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Director – Dr. Habil. *Gražina Tautvaišienė*

STAFF

Distinguished professor: Habil. Dr. G. Juzeliūnas

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

Research professors: Dr. K. Černis, Dr. A. Deltuva, Prof. Habil. Dr. G. Gaigalas, Dr. (HP) V. Gontis, Doc. Dr. V. Jonauskas, Habil. Dr. B. Kaulakys (part-time), Dr. H. Kjeldsen, Dr. A. Kučinskas (part-time), Dr. J. Ruseckas, Habil. Dr. G. Tautvaišienė (part-time), Habil. Dr. K. Zdanavičius (affiliated).

Associate professors: Doc. Dr. T. Gajdosik, Dr. D. Narbutis (part-time), Dr. R. Stonkutė (part-time), Dr. K. Zubovas (part-time), Doc. Dr. D. Šatkovskienė (affiliated).

Senior researchers: Doc. Dr. A. Acus, Dr. F. Grundahl, Dr. R. Janulis (part-time), Dr. A. Juodagalvis, Habil. Dr. V. Gineitytė (affiliated), Dr. D. Jurčiukonis, Dr. R. Karpuškienė, Dr. A. Kazlauskas (part-time), Dr. R. Kisielius, Dr. A. Kynienė, Dr. S. Kučas, Dr. Š. Mikolaitis, Prof. Dr. (HP) E. Norvaišas (part-time), Dr. E. Pakštienė, Dr. V. Regelskis, Dr. J. Sperauskas, Dr. E. Stonkutė, Dr. J. Tamulienė, Dr. A. Vektarienė, Dr. G. Vektaris, Dr. J. Zdanavičius.

Researchers: Dr. K. Brogaard, Dr. Y. Chorniy, Dr. V. Čepas (part-time), Dr. V. Dobrovolskas, Dr. A. Drazdauskas, Dr. V. Dūdėnas, Dr. C. von Essen, Dr. R. Juršėnas, Dr. H. R. Hamedi, Dr. R. Kazakevičius, Dr. J. Klevas, Dr. A. Kononovičius, Dr. V. Kudriašov (part-time), Dr. Š. Masys, Dr. M. Maskoliūnas, Dr. R. Minkevičiūtė, Dr. A. Mekys (part-time), Dr. A. Momkauskaitė, Dr. V. Novičenko, Dr. L. Radžiūtė, Dr. P. Rynkun.

Research assistants: M. Macijauskas (part-time), M. Račiūnas (part-time), S. Raudeliūnas (part-time), G. Žlabys (part-time).

Project-specialists: M. Amrozas (part-time), V. Bagdonas (part-time), K. Bobraitis (part-time), S. Draukšas (part-time), K. Šiškauskaitė (part-time), C. Viscasillas Vazquez (part-time), M. Ambrosch (part-time).

Doctoral students: M. Ambrosch, S. Draukšas, E. Kolomiecās, J. Koncevičiūtė, S. Pakalka, M. Račiūnas, C. Viscasillas Vazquez, G. Žlabys.

Non-academic staff: V. Kakarienė, B. Kavaliauskienė, S. Lovčikas, Ž. Naimovičienė, B. Šatkovskis, B. Prunskienė (part-time).

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 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

Theoretical investigation of crystalline and electronic structure of perovskite crystals

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

Quantum chemistry

Complexity and statistical physics applications in economics, finance and other social sciences

Fluctuations and noise, theory of 1/f noise

MAIN CONFERENCES ORGANIZED IN 2019

International Workshop of the COST CA CA16117 Action “Chemical Elements as Tracers of the Evolution of the Cosmos”, WG3 “Astronomical observations and interpretation”, Feb 27 – Mar 1, 2019, Vilnius, <http://www.chetec.eu/events/chetec-working-group-3-workshop-2019>

Lithuanian National Physics Conference LNFK-43, October 3 – 5, Kaunas University of Technology, Kaunas, <https://lnfk43.ktu.edu/#Organizacinis-komitetas>

International summer school “Space missions: ground-based observations and science communication”, June 11 – 21, 2019, VU ITPA Molėtai Astronomical Observatory, <http://www.mao.tfai.vu.lt/europlanett2019>

MAIN SCIENTIFIC ACHIEVEMENTS IN 2019

A linear relationship between stellar ages and their carbon-to-nitrogen abundance ratios was derived for giant stars in the Gaia-ESO Survey on a basis of the elemental abundances determined by the Vilnius University Node lead by G. Tautvaišienė. The paper was published in *Astronomy and Astrophysics*, 629, id.A62, 26 pp. by G. Casali et al. and highlighted in *Nature Research* <https://www.nature.com/articles/d41586-019-02729-8>

RESEARCH PROJECTS CARRIED OUT IN 2019

Projects Supported by University Budget

Stellar chemical composition and asteroseismic activity in the Milky Way Galaxy. Dr. Habil. G. Tautvaišienė. 2016–2020.

We continued our investigations of mixing processes in evolved stars. Using observational data from the Gaia-ESO spectroscopic survey, we performed the chemical composition analysis of stellar photospheres and compared the results with the latest stellar evolution models. We investigate the effects of thermohaline mixing on C and N abundances. The current models including thermohaline mixing are able to reproduce very well the C and N abundances over the whole metallicity range investigated by the Gaia-ESO survey data. We also investigated transit timing variation trends for planet-harboring stars WASP-12 and WASP-4. We combined the data of previous observations together with the newly acquired data from the TESS satellite and this allowed us to identify possible additional companions in their planetary systems. Furthermore, looking at the GM Cephei star, we identified possible structures in its circumstellar disk, which might include dust clumps of various sizes.

Main publications:

Lagarde, N.; Reylé, C.; Robin, A. C.; Tautvaišienė, G.; Drazdauskas, A.; Mikolaitis, Š.; Minkevičiūtė, R.; Stonkutė, E.; Chorniy, Y.; Bagdonas, V.; Miglio, A.; Nasello, G.; Gilmore, G.; Randich, S.; Bensby, T.; Bragaglia, A.; Flaccomio, E.; Francois, P.; Korn, A. J.; Pancino, E.; Smiljanic, R.; Bayo, A.; Carraro, G.; Costado, M. T.; Jiménez-Esteban, F.; Jofré, P.;

Martell, S. L.; Masseron, T.; Monaco, L.; Morbidelli, L.; Sbordone, L.; Sousa, S. G.; Zaggia, S., The Gaia-ESO Survey: impact of extra mixing on C and N abundances of giant stars, 2019, *Astronomy & Astrophysics*, Volume 621, id.A24, pp. 10.1051/0004-6361/201732433

Baluev, R. V.; Sokov, E. N.; Jones, H. R. A.; Shaidulin, V. Sh; Sokova, I. A.; Nielsen, L. D.; Benni, P.; Schneider, E. M.; Villarreal D'Angelo, C.; Fernández-Lajús, E.; Di Sisto, R. P.; Baştürk, Ö.; Bretton, M.; Wunsche, A.; Hentunen, V. -P.; Shadick, S.; Jongen, Y.; Kang, W.; Kim, T.; Pakštienė, E.; Qvam, J. K. T.; Knight, C. R.; Guerra, P.; Marchini, A.; Salvaggio, F.; Papini, R.; Evans, P.; Salisbury, M.; Garcia, F.; Molina, D.; Garlitz, J.; Esseiva, N.; Ogmen, Y.; Karavaev, Yu; Rusov, S.; Ibrahimov, M. A.; Karimov, R. G. Homogeneously derived transit timings for 17 exoplanets and reassessed TTV trends for WASP-12 and WASP-4, 2019, *Monthly Notices of the Royal Astronomical Society*, Volume 490, Issue 1, p.1294-1312 10.1093/mnras/stz2620

