

# Faculty of Physics

## INSTITUTE OF THEORETICAL PHYSICS AND ASTRONOMY

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**Director** – Prof. Dr. Egidijus Anisimovas

### STAFF

**Distinguished professor:** Habil. Dr. G. Juzeliūnas

**Professors:** Prof. Dr. E. Anisimovas, Habil. Dr. A. Bartkevičius (affiliated), Habil. Dr. R. Karazija (affiliated), Prof. Habil. Dr. B. Kaulakys (affiliated), Prof. Dr. A. Kučinskas (part-time), Habil. Dr. G. Tautvaišienė (part-time), Prof. Dr. (HP) V. Vansevičius (part-time).

**Research professors:** Dr. K. Černis, Dr. A. Deltuva, Habil. Dr. G. Gaigalas, Dr. (HP) V. Gontis, Doc. Dr. V. Jonauskas, Prof. Dr. A. Kučinskas (part-time), Habil. Dr. L. Piliugin, Habil. Dr. G. Tautvaišienė (part-time).

**Associate professors:** Dr. A. Drazdauskas (part-time), Doc. Dr. T. Gajdosik, Dr. Š. Mikolaitis (part-time), Dr. D. Narbutis (part-time), Dr. E. Stonkutė (part-time), Dr. R. Stonkutė (part-time), Dr. K. Zubovas (part-time), Doc. Dr. D. Šatkovskienė (affiliated).

**Senior researchers:** Doc. Dr. A. Acus, Dr. A. Drazdauskas (part-time), Dr. R. Janulis (affiliated), Dr. A. Juodagalvis, Dr. C. von Essen, Habil. Dr. V. Gineitytė (affiliated), Dr. H. R. Hamedī, Dr. D. Jurčiukonis, Dr. R. Juršėnas, Dr. R. Karpuškienė, Dr. A. Kazlauskas (affiliated), Dr. R. Kisielius, Dr. L. Kitovienė, Doc. Dr. A. Kynienė, Dr. A. Kononovičius, Dr. S. Kučas (affiliated), Dr. Š. Masys, Dr. Š. Mikolaitis (part-time), Dr. R. Minkevičiūtė, Prof. Dr. (HP) E. Norvaišas (affiliated), Dr. V. Novičenko, Dr. E. Pakštienė, Dr. V. Regelskis, Dr. P. Rynkun, Dr. J. Sperauskas (affiliated), Dr. E. Stonkutė (part-time), Dr. J. Tamulienė, Dr. A. Vektarienė, Dr. G. Vektaris (affiliated), Dr. J. Zdanavičius.

**Assistants:** Dr. V. Dobrovolskas (part-time).

**Researchers:** Dr. Y. Chorniy, Dr. V. Čepas (part-time), Dr. V. Dobrovolskas (part-time), Dr. V. Dūdėnas, Dr. R. Kazakevičius, Dr. J. Klevas, Dr. V. Kudriašov (part-time), Dr. M. Mackoīt-Sinkevičienė, Dr. M. Maskoliūnas, Dr. A. Mekys (part-time), Dr. A. Momkauskaitė, Dr. V. Mulevičius, Dr. D. Semionov (part-time), Dr. C. Viscasillas Vázquez.

**Junior research fellows/assistants:** M. Ambrosch, M. Ambrozas, J. Braver, S. Draukšas, Š. Jacevičius, E. Kolomiecās, M. Račiūnas, S. Raudeliūnas (part-time).

**Doctoral students:** R. Adomavičienė, M. Ambrosch, M. Ambrozas, V. Bagdonas, B. Bale, J. Braver, S. Draukšas, E. Gvozdiovas, Š. Jacevičius, E. Kolomiecās, J. Koncevičiūtė, E. Ledinauskas, A. Sharma, R. Skorulskienė, A. Vitkus.

### RESEARCH AREAS

Analysis of atoms, subatomic particles or their ensembles, complex systems, electromagnetic radiation and cosmic objects

### RESEARCH INTERESTS

- Galactic structure and chemodynamical evolution of stellar populations
- Chemical composition and mixing phenomena in stellar atmospheres
- Convection and non-equilibrium radiative transfer in stellar atmospheres
- Stellar asteroseismology
- Planet hosting stars and exoplanet transits
- Structure and evolution of galaxies
- Search and positional observations of comets and asteroids
- Theoretical atomic spectroscopy
- Algorithms and computer programs for theoretical atomic spectroscopy, plasma physics, astrophysics, and other fields
- Application of quantum mechanics and electrodynamics for transitions in atoms, molecules and molecular complexes
- Interactions of atoms and molecules with electrons and radiation
- Modeling of nanoparticles
- Algebraic techniques for nuclear and particle physics
- Analysis of pp collision data recorded at CERN CMS experiment
- Neutrinos in the extended Standard model
- Scattering processes in few-body nuclear systems
- Quantum optics and ultra-cold atoms
- Bose-Einstein condensates
- Condensed matter systems
- Driven quantum systems
- Complexity and statistical physics
- Physics of socio-economic systems

## **DOCTORAL DISSERTATIONS MAINTAINED IN 2023**

J. Koncevičiūtė. Theoretical study of electron-impact double and triple ionization using multi-step approach.

## **MAIN CONFERENCES ORGANIZED IN 2023**

International summer school „Space Missions: Ground-based Observations and Science Communication“, August 8-18, 2023, Molėtai.

International school „Better Inclusion, Better Science, Building Impact in MW-GAIA“, July 3-5, 2023, Vilnius.

International meeting „Humboldt Kolleg on Synthetic Quantum Matter“, July 2-6, 2023, Vilnius

## **MAIN SCIENTIFIC ACHIEVEMENTS IN 2023**

**Quantum complexity and neural networks.** Neural network quantum states are a powerful tool for identifying the ground states of many-body quantum systems. However, due to their complex variational landscape, traditional methods rely on computing the quantum geometric tensor, leading to limited scalability and computational efficiency. We have introduced a method that avoids computing the metric tensor and relies solely on gradient descent with Euclidean metric. Our approach is

competitive with other state of the art methods and, by facilitating the use of larger neural networks, it could enable the exploration of previously intractable problems in many-particle quantum systems. The research, was published in E. Ledinauskas and E. Anisimovas, *SciPost Physics* 15, 229 (2023); doi: 10.21468/SciPostPhys.15.6.229.

**Physical Review C Editor's suggestion.** A. Deltuva and D. Jurčiukonis, Nonlocal optical potential in inelastic deuteron scattering off  $^{24}\text{Mg}$ , *Phys. Rev. C* 107, 064602 (2023). In this paper, nonlocal nucleon-nucleus optical potential with rotational quadrupole deformation is developed. Significant effects on the inelastic differential cross section are found at forward angles up to the first peak and at larger angles beyond the second peak. Nonlocal optical potential provides a simultaneous reasonable reproduction of the experimental data for the elastic and inelastic proton- $^{24}\text{Mg}$  and deuteron- $^{24}\text{Mg}$  scattering not achieved using local potentials.

