

Jens Boos

Curriculum Vitae

Research Interests

I am interested in quantum effects and new physics involving black holes and gravity. In particular, I study **non-local physics** at both the classical and quantum regime, and my long-term goal is to understand whether fundamental non-locality can remove the singularities inside of black holes and within cosmological theories.

In Brief

13 publications, 2 preprints, 1 book review, 2 Honorable Mentions in the 2020 and 2018 Gravity Research Foundation Essay Competition, $h_{\text{HEP}} = 6$, 37 talks (7 invited), 14 attended conferences, taught 7 graduate courses, designed 4 of them, \$356,724 of funding in 9 awards and scholarships.

Positions

2020– **Postdoctoral Research Associate of Physics**, *High Energy Theory Group, College of William & Mary*, Williamsburg, VA, United States.

Education

2016–2020 **Doctor of Philosophy (Ph.D.) in Physics**, *University of Alberta*, Edmonton, Canada.
Vanier scholar, *GPA – 3.8* (Ph.D. awarded Sep 16, 2020.)

2015–2016 **Master of Science in Physics**, *University of Waterloo*, Waterloo, Canada.
Perimeter Scholars International, *Perimeter Institute*, Waterloo, Canada.
GPA – program traditionally not graded

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.

Submitted Papers

- S1. J.B., “Effects of non-locality in gravity and quantum theory,” arXiv:2009.10856 [gr-qc], Ph.D. thesis, 234 pages, University of Alberta (2020). To be submitted to *Springer Theses*.

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Publications

13. J.B., “Angle deficit & non-local gravitoelectromagnetism around a slowly spinning cosmic string,” arXiv:2003.13847 [gr-qc], to appear in the special issue of Int. J. Mod. Phys. D, honorable mention in the Gravity Research Foundation Essay Competition 2020.
12. J.B., Jose Pinedo Soto, and Valeri P. Frolov, “Ultrarelativistic spinning objects in non-local ghost-free gravity,” Phys. Rev. D **101** (2020) no. 12, 124065; arXiv:2004.07420 [gr-qc].
11. J.B., Valeri P. Frolov, and Andrei Zelnikov, “Ghost-free modification of the Polyakov action and Hawking radiation,” Phys. Rev. D **100** (2019) no. 10, 104008; arXiv:1909.01494 [hep-th].
10. 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].
9. J.B., Valeri P. Frolov, and Andrei Zelnikov, “Probing the vacuum fluctuations in scalar ghost-free theories,” Phys. Rev. D **99** (2019) no. 7, 076014; arXiv:1901.07096 [hep-th].
8. 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].
7. 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].
6. 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], honorable mention in the Gravity Research Foundation Essay Competition 2018.
5. J.B., Valeri P. Frolov, and Andrei Zelnikov, “The gravitational field of p -branes in linearized ghost-free gravity,” Phys. Rev. D **97** (2018) no. 8, 084021; arXiv:1802.09573 [gr-qc].
4. J.B. and Valeri P. Frolov, “Principal Killing strings in higher-dimensional Kerr–NUT–(A)dS spacetimes,” Phys. Rev. D **97** (2018) no. 8, 084015; arXiv:1801.00122 [gr-qc].
3. J.B. and Valeri P. Frolov, “Stationary black holes with stringy hair,” Phys. Rev. D **97** (2018) no. 2, 024024; arXiv:1711.06357 [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].

Working Papers

- W1. J.B. and Alberto Favaro, “Kerr principal null directions from Bel–Robinson and Kummer surfaces,” arXiv:1703.10791 [gr-qc].

Book Reviews

- R1. “On Gravity: A Brief Tour of a Weighty Subject,” (Princeton University Press, 2018), Physics in Canada, Canadian Association of Physicists, 2019.

