

Research Interests

My interests are the description of space and time; classically, in the framework of General Relativity and more general theories, as well as in the domain of quantum field theory in curved spacetime. I am particularly interested in methods from effective field theory and modern differential geometry, and how they can help us to understand quantum effects and new physics involving black holes and gravity.

Education

- 2016–present **Doctor of Philosophy (Ph.D.) in Physics**, *University of Alberta*, Canada.
Vanier scholar; expected completion: Sept. 2020
- 2015–2016 **Master of Science in Physics**, *University of Waterloo*, Canada.
Perimeter Scholars International, *Perimeter Institute for Theoretical Physics*, Waterloo, Canada.
- 2012–2015 **Master of Science in Physics**, *University of Cologne*, Cologne, Germany.
GPA – 1.0 (honor’s branch)*
- 2009–2012 **Bachelor of Science in Physics**, *RWTH Aachen University*, Aachen, Germany.
GPA – 1.1 excellent*
- 2000–2009 **Abitur**, *Heinrich-Heine Gymnasium*, Oberhausen, Germany.
*GPA – 1.0**

*German grading system: 1.0 corresponds to the highest possible grade.

Publications

11. J.B., Valeri P. Frolov, and Andrei Zelnikov, “On thermal field fluctuations in ghost-free theories,” *Phys. Lett. B* **793** (2019) 290; arXiv:1904.07917 [hep-th].
10. J.B., Valeri P. Frolov, and Andrei Zelnikov, “Probing the vacuum fluctuations in scalar ghost-free theories,” *Phys. Rev. D* **99** (2019) 076014; arXiv:1901.07096 [hep-th].
9. Yakov Itin, Yuri N. Obukhov, J.B., and Friedrich W. Hehl, “Premetric teleparallel theory of gravity and its local and linear constitutive law,” *Eur. Phys. J. C* **78** (2018) 907; arXiv:1808.08048 [gr-qc].
8. J.B., Valeri P. Frolov, and Andrei Zelnikov, “Quantum scattering on a delta potential in ghost-free theory,” *Phys. Lett. B* **782** (2018) 688; arXiv:1805.01875 [hep-th].
7. J.B., “Gravitational Friedel oscillations in higher-derivative and infinite-derivative gravity?,” *Int. J. Mod. Phys. D* **27** (2018) 1847022; arXiv:1804.00225 [gr-qc].
6. J.B., Valeri P. Frolov, and Andrei Zelnikov, “The gravitational field of p -branes in linearized ghost-free gravity,” *Phys. Rev. D* **97** (2018) 084021; arXiv:1802.09573 [gr-qc].
5. J.B. and Valeri P. Frolov, “Principal Killing strings in higher-dimensional Kerr–NUT–(A)dS spacetimes,” *Phys. Rev. D* **97** (2018) 084015; arXiv:1801.00122 [gr-qc].

4. J.B. and Valeri P. Frolov, “Stationary black holes with stringy hair,” *Phys. Rev. D* **97** (2018) 024024; arXiv:1711.06357 [gr-qc].
3. J.B. and Alberto Favaro, “Kerr principal null directions from Bel–Robinson and Kummer surfaces,” arXiv:1703.10791 [gr-qc].
2. J.B. and Friedrich W. Hehl, “Gravity-induced four-fermion contact interaction implies gravitational intermediate W and Z type gauge bosons,” *Int. J. Theor. Phys.* **56** (2017) 751; arXiv:1606.09273 [gr-qc].
1. J.B., “Plebański–Demiański solution of general relativity and its expressions quadratic and cubic in curvature: analogies to electromagnetism,” *Int. J. Mod. Phys. D* **24** (2015) 1550079; arXiv:1412.1958 [gr-qc].

Awards and Scholarships

- 2017–2020 Vanier Canada Graduate Scholarship
Natural Sciences and Engineering Research Council of Canada
 President’s Doctoral Prize of Distinction
University of Alberta
- 2016–2019 Golden Bell Jar Graduate Scholarship in Physics
University of Alberta
- 2016–2017 Dean’s Excellence Recruitment Scholarship Award
 University of Alberta Doctoral Recruitment Scholarship
University of Alberta
- 2015–2016 Perimeter Scholars International Award
Perimeter Institute for Theoretical Physics
- 2013–2015 Member of Bonn–Cologne Graduate School Honor’s Branch
University of Cologne

Honors and Distinctions

- 2019 Finalist, three-minute thesis (3MT) competition
Faculty of Graduate Studies and Research, University of Alberta
- 2018 Honorable Mention, Essay Competition 2018
Gravity Research Foundation
 First prize, Annual Symposium for Graduate Physics Research
Graduate Physics Student Association, University of Alberta
 Semi-finalist prize, Images of Research Competition 2018 (link)
University of Alberta
- 2013 Selected for Dean’s List 2013
RWTH Aachen University
- 2012 becoMINT graduate prize
Robert Bosch corporation
- 2009 State distinction for best Abitur* graduates
Patron: prime minister of North Rhine-Westfalia, Germany
 Manfred Lennings medal for best Abitur* grade
Rotary Club Oberhausen

*diploma from German secondary schools qualifying for university admission or matriculation.

