

# Ana María Rey

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## CONTACT INFORMATION

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## RESEARCH INTERESTS

Degenerate Fermi gases and Bose-Einstein condensates, optical lattices, quantum phase transitions, strongly correlated systems, quantum information, quantum simulations, precision measurements, non-equilibrium phenomena, entanglement generation, quantum magnetism, disordered systems, alkaline earth atoms, polar molecules.

## EDUCATION

**University of Maryland**, College Park, Maryland, USA.

Ph.D., Physics, August 2004.

- Dissertation Title: “Ultracold bosonic atoms in optical lattices.”
- Advisors: Charles W. Clark and Theodore R. Kirkpatrick.

**Universidad de los Andes**, Bogotá, Colombia

B.S., Physics, March 1999.

- Dissertation Title: “Propagation of electromagnetic radiation in Kerr’s metric.”
- Advisor: Rafael Bautista.

## APPOINTMENTS

**JILA and University of Colorado Physics Department** at Boulder, CO, USA.

Professor Adjoint, Physics Department, September 2017–present

Associate Research Professor, Physics Department, January 2013–August 2017

Assistant Research Professor, Physics Department, August 2008–January 2013.

JILA Fellow, January 2012–present.

Associate JILA Fellow, August 2008–January 2012.

**National Institute of Standards and Technology (NIST)**, Boulder, Colorado USA,

NIST Fellow, August 2017–present.

**Institute for Theoretical, Atomic, Molecular and Optical Physics (ITAMP)** at the Harvard-Smithsonian Center for Astrophysics, Cambridge, Massachusetts, USA.

Postdoctoral fellow, September 2005–July 2008.

**National Institute of Standards and Technology (NIST)**, Gaithersburg, Maryland, USA,

Postdoctoral researcher, September 2004–August 2005.

**University of Maryland**, College Park, Maryland, USA,

Research Assistant, September 2000–August 2004.

HONORS AND  
AWARDS

Blavatnik National Awards for Young Scientists, 2019  
Alexander Cruickshank Award in Atomic Physics, 2017.  
Elected APS Fellow by the Topical Group Precision Measurement & Fundamental Constants, 2015.  
Early Career National Hispanic Scientist of the Year, Museum of Science and Industry, Tampa, FL, 2014.  
Maria Goeppert Mayer Award, 2014.  
Presidential Early Career Award for Scientists and Engineers, December 2013.  
MacArthur Fellow, September 2013.  
Great Minds in STEM, “Most Promising Scientist award,” October 2013.  
CSWP Woman Physicist of the Month Award, June 2012.  
Fundacion Alejandro Angel Escobar, Exact, Physical and Natural Sciences Prize, September 2007.  
Postdoctoral fellowship, ITAMP 2005–2008.  
Atomic, Molecular, and Optical Physics Outstanding Doctoral Thesis Award (DAMOP thesis prize), American Physical Society, 2005.  
Cooperative Fellowship NIST/Chemical Physics (UMD), 2002-2004.  
Departmental Fellowship, University of Maryland, 2000-2002.  
Magna cum Laude B.S. Physics degree, Universidad de los Andes, 1999.  
Best GPA award, Universidad de los Andes, 1997 and 1998.  
“Beca 40 años” Fellowship, Universidad de los Andes, 1994–1998.

CURRENT  
COLLABORATORS

John Bollinger (NIST)  
Charles. W. Clark (NIST and University of Maryland, JQI)  
Andrew Daley (University of Strathclyde)  
Alexey Gorshkov (NIST and University of Maryland, JQI)  
Victor Gurarie (University of Colorado)  
Kaden Hazard (Rice University)  
Michael Hermele (University of Colorado)  
Murray Holland (JILA, University of Colorado)  
Michael Kastner (National Institute for Theoretical Physics, South Africa)  
Bruno Laburthe-Tolra (Université Paris)  
Andrew Ludlow (NIST)  
Mikhail Lukin (Harvard University)  
Chris Oates (NIST)  
Tilman Pfau (Stuttgart University)  
Anatoli Polkovnikov (Boston University)  
Leo Radzihovsky (University of Colorado)  
Cindy Regal (JILA, University of Colorado)  
Mariana Safronova (University of Delaware)  
Johannes Schachenmayer (University of Strasbourg)  
Florian Schreck (University of Amsterdam)  
James Thompson (JILA, NIST, University of Colorado)  
Jun Ye (JILA, NIST, University of Colorado)  
Susanne Yelin (University of Connecticut)  
Peter Zoller (Universität Innsbruck)

MENTORS PhD Advisors: Charles W. Clark (2000–2004) NIST, University of Maryland.  
Postdoctoral Advisor: Charles W. Clark (2004–2005) NIST, University of Maryland.  
Postdoctoral Advisor: Mikhail Lukin (2005–2008), ITAMP-Harvard.

CURRENT STUDENTS Bhuvanesh Sundar (Postdoc, February 2021–present).

AND  
POSTDOCTORAL  
ASSOCIATES Jeremy Young (Postdoc, May 2020–present).  
Sanaa Agarwal (May 2020–present).  
Thomas Bilitewski (Postdoc, September 2019–present).  
Anjun Chu (May 2019–present).  
Asier Piñeiro Orioli (Postdoc, February 2018–present).  
Diego Barberena (January 2018–present).  
Sean Muleady (January 2018–present).  
Mikhail Mamaev (August 2017–present).  
Michael Perlin (January 2017–present).

PRIOR STUDENTS Kevin Gilmore (January 2017–May 2021).  
AND  
POSTDOCTORAL  
ASSOCIATES Itamar Kimchi (Postdoc, October 2019–December 2020).  
Peiru He (Postdoc, September 2019–September 2020; Graduate student, January 2014–September 2019).  
Robert Lewis-Swan (Postdoc, September 2016–August 2020)  
Chunlei Qu (Postdoc, August 2017–December 2019).  
Leonid Isaev (Postdoc, November 2014–December 2018).  
Arghavan Safavi-Naini (Postdoc, September 2014–July 2018).  
Jamir Marino (Postdoc, August 2017–February 2018).  
Óscar Leonardo Acevedo Pabón (Postdoc, September 2015–September 2017).  
Martin Gärttner (Postdoc, November 2014–December 2016).  
Michael Wall (Postdoc, June 2012–October 2016).  
Sergey Syzranov (Postdoc, October 2013–September 2016).  
Johannes Schachenmayer (Postdoc, June 2012–September 2016).  
Kaden Hazzard (Postdoc, June 2010–June 2014).  
Alex Pirovski (Postdoc, August 2012–January 2014).  
Gang Chen (Postdoc, June 2010–January 2013).  
Salvador Manmana (Postdoc, June 2010–September 2012).  
Javier Von Stecher (Postdoc, September 2008–August 2011).  
Bjorn Sumner (September 2019–December 2019).  
Andrew Koller (June 2012–May 2017).  
Bihui Zhu (June 2012–May 2017).  
Shuming Li (September 2008–July 2014).  
Michael Foss-Feig (September 2008–November 2012).  
Chester Rubbo (September 2008–June 2012).

## TEACHING

- Spring 2020:* Phys 5260, Quantum Mechanics 2.  
*Spring 2018:* Phys 5040, Intermediate Mathematical Physics 2.  
*Spring 2016:* Phys 7550, Atomic and Molecular Spectra.  
*Spring 2014:* Phys 7550, Atomic and Molecular Spectra.  
*Spring 2012:* Phys 7550, Atomic and Molecular Spectra.  
*Spring 2011:* Phys 2210, Classical Mechanics and Mathematical Methods.  
*Spring 2010:* Phys 3320, Principles of Electricity and Magnetism II.  
*Spring 2009:* Phys 4410, Introduction to Quantum Mechanics II.

