

# Joseph M. Renes

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Institut für Angewandte Physik  
Technische Universität Darmstadt  
Hochschulstr. 4a  
D-64289 Darmstadt, Germany

joerenes@gmail.com  
<http://www.ugcs.net/~yukon>  
Tel. +49 6151 16 2381  
Fax +49 6151 16 3279

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## RESEARCH INTERESTS

Quantum information and quantum computation; especially fault-tolerant quantum computation, quantum cryptography and key distribution, topological quantum computation, classical and quantum simulation of many-body systems, quantum reference frames, and foundations of quantum mechanics.

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## EDUCATION

**Habilitation**, Physics, Technische Universität Darmstadt, expected 2011.

**PhD**, Physics, University of New Mexico, 2004.

Thesis: *Frames, Designs, and Codes in Quantum Information Theory*.

Advisor: Carlton M. Caves.

**MS**, Physics, University of New Mexico, 2002.

**BS with Honor**, Physics, California Institute of Technology, 1999.

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## AWARDS & HONORS

Alexander von Humboldt Postdoctoral Fellowship, 2005–2007.

UNM Physics & Astronomy Department Chairman's Award for Best Dissertation, 2005.

Caltech Haren Lee Fisher Memorial Prize in Junior Physics, 1998.

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## POSITIONS

2006–present	Postdoctoral Scholar Group of G. Alber, Technische Universität Darmstadt
2005–2006	Postdoctoral Scholar Group of N. Lütkenhaus, Universität Erlangen-Nürnberg
2004	Postdoctoral Scholar Group of Th. Beth, Universität Karlsruhe

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## TEACHING EXPERIENCE

2010	Head Teaching Assistant, <i>Quantum Mechanics</i> (Bachelor), TU Darmstadt
2009	Head Teaching Assistant, <i>Mathematical Methods of Physics</i> (Bachelor), TU Darmstadt <u>Lecturer</u> , <i>Quantum Information and Computation</i> (Master), TU Darmstadt
2008	Teaching Assistant, <i>General Relativity</i> (Master), TU Darmstadt Head Teaching Assistant, <i>Quantum Mechanics</i> (Bachelor), TU Darmstadt
2007	Teaching Assistant, <i>Classical Particles and Fields</i> (Bachelor), TU Darmstadt Teaching Assistant, <i>Theoretical Quantum Optics</i> (Diplom), TU Darmstadt
2005	Teaching Assistant, <i>Quantum Information Theory I</i> (Diplom), Uni Erlangen
1999	Laboratory Teaching Assistant, <i>Physics 102</i> (Bachelor), University of New Mexico Laboratory Teaching Assistant, <i>Ph 7</i> (Bachelor), Caltech

PUBLICATIONS

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18. S. D. Bartlett, G. K. Brennen, A. Miyake, and J. M. Renes, *Quantum Computational Renormalization in the Haldane Phase*, Physical Review Letters **105** 110502 (2010); arXiv:1004.4096v3 [quant-ph].
17. M. Berta, M. Christandl, R. Colbeck, J. M. Renes, and R. Renner, *The Uncertainty Principle in the Presence of Quantum Memory*, Nature Physics **6** 659 (2010); arXiv:0909.0950v3 [quant-ph].
16. J.-C. Boileau and J. M. Renes, *Optimal State Merging Without Decoupling*, Lecture Notes in Computer Science **5906**, 76 (2009); arXiv:0905.1324v1 [quant-ph].
15. J. M. Renes and J.-C. Boileau, *Conjectured Strong Complementary Information Tradeoff*, Physical Review Letters **103**, 020402 (2009); arXiv:0806.3984v1 [quant-ph].
14. G.O. Myhr, J. M. Renes, A. C. Doherty, N. Lütkenhaus, *Symmetric extension in two-way quantum key distribution*, Physical Review A **79**, 042329 (2009); arXiv:0812.3607v2 [quant-ph].
13. J. M. Renes and J.-C. Boileau, *Physical Underpinnings of Privacy*, Physical Review A **78**, 032335 (2008); arXiv:0803.3096v2 [quant-ph].
12. O. Kern and J. M. Renes, *Improved one-way rates for BB84 and 6-state protocols*, Quantum Information and Computation **8**, 0756-0772 (2008); arXiv:0712.1494v2 [quant-ph].
11. G. Smith, J. M. Renes, and J. A. Smolin, *Structured codes improve the Bennett-Brassard-84 quantum key rate*, Physical Review Letters **100**, 170502 (2008); quant-ph/0607018.
10. J. M. Renes, *Equiangular Tight Frames from Paley Tournaments*, Linear Algebra and its Applications **426**, 497 (2007); math.FA/0408287.
9. J. M. Renes and G. Smith, *Noisy Processing and Distillation of Private Quantum States*, Physical Review Letters **98**, 020502 (2007); quant-ph/0603262.
8. J. M. Renes and M. Grassl, *Generalized decoding, effective channels, and simplified security proofs in quantum key distribution*, Physical Review A **74**, 022317 (2006); quant-ph/0505061.
7. J.-C. Boileau, K. Tamaki, J. Batuwantudawe, R. Laflamme, and J. M. Renes, *Unconditional Security of Three State Quantum Key Distribution Protocols*, Physical Review Letters **94**, 040503 (2005); quant-ph/0408085.
6. J. M. Renes, *Equiangular Spherical Codes in Quantum Cryptography*, Quantum Information and Computation **5**(1), 080-091 (2005); quant-ph/0409043.
5. J. M. Renes, *Optimal Protocols and Tradeoffs in Quantum Key Distribution*, AIP Conference Proceedings (Quantum Communication, Measurement, and Computing, Glasgow, Scotland) **734**, 327 (2004).
4. J. M. Renes, *Spherical Code Key Distribution Protocols for Qubits*, Physical Review A **70**, 052314 (2004); quant-ph/0402135.
3. J. M. Renes, R. Blume-Kohout, A. J. Scott, and C. M. Caves, *Symmetric Informationally Complete Quantum Measurements*, Journal of Mathematical Physics **45**(6), 2171–2180 (2004); quant-ph/0310075.
2. C. M. Caves, C. A. Fuchs, K. K. Manne, and J. M. Renes, *Gleason-Type Derivations of the Quantum Probability Rule for Generalized Measurements*, Foundations of Physics **34**(2), 193–209 (2004); quant-ph/0306179.
1. A. M. Childs, J. Preskill, and J. Renes *Quantum Information and Precision Measurement*, Journal of Modern Optics **47**(2), 155–176 (2000); quant-ph/9904021.

