October 6, 2019

Houssam Abdul-Rahman

Curriculum Vitae

Contact Information

Department of Mathematics
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Tucson, AZ 85721

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Research Interests

Mathematical Physics: My current research lies broadly in the area of analysis with specific emphasis on problems related to Mathematical Physics. The general goal is to develop new mathematical tools for the analysis of many-body systems in quantum mechanics. A particular interest is to prove theorems that help in better understanding of problems that combine effects of disorder and interactions for large quantum systems. My work centers on models relevant in quantum information theory and condensed matter physics. The tools I use mostly come from operator theory, matrix analysis, probability, and spectral theory.

Other Interests: Curve (circle) fitting, Monte Carlo methods, and simulated annealing optimization.

Education

2011-2016 **PhD** in Applied Mathematics.
University of Alabama at Birmingham.
Thesis: "Entanglement in Disordered Quantum XY Chains" - Mathematical Physics.
Advisor: Günter Stolz, Gpa: 4.0.

2002-2005 **MSc degree** in Mathematics
Jordan University of Science and Technology.
Thesis: "Monte Carlo Integration".
Gpa: 92.6/100. (Distinguished)

1998-2002 **BSc degree** in Mathematics
Jordan University of Science and Technology.
Project: "Continuous Simulated Annealing".

Employment

2016- **Postdoctoral Research Associate.**
Department of Mathematics, University of Arizona.

2011-2016 **Graduate Teaching Assistant.**
Department of Mathematics, University of Alabama at Birmingham.

Employment (Cont.)

2006-2011 **Lecturer in Mathematics.**
Full time: Alruya bilingual school (international), Kuwait.
Part time: Open Arab University, Kuwait.

2005-2006 **Lecturer in Mathematics.**
University of Petra, Jordan.

2002-2005 **Graduate Teaching Assistant.**
Department of Mathematics, Jordan University of Science and Technology.

Service

2019- **Member:** The *Undergraduate Committee*, Department of Mathematics at University of Arizona.

2018-2019 **Postdoc Representative:** The *Postdoctoral Committee*, Department of Mathematics at University of Arizona.

Oct 2018 **Founder:** The *Math Physics group* webpage, University of Arizona.
Link: http://math.arizona.edu/∼mathphys

2018 **Book co-editor:** *Contemporary Mathematics: Analytic Trends in Mathematical Physics* (in press), as a proceedings of the Arizona School of Analysis and Mathematical Physics (with R. Sims and A. Young).

Mar 2018 **Co-organizer:** The Arizona School of Analysis and Mathematical Physics (with R. Sims and A. Young). University of Arizona, Tucson, AZ.
Link: http://math.arizona.edu/∼mathphys/AZSchool18

2017-2019 **Supervisor:** The University of Arizona *Undergraduate Teaching Assistant (UTA)* students:
- Alireza Afshan (Spring 2019)
- Wes Johnson (Fall 2018).
- Rubbal Kumar (Fall 2017, Spring 2018).

Since 2017 **Referee for:** *Journal of Mathematical Physics*, *Journal of Statistical Physics*.

Grants

Pending *Analysis NSF Research Grant*, (submitted Oct 1, 2019).

2019-2021 *AMS-Simons Travel Grant.*

Jan 2018 *NSF Conference Grant*, Co-PI (DMS#1800724).
Arizona School of Analysis and Mathematical Physics.

Academic Honors

Mar 2016 *Outstanding PhD Student in the Department of Mathematics.*
University of Alabama at Birmingham.

2014-2015 *Graduate Fellowship*, Department of Mathematics.
University of Alabama at Birmingham.

Apr 2013 *Caroline and Charles W. Ireland International Student Scholarship.*
University of Alabama at Birmingham.

May 2012 *Math Department Award for best first year graduate student.*
University of Alabama at Birmingham.

May 2005 *The First Ranked Student Award* (MSc. degree).
Jordan University of Science and Technology.

May 2002 *The First Ranked Student Award* (BSc.- 87 students).
Jordan University of Science and Technology.

Publications and Preprints

[1] **H. Abdul-Rahman**, C. Fischbacher, and G. Stolz. *Entanglement bounds in the XXZ quantum spin chain* (submitted).
ARXIV: 1907.11420.

[2] **H. Abdul-Rahman**, M. Lemm, A. Lucia, B. Nachtergaele, and A. Young. *A class of two-dimensional AKLT models with a gap.* Contemporary Mathematics (to appear).
ARXIV: 1901.09297.

[3] **H. Abdul-Rahman**, R. Sims, and G. Stolz. *On the regime of localized excitations for disordered oscillator systems* (submitted).
ARXIV: 1810.12769.

[4] **H. Abdul-Rahman**. *Entanglement of a class of non-Gaussian states in disordered harmonic oscillator systems.* Journal of Mathematical Physics, 59, 031904 (2018).
ARXIV: 1707.07063, DOI: 10.1063/1.5000708.
Note: This paper has been chosen to be in the *Editor's Pick* collection.

