



LATVIJAS UNIVERSITĀTE
**ATOMFIZIKAS UN
SPEKTROSKOPIJAS
INSTITŪTS**



University of Latvia Team: Laboratory of Theoretical Physics

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University of Latvia*





University of Latvia

University of Latvia (LU), founded in 1919, is currently ranked among the 1200 world universities.



<https://www.lu.lv/>

With more than 14 000 students, 13 faculties and over 20 research institutes and independent study centers, it is one of the largest comprehensive and leading research universities in the Baltics.

The University offers more than 130 state accredited academic and professional study programs and is continuously developing—expanding the horizons of academic work and scientific research, collaborating internationally, increasing the number of international study programs, as well as strengthening its cooperation with industrial partners.

The main goal of LU on the research side is to continue to sustain its internationally recognized fundamental and applied research and to advance further development providing knowledge and novel technologies.



LATVIJAS
UNIVERSITĀTE
ANNO 1919

**AKADĒMISKAIS
CENTRS**



SPORTA INFRASTRUKTŪRA

- Daudzfunkcionāla sporta zāle
- Sporta laukumi

Plānotā būves platība
10 000 m²

RAKSTU MĀJA

- Datorika
 - Biznesa vadība un ekonomika
 - Sociālās zinātnes
 - Pedagoģija, psiholoģija un māksla
 - Humanitārās zinātnes
 - Teoloģija
 - Tiesību zinātnes
 - Vēsture un filozofija
- Vairāki zinātnju institūti un pētniecības centri

Plānotais studentu skaits **11 000**
Kopējā telpu platība **32 000 m²**

DABAS MĀJA

Ēka nodota ekspluatācijā 2015.gadā

- Bioloģija
 - Ķīmija
 - Optometrijas un redzes zinātnes
 - Ģeogrāfija un zemes zinātnes
 - Farmācija
- Vairāki valsts nozīmes pētniecības centri

Plānotais studentu skaits **2500**
Kopējā telpu platība **20 000 m²**

ZINĀTŅU MĀJA

- Medicīna
 - Fizika un matemātika
- Vairāki zinātnju institūti un pētniecības centri