Huang, P. C.; Chen, W. P.; Mugrauer, M.; Bischoff, R.; Budaj, J.; Burkhanov, O.; Ehgamberdiev, S.; Errmann, R.; Garai, Z.; Hsiao, H. Y.; Hu, C. L.; Janulis, R.; Jensen, E. L. N.; Kiyota, S.; Kuramoto, K.; Lin, C. S.; Lin, H. C.; Liu, J. Z.; Lux, O.; Naito, H.; Neuhäuser, R.; Ohlert, J.; Pakštienė, E.; Pribulla, T.; Qvam, J. K. T.; Raetz, St.; Sato, S.; Schwartz, M.; Semkov, E.; Takagi, S.; Wagner, D.; Watanabe, M.; Zhang, Yu, Diagnosing the Clumpy Protoplanetary Disk of the UXor Type Young Star GM Cephei, 2019, *The Astrophysical Journal*, Volume 871, Issue 2, article id. 183, pp. 10.3847/1538-4357/aaf793

Star formation and dust clouds in the Orion and Perseus arms of the Galaxy. Prof. V. Straižys. 2016–2020.

The open clusters IC 1369 in Cygnus and its vicinity was investigated applying two-dimensional photometric classification of stars measured in the Vilnius seven-color photometric system. Cluster members were identified applying the Gaia DR2 parallaxes and proper motions. The following parameters of the cluster were derived: the distance is 3300 ± 450 pc, the mean extinction is 2.54 mag, the age is 300–350 Myr. In the direction of IC 1369 the extinction rise up to about 2.0 mag takes place at 300–700 pc and is caused by the dust cloud LDN 970 and the northern extension of the Great Cygnus Rift. The catalogue of the investigated stars in the direction of IC 1369 contains 2694 stars down to 20 mag.

Main publications:

Straižys, V., Boyle, R. P., Raudeliūnas, S., Zdanavičius, J., Janusz, R., Macijauskas, M., Lazauskaitė, R., K., Černis, Zdanavičius, K., Maskoliūnas, M., Čepas, V., and Kazlauskas, A., Open cluster IC 1369 and its vicinity: multicolor photometry plus Gaia DR2 astrometry, submitted to “The Astronomical Journal”.

Hydrodynamical phenomena and radiative transfer in stellar atmospheres. Dr. A. Kučinskas. 2015–2019.

We investigated the influence of convection on the formation of spectral lines of diatomic molecules CH and OH in the metal-poor subgiant BD+44493. We demonstrate that the influence of convection is very significant which, in turn, may lead to abundance corrections for carbon and oxygen of up to 0.6 and 0.9 dex if determined from the CH and OH lines, respectively. Our findings show that abundance corrections for the two elements do change with the metallicity and may thus influence the trends of [O/Fe]-[Fe/H] and [C/Fe]-[Fe/H] observed in various Galactic populations.

Main publications:

Kolomicas, E., A. Kučinskas, A., J. Klevas, H.-G. Ludwig, M. Steffen, P. Bonifacio, E. Caffau, 3D LTE abundances of carbon and oxygen from molecular lines in the metal-poor subgiant BD+44493, submitted to “Astronomy and Astrophysics”.

Stochastic Effects in Stellar Systems. Prof. Dr. (HP) V. Vansevičius. 2019–2023.

We studied the Leo A galaxy based on deep Subaru and HST photometry data and discovered 5 star clusters of low mass. Two clusters are young (~ 20 Myr) and overlapping with H II regions, the other three clusters are older (≥ 100 Myr). For the first time it was shown that star clusters can form in such low metallicity galaxies with undetected molecular gas. We investigated the possibility that tidal disruptions of stars are responsible for the observed AGN in dwarf galaxies. The calculated properties of outflows driven by AGN show that they might have noticeable effects on the host galaxies. We derived spectroscopic orbits of 57 stars, mostly nearby dwarfs of spectral types K and M. Their periods range from 2.2 days to 14 years. Many stars belong to hierarchical systems containing three or more components, including 20 new hierarchies discovered.

Main publications:

Stonkutė, R., Naujalis, R., Čeponis, M., Leščinskaitė, A., Vansevičius, V. 2019. Star clusters in the dwarf irregular galaxy Leo A. *Astronomy and Astrophysics*, 627, id.A7, 5 pp.

Zubovas, K. 2019. Tidal disruption events can power the observed AGN in dwarf galaxies. *Monthly Notices of the Royal Astronomical Society*, 483, 1957-1969.

Sperauskas, J., Deveikis, V., Tokovinin, A. 2019. Spectroscopic orbits of nearby stars. *Astronomy & Astrophysics*, 626, id.A31, 17 pp.

Astrometry and photometry of small Solar-system bodies. Dr. K. Černis. 2016–2020.

Thirteen new asteroids have been discovered. A new precise orbit of the NEO object 1986 DA was determined. We detected its rotational period and other physical characteristics. Fourier transform was applied to determine its rotation period of (3.12 ± 0.02) h. We published 5712 astrometric positions of 1550 asteroids. Near Earth Objects, TNO, Main Belt asteroids and comets were observed with the 0.35/0.51 m Maksutov telescope (Molėtai Observatory), with the 0.80/1.20 m Schmidt telescope (Baldone Observatory, Latvia), with the 1.8 m Vatican telescope (Mt. Graham, Arizona, U.S.A.), and with the 0.65 m Hamiltonian telescope (Crimea, Ukraine). Noctilucent clouds were observed in summer time from the Vilnius station. Five asteroids were named by Švitrigaila, Kakaras, Klimka, and Baldone.

Main publications:

Černis, K., Egliūtis, I. Discovery of nine new asteroids and astrometric observations of 550 asteroids (1944 positions) in Baldone Astronomical Observatory (Code 069). M.P.C. 112836 (2019 May. 18).

Borisov, G., Černis, K. Discovery of Mars crosser asteroid 2019 VH6 and astrometric observations of comet C/2019 V1 (Borisov) in Crimea Astronomical Observatory (Code L51). M.P.E.C. 2019-X120 .

Černis, K., R. Boyle, Kikwaya, J. B. Astrometric observations of 27 asteroids (156 positions) in Vatican Astronomical Observatory (Code 290). M.P.C. 112843 (2019 May. 18).

Multielectron processes in complex atomic systems. Dr. V. Jonauskas. 2019–2023.

The ab initio quasirelativistic approach developed specifically for the calculation of spectral parameters of highly charged ions was used to derive transition data for the Nb-like tungsten ion W33+. Electron-impact single-ionization cross sections for the W5+ ion have been studied experimentally and theoretically. Electronic g-tensor calculations were done for paramagnetic defects inserted into small hydrogenated nanodiamond, showing that it can be used to model magnetic properties of defects with no vacancies.

