

# Dr. Oleksandr Tomalak

## Neutrino Physics, Nucleon Structure (Theory)

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### Education

- 11/2012–10/2016 **Ph.D. in Theoretical Physics**, Johannes Gutenberg-Universität Mainz, Mainz, Germany, *Summa Cum Laude*.  
Dissertation *Two-Photon Exchange Corrections in Elastic Lepton-Proton Scattering*  
Supervisor Prof. Dr. Marc Vanderhaeghen
- 07/2010–06/2012 **MS in Theoretical Physics**, Taras Shevchenko National University, Kyiv, Ukraine, *Red Diploma*.  
Speciality: Nuclear and Particle Physics, Quantum Field Theory  
Thesis "Generation of Gravitational Waves during Magnetic Instability in Early Universe"  
Supervisor Dr. Yurii Shtanov
- 09/2006–06/2010 **BS in Physics**, Taras Shevchenko National University, Kyiv, Ukraine, *Red Diploma*.  
Speciality: Nuclear and Particle Physics, Quantum Field Theory  
Thesis "Muons Registration Efficiency Determination for F<sub>2</sub> Proton Structure Function Measurement in ZEUS Experiment"  
Supervisor Prof. Dr. Vladimir Aushev

### Work Experience

- since 2025 **Tenure-track Associate Professor**, Institute of Theoretical Physics, Chinese Academy of Sciences, Beijing, P. R. China.
- To control antineutrino fluxes from nuclear power plants and increase precision of reactor antineutrino experiments, I performed detailed evaluation of radiative corrections in the inverse beta decay within the effective field theory with heavy nucleons. I updated the corresponding cross sections with previously-unaccounted percent-level contributions and provided the first results for the electron energy spectrum and various differential cross sections.
  - To determine the normalization of vector and axial-vector nucleon form factors, I performed the matching of the hadronic model at GeV energies to Chiral Perturbation Theory at low energies. New relations allow well-defined extraction of the nucleon form factors from (anti)neutrino scattering data.
  - Developed framework for the determination of most uncertain hadronic contributions in low-energy neutral-current processes such as (anti)neutrino-electron and coherent elastic (anti)neutrino-nucleus scattering at very low energies. Within this framework, I improved uncertainty of these contributions by a factor 34.
  - I evaluated the contribution of the  $\Delta$  resonance to elastic (anti)neutrino-nucleon charged-current scattering for the first time and verified my previous uncertainty estimates for radiative corrections to this reaction.
  - Evaluated QED nuclear medium effects for elastic scattering on nucleons and neutral-current deep inelastic scattering for energies of the electron-ion collider (EIC) and the electron-ion collider in China (EICC) experiments.

2025 **Guest scientist**, Institute for Nuclear Physics, Johannes Gutenberg-Universität Mainz, Mainz, Germany.

-I provided my results for the pion-nucleon contribution to the invariant amplitudes and unpolarized cross sections in elastic electron-proton scattering as well as calculations of inelastic excitations in elastic muon-proton scattering for implementation in McMule Monte Carlo event generator.

2021-2024 **Director's Postdoctoral Fellow**, Los Alamos National Laboratory, NM, USA.

- In Collaboration with experimentalists, theorists, and experts in lattice QCD, we applied my calculations of radiative corrections to the extraction of nucleon axial-vector form factor and radius from antineutrino-hydrogen and neutrino-deuterium data. Effects from radiative corrections on the axial-vector radius are relatively small, while the axial-vector form factor from MINERvA and FERMILAB datasets changes by more than  $\sigma/2$ .

- Developed framework for the evaluation of the  $\Delta$  resonance to elastic (anti)neutrino-nucleon charged-current scattering and to production of pions by neutral- and charged-current (anti)neutrino-nucleon scattering.

- Mentoring a Ph.D. student, we revisited the framework for production of pions on nucleons by neutrinos and antineutrinos and derived all necessary expressions for fits of the experimental data with the best description of vector contributions.

- Mentoring a Ph.D. student, we defined the invariant amplitudes in the elastic (anti)neutrino-nucleon scattering and derived expressions for the unpolarized cross section and single-spin asymmetries. Based on the nucleon form factors and prior evaluations of radiative corrections, we predicted these observables and explored the impact of modern and future measurements on constraining the invariant amplitudes, as well as provide new constraints from the recent MINERvA data.

- Performed sensitivity study of the extraction of the nucleon axial-vector form factor and radius from antineutrino-hydrogen interactions in future neutrino experiments. Projected experimental errors found to be at permille level, which is below the uncertainties from the current knowledge of nucleon electromagnetic form factors.

- Interpreted new data for the axial-vector form factor by the MINERvA Collaboration by comparing cross-section predictions based on the phenomenological fits to the deuterium bubble-chamber data and on lattice-QCD calculations of the axial-vector nucleon form factor; both are in good agreement with new MINERvA data. Quantified tension between the lattice QCD and bubble-chamber data at  $\sim 2.5\sigma$  level for the first time.

- Introduced framework for the determination all next-to-leading order interactions in the heavy-baryon chiral perturbation theory.

- Provided robust physical description of radiative corrections to  $\beta$  decay and (anti)neutrino-nucleon scattering by determining the low-energy vector and axial-vector coupling constants in the effective field theory with heavy nucleons. For the low-energy theory, I matched the Standard Model to the four-fermion theory and, in collaboration with world-leading experts in chiral perturbation theory and electroweak interactions, to the heavy-baryon chiral perturbation theory.

- To allow precise constraints of incoming neutrino fluxes with inverse muon decay reaction, I evaluated radiative corrections to this process and performed a detailed study of experimentally-accessible distributions.

- To improve neutrino flux predictions, I evaluated precise (anti)neutrino energy spectra from kaon, pion, and muon decays, analytically and numerically accounting for radiative corrections.
- Developed framework for the evaluation of the newly-formulated QED nuclear medium effects for elastic scattering on nucleons and neutral-current deep inelastic scattering at electron-ion collider (EIC) experiment.
- In collaboration with an expert in QCD medium effects, I formulated and evaluated QED nuclear medium effects in charged-current elastic (anti)neutrino-nucleon and lepton-nucleon scattering within an effective field theory framework, and became the first to calculate the corresponding QED effects: changes in cross sections, transverse momentum distributions of charged leptons, and angular deflection of lepton tracks.
- In collaboration with experimentalists, a theoretician, and a Ph.D. student, I determined the precise flavor ratios in charged-current elastic (anti)neutrino-nucleon scattering, accounting for radiative corrections. I calculated cross sections of this process and the corresponding Bremsstrahlung for experimental setups of modern and future accelerator neutrino experiments and for various kinematic conditions. The latter two research directions provided first-ever calculations of these effects for the analysis of neutrino and electron scattering data.

Fall 2021 **Postdoctoral researcher**, Los Alamos National Laboratory, NM, USA.

- As the first step in improving the neutrino flux predictions, I calculated virtual contributions to the neutrino energy spectra from muon decay.
- Consulting with experimentalists and theoreticians, I also significantly improved codes for the calculation of radiative corrections to charged-current elastic (anti)neutrino-nucleon scattering by accounting for the real radiation from initial- and final-state neutrons.

2018-2021 **Postdoctoral researcher**, University of Kentucky, Lexington, KY, USA and Fermilab, Batavia, IL, USA.

- In collaboration with an expert in effective field theory, I formulated a four-fermion effective field theory for neutrino physics and have precisely determined effective couplings, accounting for electroweak and strong contributions. This effective field theory is the basis for an *ab initio* evaluation of cross sections and decay rates in processes with neutrinos at low energies.
- To constrain the neutrino flux in accelerator-based experiments by scattering neutrino beams from atomic electrons, I improved our knowledge of cross sections for this "Standard Candle."
- To achieve more precise nuclear physics inputs in the search for dark matter, I improved our knowledge of the recently-discovered coherent elastic neutrino-nucleus scattering process by formulating radiative corrections within the developed four-fermion effective field theory. Based on this work, I performed the first uncertainty quantification for cross sections in these processes.
- In collaboration with an expert in effective field theory and a Ph.D. student, I formulated and tested a new factorization framework for radiative corrections in charged-current elastic (anti)neutrino-nucleon scattering.
- In collaboration with a theoretician, a postdoc, and a Ph.D. student, I also applied my state-of-the-art calculations of two-photon exchange corrections to elastic electron-proton scattering data for the extraction of nucleon vector form factors.

- We presented the latter in a form convenient for applications and exploited the form factors to evaluate the hadronic contributions to atomic energy levels and (anti)neutrino-nucleon scattering cross sections.
- Further, to identify the observables that provide the best access to the nucleon structure, I quantified the sensitivity of polarization observables in neutrino physics to the axial and induced pseudoscalar form factors.
- Additionally, to improve the precision of spectroscopy measurement analysis, I calculated hadronic contributions to the shift of atomic S-energy levels due to the two-photon exchange corrections on the neutron inside the nucleus.

2016-2018 **Postdoctoral researcher**, Johannes Gutenberg-Universität Mainz, Mainz, Germany.