Plānotais studentu skaits **2000**
Kopējā telpu platība **20 000 m²**

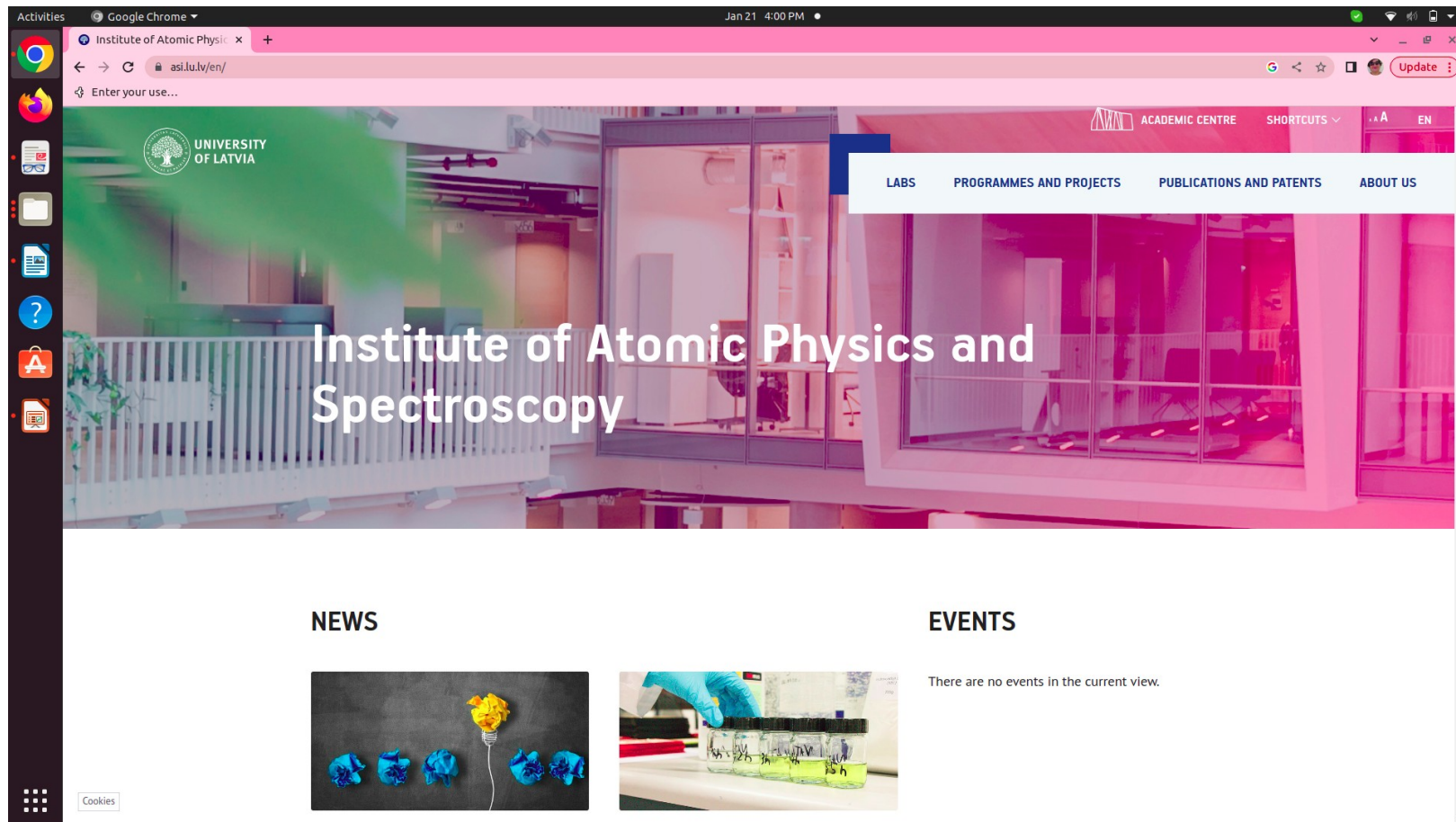
VIESNĪCAS UN APARTAMENTI

- Studentiem
- Veslektoriem
- Pirmajos stāvos apkalpes objekti

Plānotais vietu skaits **3000**
Kopējā telpu platība **50 000 m²**

TEHNOLOĢIJU CENTRS

- Fizikas institūts
- Augstas enerģijas elektronu un protonu starojuma iekārtas
- Gamma staru un un brahiterapijas medicīniskās iekārtas
- Personalizētā un reģeneratīvā medicīna
- Hibrīdo viedo materiālu un pārklājumu izpēte
- Biznesa inkubatori (Spin-offs: start-ups)



Institute of Atomic Physics and Spectroscopy (IAPS) of the University of Latvia (UL) performs internationally recognized fundamental and applied research in atomic physics, spectroscopy, photonics, quantum physics and related areas. New optical methods and devices for applications in industry, medicine and environmental monitoring are being developed as well. The Institute has been supported by the European Commission as the Centre for Excellence in Fundamental and Applied Studies.



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Laboratory of Theoretical Physics

asi.lu.lv/en/labs/laboratory-of-theoretical-physics/



Laboratory of Theoretical Physics

$\hbar ckF, \quad u = \omega t - kz,$

HEAD OF LABORATORY – DR. RITA VEILANDE

Researcher group:

- Senior researcher, Dr.phys. Rita Veilande (SCOPUS Author ID: 6506753619)
- Senior researcher, Dr.hab.phys. Imants Bersons (SCOPUS Author ID: 55938619500)
- Senior researcher, Dr. Teodora V. Kirova (SCOPUS Author ID: 12759956200)



