

Julio T. Barreiro

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ACADEMIC EMPLOYMENT

- 2014- Assistant Professor, **Department of Physics, University of California, San Diego**
A fermionic quantum computer and simulator: fine control of many individual fermions
- 2012-2014 Max-Planck society postdoctoral fellow, **Max-Planck Institute of Quantum Optics & Ludwig-Maximilians Universität**, Munich, Germany. PI: I. Bloch
Experiments with ultracold bosons in optical superlattices
- 2009-2011 Marie-Curie postdoctoral fellow, **Universität Innsbruck**, Austria. PI: R. Blatt
Quantum information and simulations with trapped ions

EDUCATION

- University of Illinois at Urbana-Champaign (UIUC)**, USA
2008 PhD physics. Advisor: P. G. Kwiat. *Hyperentanglement for Quantum Communication*
- 2003 MSc physics
- 2001/2002 **Columbia University**, New York, USA. Graduate physics courses
Universidad Nacional Autónoma de México (UNAM)
- 2001 BSc Physics. *Hydrodynamic effects in the pion spectra of ultrarelativistic heavy-ion collisions*
- 2000 BSc Computer Science

HONORS AND AWARDS (SELECTION)

- 2013 City of Innsbruck prize for scientific research, together with P. Schindler, M. Müller & T. Monz
- 2011 Lise-Meitner Postdoctoral Fellowship, Austria: *A driven dissipative quantum phase transition*
- 2010 Lindau Nobel Laureate Meeting, EU commission
- 2009 Marie-Curie Postdoctoral Fellowship, EU commission: *Entanglement for quantum inf. with ion strings*
- 2008 The Donald and Shirley Jones Fellowship for Research Excellence, UIUC
- 2007 Mavis Memorial Fund Award for Excellence in Engineering Education, UIUC
- 2005 Third Place Team: Charlie Townes *Amazing Light* Competition (Paul Kwiat)
- 2001 Fulbright Scholar, 2000 Gabino Barreda Medal, UNAM, Highest GPA Physics & Computer Science
- 1998 CERN-UNAM Foundation Award: Summer student at CERN

PUBLICATIONS (* TOP 5) SUMMARY: 2 NATURE, 2 SCIENCE, 9 NATURE PHYS., 9 PRL, 2PRA, 1NJP, 1 PRC

26. JTB

“Phononic crystals: Entering an acoustic phase”

Nature Phys. 11, 215 (2011). [\[pdf\]](#)

25. M. Aidelsburger, M. Lohse, C. Schweizer, M. Atala, JTB, S. Nascimbene, N. R. Cooper, I. Bloch and N. Goldman, “Measuring the Chern number of Hofstadter bands with ultracold bosonic atoms”

Nature Phys. 11, 162 (2015). [\[pdf\]](#) [\[News & Views\]](#)

24. M. Atala, M. Aidelsburger, M. Lohse, JTB, B. Paredes, I. Bloch

“Observation of chiral currents with ultracold atoms in bosonic ladders”

Nature Phys. 10, 588 (2014). [\[pdf\]](#) [\[News & Views\]](#)

23. P. Schindler, D. Nigg, T. Monz, JTB, E. A. Martinez, S. X. Wang, S. Quint, M. F. Brandl, V. Nebendahl, C. F. Roos, M. Chwalla, M. Hennrich & R. Blatt, “A quantum information processor with trapped ions”

New J. Phys. 15, 123012 (2013). [\[pdf\]](#)

22. M. Aidelsburger, M. Atala, M. Lohse, JTB, B. Paredes & I. Bloch

“Realization of the Hofstadter Hamiltonian with ultracold atoms in optical lattices”

Phys. Rev. Lett. 111, 185301 (2013). [\[pdf\]](#) [\[Viewpoint\]](#)

21. M. Atala, M. Aidelsburger, JTB, D. Abanin, T. Kitagawa, E. Demler & I. Bloch

“Direct measurement of the Zak phase in topological Bloch bands”

Nature Phys. 9, 795 (2013). [\[pdf\]](#)

20. * **JTB**, J.-D. Bancal, P. Schindler, D. Nigg, M. Hennrich, T. Monz, N. Gisin & R. Blatt,

“Demonstration of genuine multipartite entanglement with device-independent witnesses”

Nature Phys. 9, 559 (2013). [\[pdf\]](#)

19. P. Schindler, M. Müller, D. Nigg, JTB, E. A. Martinez, M. Hennrich, T. Monz, S. Diehl, P. Zoller & R. Blatt,

“Quantum simulation of dynamical maps with trapped ions”