Main publications:

R. Karpuškienė, R. Kisielius. Theoretical level energies and transition data for 4p64d5, 4p54d6 and 4p64d44f configurations of W33+ ion. *At. Data and Nucl. Data Tables*, 125, 287-312 (2019).

V. Jonauskas, A. Kynienė, S. Kučas, S. Pakalka, Š. Masys, A. Prancikevičius, A. Borovik, Jr., M. F. Gharaibeh, S. Schippers, and A. Müller. Electron-impact ionization of W5+, *Phys. Rev. A* 100, 062701 (2019).

V. Jonauskas, Š. Masys, Double- and triple-Auger processes in C1+, *J. Quantitative Spectroscopy and Radiative Transfer*, 229, 11 – 16 (2019).

Correlation and relativistic effects in complex atoms and ions. Prof. G. Gaigalas. 2015–2019.

New method of continuum wave functions computation was demonstrated for Xe atom. EDM moments were computed and continuum contribution to the atom electric dipole moment (EDM) was evaluated. New version of GRASP programme package was prepared and published in the latest Fortran 95 version. New version of the program for relativistic isotope shift computations (RIS4) was prepared.

Main publications:

P. Syty, J. E. Sienkiewicz, L. Radžiūtė, G. Gaigalas, P. Rynkun and J. Bieroń, Continuum wave functions for estimating the electric dipole moment: Calculation based on a multiconfiguration Dirac-Hartree-Fock approximation, *Physical Review A* **99**, 012514 (2019) (<https://doi.org/10.1103/PhysRevA.99.012514>).

J. Ekman, P. Jonsson, M. Godefroid, C. Naze, G. Gaigalas, J. Bieroń, RIS4: A program for relativistic isotope shift calculations, *Computer Physics Communications* 235, 433-446 (2019) (DOI: 10.1016/j.cpc.2018.08.017).

C. Froese Fischer, G. Gaigalas, P. Jonsson, J. Bieron, GRASP2018-A Fortran 95 version of the General Relativistic Atomic Structure Package, *Computer Physics Communications* 237, 184-187 (DOI: 10.1016/j.cpc.2018.10.032).

Theoretical Study of Light Nuclei and Elementary Particles. Dr. A. Deltuva. 2016–2020.

The four-neutron system was studied in the framework of exact continuum equations, demonstrating the shortcomings of bound-state-type treatments and the absence of an observable tetraneutron resonance. Differential cross sections and analyzing powers have been calculated for three-body breakup reactions involving various light nuclei (deuteron, helium, beryllium, carbon) and polarized proton or electron beams. Renormalization of the finite-range inverse-cube potential was investigated in two- and three-body systems.

Main publications:

Comment on "Is a trineutron resonance lower in energy than a tetraneutron resonance?" A. Deltuva, R. Lazauskas, Phys. Rev. Lett. 123, 069201 (2019).

Tetraneutron resonance in the presence of a dineutron. A. Deltuva, R. Lazauskas, Phys. Rev. C 100, 044002 (2019).

Core-excitation effects in three-body breakup reactions studied using the Faddeev formalism. A. Deltuva, Phys. Rev. C 99, 024613 (2019).

Optical, Kinetic, and Topological Properties of Cold Atoms and Condensed Molecular Structures. Habil. Dr. G. Juzeliūnas, 2018–2021.

A method was proposed and studied allowing to achieve a complete energy conversion between laser pulses carrying orbital angular momentum in a cloud of cold atoms characterized by a double-Lambda atom-light-coupling scheme. Propagation of optical solitons was investigated in a medium of atoms characterized by five energy levels coupled in a cyclic way. The combination of oscillating magnetic forces and radio-frequency (rf) pulses was shown to provide rf photons with tunable momentum. It was demonstrated that the Larkin-Ovchinnikov state can be realized in a bilayer Fermi gas of ultracold atoms subjected to a laser-assisted interlayer tunneling. The redox activity of 2-arylamino-benzoquinones was studied by calculation of quantum chemical structure-activity descriptors. New data on the fragmentation of the glutamine molecule under low-energy electron impact were obtained. The resolvent formulas of Krein-Naimark type were presented in terms of the gamma-field and the abstract Weyl function.

Main publications:

V. Galitski, G. Juzeliūnas and I. B. Spielman, Artificial gauge fields with ultracold atoms, Physics Today **72**(1), 38 (2019).

H. R. Hamed, J. Ruseckas, E. Paspalakis, and G. Juzeliūnas, Transfer of optical vortices in coherently prepared media, Phys. Rev. A **99**, 033812 (2019).

B. Shteynas, J. Lee, F. C. Top, J.-R. Li, A. O. Jamison, G. Juzeliūnas and W. Ketterle, How to Dress Radio-Frequency Photons with Tunable Momentum, Phys. Rev. Lett. **123**, 033203 (2019).

Evolution and Statistics of Complex Systems. Prof. B. Kaulakys. 2017–2021.

We proposed and generalized the Bessel-like birth-death process having clear representation by the SDEs. The new process helps us to integrate the alternatives of description and to derive the equations for the probability density function (PDF) of the burst and inter-burst duration of the proposed continuous time birth-death processes. We have performed analysis

of NBA regular season data showing that the empirical observations are consistent with random models, thus disproving presence of memory in these time series.

Main publications:

V. Gontis, A. Kononovičius. Bessel-like birth-death process. *Physica A* **540**: 123119 (2020). [doi: 10.1016/j.physa.2019.123119](https://doi.org/10.1016/j.physa.2019.123119).

A. Kononovičius. Illusion of persistence in NBA 1995-2018 regular season data. *Physica A* **520**: 250-256 (2019) [doi: 10.1016/j.physa.2019.01.039](https://doi.org/10.1016/j.physa.2019.01.039).

National Research Projects

Global Grant research project „**Stellar and exoplanet investigations in the context of the TESS and JWST space missions**” (No. 09.3.3-LMT-K-712-01-0103) Dr. habil. G. Tautvaišienė, 2018 – 2022.

In this project we aim to carry out a detailed spectral analysis for a sample of about 1000 bright Galactic field F, G, and K stars and to analyze observations of the NASA TESS space telescope data obtained in the northern sky. We have already observed all 302 stars in the northern continuous viewing zone of the TESS space telescope. The main atmospheric parameters and the chemical composition have been determined. Together with data from other surveys we have derived the kinematic parameters and ages for our sample of objects. The TESS spacecraft is currently carrying out observations in this exact region, and the data which will be available soon, will allow us to investigate planet hosting stars and their planets in more detail.