## INVITED TALKS

- 1 *Advances in Quantum Simulation with Planar Ion Crystals*, Quantum, Atomic and Neutron Physics Research Group Seminar, Johannes Gutenberg University, Mainz, Germany June 2021.
- 2 *Advances in Quantum Simulation with Planar Ion Crystals*, Condensed Matter Zoom Seminar, Department of Physics, Princeton University, Princeton, NJ, April 2021.
- 3 *New Directions in Quantum Simulations with Long-lived Sr Dipoles in a Cavity*, Many Body Physics in Open Quantum Systems, Princeton Center for Theoretical Science Series, Princeton University, Princeton, NJ, January 2021.
- 4 *Building with Crystals of Light and Quantum Matter: From Clocks to Quantum Computers*, Physics Department Colloquium, Lancaster University, Lancaster, United Kingdom, January 2021.
- 5 *Building with Crystals of Light and Quantum Matter: From Clocks to Quantum Computers*, CIFAR Virtual Seminar, Canadian Institute for Advanced Research (CIFAR), Toronto, Ontario, Canada, November 2020.
- 6 *Building with Crystals of Light and Quantum Matter: From Clocks to Quantum Computers*, Department of Physics Colloquium (virtual presentation), The Ohio State University, Columbus, OH, November 2020.
- 7 *Dynamical Phase Transitions in Cold Atoms*, Quantum Optics Seminar (virtual presentation), Universidad Nacional de Colombia, Bogota, Colombia, November 2020.
- 8 *Dynamical Phase Transitions in Cold Atomic Gases*, Department of Physics and Astronomy Colloquium (virtual presentation), Washington State University, Pullman, WA, November 2020.
- 9 *Dynamical Phase Transitions in Cold Atomic Gases*, Martin A. Fisher School of Physics, Department Colloquium (virtual presentation), Brandeis University, Waltham, MA, November 2020.
- 10 *Dynamical Phase Transitions in Cold Atomic Gases*, UC Santa Barbara Physics Virtual Department Colloquium, University of California Santa Barbara, CA, October 2020.
- 11 *Dynamical Phase Transitions in Cold Atomic Gases*, Department of Physics Virtual Physics Colloquium, Columbia University, New York, NY, October 2020.

- 12 *Dynamical Phase Transitions in Cold Atomic Gases*, Max Planck Institute for the Physics of Complex Systems Colloquium (virtual presentation), Max Planck Institute for the Physics of Complex Systems, Dresden, Germany, September 2020.
- 13 *Dynamics of Interacting Fermions Under Spin-orbit Coupling*, Quantum Matter Seminars (virtual presentation), Northeastern University, Boston, MA, <https://www.youtube.com/watch?v=F833p-ztUqM>, August 2020.
- 14 *Observation of Dynamical Phase Transitions in Cold Atomic Gases*, Quantum Science Seminar online, (virtual presentation), [<https://www.youtube.com/watch?v=rLMTSSBu5mw>], July 2020.
- 15 *Entanglement Dynamics and Scrambling in a Trapped Ion Quantum Magnet*, Quantum Chaos 2020 Seminar Series online, (virtual presentation), <https://www.youtube.com/watch?v=yN7rMmA615U>, July 2020.
- 16 *Observation of Dynamical Phase Transitions in Cold Atomic Gases*, Physics and Astronomy Colloquium (virtual presentation), Dartmouth College, Hanover, NH, May 2020.
- 17 *Building with Crystals of Light and Quantum Matter: From Clocks to Computers*, Plenary talk, APS Conference for Undergraduate Women in Physics 2020, University of Maryland and NIST, Gaithersburg, MD, January 2020.
- 18 *Observation of Dynamical Phase Transitions in Cold Atomic Gases*, Pritzker School of Molecular Engineering Seminar, University of Chicago, Chicago, IL, January 2020.
- 19 *Building with Crystals of Light and Quantum Matter: From Clocks to Computers*, Physics and Astronomy Colloquium, School of Physics and Astronomy, University of Minnesota Minneapolis, MN, November 2019.
- 20 *Entanglement Dynamics and Fast Scrambling in a Trapped Quantum Magnet*, Condensed Matter Seminar, School of Physics and Astronomy, University of Minnesota Minneapolis, MN, November 2019.
- 21 *Enhancing Metrology Using Quantum-correlated Matter*, Vienna Graduate Conference on Complex Quantum Systems (CoQuS), University of Vienna, Vienna, Austria, October 2019.
- 22 *Building with Crystals of Light and Quantum Matter: From Clocks to Computers*, Department of Physics and Astronomy Colloquium, University of North Carolina, Chapel Hill, NC, September 2019.
- 23 *Engineering Spin Squeezing in a 3D Optical Lattice with Interacting Spin-orbit-coupled Fermions*, Wilhelm und Else Heraeus Seminar #702: Otto Stern's Molecular Beam Research and its Impact on Science, University of Frankfurt, Frankfurt, Germany, September 2019.
- 24 *Dynamics of Interacting Fermions Under Spin-orbit Coupling*, XXXIst International Conference on Photonic, Electronic, and Atomic Collisions (ICPEAC), Deauville, France, July 2019.
- 25 *New Frontiers on Many-body Physics with Atomic Clocks*, Designing Artificial Quantum Matter (DAQM) Conference, San Sebastian, Spain, July 2019.
- 26 *Atomic Clocks: From Timekeepers to Quantum Computers*, 2019 Blavatnik Science Symposium, New York Academy of Sciences, New York, NY, July 2019.

- 27 *Enhanced Metrology with Correlated Quantum Matter*, International Conference on Laser Spectroscopy (ICOLS) 2019, Queenstown, New Zealand, July 2019.
- 28 *Engineering Spin Squeezing in a 3D Optical Lattice with Interacting Spin-orbit-coupled Fermions*, Emergent Phenomena in Ultracold Atoms: Merging Topology, Interaction, and Dynamics Conference, Beijing, China, June 2019.
- 29 *Observation of a Dynamical Phase Transition in a Quantum Degenerate Fermi Gas*, American Physical Society Division of Atomic, Molecular, and Optical Physics Meeting (DAMOP), Milwaukee, WI, May 2019.
- 30 *New Direction on Quantum Simulations with Long-lived Sr Dipoles in a Cavity*, Open Quantum System Dynamics: Quantum Simulators and Simulations Far From Equilibrium, Kavli Institute for Theoretical Physics, University of California Santa Barbara, Santa Barbara, CA, May 2019.
- 31 *New Direction on Quantum Simulations with Long-lived Strontium Dipoles in a Cavity*, Universal Themes of Bose-Einstein Condensation (UBEC 2019) Conference, Pittsburgh, PA. April 2019.
- 32 *Unifying Fast Scrambling, Thermalization, and Entanglement through the Measurement of FOTOCs*, Aspen Center for Physics Winter Conference: Many Body Quantum Chaos, Aspen, CO, March 2019.
- 33 *Enhanced Metrology Using Quantum-correlated Matter*, American Physical Society March Meeting, Boston, MA, March 2019.
- 34 *Collective Spin Dynamics of Weakly Interacting Fermions: From Dynamical Phase Transitions to Spin Squeezing*, SFB-FoQuS International Conference, University of Innsbruck, Innsbruck, Austria, February 2019.
- 35 *Entanglement Dynamics and Scrambling in a Trapped Ion Quantum Magnet*, Condensed Matter Physics Seminar, Department of Physics and Astronomy, Michigan State University, East Lansing, MI, December 2018.
- 36 *Observation of a Dynamical Phase Transition in the Collective Heisenberg Model*, Quantum Optics IX Conference, Cartagena de Indias, Colombia, October 2018.
- 37 *Collective Spin Dynamics of Weakly Interacting Fermions*, Quantum Phases of Fermions in Optical Lattices: The Low-Temperature Frontier, ITAMP Workshop, Harvard University, Cambridge, MA, October 2018.
- 38 *Building with Crystals of Light and Quantum Matter: From Clocks to Computers*, Department of Physics and Astronomy Colloquium, University of Alberta, Edmonton, Alberta, Canada, October 2018.
- 39 *Building with Crystals of Light and Quantum Matter: From Clocks to Computers*, Department of Physics and Astronomy Colloquium, Northwestern University, Evanston, IL, September 2018.
- 40 *Entanglement Dynamics and Scrambling in a Trapped Ion Magnet*, Novel Approaches to Quantum Dynamics, Kavli Institute for Theoretical Physics (KITP), UCSB, Santa Barbara, CA, August 2018.
- 41 *Entanglement Dynamics in a Trapped Ion Quantum Magnet*, 26th International Conference on Atomic Physics, Barcelona, Spain, July 2018.
- 42 *Entanglement Dynamics in a Trapped Ion Quantum Magnet*, 2018 H. L. Welsh Lectures in Physics, University of Toronto, Toronto, Canada, May 2018.