## RESEARCH PROJECTS CARRIED OUT IN 2023

- **Projects Supported by University Budget**

**Chemical composition of stars and exoplanets, and chemical evolution of the Galaxy.** Dr. Habil. G. Tautvaišienė. 2021–2025. The main results include investigations of chemical evolution of Mg and Al in the Milky Way with machine learning; origin of neutron-capture elements and the evolution of s- and r-process elements across the Milky Way; searching for Milky Way twins using the radial abundance distribution as a strict criterion, preparations of the ground for 4MOST and WEAVE galactic surveys in chemical evolution investigations of lithium with machine learning.

### Main publications:

1. Ambrosch, M., Guiglion, G., Mikolaitis, Š., Chiappini, C., Tautvaišienė, G., Nepal, S., Gilmore, G., Randich, S., Bensby, T., Bayo, A., Bergemann, M., Morbidelli, L., Pancino, E., Sacco, G. G., Smiljanic, R., Zaggia, S., Jofré, P., & Jiménez-Esteban, F. M., The Gaia-ESO Survey: Chemical evolution of Mg and Al in the Milky Way with machine learning, *Astronomy and Astrophysics*, 672, A46 (2023).
2. Molero, M., Magrini, L., Matteucci, F., Romano, D., Palla, M., Cescutti, G., Viscasillas Vázquez, C., & Spitoni, E., Origin of neutron-capture elements with the Gaia-ESO survey: the evolution of s- and r-process elements across the Milky Way, *MNRAS*, 523, 2974 (2023).
3. Pilyugin, L. S., Tautvaišienė, G., & Lara-López, M. A., Searching for Milky Way twins: Radial abundance distribution as a strict criterion, *Astronomy and Astrophysics*, 676, A57 (2023).

**Magnetohydrodynamical phenomena and radiative transfer in stellar atmospheres.** Prof. Dr. A. Kučinskas. 2020–2024. We studied abundances of s-process element Sr in the atmospheres of red giant branch stars of the Galactic globular cluster (GGC) 47 Tuc. We find that Sr abundance is weakly correlated with that of Na. Together with the results of our earlier study of Zr in the same cluster, our findings suggest that the s-process elements have been synthesized by the same polluters that enriched the second population stars with light elements. Potential candidate polluters were discussed.

### Main publications:

1. Kolomicas, E., Kučinskas, A., Klevas, J., Dobrovolskas, V. Abundance of strontium in the Galactic globular cluster 47 Tuc, *Astronomy & Astrophysics*, in press (2024); doi: 10.1051/0004-6361/202347936

**Stochastic Effects in Stellar Systems.** Prof. Dr. (HP) V. Vansevicius. 2019–2023. Research activities were carried out in three main directions: i) studies of stochastic star formation history in the dwarf irregular galaxy Leo A; ii) studies of star clusters in the Andromeda galaxy (a new method stochastic cluster classification was developed); iii) studies of active galactic nucleus luminosity histories (a neural network-based approach was proposed).

**Main publications:**

1. I. Dumbryte, D. Narbutis, M. Androulidaki, et. al. Teeth Microcracks Research: Towards Multi-Modal Imaging. *Bioengineering*, Vol. 10 (12), 1354. (2023).
2. D. Samsonas, E. Skliutas, A. Čiburys, L. Kontenis, D. Gailevičius, J. Beržins, D. Narbutis, V. Jukna, M. Vengris, S. Juodkazis, M. Malinauskas. 3D nanopolymerization and damage threshold dependence on laser wavelength and pulse duration. *Nanophotonics* 12(8), 1537 (2023).
3. E. Skliutas, D. Samsonas, A. Čiburys, L. Kontenis, D. Gailevičius, J. Beržins, D. Narbutis, V. Jukna, M. Vengris, S. Juodkazis, M. Malinauskas. *Virtual and Physical Prototyping*, 18(1), e2228324 (2023).

**Astrometry and photometry of hazard asteroids.** Dr. K. Černis. 2023–2027. Twenty-five new asteroids have been discovered. New large Transneptunian object (TNO) 2021 XD7 was observed performing astrometry and photometry in 2023. We published about 6000 astrometric positions of more than 500 asteroids. Kuiper Belt, Near Earth Objects, Main Belt asteroids and comets were observed mainly with the 1.83 m Vatican Observatory telescope (Mt. Graham, Arizona, USA). Four asteroids were named by Gucevičius (453256), Žemaitė (348511), Maskoliūnas (225033) and Birštonas (555128).

**Main publications:**

1. Černis, K., Boyle, R. P. Astrometric and photometric observations of comet C/2022 E3 (ZTF) in Mt. Graham Observatory (Code 290). *M.P.C.* 162028 (2023 Apr. 7).
2. K. Černis, J. Zdanavičius. Astrometric observations of 19 asteroids (90 positions) in Moletai Astronomical Observatory (Code 152). *M.P.C.* 164852 (2023 Sep. 12).
3. Dalin, P., Suzuki, H., Pertsev, N., Perminov, V., Shevchuk, N., Tsimerinov, E., Zalcik, M., Brausch, J., McEwan, T., McEachran, I., Connors, M., Schofield, I., Dubietis, A., Černis, K., Zadorozhny, A., Solodovnik, A., Lifatova, D., Grønne, J., Hansen, O., Andersen, H., Melnikov, D., Manevich, A., Gusev, N., Romejko, V.: The strong activity of noctilucent clouds at middle latitudes in 2020. *Polar Science*, Vol. 35, 100920 (2023).

**Multielectron processes in complex atomic systems.** Dr. V. Jonauskas. 2019–2023. Electron-impact ionization was analyzed for all 34 levels of the ground configuration of the Fe<sup>2+</sup> ion. The single ionization from levels of the ground configuration of the N<sup>+</sup> ion was studied. The systematic theoretical study of the cascaded Auger decay following the 3d → 5p excitation was presented in Kr. The origin of the Kr<sup>3+</sup> ions in the cascade is explained by analyzing the influence of the correlation effects. Low-cost methods were tested to evaluate their performance in reproducing the geometries of paramagnetic defects in nanodiamonds. The quasirelativistic approach with transformed radial orbitals was utilized to determine spectroscopic parameters for the W<sup>32+</sup> ion.

**Main publications:**

1. S. Kučas, V. Jonauskas, Time evolution of the Auger cascade for Kr 3d<sup>9</sup>5p, *Phys. Rev. A* 108, 022810 (2023).

2. Š. Masys, V. Jonauskas, Z. Rinkevicius. Geometries of defects in nanodiamonds optimized with the low-cost methods: How good are they for the electronic g-tensor calculations? *Diam. Relat. Mater.* 136, 110009 (2023).
3. A. Kynienė, R. Kisielius, V. Jonauskas, Electron-impact single ionization for the Fe<sup>2+</sup> ion, *Astronomy & Astrophysics* 677, A170 (2023).

