Curriculum Vitae

Personal Information

Name: Alexandru Dima

ORCID: 0000-0003-4641-3946

Research interests: gravitational physics, general relativity, numerical relativity, black hole and neutron star physics, modified gravity, astro-particle physics, dark matter and dark energy

Current Professional Status

2023 - present: Postdoctoral Researcher,
Department of Physics,
Sapienza University of Rome, Rome, Italy
PI: Prof. Paolo Pani

2021 - 2023: Postdoctoral Research Associate,
Department of Physics and National Center for Supercomputing Applications,
University of Illinois at Urbana-Champaign, IL, USA
supported by NSF-CSSI Grant Award Number (FAIN) 2004879
"The Einstein Toolkit ecosystem: Enabling fundamental research in the era of multi-messenger astrophysics"
PIs: Prof. Helvi Witek, Dr. Roland Haas

Education

2017 - 2021: PhD in Astroparticle Physics, *cum Laude*
Thesis on "*Testing the gravitational phenomenology of compact objects: superradiance, scalarization and screening mechanisms*".
Supervisor: Prof. Enrico Barausse,
SISSA, Italy.

2015 - 2017: Master's degree in Theoretical Physics, 110/110 *cum Laude*.
Thesis on "*Nonlinear aspects of the effective theory of dark energy*",
Supervisors: Prof. Filippo Vernizzi, Prof. Sabino Matarrese
University of Padova, Italy.

2012 - 2015: Bachelor Degree in Physics, 110/110.
Thesis on "*Experimental violations of Bell's inequalities with time bin and polarization entanglement*",
Supervisor: Dr. Giuseppe Vallone,
University of Padova, Italy.

Grants, fellowships and awards

2022 - present BRIDGE Seed Fund -
member of exchange program with the University of Birmingham, UK
PIs: Prof. H. Witek, Dr. P. Schmidt

2021 Amaldi Research Center 2021 prize for the PhD thesis:
"Testing the gravitational phenomenology of compact objects: superradiance, scalarization and screening mechanisms"

2021 - present support from NSF-CSSI Grant Award Number (FAIN) 2004879:
"The Einstein Toolkit ecosystem: Enabling fundamental research in the era of multi-messenger astrophysics",
PIs: Prof. Helvi Witek, Dr. Roland Haas

2018 Short Term Scientific Mission supported by the COST Action CA16104.
Hosting institution: IAP, Paris, France.

2017 Erasmus+ scholarship.
Supervisors: Prof. S. Matarrese, Prof. F. Vernizzi
Hosting institution: IphT, Saclay, France.

High-perfomance computing time grants

2022 XSEDE allocation TG-PHY210114
"Probing strong-field gravity with numerical relativity simulations"
supported by NSF Grant No. ACI-1548562,
member of HPC grant at SDSC's Expanse; CPU time: 3.4M CPU hours
PI: Prof. Helvi Witek

2022 Delta Illinois Allocation
"GPU Computing for Computational Astrophysics with the Einstein Toolkit,"
Member of HPC Grant at Delta, GPU time: 2,900.0 GPU hours; CPU time: 205,800 CPU hours
PI: Prof. Helvi Witek

2021 2021 Illinois Blue Waters allocation,
"Strong field tests of gravity: numerical relativity in quadratic gravity"
Member of HPC grant at Blue Waters; CPU time: 689,000 node-hours
PI: Prof. Helvi Witek

List of publications

Published in peer-reviewed journals

2023 **Title**: Black holes in massive dynamical Chern-Simons gravity: Scalar hair and quasi-bound states at decoupling.
Journal: Phys. Rev. D **108** (2023) no.4, 044078, e-Print: 2305.07704 [gr-qc]
(4 citations counted in INSPIRE as of 26 Sep 2023)
Authors: C. Richards, **A. Dima** and H. Witek.

2021 **Title**: Dynamical Chameleon Neutron Stars: stability, radial oscillations and scalar radiation in spherical symmetry.
Journal: Phys. Rev. D **104** (2021) 8, 084017, e-Print: 2107.04359 [gr-qc]
(15 citations counted in INSPIRE as of 26 Sep 2023)
Authors: **A. Dima**, M. Bezares, E. Barausse.

2020 **Title**: Spin-induced black hole spontaneous scalarization.
Journal: Phys. Rev. Lett. **125** (2020), 231101, e-Print: 2006.03095 [gr-qc]
(135 citations counted in INSPIRE as of 26 Sep 2023)
Authors: **A. Dima**, E. Barausse, N. Franchini, T. Sotiriou.

2020 **Title**: Numerical investigation of plasma-driven superradiant instabilities.
Journal: Class. Quant. Grav. **37** (2020) 17, 175006, e-Print: 2001.11484 [gr-qc]
(32 citations counted in INSPIRE as of 26 Sep 2023)
Authors: **A. Dima**, E. Barausse.

2017 **Title**: Vainshtein Screening in Scalar-Tensor Theories before and after GW170817: Constraints on Theories beyond Horndeski.
Journal: Phys. Rev. D **97** (2018) 10, 101302, e-Print: 1712.04731 [gr-qc]
(115 citations counted in INSPIRE as of 26 Sep 2023)
Authors: **A. Dima**, F. Vernizzi.

In preparation

2023 **Title**: Black hole hair in axi-dilaton gravity: numerical solutions beyond the small-spin approximation.
in preparation.
Authors: **A. Dima**, C. Richards, H. Witek.