Main publications:

Huber, D.; Chaplin, W. J.; Chontos, A.; Kjeldsen, H.; Christensen-Dalsgaard, J.; Bedding, T. R.; Ball, W.; Brahm, R.; Espinoza, N.; Henning, T.; Jordán, A.; Sarkis, P.; Knudstrup, E.; Albrecht, S.; Grundahl, F.; et al. A Hot Saturn Orbiting an Oscillating Late Subgiant Discovered by TESS, 2019, *The Astronomical Journal*, Volume 157, Issue 6, article id. 245, pp. 10.3847/1538-3881/ab1488

von Essen, C.; Wedemeyer, S.; Sosa, M. S.; Hjorth, M.; Parkash, V.; Freudenthal, J.; Mallonn, M.; Miculán, R. G.; Zibecchi, L.; Cellone, S.; Torres, A. F., Indications for transit-timing variations in the exo-Neptune HAT-P-26b, 2019, *Astronomy & Astrophysics*, Volume 628, id.A116, pp. 10.1051/0004-6361/201731966

von Essen, C.; Stefansson, G.; Mallonn, M.; Pursimo, T.; Djupvik, A. A.; Mahadevan, S.; Kjeldsen, H.; Freudenthal, J.; Dreizler, S., First light of engineered diffusers at the Nordic Optical Telescope reveal time variability of the optical eclipse depth of WASP-12b, 2019, *Astronomy & Astrophysics*, Volume 628, id.A115, pp. 10.1051/0004-6361/201935312

Global Grant research project “**Quantum engineering in cold atomic gases**” (No. 09.3.3-LMT-K-712-01-0051) Prof. E. Anisimovas, 2018 – 2022.

We focused on the study of quantum gases in quasiperiodic optical lattices. These systems support phasonic degrees of freedom that are unique to quasiperiodic structures, play a central role in poorly-understood properties of quasicrystals but are challenging to access dynamically in the solid state. We realized phasonic spectroscopy of a quasicrystal, using quantum gas in a quasiperiodic optical lattice. We observed that strong phasonic driving produces a

nonperturbative high-harmonic response strikingly different from the effects of standard dipolar driving, and identified spectroscopic signatures of quasiperiodicity and interactions.

Main publications:

H. R. Hamedī, E. Paspalakis, G. Žlabys, G. Juzeliūnas, and J. Ruseckas, Complete energy conversion between light beams carrying orbital angular momentum using coherent population trapping for a coherently driven double- Λ atom-light-coupling scheme, *Physical Review A* 100, 023811 (2019).

S. V. Rajagopal, T. Shimasaki, P. Dotti, M. Račiūnas, R. Senaratne, E. Anisimovas, A. Eckardt, and D. M. Weld, Phasonic Spectroscopy of a Quantum Gas in a Quasicrystalline Lattice, *Physical Review Letters* 123, 223201 (2019).

Research Council of Lithuania. **Quantum phases and phase transitions in restricted-geometry condensates** (No. APP-4/2016). Prof. dr. E. Anisimovas. 2016–2019.

The project was completed during the first three months of the year. We focused on quantum dynamics of systems with fast spatial modulation of the Hamiltonian. Employing the formalism of supersymmetric quantum mechanics and decoupling fast and slow spatial oscillations we demonstrated that the effective dynamics is governed by a Schrödinger-like equation of motion and constructed the effective Hamiltonian.

Main publications:

V. Novičenko, J. Ruseckas, and E. Anisimovas, Quantum dynamics in potentials with fast spatial oscillations, *Physical Review A* 99, 043608 (2019).

Research Council of Lithuania. **Interstellar clouds and star forming in the Great Cygnus Rift of the Milky Way** (S-MIP–17-74). Dr. S. A. Kazlauskas. 2017 – 2019.

A goal of this project is to investigate a group of interstellar clouds and star forming regions (SFRs) located in the direction of the Great Cygnus Rift, between the Galactic longitudes 70 – 90 deg. Using the seven-colour Vilnius photometric system as well as astrometric data from the Gaia orbiting observatory we determined the membership, distances, ages, and interstellar extinction to the open clusters IC 4996.

Main publications:

Straižys, V., Boyle, R.P., Milašius, K., Černis, K., Macijauskas, M., Munari, U., Janusz, R., Zdanavičius, J., Zdanavičius, K., Maskoliūnas, M., Raudeliūnas, S., Kazlauskas, A. *A young open cluster IC 4996 and its vicinity: multicolor photometry plus Gaia DR2 astrometry*, *Astronomy & Astrophysics*, 623, A22 (2019)

Research Council of Lithuania postdoctoral fellowship **Physical modeling of order book and opinion dynamics** (09.3.3-LMT-K-712-02-0026). Dr. A. Kononovičius, supervisor dr. J. Ruseckas, 2017 – 2020.

A method to approximate the first passage time distributions of the birth-death processes was proposed. An extension of the voter model which reproduces empirical census and electoral data was proposed. The extension removes opinion dynamics, but introduces the movement into the voter model.

Main publications:

A. Kononovičius, Compartmental voter model, Journal of Statistical Mechanics 2019: 103402 (2019). [doi: 10.1088/1742-5468/ab409b](https://doi.org/10.1088/1742-5468/ab409b).

A. Kononovičius and J. Ruseckas, Order book model with herding behavior exhibiting long-range memory, Physica A 525: 171-191 (2019). [doi: 10.1016/j.physa.2019.03.059](https://doi.org/10.1016/j.physa.2019.03.059).

A. Kononovičius and V. Gontis, Approximation of the first passage time distribution for the birth-death processes, Journal of Statistical Mechanics 2019: 073402 (2019). [doi: 10.1088/1742-5468/ab2709](https://doi.org/10.1088/1742-5468/ab2709).

Research Council of Lithuania postdoctoral fellowship **Algebraic analysis of strongly correlated systems** (09.3.3-LMT-K-712-02-0017). Dr. V. Regelskis, supervisor dr. A. Acus, 2017 – 2019.

The vacuum vector triviality issue in the orthogonal spin chains was resolved. A new algebraic fusion-based approach to the spectral problem to oust the lesser perturbative approach was developed.

Main publications:

A. Gerrard, N. MacKay and V. Regelskis, Nested Algebraic Bethe Ansatz for Open Spin Chains with Even Twisted Yangian Symmetry, Ann. Henri Poincaré, Volume 20 (2019), p. 339-392. <https://doi.org/10.1007/s00023-018-0731-1>

N. Guay, V. Regelski and C. Wendlandt, Vertex representations for Yangians of Kac-Moody algebras, Journal de l'École polytechnique — Mathématiques, Volume 6 (2019), p. 665-706. <https://doi.org/10.5802/jep.103>

Research Council of Lithuania postdoctoral fellowship. **Functionalized nanodiamonds: Investigation of magnetic properties** (09.3.3-LMT-K-712-02-0077). Dr. Š. Masys, supervisor dr. J. Tamulienė, 2017 – 2019.

Electronic g-tensor dependence on the size, shape, and surface functionalization of nanodiamonds (NDs) was investigated by selecting dangling bonds and single substitutional nitrogen atoms as paramagnetic defects. The performed calculations have revealed that paramagnetic defects introduced into smaller models of NDs behave in a very similar manner as those embedded into larger ones, but g-tensor dependence on different shape and surface functionalization can be considered as more pronounced.

Main publications

Š. Masys, Z. Rinkevičius, J. Tamulienė, On the magnetic properties of nanodiamonds: Electronic g-tensor calculations, J. Chem. Phys. 151, 044305 (2019)

Š. Masys, Z. Rinkevičius, J. Tamulienė, Electronic g-tensors of nanodiamonds: Dependence on the size, shape, and surface functionalization, J. Chem. Phys. 151, 144305 (2019)

Research Council of Lithuania postdoctoral fellowship **Theoretical study of atomic parameters with applications to astrophysics** (Nr. 09.3.3-LMT-K-712-02-0072). Dr. P. Rynkun, supervisor Prof. Dr. G. Gaigalas, 2017 – 2019.