[5] **H. Abdul-Rahman**, R. Sims, and G. Stolz. *Correlations in disordered quantum harmonic oscillator systems: The effects of excitations and quantum quenches.* Contemporary Mathematics, 717, 31-47 (2018).
ARXIV: 1704.04841, DOI: 10.1090/conm/717.

[6] **H. Abdul-Rahman**, B. Nachtergaele, R. Sims, and G. Stolz. *Localization properties of the XY spin chain: A review of mathematical results with an eye toward many-body localization.* Annalen der Physik (Berlin), 529 (7), 1600280 (2017).
ARXIV: 1610.01939, DOI: 10.1002/andp.201600280.

[7] **H. Abdul-Rahman**, B. Nachtergaele, R. Sims, and G. Stolz. *Entanglement dynamics of disordered quantum XY chains.* Letters in Mathematical Physics, 106 (5), 649-674 (2016).
ARXIV: 1510.00262, DOI: 10.1007/s11005-016-0835-9.

Publications and Preprints (Cont.)

[8] **H. Abdul-Rahman** and G. Stolz. *A uniform area law for the entanglement of eigenstates in the disordered XY chain.* Journal of Mathematical Physics, 56, 121901 (2015).
ARXIV: 1505.02117, DOI: 10.1063/1.4938573.

[9] **H. Abdul-Rahman** and N. Chernov. *Fast and numerically stable circle fit.* Journal of Mathematical Imaging and Vision, 49 (2), 289-295 (2014).
ARXIV: 1505.03795, DOI: 10.1007/s10851-013-0461-4.

[10] M. Alrefaei and **H. Abdul-Rahman**. *An adaptive Monte Carlo integration algorithm with general division approach.* Mathematics and Computers in Simulation, 79 (1), 49-59 (2008).
DOI: 10.1016/j.matcom.2007.09.009.

[11] M. Alrefaei and **H. Abdul-Rahman**. *Two sequential algorithms for selecting one of the best simulated systems.* WSEAS Transactions on Systems, 3, 2517-2522 (2004).

Invited/Contributed Talks

Slides: http://math.arizona.edu/~houssam/Talks.html

Oct 2019 (*Invited*) Entanglement bounds in the XXZ quantum spin chain.
Math Physics Seminar, Michigan State University, MI.

Jan 2019 (*Invited*) Dynamical entanglement in disordered harmonic oscillators.
Special session on localization and delocalization for disordered quantum systems.
The Joint Mathematics Meeting, Baltimore, MD.

Oct 2018 (*Invited*) Localization and entanglement in disordered oscillator systems.
Entanglement and dynamical systems workshop.
Simons Center of Geometry and Physics, Stony Brook University, NY.

Oct 2018 (*Invited*) The localized phase of excitations in disordered harmonic oscillator systems.
Special session on ergodic and topological quantum systems.
AMS Fall Central Sectional Meeting, University of Michigan, MI.

Jan 2018 (*Invited*) Entanglement of a class of non-Gaussian states in disordered harmonic oscillator systems.
Special session on spectral theory, disorder and quantum physics.
The Joint Mathematics Meeting, San Diego, CA.

Jun 2017 Quenched correlations in the disordered harmonic oscillator systems.
The Great Lakes Mathematical Physics Meeting, Michigan State University, MI.

Feb 2017 (*Invited*) Entanglement and transport in two disordered quantum many-body "toy" systems.
35th Annual Western States Mathematical Physics Meeting, Caltech, CA.

Oct 2016 (*Invited*) Entanglement and transport in disordered quantum XY chains.
Special session on quantum mechanics with random features.
QMath13: Mathematical Results in Quantum Physics, Georgia Tech, GA.

Jun 2016 (*Invited*) Dynamical entanglement entropy in disordered XY chains.
The Great Lakes Mathematical Physics Meeting, Michigan State University, MI.

Invited/Contributed Talks (Cont.)

Mar 2016 (*Invited*) Dynamical entanglement entropy in disordered XY chains.
Special session on mathematical physics and spectral theory.
AMS Southeastern Sectional Meeting, University of Georgia, GA.

Mar 2015 (*Invited*) An area law for the entanglement of eigenstates in disordered XY chain.
Special session on spectral theory, disorder, and quantum many body physics.
AMS Central Sectional Meeting, Michigan State University, MI.

Local Talks

Mathematical Physics and Probability seminar, University of Arizona, AZ

Oct 2019 Entanglement bounds in the XXZ quantum spin chain.

Oct 2018 The localized phase of excitations in disordered harmonic oscillator systems.

Oct 2017 Entanglement of a class of non-Gaussian states in disordered harmonic oscillator systems.

Sep 2016 Entanglement and transport in disordered quantum XY chains.

Probability and Mathematical Physics seminar, University of Alabama at Birmingham, AL.

Oct 2015 Dynamical entanglement entropy in disordered XY chains.

Feb 2015 An area law for the entanglement of eigenstates in disordered XY chain.