Dina Berzina- administrative manager

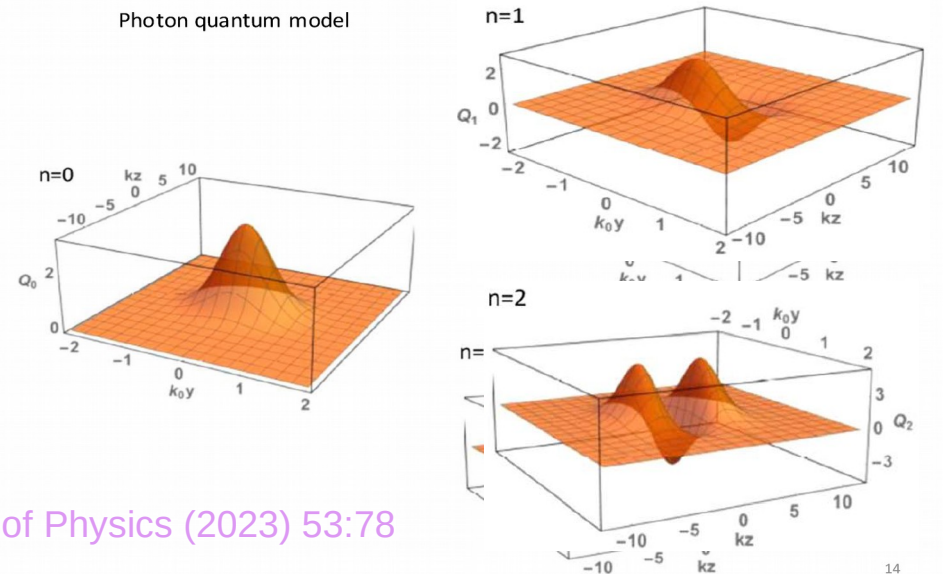
Cookies



Main directions of scientific work:

R. Veilande, I.Bersons

- calculations of energy structures for atoms and molecules affected by various external fields;
- mathematical description of photon;
- studying new non-linear equations for space-localized, three-dimensional electromagnetic solitons;
- Spectrum modeling for vitamin D2 and D3

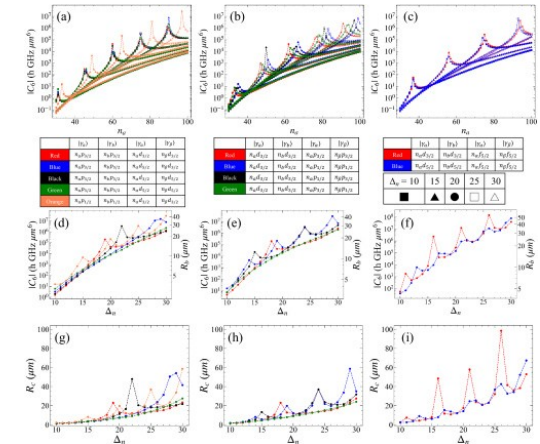




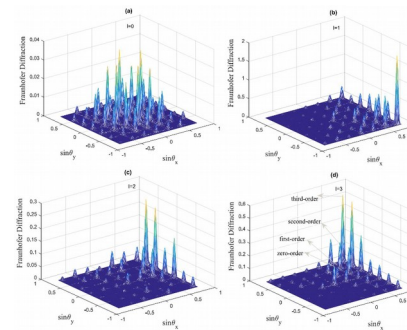
T. Kirova

-quantum and nonlinear optics using Rydberg-State atoms: Rydberg EIT, dipole blockade in Rydberg media;

[Optics Express 31\(22\), 37094\(2023\)](#)



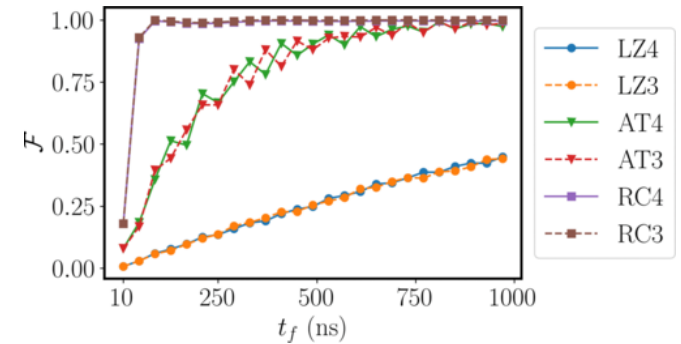
-coherent effects with spatially dependent fields and light vortices (EIG, localization)



[Sci Rep 11, 20721 \(2021\)](#)

-high-fidelity quantum control via Autler-Townes splitting

[Phys. Rev. A, 106, 052802 \(2022\)](#)



