

Eric A. Chitambar

Associate Professor of Physics
Southern Illinois University Carbondale
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Carbondale, IL 62901
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Research Interests

Quantum computing and information theory
Multi-partite entanglement theory
Information-theoretic security
Linear algebra and convex optimization
Computational complexity theory
Foundations of quantum mechanics

Education

Ph.D., Physics, August 2010
University of Michigan
Ann Arbor, MI
Dissertation title: *Computational Complexity in Entanglement Transformations*
Adviser: Prof. Yaoyun Shi

Graduate Teaching Certificate, December 2010
University of Michigan
Ann Arbor, MI

M.S., Physics, June 2008
University of Michigan
Ann Arbor, MI

B.S., Physics, May 2005
University of Notre Dame
Notre Dame, IN
Secondary Concentration: Philosophy

Employment

7/2017–Present:
Associate Professor of Physics
Southern Illinois University

8/2012–6/2017:
Assistant Professor of Physics
Southern Illinois University

Research Experience

4/2012–8/2012:

Postdoctoral Fellow
The Perimeter Institute for Theoretical Physics
Waterloo, ON, Canada

6/2010–3/2012:

Postdoctoral Fellow
Department of Physics, University of Toronto
Toronto, ON, Canada
Supervisor: Prof. Hoi-Kwong Lo

3/2009–6/2009 &
10/2009–11/2009:

Visiting Research Assistant
Department of Mathematics, University of Bristol &
Centre for Quantum Technologies, National University of Singapore
Bristol, U.K. & Singapore
Supervisor: Prof. Andreas Winter

9/2008–12/2008:

Visiting Research Assistant
Department of Computer Science and Technology, Tsinghua University
Beijing, China
Supervisor: Prof. Runyao Duan

5/2007–5/2010:

Research Assistant
Department of Electrical Engineering and Computer Science, University of Michigan
Ann Arbor, MI
Supervisor: Prof. Yaoyun Shi

Grants and Funding Awards

Office of Naval Research (ONR) Applied Research in Quantum Information Science (Co-PI)

A grant funding the development of free-space quantum key distribution (QKD), in collaboration with theorists and experimentalists from the University of Tennessee, the University of Toronto, and Oak Ridge National Labs.

Awarded July 22, 2015 (Three year grant, extendable)

U.S. National Science Foundation (NSF) Faculty Early Career Development (CAREER) Program

The most prestigious award offered by the U.S. government to young faculty for research in fundamental science.

Awarded April 25, 2014 (Five year grant)

Southern Illinois University Faculty Seed Grant

A competitive internal grant awarded to only a few new faculty members at Southern Illinois University.

Awarded August 29, 2013

U.S. National Science Foundation (NSF) Travel Grant for the Nordita/Mittag-Leffler Conference on Quantum Information Theory

A competitive travel grant awarded to select young researchers for one month of collaboration at the Nordita Institute for Theoretical Physics in Stockholm, Sweden.

Awarded July 26, 2010

Honors and Awards

College of Science Early Career Faculty Excellence Award

Awarded in 2015 to one Assistant Professor at Southern Illinois University, Carbondale

Rackham Regents' Fellowship

Awarded in 2005 to one student per department as a competitive graduate student fellowship at the University of Michigan

Department of Physics Citizenship Award

Awarded in 2005 to one student at the University of Notre Dame

Sigma Pi Sigma National Physics Honor Society

Inducted in 2005

Preprints

[7] Chitambar, E., “Dephasing-Covariant Operations Enable Asymptotic Reversibility of Quantum Resources.” arXiv:1711.10606, Submitted to *Phys. Rev. A* (2017).

[6] Chitambar, E., de Vicente, J., Girard, M., and Gour, G., “Entanglement manipulation and distillability beyond LOCC.” arXiv:1711.03835, Submitted to *Comm. Math. Phys.* (2017).

[5] Zhao, Q., Liu, Y., Yuan, X., Chitambar, E., Ma, X., “One-Shot Coherence Dilution.” arXiv:1707.02522 (2017), Accepted into *Phys. Rev. Lett.*

[4] Chitambar, E., Fortescue, B., and Hsieh, M.-H., “The Conditional Common Information in Classical and Quantum Secret Key Distillation.” Submitted to *IEEE Trans. Inf. Theory* (2017).

[3] *Dilley, D. and Chitambar, E., “More Nonlocality with Less Entanglement in CHSH Experiments.” To be submitted (2017).