- To improve our knowledge of inelastic contributions to the most uncertain two-photon exchange corrections in elastic electron-proton scattering, I developed and tested a novel method of analytical continuation for multiparticle intermediate states in the dispersive evaluation of two-photon exchange diagrams. I have evaluated pion-nucleon contributions to two-photon exchange corrections in elastic electron-proton scattering at larger momentum transfers ( $< 1 \text{ GeV}^2$ ), an order of magnitude improvement over my previous work.
- In collaboration with a theoretician and two Ph.D. students, I calculated radiative corrections to the lepton-pair photoproduction on a hydrogen target in the soft-photon limit and without approximations, accounting for all one-loop QED contributions. These results are of paramount importance for testing lepton universality in low-energy experiments.
- For modern spectroscopy measurements, I precisely quantified higher-order hadronic contributions to the atomic S-energy levels in ordinary and muonic hydrogen, the proton-neutron mass difference, and then found an unprecedented relation between the hyperfine splitting in ordinary and muonic hydrogen.
- This relation allowed me to reduce uncertainty by a factor of 20 in two-photon exchange corrections to the hyperfine splitting in muonic hydrogen, compared to previous dispersive evaluations.

2017 **Guest scientist**, Department of Physics, University of Pavia, Pavia, Italy.

- I shared codes for the evaluation of the pion-nucleon contribution to the two-photon exchange correction in elastic electron-proton scattering with Prof. Dr. Barbara Pasquini. My results for the imaginary parts of two-photon exchange amplitudes were validated on the example of single-spin asymmetries.

2012-2016 **Ph.D. student**, Johannes Gutenberg-Universität Mainz, Mainz, Germany.

- To quantify the most uncertain radiative correction in elastic electron-proton scattering, I developed a new subtracted dispersion relation framework for the two-photon exchange corrections in elastic electron-proton scattering and then applied it to the experimental data. As a crucial cornerstone in this effort, I developed a novel method of analytical continuation for one-particle intermediate states.
- I also performed first calculations of the two-photon exchange corrections to elastic muon-proton scattering for the dominant contribution from the proton intermediate state.
- I further included inelastic excitations for the scattering in the near-forward direction, both in elastic electron-proton and muon-proton scattering.

- I have consistently evaluated pion-nucleon contributions to the two-photon exchange in elastic electron-proton scattering at very low momentum transfers ( $Q^2 < 0.064 \text{ GeV}^2$ ), for the first time.
  - As an important ingredient in the calculation of inelastic contributions to the two-photon exchange, I developed a new method for evaluating the subtraction function in the forward doubly-virtual Compton scattering, applied it to the experimental data, and obtained unexpected results, which were later confirmed by alternative approaches.
  - To further enhance our understanding of fundamental atomic physics, I developed and tested a new dispersion relation framework for the two-photon exchange corrections to atomic energy levels in ordinary and muonic hydrogen.
- 2012-2015 **Ph.D. student**, Taras Shevchenko National University, Kyiv, Ukraine.
- To clarify the origin of extragalactic magnetic fields, I analytically and numerically quantified the production of gravitational waves and the evolution of cosmological magnetic instability in the early universe.
- 2015 **Guest scientist**, Department of Physics, University of Pavia, Pavia, Italy.
- I compared my results for the pion-nucleon contribution to the single-spin asymmetry in elastic electron-proton scattering with similar results achieved by Prof. Dr. Barbara Pasquini. We found an agreement between our calculations.
- 2010 - 2011 **Member of D0 collaboration**, D0 Experiment, Fermilab, Batavia, IL, USA.
- Contributing to data-taking efforts, I monitored the calorimeter system, the muon system, and the data acquisition (DAQ) system during physics runs.
  - As a technical task, I estimated the purity of photon+jet events for the jet energy scale studies.
  - For precise studies of strange quark parton distribution functions, I determined the  $W+c+jets$  to  $W+jets$  cross-section ratio, exploiting machine-learning techniques as a part of the physics program in the QCD group, in collaboration with Dr. Dmitry Bandurin.
- 2009 - 2010 **Bachelor student**, ZEUS Experiment, DESY, Hamburg, Germany.
- For all precise analyses with muons, I determined the efficiencies of muon reconstruction algorithms at the ZEUS experiment for the 2006-2007 data-taking period, in collaboration with Dr. Massimo Corradi.

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## Awards and Honors

- 09/2020-06/2021 Universities Research Association (URA) Salary Support, Fermilab, USA
- 09/2019-12/2019 Universities Research Association (URA) Visiting Scholars Program, Fermilab, USA
- 05/2017 Prize for Outstanding Doctoral Research, Faculty 08: Physics, Mathematics and Computer Science, Johannes Gutenberg-Universität Mainz, Mainz, Germany
- 06/2012 Alumnus of the Year, Taras Shevchenko National University, Kyiv, Ukraine
- 04/2007 Absolute Winner of Ukrainian Students Olympiad in Theoretical Physics, Kharkiv, Ukraine
- 07/2006 Silver Medal, 37th International Physics Olympiad, Singapore

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## Fellowships

- 10/2021-10/2024 Director's Postdoctoral Fellowship, Los Alamos National Laboratory, Los Alamos, NM, USA

- 11/2014-12/2018 Fellowship in Collaborative Research Centre (CRC) 1044 (The Low-Energy Frontier of the Standard Model), Johannes Gutenberg-Universität Mainz, Mainz, Germany
- 11/2012-11/2014 Fellowship in the Graduate School "Symmetry Breaking in Fundamental Interactions," Johannes Gutenberg-Universität Mainz, Mainz, Germany (top 10 % admitted)
- 05/2011-12/2011 World Federation of Scientists National Scholarship Program for developing and newly emergent countries, Bogolyubov Institute for Theoretical Physics, Kyiv, Ukraine
- 09/2010-06/2011 Parliamentary scholarship for outstanding students, Kyiv, Ukraine
- 09/2006-08/2008 Presidential scholarship for International Olympiad winners, Kyiv, Ukraine

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## Proposal writing

- 12/2022-06/2023 Neutrino-Nucleus Interactions for New Physics Discovery, Los Alamos National Laboratory, Los Alamos, NM, USA
- 12/2022-05/2023 Measuring Low Energy Neutrino Cross Sections with the Coherent Captain-Mills Experiment, Los Alamos National Laboratory, Los Alamos, NM, USA
- 12/2021-04/2022 Neutrino-Nucleus Interactions for New Physics Discovery, Los Alamos National Laboratory, Los Alamos, NM, USA
- 11/2021-01/2022 A Novel Intelligent Toolbox for Detecting Subtle Signals from Neutrinos and New Particles, Los Alamos National Laboratory, Los Alamos, NM, USA
- 08/2022-09/2022 Precision Neutrino Interactions: Radiative corrections, elementary target data and polarization asymmetries, URA Visiting Scholars Program, Fermilab, Batavia, IL, USA
- 05/2021-07/2021 Radiative corrections for the discovery of CP violation in the lepton sector, Director's Postdoctoral Fellowship, Los Alamos National Laboratory, Los Alamos, NM, USA
- 01/2020-03/2020 Radiative corrections and neutrino scattering, URA Salary Support, Fermilab, Batavia, IL, USA
- 08/2019-09/2019 Phenomenology and radiative corrections in neutrino interactions, Neutrino Theory Network Group Proposal, Fermilab, Batavia, IL, USA
- 01/2019-02/2019 Radiative corrections and neutrino scattering, URA Visiting Scholars Program, Fermilab, Batavia, IL, USA

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## Languages

English	Fluent	C1 level (JGU Mainz, 2018)
German	Upper intermediate	C1 level (JGU Mainz, 2018)
Ukrainian	Fluent	
Russian	Fluent	
Mandarin Chinese	Elementary	

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## Computer Skills

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| <ul style="list-style-type: none"> <li>- Wolfram Mathematica</li> <li>- Maple</li> <li>- Mathcad</li> <li>- Windows</li> <li>- HTML, CSS</li> <li>- Flask</li> </ul> | <ul style="list-style-type: none"> <li>- LaTeX</li> <li>- Origin</li> <li>- DataGraph</li> <li>- Linux</li> <li>- SQL</li> <li>- office software</li> </ul> | <ul style="list-style-type: none"> <li>- C, C++</li> <li>- Fortran</li> <li>- Python, R</li> <li>- OS X</li> <li>- JavaScript</li> <li>- video conferencing software</li> </ul> | <ul style="list-style-type: none"> <li>- Bash</li> <li>- Batch</li> <li>- Root</li> <li>- JaxoDraw</li> <li>- Jinja</li> </ul> |
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## Soft Skills Training

- 2021-2023 Preparation of Papers and Job Applications, LANL, Los Alamos, NM, USA
- 2021 Preparation of Job Applications, University of Kentucky, Lexington, KY, USA
- 11/2017 Frontiers and Careers in Photonuclear Physics, Annabelle Hotel, Paphos, Cyprus
- 11/2015 Frontiers and Careers in Photonuclear Physics, Annabelle Hotel, Paphos, Cyprus
- 08/2014 Frontiers and Careers in Photonuclear Physics, MIT, Cambridge, MA, USA
- 11/2013 Time and Self Management, Johannes Gutenberg-Universität Mainz, Mainz, Germany