We obtain accurate and extensive results of electric dipole (E1), magnetic dipole (M1), and electric quadrupole (E2) transition for Cl III and Ar IV ions using MCDHF and RCI methods. The accuracy of results is evaluated comparing energy levels with data from NIST database and by the agreement of transition rates between length and velocity gauges. The averaged uncertainty of computed energy levels compared with NIST data is 0.18% and 0.21%, respectively for Cl III and Ar IV ions. The mean dT for all presented E1 transitions is 5.95% and 6.47%, respectively, for the Cl III and Ar IV ions.

Main publications:

P. Rynkun, G. Gaigalas, P. Jönsson, Theoretical investigation of energy levels and transition data for S II, Cl III, Ar IV, *Astronomy & Astrophysics* **623**, A155 (2019). (<https://doi.org/10.1051/0004-6361/201834931>)

Research Council of Lithuania postdoctoral fellowship **Topological properties of periodically driven quantum systems** (09.3.3-LMT-K-712-0.2-0065) Dr. V. Novičenko, supervisor dr. habil. G. Juzeliūnas, 2017 – 2019.

We consider a quantum spin-particle in a magnetic field which oscillates in time. By neglecting kinetic energy of a spin-particle, we show that oscillating magnetic field with slowly varying amplitude induces Non-Abelian geometric phases into evolution operator. For the case of spin-particle with kinetic energy, spatially non-homogeneous oscillating magnetic field induces spin-orbit coupling potential. Such potential can have form of a purely 3D spin-orbit coupling when three components of the orbital angular momentum operator coupled with three components of the spin operator.

Main publications

V. Novičenko, G. Juzeliūnas: Non-Abelian geometric phases in periodically driven systems, *Phys. Rev. A* **100**, 012127 (2019)

P. Račkauskas, V. Novičenko, H. Pu, G. Juzeliūnas: Non-Abelian geometric potentials and spin-orbit coupling for periodically driven systems, *Phys. Rev. A* **100**, 063616 (2019)

EU Structural Funds project “**Equip schools with the tools of nature and technology education**” (No. 09.1.3-CPVA-V-704-02-0001), leader Education supply centre of the ministry of education and science of the Lithuanian, one of the executors Dr. A. Kynienė, 2017 – 2019.

Training Equipment Kits for school-children of 5–8 level that provide appropriate general education programmes were selected. 30 descriptions of teaching aids and equipment for physics teacher were developed and 5 video descriptions were prepared for harder tasks.

International Research Projects

EC Horizon2020 project “**EUROPLANET2020 – Research Infrastructure**” (project No. 654208). Dr. Habil. G. Tautvaišienė. 2015 – 2019.

We were working within the work packages dedicated to on-ground observations, coordination and training of amateur astronomers and planetary science outreachers. A summer school was organized on June 11– 21, 2019 at the Molėtai Astronomical Observatory. The aim of the course was to give participants an introduction into space missions and the ground-based observations required by space missions before and after launch, as well as an introduction to science communication. 21 participants from 16 countries (Armenia, Austria, Bulgaria, Croatia, France, Georgia, Germany, Ireland, Italy, Lithuania, Norway, Spain, Poland, Romania, Turkey, United Kingdom) have been trained.

Main publications:

Scherf, M.; Snodgrass, C.; Kargl, G.; Hueso, R.; Tautvaisiene, G.; Podlewska-Gaca, E.; Santana-Ros, T.; Colas, F., Amateur collaboration within Europlanet 2020 and beyond, 2019, EPSC-DPS Joint Meeting 2019, held 15-20 September 2019 in Geneva, Switzerland, id. EPSC-DPS2019-1612

Lithuanian-Japanese project **Theoretical Studies of Structure and Properties of Heavy Elements Toward Identification of Gravitational Wave Sources** funded by Research Council of Lithuania (S-LJB-18-1). 2018–2020. Prof. dr. G. Gaigalas.

By employing multiconfiguration Dirac-Hartree-Fock and relativistic configuration interaction methods, we calculate the energy levels and transition data of electric dipole transitions for singly ionized lanthanides. Comparing with various databases we obtained ten times more data for lanthanides, with 10% accuracy. Investigation was done on Nd III, Er III and Nd IV ions. The accuracy was up to 10%. Based on these elements analysis on opacity has been done. The results of the above-mentioned research have attracted interest of international research community and have been publicized by *Eurekalert* at https://www.eurekalert.org/pub_releases/2019-03/nion-fsa031119.php

Main publications:

G. Gaigalas, D. Kato, P. Rynkun, L. Radžiūtė, and M. Tanaka, Extended calculations of energy levels and transition rates of Nd II-IV ions for application to neutron star mergers *The Astrophysical Journal Supplement Series*, 240:29 (17pp), (2019). (<https://doi.org/10.3847/1538-4365/aaf9b8>)

P. Rynkun, L. Radžiūtė, G. Gaigalas, and P. Jönsson Theoretical investigation of energy levels and transition data for P II, *Astronomy & Astrophysics*, 622, A167 (2019). (<https://doi.org/10.1051/0004-6361/201834696>)

Research Council of Lithuania. **Polish – Lithuanian Black Hole hunt** (S-LL-19-2). Dr. M. Maskoliūnas. 2019 – 2021.

A goal of this project is to use of the Lithuanian and Polish expertise in photometric observations and data analysis in order to detect first lensing black holes and derive the demography of these dark objects in the Galactic Disk. The black holes in motion in the Milky Way would cause regular stars to brighten temporarily due to microlensing. The software for the network operation and homogenous data processing provided by the European Coordination grant, OPTICON (<http://www.astro-opticon.org>). In this project we collaborate

with OPTICON and include the Polish and Lithuanian scientists and telescopes into a broader European network of researchers involved in the time-domain astronomy. Without the dedicated follow-up, lasting months to even years, the events observed by Gaia will not be possible to distinguish from regular stars.

Main publications:

Wyrzykowski, Łukasz; Mróz, P.; Rybicki, K. A.; Cepas, V.; Maskoliūnas, M.; Pakstienė, E.; Zdanavicius, J.; *and 179 more*, Full orbital solution for the binary system in the northern Galactic disc microlensing event Gaia16aye // accepted for publication in *Astronomy & Astrophysics*.

Lithuanian Academy of Sciences. **Lithuanian cooperation with CERN**. Dr. A. Juodagalvis, since 2008. Project “Physics of subatomic particles in the CERN CMS experiment” (DaFi2019).

Activities at the Compact Muon Solenoid (CMS) experiment at CERN are focused on participation in the Detector performance group of the CMS muon system upgrade project GEM. GEM-related database integration into CMS software (CMSSW) and DAQ systems were targeted. DCS shifts at GEM Cosmic Stand Test (QC8) were carried out. The analysis of the CMS pp collision data recorded in 2015 was finalized and analysis of the 2016 data was continued aiming to deduce Drell-Yan process properties at the center-of-mass energy of 13 TeV. A study of the Grimus-Neufeld model was continued. The idea of using the measured neutrino mixing matrix as model input parameters was finalized in a publication. Other studies of Standard Model extensions were performed.