**Correlation and relativistic effects in complex atoms and ions.** Prof. G. Gaigalas. 2020–2024. Configuration state function generators (CSFGs) method has been developed. It was shown how the introduction of CSFGs allow for a substantial reduction of the computational load in RCI calculations. The computational methodology based on CSFGs was implemented in GRASP, it was applied to a number of atomic systems. It demonstrated reductions of CPU time with factors up to 68 for RCI calculations based on GSFG, restrictions on Breit integrals and with a priori condensed expansions compared to ordinary RCI calculations without restrictions on Breit integrals and with full expansions.

**Main publications:**

1. Y. T. Li, K. Wang, R. Si, M. Godefroid, **G. Gaigalas**, Ch. Y. Chen, and P. Jönsson, Reducing the computational load – atomic multiconfiguration calculations based on configuration state function generators, *Computer Physics Communications*, 283, 108562 (2023).
2. K. Hotokezaka, M. Tanaka, D. Kato, and **G. Gaigalas**, Tellurium emission line in kilonova AT 2017gfo, *Monthly Notices of the Royal Astronomical Society*, 526, L155 - L159 (2023).
3. P. Jönsson, M. Godefroid, **G. Gaigalas**, J. Ekman, J. Grumer, W. Li, J. Li, T. Brage, I.P. Grant, J. Bieroń, and C. Froese Fischer, An Introduction to Relativistic Theory as Implemented in GRASP, *Atoms*, 11, 7 (2023).

**Theoretical Study of Light Nuclei and Elementary Particles.** Dr. A. Deltuva. 2021–2025. Explicit formula for arbitrary function was obtained for diagonalizable multivectors of general Cl(p,q) Clifford algebras. Grothendieck ring of the Yangian was studied and new functional relations of transfer matrices were obtained. Singularity structure of the proton-deuteron scattering equations in the momentum-space was investigated.

**Main publications:**

1. A. Acus, A. Dargys, "Calculation of the Exponential in Arbitrary Clifford Algebra", p.16-27, *Lecture Notes in Computer Science (LNCS, volume 13862)* Part of the book series: LNCS, Empowering Novel Geometric Algebra for Graphics and Engineering 7th International Workshop, ENGAGE 2022, Virtual Event, September 12, 2022, Proceedings, <https://doi.org/10.1007/978-3-031-30923-6>
2. A. Acus, A. Dargys, "The characteristic polynomial in calculation of exponential and elementary functions in Clifford algebras", *Mathematical Methods in the Applied Sciences*, 2023 <https://onlinelibrary.wiley.com/doi/10.1002/mma.9524>

**Topological and kinetic properties of cold atoms and condensed molecular systems.** Habil. Dr. G. Juzeliūnas, 2022–2026. The influence of incremental methylene groups on the energetic properties of aromatic nitramines was established. The impact of electromagnetic field of radiation on valine is evaluated. It was demonstrated that atoms interacting with a pair of optical vortices produce a quantized torque on each trapped atom that is directly proportional to the topological charge of the vortex beams. This torque imparts a rotation to the entire ensemble, thereby generating an atomic

current flow. Quantum entanglement between a hole spin confined to a semiconductor quantum dot and a photon was investigated.

**Main publications:**

1. Hamid R. Hamed and Emmanuel Paspalakis, Harnessing optical vortices to control current flow via quantized torque in coherently prepared multilevel atoms, *Optik* 291, 171384(2023).
2. Meisam Memarzadeh, Mostafa Sahrai, and Hamid R. Hamed, Quantum entanglement between a hole spin confined to a semiconductor quantum dot and a photon, *The European Physical Journal Plus* 138, 75 (2023)
3. Teodora Kirova; Jelena Tamulienė, Numerical studies of the impact of electromagnetic field of radiation on valine, *Materials* 16, 1814 (2023).

**Complex nonlinear phenomena in stochastic physical and social systems.** Dr.(HP) V. Gontis. 2022–2025. We investigated the power-law distribution of limit order cancellation times in financial markets. The combination of power-law distributions for limit order volumes and cancellation times introduces a novel approach to modeling order disbalance in the financial markets. We have introduced a variant of the voter model with time-dependent herding behavior, demonstrating that despite being a Markov process, it behaves as a long-range memory process similar to the bounded fractional Brownian motion. We have examined the conditions necessary to observe pure  $1/f$  noise in a signal composed of nonoverlapping rectangular pulses: if the gaps are power-law distributed, then the pulses can follow any distribution as long as they are long on average.

**Main publications:**

1. V. Gontis, Discrete  $q$ -Exponential Limit Order Cancellation Time Distribution, *Fractal Fract.* 7, 581 (2023).
2. R. Kazakevičius, A. Kononovicius. Anomalous diffusion and long-range memory in the scaled voter model. *Physical Review E* 107: 024106 (2023).
3. A. Kononovicius, B. Kaulakys.  $1/f$  noise from the sequence of nonoverlapping rectangular pulses. *Physical Review E* 107: 034117 (2023).

- **National Research Projects**

**Optical Control of Ultracold atoms.** (Project No. S-MIP-20-36). Research Council of Lithuania. Project leader: Habil. Dr. G. Juzeliūnas. 2020–2023. Topological charge pumping was studied in subwavelength Raman lattices. By introducing an adiabatically varied phase in the driving protocol, Thouless pumping was demonstrated in a time crystalline structure. Two-dimensional (2D) optical lattice was proposed and analyzed for ultracold atoms with spatial features below the diffraction limit created by a bichromatic optical standing wave. Subwavelength confinement of a quantum emitter in ladder configuration was analyzed adjacent to a nanostructured plasmonic metasurface.

**Main publications:**

1. D. Burba, M. Račiūnas, I. B. Spielman and G. Juzeliūnas, Topological charge pumping with subwavelength Raman lattices, *Phys. Rev. A* 107, 023309 (2023).
2. E. Gvozdiovas, I. B. Spielman and G. Juzeliūnas, Interference-induced anisotropy in a two-dimensional dark-state optical lattice, *Phys. Rev. A* 107, 033328 (2023).
3. Hamid R. Hamed, Viktor Novičenko, Gediminas Juzeliūnas, Vassilios Yannopoulos and Emmanuel Paspalakis, Subwavelength confinement of a quantum emitter in ladder configuration adjacent to a nanostructured plasmonic metasurface, *Physica E* 151, 115711(2023).

**Spin-orbit coupling for the generation of non-trivial quantum correlations in ultra-cold atomic systems.** (Project No. S-LL-21-3). Research Council of Lithuania. 2021-2024. Project leader: Habil. Dr. G. Juzeliūnas. Interaction of light with atoms characterized by a larger spin was studied aimed at finding the ways to produce squeezing for such atoms placed in an optical lattice. A publication on this topic is currently under preparation.