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## Mentoring

- 2022-2024 Ph.D. student Kevin Quirion (Project: Pion Neutrinoproduction on Nucleons)
- 2020-2021 Ph.D. student Qing Chen (Project: SCET and Radiative Corrections in Neutrino-Nucleon Scattering)
- 2019-2024 Ph.D. student Kaushik Borah (Project: Nucleon Form Factors and Applications)
- 2016-2019 Ph.D. student Matthias Heller (Project: Radiative Corrections in Electron Scattering)
- 2015 M.Sc. student Volodymyr Shubnyi (Thesis: Narrow  $\Delta$ -Resonance Two-Photon Exchange Contribution to Elastic ep Scattering)

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## List of Advanced Courses

- Mathematics Group Theory in Elementary Particle Physics, Probability Theory and Mathematical Statistics, Complex Variable Theory, Differential and Integral Equations, Vector and Tensor Analysis, Programming and Mathematical Modeling, Methods of Mathematical Physics
- Physics Scattering Theory, Relativistic Quantum Mechanics, Quantum Mechanics of Particles with Spin, Quantum Mechanics through Path Integrals, Introduction to Quantum Field Theory (QFT), Quantum Electrodynamics (QED), Gauge Field Theory and Standard Model, Renormalization Group Methods and Applications, Lattice QFT, Statistical QFT, Directly Integrable Systems in QFT, Modern QFT Methods in Solid-state Physics, Quantum Effects in External Fields, Relativistic Theory of Gravity, Introduction to Theoretical Cosmology, Electroweak Interactions, Introduction to Neutrino Physics, Experimental Particle Physics and Collider Physics, Hydrodynamics and Physical Kinetics, Plasma Electrodynamics, MITx Effective Field Theories, Nucleon Structure, MITx Quantum Information Science I, CERN Practical Introduction to Quantum Computing, LANL Deep Learning Short Course

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## Teaching Experience

- 03/2019 **Teaching assistant**, University of Kentucky, Lexington, KY, USA.  
"Electrodynamics and Optics" (300-level Physics).
- 04/2014-08/2014 **Teaching assistant**, Johannes Gutenberg-Universität Mainz, Mainz, Germany.  
"Classical Electrodynamics" (300-level Physics).
- 10/2013-02/2014 **Teaching assistant**, Johannes Gutenberg-Universität Mainz, Mainz, Germany.  
"Advanced Quantum Mechanics and Quantum Field Theory" (400-level Physics).
- 04/2013-08/2013 **Teaching assistant**, Johannes Gutenberg-Universität Mainz, Mainz, Germany.  
"Advanced Quantum Mechanics and Quantum Field Theory" (400-level Physics).
- 09/2008-05/2009 **Teaching assistant**, Scientific and Educational Centre of Bogolyubov Institute for Theoretical Physics, Kyiv, Ukraine.  
"Classical Mechanics" (200-level Physics). Seminars for first-year undergraduate students.

10/2007-12/2009 **Teaching assistant**, Ukrainian Lyceum of Physics and Mathematics, Kyiv, Ukraine.  
Physics Olympiad preparation for high school students.

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## Professional activities

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### Organization of Conferences and Meetings (8)

- 10/2025 2nd Workshop on Neutrino Scattering: Theory, Experiment, and Phenomenology (vSTEP 2025), Beijing, China
- 03/2023 Chair on session "Neutrino Interactions", CERN Neutrino Platform Week 2003, CERN, Geneva, Switzerland
- 01/2022-10/2023 Coordinator, T-2 Group Seminars, Los Alamos National Laboratory, Los Alamos, NM, USA
- 07/2021 Co-chair on parallel sessions, American Physical Society Division of Particles and Fields (APS DPF) Meeting 2019, Florida State University, Tallahassee, FL, USA
- 03/2021 Discussion leader, NUSTEC Workshop New Directions in Neutrino-Nucleus Scattering, Fermilab, IL, USA
- 10/2020 Organizer, 9th "Particle physics in Indiana, Kentucky, Illinois, Michigan, and Ohio" meeting, Lexington, KY, USA
- 01/2020-05/2021 Coordinator, Nuclear Seminars, University of Kentucky, Lexington, KY, USA

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### Participation in Schools and Meetings (15)

- 03/2023 CERN Neutrino Platform Pheno Week 2023  
CERN, Geneva, Switzerland
- 06/2022 TMD Collaboration Meeting  
New Mexico Consortium, Santa Fe, NM, USA
- 02/2022-03/2022 Neutrinos as a Portal to New Physics and Astrophysics  
KITP Program, Santa Barbara, CA, USA
- 01/2022 Neutrino-Nucleus Interactions in Standard Model and Beyond  
CERN, Zoom
- 01/2022 TMD Collaboration Winter School  
New Mexico Consortium, Santa Fe, NM, USA
- 12/2020 Snowmass21 NF06 Electron Scattering Workshop  
Zoom
- 06/2020 World SCET 2020  
Zoom, Slack
- 04/2020 Higgs and Effective Field Theory - HEFT 2020  
Universidad de Granada, Granada, Spain
- 11/2019 Lattice QCD at Fermilab: Celebrating the Career of Paul Mackenzie  
Fermilab, Batavia, IL, USA
- 05/2019 Nuclear and Particle Theory for Accelerator and Neutrino Experiments  
Fermilab, Batavia, IL, USA
- 12/2018 Physics Opportunities in the Near DUNE Detector Hall  
Fermilab, Batavia, IL, USA
- 10/2018 Electromagnetic Observables for Low-Energy Nuclear Physics  
Helmholtz Institut Mainz, Mainz, Germany
- 01/2014 GGI Lectures on the Theory of Fundamental Interactions  
Galileo Galilei Institute for Theoretical Physics, Firenze, Italy



- 06/2013 Non-perturbative QCD: Hadron Structure and Hadronic Matter  
ICTP SFAIR, Sao Paulo, Brazil
- 08/2011 Wolfram Mathematica School on Theoretical Physics "Scattering Amplitudes and  
AdS/CFT"  
Perimeter Institute, Canada

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## Guest Editor for Journals

09/2025-present *Universe*

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## Referee for Journals (16)

05/2024-present *Particles*  
04/2024-present *Modern Physics Letters A*  
03/2024-present *Galaxies*  
08/2023-present *Physical Sciences Forum*  
07/2023-present *Physical Review Letters*  
05/2023-present *European Physical Journal Plus*  
02/2023-present *Universe*  
12/2022-present *Symmetry*  
10/2022-present *Instruments*  
04/2022-present *International Journal of Modern Physics A*  
08/2020-present *Physical Review D*  
03/2020-present *Physical Review A*  
10/2019-present *Physics Letters B*  
01/2019-present *European Physical Journal A*  
08/2018-present *Annalen der Physik*  
05/2018-present *Physical Review C*

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## Membership in Scientific Organizations

08/2015-present American Physical Society  
03/2013-12/2020 German Physical Society

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## List of Publications (71)

The up-to-date publication and citation information can be found on the web page below:

<https://inspirehep.net/authors/1077543>

ORCID: [0000-0002-4827-5842](https://orcid.org/0000-0002-4827-5842)

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## Publications Under Review

4. **O. Tomalak**  
On radiative corrections to inverse beta decay at low energies  
*hep-ph/2512.07957*, 2 citations
3. **O. Tomalak**  
Theory of inverse beta decay for reactor antineutrinos  
*hep-ph/2512.07956*, 2 citations

2. **O. Tomalak**  
Reducing Hadronic Uncertainty in Low-Energy Neutral-Current Processes  
*hep-ph/2506.03255* , 1 citation
1. **O. Tomalak**  
Resonance Contributions to Charged-Current (Anti)Neutrino-Nucleon Elastic Scattering at GeV Energies  
*hep-ph/2509.24011*

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## Peer-Reviewed Journal Articles