Attended Conferences and Schools

- 2018 **Hundred Years of Gauge Theory**
Physikzentrum German Physical Society, Bad Honnef, Germany
Prospects in Theoretical Physics – From Qubits to Spacetime
Institute for Advanced Study, Princeton, USA
Joint Canada-Asia Pacific Conf. on General Relativity and Relativistic Astrophysics
University of Alberta, Edmonton, Canada
- 2017 **Geometric Foundations of Gravity**
University of Tartu, Estonia
Mathematical Physics and General Relativity Symposium in Honor of Professor Ivor Robinson
University of Texas at Dallas, USA
- 2016 **Time in Cosmology**
Perimeter Institute for Theoretical Physics, Waterloo, Canada
Black Holes' New Horizons
Casa Matemática Oaxaca, Mexico
- 2015 **14th Marcel Grossmann Meeting**
University of Rome (La Sapienza), Italy
DPG (German Physical Society) Spring Meeting
Technical University Berlin, Germany
- 2014 **569th Wilhelm and Else Heraeus Seminar on Quantum Cosmology**
Physikzentrum German Physical Society, Bad Honnef, Germany
Graduate School “From Classical to Quantum GR: Applications to Cosmology”
University of Sussex, United Kingdom
- 2013 **Second Erlangen Fall School on Quantum Geometry**
University of Erlangen–Nuremberg, Germany
Jürgen Ehlers Spring School “Gravitational Physics”
Max Planck Institute for Gravitational Physics, Potsdam, Germany

Talks and Invited Seminars

- Apr 2019 **An exact Kerr–(A)dS black hole solution with torsion and curvature**
Gravity seminar, University of Alberta, Canada
Black holes and Einstein’s end of eternity
3MT Finals 2019, University of Alberta, Canada
- Nov 2018 **Quantum-mechanical scattering on a delta potential in ghost-free theory**
Gravity seminar, University of Alberta, Canada
- Oct 2018 **An exact stationary string configuration attached to a rotating black hole**
Graduate research symposium, University of Alberta, Canada
- Jun 2018 **Principal Killing strings in higher-dimensional Kerr–NUT–(A)dS spacetimes**
JCAPC GRRRA 2018, University of Alberta, Canada
- Mar 2018 **Linearized short-distance modifications of Einstein’s General Relativity**

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- Graduate weekend, University of Alberta, Canada*
- Jan 2018 Cosmic strings in stationary BH geometries: stringy matter, principal Killing strings
Invited talk, University of Cologne, Germany
- Aug 2017 Curvature tensors in a 4D Riemann–Cartan space: decompositions and superenergy
Geometric Foundations of Gravity, University of Tartu, Estonia
- May 2017 The Bel–Robinson tensor as an irreducible piece of the Bel tensor
Mathematical Physics and General Relativity Symposium in Honor of Professor Ivor Robinson, University of Texas at Dallas, USA
- Sep 2016 Quasi-normal modes: what can ringing black holes tell us about quantum gravity?
Symposium for Graduate Physics Research, University of Alberta, Canada
- May 2016 Quasi-normal modes of the BTZ black hole and (2+1)D Poincaré gauge theory of gravity
Invited talk, Black Holes’ New Horizons, Casa Matemática Oaxaca, Mexico
- Mar 2016 Gauge structures in gravity
Gravity seminar, University of Alberta, Canada
- Dec 2015 Poincaré gauge theory and its deformed Lie algebra – mass-spin classification of elementary particles
PSI seminar, Perimeter Institute for Theoretical Physics, Canada
- Nov 2015 Classical aspects of Poincaré gauge theory of gravity
Quantum gravity seminar, Perimeter Institute for Theoretical Physics, Canada
- Sep 2015 Differential forms: from classical force to the Wilson loop
PSI seminar, Perimeter Institute for Theoretical Physics, Canada
- Jul 2015 Plebański–Demiański solution of general relativity and its expressions quadratic and cubic in curvature: analogies to electromagnetism
14th Marcel Grossmann Meeting, University of Rome (La Sapienza), Italy
- Mar 2015 Plebański–Demiański solution of general relativity and its expressions quadratic and cubic in curvature: analogies to electromagnetism
DPG (German Physical Society) Spring Meeting, Berlin, Germany
- Apr 2015 Poincaré gauge theory of gravity — an introduction
Invited talk, BCGS seminar, Physikzentrum German Physical Society, Bad Honnef, Germany
- Feb 2015 Quasi-normal modes of the BTZ black hole with torsion
Gravitation and Relativity seminar, University of Cologne, Germany
- Nov 2014 Second order curvature invariants for the Plebański–Demiański solution
Gravitation and Relativity seminar, University of Cologne, Germany
- Jun 2014 Poincaré gauge theory of gravity
Gravitation and Relativity seminar, University of Cologne, Germany
- Jun 2014 Exterior calculus and Einstein–Cartan theory
Gravitation and Relativity seminar, University of Cologne, Germany

