

Julio T. Barreiro

Department of Physics, University of California, San Diego
9500 Gilman Dr. #0319, La Jolla, CA 92093-0319

+1 (858) 246 0108
barreiro@ucsd.edu

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, 7 NATURE PHYS., 9 PRL, 2PRA, 1NJP, 1 PRC

25. M. Aidelsburger, M. Lohse, C. Schweizer, M. Atala, JTB, S. Nascimbene, N. R. Cooper, I. Bloch and N. Goldman, “Revealing the topology of Hofstadter bands with ultracold bosonic atoms”
[arXiv:1407.4205](#) *submitted to Nature Phys.* (2014).
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](#) (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 Hoftstadter 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)

- 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)