52. **Sh. Bhattacharya, O. Tomalak, and I. Vitev**  
QED nuclear medium effects at EIC energies  
*Phys. Rev. D 112 3, 033001 (2025)*, *nucl-th/2502.06943*, 1 citation
51. **V. Cirigliano, W. Dekens, E. Mereghetti and O. Tomalak**  
Effective field theory for radiative corrections to charged-current processes II: Axial-vector coupling  
*Phys. Rev. D 111 5, 053005 (2025)*, *nucl-th/2410.21404*, 6 citation
50. **K. Borah, M. Betancourt, R. Hill, Th. Junk, and O. Tomalak**  
Invariant amplitudes, unpolarized cross sections, and polarization asymmetries in antineutrino-nucleon and neutrino-nucleon elastic scattering  
*Phys. Rev. D 110 1, 013004 (2024)*, *hep-ph/2403.04687*, 3 citations
49. **O. Tomalak, M. Betancourt, K. Borah, R. Hill, and Th. Junk**  
Constraints on new physics with neutrino-nucleon scattering data  
*Phys. Lett. B 854, 138718 (2024)*, *hep-ph/2402.14115*, 4 citations
48. **A. Afanasev et al.**  
Radiative Corrections: From Medium to High Energy Experiments  
*Eur. Phys. J. A 60, no. 4, 91 (2024)*, *hep-ph/2306.14578*, 13 citations
47. **O. Tomalak, and I. Vitev**  
Medium-induced photon bremsstrahlung in neutrino-nucleus, antineutrino-nucleus, and electron-nucleus scattering from multiple QED interactions  
*Phys. Rev. D 109 7, 073010 (2024)*, *hep-ph/2402.16851*, 5 citations
46. **R. Petti, R. Hill and O. Tomalak**  
Nucleon axial-vector radius and form factor from future neutrino experiments  
*letter in Phys.Rev.D 109 5, L051301 (2024)*, *hep-ph/2309.02509*, 11 citations
45. **O. Tomalak and I. Vitev**  
Broadening of particle distributions in electron- and (anti)neutrino-nucleus scattering from QED interactions  
*Phys. Rev. D 108 9, 093003 (2023)*, *hep-ph/2310.01414v1*, 5 citations
44. **O. Tomalak, R. Gupta and T. Bhattacharya**  
Confronting axial-vector form factor from lattice QCD with MINERvA antineutrino-proton data  
*Phys. Rev. D 108 7, 074514 (2023)*, *hep-ph/2307.14920*, 20 citations
43. **V. Cirigliano, W. Dekens, E. Mereghetti and O. Tomalak**  
Effective field theory for radiative corrections to charged-current processes I: Vector coupling  
*Phys. Rev. D 108, 053003 (2023)*, *hep-ph/2306.03138*, 38 citations
42. **O. Tomalak, K. Borah, R. J. Hill, K. S. McFarland and D. Ruterbories**  
Radiative corrections to inverse muon decay for accelerator neutrinos  
*Phys. Rev. D 107, 093005 (2023)*, *hep-ph/2211.15947*, 1 citations

41. **O. Tomalak, Q. Chen, R. J. Hill, K. S. McFarland and Cl. Wret**  
Theory of QED radiative corrections to neutrino scattering at accelerator energies  
*Phys. Rev. D* 106, 093006 (2022), editors suggestion, hep-ph/2204.07939, 30 citations
40. **O. Tomalak and I. Vitev**  
QED medium effects in (anti)neutrino-nucleus and electron-nucleus scattering: elastic scattering on nucleons  
*Phys. Lett. B* 835, 137492 (2022), nucl-th/2206.10637, 7 citations
39. **O. Tomalak, Q. Chen, R. J. Hill and K. S. McFarland**  
QED radiative corrections for accelerator neutrinos  
*Nature Commun.* 13 (2022), 1, 5286, hep-ph/2105.07939, 34 citations
38. **O. Tomalak**  
Radiative (anti)neutrino energy spectra from muon, pion, and kaon decays  
*Phys. Lett. B* 829, 137108 (2022), hep-ph/2112.12395, 9 citations
37. **C. Peset, A. Pineda and O. Tomalak**  
The proton radius (puzzle?) and its relatives  
*Prog. Part. Nucl. Phys.* 121 (2021) 103901, hep-ph/2106.00695, 28 citations
36. **O. Tomalak, P. Machado, V. Pandey and R. Plestid**  
Flavor-dependent radiative corrections in coherent elastic neutrino-nucleus scattering  
*JHEP* 2102, 097 (2021), hep-ph/2011.05960, 71 citations
35. **O. Tomalak**  
Axial and pseudoscalar form factors from charged current quasielastic neutrino-nucleon scattering  
*Phys. Rev. D* 103, 013006 (2021), hep-ph/2008.03527, 12 citations
34. **K. Borah, R. J. Hill, G. Lee and O. Tomalak**  
Parameterization and applications of the low- $Q^2$  nucleon vector form factors  
*Phys. Rev. D* 102, 074012 (2020), hep-ph/2003.13640, 68 citations
33. **R. J. Hill and O. Tomalak**  
On the effective theory of neutrino-electron and neutrino-quark interactions  
*Phys. Lett. B* 805, 135466 (2020), hep-ph/1911.01493, 31 citations
32. **O. Tomalak**  
Electromagnetic proton-neutron mass difference  
*Eur. Phys. J. Plus* 135:411 (2020), hep-ph/1810.02502, 10 citations
31. **O. Tomalak and R. J. Hill**  
Theory of elastic neutrino-electron scattering  
*Phys. Rev. D* 101, 033006 (2020), hep-ph/1907.03379, 58 citations
30. **M. Heller, O. Tomalak, M. Vanderhaeghen and Sh. Wu**  
Leading order corrections to the Bethe-Heitler process in the  $\gamma p \rightarrow l^+ l^- p$  reaction  
*Phys. Rev. D* 100, 076013 (2019), editors suggestion, hep-ph/1906.02706, 15 citations
29. **O. Tomalak**  
Two-photon exchange on the neutron and the hyperfine splitting  
*Phys. Rev. D* 99(5), 056018 (2019), hep-ph/1812.03884, 11 citations
28. **O. Tomalak**  
Two-photon exchange correction to the Lamb shift and hyperfine splitting of S levels  
*Eur. Phys. J. A* 55, no. 5, 64 (2019), hep-ph/1808.09204, 42 citations

27. **O. Tomalak and M. Vanderhaeghen**  
Dispersion relation formalism for the two-photon exchange correction to elastic muon-proton scattering: elastic intermediate state  
*Eur. Phys. J. C* 78, no. 6, 514 (2018), *hep-ph/1803.05349*, 30 citations
26. **M. Heller, O. Tomalak and M. Vanderhaeghen**  
Soft-photon corrections to the Bethe-Heitler process in the  $\gamma p \rightarrow l^+ l^- p$  reaction  
*Phys. Rev. D* 97(7), 076012 (2018), *hep-ph/1802.07174*, 14 citations
25. **O. Tomalak**  
Hyperfine splitting in ordinary and muonic hydrogen  
*Eur. Phys. J. A* 54, no. 1, 3 (2018), *hep-ph/1709.06544*, 17 citations
24. **O. Tomalak**  
Two-photon exchange correction to the hyperfine splitting in muonic hydrogen  
*Eur. Phys. J. C* 77, no. 12, 858 (2017), *hep-ph/1708.02509*, 31 citations
23. **O. Tomalak, B. Pasquini and M. Vanderhaeghen**  
Two-photon exchange contribution to elastic  $e^-$ -proton scattering: Full dispersive treatment of  $\pi N$  states and comparison with data  
*Phys. Rev. D* 96(9), 096001 (2017), *hep-ph/1708.03303*, 34 citations
22. **O. Tomalak**  
Forward two-photon exchange in elastic lepton-proton scattering and hyperfine splitting correction  
*Eur. Phys. J. C* 77, no. 8, 517 (2017), *hep-ph/1701.05514*, 24 citations
21. **O. Tomalak, B. Pasquini and M. Vanderhaeghen**  
Two-photon exchange corrections to elastic electron-proton scattering: Full dispersive treatment of  $\pi N$  states at low momentum transfers  
*Phys. Rev. D* 95(9), 096001 (2017), *hep-ph/1612.07726*, 28 citations
20. **M. Sydorenko, O. Tomalak and Yu. Shtanov**  
Magnetic fields and chiral asymmetry in the early hot universe  
*JCAP* 10, 018 (2016), *astro-ph/1607.04845*, 11 citations
19. **O. Tomalak and M. Vanderhaeghen**  
Two-photon exchange correction in elastic unpolarized muon-proton scattering at low momentum transfer  
*Eur. Phys. J. C* 76, no. 3, 125 (2016), *hep-ph/1512.09113*, 45 citations
18. **O. Tomalak and M. Vanderhaeghen**  
Two-photon exchange correction in elastic unpolarized electron-proton scattering at small momentum transfer  
*Phys. Rev. D* 93, 013023 (2016), *hep-ph/1508.03759*, 43 citations
17. **O. Tomalak and M. Vanderhaeghen**  
Subtracted dispersion relation estimate of two-photon exchange  
*EPJ A Highlight and Europhysics News* 46/3
16. **O. Tomalak and M. Vanderhaeghen**  
Subtracted dispersion relation formalism for the two-photon exchange correction in elastic electron-proton scattering: comparison with data  
*Eur. Phys. J. A* 51, no. 2, 24 (2015), *hep-ph/1408.5330*, 71 citations
15. **O. Tomalak and M. Vanderhaeghen**  
Two-photon exchange corrections in elastic muon-proton scattering  
*Phys. Rev. D* 90, 013006 (2014), *hep-ph/1405.1600*, 42 citations
14. **ZEUS Collaboration; H. Abramowicz et al.**  
Exclusive electroproduction of two pions at HERA  
*Eur. Phys. J. C* 72, 1869 (2012), *hep-ex/1111.4905*, 23 citations