Main publications:

CMS Collaboration [from Lithuania: V. Dūdėnas, A. Juodagalvis, J. Vaitkus], “Measurement of the differential Drell-Yan cross section in proton-proton collisions at $\sqrt{s}=13$ TeV”, *JHEP* 1912 (2019) 59, DOI: [10.1007/JHEP12\(2019\)059](https://doi.org/10.1007/JHEP12(2019)059) .

D. Jurčiukonis, T. Gajdosik, and A. Juodagalvis, “Seesaw neutrinos with one right-handed singlet field and a second Higgs doublet,” *JHEP* 1911 (2019) 146, DOI: [10.1007/JHEP11\(2019\)146](https://doi.org/10.1007/JHEP11(2019)146).

D. Jurčiukonis and L. Lavoura, “More models for lepton mixing with four constraints,” *JHEP* 1907 (2019) 157, DOI: [10.1007/JHEP07\(2019\)157](https://doi.org/10.1007/JHEP07(2019)157) .

International programme **Gaia-ESO Spectroscopic Survey** (ESO project 188.B-3002). Dr. Habil. G. Tautvaišienė. 2012 – 2021.

We investigated the relation between stellar ages and their carbon-to-nitrogen abundance ratios and found that for evolved stars, there is a linear dependency between these two values – larger carbon-to-nitrogen ratios were found in older stars and vice versa. Furthermore, we looked at the age spread in the stellar cluster NGC 6530 trying to identify its stellar formation history. We determined that there is a real age spread between the stars. This conclusion is supported by stellar kinematics as well, showing that the younger stars are found mainly around the cluster center. We fully characterized the open cluster Pismis 18, confirming its present location in the inner Galactic disc with a younger age than the previous literature values . We for the first time, determined its metallicity and detailed chemical composition.

Its $[\alpha/\text{Fe}]$ and $[\text{s-elements}/\text{Fe}]$ are slightly super-solar, in agreement with other inner-disc open clusters observed by the Gaia-ESO survey.

Main publications:

Casali, G.; Magrini, L.; Tognelli, E.; Jackson, R.; Jeffries, R. D.; Lagarde, N.; Tautvaišienė, G.; Masseron, T.; Degl'Innocenti, S.; Prada Moroni, P. G.; Kordopatis, G.; Pancino, E.; Randich, S.; Feltzing, S.; Sahlholdt, C.; Spina, L.; Friel, E.; Roccatagliata, V.; Sanna, N.; Bragaglia, A.; Drazdauskas, A.; Mikolaitis, Š.; Minkevičiūtė, R.; Stonkutė, E.; Chorniy, Y.; Bagdonas, V.; Jimenez-Esteban, F.; Martell, S.; Van der Swaelmen, M.; Gilmore, G.; Vallenari, A.; Bensby, T.; Kozlov, S. E.; Korn, A.; Worley, C.; Smiljanic, R.; Bergemann, M.; Carraro, G.; Damiani, F.; Prisinzano, L.; Bonito, R.; Franciosini, E.; Gonneau, A.; Hourihane, A.; Jofre, P.; Lewis, J.; Morbidelli, L.; Sacco, G.; Sousa, S. G.; Zaggia, S.; Lanzafame, A. C.; Heiter, U.; Frasca, A.; Bayo, A., The Gaia-ESO survey: Calibrating a relationship between age and the $[\text{C}/\text{N}]$ abundance ratio with open clusters, 2019, *Astronomy & Astrophysics*, Volume 629, id.A62, pp. 10.1051/0004-6361/201935282

Prisinzano, L.; Damiani, F.; Kalari, V.; Jeffries, R.; Bonito, R.; Micela, G.; Wright, N. J.; Jackson, R. J.; Tognelli, E.; Guarcello, M. G.; Vink, J. S.; Klutsch, A.; Jiménez-Esteban, F. M.; Roccatagliata, V.; Tautvaišienė, G.; Gilmore, G.; Randich, S.; Alfaro, E. J.; Flaccomio, E.; Kozlov, S.; Lanzafame, A.; Pancino, E.; Bergemann, M.; Carraro, G.; Franciosini, E.; Frasca, A.; Gonneau, A.; Hourihane, A.; Jofré, P.; Lewis, J.; Magrini, L.; Monaco, L.; Morbidelli, L.; Sacco, G. G.; Worley, C. C.; Zaggia, S., The Gaia-ESO Survey: Age spread in the star forming region NGC 6530 from the HR diagram and gravity indicators, 2019, *Astronomy & Astrophysics*, Volume 623, id.A159, pp. 10.1051/0004-6361/201834870

Hatzidimitriou, D.; Held, E. V.; Tognelli, E.; Bragaglia, A.; Magrini, L.; Bravi, L.; Gazeas, K.; Dapergolas, A.; Drazdauskas, A.; Delgado-Mena, E.; Friel, E. D.; Minkevičiūtė, R.; Sordo, R.; Tautvaišienė, G.; Gilmore, G.; Randich, S.; Feltzing, S.; Vallenari, A.; Alfaro, E. J.; Flaccomio, E.; Lanzafame, A. C.; Pancino, E.; Smiljanic, R.; Bayo, A.; Bergemann, M.; Carraro, G.; Casey, A. R.; Costado, M. T.; Damiani, F.; Franciosini, E.; Gonneau, A.; Jofré, P.; Lewis, J.; Monaco, L.; Morbidelli, L.; Worley, C. C.; Zaggia, S., The Gaia-ESO Survey: The inner disc, intermediate-age open cluster Pismis 18, 2019, *Astronomy & Astrophysics*, Volume 626, id.A90, pp. 10.1051/0004-6361/201834636

Long-term international project **The Whole Earth Telescope (WET)**. Dr. E. Pakštienė, Dr. R. Janulis.

34 years of photometric observations of the DBV type white dwarf GD358 were summarized. The complete data set included archival data from 1982 to 2006, and 1195.2 hr of new observations from 2007 to 2016. From this data set, 15 frequencies representing g-mode pulsation modes were extracted and recognized as $\ell = 1$ modes. A detailed asteroseismic analysis was performed using models that include parameterized, complex, carbon and oxygen core composition profiles to fit the periods. Our best-fit model has a temperature of 23650 K and a mass of 0.5706 $M(\text{Sun})$.

Main publications:

1. Bischoff-Kim, Agnès; Provencal, J. L.; Bradley, P. A.; Montgomery, M. H.; Shipman, H. L.; Harrold, Samuel T.; Howard, B.; Strickland, W.; Chandler, D.; Campbell, D.; Arredondo, A.; Linn, R.; Russell, D. P.; Doyle, D.; Brickhouse, A.; Peters, D.; Kim, S. -L.; Jiang, X. J.; Mao, Y. -N.; Kusakin, A. V.; Sergeev, A. V.; Andreev, M.; Velichko, S.; Janulis, R.