**Coherent Optical Control of Atomic Systems.** (Project No. P-LLT-22-14). Research Council of Lithuania. 2022-2024. Project leader: Habil. Dr. G. Juzeliūnas. It was demonstrated that it is possible to generate and control dynamically synthetic Landau levels and robust chiral edge states for neutral dark-state polaritons using electromagnetically induced transparency in our theoretical studies. Azimuthal dependence of electromagnetically induced grating in a double V-type atomic system next to a plasmonic nanostructure allowing to remote distance control of Fraunhofer diffraction patterns. The propagation and generation of matched optical vortices of slow light within a four-level tripod atomic system was investigated.

**Main publications:**

1. Y.-H. Kuan, S.-Y. Lee, S.-W. Shao, W.-C. Chiang, I.-K. Liu, J. Ruseckas, G. Juzeliūnas, Y.-J. Lin, and W.-T. Liao, Synthetic Landau levels and robust chiral edge states for dark-state polaritons in a static and scalable continuum media, *Phys. Rev. Research* **5**, L042029 (2023).
2. S. H. Asadpour, Teodora Kirova, Hamid R. Hamedi, V. Yannopapas and E. Paspalakis, Azimuthal dependence of electromagnetically induced grating in a double V-type atomic system near a plasmonic nanostructure, *The European Physical Journal Plus* **138**, 246 (2023).
3. Hamid R. Hamedi, Ite A. Yu, and Emmanuel Paspalakis, Matched optical vortices of slow light using a tripod coherently prepared scheme, *Phys. Rev. A* **108**, 053719 (2023).

**Few-cluster nuclear reactions: towards many-body problem.** (Project No. S-MIP-22-72). Research Council of Lithuania. 2022–2025. Project leader: Dr. A. Deltuva. Nonlocal optical potentials considering collective degrees of freedom via the core excitation were developed for nucleon interaction with Be-10 and Mg-24. Using rigorous momentum-space integral equations for transition operators, deuteron inelastic scattering and stripping and pickup reactions were studied. The nonlocality effect was shown to improve the consistency in the description of two- and three-cluster reactions.

**Main publications:**

1. Nonlocal optical potential with core excitation in  $^{10}\text{Be}(d, p)^{11}\text{Be}$  and  $^{11}\text{Be}(p, d)^{10}\text{Be}$  reactions. A. Deltuva, D. Jurčiukonis, *Phys. Lett. B* **840**, 137867 (2023).
2. Nonlocal optical potential in inelastic deuteron scattering off  $^{24}\text{Mg}$ . A. Deltuva, D. Jurčiukonis, *Phys. Rev. C* **107**, 064602 (2023).

**An Investigation of Kilonova Ejecta in Neutron Star Merger.** (Project No. S-LJB-23-1). Research Council of Lithuania. 2023–2025. Project leader: Habil. Dr. G. Gaigalas. Atomic properties calculations were done for Ge-like sequence: As II, Se III, Br IV, and Kr V. The multiconfiguration Dirac-Hartree-Fock and RCI methods were used in the present research. We computed the energy levels of  $4s^24p^2$ ,  $4s4p^3$ ,  $4p^4$ ,  $4s^24p\{5s, 6s, 5p, 6p, 4d, 5d, 4f\}$ , and  $4s4p^2\{4d, 5s\}$  configurations and E1, M1, and E2 transitions between states of these configurations. The accuracy of transition data was investigated using the quantitative and qualitative evaluation method. We applied our results to astrophysics by constructing the list of M1-type transitions for kilonova.

**Chemical elements as clocks for the stellar age determination.** (Project No. S-MIP-23-24). Research Council of Lithuania. 2023–2026. Project leader: Habil. Dr. G. Tautvaišienė. The project aims to address the emerging chemical-clock method applicability in different Galactic disc radial and vertical locations and stellar populations by investigating Galactic field stars and open stellar clusters. In 2023, we investigated the role of radial migration in open cluster and field star populations using Gaia DR3 data for 40 open clusters and 66 000 main sequence turn-off field stars.

**Main publications:**

1. Viscasillas Vázquez, C., Magrini, L., Spina, L., Tautvaišienė, G., Van der Swaelmen, M., Randich, S., & Germano Sacco, G., The role of radial migration in open cluster and field star populations with Gaia dr3, *Astronomy and Astrophysics*, 679, A122 (2023).

**The dynamical evolution of open clusters in the Perseus arm of the Milky Way galaxy.** (Project No. S-MIP-23-89). Research Council of Lithuania. 2023–2026. Dr. J. Zdanavičius. The project aims to understand the Galactic disk's formation and evolution investigating Open clusters in the disruption process. We will use Gaia DR3 astrometry coupled with available Gaia DR3 broadband photometry, Vilnius system photometry, PanSTARRS medium band photometry, and infra-red photometry from 2MASS and UKIRT GPS surveys to search for previously missed clusters members. We observed 10 open clusters with the aim to make the standards of the Vilnius photometric system.

**Comparison of neutron capture chemical elements enrichment in Galactic thin and thick disks.** (Project No. P-ST-22-124). Research Council of Lithuania (Students' research during the semester). 2022/09/01 – 2023/03/31. Student – Vilius Bagdonas, project supervisor – Habil. Dr. Gražina Tautvaišienė. During this project, student Vilius Bagdonas derived abundances of barium, lanthanum, cerium, praseodymium, neodymium and europium for more than 100 stars in the solar neighbourhood. The results were used to draw conclusions about the evolution of thin and thick Galactic discs.

**Action plan of Lithuanian associate membership at CERN 2022 - 2027.** Lithuanian Ministry of Education, Science and Sports. Project leader - prof. R. Aleksiejūnas (VU Institute of Photonics and Nanotechnologies). Project participants, members of the Nuclear and elementary particle physics group: dr. A. Juodagalvis, dr. D. Jurčiukonis, assoc. prof. T. Gajdosik, dr. V. Dūdėnas, PhD students S. Draukšas and M. Ambrozus. Activities at the Compact Muon Solenoid (CMS) experiment focused on the analysis of the proton-proton collision data recorded with the CMS detector and the pixel detector prototype testing software for the Phase-2 CMS upgrade. The data-driven background estimation procedure for the Drell-Yan differential cross-section measurement was scrutinized for Run-2 CMS data selecting the best approach. The  $d\sigma/dm$  measurement analysis approaches the pre-approval stage. Improvements were made to computer software that is used to characterize and calibrate the pixel detector prototype chips. The chip test site preparations started. Remote DAQ and on-site DCS shifts at the CMS detector control center were taken. The On-Shell renormalization scheme for scalars has been defined to all orders in perturbation theory. Zbb couplings in a left-right model and both two- and three-body lepton-flavour-violating decays in the Grimus-Neufeld model were studied. Also, the investigation of oblique parameters and the analysis of the centers of discrete groups as stabilizers of dark matter were undertaken.