Nature Phys. 9, 361 (2013). [\[pdf\]](#)

18. P. Schindler, D. Nigg, T. Monz, JTB, E. A. Martinez, M. Chwalla, M. Hennrich & R. Blatt

“Undoing a quantum measurement”

Phys. Rev. Lett. 110, 070403 (2013). [\[pdf\]](#) [\[Synopsis\]](#)

17. T. Graham, JTB, M. Mohseni & P. G. Kwiat

“Hyperentanglement-enabled direct characterization of quantum dynamics”

Phys. Rev. Lett. 110, 060404 (2013). [\[pdf\]](#)

16. D. Nigg, JTB, P. Schindler, M. Mohseni, T. Monz, M. Chwalla, M. Hennrich & R. Blatt

“Experimental characterization of quantum dynamics through many-body interactions”

Phys. Rev. Lett. 110, 060403 (2013). [\[pdf\]](#)

15. JTB
“Quantum Physics: Environmental effects controlled”
Nature Phys. 7, 927 (2011). [pdf]
14. B. Lanyon, C. Hempel, D. Nigg, M. Müller, R. Gerritsma, F. Zähringer, P. Schindler, JTB, G. Kirchmair, M. Hennrich, P. Zoller, R. Blatt & C. F. Roos, “Universal digital quantum simulations with trapped ions”
Science 334, 57 (2011). [pdf]
13. P. Schindler, JTB, T. Monz, D. Nigg, M. Chwalla, M. Hennrich & R. Blatt
“Experimental repetitive quantum error correction”
Science 332, 1059 (2011). [pdf]
12. * JTB, M. Müller, P. Schindler, D. Nigg, T. Monz, M. Chwalla, M. Hennrich, C. F. Roos & R. Blatt
“An open-system quantum simulator with trapped ions”
Nature 470, 486 (2011). [pdf]
11. T. Monz, P. Schindler, JTB, M. Chwalla, D. Nigg, W. A. Coish, M. Harlander, W. Hänsel & R. Blatt
“14-qubit entanglement: creation and coherence”
Phys. Rev. Lett. 106, 130506 (2011). [pdf]
10. * JTB, P. Schindler, O. Gühne, T. Monz, M. Chwalla, C. F. Roos, M. Hennrich & R. Blatt
“Experimental multiparticle entanglement dynamics induced by decoherence”
Nature Phys. 6, 943 (2010). [pdf] [News & Views]
9. JTB, T. C. Wei & P. G. Kwiat
“Remote preparation of single-photon ‘hybrid’ entangled and vector-polarization states”
Phys. Rev. Lett. 105, 030407 (2010). [pdf]
8. M. Mohseni, A. T. Rezakhani, JTB, P. G. Kwiat & A. Aspuru-Guzik
“Quantum process estimation via generic two-body correlations”
Phys. Rev. A 81, 032102 (2010). [pdf]
7. * JTB, T. C. Wei & P. G. Kwiat, “Beating the channel capacity limit for linear photonic dense coding”
Nature Phys. 4, 282 (2008). [pdf] [News & Views] [Nature Highlight]
6. T. C. Wei, JTB & P. G. Kwiat, “Hyperentangled Bell-state analysis”
Phys. Rev. A 75, 060305(R) (2007). [pdf]
5. O. Hosten, M. T. Rakher, JTB, N. A. Peters & P. G. Kwiat
“Counterfactual quantum computation via quantum interrogation”
Nature 439, 949 (2006). [pdf] [News & Views]
4. * JTB, N. K. Langford, N. A. Peters & P. G. Kwiat, “Generation of hyperentangled photons”
Phys. Rev. Lett. 95, 260501 (2005). [pdf] [Nature Highlight]
3. N. A. Peters, JTB, M. E. Goggin, T.-C. Wei & P. G. Kwiat
“Remote state preparation: Arbitrary remote control of photon polarization”
Phys. Rev. Lett. 94, 150502 (2005). [pdf]
2. M. Ericsson, D. Achilles, JTB, D. Branning, N. A. Peters & P. G. Kwiat
“Measurement of geometric phase for mixed states using single photon interferometry”
Phys. Rev. Lett. 94, 050401 (2005). [pdf]
1. A. Ayala, JTB & L. M. Montano
“Density and expansion effects on pion spectra in relativistic heavy-ion collisions”
Phys. Rev. C 60, 014904 (1999). [pdf]