Awards and Scholarships

- 2017–2020 Vanier Canada Graduate Scholarship
Natural Sciences and Engineering Research Council of Canada
Golden Bell Jar Graduate Scholarship in Physics
University of Alberta
- 2019 Andrew Stewart Memorial Graduate Prize
Graduate Student Travel Award
University of Alberta
- 2017 President’s Doctoral Prize of Distinction
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

- 2020 Physics Department Nominee for Governor General’s Gold Medal
University of Alberta
Faculty of Science Doctoral Dissertation Award
Faculty of Science, University of Alberta
Honorable Mention, Essay Competition 2020
Gravity Research Foundation
Semi-finalist prize, Images of Research Competition 2020
University of Alberta
- 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
University of Alberta
- 2013 Selected for Dean’s List 2013
RWTH Aachen University
- 2012 becoMINT graduate prize
Robert Bosch corporation

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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

2020 Nobel Laureate Discussion Panel on “The Greatest Physics Discoveries of the 20th Century”

Online seminar hosted by the HAPP Centre at the University of Oxford, UK

2019 25th Saalburg Summer School – Foundations and New Methods in Theoretical Physics

Heigenbrücken, Germany

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

Theoretical Physics Institute, University of Alberta

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Talks and Invited Seminars

- Sep 2020 Effects of non-locality in gravity and quantum theory
Ph.D. Defense, University of Alberta, Canada
- Jun 2020 Ultrarelativistic objects in non-local infinite-derivative gravity
Invited talk, William & Mary, United States
- Dec 2019 What is a black hole?
Invited talk, Rotary Club Oberhausen, Germany
- Sep 2019 Black holes and mathematical sandpaper
Graduate research symposium, University of Alberta, Canada
- Aug 2019 Black holes, strings, and hidden symmetries
Invited talk, Department of Applied Mathematics and Theoretical Physics, University of Cambridge, UK
- Towards surface charges in spacetimes with curvature and torsion
Invited talk, Université Libre de Bruxelles, Belgium
- Non-local “ghost-free” gravity
University of Cologne, Germany
- 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 GRRA 2018, University of Alberta, Canada
- Mar 2018 Linearized short-distance modifications of Einstein’s General Relativity
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

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- 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
- Aug 2012 Physics inside the Schwarzschild radius
Department for Theoretical Particle Physics, RWTH Aachen University, 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
- 2019–present European Physical Journal C

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

Teaching Experience

- 2020 Differential Geometry Student Meetings[‡]
- 2019 Black Hole Student Meetings[‡]
Conformal Field Theory Student Meetings[‡]
- 2018 Gauge Theory Student Meetings[‡]
Quantum Field Theory Student Meetings[‡]
Graduate seminars, University of Alberta, <http://www.spintwo.net/Courses/>
- 2015 Geometry in Physics
Teaching assistant, graduate course, University of Cologne, Prof. Alexander Altland.
- 2014 Advanced Seminar on General Relativity & Cosmology
General Relativity & Cosmology II
Teaching assistant, graduate course, University of Cologne, Prof. Claus Kiefer.

[‡]Independently organized events outside the department's regular curriculum.

Organized Conferences

- 2018 Joint Canada-Asia Pacific Conference on General Relativity and Relativistic Astrophysics, University of Alberta, Edmonton, Canada
Member of local organizing committee, chairperson in afternoon session.
- 2014 569th Wilhelm and Else Heraeus Seminar on Quantum Cosmology, German Physical Society, Bad Honnef, Germany
Development of conference website and database backend for participant management.

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)

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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

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, DaVinci Resolve 15

programming BASIC, C, Java, Python

office LibreOffice Writer, Calc, Impress; Microsoft Word, Excel, Powerpoint

web HTML, CSS, PHP, JavaScript, Ajax, MySQL, jQuery, Typo3, webdesign

Other Interests

digital microcontroller electronics (see educational blog www.friendlywire.com), programming, collecting vintage vacuum “Nixie” tubes (see personal website www.jb-electronics.de), webdesign, piano (Boogie Woogie, Rock’n’Roll), ballroom dancing, running

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 (vfrolov@ualberta.ca)

Ph.D. supervisor, University of Alberta, Canada

Prof. Don N. Page (dpage@ualberta.ca)

Ph.D. committee member, University of Alberta, Canada

Prof. David Kubiznak (dkubiznak@perimeterinstitute.ca)

M.Sc. mentor, Perimeter Institute for Theoretical Physics, Canada

Prof. Friedrich W. Hehl (hehl@thp.uni-koeln.de)

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

Further information available upon request. Last update: November 2020

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