Pakstiene, E.; Aliçavuş, F.; Horoz, N.; Zola, S.; Ogłóza, W.; Koziel-Wierzbowska, D.; Kundera, T.; Jableka, D.; Debski, B.; Baran, A.; Meingast, S.; Nagel, T.; Loebing, L.; Heinitz, C.; Hoyer, D.; Bognár, Zs.; Castanheira, B. G.; Erdem, A., GD358: Three Decades of Observations for the In-depth Asteroseismology of a DBV Star, 2019, *The Astrophysical Journal*, Volume 871, Issue 1, article id. 13, pp. 10.3847/1538-4357/aae2b1

Long-term international project **Kepler Follow-up Program of Kepler Objects of Interest (KFOP-KOIs)**. Dr. E. Pakštienė, Dr. R. Janulis. Since 2016.

KFOP-KOIs is a multisite photometric follow-up of Kepler KOIs, the framework of a large collaboration between institutions around the globe. Its main goal is to continue with Kepler's heritage, to increase the number of confirmed and characterized exoplanets by means of the Transit Timing Variations (TTV) technique. We observed such objects from the list of Kepler Objects of Interest (KOI) with the 1.65 m telescope at the Molėtai Astronomical Observatory: KOI 0377.01 (on Apr. 21), KOI 0410.01 (on Aug. 15), and KOI 0377.02 (on Sep. 3).

COST Action CA16201 “**Unravelling new physics at the LHC through the precision frontier**” (ParticleFace) (<http://particleface.eu/>). Action Chair: Dr. German Rodrigo (Valencia, Spain) (24 countries). Dr. A. Juodagalvis, Management Committee Member. 2017 – 2021.

COST action “ParticleFace” was joined in 2019. Partial support was received for 3 activities (the remaining costs were covered from the project funded by the Lithuanian Academy of Sciences, DaFi2019). V. Dūdėnas went to the “School of Analytic Computing in Theoretical High-Energy Physics” (Atrani, Italy, 2–11 October 2019) and went to the conference “Matter to the Deepest” (Katowice, Poland, 1–6 September 2019). D. Jurčiukonis went on STSM to the University of Lisbon to collaborate with L. Lavoura on the investigation of the lepton-flavour violating processes (like a tau particle decay to a muon and a photon) in a multi-Higgs-doublet model. To get to know WG1 and WG2 better, A. Juodagalvis and T. Gajdosik used the DaFi2019 funds to participate in the “15th Vienna Central European Seminar: Precision Physics at the LHC” (Wien, 28–29 November 2019).

COST Action CA16117 „**Chemical Elements as Tracers of the Evolution of the Cosmos**” (ChETEC) (http://www.cost.eu/COST_Actions/ca/ca11617). Action Chair: Dr. Raphael Hirschi, (England) (30 countries). Dr. A. Kučinskas, Managing Committee Member, Member of the project Core Group, Co-lead of the Working Group 3 (Astronomical Observations). 2017– 2021.

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.

In a framework of this COST action, Carlos Viscasillas Vázquez attended the international workshop of CA18104 WG1 “The Gaia Treasure Hunt”, which was organised in Cambridge, United Kingdom on 3–5 September, 2019.

Long-term international project **Researchers' Night**. Dr. E. Stonkutė, S. Lovčikas. Since 2005.

The main purpose of this project is meetings of scientists with the general public. Such meetings took place on the 27-th of September at the Molėtai Astronomical Observatory of the Institute of Theoretical Physics and Astronomy. It is a Europe-wide public event dedicated to popular science. 27 countries and over 128 applicants involved. The Molėtai Astronomical Observatory programme included 8 lectures given by six lecturers, tours to professional telescopes, stargazing, CERN Virtual visit. The especially notable event was the online video-tour of CERN and discussion with scientists working there. Almost all staff of the Observatory and several scientists from other departments have met with ~400 people visiting the Observatory.

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

Aarhus University (Denmark)

European Organization for Nuclear Research CERN (Switzerland)

Astrophysical Institute Potsdam, Potsdam (German)

Landessternwarte Heidelberg, University of Heidelberg, Heidelberg (Germany)

Max Planck Institute for Astrophysics, Heidelberg (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)

Capital Normal University, Beijing (China)

University of Patras (Greece)

University of Chicago (USA)

National Institute for Fusion Science (Japan)

National Tsing Hua University, Hsinchu (Taiwan)

Materials Science and Applied Mathematics, Malmö University, Malmö (Sweden)

Chimie Quantique et Photophysique, Université Libre de Bruxelles (Belgium)

University of Lisbon (Portugal)

OTHER SCIENTIFIC ACTIVITIES

Dr. A. Drazdauskas –

- member of the International Astronomical Union (IAU).

Dr. K. Černis –

- member of the International Astronomical Union (IAU).

Prof. Habil. Dr. G. Gaigalas –

- council member of CompAS (The International collaboration on Computational Atomic Structure) group (<http://ddwap.mah.se/tsjoek/compas/>)

Dr. V. Gontis –

- member of the association of *Euroscience*, <http://www.euroscience.org/>
- council member of the Lithuanian Scientific Society;
- Academic editor of Plos One.

Dr. A. Juodagalvis –

- contact person for the CMS outreach and communication in Lithuania, representing the Lithuanian Team at CERN CMS experiment (since 2015);
- Lithuanian representative in CERN Finance Committee (since 2018);
- member of the Council of Experimental nuclear and particle physics center at the Faculty of Physics of Vilnius University (since 2018);
- member of the Board of Lithuanian Physics Society (since 2018), scientific secretary.

Dr. R. Juršėnas –

- member of the American Mathematical Society.

Distinguished Professor G. Juzeliūnas –

- True member of the Lithuanian Academy of Sciences;
- Board member of Atomic Molecular Physics and Optical Division (AMOPD) of European Physical Society (EPS);
- Associated member of the National Center for Theoretical Sciences at the National Tsing Hua University, Taiwan;
- Guest Editor of a Topical issue of the European Journal of Physics D;
- Academic editor of the journal “Plos One”.

Dr. H. R. Hamedi –

- Member of Lithuanian Physics Society
- Member of Physics Society of Iran.

Prof. 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;
- council member of the Lithuanian Scientific Society.

Prof. R. Karazija –

- editorial board member of the Lithuanian Journal of Physics;
- member of the Lithuanian Academy of Sciences.

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;
- Chair of the Assessment of National Physics Maturity Examination Commission;
- Member of the Lithuanian Pupil Physics Olympiad Commission;
- Council member of the Lithuanian Scientific Society.

Dr. A. Kučinskas –

- member of the Board of Directors of the International Journal Astronomy and Astrophysics;
- member of the Open Access Working group of the International Journal Astronomy and Astrophysics;
- vice-president, the Lithuanian Astronomical Society;
- member of the International Astronomical Union (IAU);
- National Contact Point of the IAU;
- member of the European Astronomical Society (EAS);

- National Representative at the EAS;
- vice-chair of the Council of the Faculty of Physics, Vilnius University
- member of the Central Appellation Commission of the Senate of Vilnius University

Dr. M. Maskoliūnas –

- member of the International Astronomical Union (IAU).

Dr. Š. Mikolaitis –

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

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 Institute of Physics;
- member of the European Physics Society.