- 43 *Exploring Adiabatic Quantum Dynamics of the Dicke Model in a Trapped Ion Quantum Simulator*, FINESSE 2018: Finite Temperature Non-Equilibrium Superfluid Systems, Wanaka, Otago, New Zealand, February 2018.
- 44 *Building with Crystals of Light and Quantum Matter: From Clocks to Computers*, Department of Physics Colloquium, Fudan University, Shanghai, China, December 2017.
- 45 *New Direction on Quantum Simulations With Long-Lived Strontium Dipoles in a Cavity*, Gintzon Lab AMO Seminar, Stanford University, Stanford, CA, December 2017.
- 46 *Building with Crystals of Light and Quantum Matter: From Clocks to Computers*, Department of Physics and Astronomy Colloquium, Ohio University, Athens, GA, October 2017.
- 47 *Building with Crystals of Light and Quantum Matter: From Clocks to Computers*, Quantum Lunch Seminar, Los Alamos National Laboratory, Los Alamos, NM, November 2017.
- 48 *Building with Crystals of Light and Quantum Matter: From Clocks to Computers*, Department of Physics Colloquium, Simon Fraser University, Vancouver, Canada, October 2017.
- 49 *Dynamics of Interacting Fermions Under Spin-Orbit Coupling in an Optical Lattice Clock*, QUSENC 17: Quantum Sensing with Quantum Correlated Systems Workshop, Max Planck Institute for the Physics of Complex Systems, Dresden, Germany, September 2017.
- 50 *Stable Ferromagnetism in a Weakly Interacting Quantum Degenerate Fermi gas: Exploring a Pathway First Opened by Debbie [Jin]*, BEC 2017-Frontiers in Quantum Gases, Sant Feliu de Guixols, Spain, September 2017.
- 51 *Building with Crystals of Light and Quantum Matter: From Clocks to Computers*, American Physical Society Colloquium, APS Editorial Offices, Ridge, NY, August 2017.
- 52 *Collective Effects and Spin Squeezing in Long-lived Atomic Dipoles: Towards a New Generation of Atomic Clocks*, CoCoAL-Cooperative and Collective Atom Light Interactions Workshop, Durham University, Durham, UK, July 2017.
- 53 *Quantum Spin Dynamics, Coherences, and Entanglement in Systems with Long-range Interactions*, Spin Phenomena Interdisciplinary Center (SPICE) Workshop: Non-equilibrium Quantum Matter, Budenheim, Germany, May 2017.
- 54 *Exploring Quantum Magnetism with Atoms and Ions: From Clocks to Computers*, Universidad Nacional de Colombia, Catedra Sesquicentenario, Bogotá, Colombia, May 2017.
- 55 *Quantum Spin Dynamics, Coherences and Entanglement in a Trapped Ion Magnet*, JQI 10th Anniversary Symposium, JQI, University of Maryland, College Park, MD, May 2017.
- 56 *Building with Crystals of Light and Quantum Matter: From Clocks to Computers*, Katharine Blodgett Gebbie Symposium, NIST, Gaithersburg, MD, May 2017.
- 57 *Quantum Spin Dynamics, Coherences and Entanglement in Trapped Ion Arrays*, Quantum State Engineering 2017 Workshop, Hannover, Germany, March 2017.

- 58 *Quantum Magnetism in Different AMO Systems*, American Physical Society March Meeting, New Orleans, LA, March 2017.
- 59 *Building with Quantum Spin Dynamics, Coherences and Entanglement in Systems with Long-Range Interactions*, Department of Astronomy and Physics Colloquium, University of New Mexico, Albuquerque, NM, March 2017.
- 60 *Building with Crystals of Light and Quantum Matter: From Clocks to Computers*, Department of Physics Colloquium, University of Michigan, Ann Arbor, MI, March 2017.
- 61 *Light Scattering in Dense Atomic Samples*, Dodd-Walls Centre for Photonics and Quantum Technologies Annual Symposium, University of Otago, Dunedin, New Zealand, January 2017.
- 62 *Building with Crystals of Light and Quantum Matter: From Clocks to Computers*, Department of Physics Colloquium, University of Washington, Seattle, WA, December 2016.
- 63 *Building with Crystals of Light and Quantum Matter: From Clocks to Computers*, Department of Physics Colloquium, University of Arizona, Tucson, AZ, November 2016.
- 64 *Building with Crystals of Light and Quantum Matter: From Clocks to Computers*, Colombian Student Association at Purdue (CSAP) 2nd Academic Event, “Latino Research Experience: Talento Local y de Exportacion”, Purdue University, West Lafayette, IN, October 2016.
- 65 *Building with Crystals of Light and Quantum Matter: From Clocks to Computers*, The 182nd Institute for Molecular Science Colloquium, National Institutes of Natural Sciences, Okazaki, Japan, October 2016.
- 66 *Building with Crystals of Light and Quantum Matter: I. From Superfluids to Magnets; II. From Clocks to Computers; and III. From Atoms to Molecules*, Okinawa School of Physics, Okinawa Institute of Science and Technology, Okinawa, Japan, October 2016.
- 67 *Quantum Spin Dynamics, Coherences and Entanglement in Trapped Ion Arrays*, Long-range Interactions in the Ultracold Workshop, Ercolano, Italy, June 2016.
- 68 *Quantum Spin Dynamics, Coherences and Entanglement in Trapped Ions*, The 25th International Conference on Atomic Physics, ICAP 2016, Seoul, Republic of Korea, July 2016.
- 69 *Quantum Spin Dynamics and Entanglement in Systems with Long-Range Interactions*, Quantum Non-Equilibrium Phenomena Workshop, Natal, Brazil, June 2016.
- 70 *Quantum Dynamics and Topological Excitations in Dipolar Gases*, American Physical Society, DAMOP meeting, Providence, RI, May 2016.
- 71 *Building with Crystals of Light and Quantum Matter*, Physics Research Conference, California Institute of Technology, Pasadena, CA, May 2016.
- 72 *New Perspectives on Quantum Simulation with Alkaline-Earth Atoms*, CMTC Seminar, University of Maryland, College Park, MD May, 2016.
- 73 *Building with Crystals of Light and Quantum Matter*, Boulder conversation with extraordinary people, Boulder History Museum, Boulder, CO, April 2016.