13. **ZEUS Collaboration; H. Abramowicz et al.**  
Search for single-top production in  $ep$  collisions at HERA  
*Phys. Lett. B* 708, 27-36 (2014), *hep-ex/1111.3901*, 62 citations
12. **ZEUS Collaboration; H. Abramowicz et al.**  
Scaled momentum distributions for  $K_S^0$  and  $\Lambda/\bar{\Lambda}$  in DIS at HERA  
*JHEP* 1203, 020 (2012), *hep-ex/1111.3526*, 6 citations
11. **ZEUS Collaboration; H. Abramowicz et al.**  
Measurement of the  $t$  dependence in exclusive photoproduction of  $\Upsilon(1S)$  mesons at HERA  
*Phys. Lett. B* 708, 14-20 (2014), *hep-ex/1111.2133*, 37 citations
10. **ZEUS Collaboration; H. Abramowicz et al.**  
Measurement of heavy-quark jet photoproduction at HERA  
*Eur. Phys. J. C* 71, 1659 (2011), *hep-ex/1104.5444*, 24 citations
9. **ZEUS Collaboration; H. Abramowicz et al.**  
Measurement of beauty production in deep inelastic scattering at HERA using decays into electrons  
*Eur. Phys. J. C* 71, 1573 (2011), *hep-ex/1101.3692*, 30 citations
8. **ZEUS Collaboration; H. Abramowicz et al.**  
Study of tau-pair production at HERA  
*JHEP* 1102, 117 (2011), *hep-ex/1101.1390*, 4 citations
7. **ZEUS Collaboration; H. Abramowicz et al.**  
Measurement of the energy dependence of the total photon-proton cross section at HERA  
*Phys. Lett. B* 697, 184-193 (2011), *hep-ex/1011.1652*, 12 citations
6. **ZEUS Collaboration; H. Abramowicz et al.**  
Inclusive dijet cross sections in neutral current deep inelastic scattering at HERA  
*Eur. Phys. J. C* 70, 965-982 (2010), *hep-ex/1010.6167*, 60 citations
5. **ZEUS Collaboration; H. Abramowicz et al.**  
Measurement of high- $Q^2$  charged current deep inelastic scattering cross sections with a longitudinally polarised positron beam at HERA  
*Eur. Phys. J. C* 70, 945-963 (2010), *hep-ex/1008.3493*, 47 citations
4. **ZEUS Collaboration; H. Abramowicz et al.**  
Measurement of  $D^+$  and  $\Lambda_c^+$  production in deep inelastic scattering at HERA  
*JHEP* 1011, 009 (2010), *hep-ex/1007.1945*, 40 citations
3. **ZEUS Collaboration; H. Abramowicz et al.**  
Measurement of beauty production in DIS and  $F_2^{b\bar{b}}$  extraction at ZEUS  
*Eur. Phys. J. C* 69, 347-360 (2010), *hep-ex/1005.3396*, 36 citations
2. **ZEUS Collaboration; H. Abramowicz et al.**  
Inclusive-jet cross sections in NC DIS at HERA and a comparison of the  $k_T$ , anti- $k_T$  and SISCone jet algorithms  
*Phys. Lett. B* 691, 127-137 (2010), *hep-ex/1003.2923*, 56 citations
1. **ZEUS Collaboration; H. Abramowicz et al.**  
Scaled momentum spectra in deep inelastic scattering at HERA  
*JHEP* 1006, 009 (2010), *hep-ex/1001.4026*, 20 citations

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## Conference Proceedings

4. **O. Tomalak**  
Radiative corrections to neutron beta decay and (anti)neutrino-nucleon scattering from low-energy effective field theory  
*Few-Body Syst.* 64, 23 (2023), *hep-ph/2302.00642*, 3 citations
3. **O. Tomalak**  
How well do we know neutrino-electron scattering? EFT approach  
*PoS NuFact 2019 (2020) 049*, *hep-ph/1911.03528*, 1 citation
2. **O. Tomalak**  
Two-photon exchange correction in elastic lepton-proton scattering  
*Few-Body Syst.* 59, 87 (2018), *hep-ph/1806.01627*, 14 citations
1. **O. Tomalak**  
Two-photon exchange corrections in elastic electron-proton scattering  
*PoS Bormio 2015 (2015) 015*, *hep-ph/1601.08033*

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## Technical Reports and White Papers

9. **R. Abir et al.**  
The case for an EIC Theory Alliance: Theoretical Challenges of the EIC  
*White Paper on EIC Theory Alliance (2023)*, 80 citation
8. **B. Acharya et al.**  
Fundamental Symmetries, Neutrons, and Neutrinos (FSNN): Whitepaper for the 2023 NSAC Long Range Plan  
*Topical Collaboration White Paper (2023)*, 17 citations
7. **L. Alvarez-Ruso et al.**  
Bubble chamber detectors with light nuclear targets: a Snowmass white paper  
*Snowmass White Paper (2022)*, 4 citations
6. **L. Alvarez-Ruso et al.**  
Neutrino scattering measurements on hydrogen and deuterium: a Snowmass white paper  
*Snowmass White Paper (2022)*, 18 citations
5. **S. Alioli et al.**  
Event generators for high-energy physics experiments  
*Snowmass White Paper (2022)*, 160 citations
4. **R. M. Abraham et al.**  
Tau neutrinos in the next decade: from GeV to EeV  
*J.Phys.G* 49 (2022) 11, 110501, *Snowmass White Paper (2022)*, 65 citations
3. **L. Alvarez-Ruso et al.**  
Theoretical tools for neutrino scattering: interplay between lattice QCD, EFTs, nuclear physics, phenomenology, and neutrino event generators  
*Snowmass White Paper (2022)*, 82 citations
2. **J. Arrington et al.**  
Physics opportunities for the Fermilab Booster replacement  
*Snowmass White Paper (2022)*, 14 citations
1. **Dm. Bandurin and O. Tomalak**  
Optimization of W+c-jet events selection using MVA BL and BC taggers  
*DZero Note 6196, Fermilab (2011)*

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## Dissertation

**O. Tomalak**

*Two-photon Exchange Corrections in Elastic Lepton-Proton Scattering*

Ph.D. thesis

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## Professional presentations (170)

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### Invited Talks (53)

- 04/2026 *QED radiative corrections for neutrino scattering*  
The 2nd Nuclear Radius Extraction Collaboration Workshop, Stony Brook, USA  
(online talk)
- 12/2025 *Neutrino physics*  
X Winter School for High-School Students in Physics, Kyiv, Ukraine (online talk)
- 12/2025 *Low-energy electroweak physics*  
Sun Yat-sen University, Zhuhai, Guangdong, China (seminar)
- 10/2025 *Radiative corrections to neutrino-nucleon/nucleus cross section*  
Neutrino Interactions for Current and Future Experiments, KEK, Tsukuba, Japan  
(talk)
- 10/2025 *Radiative corrections and cross sections in neutrino physics*  
Neutrino scattering: Theory, Experiment, Phenomenology ( $\nu$ STEP 2025), Beijing, China (talk)
- 10/2025 *Constraints on new physics with (anti)neutrino-nucleon scattering data*  
NuInt 2025, 15th International Workshop on Neutrino-Nucleus Interactions, MITP, Mainz, Germany (talk)
- 07/2025 *Radiative (anti)neutrino energy spectra from muon, pion, and kaon decays*  
Virtual NuSTORM meeting (seminar)
- 06/2025 *Effective field theory for radiative corrections to charged-current processes: neutron decay,  $V_{ud}$ , and  $g_A$ . Hadronic uncertainty in neutral currents*  
Theory Workshop on Neutrino Physics, Center for Theoretical Underground Physics and Related Areas, Lead, South Dakota, USA
- 06/2025 *On the uncertainty of coherent elastic neutrino-nucleus scattering at low energies*  
Magnificent CEvNS 2025, Sao Paulo, Brazil
- 06/2025 *QED nuclear medium effects at EIC energies*  
Bridging Theory and Experiment at the Electron-Ion Collider, Institute for Nuclear Theory, University of Washington, Seattle, WA, USA
- 03/2025 *Theoretical inputs for low-energy electroweak physics*  
Institute for Theoretical Physics, Beijing, China (talk)
- 03/2025 *Theory and experiment for low-energy electroweak physics*  
Institute for Theoretical Physics, Beijing, China (talk)
- 02/2025 *QED nuclear medium effects at EIC energies*  
ePIC meeting, Brookhaven National Laboratory, Upton, NY, USA (seminar)
- 02/2025 *Understanding Quark and Neutrino Mixing: Theory, Experiments, and Advances*  
University of Warsaw, Warsaw, Poland (seminar)
- 01/2025 *Theory and experiment for low-energy electroweak physics*  
6th Peng Huanwu Young Scientists' Forum on Theoretical Physics and Interdisciplinary Studies, ITP/CAS, Beijing, China (talk)