[2] †Spaulding, A., †Berger, S., and Chitambar, E., “Winning Mermin’s Game using Popescu-Rohrlich Boxes.” To be submitted (2017).

[1] Guo, C., Chitambar, E., Duan, R., “Common Resource State for Preparing Multipartite Quantum Systems via Local Operations and Classical Communication,” arXiv:1601.06220. To be submitted to (2017).

* Graduate student in group

† Undergraduate student in group

Publications

[30] Chitambar, E. and Hsieh, M.-H., “Round Complexity in the Local Transformations of Quantum and Classical States.” *Nature Communications* **8**, 2086 (2017).

- [29] Chitambar, E., Gour, G., “Comparison of Incoherent Operations and Measures of Coherence,” *Phys. Rev. A* **94**, 052336 (2016).
- [28] Chitambar, E., Gour, G., “Critical Examination of Incoherent Operations and a Physically Consistent Resource Theory of Quantum Coherence,” *Phys. Rev. Lett.* **117**, 030401 (2016).
Editor’s Suggestion.
- [27] Chitambar, E. and Hsieh, M.-H., “Relating the Resource Theories of Entanglement and Quantum Coherence,” *Phys. Rev. Lett.* **117**, 020402 (2016).
- [26] Streltsov, A., Chitambar, E., Rana, S., Bera, M. N., Winter, A., Lewenstein, M., “Entanglement and Coherence in Quantum State Merging,” *Phys. Rev. Lett.* **116**, 240405 (2016).
- [25] Chitambar, E., Hsieh, M.-H. and Winter, A., “The Private and Public Correlation Cost of Three Random Variables with Collaboration,” *IEEE Trans. Inf. Theory* **62**, 2034 (2016).
- [24] Chitambar, E., Streltsov, A., Rana, S., Bera, M.N., Adesso, G., Lewenstein, M. “Assisted Distillation of Quantum Coherence,” *Phys. Rev. Lett.* **116**, 070402 (2016).
- [23] Chitambar, E., Abu-Nada, A., Ceballos, R., Byrd, M., “Restrictions on Initial System-Environment Correlations Based on the Dynamics of an Open Quantum System,” *Phys. Rev. A* **92**, 052110 (2015).
- [22] Chitambar, E., Fortescue, B., and Hsieh, M.-H., ”A Classical Analog to Entanglement Reversibility,” *Phys. Rev. Lett.* **115**, 090501 (2015).
- [21] Chitambar, E., Fortescue, B., and Hsieh, M.-H., ”Distributions Attaining Secret Key at a Rate of the Conditional Mutual Information,” *Advances in Cryptology – CRYPTO 2015, Conference Proceedings*, 432 (2015).
- [20] Chitambar, E. and Hsieh, M.-H., “Asymptotic State Discrimination and a Strict Hierarchy in Distinguishability Norms,” *J. Math. Phys.* **55**, 112204 (2014).
- [19] †Maxwell, K. and Chitambar, E., “Bell Inequalities with Communication Assistance,” *Phys. Rev. A* **89**, 042108 (2014).
- [18] Chitambar, E., Leung, D., Mančinska, L., Ozols, M. and Winter, A., “Everything You Always Wanted to Know About LOCC (But Were Afraid to Ask),” *Commun. Math. Phys.* **328**, 303 (2014).
- [17] Chitambar, E., Duan, R. and Hsieh, M.-H., “When Do Local Operations and Classical Communication Suffice for Two-Qubit State Discrimination?” *IEEE Trans. Inf. Theory* **60**, 1549 (2014).
- [16] Chitambar, E. and Hsieh, M.-H., “Revisiting the Optimal Detection of Quantum Information,” *Phys. Rev. A* **88**, 020302(R) (2013). **Rapid Communication.**
- [15] Chitambar, E. “Quantum Correlations in Large-Dimensional States of High Symmetry,” *Phys. Rev. A* **86**, 032110 (2012).
- [14] Chitambar, E., Cui, W. and Lo, H.-K., “Entanglement Monotones for W-type States,” *Phys. Rev. A* **85**, 062316 (2012).
- [13] Chitambar, E., Cui, W. and Lo, H.-K., “Increasing Entanglement Monotones by Separable Operations,” *Phys. Rev. Lett.* **108**, 240504 (2012).