- 74 *Building with Crystals of Light and Quantum Matter*, Colloquium Lecture, IST, Austria, March 2016.
- 75 *New Perspectives on Quantum Simulation with Alkaline-Earth Atoms*, Kavli Foundation Special Symposium on Physics Frontiers, Baltimore Convention Center, MD, March 2016.
- 76 *Quantum Spin Dynamics and Entanglement in Systems with Long-range Interactions*, March meeting, Baltimore, MD, March 2016.
- 77 *New Perspectives on Quantum Simulation with Alkaline Earth Atoms*, Solvay Workshop on quantum simulation with cold matter and phonons, Brussels, Belgium, February 2016.
- 78 *Building with Crystals of Light and Quantum Matter: From Clocks to Computers*, 11th Annual Conference for Undergraduate Women in Physics, University of California, San Diego, San Diego, CA, January 2016.
- 79 *New Perspectives on Quantum Simulation with Alkaline Earth Atoms*, Institute for Advanced Study Program and Croucher Conference on Topological Phases in Condensed Matter and Cold Atomic Systems, Hong Kong University of Science and Technology Jockey Club Institute for Advanced Study, Hong Kong, December 2015.
- 80 *New Frontiers in Quantum Simulation with Alkaline-earth Atoms*, Max Planck Institute of Quantum Optics Colloquium, Garching, Germany, December 2015.
- 81 *Building with Crystals of Light and Quantum Matter: From Clocks to Computers*, Cornell University Physics Colloquium, Krumhansl Lecture, Ithaca NY, November 2015.
- 82 *Construyendo con Cristales de Luz y Atomos Fríos*, Universidad Nacional de Colombia, Physics colloquium, Bogotá, Colombia, October 2015.
- 83 *New Perspectives in Quantum Simulations with Alkaline-earth Atoms*, Second International Workshop on Ultracold Quantum Matter (UQUAM), Innsbruck, Austria, September 2015.
- 84 *Building with Crystals of Light and Quantum Matter: From Clocks to Computers*, Yale University Physics Club, New Haven CT, September 2015.
- 85 *Dynamics of Long-range Interacting Spin Systems*, Synthetic Quantum Magnetism International Workshop, Max Planck Institute for the Physics of Complex Systems, Dresden, Germany, September 2015.
- 86 *New Frontiers in Quantum Simulation With Precision Laser Spectroscopy*, 22nd International Conference on Laser Spectroscopy (ICOLS 2015), Singapore, June–July 2015.
- 87 *New Perspectives on Quantum Simulation with Ultra-cold Polar Molecules*, Colombia in the International Year of Light 2015, Universidad de los Andes, Bogotá, Colombia and Universidad de Antioquia, Medellín, Colombia, June 2015.
- 88 *Building with Crystals of Light and Quantum Matter*, Argonne National Laboratory Physics Colloquium, Lemont, IL, May 2015.
- 89 *Building with Crystals of Light and Quantum Matter*, University of Chicago Physics Colloquium, Chicago, IL, May 2015.

- 90 *Quantum Magnetism at Temperature Regimes Above Quantum Degeneracy*, Topological and Strongly Correlated Phases in Cold Atoms Conference, Princeton University, Princeton, NJ, April 2015.
- 91 *Building with Crystals of Light and Quantum Matter*, University of Houston Physics Colloquium, Houston, TX, April 2015.
- 92 *Quantum Magnetism at Temperature Regimes Above Quantum Degeneracy*, Institute for Nuclear Theory Program INT-15-1, Frontiers in Quantum Simulation with Cold Atoms, Seattle, WA, April 2015.
- 93 *New Frontiers on Quantum Simulation with Ultra-cold Polar Molecules*, German Physical Society (Deutsche Physikalische Gesellschaft) Spring Meeting, Graduating Symposium, Heidelberg, Germany, March 2015.
- 94 *Building with Crystals of Light and Quantum Matter*, University of Connecticut, Physics Colloquium, Storrs, CT, March 2015.
- 95 *Building with Crystals of Light and Quantum Matter*, Williams College, Physics Colloquium, Williamstown, MA, March 2015.
- 96 *Synchronization of Radiating Dipoles*, Exploratory workshop: Rydberg physics with two electron systems, University of Hamburg, Hamburg, Germany, February 2015.
- 97 *Building with Crystals of Light and Quantum Matter*, Colorado State Physics Colloquium Fort Collins, CO, December 2014.
- 98 *Building with Crystals of Light and Quantum Matter*, Museum of Science and Industry (MOSI), Hispanic Scientist of the Year, Tampa, Florida, October 2014.
- 99 *About Ana Maria Rey, MOSI Hispanic Scientist of the Year*, Museum of Science and Industry, Hispanic Scientist of the Year, Tampa, Florida, October 2014.
- 100 *Synchronization of Radiating Dipoles, Many-Body Dynamics and Open Quantum Systems*, University of Strathclyde, Glasgow, Scotland, October 2014.
- 101 *Building with Crystals of Light and Quantum Matter*, Heidelberg Center for Quantum Dynamics Colloquium, University of Heidelberg, Germany, October 2014.
- 102 *Building with Crystals of Light and Quantum Matter*, Duke University, Physics Colloquium Durham, North Carolina, September 2014.
- 103 *New Perspectives on Quantum Simulation*, IWQCDII, Medellin, Antioquia, Colombia, August 2014.
- 104 *Construyendo con cristales de luz y atomos*, Explora en Bicicleta, Medellin, Antioquia, Colombia, August 2014.
- 105 *New Perspectives on Quantum Simulation*, “Quantum Science”, Gordon Research Conference Easton, MA, July 2014.
- 106 *ICAP Summer School Lectures*, Williamsburg, VA, July 2014.
- 107 *New Perspectives on Quantum Simulation*, DAMOP Meeting, Prize Session 2014, Madison, WI, June 2014
- 108 *Building with Crystals of Light and Quantum Matter*, University of Hamburg Physics Colloquium, Hamburg, Germany, June 2014.

