

## USHNISH RAY

Cell: (315) 750-0878  
[uray@caltech.edu](mailto:uray@caltech.edu)

Arthur Amos Noyes Laboratory of Chemical Physics  
1200 East California Blvd., Pasadena, CA 91125

### EDUCATION

---

- *MS & PhD* in Physics, University of Illinois at Urbana-Champaign, September 2008 – May 2015
- *BA summa cum laude* with *High Honors* in Physics & *High Honors* in Computer Science Colgate University, September 2004 – May 2008

### EXPERIENCE

---

- *Postdoctoral Research Scholar*, Chan Group at California Institute of Technology, July 2016 - present
- *Postdoctoral Research Scholar*, Chan Group at Princeton University, September 2015 - July 2016
- *Research Assistant*, Ceperley Group at the University of Illinois at Urbana-Champaign, June 2010 - May 2015
- *Teaching Assistant*, Physics Department at the University of Illinois at Urbana-Champaign, January 2010 – May 2010
- *Research Assistant*, LevLab at the University of Illinois at Urbana-Champaign, September 2008 – December 2009
- *Teaching Assistant*, Colgate University Physics Department, September 2005 – May 2008
- *Teaching Assistant*, Colgate University Computer Science Department, January 2005 – May 2008
- *Summer Researcher*, Colgate University Physics Department, June 2007 – August 2007
- *Summer Researcher*, Colgate University Physics Department, June 2006 – August 2006
- *Network Security and Software Development Consultant*, Stadmed Pvt. Ltd (India), 2002-2003
- *Software developer* for St. James' School, Calcutta 2001-2002

### SELECTED AWARDS & MEMBERSHIPS

---

- *University of Illinois at Urbana-Champaign Fellowship*, September 2008
- *Physics and Astronomy Alumni Award*: Colgate, April 2008
- *Award for Academic Excellence in Computer Science*: Colgate, April 2008
- *Charles A. Dana Scholar*: Colgate, 2006-2008
- *Phi Beta Kappa*: Colgate, September 2007
- *Schlichting Student Researcher*: Colgate, May 2007
- *Extraordinary Talent in Computing*: Telegraph School Awards, Calcutta 2002

## TECHNICAL SUMMARY

---

*Programming Languages:* C/C++, Fortran, Java, Python, PHP, VB, Objective C, Assembly Language

*Parallel libraries:* OpenMP, POSIX, MPI, CUDA

*Research Libraries:* BLOCK, PYSCF, CANSS, QMCPACK, CSSER, ARPACK++, BOOST, GSL, BLAS, MOLPRO

*Development Environments:* Matlab, Mathematica, XCODE, Eclipse

## RESEARCH HIGHLIGHTS

---

- *Designed and implemented state-of-the-art code following Density Matrix Embedding Theory (DMET) for strongly correlated systems.*
- *Designed and implemented large scale Diffusion Monte Carlo code based on the Cloning algorithm (CANSS) for simulating non equilibrium stationary states. Capable of simulating properties of realistic materials such as carbon nanotubes.*
- *Designed and implemented large scale Quantum Monte Carlo code based on the SSE algorithm (CSSER) for Bosonic systems. Capable of simulating more than 500,000 particles.*
- *Performed state of the art calculations for disordered quantum systems in condensed matter — the largest of its kind to date.*
- *Collaboration effort with experiments recognized on Physics Illinois APS TV short film ([physics.illinois.edu](http://physics.illinois.edu)).*
- *Part of team that trapped and cooled Dysprosium atoms for the first time.*

## PUBLICATIONS

---

- Bruno R. de Abreu, Ushnish Ray, Silvio A. Vitiello, David Ceperley, “Properties of the Superfluid in the Disordered Bose-Hubbard Model,” *In preparation*, (2017).
- Ushnish Ray, Garnet Kin-Lic Chan, David T. Limmer, "Exact fluctuations of nonequilibrium steady states from approximate auxiliary dynamics," *arXiv:1708.09482* (2017).
- Ushnish Ray, Garnet Kin-Lic Chan and David Limmer, “Importance sampling large deviations in non-equilibrium steady states: Part 1,” *J. Chem. Phys.*, 148 (12), 124120 (2018). **(Selected as Editors’ picks and website front-page article, March 29, 2018.)**
- Mario Motta, David M. Ceperley, Garnet Kin-Lic Chan, John A. Gomez, Emanuel Gull, Sheng Guo, Carlos Jimenez-Hoyos, Tran Nguyen Lan, Jia Li, Fengjie Ma, Andrew J. Millis, Nikolay V. Prokofev, Ushnish Ray, Gustavo E. Scuseria, Sandro Sorella, Edwin M.