- [12] Chitambar, E. “Local Transformations Requiring Infinite Rounds of Classical Communication,” *Phys. Rev. Lett.* **107**, 190502 (2011).
- [11] Cui, W., Chitambar, E. and Lo, H.-K., “Randomly Distilling W-Class States into General Configurations of Two-Party Entanglement,” *Phys. Rev. A* **84**, 052301 (2011).
- [10] Chitambar, E., Miller, C. and Shi, Y., “Deciding Unitary Equivalence Between Matrix Polynomials and Sets of Bipartite Quantum States,” *Quant. Inf. Comp.* **11**, 0813 (2011).
- [9] Chen, L., Chitambar, E., Modi, K. and Vacanti, G., “Multipartite Classical States and Detecting Quantum Discord,” *Phys. Rev. A* **83**, 020101 (Rapid Communication) (2011).
- [8] Yan, F., Gao, T. and Chitambar, E., “Two Local Observables are Sufficient to Characterize Maximally Entangled States of N Qubits,” *Phys. Rev. A* **83**, 022319 (2011).
- [7] Cui, W., Chitambar, E. and Lo, H.-K., “Optimal Entanglement Transformations among N -Qubit W-Class States,” *Phys. Rev. A* **82**, 062314 (2010).
- [6] Chen, L., Chitambar, E., Duan, R., Ji, Z. and Winter, A. “Tensor Rank and Stochastic Entanglement Catalysis for Multipartite Pure States,” *Phys. Rev. Lett.* **105**, 200501 (2010).
- [5] Chitambar, E., Miller, C. and Shi, Y., “Matrix Pencils and Entanglement Classification” *J. Math. Phys.* **51**, 072205 (2010).
- [4] Yu, N., Chitambar, E., Guo, C. and Duan, R. “Bounding the Tensor Rank of $|W\rangle^{\otimes n}$,” *Phys. Rev. A* **81**, 014301 (2010).
- [3] Chitambar, E., Duan, R. and Shi, Y., “Multipartite to Bipartite Entanglement Transformations and Polynomial Identity Testing,” *Phys. Rev. A* **81**, 052310 (2010).
- [2] Chitambar, E. and Duan, R., “Nonlocal Entanglement Transformations Achievable by Separable Operations,” *Phys. Rev. Lett.* **103**, 110502 (2009). Also selected for publication in *Virt. J. Nan. Sci. & Tech.* **20**, 12 (2009).
- [1] Chitambar, E., Duan, R. and Shi, Y., “Tripartite Entanglement Transformations and Tensor Rank,” *Phys. Rev. Lett.* **101**, 140502 (2008).

† Undergraduate student in group

Conference Talks

- “Round Complexity in the Local Transformations of Quantum and Classical States,” *Quantum Information Processing (QIP) 2017*, Seattle, WA: January 19, 2017.
- “Relating the Resource Theories of Coherence and Entanglement,” *Asian Quantum Information Science Conference (AQIS) 2016*, Taipei, Taiwan: August 29, 2016.
- “Are Incoherent Operations Physically Consistent?,” *Asian Quantum Information Science Conference*, Taipei, Taiwan: August 29, 2016.
- “Quantum Versus Classical Advantages in Secret Key Distillation (and Their Links to Quantum Entanglement),” *ArcticCrypt 2016*, Longyearbyen, Norway: July 19, 2016.
- “Distributions Attaining Secret Key at a Rate of the Conditional Mutual Information,” *CRYPTO 2015*, Santa Barbara, CA: August 19, 2015.

- “When do Local Operations and Classical Communication Suffice for Two-Qubit State Discrimination?” *Asian Quantum Information Science Conference (AQIS) 2013*, Chennai, India: August 26, 2013.
- “Everything You Always Wanted to Know About LOCC (But Were Afraid to Ask),” *Quantum Information Processing (QIP) 2013*, Beijing, China: January 21, 2013.
- “Quantum Correlations in Large-Dimensional States of High Symmetry,” APS March Meeting 2012, Boston, MA: March 2, 2012.
- “Increasing Entanglement by Separable Operations and New Monotones for W-type Entanglement,” Accepted as a plenary talk at *Quantum Information Processing (QIP) 2012*, Montreal, Canada. This is the most prestigious conference in the field of quantum information, and plenary talks are awarded to only 4 submissions as these talks recognize the most significant research findings of the year.
- “Local Transformations Requiring Infinite Rounds of Classical Communication,” and “Random Distillation of W-class state into general configurations of two party entanglement,” Both talks accepted at *11th Asian Conference of Quantum Information Science (AQIS) 2011*, Busan, Korea. This is the largest scientific conference on quantum information held in Asia.
- “Optimal Entanglement Transformations among N -Qubit W-Class States,” *Workshop on Quantum Communication and Key Distribution*, Nordita Institute for Theoretical Physics, Stockholm, Sweden: October 21, 2010.