2023 **Title**: Fixing the 3+1 Einstein-scalar-Gauss-Bonnet equations.
in preparation.
Authors: **A. Dima**, B. Shiralilou, H. O. Silva, L. Gualtieri, T. Hinderer, S. Nissanke, N. Ortiz, T. P. Sotiriou, H. Witek

Public codes

- Leonardo Werneck, Samuel Cupp, Thiago AssumpÃ§Ã£o, Steven R. Brandt, Cheng-Hsin Cheng, Peter Diener, Jake Doherty, Zachariah Etienne, Roland Haas, Terrence Pierre Jacques, Beyhan KarakaÅ, Konrad Topolski, Bing-Jyun Tsao, Miguel Alcubierre, Daniela Alic, Gabrielle Allen, Marcus Ansorg, Maria Babiuc-Hamilton, Luca Baiotti, ... Yosef Zlochower. (2023). *The Einstein Toolkit* (The "Karl Schwarzschild" release, ET_2023_05). Zenodo. https://doi.org/10.5281/zenodo.7942541
- H. Witek, M. Zilhao, G. Bozzola, C.-H. Cheng, A. Dima, M. Elley, G. Ficarra, T. Ikeda, R. Luna, C. Richards, N. Sanchis-Gual, and H. Silva, *Canuda: a public numerical relativity library to probe fundamental physics* (2023), https://doi.org/10.5281/zenodo.7791842

Talks, Conferences, Workshops and Schools

2023 **Talk (invited)**: Introduction to Numerical Relativity.
Event: North American Einstein Toolkit School and Workshop, Rochester Institute of Technology, Rochester, NY.

2023 **Talk (invited)**: Into the wilds of strong gravity.
Event: ARC Prize Ceremony, Amaldi Research Center, Sapienza University, Rome.

2022 **Event**: New frontiers in strong gravity, Cientro de Ciencias de Benasque "Pedro Pascual", Benasque, Spain.

2022 **Talk (contributed)**: Binary Black Hole simulations in axi-dilaton gravity.
Event: North American Einstein Toolkit School 2022 - University of Idaho, Moscow, Id, USA.

2022 **Talk (contributed)**: Binary Black Hole merger simulations in scalar-Gauss-Bonnet gravity.
Event: American Physical Society - April meeting 2022, New-York, NY, USA.

2021 **Event**: Midwest Relativity Meeting 2021, Urbana-Champaign, IL, USA.

2021 **Talk (contributed)**: Neutron star simulations in screened modified gravity.
Event: North American Einstein Toolkit School 2021, Urbana-Champaign, IL, USA. (Attended virtually)

2021 **Talk (contributed)**: Neutron star simulations in screened modified gravity.
Event: 57th Karpacz Winter School of Theoretical Physics - "Equation of state of dense matter and multimessenger astronomy", Karpacz, PL.

2021 **Talk (contributed)**: Spin-induced spontaneous scalarization.
Event: XIII Black Holes Workshop, Lisbon. (Attended virtually)

2020 **Event**: Mathematical and Computational Approaches for the Einstein Field Equations with Matter Fields, ICERM Workshop, Brown University. (Attended virtually)

2020 **Event**: Advances in Numerical Relativity: Mathematical and Computational Approaches for Solving the Source-Free Einstein Field Equations, ICERM Workshop, Brown University. (Attended virtually)

2020 **Talk (contributed)**: Numerical investigation of superradiant instabilities.
Event: 3rd meeting of the GWVerse COST action, Trieste, Italy.

2019 **Talk (contributed)**: Black holes and superradiant instabilities in time domain.
Event: Astro@TS 2019, Trieste, Italy.

2019 **Talk (contributed)**: Superradiant instabilities from the plasma frequency.
Event: European Einstein Toolkit Meeting 2019, London, UK.

2019 **Event**: ICTP Summer School on Geometry and Gravity, 2019, Trieste, Italy.

2018 **Event**: Fundamental Physics with LISA, Arcetri, Firenze, Italy.

2018 **Event**: ICTP Summer School on Cosmology, 2018, Trieste, Italy.

Mentoring experience

2021-present C. Richards,
PhD in Physics, University of Illinois Urbana-Champaign,
Project: Strong field tests of gravity with black holes
under the supervision of Prof. H. Witek

2021-present C.-H. Cheng,
PhD in Physics, University of Illinois Urbana-Champaign,
Project: Compact binaries and ultra-light fields
under the supervision of Prof. H. Witek

Outreach activities

12/2020 "Not all black holes are the same", SISSA press release
`https://www.sissa.it/news/not-all-black-holes-are-same`

12/2020 "Buchi neri, la ricrescita si vede", MEDIA INAF
`https://www.media.inaf.it/2020/12/09/buchi-neri-la-ricrescita-si-vede/`

12/2020 "Le caratteristiche dei Buchi Neri", Podcast Co.Scienza
(timestamp minute start-17:00)

Other skills

Programing Languages and HPC experience

- C, C++, Python, Fortran, Julia
- General knowledge of HPC workload managers (e.g TORQUE, SLURM)
- Experience with large numerical simulations on supercomputing clusters like CINECA, XSEDE/Expanse, NCSA Blue Waters, NCSA Delta.

Languages

- Romenian and Italian native speaker, fluent in English, intermediate Spanish, basic knowledge of French and German.

References

Prof. Helvi Witek, hwitek@illinois.edu, University of Illinois at Urbana-Champaign, Urbana, IL, USA.

Dr. Roland Haas, rhaas@illinois.edu, National Center for Supercomputing Applications, Urbana, IL, USA.

Prof. Enrico Barausse, barausse@sissa.it, Scuola Internazionale Superiore di Studi Avanzati, SISSA, Trieste, Italy.

Prof. Thomas Sotiriou, Thomas.Sotiriou@nottingham.ac.uk, University of Nottingham, Nottingham, UK.