- 01/2025 *Understanding Quark and Neutrino Mixing: Theory, Experiments, and Advances*  
Academia Sinica, Taipei City, Taiwan (colloquium)
- 08/2024 *New physics in (anti)neutrino-nucleon scattering and QED nuclear medium effects*  
Theory Division, Fermilab, Batavia, IL, USA (chalk talk)
- 07/2024 *Charged-current (anti)neutrino-nucleon scattering and QED nuclear medium effects*  
Theory Workshop on Neutrino Physics, Center for Theoretical Underground Physics and Related Areas, Lead, South Dakota, USA
- 04/2024 *Radiative corrections to neutrino-nucleon/nucleus cross section*  
The 2nd Short-Baseline Experiment-Theory Workshop, Hotel Santa Fe, Santa Fe, NM, USA
- 03/2024 *Invariant amplitudes and new physics constraints with (anti)neutrino-nucleon scattering data*  
Brown Bag Seminar, University of Washington, Seattle, WA, USA (colloquium)
- 01/2024 *Theory and experiment for low-energy electroweak physics*  
Texas A&M University, College Station, TX, USA (colloquium)
- 11/2023 *Nucleon axial-vector form factor, neutrino cross sections, and QED nuclear medium effects*  
EINN 2023, Electromagnetic Interactions with Nucleons and Nuclei, Annabelle Hotel, Paphos, Cyprus
- 09/2023 *Theory and experiment for precise neutrino physics*  
University of New Mexico, Albuquerque, NM, USA
- 08/2023 *Neutrino-nucleus interactions in precision era*  
T Division Science for the Future: NPAC/Space Town Hall, Los Alamos National Laboratory
- 08/2023 *From axial form factor to neutrino scattering cross sections*  
Lattice QCD and Probes of New Physics, New Mexico Consortium, Santa Fe, NM, USA
- 07/2023 *Radiative corrections in neutrino physics*  
Theory Workshop on Neutrino Physics, Center for Theoretical Underground Physics and Related Areas, Lead, South Dakota, USA
- 05/2023 *Effective field theory approach for radiative corrections in neutron beta decay*  
Collider, Dark Matter, and Neutrino Physics, Mitchell Institute for Fundamental Physics and Astronomy, Texas A&M University, College Station, TX, USA
- 05/2023 *QED radiative corrections to charged-current neutrino scattering for accelerator neutrinos*  
New physics searches at the precision frontier, Institute for Nuclear Theory, University of Washington, Seattle, WA, USA
- 04/2023 *Radiative corrections to low-energy neutral-current neutrino scattering and DAR sources*  
Interplay of Nuclear, Neutrino and BSM Physics at Low-Energies, Institute for Nuclear Theory, University of Washington, Seattle, WA, USA
- 04/2023 *Theory and experiment for precision neutrino physics*  
Old Dominion University, Norfolk, VA, USA (colloquium)
- 03/2023 *Radiative corrections to low-energy neutral-current neutrino scattering and DAR sources*  
Magnificent CEvNS 2023, Munich, Germany



- 11/2022 *Radiative corrections to neutron beta decay from low-energy effective field theory*  
Baryons 2022, International Conference on the Structure of Baryons, Seville, Spain
- 10/2022 *QED radiative corrections to charged-current neutrino-nucleon elastic scattering at GeV energies*  
NuINT 2022, 13th International Workshop on Neutrino-Nucleus Interactions in the Few GeV Regions, Seoul, South Korea
- 08/2022 *An overview of cross sections in neutrino physics*  
CIPANP 2022, 14th Conference on the Intersections of Particle and Nuclear Physics, Orlando, Florida, USA
- 07/2022 *QED radiative corrections to charged-current neutrino-nucleon elastic scattering for accelerator neutrino experiments*  
ECT\* Workshop on Radiative Corrections from medium to high energy experiments
- 06/2022 *Radiative corrections for proton radius measurements*  
PREN 2022 Convention: International STRONG-2020 Workshop on the Proton Charge Radius and related topics, in-person by Andrei Afanasev
- 03/2022 *Radiative corrections*  
NUSTEC Workshop New Directions in Neutrino-Nucleus Scattering
- 02/2022 *Radiative corrections in electron and neutrino scattering*  
KITP Program: Neutrinos as a Portal to New Physics and Astrophysics, Santa Barbara, CA, USA
- 06/2021, 09/2021 *QED radiative corrections to charged-current neutrino-nucleon elastic scattering*  
Joint neutrino theory-experiment meeting, Fermilab, Batavia, IL, USA
- 03/2021 *Radiative corrections*  
NUSTEC Workshop New Directions in Neutrino-Nucleus Scattering, online
- 03/2021 *Radiative corrections and neutrino scattering*  
Joint neutrino theory-experiment meeting, Fermilab, Batavia, IL, USA
- 11/2020 *Flavor dependence and radiative corrections in CEvNS*  
Neutrino Cross-Talk, CERN
- 07/2020 *Prospects in precise neutrino interactions*  
TF06 Working group, Theory Frontier kickoff meeting, Snowmass 2021, USA
- 03/2020 *Elastic neutrino-electron scattering. Modern theory and applications*  
Electrons for neutrinos meeting, Institute for Nuclear Physics, Johannes Gutenberg-Universität Mainz, Mainz, Germany
- 11/2019 *Nucleon vector form factors via  $z$ -expansion in GENIE*  
Joint neutrino theory-experiment meeting, Fermilab, Batavia, IL, USA
- 09/2019 *Radiative corrections in neutrino-electron scattering*  
GENIE meeting, Fermilab, Batavia, IL, USA
- 10/2018 *Status and prospects of radiative corrections in elastic electron-proton scattering*  
Platform for Research and Applications with Electrons (PRAE) International Workshop, LAL-IPNO-IMNC, Orsay, France
- 05/2018 *Low-energy proton structure and two-photon exchange corrections*  
MLL Kolloquium, Garching, Germany (colloquium)
- 11/2017 *Two-photon exchange correction to the hyperfine splitting in ordinary and muonic hydrogen*  
EINN 2017, Electromagnetic Interactions with Nucleons and Nuclei, Annabelle Hotel, Paphos, Cyprus

- 11/2015 *Two-photon exchange corrections in elastic  $lp$  scattering at low momentum transfer*  
EINN 2015, Electromagnetic Interactions with Nucleons and Nuclei, Annabelle Hotel, Paphos, Cyprus
- 09/2013 *Two-photon exchange corrections in elastic  $ep$  scattering. Dispersive framework*  
MITP Workshop on Low-Energy Precision Physics, Mainz, Germany
- 07/2012 *History of QCD and development of electroweak theory*  
Summer internship for undergraduate students, Bogolyubov Institute for Theoretical Physics, Kyiv, Ukraine
- 07/2011 *Electroweak physics, top quark and Higgs boson at Tevatron and LHC. Searches for new physics*  
Summer internship for undergraduate students, Bogolyubov Institute for Theoretical Physics, Kyiv, Ukraine

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## Contributed Talks (106)

- 11/2025 *Charged-current neutrino scattering cross sections and radiative corrections*  
Workshop in Neutrinos and related New Physics Research (NuPhyR), Zhuhai, Guangdong, China (talk)
- 11/2025 *Effective field theory for radiative corrections to charged-current processes: neutron decay,  $V_{ud}$ , and  $g_A$ . Hadronic uncertainty in neutral currents*  
Baryons 2025, Jeju, South Korea (talk)
- 10/2025 *Effective field theory for radiative corrections to charged-current processes: neutron decay,  $V_{ud}$ , and  $g_A$ . Hadronic uncertainty in neutral currents*  
E18 Group, Physics Department, Technical University of Munich, Garching, Germany (seminar)
- 09/2025 *QED nuclear medium effects at EIC energies*  
Spin 2025, Qingdao (Tsingtao), Shandong Province, China (talk)
- 04/2025 *Quarks, Leptons, and the Big Bang*  
Hampton University, Hampton, VA, USA (talk)
- 04/2025 *Theory and experiment for low-energy electroweak physics*  
Hampton University, Hampton, VA, USA (talk)
- 03/2025 *Theoretical inputs for low-energy electroweak physics*  
University of Warsaw, Warsaw, Poland (talk)
- 01/2025 *Theory and experiment for low-energy electroweak physics*  
Particle and Nuclear Physics Online Forum, Tsinghua University, Beijing, China (talk)
- 01/2025 *Theory and experiment for low-energy electroweak physics*  
Center for Theoretical Physics & Natural Philosophy, Mahidol University, Nakhon-sawan, Thailand (talk)
- 01/2025 *Theory and experiment for low-energy electroweak physics*  
University of Tennessee, Knoxville, TN, USA (talk)
- 12/2024 *Theory and experiment for low-energy electroweak physics*  
International Young Scholars Forum on Physics and Astronomy, School of Physics and Astronomy and Tsung-Dao Lee Institute of Shanghai Jiao Tong University, Shanghai, China (talk)
- 12/2024 *Theory and experiment for low-energy electroweak physics*  
Southern Methodist University, Dallas, TX, USA (talk)