## INVITED TALKS

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- *Dissecting Quantum Information: Classical conditions for quantum error-correction*, Workshop on Cryptography from Storage Imperfections, Caltech, Pasadena, USA, 22 March 2010.
- *Quantum Information as Complementary Classical Information*, Quantumlah Seminar, National University of Singapore, 08 September 2009.
- *Quantum Info as Complementary Classical Info: Secret Key and Entanglement Distillation via Processing Complementary Information*, Quantum Information Theory Seminar, ETH, Zürich, Switzerland, 17 March 2009.
- *Measurement-Based Quantum Computation in Realistic Spin-1 Chains*, Condensed Matter Seminar, Max Planck Institute for the Physics of Complex Systems, Dresden, Germany, 12 March 2009.
- *Quantum Information as Complementary Classical Information*, A2 Workshop, Braunschweig, Germany, 11 February 2009.
- *Entanglement and Secret-Key Distillation from a Complementary Information Tradeoff*, Perimeter Institute Quantum Discussions, Perimeter Institute for Theoretical Physics, Waterloo, Canada, 13 August 2008.
- *Private States in Quantum Key Distribution*, Workshop on the Theory and Realisation of Practical Quantum Key Distribution, Waterloo, Canada, 13 June 2007.
- Tutorial: *Quantum Communication and Cryptography*, Fifth Informal Quantum Information Gathering, Innsbruck, Austria, 12 April 2007.
- *Quantum key distribution for the lazy and careless: Noisy preprocessing and twisted states*, CAS Seminar, University of New Mexico, 26 October 2006.
- *Quantum key distribution for the lazy, faulty, and careless: Noisy preprocessing, twisted states, and degenerate codes*, IQC Colloquium, University of Waterloo, 16 October 2006.
- *Quantum Perspectives on Classical Problems: Quantum Information Theory and Quantum Key Distribution*, Theory Colloquium, TU Darmstadt, 22 May 2006.
- *Encoding Quantum Information in Transverse Modes of Light*, Max Planck Research Group, Institute of Optics, Information, and Photonics, Erlangen, Germany, 25 June 2005.
- *Spherical Codes and Designs in Quantum Cryptography*, Quantum Institute Visitor Symposium “Quantum Lunch,” Los Alamos National Laboratory, 5 February 2004.