**Main publications:**



1. D. Jurčiukonis and L. Lavoura, *The Zb vertex in a left–right model*, Nucl. Phys. B 996 (2023) 116373. (<https://doi.org/10.1016/j.nuclphysb.2023.116373>).
2. D. Jurčiukonis and L. Lavoura, *The centers of discrete groups as stabilizers of dark matter*, PTEP **2023** (2023) 2, 023B02. (<https://doi.org/10.1093/ptep/ptad004>).
3. V. Dūdėnas, T. Gajdosik, U. Khasianevich, W. Kotlarski, D. Stöckinger, *Box-enhanced charged lepton flavor violation in the Grimus-Neufeld model*, Phys. Rev. D 107 (2023) 5, 055027. (<https://doi.org/10.1103/PhysRevD.107.055027>).

- **International Research Projects**

**EUROPLANET2024 – Research Infrastructure.** (Project No. 871149). EC Horizon2020 project. 2020 – 2024. Dr. Habil. G. Tautvaišienė. We were working within the work packages dedicated to on-ground observations and early careers training and education. Using observations at the Molėtai Astronomical Observatory, exoplanet-hosting stars were investigated as well as transits of exoplanets. We have organized the international summer school „Space missions: ground-based observations and science communication“, August 8-18, 2023 at the Molėtai Observatory. The research course on asteroid observations was organized at the Tartu Observatory in Estonia. The international conference “Europlanet Telescope Network Science Workshop” was organized in Slovakia.

**Main publications:**

1. Marciniak, A., ... Adomavičienė, R., ... Pakštienė, E., et al. Scaling slowly rotating asteroids with stellar occultations, *Astronomy and Astrophysics*, 679, A60 (2023).

**Chemical Elements as Tracers of the Evolution of the Cosmos – Infrastructures for Nuclear Astrophysics (ChETEC-INFRA).** (Grant agreement No. 101008324). EC Horizon 2020 project. 2021-2025. Prof. Dr. A. Kučinskas. Nuclear astrophysics requires a diverse set of research infrastructures for progress: telescopes for astronomical observations, nuclear laboratories to measure nuclear properties, and supercomputers to compute complex stellar models. ChETEC-INFRA project (<https://www.chetec-infra.eu>) networks 13 infrastructures from a variety of European countries. Under the umbrella of this project, 3 nights have been provided in 2021 at Molėtai astronomical observatory (MAO) for the international project aimed to study the origins of s-process elements using the MAO VUES spectrograph. A. Kučinskas leads a ChETEC-INFRA Work Package 5 (WP5) “Astronuclear Abundances”. A pilot grid of 1.5D NLTE abundance corrections for Ba has been produced in 2024 and analysis of s-process elements in the first MINCE sample has been accomplished, two papers are in the submission stage.

**Main publications:**

1. François, P., Cescutti, G., Bonifacio, P., Caffau, E., Monaco, L., Franchini, M., Lombardo, L., Matas Pinto, A. M., Lucertini, F., Spitoni, E., Lallement, R., Sbordone, L., Mucciarelli, A., Spite, M., Hansen, C. J., Di Marcantonio, P., Kučinskas, A., Dobrovolskas, V., Korn, A. J., Valentini, M., Magrini, L., Cristallo, S., Matteucci, F. MINCE II. Neutron capture elements. 2022, *Astronomy & Astrophysics*, submitted.

International programme **Gaia-ESO Spectroscopic Survey** (ESO project 188.B-3002). Dr. Habil. G. Tautvaišienė. 2012 – 2023. The main results include constraints on the origin of the r-process elements in the Galactic thin-disc population. We found that Eu in the thin disc is predominantly produced by

sources with short lifetimes, such as magneto-rotationally driven supernovae. While mapping the shape and evolution of the radial abundance gradients in the Galaxy with open clusters, we determined that the [Fe/H] gradient has a slope of -0.054 dex/kpc. We provided evidence that there are super-metal-rich stars in the Solar vicinity which were relocated from the inner parts of the Galaxy.

### **Main publications:**

1. Van der Swaelmen, M., Viscasillas Vázquez, C., Cescutti, G., Magrini, L., Cristallo, S., Vescovi, D., Randich, S., Tautvaišienė, G., Bagdonas, V., Bensby, T., Bergemann, M., Bragaglia, A., Drazdauskas, A., Jiménez-Esteban, F., Guiglion, G., Korn, A., Masseron, T., Minkevičiūtė, R., Smiljanic, R., Spina, L., Stonkutė, E., & Zaggia, S., The Gaia-ESO survey: Placing constraints on the origin of r-process elements, 2023, *Astronomy and Astrophysics*, 670, A129.
2. Magrini, L., Viscasillas Vázquez, C., Spina, L., Randich, S., Romano, D., Franciosini, E., Recio-Blanco, A., Nordlander, T., D'Orazi, V., Baratella, M., Smiljanic, R., Dantas, M. L. L., Pasquini, L., Spitoni, E., Casali, G., Van der Swaelmen, M., Bensby, T., Stonkute, E., Feltzing, S., Sacco, G. G., Bragaglia, A., Pancino, E., Heiter, U., Biazzo, K., Gilmore, G., Bergemann, M., Tautvaišienė, G., Worley, C., Hourihane, A., Gonneau, A., & Morbidelli, L., The Gaia-ESO survey: Mapping the shape and evolution of the radial abundance gradients with open clusters, 2023, *Astronomy and Astrophysics*, 669, A119.
3. Dantas, M. L. L., Smiljanic, R., Boesso, R., Rocha-Pinto, H. J., Magrini, L., Guiglion, G., Tautvaišienė, G., Gilmore, G., Randich, S., Bensby, T., Bragaglia, A., Bergemann, M., Carraro, G., Jofré, P., & Zaggia, S., The Gaia-ESO Survey: Old super-metal-rich visitors from the inner Galaxy, 2023, *Astronomy and Astrophysics*, 669, A96.

International programme **PLATO Science Management**. Prof. Dr. A. Kučinskas. 2020 – 2027. A long-term partnership has been established in late 2020 between the Stellar Atmosphere Physics (SAP) group at ITPA and the European Space Agency's science mission "PLATO" Science Management Work Package 120 "Stellar Science", with prof. dr. A. Kučinskas and dr. J. Klevas becoming the PLATO WP 120 official members. During 2023 the SAP group at ITPA has provided the PLATO Science Management consortium with an extensive grid of 3D hydrodynamical model atmospheres of M-type dwarfs which, in cooperation with the PLATO consortium, will be used for the determination of 3D NLTE chemical abundances in the atmospheres of the PLATO target stars. A publication summarizing first scientific results is in preparation, the publication on the entropy calibration across the H-R diagram has been submitted for publication. The M-dwarf grid, first results from adding magnetic fields to the M-dwarf model atmospheres and current model atmosphere computations at Vilnius University were presented in an invited talk at the sixth PLATO WP122 ("Non-seismic parameters and model atmospheres") workshop held in April 25-26th in Liege (Belgium) by A. Kučinskas and J. Klevas.