Invited Talks, Seminars and Workshops

- “Dephasing-Covariant Operations Enable Asymptotic Reversibility of Quantum Resources,” Quantum Computation and Quantum Information Program, Academy of Mathematics and Systems Science, Beijing, China: November 13, 2017.
- “Entanglement Classification and Tensor Rank,” Department of Physics Colloquium, Shanghai Jiao Tong University, Shanghai, China: June 5, 2017.
- “Surprising Computational Problems that Emerge in the Study of Quantum Entanglement,” Department of Mathematics Colloquium, Southeastern Missouri State University, Cape Girardeau, Missouri: April 19, 2017.
- “A Classical Analog to Entanglement Reversibility,” *Canadian Mathematical Society (CMS) Winter Meeting*, Niagara Falls, Canada: December 3, 2016.
- “Quantum Coherence and Entanglement - A Resource Theory Perspective,” *3rd Seefeld Quantum Information Workshop*, Seefeld, Austria: June 30, 2016.
- “A Critical Examination of Coherence Resource Theories,” Joint Center for Quantum Information and Computer Science (QuICS) Seminar, University of Maryland, College Park, MD: February 18, 2016.
- “Unifying Quantum Entanglement and Classical Secrecy,” Centre for Quantum Computation and Intelligent Systems Seminar, University of Technology Sydney, Sydney, NSW, Australia: October 8, 2014.
- “An Introduction to Quantum Information and Entanglement Theory,” Department of Physics Colloquium, University of Notre Dame, Notre Dame, IN: August 29, 2014.

- “The Private and Public Correlation Costs of Three Random Variables with Collaboration,” *2nd Seefeld Quantum Information Workshop*, Seefeld, Austria: June 30, 2014.
- “Quantum Operations under Locality Constraints,” *1st IMSc School on Quantum Information*, The Institute of Mathematical Sciences, Chennai, India: January 26-31, 2014.
- “An Introduction to Entanglement Theory,” *Quantum Information Summer School*, Shanghai Jiao Tong University, Shanghai, China: August 24-26, 2012.
- “Exploring the Boundary of LOCC Operations,” *International Workshop on Quantum Computing and Quantum Information Processing 2012*, Beijing, China: August 31, 2012.
- “The Structure of LOCC Operations,” *Seefeld Quantum Information Workshop*, Seefeld, Austria: July 3, 2012.
- “LOCC Instruments,” Department of Computer Science Seminar, McGill University, Montreal, QC, Canada: June 7, 2012.
- “Manipulating Entanglement in the Distant-Lab (LOCC) Setting,” Department of Physics Colloquium, Southern Illinois University, Carbondale, IL: April 18, 2012.
- “An Introduction to Quantum Correlations and Quantum Discord,” Mini-workshop on the General Quantumness of Correlations, *Institute for Quantum Computing*, University of Waterloo, Waterloo, ON, Canada: February 23, 2012.
- “Quantum Correlations in Large Dimensions and Relating the Various Measures of Quantumness,” *Quantum Discord Workshop 2012*, Singapore: January 12, 2012.
- “Manipulating Entanglement by Local Operations and Classical Communication (LOCC),” Department of Mathematics Colloquium, University of Guelph, Guelph, ON, Canada: October 18, 2011.
- “Local Transformations Requiring Infinite Rounds of Classical Communication,” *Institute for Quantum Computing* Colloquium, University of Waterloo, Waterloo, ON, Canada: February 28, 2011.
- “Entanglement Classification Using Matrix Pencils,” Computer Science Theory Seminar, University of Michigan, Ann Arbor, MI: January 29, 2010.
- “Encoding Various Decision Problems as a Question of Entanglement Convertibility,” Quantum Computation & Information Group Seminar, Bristol University, Bristol, U.K.: March 25, 2009
- “Entanglement Transformations: The Possibility of Converting Quantum States Across Great Distances,” Physics Graduate Student Symposium, University of Michigan, Ann Arbor, MI: June 11, 2008.

Public Talks

- “What is a Qubit?” *Science Cafe*, Carbondale, IL: October 26, 2017.
- “A Glimpse into Quantum Information Science,” *SIU Chancellor’s Scholars Weekend*, Carbondale, IL: February 7, 2015.