## CONTRIBUTED CONFERENCE PRESENTATIONS

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- *Optimal State Merging Without Decoupling*, Fourth Workshop on the Theory of Quantum Computation, Communication, and Cryptography, Waterloo, Canada, 13 May 2009.
- *Measurement-Based Quantum Computation in Realistic Spin-1 Chains*, 11th Annual Workshop of the Southwest Quantum Information and Technology Network, Seattle, 21 February 2009.
- *Entanglement and Secret-Key Distillation from a Complementary Information Tradeoff* (poster), The Ninth International Conference on Quantum Communication, Measurement and Computing (QCMC), Calgary, Canada, 23 August 2008.
- *Complementarity and Privacy: From Private State Distillation to Quantum Channel Coding*, Fifth Central European Quantum Information Processing Workshop, Telč, Czech Republic, 5 June 2008.
- *Complementarity, Privacy, and Entanglement*, Spring Meeting of the German Physical Society, Darmstadt, Germany, 13 March 2008.
- *Private States, Privacy Amplification, and the Uncertainty Principle*, Spring Meeting of the German Physical Society, Düsseldorf, Germany, 21 March 2007.
- *Private States in QKD: Better Key Rates from Existing Protocols* (poster), The Tenth Workshop on Quantum Information Processing (QIP), Brisbane, Australia, 31 January 2007.
- *Twisted States and Denerate Codes in Quantum Key Distribution* (poster), Gordon Research Conference: Quantum Information Science, Il Ciocco, Italy, 8 May 2006.

- *Effective Channels in Quantum Key Distribution*, Spring Meeting of the German Physical Society, Frankfurt, Germany, 16 March 2006.
- *Entanglement-Based Distillation of Secret Keys in Arbitrary Prepare & Measure QKD Protocols* (poster), The Ninth Workshop on Quantum Information Processing (QIP), Paris, 18 January 2006.
- *Effective Channels in Quantum Key Distribution*, Fourth Informal Quantum Information Gathering, Paris, France, 24 July 2005.
- *Two Protocols for Spherical Codes in Quantum Cryptography*, Seventh International Conference on Quantum Communication, Measurement and Computing, Glasgow, Scotland, 26 July 2004.
- *Equiangular Spherical Codes in Quantum Cryptography*, Sixth Annual Workshop of the Southwest Quantum Information and Technology (SQuInT) Network, La Jolla, CA, 21 February 2004.
- *Towards a Quantum de Finetti Theorem*, Sixth Biennial Conference of the International Quantum Structures Association (IQSA), Vienna, 5 July 2002.
- *Frame Functions for Qubits*, MSI International conference “Quantum Theory: reconsideration of foundations”, Växjö University, Sweden, 21 June 2001.

#### PATENTS

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*Quantum Key Distribution*, US Patent Document Number 20070076871, to be issued shortly.

#### RESEARCH VISITS

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- 2010-06 Perimeter Institute for Theoretical Physics, Waterloo, Canada  
Quantum Information Theory group
- 2009-11 Institute for Quantum Information, Caltech. Group of John Preskill
- 2009-10 Perimeter Institute for Theoretical Physics, Waterloo, Canada  
Quantum Information Theory group
- 2009-09 Centre for Quantum Technologies, National University of Singapore  
Group of Andreas Winter
- 2009-05 ETH Zürich. Group of Renato Renner
- 2008-08 Perimeter Institute for Theoretical Physics, Waterloo, Canada  
Quantum Information Theory group
- 2008-06 Czech Technical University in Prague. Group of Igor Jex
- 2008-02 University of Sydney, Australia. Group of Stephen Bartlett
- 2006-11 University of New Mexico, Albuquerque, USA. Group of Carlton Caves
- 2006-10 Insitute for Quantum Computing, University of Waterloo, Canada  
Group of Norbert Lütkenhaus
- 2005-11 University of Queensland, Brisbane, Australia. Group of Michael Nielsen
- 2001-11 Kavli Institute of Theoretical Physics, University of California at Santa Barbara  
Program on Quantum Information: Entanglement, Decoherence and Chaos
- 2001-05 Bell Laboratories, Murray Hill NJ, USA. Group of Christopher Fuchs

#### PROFESSIONAL ACTIVITIES

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Referee for Physical Review Letters, Physical Review A, and Quantum Information & Computation, New Journal of Physics, and the International Journal of Quantum Information.

Member of the American Physical Society and the Deutsche Physikalische Gesellschaft.

#### PERSONAL DETAILS

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Born 4 July 1977 in Moscow, Idaho, USA. US Citizen.

Language abilities: English (native) and German (fluent).

REFERENCES

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Prof. Dr. Gernot Alber  
Institut für Angewandte Physik  
TU Darmstadt  
Hochschulstraße 4a  
64289 Darmstadt, Germany  
+49 6151 164802

Prof. Dr. Carlton M. Caves  
Department of Physics and Astronomy  
University of New Mexico  
MSC 07 42201  
Albuquerque, NM 87131-0001 USA  
+1 505 2778674

Prof. Dr. Renato Renner  
Institut für Theoretische Physik  
ETH Zürich  
8093 Zürich, Switzerland  
+41 44 6333458