COST Action CA22113 "**Fundamental challenges in theoretical physics**". Dr. Vidas Regelskis and Dr. Vincentas Mulevičius. 2023-2027. This project aims to develop a comprehensive approach for studying strongly-interacting systems in classical and quantum physics by exploiting symmetries, dualities, and the internal consistency of the underlying theories. It will bring together theoretical and mathematical physicists with expertise in quantum field theory, string theory, gravity, geometry and information theory, thus establishing the first network of this kind centered around Europe. The project will involve a number of activities such as conferences, research workshops and summer schools across the participating countries. It is planned that a summer school and a workshop on "Quantum Symmetries and Quantum Topology" will be held in Lithuania in June 2026, provided facility requirements for the meeting are met.

COST Action CA18104 „**Revealing the Milky Way with Gaia**” (ORIGINS) (<https://www.cost.eu/actions/CA18104>). Action Chair: Nicholas Walton) (28 countries). Dr. Š. Mikolaitis, Managing Committee Member, Lead of the Working Group 5. 2019–2023. We organised a workshop "MW-Gaia WG5 School: Better Inclusion, Better Science, Building Impact in MW-GAIA". It was held from July 3 to 5 in cooperation with the Embassy of Spain in Lithuania. Nine lecturers and tutors shared their experience with 43 students from 16 countries on-site and online. Three public events were held: (1) Sara Garcia's (ESA astronaut) talk “Human Spaceflights in the 21st Century” at the Vilnius University Library Scientific Communication and Information Center, on July 4; (2) The meeting with Dr. Enrique Pérez-Montero at the Lithuanian Audiosensory Library on June 5; (3) The exhibition "AstrónomAs" at the Institute of Theoretical Physics and Astronomy from 3 to 10 July.

NSF Collaborative Project AST/2009811 “**Fulfilling the Atomic Physics Needs for Spectroscopic Diagnostics of Cosmic Chemical Evolution**” PI: Prof. V.P. Kulkarni, Collaborator: R. Kisielius, 2020.09 – 2023.09. The converged data set of oscillator strengths for the key ultraviolet resonant, excited, and fine-structure lines of the P II ion was produced by employing a quasirelativistic Hartree-Fock approximation. Data accuracy was evaluated applying a feed-back from observed astrophysical spectra obtained with the Far-Ultraviolet Spectroscopic Explorer for OB stars and the Very Large Telescope for a quasar.

“**Construction of atomic data and plasma modeling toward understanding the origin of heavy elements**” (FY2023 NIFS General Collaboration Project, Japan). NIST supervisors: Dr. D. Kato, Collaborators: Prof. Dr. G. Gaigalas, Dr. L. Kitovienė, Dr. P. Rynkun. 2023 April 1 to 2024 March 31. Using the atomic data (AD) calculated with HULLAC and GRASP, the absorption coefficient in the kilonova ejecta and light curves of kilonova were calculated and the impact of the accuracy in AD was evaluated. Comparing the experimental data of laser induced breakdown spectroscopy at UEC with theoretical AD, accurate AD for Ce III and La III were developed. Systematic M1 transition data covering all the elements to understand the properties of late-time emission-line spectra of kilonovae were constructed. Using these data, non-LTE calculations of emission line spectra were performed.

International Atomic Energy Agency, “**Electron-impact ionization for injected impurities into the plasma**” (project No. 26498/SU2213), Dr. V. Jonauskas, 2022-2027. Intentional injection of impurities into plasma of the thermonuclear reactors plays an important role in the field of nuclear fusion. This process helps to reduce a potential damage to structural materials composing walls and critical components of the reactors. Nitrogen is one of elements that is used as a seeding impurity in the thermonuclear reactors to reduce power reached by divertor components. Electron impact ionization of nitrogen atom has been theoretically investigated for direct and indirect processes.

## **MAIN R&D&I (RESEARCH, DEVELOPMENT AND INNOVATION) PARTNERS**

Aarhus University (Denmark)

European Organization for Nuclear Research CERN (Switzerland)

Astrophysical Institute Potsdam, Potsdam (Germany)

Landessternwarte Heidelberg, University of Heidelberg, Heidelberg (Germany)

Max Planck Institute for Astronomy, Heidelberg (Germany)  
Darmstadt University, Darmstadt (Germany)  
Observatoire de Paris, CNRS, Université Paris Diderot (France)  
Oslo University, Oslo (Norway)  
Osservatorio Astronomico di Trieste, Trieste (Italy)  
Uppsala University Observatory, Uppsala (Sweden)  
Odessa National University, Odessa (Ukraine)  
Center for Physical Sciences and Technology (Lithuania)  
National Institute of Standards and Technology (USA)  
University of Patras (Greece)  
National Institute for Fusion Science (Japan)  
National Tsing Hua University, Hsinchu (Taiwan)  
Materials Science and Applied Mathematics, Malmö University, Malmö (Sweden)  
University of Lisbon (Portugal)  
University of Seville (Spain)  
Pisa University & INFN (Italy)  
Institute of Physics, Polish Academy of Sciences (Poland)  
KTH Royal Institute of Technology (Sweden)  
University of South Carolina (USA)  
Space Telescope Science Institute (USA)  
Institute of Electron Physics, Ukrainian National Academy of Sciences (Ukraine)  
University of Latvia, Riga (Latvia)  
National Technical University of Athens (Greece)

## **OTHER RESEARCH ACTIVITIES**

### **Prof. Dr. E. Anisimovas –**

- chairman of the [Council of the Faculty of Physics](#), Vilnius University;
- board member of the [Lithuanian Quantum Technologies Association](#).

### **Dr. A. Deltuva –**

- member of the [International Faddeev Medal Committee](#);
- national representative of the European Research Committee for Few-Body Physics.

### **Dr. V. Dobrovolskas –**

- member of the [Lithuanian Astronomical Society](#);
- member of the [European Astronomical Society](#).

### **Dr. A. Drazdauskas –**

- member of the [International Astronomical Union](#) (IAU);

### **Dr. K. Černis –**

- member of the [International Astronomical Union](#) (IAU);
- member of the [European Astronomical Society](#).

### **Prof. Habil. Dr. G. Gaigalas –**

- council member of [CompAS](#) (International collaboration on Computational Atomic Structure) group;
- editorial board member of the journal [Atoms](#);

- member of the Programme Committee, [45<sup>th</sup> Lithuanian National Conference of Physics](#), Vilnius, Lithuanian 25-27 October, 2023.

**Dr. T. Gajdosik**

- member of the [Austrian Physical Society](#) (OePG);
- member of the CERN Baltic Group coordination team “Study group”.

**Dr. V. Gontis –**

- member of the [EuroScience](#) association;
- council member of the [Lithuanian Scientific Society](#);
- academic editor of the journal [Plos One](#).

**Dr. V. Jonauskas -**

- member of the [Lithuanian Physics Society](#);
- member of [The Global Network for the Atomic and Molecular Physics of Plasmas](#) (International Atomic Energy Agency);
- member of the Programme Committee, [45<sup>th</sup> Lithuanian National Conference of Physics](#), Vilnius, Lithuanian 25-27 October, 2023.