- 109 *New Perspectives on Quantum Simulation*, Lectures, SFB925 Summer Conference and Summer School “Light induced dynamics and control of correlated quantum systems”, Hohwacht, Germany, June 2014.
- 110 *Building with Crystals of Light and Quantum Matter: From Clocks to Computers*, Louisiana State University Physics Colloquium, Baton Rouge, LA, May 2014.
- 111 *Building with Crystals of Light and Quantum Matter: From Clocks to Computers*, NIST Colloquium, Gaithersburg, MD, May 2014.
- 112 *Building with Crystals of Light and Quantum Matter: From Clocks to Computers*, Massachusetts Institute of Technology Physics Colloquium, Boston, MA, May 2014.
- 113 *New Perspectives on Quantum Simulation*, Center for Ultracold Atoms Seminar, Harvard University, Boston, MA, May 2014.
- 114 *Building with Crystals of Light: From Clocks to Computers*, AFOSR Colloquium, Arlington, VA, May 2014.
- 115 *New Frontiers in Quantum Simulations Enabled by Precision Spectroscopy*, From Atomic to Mesoscale: The Role of Quantum Coherence in Systems of Various Complexities, ITAMP Workshop, Cambridge, MA, March 2014.
- 116 *Quantum Simulation with Polar Molecules*, March Meeting, Denver, CO, March 2014.
- 117 *Building with Crystals of Light: From Clocks to Computers*, Saturday Physics Series, Boulder, CO, February 2014.
- 118 *New Frontiers in Quantum Simulations Enabled by Precision Spectroscopy*, The Moore Workshop on Quantum Materials in AMO and Condensed Matter Physics, Carmel Valley, CA, February 2014.
- 119 *Optical Lattices: From Precise Timekeepers to Quantum Simulators*, Physics Colloquium, Universidad de los Andes, Bogotá, Colombia, October 2013.
- 120 *Optical Lattices: From Precise Timekeepers to Quantum Simulators*, Physics Colloquium, Universidad Nacional de Colombia, Bogotá, Colombia, October 2013.
- 121 *Exploring Quantum Magnetism with Polar Molecules*, Center for Quantum Information and Control (CQuIC) seminar series, University of New Mexico, Albuquerque, NM, August 2013.
- 122 *Exploring Quantum Magnetism with Polar Molecules*, Aspen Workshop on Optical Lattice Emulators and Beyond, Aspen, CO, August 2013.
- 123 *Exploring Non-equilibrium Many-body Physics with Alkaline Earth Atoms and Molecules*, Conference on Lasers and Electro-Optics (CLEO), San Jose, CA, June 2013.
- 124 *Non-Equilibrium Many-Body Physics with Alkaline-Earth Atoms and Polar Molecules*, 11th US-Japan Joint Seminar, Nara, Japan, April 2013.
- 125 *Exploring Non-equilibrium Many-Body Physics with Polar Molecules*, Kavli Institute for Theoretical Physics (KITP), UCSB, Santa Barbara, CA, March 2013.
- 126 *Atomic Clocks: From Precise Timekeepers to Quantum Simulators*, Session: What is Hot in Cold, AAAS meeting, Boston, MA, February 2013.

- 127 *Exploring Quantum Many-Body Physics in Atomic Clocks*, Group II workshop, Tokyo, Japan, October 2012.
- 128 *Quantum Magnetism with Polar Molecules*, AMO Seminar, University of California, Berkeley, CA, September 2012.
- 129 *Quantum Dynamics in Strongly Correlated Systems*, "Quantum Science" Gordon Conference, Stonehill College, MA, August 2012.
- 130 *Precise Time Keeping Needs Many-Body Physics*, Physics Colloquium, University of Princeton, Princeton, NY March 2012.
- 131 *Precise Time Keeping Needs Many-Body Physics*, Applied Math Colloquium, University of Colorado Boulder, Boulder, CO January 2012.
- 132 *Exploring Many-Body Physics with Alkaline Earth Atoms*, Aspen Winter Conference, Aspen, CO, January 2012.
- 133 *Precise Time Keeping Needs Many-Body Physics*, Physics Colloquium, George Mason University, Fairfax, VA, November 2011.
- 134 *Resolved Interaction Sidebands*, SPIE Conference 2011, San Diego, CA, August 2011.
- 135 *New Perspectives with Alkaline Earth Atoms*, Gordon Conference on Atomic Physics, West Dover, VT, June 2011.
- 136 *Ultra-cold Bosonic Atoms in Optical Lattices*, APS-Tutorial March Meeting, Dallas, TX March 2011.
- 137 *Probing the Kondo Lattice Model with Ultracold Atoms*, CUA/MIT Boston, MA, September 2010.
- 138 *Two-orbital  $SU(N)$  Magnetism with Ultracold Alkaline-Earth Atoms*, APS DAMOP Meeting, Houston, May 26, 2010.
- 139 *Quantum Simulations with Ultra-Cold Atoms*, Physics Colloquium at Colorado State University, Fort Collins, CO, March 22, 2010.
- 140 *Optical Lattice Emulator Phase II Kick-Off Meeting*, Miami, FL, December 3, 2009.
- 141 *Controlling and Probing Interaction-Induced Ferromagnetism in Optical Superlattices*, AMO Seminar University of Toronto, Toronto, Canada, December 1, 2009.
- 142 *The Super Cool Atom Computer*, Saturday Physics Series, JILA and University of Colorado, November 14, 2009.
- 143 *Two-orbital  $SU(N)$  Magnetism with Ultracold Alkaline-Earth Atoms*, Ultracold Group II workshop, University of Maryland, College Park, MD, September 17, 2009.
- 144 *Ultracold Atoms as Quantum Simulators of Condensed Matter Hamiltonians*, Optics Seminar, JILA and University of Colorado, Boulder, CO, December 1, 2008.
- 145 *Ultracold Atoms as Quantum Simulators of Condensed Matter Hamiltonians*, Physics Department Colloquium, Colorado School of Mines, Golden, CO, November 18, 2008.

- 146 *Alkaline-Earth-Atoms Tool Box*, New Laser Scientist Conference, Rochester, NY October 24, 2008.
- 147 *Alkaline-Earth-Atoms Tool Box*, The Center for Advanced Studies Seminar, University of New Mexico, October 9, 2008.
- 148 *Exploring Quantum Magnetism in Optical Super-Lattices*, Quantum Seminar, Los Alamos National Laboratory, Los Alamos, NM, October 2, 2008.
- 149 *Alkaline Earth Atoms as Quantum Simulators of Novel Hamiltonians* Informal AMO Theory Seminar, JILA and University of Colorado, Boulder, CO, September 25, 2008.
- 150 *Exploring Quantum Magnetism with Optical Super-Lattices*, Bi-group Seminar, JILA and University of Colorado, Boulder, CO, September 15, 2008.
- 151 *Preparation and Detection of d-wave Superfluidity with Cold Atoms*, APS DAMOP Meeting, Pennsylvania State University, State College, PA, May 28, 2008.
- 152 *Preparation and Detection of d-wave Superfluidity with Cold Atoms*, Cambridge-Connecticut AMO Open House, Harvard University, Boston, MA, April 11, 2008.
- 153 *Probing and Controlling Quantum Magnetism with Ultra-Cold atoms*, APS March Meeting, New Orleans, LA, March 12, 2008.
- 154 *Preparation and Detection of Magnetic Quantum Phases in Optical Superlattices*, AMO Seminar, University of Connecticut, Storrs, CT, September 24, 2007.
- 155 *Quantum Magnetism in Optical Superlattices*, AMO Seminar, Stony Brook University, Stony Brook, NY, December 3, 2007.
- 156 *Controllable Generation of Entanglement and Frustrated Spin States in Optical Lattices*, QIBEC Seminar series at NIST, Gaithersburg, MD, August 2, 2007.
- 157 *Condensate and Non-condensate Dynamics in Optical Lattices*, Non-equilibrium Behavior in Superfluid Gases at Finite Temperature Workshop, Sandbjerg, Denmark, June 12, 2007.
- 158 *Preparation and Detection of Magnetic Quantum Phases in Optical Superlattices*, AMO seminar, University of Delaware, Newark, DE, April 23, 2007.
- 159 *Preparation and Detection of Magnetic Quantum Phases in Optical Superlattices*, AMO Seminar, University of Massachusetts, Boston, MA, April 18, 2007.
- 160 *Robust Entanglement Generation with Strongly Interacting Atoms*, CIAR Quantum Simulation Meeting, Vancouver, Canada, February 21, 2007.
- 161 *Equilibrium and Non-equilibrium Dynamics of Atoms in Optical Lattices*, JQI Seminar Series, University of Maryland, College Park, MD, January 29, 2007.
- 162 *Theory of Strongly Correlated Atoms*, Emerging Themes in Physics Workshop, University of Texas, Austin, TX, October 2006.
- 163 *Quantum Coherence of Hard-Core-Bosons and Fermions: Extended, Glassy and Mott Phases*, ITAMP-Harvard Physics Department Joint Atomic Physics Colloquium, April 2006.
- 164 *Quantum Coherence of Hard Core Bosons in Superlattices*, AMO Seminar, University of Texas, Austin, TX, April 2006.