- 12/2024 *Theory and experiment for low-energy electroweak physics*  
Koc University, Istanbul, Turkey (talk)
- 11/2024 *Theory and experiment for low-energy electroweak physics*  
High Energy Theory Group, Academia Sinica, Taipei City, Taiwan (talk)
- 05/2024 *Effective field theory for radiative corrections to neutron decay*  
First Collaboration Meeting, Nuclear Theory for New Physics, The Washington University in St. Louis Department of Physics and the McDonnell Center for the Space Sciences, Saint Louis, MI, USA (talk)
- 04/2024 *QED nuclear medium effects in neutrino-nucleus and electron-nucleus scattering*  
The XXI annual workshop on Soft-Collinear Effective Theory, Salamanca, Spain (talk)
- 04/2024 *Understanding Universe with new Theory for Precision Beta Decay*  
Science in 3 prescreening, Los Alamos National Laboratory (talk)
- 04/2024 *Nucleon axial-vector form factor, radiative corrections, QED nuclear medium effects, and neutron decay*  
T2 Nuclear Physics Group Meeting, Los Alamos National Laboratory (seminar)
- 04/2024 *QED nuclear medium effects in neutrino-nucleus and electron-nucleus scattering*  
APS April Meeting 2024, Sacramento Convention Center, Sacramento, CA, USA (talk)
- 03/2024 *Invariant amplitudes and new physics constraints with (anti)neutrino-nucleon scattering data*  
Brownbag Seminar at the University of Washington, University of Washington, Seattle, WA, USA (seminar)
- 01/2024 *Theoretical inputs for precise electroweak physics*  
Florida International University, Miami, FL, USA (talk)
- 12/2023 *Low-energy Neutrino, Nuclear and Hadron Physics*  
Texas A&M University, College Station, TX, USA (talk)
- 11/2023 *Invariant amplitudes, unpolarized cross sections, and polarization asymmetries in (anti)neutrino-nucleon elastic scattering*  
The 2023 Fall Meeting of the APS DNP and JPS, Hilton Waikoloa Village, HI, USA (talk)
- 11/2023 *Nucleon axial-vector radius and form factor from lattice QCD, MINERvA antineutrino-proton data, and future neutrino experiments*  
The 2023 Fall Meeting of the APS DNP and JPS, Hilton Waikoloa Village, HI, USA (talk)
- 11/2023 *Effective field theory approach for radiative corrections to neutron decay*  
The 2023 Fall Meeting of the APS DNP and JPS, Hilton Waikoloa Village, HI, USA (talk)
- 11/2023 *Nucleon axial-vector form factor, neutron decay, and QED nuclear medium effects*  
Theory group, Institute for Nuclear Physics, Johannes Gutenberg-Universität Mainz, Mainz, Germany (seminar)
- 06/2023 *Unlocking mysteries at smallest and largest scales*  
Science in 3, Los Alamos National Laboratory (talk)
- 05/2023 *Radiative corrections in neutrino physics*  
P-Division Meeting, Los Alamos National Laboratory (seminar)
- 04/2023 *Radiative corrections in neutrino physics*  
Science in 3 prescreening, Los Alamos National Laboratory (talk)

- 04/2023 *Status of proton radius puzzle and QED radiative corrections for accelerator neutrinos*  
Korean Institute for Advanced Studies (KIAS), Seoul, South Korea (seminar)
- 04/2023 *Theoretical inputs for Nucleon Structure, Atomic Physics, and Neutrino Physics*  
Argonne Theory Group Seminar, Physics Division, Lemont, IL, USA (seminar)
- 04/2023 *Radiative corrections in electron and neutrino physics*  
JLab Theory Center Seminar, Newport News, VA, USA (seminar)
- 03/2023 *QED radiative corrections for accelerator neutrinos*  
SCET Workshop 2023, Lawrence Berkeley National Lab, USA (talk)
- 03/2023 *Radiative corrections for precise low- and high-energy (anti)neutrino fluxes*  
XXX International Workshop on Deep-Inelastic Scattering and Related Subjects, Michigan State University, East Lansing, Michigan, USA (talk)
- 03/2023 *QED radiative corrections for accelerator neutrinos*  
Theory group, Institute for Nuclear Physics, Johannes Gutenberg-Universität Mainz, Mainz, Germany (seminar)
- 01/2023 *Radiative corrections in neutrino physics*  
Institute for Nuclear Theory Seminar S@INT, University of Washington, Seattle, WA, USA (seminar)
- 07/2022 *QED nuclear medium effects in neutrino-nucleus and electron-nucleus scattering*  
27th International Symposium on Particles, Strings and Cosmology (PASCOS 2022), Heidelberg, Germany (talk)
- 06/2022 *QED nuclear medium effects in neutrino-nucleus and electron-nucleus scattering*  
T2 Symmetry Lunch Seminar, Los Alamos National Laboratory (seminar)
- 07/2022 *Radiative corrections in neutrino physics*  
Science in 3 prescreening, Los Alamos National Laboratory (talk)
- 07/2022 *QED nuclear medium effects in lepton-nucleus scattering*  
International Conference on High Energy Physics, ICHEP 2022, Bologna, Italy (talk)
- 06/2022 *QED nuclear medium effects in neutrino-nucleus and electron-nucleus scattering*  
T2 Symmetry Lunch Seminar, Los Alamos National Laboratory (seminar)
- 04/2022 *Radiative corrections to charged-current neutrino scattering at GeV energies*  
SCET Workshop 2022, Bern, Switzerland (talk)
- 01/2022 *Superaligned  $\beta$  decays*  
T2 Symmetry Lunch Seminar, Los Alamos National Laboratory (seminar)
- 01/2022 *Theoretical inputs for neutrino physics, nucleon structure, atomic physics, and cosmology*  
T2 Nuclear Physics Group Meeting, Los Alamos National Laboratory (seminar)
- 10/2021 *Axial and pseudoscalar form factors from charged-current quasielastic neutrino-nucleon scattering*  
2021 Fall Meeting of the APS DNP, Virtual Meeting, USA (talk)
- 10/2021 *Radiative corrections for neutrino oscillation experiment and beyond*  
T2 Nuclear Physics Group Meeting, Los Alamos National Laboratory (seminar)
- 10/2021 *Axial and pseudoscalar form factor with tau neutrinos*  
Tau Neutrinos from GeV to EeV 2021 (NuTau2021), Brookhaven National Laboratory, Upton, NY, USA (talk)
- 09/2021 *QED radiative corrections to charged-current neutrino-nucleon elastic scattering for accelerator neutrino experiments*  
NuFACT 2021, 22nd International Workshop on Neutrinos from Accelerators, Cagliari, Italy (talk)

- 07/2021 *QED radiative corrections to charged-current neutrino-nucleon elastic scattering*  
APS DPF Meeting 2021, Florida State University, FL, USA (talk)
- 06/2021 *QED radiative corrections to charged-current neutrino-nucleon elastic scattering for accelerator neutrino experiments*  
WIN 2021, University of Minnesota, USA (talk)
- 05/2021 *Axial and pseudoscalar form factors from charged-current quasielastic neutrino-nucleon scattering*  
Phenomenology 2021, University of Pittsburgh, USA (talk)
- 05/2021 *Radiative corrections in neutrino scattering*  
RADCOR-LoopFest 2021, Florida State University, Tallahassee, FL, USA (talk)
- 05/2021 *Radiative corrections in neutrino physics*  
First European Consortium for Astroparticle Theory (EuCAPT) Annual Symposium, CERN (talk)
- 04/2021 *Axial and pseudoscalar form factors from charged-current quasielastic neutrino-nucleon scattering*  
Phenomenology in Illinois, Kentucky, Indiana, Michigan, and Ohio, Northwestern University, IL, USA (talk)
- 03/2021 *Radiative corrections in neutrino scattering*  
Nuclear Physics group, University of Kentucky, Lexington, KY, USA (seminar)
- 02/2021 *Radiative corrections and neutrino scattering*  
Nuclear Theory Group, University of Washington, Seattle, WA, USA (seminar)
- 12/2020 *Radiative corrections and neutrino scattering*  
T2 Nuclear Physics Group Meeting, Los Alamos National Laboratory (seminar)
- 11/2020 *Flavor dependence and radiative corrections in CEvNS*  
Magnificent CEvNS 2020, Virtual Meeting, Cyberspace (talk)
- 10/2020 *Electromagnetic proton form factors for neutrino physics and atomic spectroscopy*  
2020 Fall Meeting of the APS DNP, Virtual Meeting, USA (talk)
- 09/2020 *Radiative corrections in neutrino scattering*  
TF11 Working group, Workshop on Neutrino Theory, Snowmass 2021, USA (talk)
- 08/2020 *Radiative corrections to charged current quasielastic neutrino-nucleon scattering in effective field theory*  
New Perspectives 2020 (2.0), Fermilab, Batavia, IL, USA (talk)
- 07/2020 *Electromagnetic proton form factors for neutrino physics and atomic spectroscopy*  
Neutrino Seminar Series, Fermilab, Batavia, IL, USA (seminar)
- 05/2020 *How well do we know neutrino-electron scattering? EFT approach for neutrino interactions*  
Phenomenology 2020 Symposium, University of Pittsburg, Pittsburg, PA, USA (talk)
- 04/2020 *Two-photon exchange corrections and low-energy nucleon structure*  
JLab Theory Center Seminar, Newport News, VA, USA (seminar)
- 11/2019 *Elastic neutrino-electron scattering. Modern theory and applications*  
High Energy Physics Seminar, Michigan State University, East Lansing, MI, USA (seminar)
- 11/2019 *Elastic neutrino-electron scattering in effective field theory*  
Nuclear Physics group, University of Kentucky, Lexington, KY, USA (seminar)

