# ANDRIUS TAMOSIUNAS

Postdoc at the Particle Cosmology Group, University of Nottingham
andrius.tamosiunas@nottingham.ac.uk, Nationality: Lithuanian (EU), +44 7783 132285

## CURRENT POSITION

**Particle Cosmology Group, University of Nottingham** *September 2020 - Present*

Postdoctoral Research Associate
Research area: tests of gravity models with screening mechanisms using numerical techniques
Line manager: Prof Clare Burrage

## EDUCATION

**ICG, University of Portsmouth** *October 2017 - September 2020*
PhD in Cosmology
Research area: tests and simulations of modified gravity on galaxy cluster scales
Supervisors: Prof David Bacon, Prof Kazuya Koyama, Prof Bob Nichol

**University of Edinburgh** *September 2010 - July 2015*
Mphys in Physics
Thesis topic: phenomenology of hybrid inflation
Supervisor: Prof Andrew Liddle

## RESEARCH PROJECTS

**Testing Gravity Models with Screening Mechanisms** *Ongoing*

In this project we work towards testing modified gravity models with screening mechanisms using numerical techniques. Signatures of modified gravity could also be detected using galaxy cluster and cosmic void data. However, this depends strongly on the underlying mass distribution and the shape of the used clusters or voids. In this project we investigate how the modified gravity effects depend on the shape of galaxy clusters and voids. This is investigated using numerical techniques, such as the finite element method (FEM) as well by using cosmological simulation data.

**Emulating Cosmological Simulations Using Machine Learning** *Ongoing*

Using generative adversarial networks (GANs), to efficiently emulate large scale structure simulations. In addition, studying the use of machine learning in detecting modifications of gravity and different cosmologies using large scale structure simulation and observational data from galaxy clusters.

**Testing Modified Gravity on Galaxy Cluster Scales** *Ongoing*

In this project we use simulations and observational data (X-ray + weak lensing) to constrain various modified gravity models on galaxy cluster scales. In particular, our techniques allow putting strong constraints on models like Emergent Gravity, $f(R)$ and chameleon gravity. In addition we are working on expanding the tests to other models such as symmetron gravity and superfluid dark matter.

## PUBLICATIONS

**Published/preprint:**

- **A. Tamosiunas**, K. Koyama, H. A. Winther, D. Bacon, R. C. Nichol, B. Mawdsley, *Investigating Cosmological GAN Emulators Using Latent Space Interpolation*, MNRAS, **506(2)**, pp. 3049-3067, doi: 10.1093/mnras/stab1879, 2021

- **A. Tamosiunas**, D. Bacon, K. Koyama, R. C. Nichol, *Testing Emergent Gravity on Galaxy Cluster Scales*, JCAP, 2019(**05**), p. 053, doi: 10.1088/1475-7516/2019/05/053, 2019

**In preparation:**

- **A. Tamosiunas**, C. Briddon, C. Burrage, W. Cui, A. Moss, *Chameleon Screening Depends on the Shape and Structure of NFW Halos*, 2021, (to be submitted to JCAP)
- C. Briddon, C. Burrage, A. Moss, **A. Tamosiunas**, *Selkie: A Tool for Investigating the Chameleon Field of Arbitrary Sources*, 2021 (to be submitted to JCAP)

**Other:**

- PhD Thesis: *Testing and Emulating Modified Gravity on Cosmological Scales*, arXiv:2011.08786, 2020

## PROFESSIONAL EXPERIENCE

**EasyJet** *2015-2017*
*Yield Developer in the Data Science Department*

Developed artificial neural network and other big data algorithms to predict how the economic and non-economic events affect flight ticket prices.

## COLLABORATIONS

**Dark Energy Survey:** galaxy cluster working group
**Euclid:** cosmological simulation working group
**The Three Hundred Project:** member of the collaboration
**DISCnet:** a member of the Data Intensive Science Centre and the South East Physics Network

## GRANTS AND STUDENTSHIPS

| | | |
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| 06/2019 | **Research and Innovation Growth Funding** | GBP 2,000 |
| 06/2018 | **SA-DISCnet GCRF grant for a summer placement** | GBP 6,000 |
| 11/2017 | **DISCnet (data-intensive science) STFC studentship** | GBP 11,200/year |

## SELECTED TALKS

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| 07/2021 | **The Three Hundred Project Collaboration Meeting** |
| | *Looking for Fifth Force Using Galaxy Clusters* |
| 07/2021 | **National Astronomy Meeting 2021 (University of Bath)** |
| | *Tests of Modified Gravity with Simulations and Numerical Methods* |
| 04/2021 | **Cosmology Journal Club (ETH Zurich)** |
| | *Emulating Cosmological Simulations with Generative Adversarial Networks* |
| 03/2021 | **FEniCS 2021 (University of Cambridge)** |
| | *Astrophysical Tests of Gravity using FEniCS* |
| 03/2021 | **LPPM 2021: The First Lithuanian Particle Physics Meeting (CERN)** |
| | *Theoretical and Experimental Tests of Modified Gravity* |
| 11/2020 | **Weekly Cosmology Seminar (University of Oslo)** |
| | *Testing Modified Gravity with Galaxy Clusters* |

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| 12/2019 | **30th Texas Symposium on Relativistic Astrophysics (ICG, Portsmouth)** |
| | *Emulating Cosmological Simulations with GANs (**best student talk prize**)* |
| 11/2019 | **Dark Energy Survey Collaboration Meeting (University of Sussex)** |
| | *Testing Modified Gravity with Cluster Weak Lensing* |
| 04/2019 | **BritGrav 2019 (Durham University)** |
| | *Tests of Emergent Gravity on Galaxy Cluster Scales* |
| 04/2019 | **From Zero to Infinity (University of Southampton)** |
| | *Modified Gravity vs Dark Matter* |
| 03/2019 | **Cosmology Lunch Seminar (University of Sussex)** |
| | *Testing Emergent Gravity* |
| 01/2019 | **Testing Gravity 2019 (Simon Fraser University)** |
| | *Testing Emergent Gravity* |

## TECHNICAL STRENGTHS

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| **Simulations and HPC computing:** | L/MG-PICOLA, hi_class, Enzo, Google Cloud computing |
| **Simulation data analysis:** | Illustris, MultiDark, Millenium |
| **Numerical methods:** | finite element method (FEniCS/Dolfin) |
| **Machine learning:** | Deep learning, genetic algorithms, GANs/VAEs |

## TEACHING AND OTHER EXPERIENCE

**Particle Cosmology Journal Club Organiser** *2021*

Organize the bi-weekly particle cosmology group journal club

**30th Texas Symposium on Relativistic Astrophysics: Local Organizing Comity** *2019*

Helped in organizing the conference

**Work-Experience Summer Student Supervisor** *2019*

Supervised an A-level work-experience summer student

**Advanced Computational Physics Teaching Assistant** *2019*

Teaching 2nd and 3d year undergraduate students scientific programming

**"Isaac Physics" Teaching Assistant** *2019*

Helped A-level physics students to get prepared for the A-level physics exam