- 165 *Hanbury-Brown-Twiss Interferometry in Superlattices*, Laser Physics Workshop, L'Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, August 2006.
- 166 *Extended Fermionization of 1D Bosons in Optical Lattices*, Third International Workshop in Theory of Quantum Gases and Quantum Coherence, Cortona, Italy, November 2005.
- 167 *Damped Center of Mass Oscillations of a 1-D Bose Gas in an Optical Lattice*, Quantum Coherence and Information Seminar, University of Maryland, College Park, MD, April 2005.
- 168 *Fermionization of Bosons in an Optical Lattice: A simple picture*, Statistical Physics Seminar, University of Maryland, College Park, MD, March 2005.
- 169 *Bragg Spectroscopy of Bosonic Atoms in One-dimensional Lattices*, CAMP Seminar, Pennsylvania State University, State College, PA, November 2004.
- 170 *Bragg Spectroscopy of Ultracold Atoms Loaded in an Optical Lattice*, Quantum Coherence and Information Seminar, University of Maryland, College Park, MD, April 2004.
- 171 *BEC Dynamics in a Patterned Loaded Optical Lattice*, AMO Physics Seminar, State University of New York at Stony Brook, NY, December 2003.
- 172 *Going Beyond the Popov Approximation to Describe Dynamical and Equilibrium Properties of a BEC in an Optical Lattice*, Laser Physics Workshop, University of Hamburg, Hamburg, Germany, August 2003.
- 173 *Quantum Dynamics of a Period-three Pattern Loaded BEC in an Optical Lattice*, Quantum Coherence and Information Seminar, University of Maryland, College Park, MD, February 2003.

## OUTREACH

Co-organized the 2021 Boulder School for Condensed Matter and Materials Physics on ultracold matter . <https://boulderschool.yale.edu/2018/boulder-school-2018>. The school provides education for advanced graduate students and postdoctoral fellows working in condensed matter physics, materials science and related fields. The school enables approximately 50 students to work at the frontiers of science and technology by providing expert training not easily available within the traditional system of graduate education and postdoctoral apprenticeship.

Presented Saturday Physics Series Lecture, "Atomic Clocks: The Greatest Rulers of Time," Department of Physics, University of Colorado Boulder. The Saturday Physics Series lectures are geared toward high school students and adults to highlight the exciting research and practical potential of physics. The lectures are free and open to the public.

Participated in a discussion with a new student group in the CU Physics department called COSMOS which is aimed at providing a community of support for students of color (particularly Black and Latina/o students) within physics and astrophysics. The group holds its meetings from 5–6pm MT on every other Monday. Joined on March 22, 2021.

My biography was published on: The New York Times bestselling *Good Night Stories for Rebel Girls*, a children's book packed with 100 bedtime stories about the life of 100 extraordinary women from the past and the present, and illustrated by 60 female artists from all over the world. Each woman's story is written in the style of a fairy tale. Each story has a full-page, full-color portrait that captures the spirit of the portrayed hero.

Participated as a mentor in the NIST Women-in-STEM group that hosted a 'Flash Mentoring' virtual event on March 11, 2021 (1:30–3:00 PM EST) in recognition of Women's History Month. The

format of this event was small group (6 participants) breakouts with a mentor and assigned facilitator focused on one of the following four topics: Career Advancement, Professional Development, Leadership Development, and Work-Life Balance. As a mentor I spoke with 3 different groups for 20 minutes each.

*Denver Public Schools Curiosity Series*, conversations with Denver Public Schools students on a career in physics, February 3, 2021. This program hopes to inspire curiosity and encourage students by offering an opportunity to explore different career paths with experts, many of whom have broken social barriers to become successful.

Participated as a panelist on the Conference for Undergraduate Underrepresented Minorities in Physics. Quantum Showcase Panel on January 8, 2021. With the next “quantum revolution” upon us that will have a significant impact on new developments in science, finance, optimization, and computing, there is a growing demand for qualified scientists to build up the quantum industry. This was a panel of diverse and leading experts in the quantum field presenting their perspectives and how they view the impact of quantum on our world.

Discussion with Graduate students as part of the Department of Physics Colloquium (virtual) at the Ohio State University, Columbus, OH, November 2020.

Gave a short presentation on June 19, 2020 encouraging a group of high-school students in Colombia to continue their career dreams. The ceremony was hosted by the ministry of education in Colombia. <https://t.co/F2PKVA6QXH> <https://twitter.com/Mineduccion/status/1274012807265234944?s=20>

Chaired the KITP advisory board 2020-2021. The Advisory Board plays an essential role in the success of the Institute, giving it advice and helping formulate the programs. The board is representative of the international physics community and is instrumental in conveying to the Institute the desires, suggestions and concerns of the community, as well as serving as a pool of potential organizers for programs

*What I wish I knew as a Grad Student/PostDoc*, Panel discussion at JILA for The International Day of Women and Girls in Science, February 11, 2020. The day recognizes the critical role women and girls play in science and technology.

*Building with Crystals of Light and Quantum Matter: From Clocks to Computers*, APS Conference for Undergraduate Women in Physics 2020, University of Maryland and NIST, Gaithersburg, MD, January 2020. Lecture and meetings targeted to undergraduate women in physics to encourage them to continue in physics, and to share professional experiences, advice, and ideas.

*Lunch with Women in Physics and Astronomy Group*, Physics and Astronomy Colloquium, School of Physics and Astronomy, University of Minnesota Minneapolis, MN, November 2019.

*Lunch with Women in Physics Club*, Department of Physics and Astronomy Colloquium, University of North Carolina, Chapel Hill, NC, September 2019.

Interview with Greg Moldow, High School Gifted and Talented (GT) Coordinator Denver Public Schools. Also met and talked with high school students for an hour. <https://youtu.be/EqeXmlyJmCg>. February 2019.

*Entanglement in AMO physics*, tutorial at the 2019 Quantum Information Processing (QIP) Conference, Saturday, January 12, 2019 (University of Colorado Boulder). Tutorial for approximately 100 undergraduates and people interested in quantum information both working at universities and industry. <https://jila.colorado.edu/qip2019/program.html#tutorials>

Co-organized (with Profs. A. Hock, M. Grenier, and E. Demler), the 2018 Gordon Research Conference in Quantum Science “Non-Equilibrium Quantum Matter and Scalable Quantum Computing”, July 29–August 3, 2018, Stonehill College, Easton, MA. As a part of the conference I organized a

power hour with JILA graduate student Julia Cline. The GRC Power Hour is an optional informal gathering open to all meeting participants. It is designed to help address the challenges women face in science and support the professional growth of women in our communities by providing an open forum for discussion and mentoring.

Co-organized the 2018 Boulder School for Condensed Matter and Materials Physics on quantum information. <https://boulderschool.yale.edu/2018/boulder-school-2018>. The school enables approximately 50 students to work at the frontiers of science and technology by providing expert training not easily available within the traditional system of graduate education and postdoctoral apprenticeship.

*Tools for Understanding Complexity*, McArthur Fellows Gathering, The Johnson Foundation@Wingspread, Racine, WI, May 2018.

*Quantum clocks: The Greatest Rulers of Time*, Welsh Lectures in Physics 2018 Public Talk, Department of Physics, University of Toronto, Toronto, Canada, May 2018. "The Welsh Lectures in Physics have been held annually since 1975 in honour of H.L. Welsh, a distinguished former faculty member in the Physics Department. They are the major public event in the life of the Department of Physics and are intended to celebrate discoveries in physics and their wider impact. They are intended to be broadly accessible to an audience drawn from across the university, other academic institutions and the interested public." Approximately 100 participants.