- 11/2019 *Elastic neutrino-electron scattering. Modern theory, MINERvA measurement and future prospects*  
Joint Experimental-Theoretical Physics Seminar, Fermilab, Batavia, IL, USA (seminar)
- 11/2019 *Elastic neutrino-electron scattering in effective field theory*  
Phenomenology in Illinois, Kentucky, Indiana, Michigan, and Ohio, University of Cincinnati, Cincinnati, OH, USA (talk)
- 10/2019 *Elastic neutrino-electron scattering in effective field theory*  
High Energy Theory group, Brookhaven National Laboratory, Upton, NY, USA (seminar)
- 10/2019 *Hyperfine splitting in muonic hydrogen and two-photon exchange on nucleons*  
2019 Fall Meeting of the APS DNP, Crystal City, VA, USA (talk)
- 10/2019 *Elastic neutrino-electron scattering in effective field theory*  
Topics in Cosmic Neutrino Physics, Fermilab, Batavia, IL, USA (talk)
- 09/2019 *Elastic neutrino-electron scattering in effective field theory*  
RADCOR 2019, 14th International Symposium on Radiative Corrections, Avignon, France (talk)
- 08/2019 *Elastic neutrino-electron scattering in effective field theory*  
NuFACT 2019, 21st International Workshop on Neutrinos from Accelerators, Daegu, South Korea (talk)
- 08/2019 *Elastic neutrino-electron scattering in effective field theory*  
Theory group, Institute for Nuclear Physics, Johannes Gutenberg-Universität Mainz, Mainz, Germany (seminar)
- 07/2019 *Elastic neutrino-electron scattering within effective field theory*  
APS DPF Meeting 2019, Boston, MA, USA (talk)
- 06/2019 *Elastic neutrino-electron scattering within effective field theory*  
New Perspectives 2019, Fermilab, Batavia, IL, USA (talk)
- 03/2019 *Two-photon exchange in lepton-proton scattering and spectroscopy*  
Phenomenology in Illinois, Kentucky, Indiana, Michigan, and Ohio, University of Michigan, Ann Arbor, MI, USA (talk)
- 07/2018 *Two-photon exchange in lepton-proton scattering and spectroscopy*  
Mainz Institute for Theoretical Physics (MITP) Workshop on "Proton Radius Puzzle", Johannes Gutenberg-Universität Mainz, Mainz, Germany (talk)
- 04/2018 *Low-energy proton structure and two-photon exchange corrections*  
Theory group, Institute for Nuclear Physics, Johannes Gutenberg-Universität Mainz, Mainz, Germany (seminar)
- 04/2018 *Two-photon exchange corrections to elastic lepton-proton scattering and atomic spectroscopy*  
Paul Scherrer Institute, Villigen, Switzerland (seminar)
- 11/2017 *Dispersive and model calculations of two-photon exchange vs data*  
EINN 2017, Electromagnetic Interactions with Nucleons and Nuclei, Annabelle Hotel, Paphos, Cyprus (talk)
- 09/2017 *Two-photon exchange calculations versus data*  
The Electroweak Box, Amherst Center for Fundamental Interactions, Amherst, MA, USA (talk)
- 09/2017 *Two-photon corrections*  
Annual CRC 1044 School, Boppard, Germany (talk)

- 08/2017 *Two-photon exchange correction in elastic lepton-proton scattering. Dispersive and model calculations*  
NSTAR 2017, 11th International Workshop on Physics of Excited Nucleons, Columbia, SC, USA (talk)
- 08/2017 *Two-photon exchange correction in elastic lepton-proton scattering. Dispersive and model calculations*  
Theory group, Institute for Nuclear Physics, Johannes Gutenberg-Universität Mainz, Mainz, Germany (seminar)
- 03/2017 *Two-photon exchange corrections in elastic lepton-proton scattering*  
Department of Physics, University of Pavia, Pavia, Italy (seminar)
- 10/2016 *Two-photon exchange corrections in elastic lepton-proton scattering*  
Department of Physics, University of Maryland, College Park, MD, USA (seminar)
- 10/2016 *Two-photon exchange corrections in elastic lepton-proton scattering*  
Institute for Nuclear Theory, University of Washington, Seattle, WA, USA (seminar)
- 10/2016 *Two-photon exchange corrections in elastic lepton-proton scattering*  
2016 Fall Meeting of the APS DNP, Vancouver, BC, Canada (talk)
- 04/2016 *Two-photon exchange corrections in elastic lepton-proton scattering*  
Department of Physics, Temple University, Philadelphia, PA, USA (seminar)
- 04/2016 *Two-photon exchange corrections in elastic lepton-proton scattering*  
Laboratory for Nuclear Science, MIT, Cambridge, MA, USA (seminar)
- 04/2016 *Two-photon exchange corrections in elastic lepton-proton scattering*  
Physics Department, College of William and Mary, Williamsburg, VA, USA (seminar)
- 04/2016 *Two-photon exchange corrections in elastic lepton-proton scattering*  
JLab Theory Center Seminar, Newport News, VA, USA (seminar)
- 04/2016 *Two-photon exchange corrections in elastic lepton-proton scattering*  
APS April Meeting 2016, Salt Lake City, UT, USA (talk)
- 03/2016 *Two-photon exchange corrections in elastic lepton-proton scattering*  
Theory group, Institute for Nuclear Physics, Johannes Gutenberg-Universität Mainz, Mainz, Germany (seminar)
- 11/2015 *Two-photon exchange corrections in elastic lp scattering at low momentum transfer*  
Frontiers and Careers in Photonuclear Physics, Annabelle Hotel, Paphos, Cyprus (talk)
- 10/2015 *Two-photon exchange corrections in elastic lp scattering at low momentum transfer*  
Annual CRC 1044 School, Boppard, Germany (talk)
- 09/2015 *Two-photon exchange corrections in elastic lp scattering at low momentum transfer*  
Probing Hadron Structure with Lepton and Hadron Beams, Erice, Sicily, Italy (talk)
- 06/2015 *Two-photon exchange corrections in elastic lepton-proton scattering*  
Department of Physics, University of Pavia, Pavia, Italy (seminar)
- 03/2015 *Two-photon exchange corrections in elastic lepton-proton scattering*  
German Physical Society Spring Meeting, Heidelberg, Germany (talk)
- 09/2014 *Two-photon exchange corrections in elastic lepton-proton scattering*  
Summer School "Symmetries and Fundamental Interactions 2014", Abbey Frauenwirth, Chiemsee Island, Bayern, Germany (talk)
- 08/2014 *Two-photon exchange corrections in elastic electron-proton and muon-proton scattering. Elastic contribution. Dispersive framework*  
Frontiers and Careers in Photonuclear Physics, MIT, Cambridge, MA, USA (talk)

- 06/2014 *Two-photon exchange corrections in elastic electron-proton and muon-proton scattering. Elastic contribution. Dispersive framework*  
Mainz Institute for Theoretical Physics (MITP) Workshop on "Proton Radius Puzzle", Schloss Waldthausen, Mainz, Germany (talk)
- 03/2014 *Two-photon exchange corrections in elastic ep scattering. Dispersive framework*  
German Physical Society Spring Meeting, Frankfurt, Germany (talk)
- 11/2013 *Two-photon exchange corrections in elastic ep scattering. Dispersive framework*  
EINN 2013, Electromagnetic Interactions with Nucleons and Nuclei, Annabelle Hotel, Paphos, Cyprus (talk)
- 10/2013 *Two-photon exchange corrections in elastic ep scattering. Dispersive framework*  
Annual CRC 1044 School, Boppard, Germany (talk)
- 09/2013 *Two-photon exchange corrections in elastic ep scattering. Dispersive framework*  
Graduate School Annual Retreat, Kloster Eberbach, Eltville, Germany (talk)

### Posters at International Conferences (11)

- 06/2022 *QED corrections to charged-current neutrino-nucleon elastic scattering*  
Neutrino 2022, Seoul, South Korea, online conference
- 04/2022 *From QCD to QED and back: medium effects in neutrino-nucleus and electron-nucleus scattering from Glauber photon interactions*  
29th International Conference on Ultrarelativistic Nucleus-Nucleus Collisions, Quark Matter 2022, online participation, Gathertown, Krakow, Poland
- 09/2021 *QED corrections to charged-current neutrino-nucleon elastic scattering*  
Particles and Nuclei International Conference, PANIC 2021, online conference, Lisbon, Portugal
- 04/2021 *QED radiative corrections to neutrino-nucleon scattering at GeV energies*  
World SCET 2021, online conference
- 06/2020 *Elastic neutrino-electron scattering. Theory for experiment*  
Neutrino 2020, online conference
- 06/2019 *Elastic neutrino-electron scattering in effective field theory*  
Lepton-Photon 2019, Toronto, ON, Canada
- 08/2018 *Hyperfine splitting in ordinary and muonic hydrogen*  
Gordon Research Conference "Photonuclear Reactions", Holderness, NH, USA
- 11/2017 *Two-photon exchange correction to the hyperfine splitting in ordinary and muonic hydrogen*  
EINN 2017, Electromagnetic Interactions with Nucleons and Nuclei, Annabelle Hotel, Paphos, Cyprus (winner of the poster competition)
- 11/2015 *Two-photon exchange corrections in elastic lepton-proton scattering at low momentum transfer*  
EINN 2015, Electromagnetic Interactions with Nucleons and Nuclei, Annabelle Hotel, Paphos, Cyprus (winner of the poster competition)
- 01/2015 *Two-photon exchange corrections in elastic lepton-proton scattering*  
53rd International Winter Meeting on Nuclear Physics, Bormio, Italy (winner of the poster competition)
- 08/2014 *Two-photon exchange corrections in elastic lepton-proton scattering*  
Gordon Research Conference "Photonuclear Reactions", Holderness, NH, USA

*Tomalak*

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