REFEREE SERVICE

Science, Nature Phys., Nature Photon., Phys. Rev. Lett., Nature Comm., Opt. Express, Optics Lett., Sci. Rep., J. Opt. Soc. Am. A & B, Opt. Commun., Applied Physics B, Europhysics Letters, Eur. Phys. J. D

PUBLICATIONS, NON-PEER REVIEWED

9. JTB, D. Meschede, E. Polzik, E. Arimondo, F. Illuminati & L. Lugiato
“Atoms, photons and entanglement for quantum information technologies”
Procedia Computer Science, European Future Technologies Conference and Exhibition FET (2011). [pdf]
8. P. Zoller, JTB & M. Müller, “Open-system quantum simulation with atoms and ions”
Laser Spectroscopy - ICOLS 2011: Proc. of the 20th Int. Conf., Logos Verlag Berlin (2011). [pdf]
7. JTB & P. G. Kwiat, “Hyperentanglement for advanced quantum communication”
Proc. SPIE 7092, P920 (2008). [pdf]
6. O. Hosten, M. T. Rakher, JTB, N. A. Peters & P. G. Kwiat, “Counterfactual computation revisited”
[arXiv:quant-ph/0607101](https://arxiv.org/abs/quant-ph/0607101) (2006).
5. N. A. Peters, K. J. Arnold, A. P. VanDevender, E. R. Jeffrey, R. Rangarajan, O. Hosten, JTB, J. B. Altepeter & P. G. Kwiat, “Towards a quasi-deterministic single-photon source,”
Proc. SPIE 6305, 630507 (2006). [pdf]
4. N. A. Peters, JTB, M. E. Goggin, T.-C. Wei & P. G. Kwiat, “Remote state preparation: Arbitrary remote control of photon polarization for quantum communication,” *Proc. SPIE* 5893, 589308 (2005). [pdf]

3. P. G. Kwiat, J. B. Altepeter, JTB, M. E. Goggin, E. Jeffrey, N. A. Peters, and A. P. VanDevender, “The conversion revolution: down, up, and sideways,” *AIP Conf. Proc.* 734, 337 (2004). [pdf]
2. M. Ericsson, D. Achilles, JTB, D. Branning, N. A. Peters & P. G. Kwiat, “Geometric phase for mixed states using single-photon interferometry,” *AIP Conf. Proc.* 734, 370 (2004). [pdf]
1. P. G. Kwiat, J. Altepeter, JTB, D. A. Branning, E. R. Jeffrey, N. Peters & A. P. VanDevender, “Optical technologies for quantum information science,” *Proc. SPIE* 5161, 87 (2004). [pdf]

INVITED TALKS

- 2015 *A fermionic quantum computer: fine control of individual fermions*
 May CLEO, San Jose, CA
- 2014 *Atoms, Ions and Photons for Quantum Tasks: Strengths and Weaknesses*
 June CLEO, San Jose, CA
- 2012 *Direct measurement of the Zak phase in topological Bloch bands*
 Sep Blatt group retreat, Obergurgl, Austria
- 2011 *14-qubit entanglement: creation and coherence*
 June DAMOP, Atlanta, USA
- Quantum computation and simulations using dissipation*
 May Quantum Science and Technology workshop, Rovereto, Italy
- Open-system quantum simulations with trapped ions*
 May FET’11, The European Future Technologies Conference and Exhibition, Budapest, Hungary
- Open-system quantum simulations with Rydberg atoms and ions*
 Feb Quantum simulation, Benasque Sciences Center, Spain
- 2010 *Entanglement experiments with photons and ions*
 Jan Colloquium at Universidad Autónoma de San Luis Potosí, México
- 2008 *Hyperentanglement for advanced quantum communication*
 Aug SPIE Optics + Photonics, San Diego, USA
- 2006 *Hyperentanglement for q. comm.: Remote preparation of single-photon entangled states*
 Aug Int. Conf. on Quantum Foundation and Technology ’06, Zhejiang University, China