*Catedra Huellas que Inspiran (Footsteps that Inspire)*, Universidad Nacional de Colombia, Catedra Sesquicentenario, Bogotá, Colombia, May 2017 (<https://www.youtube.com/watch?v=pxUomuldj0>).

*Building with Crystals of Light and Quantum Matter: From Clocks to Computers*, Colombian Student Association at Purdue (CSAP) 2nd Academic Event, "Latino Research Experience: Talento Local y de Exportacion", Purdue University, West Lafayette, IN, October 2016. This annual event is aimed at connecting students with the experiences of established Latin American researchers or researchers working in cooperation with Latin American countries, especially Colombia.

*Building with Crystals of Light and Quantum Matter: From Clocks to Computers*, 11th Annual Conference for Undergraduate Women in Physics, University of California, San Diego, San Diego, CA, January 2016. Lecture and meetings targeted to undergraduate women in physics to encourage them to continue in physics, and to share professional experiences, advice, and ideas.

*Ana Maria Rey. Who Am I?*, Catedra Huellas que Inspiran (Footsteps that Inspire), Universidad Nacional de Colombia, Bogotá, Colombia, October 2015. Lecture to approximately 2000 undergraduate students to inspire them to continue and complete their academic careers ([http://www.unal.edu.co/diracad/catedras/huellas/2015-II/huellas\\_2015\\_II/invitados.html](http://www.unal.edu.co/diracad/catedras/huellas/2015-II/huellas_2015_II/invitados.html)).

Universidad de los Andes, Bogotá, Colombia, March 2015. Undergraduate commencement speech.

*Building with Crystals of Light and Quantum Matter*, Williams College, Physics Colloquium, Williamstown, MA, March 2015. Lecture targeted to approximately 25 undergraduate students.

*About Ana Maria Rey, MOSI, Hispanic Scientist of the Year*, (<http://mosinsoy.org/>) Museum of Science and Industry, Tampa, FL, October 2014. Three lectures at IMAX-MOSI Tampa, each given to approximately 300 school students brought to "Meet the Scientist Day" at MOSI, to meet and listen to presentations by the scientists about their life stories and path to a career in science.

*New Perspectives on Quantum Simulation*, IWQCDII, Medellin, Antioquia, Colombia, August 2014. Lecture given to participants of the IWQCDII workshop. August 2014.



*Construyendo con cristales de luz y atomos*, Explora en Bicicleta, Medellin, Antioquia, Colombia, August 2014. Public lecture in Colombia: <http://www.parqueexplora.org/visitenos/noticias/desde-relojes-hasta-computadores-cuanticos-con-cristales-de-luz-y-atomos/> and <http://www.parqueexplora.org/visitenos/noticias/reviva-los-ciencia-en-bicicleta-de-agosto/>

ICAP Summer school lectures, Williamsburg, VA, July 2014. Three lectures targeted to 50 graduate students.

*New Perspectives on Quantum Simulation*, Summer school lectures, “Light induced dynamics and control of correlated quantum systems” Summer School, Hohwacht, Germany, June 2014. Summer school lectures targeted to approximately 50 graduate students

Co-organized (with Profs. E. Demler, M. Lukin, and G. Refael), the ITAMP Workshop: “Non-equilibrium dynamics and correlations in strongly interacting atomic, optical and solid state systems”, held January 26–28, 2009 at ITAMP, Harvard.

Member of the American Physical Society. Phys. Rev. X Referee for several international journals. Member (2010) and chair (2011) of The DAMOP Thesis Prize Committee.

Reviewer and panel review member of NSF

#### BOOKS

- 1 A. M. Kaufman, M. C. Tichy, F. Mintert, A. M. Rey, and C. A. Regal, “The Hong-Ou-Mandel effect with atoms”, in *Advances in Atomic, Molecular, and Optical Physics*, edited by Ennio Arimondo, Louis F. DiMauro, Susanne F. Yelin, Volume 67, **Academic Press**, pp. 377–428 (2018).
- 2 M. L. Wall, K. R. A. Hazzard, and A. M. Rey, “Quantum Magnetism with Ultracold Molecules”, in *The Role of Quantum Coherence in Systems of Various Complexities*, edited by S. Malinovskaya and I. Novikova, **World Scientific**, pp. 3–37 (2015).
- 3 *Annual Review of Cold Atoms and Molecules*, edited by Kirk W. Madison, Yiqiu Wang, Ana Maria Rey and Kai Bongs, **World Scientific**, Volume 3, Singapore (2015).
- 4 *Annual Review of Cold Atoms and Molecules*, edited by Kirk W. Madison, Yiqiu Wang, Ana Maria Rey and Kai Bongs, **World Scientific**, Volume 2, Singapore (2014).
- 5 *Annual Review of Cold Atoms and Molecules*, edited by Kirk W. Madison, Yiqiu Wang, Ana Maria Rey and Kai Bongs, **World Scientific**, Volume 1, Singapore (2013).

#### PUBLICATIONS IN REFEREED JOURNALS

- 1 A. Cidrim, P. Orioli, C. Sanner, R. B. Hutson, J. Ye, R. Bachelard, and A. M. Rey, *Dipole-dipole frequency shifts in multilevel atoms*, Phys. Rev. Lett. **127**, 013401 (2021).
- 2 A. M. Rey, *Ultra-cold bosonic atoms in optical lattices: An overview*, Rev. Acad. Colomb. Cienc. Ex. Fis. Nat., <https://doi.org/10.18257/raccefyn.1399> (2021).
- 3 R. J. Lewis-Swan, S. R. Muleady, S. R., D. Barberena, J. J. Bollinger, and A. M. Rey, *Characterizing the dynamical phase diagram of the Dicke model via classical and quantum probes*, Phys. Rev. Research, **3**(2), L022020 (2021).

