advanced Virgo and Advanced LIGO projects" HARMONIA project, funding: NCN (2017/26/M/ST9/00978) |
| 2017–2022 | PI in "Transient gravitational waves from neutron stars: models and data analysis" SONATA BIS project, funding: NCN (2016/22/E/ST9/00037) |

# 10 recent selected publications

*"Microlensing of long-duration gravitational wave signals originating from Galactic sources"*, Suyamprakasam, Sudhagar, Sreekanth Harikumar, Paweł Ciecielag, Przemysław Figura, Michał Bejger, and Marek Biesiada

arXiv e-prints, *arXiv:2503.21845 (Mar. 2025) arXiv:2503.21845. 2025 ( arXiv: 2503.21845 (gr-qc))*

*"The Science of the Einstein Telescope"*, Abac, Adrian et al.

arXiv e-prints, *arXiv:2503.12263 (Mar. 2025) arXiv:2503.12263. 2025 ( arXiv: 2503.12263 (gr-qc))*

*"Explainable autoencoder for neutron star dense matter parameter estimation"*, Di Clemente, Francesco, Matteo Scialpi, and Michał Bejger

arXiv e-prints, *arXiv:2501.15222 (Jan. 2025) arXiv:2501.15222. 2025 ( arXiv: 2501.15222 (physics.comp-ph))*

*"Conditional variational autoencoder inference of neutron star equation of state from astrophysical observations"*, Ferreira, Márcio and Michał Bejger

Phys. Rev. D *111.2, 023035 (Jan. 2025) p. 023035. 2025 ( arXiv: 2403.14266 (nucl-th))*

*"Neural network time-series classifiers for gravitational-wave searches in single-detector periods"*, Trovato, A., E. Chassande-Mottin, M. Bejger, R. Flamary, and N. Courty

Classical and Quantum Gravity *41.12, 125003 (June 2024) p. 125003. 2024 ( arXiv: 2307.09268 (gr-qc))*

*"Detecting the third family of compact stars with normalizing flows"*, Carvalho, Valéria, Márcio Ferreira, Constança Providência, and Michał Bejger

Phys. Rev. D *109.10, 103032 (May 2024) p. 103032. 2024 ( arXiv: 2403.09398 (nucl-th))*

*"Search for postmerger gravitational waves from binary neutron star mergers using a matched-filtering statistic"*, Królak, Andrzej, Piotr Jaranowski, Michał Bejger, Paweł Ciecielag, Orest Dorosh, and Andrzej Pisarski

Classical and Quantum Gravity *40.21, 215008 (Nov. 2023) p. 215008. 2023 ( arXiv: 2304.08171 (gr-qc))*

*"Astrophysics with continuous gravitational waves"*, Haskell, B. and M. Bejger

Nature Astronomy *7 (Oct. 2023) pp. 1160–1170. 2023 ()*

*"Denoising gravitational-wave signals from binary black holes with a dilated convolutional autoencoder"*, Bacon, Philippe, Agata Trovato, and Michał Bejger

Machine Learning: Science and Technology *4.3, 035024 (Sept. 2023) p. 035024. 2023 ( arXiv: 2205.13513 (gr-qc))*

*"Crustal Failure as a Tool to Probe Hybrid Stars"*, Pereira, Jonas P., Michał Bejger, Paweł Haensel, and Julian Leszek Zdunik

ApJ *950.2, 185 (June 2023) p. 185. 2023 ( arXiv: 2210.14048 (astro-ph.HE))*

## Software projects

**PolgrawAllSky**
Data-analysis pipeline, implementing the network-of-detectors time-domain $\mathcal{F}$-statistic method search for almost monochromatic gravitational wave signals (github.com/mbejger/polgraw-allsky)

**SageManifolds**
Contribution to the free and open source computer algebra system *SageMath* (www.sagemath.org) with the implementation of the differential geometry and symbolic tensor calculus package *SageManifolds* (sagemanifolds.obspm.fr)

# Teaching

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|---|---|
| 27.10.20–09.02.21 | Gravitational waves, monograph lecture at Nicolaus Copernicus Center, winter semester 2020/21, Warsaw, Poland |
| 8–22.07.17 | 4th Cosmology School: Introduction to cosmology lecturer, "Cosmology with Gravitational Waves", Kraków, Poland |
| 17.07.17 | Helmholtz International Summer School "Nuclear theory and astrophysical applications" lecturer, "Gravitational waves from neutron stars in the era of Advanced LIGO and Advanced Virgo detectors", Dubna, Russia |
| 24–28.10.16 | Fifth GraWIToN School (GW Initial Training Network) lecturer, "Computational aspects of continuous wave data analysis and its optimization", Rome, Italy |
| Spring 14 | Monographic lecture for graduate students *"Relativistic Astrophysics and Related Computational Methods"* (https://users.camk.edu.pl/bejger/lectures) |
| 2015– | Supervision of theses: PhD - 6, master - 1, bachelor - 1 |

# Popularization of science

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|---|---|
| 2011–2023 | Astronomy editor at the "Delta" monthly magazine, aimed at the high-school and pre-graduate students interested in mathematics, computer science, physics and astronomy (in Polish: journal author's website) |
| see also | Scientific outreach site for the list of texts and recordings |
| 2015–2021 | Polgraw-Virgo Collaboration outreach representative |

# Organization of scientific meetings

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|---|---|
| 24–26.09.2020 | Conference of the Polish Society on Relativity (Polskie Towarzystwo Relatywistyczne, SOC, 194 participants online) |
| 2–5.09.2019 | LIGO-Virgo Collaboration meeting, Warsaw, Poland (LOC, 250 participants) |
| 26–28.03.2018 | POLNS18, Warsaw, Poland (SOC & LOC, 57 participants) |
| 27–31.03.2017 | Annual NewCompStar Conference 2017, Warsaw, Poland (SOC & LOC, 150 participants) |

# Collaborations and memberships

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|---|---|
| 2021–present | Member of the Einstein Telescope Observational Science Board |
| 2011–present | Member of the Virgo gravitational-wave detector project and the LIGO-Virgo collaboration |
| 2013–2017 | Polish Einstein Telescope design & study team |
| 2015–present | International Astronomical Union |
| 2016–present | Polish Astronomical Society |