CONTRIBUTED TALKS

- 2014 *Quantum chemistry, simulations and computation with ultracold atoms*
 Aug Optics+Photonics Research workshop, UCSD
- 2013 *Realization of the Hofstadter Hamiltonian with ultracold atoms in optical lattices*
 Sept Quantum Matter, Foundations and Applications, Granada, Spain
- Demonstration of genuine multipartite entanglement with device-independent witnesses*
Quantum simulation of open-system dynamical maps with trapped ions
 June DAMOP, Quebec, Canada
- 2011 *Experimental repetitive quantum error correction*
 June DAMOP, Atlanta, USA
- An open-system quantum simulator with trapped ions*
 Mar APS March meeting, Dallas, USA & June DAMOP, Atlanta, USA
- 2010 *Multiqubit decoherence in ion-trap quantum computation*
 May DAMOP, Houston, USA
- Environment-induced bound entanglement*
 May DAMOP, Houston, USA
- Mar Deutsche Physikalische Gesellschaft meeting, Hannover, Germany
- 2008 *Hyperentanglement-assisted dense coding: Beating the channel-capacity limit*
 Mar APS March meeting, New Orleans, USA
- 2007 *Hyperentanglement for advanced and efficient quantum communication*
 Aug First European Young Scientist Conf. on Quantum Inf., Vienna, Austria
- Hyperentanglement: Generation and applications*
 May QELS, Long Beach, USA
- 2005 *Hyperentangled photons*
 Sept Frontiers in Optics, Laser Science XXI, Tucson, USA
- 2004 *Measurement of geometric phase for mixed states using single-photon interferometry*
 May QELS, San Francisco, USA

SEMINARS

- 2013 *Direct measurement of the Zak phase in topological Bloch bands*
May National Institute of Standards and Technology, Gaithersburg, USA
- 2013 *Harnessing additional degrees of freedom and the environment to experimentally enable quantum applications and simulations*
May Joint Quantum Institute, Maryland, USA & May University of Washington, Seattle, USA
Apr Columbia University, NY, USA & Mar University of Nevada, Reno, USA
Mar University of Illinois at U-C, USA & Mar Institute for Quantum Computing, Canada
Mar University of California, San Diego, USA
- 2011 *Quantum computation and simulations using dissipation*
Oct University of Amsterdam, The Netherlands
July Ludwig-Maximilians-Universität München, Germany
- 2010 *An open-system quantum simulator with trapped ions*
Nov Universidad Nacional Autónoma de México, México
- 2008 *Hyperentanglement for advanced quantum communication*
June Universität Innsbruck, Austria
June Gutenberg-Universität Mainz, Germany
- 2005 *Generation of hyperentangled photon pairs*
Nov The Institute of Photonic Sciences, Barcelona, Spain

GRANT PROPOSAL CONTRIBUTIONS (SELECTION)

- 2015 UC President's Research Catalyst Awards: *The California Institute for Quantum Emulation*
- 2011 Lise-Meitner fellowship: *A dissipative driven quantum phase transition*
- 2009 Marie-Curie fellowship: *Entanglement for quantum information with ion strings*
- 2007 Instructional equipment grant: *Experiments on entanglement and tests of local realism*
Department of Physics, UIUC. PI: D. Hertzog and P. Kwiat.
- 2006 Disruptive Technology Office (currently IARPA) grant: *Hyperentanglement for advanced quantum communication*, PI: P. Kwiat.

TEACHING

University of California, San Diego, USA

"100C Electromagnetism." Spring 2015

Ludwig-Maximilians-Universität München, Germany

Co-supervisor of graduate projects for I. Bloch: Monika Aidelsburger (PhD 2015), Marcos Atala (PhD 2014).

Universität Innsbruck, Austria. *Co-supervisor* of graduate projects for R. Blatt: Daniel Nigg (PhD 2015), Philipp Schindler "Quantum computation and simulation with trapped ions using dissipation" (PhD 2013), Thomas Monz: "Quantum information processing beyond ten ion qubits" (PhD 2011)

University of Illinois at Urbana-Champaign, USA *Teaching assistant:*

"Modern Experimental Physics," Fall 2006-Spring 2007

"Condensed Matter Physics I," Spring 2003

"University Physics, Electricity and Magnetism," Fall 2002

Co-supervisor of undergraduate projects for P. Kwiat:

Rachel Hillmer, "Transmission phase holography: spatial-mode filter design for quantum information applications," Spring 2006-Summer 2007

Kevin Uskali, "PID circuit for interferometer stabilization," Fall 2005-Fall 2006

Jack Kohoutek, "PID circuit for beam pointing stabilization," Summer 2005

Columbia University, USA

Teaching assistant: "University Physics, Electromagnetism," Fall 2001-Spring 2002

Mexican Department of Education (SEP), México

Consultant for educational textbooks for high-school physics curriculum (5 textbooks, 1999-2000)

Universidad Nacional Autónoma de México, México

Teaching assistant:

"Introduction to Computer Science II, C++ Data Structures," Spring 1998-Spring 2000

"Theoretical Physics II, Thermodynamics," Spring 1998-Spring 2000

"Computer Architecture" Spring 1997-Fall 1998

LANGUAGES

Spanish (native), English, French (basic), German (basic)