Dr. E. Pakštienė –

- member of the International Astronomical Union (IAU).

Dr. L. Radžiūtė

- member of CompAS (The International collaboration on Computational Atomic Structure) group (<http://ddwap.mah.se/tsjoek/compas/>)

Dr. P. Rynkun

- member of CompAS (The International collaboration on Computational Atomic Structure) group (<http://ddwap.mah.se/tsjoek/compas/>)

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.

Dr. R. Stonkutė –

- member of the International Astronomical Union (IAU).

Prof. V. Straizys –

- member emeritus of the Lithuanian Academy of Sciences;
- member of the working group on stellar classification of the ESA Gaia project;
- member of the International Astronomical Union;
- member of the European Astronomical Society.

Assoc. prof. dr. Dalia Šatkovskienė –

- Member of Administration Board (BoA) of European Platform of Women Scientists (EPWS, <https://epws.org/epws-general-assembly-2017/>);
- President of regional Baltic States association BASNET Forumas (<https://www.basnetforumas.eu/>).
- Lithuanian Team member of IUPAP working group on Women in Physics (WP5)
- Member of International Advisory Board (IAB) of EC HORIZON 2020 programme project BALTIC GENDER (<https://www.baltic-gender.eu/>)
- Represented Vilnius University observership in EC Horizon 2020 project GENERA (<https://genera-project.com/index.php>)

Dr. J. Tamulienė –

- management committee member of the Lithuanian Physics Society;
- leader of the Professional Union of Vilnius University.

Dr. Habil. G. Tautvaišienė –

- Vice-President of [Commission H1 The Local Universe](#) (IAU);
- Organizing Committee Member of [Commission H1 The Local Universe](#) (IAU);
- Member of [Special Nominating Committee](#) (IAU);
- vicepresident of the Lithuanian Physics Society;
- member of the International Astronomical Union (IAU);
- IAU National Outreach Coordinator <https://www.iau.org/public/noc/>;
- founding member of the European Astronomical Society;
- editorial board member of the “Mol” journal <http://mol-en.scg.org.es/editorial-board>

- editor-in-chief of the annual astronomical almanac *Lietuvos dangus (Sky of Lithuania)*;
- Chair of the Scientific organizing committee of the international Europlanet Summer School “Space missions: ground-based observations and science communication”, June 11 – 21, 2019, Molėtai, Lithuania.
- Member of the Scientific Organising Committee of the international conference "Physics of Stars and Planets: Atmospheres, Activity, Magnetic Fields" in September 16 – 20, 2019, Shamakhi, Azerbaijan.

Prof. Dr. V. Vansevičius –

- member of the International Astronomical Union (IAU);
- member of the Lithuanian Science Council.

Dr. J. Zdanavičius –

- member of the International Astronomical Union (IAU).

BEST REPORTS DELIVERED AT CONFERENCES ABROAD

Gediminas Gaigalas “Challenges of Theoretical Spectroscopy of Heavy Elements Toward Identification of Gravitational Wave Sources”, invited talk at the Conference “International Colloquium on Atomic Spectra and Oscillator Strengths for Astrophysical and Laboratory Plasmas”, June 23–27 of 2019, Fudan University Shanghai, China (<https://asos2019.fudan.edu.cn/wome/list.htm>)

Vygintas Gontis “Non-extensive birth-death processes as an origin of spurious long-range memory”, invited talk at the 10th Polish Symposium on Physics in Economy and Social Sciences (FENS), 3–5 July, 2019, Warsaw.
<https://fens2019.ncbj.gov.pl/>

Gediminas Juzeliūnas ”Periodically driven systems and geometric phases ”, invited talk at the International Workshop “Emergent phenomena in ultracold atoms: Merging topology, interaction, and dynamics June 3 – 22, 2019, Beijing, China,
(<http://ultracold.csp.escience.cn/dct/page/65580>)

Arūnas Kučinskas “3D Carbon and Oxygen abundances in CEMP Stars from Molecular Lines”, invited talk at the International Conference “Carbon-Enriched Metal Poor Stars as Probes of First-Star Nucleosynthesis, the IMF, and Galactic Assembly”, Sep 9-13, 2019, Geneva, Switzerland (<https://indico.cern.ch/event/791509/timetable/#20190909.detailed>)

Erika Pakštienė “Molėtai Astronomical Observatory and astronomy in Lithuania”, invited talk at the annual meeting of the European Astronomical Society “European Week of Astronomy and Space Science”, 24 – 28 June, 2019, Lyon, France
(<https://eas.unige.ch/EWASS2019/>)

Gražina Tautvaišienė “Carbon and nitrogen as probes of mixing processes in giant stars”, invited talk at the Symposium "The Periodic Table Through Space and Time" of the XXI Jubilee Mendeleev Congress on General and Applied Chemistry, September 9–13 of 2019, Saint–Petersburg, Russia (<http://mendeleev2019.ru/index.php/en/>)

THE MOST IMPORTANT RECEIVED NATIONAL AND INTERNATIONAL AWARDS FOR R&D ACTIVITIES

Dr. Arnoldas Deltuva, Lithuanian Science Prize.

Dr. Arnoldas Deltuva, Fellowship of the Alexander von Humboldt Foundation.

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

Prof. V. Vansevičius is a member of the Lithuanian Science Council.

Doc. A. Kynienė is the chair of the Assessment of National Physics Maturity Examination Commission.

CONSULTATIONS PROVIDED BY THE UNIT TO THE PUBLIC OR ECONOMIC ENTITIES

Regular consultations for various Police departments concerning astronomical conditions during the requested time periods when car accidents happened, dr. A. Kazlauskas.

Regular consultations to public concerning unusual astronomical events and stones found which are suspected to be of extraterrestrial origin, S. Lovčikas, V. Stražys, G. Tautvaišienė.

Regular school consultations in elementary particle physics, A. Kynienė, A. Acus, A. Juodagalvis, A. Mekys, A. Rinkevičius

MOST IMPORTANT RESEARCH DISSEMINATION ACTIVITIES

The international science-popularization event “International MasterClass: Hands-on particle physics” (March 15, 2019), organized in collaboration with the International Particle Physics https://physicsmasterclasses.org/index.php?cat=archive&page=schedule_2019

Annual popular science edition “Lietuvos dangus 2020“, published since 1989 (ISSN 1392-0987), 136 pages in Lithuanian.

In 2019 we have published 39 posts in the Physics of Risk blog written in English <http://rf.mokslasplius.lt/>. Majority of the posts contained a brief description of some model from econophysics or sociophysics along with an interactive implementation of the model.

Science popularisation event of the long-term international project Researchers’ Night 2019. 27 September, 2019, VU ITPA Molėtai Observatory.

International conference “Natural Science Education – Challenges for the School of the Future”, 10 April, 2019, VU

<https://www.vu.lt/kviecia/renginiai-mokytojams#mokytojams-chemikams-biologams-fizikams-tarptautines-konferencijos-gamtamokslinis-ugdymas-issukiai-ateities-mokyklai>

Inaugural lecture by Distinguished Professor Gediminas Juzeliūnas on Low Temperature Physics (24 October 2019), VU <https://www.vu.lt/kviecia/isskirtiniai-profesorai#2019-m>