Stoudenmire, Qiming Sun, Igor S. Tupitsyn, Steven R. White, Dominika Zgid, Shiwei Zhang, "Towards the solution of the many-electron problem in real materials: equation of state of the hydrogen chain with state-of-the-art many-body methods," *Phys. Rev. X* 7, 031059 (2017).

- Carolyn Meldgin\*, Ushnish Ray\*, Phillip Russ, David Chen, David Ceperley and Brian DeMarco, "Probing the Superfluid to Bose-glass Transition using Quantum Quenches of Disorder," *Nature Phys.*, 12, 10.1038 (2016). (**Selected as front cover of Nature Physics July 2016.**)
- Ushnish Ray, Properties of Dirty Bosons in Disordered Optical Lattices (Doctoral dissertation), University of Illinois at Urbana-Champaign (2015).
- David McKay\*, Ushnish Ray\*, Stefan Natu, Phillip Russ, David Ceperley and Brian DeMarco, "Metastable Bose-Einstein Condensation in a Strongly Correlated Optical Lattice," *Phys. Rev. A* 91, 023625 (2015). (**Selected as Editors' Suggestion.**)
- Ushnish Ray and David Ceperley, "Revealing the Condensate and Non-condensate Distributions in the Inhomogeneous Bose-Hubbard Model," *Phys. Rev. A* 87, 051603R (2013). (**Selected for Rapid Communication.**)
- Ken Segall, Dan Schult, Ushnish Ray, Toshiro Ohsumi, "Numerical simulation of thermal noise in Josephson circuits," *arXiv:1110.0172* (2011).
- Seo Ho Youn, Mingwu Lu, Ushnish Ray, and Benjamin L. Lev, "Dysprosium magneto-optical traps," *Phys. Rev. A* 82, 043425 (2010).
- E. J. Galvez, M. Malik, B. Melius, B. Gadway, and U. Ray, "Measurements of Phase Correlations between Polarization-Entangled Photons," *International Conference on Quantum Information*, OSA Technical Digest (CD), Optical Society of America, paper JWC46, (2007).

## GRANTS AND RESEARCH ALLOCATIONS

---

- Quantum Simulations of Molecular and Solid State Systems, MCA93S030, XSEDE (2016).

## INVITED TALKS

---

- Dirty Bosons in Disordered Optical Lattices, APS March Meeting, March 15, 2016.

---

\* Co-first authors

- Probing the Superfluid Bose-glass transition using dynamical and equilibrium measurements, Electronic Structure Interest Group, University of Illinois, September 2014.
- QMC Studies of OLE with Disorder, Annual Review of DARPA Optical Lattice Emulator Program, February 2, 2014.
- QMC Studies of the Experimentally Realized 3d Disordered Bose-Hubbard Model, Electronic Structure Interest Group, University of Illinois, April 24, 2013.

#### CONFERENCE PRESENTATIONS

---

- Importance sampling large deviations in non-equilibrium steady states, Gordon Research Conference: Chemistry and Physics of Liquids, August 7, 2017.
- Efficient Strategies to Access Large Deviation Functions of Stationary Non-equilibrium States, UC Berkeley Statistical Mechanics Meeting, January 13, 2017. (**Received 1st Prize for the Poster Presentation.**)
- Probing the Bose-glass-Superfluid phase boundary using quantum quenches of disorder in an optical lattice, APS DAMOP, June 4, 2014.
- Simulations of Bose-Hubbard Model, DARPA OLE, December 7, 2011.
- Progress toward the magneto-optical trapping of Dysprosium, APS DAMOP, May 20, 2009.
- Numerical simulation of flux on dynamics in a Josephson junction array, APS March Meeting, March 11, 2008.