**Dr. A. Juodagalvis –**

- Lithuanian representative in CERN Finance Committee (since 2018);
- member of the Research Group Board of the Lithuanian Particle Physics Consortium (VU, KTU, and LSMU), coordinator of the Consortium activities at CERN CMS experiment (since 2023);
- deputy team leader of the Vilnius University group at the CMS experiment at CERN, Vilnius University representative to the CMS Tracker Institutional Board;
- member of the Programme Committee, [45<sup>th</sup> Lithuanian National Conference of Physics](#), Vilnius, Lithuanian 25-27 October, 2023;
- board member of the [Lithuanian Physical Society](#), scientific secretary.

**Dr. D. Jurčiukonis –**

- member of the Research Group Board of the Lithuanian Particle Physics Consortium (VU, KTU, and LSMU).

**Dr. R. Juršėnas –**

- member of the [American Mathematical Society](#).

**Distinguished Professor G. Juzeliūnas –**

- member of the [Lithuanian Academy of Sciences](#);
- Board member of the [Lithuanian Physics Society](#);
- Associated member of the National Center for Theoretical Sciences at the National Tsing Hua University, Taiwan;
- main organiser of the [Humboldt Kolleg on Synthetic Quantum Matter](#), Vilnius, Lithuania, 2-6 July 2023;
- member of the Programme Committee, [45<sup>th</sup> Lithuanian National Conference of Physics](#), Vilnius, Lithuanian 25-27 October, 2023;
- member of Programme Committee, 25<sup>th</sup> International Conference – School on Advanced Materials and Technologies, Palanga, Lithuania, 21 – 25 August 2023;
- academic editor of the journal [Plos One](#).

**Dr. H. R. Hamedī –**

- member of [Lithuanian Physics Society](#);
- member of [Physics Society of Iran](#).

**Prof. Habil. Dr. B. Kaulakys –**

- member of the [Institute of Physics](#) (UK);
- member of the [European Physical Society](#);
- editorial board member of the [Lithuanian Journal of Physics](#);
- editorial board member of the journal [Nonlinear Analysis, Modeling and Control](#);
- vice-president of the Lithuanian Association of Nonlinear Analysts.

**Prof. R. Karazija –**

- member of the [Lithuanian Academy of Sciences](#);
- fellow of the [Institute of Physics](#) (UK);
- member of the [Italian Physical Society](#).

**Dr. L. Kitovienė**

- member of [CompAS](#) (International collaboration on Computational Atomic Structure) group;

**Dr. A. Kynienė –**

- President of the Vilnius City Board of the Physics Teachers' Association;
- member of the Vilnius City Physics Methodical Board;
- [team leader of Particle physics outreach group at the VU Experimental nuclear and particle physics centre](#);
- chairwoman of the physics maturity exam evaluation commission;
- member of the Lithuanian Pupil Physics Olympiad Commission;
- council member of the [Lithuanian Scientific Society](#);
- member of the Programme Committee, [45th Lithuanian National Conference in Physics \(Vilnius, Lithuania, October 25-27, 2023\)](#);
- member of [Lithuanian Physics Society](#);
- member of [The Global Network for the Atomic and Molecular Physics of Plasmas](#) (International Atomic Energy Agency)

**Dr. J. Klevas –**

- board member of the [Lithuanian Astronomical Society](#);
- member of the [International Astronomical Union](#) (IAU);
- member of the [European Astronomical Society](#) (EAS);
- revisor of the [Lithuanian Society of Young Researchers](#).

**Prof. A. Kučinskas –**

- chairperson of the Board of Directors of the International Journal [Astronomy and Astrophysics](#);
- member of the [Council of the Faculty of Physics](#), Vilnius University;
- member of Bachelor study programme committee "Physics";
- National Contact Point of the [International Astronomical Union](#) (IAU);
- National Representative at the [European Astronomical Society](#) (EAS);
- president of the [Lithuanian Astronomical Society](#).

**Dr. M. Mackoīt-Sinkevičienė –**

- Board member of the [Lithuanian Physics Society](#);
- president of the European Physical Society Young Minds section in Vilnius (2016-2022 03 01), elected Member of Action Committee of EPS Young Minds (since 2022);
- representative of Lithuania in [World Quantum Day](#) Action Committee (since 2020);
- member of the International Board at [IPhO](#) (since 2021);
- member of the [Lithuanian Society of Young Researchers](#).

**Dr. M. Maskoliūnas –**

- member of the [International Astronomical Union](#) (IAU).

**Dr. Š. Mikolaitis –**

- member of the [International Astronomical Union](#) (IAU);
- member of the Organizing Committee, [IAU Commission “Stellar Evolution”](#);
- member of the [European Astronomical Society](#);
- co-chair of Organizing Committee, International school „[Better Inclusion, Better Science, Building Impact in MW-GAIA](#)“, July 3-5, 2023, Vilnius.

**Dr. R. Minkevičiūtė –**

- member of the [International Astronomical Union](#) (IAU).

**Dr. D. Narbutis –**

- member of the [International Astronomical Union](#) (IAU).

**Prof. Dr. (HP) E. Norvaišas –**

- member of the [Institute of Physics](#) (UK);
- member of the [European Physical Society](#).

**Dr. E. Pakštienė –**

- member of the [International Astronomical Union](#) (IAU).

**Dr. V. Regelskis**

- associated member of the [Higher Education Academy](#) (HEA);
- member of the [Lithuanian Mathematical Society](#).

**Dr. P. Rynkun**

- member of [CompAS](#) (International collaboration on Computational Atomic Structure) group.

**Rigonda Skorulskienė –**

- Board member of the [Lithuanian Physics Society](#);
- board member of the [Lithuanian Astronomical Society](#);
- president of the Physics Teachers' Association of Lithuania;
- Team Chair and Contact Person, [IAU NAEC \(National astronomy education coordinator\) team](#).

**Dr. J. Sperauskas –**

- member of the [International Astronomical Union](#) (IAU).

**Dr. E. Stonkutė –**

- member of the [International Astronomical Union](#) (IAU).
- member of the [European Astronomical Society](#);
- secretary of the [Europlanet Society](#);
- member of the [Opticon RadioNet Pilot](#) project time allocation committee.

**Dr. R. Stonkutė –**

- member of the [International Astronomical Union](#) (IAU).

**Assoc. prof. dr. Dalia Šatkovskienė –**

- member of Board of Administration (BoA), [European Platform of Women Scientists](#) (EPWS);
- President of regional Baltic States association [BASNET Forumas](#);
- Lithuanian Team member of IUPAP working group on Women in Physics (WP5);
- CMC member of [COST action CA20137](#) - Making Early Career Researchers' Voices Heard for Gender Equality, representing the second proposer Vilnius University.
- represents Vilnius University in European Physicists [GENERA](#) network.