Master’s Theses

- Title *Symplectic boundary degrees of freedom in Poincaré gauge theory of gravity*
- Supervisors Prof. Lee Smolin & Prof. Laurent Freidel
- Title *Quasi-normal modes of the the BTZ black hole solution of (2 + 1)-dimensional Poincaré gauge theory of gravity*

Supervisors Prof. Friedrich W. Hehl & Prof. Claus Kiefer

Bachelor's Thesis

Title *Physics inside the Schwarzschild radius*
Supervisor Prof. Yvonne Y. Wong

Refereeing

2016–present Annals of Physics (Berlin)
2018–present Zeitschrift für Naturforschung A
2018–present International Journal of Modern Physics D

Memberships

2014–present DPG (German Physical Society), Division of Gravitation and Relativity
2018–present CAP (Canadian Association of Physicists), Division of Theoretical Physics
2018–present APS (American Physical Society), Division of Gravitation, Division of Astrophysics

2014–present WWF (World Wide Fund for Nature)
2014–present Welthungerhilfe Germany (NGO for development cooperation and emergency aid)

Teaching Experience

winter 2019 Conformal Field Theory Student Meetings (graduate reading class, University of Alberta)
<http://www.spintwo.net/Courses/CFT-Student-Meetings/>
fall 2018 Gauge Theory Student Meetings (graduate reading class, University of Alberta)
<http://www.spintwo.net/Courses/Gauge-Theory-Student-Meetings/>
winter 2018 QFT Student Meetings (graduate reading class, University of Alberta)
<http://www.spintwo.net/Courses/QFT-Student-Meetings/>
2015 Geometry in Physics
teaching assistant, graduate course, University of Cologne, Prof. Alexander Altland
2014 Advanced Seminar on General Relativity & Cosmology
teaching assistant, graduate course, University of Cologne, Prof. Claus Kiefer
2014 General Relativity & Cosmology II
teaching assistant, graduate course, University of Cologne, Prof. Claus Kiefer

Work Experience

2009–present freelance web developer
2014–2015 teaching assistant for various graduate-level courses
Institute for Theoretical Physics, University of Cologne
2014 Development and implementation of registration interface for the conference “569th Wilhelm and Else Heraeus Seminar on Quantum Cosmology” (see above)
Institute for Theoretical Physics, University of Cologne, Prof. Claus Kiefer
2013–2014 Development of website content management system (www.loosdrecht.net)
II. Physical Institute, University of Cologne, Prof. Paul van Loosdrecht
2013–2014 Graphic design and poster supervision for the Physical Colloquium

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Department of Physics, University of Cologne

2013 Supervision of physics department website (physik.uni-koeln.de)

Department of Physics, University of Cologne

Computer Skills

algebra Reduce with Excalc, Maple, Mathematica
data analysis ROOT data analysis framework
media \LaTeX , GIMP, Inkscape, Adobe InDesign, Adobe Premiere Pro
programming BASIC, C, Java, Python
web HTML, CSS, PHP, JavaScript, Ajax, MySQL, Typo3, webdesign

Other Interests

electronics, programming, and collecting vintage vacuum “Nixie” tubes (see personal website www.jb-electronics.de), webdesign, piano (Boogie Woogie, Rock’n’Roll), ballroom dancing

Other Projects

2012 Development of data analysis software optoScale, RWTH Aachen University
2011–2012 Undergraduate Fund Project, RWTH Aachen University
Study and construction of gas discharge electron tubes at the I. Physical Institute B, Prof. Lutz Feld

Languages

English (fluent), German (native), French (basic), Latin (basic)

References

Prof. Valeri P. Frolov

Ph.D. supervisor, University of Alberta, Canada

Prof. David Kubiznak

Mentor, Perimeter Institute for Theoretical Physics, Canada

Prof. Friedrich W. Hehl

M.Sc. supervisor, Institute for Theoretical Physics, University of Cologne, Germany

Further information available upon request. Last update: May 2019