-theoretical and numerical models for the impact of radiation on amino acids



CURRENT PROJECTS:

- Horizon Europe MSCA-SE project “Q-DYNAMO: Quantum Dynamic Control of Atomic, Molecular and Optical Process”, (2024-2027)
- Trilateral grant of the Latvian, Lithuanian, and Taiwanese Research Councils “Coherent Optical Control of Atomic Systems”, (2022-2024)
- LZP project " Mercury Contamination in Wild Birds in Latvia: Current Patterns and Reconstruction of Previous Trends " (No. lzp -2021/1-0005), (2021-2023)
- COST action CA18212 “Molecular Dynamics in GAS phase” (MD-GAS), (2019-2024)
- COST action CA21101 “Confined Molecular Systems: from a New Generation of Materials to the Stars” (COSY), (2022-2026)
- COST action CA18222 “Attosecond Chemistry” (AttoChem), (2019-2023)

COMPLETED PROJECTS:

- COST action CA16221 “Quantum Technologies with Ultracold Atoms” (AtomQT), (2017-2021)
- Latvia-France Partnership Program OSMOZE Project “States mixing in external magnetic fields in alkali atoms and molecular dimers “, (2020-2021)
- Trilateral grant of the Latvian, Lithuanian, and Taiwanese Research Councils Quantum and Nonlinear Optics with Rydberg-State Atoms”, (2016-2018)
- Latvia-France Partnership Program OSMOZE Project “Electromagnetic field-control of the blockade/antiblockade effect in Rydberg ensembles” (2016-2017)



RECENT PUBLICATIONS:

1. “Spatial Characterization of Fraunhofer Diffraction in a Four-Level Light-Matter Coupling System”, S. H. Asadpour, T. Kirova, H. R. Hamedi, and R. Asgari, [accepted Phys. Rev. A.](#)
2. “Rydberg-Rydberg Interaction Strength and Dipole Blockade Radii in the Presence of Förster Resonances”, C. E. Wu, T. Kirova, M. Auzins, and Y.-H. Chen, [Optics Express **31\(22\)**, 37094\(2023\)](#)
3. “Azimuthal Dependence of Electromagnetically Induced Grating in a Double V-type Atomic System near Plasmonic Nanostructure”, S. H. Asadpour, T. Kirova, H. R. Hamedi, V. Yannopoulos, and E. Paspalakis, [The European Physical Journal Plus **138**, Article number: 246 \(2023\)](#)
4. “High-fidelity quantum control via Autler-Townes splitting”, M. Delvecchio, T. Kirova, E. Arimondo, D. Ciampini, and S. Wimberger, [Phys. Rev. A, **106**, 052802 \(2022\)](#)
5. “Cold Atoms in Space: Community Workshop Summary and Proposed Road-Map”, many authors + T. Kirova, outcomes of the COST action CA16221 (2017-2021) “Quantum Technologies with Ultracold Atoms” (AtomQT), [EPJ Quantum Technology **9**, Article number: 30 \(2022\)](#)
6. I. Bersons, R. Veilande, O. Balcers, «Mathematical Models of Photons» [Foundations of Physics **53\(4\)**, 78 \(2023\)](#)
7. I. Bersons, R. Veilande and O. Balcers, “Model of Compact 3D Electromagnetic Solitons” [Phys. Scr. **95** \(2020\) 025203.](#)



Involvement in Q-DYNAMO

Work Packages:

WP1,2,3 “Research”: Theoretical and experimental investigations of quantum control schemes in thermal, Rydberg cold and ultracold atoms/molecules

WP4 “Training”: ESRs will be trained in modern theoretical/experimental approaches in quantum optics; provided during the ESRs’ secondments within the research WPs, and during 4 annual summer schools; complementary skills planning research activities, presentation of scientific results, preparing conference abstracts/manuscripts for publication

WP5 “Dissemination and Management”: project webpage, social media (Youtube, Facebook, LinkedIn, Twitter), short TV programs and interviews; “Scientist Night” event organized every year by LU; participation in conferences/seminars in Europe, USA, Japan, New Zealand to report the results from the project; 2 Q-DYNAMO workshops hosted by Latvia (2nd year) and Italy (4th year); 4 summer schools for ESRs