- “Quantum Computing and Information Processing,” *Academy of Science Pioneering Science Seminar*, St. Louis, MO: January 23, 2014.

Posters Presented

- “Relating Quantum Coherence and Entanglement,” *Quantum Information Processing Conference (QIP) 2016*, Banff, Canada: January 12, 2016.
- “A Classical Analog of Entanglement Reversibility,” *QCRYPT 2015*, Tokyo, Japan: September 28 - October 2, 2015.
- The Private and Public Correlation Cost of Three Random Variables with Collaboration, *14th Asian Conference of Quantum Information Science (AQIS) 2014*, Kyoto, Japan: August 20-24, 2014.
- “Asymptotic Discrimination and a Strict Hierarchy in Distinguishability Norms,” *Quantum Information Processing Conference (QIP) 2014*, Barcelona, Spain: February 3, 2014.
- “Local Transformations Requiring Infinite Rounds of Classical Communication,” *Center for Quantum Information and Quantum Control Conference (CQIQC) 2011*, Toronto, Ontario: August 8-12, 2011.
- “Multipartite Classical States and Detecting Quantum Discord,” *10th Asian Conference of Quantum Information Science (AQIS) 2010*, Tokyo, Japan: August 28-31, 2010.
- “Entanglement Classification Using Matrix Pencils,” *Quantum Information Processing Conference (QIP) 2010*, Zurich, Switzerland: January 17-22, 2010.
- “Nonlocal Entanglement Transformations Achievable by Separable Operations,” *Quantum Information Processing Conference (QIP) 2009*, Sante Fe, NM: January 12-16, 2009.
- “Tripartite Entanglement Transformations and Tensor Rank,” *Michigan Quantum Summer School*, University of Michigan, Ann Arbor, MI: June 16-28, 2008.

Teaching Experience

8/2012–Present:

Assistant/Associate Professor of Physics, Southern Illinois University

11/2010:

Guest lecturer in graduate-level quantum mechanics, University of Toronto

1/2010–4/2010 and 1/2008–4/2008:

Graduate Student Instructor, University of Michigan

Lab coordinator and lecturer in undergraduate electrodynamics

9/2002–5/2005:

Certified NCAA Student-Athlete Tutor in Math and Physics, University of Notre Dame

9/1999–5/2010:

High School and College Tutor in Math and Physics

Students and Post-Docs Mentored

Postdoctoral Fellows:

Borzumehr Toloui: August 2016 – Present.
Benjamin Fortescue: September 2013 – June 2015.

Graduate Students:

Masaya Takahashi (PhD): January 2016 – Present.
Alvin Gonzales (MS/PhD): January 2016 – Present (MS Graduated).
Daniel Diley (MS/PhD): August 2014 – Present (MS Graduated).
Shaun Wolfe (MS): January 2015 – July 2016.
Jiayang Xiao (MS): February 2013 – July 2015 (MS Graduated).

Undergraduate Students:

Terry-Ann Sneed: August 2017 – Present.
Sarah Hagen: August 2017 – Present.
Allie Spaulding: May 2017 – August 2017.
Matthew Lydy: May 2016 – August 2016.
Kei Nishimara-Gasparian: April 2015 – August 2015.
Sam Berger: June 2013 – Present.
Le'Mark Russell: September 2013 – May 2015.
Katherine Maxwell: June 2013 – December 2013.

Visiting Students:

Cheng Guo: August 2015 – December 2015.

Professional Service

- Selected as session organizer and chair for *American Physical Society (APS) March Meeting 2018*.
- Selected as guest editor for special topical issue on quantum coherence, *Journal of Physics A*: July 2017 — Present.
- Served on program committee for the *2016 Asian Quantum Information Science (AQIS) Conference*, Taipei, Taiwan: August 2016.
- Organized the *2013 Boris Musulin Symposium* at SIU, a 3-day conference attended by national and international researchers in the field of quantum information and quantum computing: Oct. 13-16, 2013.
- Served on program committee for the *8th Conference on the Theory of Quantum Computation, Communication and Cryptography*, Guelph, Ontario: May 2013.

Community Service

- Volunteered as a middle school math and science tutor with the *Boys and Girls Club* of Carbondale: November 2016 — May 2017.

Technical Skills

- Proficient in LaTeX, Mathematica
- AOCA Certified Lube Technician

Miscellaneous

Citizenship: United States of America

Hobbies: Traveling, hiking and alpine scrambling, philosophical and theological discourse, tropical fish

February 17, 2018