**Dr. J. Tamulienė –**

- Management Committee member of the [Lithuanian Physics Society](#);
- leader of the Professional Union of Vilnius University.
- ETUCE, HERCS board member;
- Guest Editor of Special issue “[Trends and Prospects in Advanced Energy Materials](#)”;
- Member of the working group for updating the description of educational science areas.

**Dr. Habil. G. Tautvaišienė –**

- President of [Commission H1 The Local Universe](#), International Astronomical Union;
- Steering Committee Member of the [Division H Interstellar Matter and Local Universe](#), International Astronomical Union;
- President of the [Lithuanian Physical Society](#);
- member of the [Research Council of Lithuania](#);
- member of the [International Astronomical Union](#) (IAU);
- International Astronomy Union [National Outreach Coordinator](#);
- founding member of the [European Astronomical Society](#) (EAS);
- editorial board member of the “[Mol](#)” journal;
- editor-in-chief of the annual astronomical almanac [Lietuvos dangus](#) (*Sky of Lithuania*);
- Chair of the [45<sup>th</sup> Lithuanian National Conference of Physics](#), Vilnius, Lithuanian 25-27 October, 2023;
- Chair of the OC of the international summer school „Space missions: ground-based observations and science communication”, August 8-18, 2023, Molėtai Observatory, Lithuania;
- Co-Chair of the international training workshop “Asteroid Investigations”, August 21-25, 2023, Tartu Observatory, Estonia;
- Co-Chair of the international conference “Europlanet Telescope Network Science Workshop”, 19-23 June 2023, Bratislava, Slovakia.

**Prof. Dr. V. Vansevičius –**

- member of the [International Astronomical Union](#) (IAU);
- member of the [European Astronomical Society](#) (EAS)
- member of the [Research Council of Lithuania](#).



**Dr. C. Viscasillas Vázquez –**

- member of the [International Astronomical Union](#) (IAU);
- member of the [European Astronomical Society](#) (EAS)
- member of the [Lithuanian Astronomical Society](#);
- member of the [Spanish Astronomical Society](#) (SEA);
- member of the [Europlanet Society](#);
- member of the [Science Society of Galicia](#) (SCG);
- National representative of the [European Association for Astronomy Education](#) (EAAE);
- member of the [Network for Astronomy School Education](#) (NASE);
- member of the Organizing Committee, International school „[Better Inclusion, Better Science, Building Impact in MW-GAIA](#)“, July 3-5, 2023, Vilnius.
- member of the Organizing Committee, International workshop "[From Star Clusters to Field Populations: Survived, Destroyed and migrated clusters](#)", November 20-23, 2023, Villa Galileo, Arcetri, Italy.

**Dr. J. Zdanavičius –**

- member of the [International Astronomical Union](#) (IAU).

**Dr. K. Zubovas –**

- member of the [Council of the Faculty of Physics](#), Vilnius University.

**BEST REPORTS DELIVERED AT CONFERENCES ABROAD**

1. “Internal Levin-Wen models”, invited talk by V. Mulevičius at Winter Workshop on Topological Order, Universität Tübingen, Germany, 29 November, 2023.
2. Invited talk by G. Tautvaišienė „CNO as key elements in stellar and galactic evolution” at the Nicolaus Copernicus World Congress, 19-21 February, 2023, Torun, Poland.
3. Invited talk by G. Tautvaišienė “Opportunities within the Europlanet 2024 Research Infrastructure” at the European Astronomical Society Annual Meeting, 10-14 July, 2023, Krakow, Poland.
4. Invited talks by Arūnas Kučinskas & Jonas Klevas “Vilnius 3D models” at the sixth PLATO WP122 ("Non-seismic parameters and model atmospheres") workshop, 25-26 April, 2023, Liege, Belgium.
5. Invited talk by E. Stonkutė “Europlanet Mentorship programme: past, present and future” at the European Astronomical Society Annual Meeting, 10-14 July, 2023, Krakow, Poland.
6. Invited talk by A. Deltuva “Nonlocal interactions for few-body reactions” at the Workshop on the Critical Stability of Few-Body Quantum Systems, ECT, Trento, Italy, 23-27 October, 2023.

**MOST IMPORTANT PARTICIPATION CASES OF RESEARCHERS IN WORKING GROUPS OR COMMISSIONS SET UP BY STATE AUTHORITIES, STATE AND MUNICIPAL INSTITUTIONS, ORGANISATIONS, BUSINESS ENTITIES**

Habil. Dr. G. Tautvaišienė is a member of the Research Council of Lithuania.

Prof. dr. V. Vansevičius was a member of the Research Council of Lithuania (until June 2023).

Doc. A. Kynienė is the chair of the Assessment of National Physics Maturity Examination Commission, member of the education program redevelopment group, and member of the Vilnius City Physics Methodical Board.

R. Skorulskienė - is a member of the Assessment of National Physics Maturity Examination Commission; a member of the education program redevelopment group; a member of working group to renew the teacher training mode

## **CONSULTATIONS PROVIDED BY THE UNIT TO THE PUBLIC OR ECONOMIC ENTITIES**

Regular consultations to various Police departments regarding astronomical conditions during the requested time periods when car accidents occurred, A. Kazlauskas.

Regular consultations to the general public regarding unusual astronomical events and the identification of suspected extraterrestrial-origin stones, G. Tautvaišienė.

Regular school consultations in the field of elementary particle physics, A. Kynienė, A. Acus, A. Juodagalvis, A. Mekys.

## **MOST IMPORTANT RESEARCH DISSEMINATION ACTIVITIES**

1. Annual popular science edition “Lietuvos dangus 2024“, published since 1989 (ISSN 1392-0987), 142 pages in Lithuanian, Responsible editor: Habil. Dr. Gražina Tautvaišienė.
2. Traveling exhibition “AstrónomAs” at the Institute of Theoretical Physics and Astronomy (Vilnius University, Faculty of Physics) Vilnius, Lithuania, July 3-10, 2023, and public seminar of Sara Garcia (ESA astronaut) “Human spaceflights in the 21st century” at the Vilnius University Library Scientific Communication and Information Center (July 4, 2023).
3. Meeting with the professional astronomer Dr. Enrique Pérez-Montero at the Lithuanian Audiosensory Library, July 5, 2023. Pérez-Montero is visually impaired and involved with the Spanish National Organization for Blind People (ONCE) where he collaborates to promote astronomy among the visually impaired community.
4. International Conference „The Situation of Young Researchers in the Baltic States: Development or Waste of Future Scientific Potential?“ organized by D. Šatkovskienė under the auspices of the speaker of the Lithuanian Parliament (Seimas), 23 of December, 2023.
5. In 2023, Dr. A. Kononovičius authored a total of 33 posts on the Physics of Risk blog (<https://rf.mokslasplius.lt>), which is available in English. Among these posts, 18 feature interactive content. Typically, these interactive elements were implementations of various econophysical or sociophysical models.