Feb 2015 The theory of fermionic operators: from 2^n to $2n$...the story in brief.

Oct 2015 An area law for entanglement entropy of a harmonic oscillator lattice.

Sep 2014 The entanglement entropy and the logarithmic negativity in an interacting harmonic oscillator system.

Feb 2012 An adaptive Monte Carlo integration algorithm.

Teaching Experience

More details: http://math.arizona.edu/~houssam/Teaching.html

2016- **Department of Mathematics, University of Arizona**

- **Fall 2019** (Math 125) Calculus I - two sections.
- **Smr 2019** (Math 413/513) Linear Algebra.
- **Sprg 2019** (Math 464) Probability Theory.
  (Math 129) Calculus II.
- **Fall 2018** (Math 313) Introduction to Linear Algebra.
- **Smr 2018** (Math 413/513) Linear Algebra.
  (Math 313) Introduction to Linear Algebra.
- **Sprg 2018** (Math 129) Calculus II.
- **Fall 2017** (Math 464) Probability Theory.
  (Math 125) Calculus I.
- **Smr 2017** (Math 313) Introduction to Linear Algebra.
- **Sprg 2017** (Math 413) Linear Algebra.
- **Fall 2016** (Math 125) Calculus I - two sections.

2011-2016 **Department of Mathematics, University of Alabama at Birmingham**

- **Sprg 2016** (Math 126) Calculus II.
- **Fall 2015** (Math 126) Calculus II.
- **Fall 2013** (Math 125) Calculus I.
- **Sprg 2013** (Math 105) Pre-Calculus.
- **Fall 2012** (Math 102) Pre-Calculus: Intermediate Algebra.

2006-2011 **Part Time Lecturer And Math Teacher**

Full Time: *Alruya Bilingual School*, Kuwait.
Teaching middle and high school Math courses.
Enrolling in many classroom management and professional development workshops.
A member of the Math curriculum committee for international accreditation.

Part Time: *Open Arab University*, Kuwait.
Courses Taught: Calculus I, Discrete Mathematics, Analytic Geometry, Probability.

2005-2006 **Lecturer in Mathematics**

Full Time: *University of Petra*, Jordan.
Courses Taught: Calculus I (MA101), Calculus II (MA102), Calculus III (MA201), Introduction to Differential Equations (MA222), Principles of Statistics (MA231), Discrete Mathematics (MA250).

Part Time: *Department of Mathematics and Statistics, JUST*, Jordan.
Courses Taught: Calculus I (MA101), Calculus II (MA102), Calculus for the Biological Sciences (MA102B).

2002-2004 **Graduate Teaching Assistant**

Department of Mathematics and Statistics, JUST, Jordan.
Tutoring in the Math Lab.
TA for: Calculus II (MA102), Ordinary Differential Equations (MA203), Operations Research (MA470).

August 19, 2019

Publication List

Houssam Abdul-Rahman

[1] **H. Abdul-Rahman**, C. Fischbacher, and G. Stolz. *Entanglement bounds in the XXZ quantum spin chain.*
ARXIV: 1907.11420.

[2] **H. Abdul-Rahman**, M. Lemm, A. Lucia, B. Nachtergaele, and A. Young. *A class of two-dimensional AKLT models with a gap.* Contemporary Mathematics (to appear).
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[3] **H. Abdul-Rahman**, R. Sims, and G. Stolz. *On the regime of localized excitations for disordered oscillator systems.* Submitted.
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[4] **H. Abdul-Rahman**. *Entanglement of a class of non-Gaussian states in disordered harmonic oscillator systems.* Journal of Mathematical Physics, 59, 031904 (2018).
ARXIV: 1707.07063, DOI: 10.1063/1.5000708.
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[6] **H. Abdul-Rahman**, B. Nachtergaele, R. Sims, and G. Stolz. *Localization properties of the XY spin chain: A review of mathematical results with an eye toward many-body localization.* Annalen der Physik (Berlin), 529 (7), 1600280 (2017).
ARXIV: 1610.01939, DOI: 10.1002/andp.201600280.

[7] **H. Abdul-Rahman**, B. Nachtergaele, R. Sims, and G. Stolz. *Entanglement dynamics of disordered quantum XY chains.* Letters in Mathematical Physics, 106 (5), 649-674 (2016).
ARXIV: 1510.00262, DOI: 10.1007/s11005-016-0835-9.

[8] **H. Abdul-Rahman** and G. Stolz. *A uniform area law for the entanglement of eigenstates in the disordered XY chain.* Journal of Mathematical Physics, 56, 121901 (2015).
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[9] **H. Abdul-Rahman** and N. Chernov. *Fast and numerically stable circle fit.* Journal of Mathematical Imaging and Vision, 49 (2), 289-295 (2014).
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[10] M. Alrefaei and **H. Abdul-Rahman**. *An adaptive Monte Carlo integration algorithm with general division approach.* Mathematics and Computers in Simulation, 79 (1), 49-59 (2008).
DOI: 10.1016/j.matcom.2007.09.009.

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