- 4 R. J. Lewis-Swan, D. Barberena, J. R. K. Cline, D. Young, J. S. Thompson and A. M. Rey, *Cavity-QED quantum simulator of dynamical phases of a Bardeen-Cooper-Schrieffer superconductor*, Phys. Rev. Lett., **126**, 173601 (2021).
- 5 S. Kelly, A. M. Rey, and J. J. Marino, *Effect of active photons on dynamical frustration in cavity QED*, Phys. Rev. Lett. **126**(13), 133603 (2021).
- 6 T. Bilitewski, L. De Marco, J.-R. Li, K. Matsuda, W. G. Tobias, G. Valtolina, J. Ye, and A. M. Rey, *Dynamical generation of spin squeezing in ultracold dipolar molecules*, Phys. Rev. Lett., **126**(11), 113401 (2021)
- 7 M. Mamaev, I. Kimchi, R. M. Nandkishore and A. M. Rey, *Tunable-spin-model generation with spin-orbit-coupled fermions in optical lattices*, Phys. Rev. Research, **3**(1), 013178 (2021).
- 8 W. Morong, S. R. Muleady, I. Kimchi, W. Xu, R. M. Nandkishore, A. M. Rey and B. DeMarco, *Disorder-controlled relaxation in a three-dimensional Hubbard model quantum simulator*, Phys. Rev. Research, **3**(1), L012009 (2021).
- 9 P. He, T. Bilitewski, C. H. Greene, and A. M. Rey, *Exploring chemical reactions in a quantum degenerate gas of polar molecules via complex formation*, Phys. Rev. A. **102**(6), (2020).
- 10 R. J. Lewis-Swan, S. R. Muleady and A. M. Rey, *Detecting out-of-time-order correlations via quasiadiabatic echoes as a tool to reveal quantum coherence in equilibrium quantum phase transitions*, Phys. Rev. Lett., **125**, 240605 (2020).
- 11 A. Chu, J. Will, J. Arlt, C. Klempt, and A. M. Rey, *Simulation of XXZ spin models using sideband transitions in trapped bosonic gases*, Phys. Rev. Lett. **125**, 240504 (2020).
- 12 D. Barberena, R. J. Lewis-Swan, J. K. Thompson, and A. M. Rey, *Atom-light entanglement for precise field sensing in the optical domain*, Phys. Rev. A., **102**, 052615 (2020).
- 13 M. A. Perlin, C. Qu, and A. M. Rey, *Spin squeezing with short-range spin-exchange interactions*, Phys. Rev. Lett. **125**, 223401 (2020).
- 14 K. Tucker, D. Barberena, R. J. Lewis-Swan, J. K. Thompson, J. G. Restrepo, and A. M. Rey, *Facilitating spin squeezing generated by collective dynamics with single-particle decoherence*, Phys. Rev. A, **102**, 051701(R), (2020).
- 15 L. Gabardos, B. Zhu, S. Lepoutre, A. M. Rey, B. Laburthe-Tolra, L. Vernac, *Relaxation of the collective magnetization of a dense 3D array of interacting dipolar  $S = 3$  atoms*, Phys. Rev. Lett., **125**, 143401 (2020). <https://doi.org/10.1103/PhysRevLett.125.143401>
- 16 L. Sonderhouse, C. Sanner, R. B. Hutson, A. Goban, T. Bilitewski, L. Yan, W. R. Milner, A. M. Rey, and J. Ye, *Thermodynamics of a deeply degenerate  $SU(N)$ -symmetric Fermi gas*, Nat. Phys. **16**, 1216–1221 (2020). <https://doi.org/10.1038/s41567-020-0986-6>.
- 17 A. Kruckenhauser, L. M. Sieberer, L. De Marco, J.-R. Li, K. Matsuda, W. G. Tobias, G. Valtolina, J. Ye, A. M. Rey, M. A. Baranov, and P. Zoller, *Quantum many-body physics with ultracold polar molecules: Nanostructured potential barriers and interactions*, Phys. Rev. A, **102**, 023320 (2020).

- 18 K. von Klitzing, T. Chakraborty, P. Kim, V. Madhavan, X. Dai, J. McIver, Y. Tokura, L. Savary, D. Smirnova, A. M. Rey, C. Felser, J. Gooth and X. Qi, *40 years of the quantum Hall effect*, Nat. Rev. Phys., **2**, 397 (2020).
- 19 M. Mamaev and A. M. Rey, *Generating multipartite spin states with fermionic atoms in a drive optical lattice*, Phys. Rev. Lett, **124**, 240401 (2020).
- 20 M. Mamaev, J. H. Thywissen, and A. M. Rey, *Quantum computation toolbox for decoherence-free qubits using multi-band alkali atoms*, Adv. Quantum Technol. (Special Issue—Chances and Challenges) **3**(11), 1900132 (2020). Online at <https://doi.org/10.1002/qute.201900132>, (2020).
- 21 R. J. Lewis-Swan, D. Barberena, J. A. Muniz, J. R. K. Cline, D. Young, J. K. Thompson, and A. M. Rey, *Protocol for precise field Sensing in the optical domain with cold atoms in a cavity*, Phys. Rev. Lett., **124**, 193602 (2020).
- 22 J. A. Muniz, D. Barberena, R. J. Lewis-Swan, D. J. Young, J. R. K. Cline, A. M. Rey and J. K. Thompson, *Exploring dynamical phase transitions with cold atoms in an optical cavity*, Nature, **580**, 602–604 (2020).
- 23 A. Patscheider, B. Zhu, L. Chomaz, D. Petter, S. Baier, A. M. Rey, F. Ferlaino, and M. J. Mark, *Controlling dipolar exchange interactions in a dense 3D array of large spin fermions*, Phys. Rev. Research, **2**, 023050 (2020).
- 24 A. Piñeiro Orioli and A. M. Rey, *Subradiance of multilevel fermionic atoms in arrays with filling  $n \geq 2$* , Phys. Rev. A, **101**, 043816 (2020).
- 25 M. A. Perlin, and A. M. Rey, *Short-time expansion of Heisenberg operators in open collective quantum spin systems*, Phys. Rev. A, **101** 023601 (2020).
- 26 R. Kaubruegger, P. Silvi, C. Kokail, R. van Bijnen, A. M. Rey, J. Ye, A. M. Kaufman, and P. Zoller, *Variational spin-squeezing algorithms on programmable quantum sensors*, Phys. Rev. Lett., **123**, 260505 (2019).
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- 29 P. He, M. A. Perlin, S. R. Muleady, R. J. Lewis-Swan, R. B. Hutson, J. Ye, and A. M. Rey, *Engineering spin squeezing in a 3D optical lattice with interacting spin-orbit-coupled fermions*, Phys. Rev. Research, **1**, 033075 (2019).
- 30 C. Qu and A. M. Rey, *Spin-squeezing and many-body dipolar dynamics in optical lattice clocks*, Phys. Rev. A, **100**, 041602(R) (2019).
- 31 M. Mamaev, I. Kimchi, M. A. Perlin, R. M. Nandkishore, and A. M. Rey., *Quantum entropic self-localization with ultracold fermions*, Phys. Rev. Lett., **123**, 130402 (2019).
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- 35 S. Smale, P. He, B. A. Olsen, K. G. Jackson, H. Sharum, S. Trotzky, J. Marino, A. M. Rey and J. H. Thywissen. *Observation of a transition between dynamical phases in a quantum degenerate Fermi gas*, Sci. Adv., **5**(8), eaax1568, (2019).
- 36 L. Isaev, A. Kaufman, G. Ortiz, A. M. Rey, and J. Ye. *Topological superfluidity with repulsive alkaline-earth atoms in optical lattices*, New J. Phys., **21**, 073049 (2019).
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- 39 M. Mamaev, R. Blatt, J. Ye, and A. M. Rey. *Cluster state generation with spin-orbit coupled fermionic atoms in optical lattices*, Phys. Rev. Lett., **122**, 160402 (2019).
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- 45 A. Goban, R. B. Hutson, G. E. Marti, S. L. Campbell, M. A. Perlin, P. S. Julienne, J. P D’Incao, A. M. Rey, and J. Ye. *Emergence of multi-body interactions in few-atom sites of a fermionic lattice clock*, Nature, **563** (7731), 369 (2018).
- 46 R. J. Lewis-Swan, M. A. Norcia, J. R. K. Cline, J. K. Thompson, and A. M. Rey. *Robust spin squeezing via photon-mediated interactions on an optical clock transition*, Phys. Rev. Lett., **121**, 070403 (2018).
- 47 A. Safavi-Naini, R. J. Lewis-Swan, J. G. Bohnet, M. Gärttner, K. A. Gilmore, J. E. Jordan, J. Cohn, J. K. Freericks, A. M. Rey, and J. J. Bollinger. *Verification of a many-ion simulator of the Dicke model through slow quenches across a phase transition*, Phys. Rev. Lett., **121**, 040503 (2018).
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- 54 M. Gärttner, P. Hauke, and A. M. Rey. *Relating out-of-time-order correlations to entanglement via multiple-quantum coherences*, Phys. Rev. Lett. **120**, 040402 (2018).
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