Curriculum Vitae, M. Haque

April 2013

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Employment & Education

- **Current institute:** (since October 2006)
  Max-Planck Institute for Physics of Complex Systems (MPI-PKS), Dresden, Germany.
  Currently Staff Scientist (fixed-term) at MPI-PKS.
  Former position title: *Distinguished PKS Postdoctoral Fellow*.
  Held one of three such fellowships at MPI-PKS, until September 2009.
- Nov. 2003 to Sept. 2006: Postdoctoral researcher, Utrecht University, the Netherlands. Employed in cold-atom theory group led by H. T. C. Stoof.
- Ph.D., October 2003. Rutgers, State University of New Jersey.
  Advisor: Andrei E. Ruckenstein.
  Thesis title: *Interaction Effects in the Weakly Repulsive Bose Gas*.
- Graduate student and teaching assistant, 1997 to 2003.
  Rutgers, State University of New Jersey; Department of Physics & Astronomy.
- Lecturer, 1996-97. Physics Department, Shahjalal University, Bangladesh.
- M.Sc., 1996; B.Sc., 1995. Shahjalal University, Bangladesh.

Research Interests

- **Area:** Condensed Matter Theory.
  Collective phenomena in electronic, nanoscale and cold-atom systems.
- **Specific topics of published research:**
  Non-equilibrium phenomena; collective quantum dynamics; quenches & ramps.
  Trapped atomic fermions and bosons — polarized fermion pairing; Feshbach resonances; BCS-BEC crossover; vortex dynamics in Bose condensates.
  Cross-discipline application of concepts from *Quantum Information Theory* (*e.g.*, entanglement measures) to condensed matter issues.
  Topological order and unconventional states in many-particle systems.
  Fractional quantum Hall states. Frustrated magnets. Spin chains.

Research Supervision

Citations refer to publication list.

- **Publication Record of Supervision:** Supervised or co-supervised junior researchers for papers [1, 4–9, 17–21, 23–25, 28, 29, 40, 42, 43].

- **Current Group:** Currently (Spring 2013) supervising at MPI-PKS:
  - two postdocs (*Shreyoshi Mondal* and *Wouter Beugeling*);
  - one MPI-PKS PhD student (*Wladimir Tschischik*);
  - one visiting PhD student (*Yulia Shchadilova*).
  - Details below.

- **PhD students and postdocs:**

  Wladimir Tschischik. PhD student with me at MPI-PKS since April 2012. Pursuing research on non-equilibrium dynamics in Bose-Hubbard systems ([5]+ongoing). (R. Moessner, the Department Director, is the formal supervisor.)

  Oleksandr Zozulya. Former PhD student of K. Schoutens at University of Amsterdam. I supervised his PhD research closely; all his PhD publications are coauthored with me [18, 19, 24, 28, 29].

  Shreyoshi Mondal. Postdoc under my supervision at MPI-PKS (Sep. 2012 – present). Working on non-equilibrium dynamics of the Kondo cloud.

  Wouter Beugeling. Postdoc under my supervision at MPI-PKS (Oct. 2012 – present). Working on the Eigenstate Thermalization Hypothesis (non-equilibrium physics).

  Yulia Shchadilova. PhD student in Moscow. Frequent visitor at MPI-PKS; e.g., visited Dec. 2012 to Feb. 2013 to work with me. Exploring non-equilibrium evolution in a model designed to show interplay of binding, itinerancy, and impurity (Kondo) physics [40].

  Vincenzo Alba. Postdoc at MPI-PKS (Oct. 2010 – Sep. 2012). Joint supervision with A, M. Läuchli. Research on the nature of entanglement spectra in 1D and 2D systems ([6, 9]+ongoing).

  Weibin Li. Former postdoc at MPI-PKS. Worked with me on vortex dynamics [25].

  Ivana Vidanovic. During PhD studies (in Belgrade), worked with me on non-equilibrium dynamics in spinor condensates [4].

  Kush Saha. PhD student in India. Visited MPI-PKS Sep.–Nov. 2012 to work with me. Explored the Bethe ansatz description of edge-related eigenstates of the open-boundary Heisenberg chain.

Alexey Mikaberidze. PhD student at MPI-PKS until 2011. Worked with me on an ecology-motivated calculation [23]. Based on this work, Mikaberidze moved to a career in theoretical ecology after his PhD in atomic/laser physics.

Frank Zimmer. Former postdoc at MPI-PKS (2009-2011). Worked with me on non-equilibrium dynamics (non-adiabatic ramps in trapped gases) [1, 43].

V. Ravi Chandra & J. Bandyopadhyay. Former postdocs at MPI-PKS. Worked with me on entanglement and dynamics in frustrated spin chains [21].

Ricardo Pinto. Former PhD student at MPI-PKS. Worked with me on non-equilibrium dynamics in 1D lattice models (interaction-induced edge effects) [20].

- **Undergraduate Research Supervision (longer project):**

  April 2011 – March 2012: Wladimir Tschischik, student from Technische Universität Chemnitz, performed one-year 'Diplomarbeit' research with me at MPI-PKS.
  Defended 'Diplomarbeit' thesis in March 2012.
  Research on non-equilibrium dynamics in Bose-Hubbard ladders [5].
  Tschischik is continuing his research with me as PhD student.

- **Undergraduate Research Supervision (short projects):**

  Supervising summer research projects for visiting undergraduates.

  Summer 2009: T. Venumadhav, visited Dresden from I.I.T. (Kanpur, India); 10 weeks.
  Research on non-equilibrium dynamics, led to publication; paper [17].
  Venumadhav is now pursuing doctoral studies at Caltech.

  February–July 2009: S. Piatecki, visited Dresden from ENS Paris; 5 months.
  Research on geometrically frustrated itinerant systems, later completed with additional collaborators [7, 11]. Piatecki is now pursuing doctoral studies at ENS Paris.

  Summer 2010: A. Balram, visited Dresden from ISERC (Pune, India); 3 months.
  Research on non-equilibrium dynamics in Bose-Hubbard rings.
  Balram is now pursuing doctoral studies at Penn State University (Pittsburgh).

  Summer 2011: S. Chatterjee, visited Dresden from I.I.T. (Kanpur, India); 10 weeks.
  Research on non-equilibrium dynamics; continued Balram's work.
  Chatterjee is starting doctoral studies at Harvard.

Organization activities

Workshop in June 2010

Title: Quantum information concepts for condensed matter problems (QICCMP)
Co-organizers: Ian Affleck (UBC, Canada); Ulrich Schollwöck (LMU, Munich).
Format: Two-week programme (June 14–25, 2010). 100^{+} participants.
Location & Funding: Max Planck Institute (MPI-PKS), Dresden, Germany.
Website: http://www.pks.mpg.de/∼qiccmp10/

Workshop in November 2012

Title: Entanglement Spectra in Complex Quantum Wavefunctions (ESiCQW)
Co-organizers: B. Andrei Bernevig (Princeton); Andreas Läuchli (Innsbruck).
Format: One-week high-intensity workshop (November 12–16, 2012).
Location & Funding: Max Planck Institute (MPI-PKS), Dresden, Germany.
Website: http://www.pks.mpg.de/∼esicqw12/

Workshop in August 2013

Title: Quantum many body systems out of equilibrium (QSOE)
Co-organizers: J. S. Caux (Amsterdam); C. Kollath (Geneva); T. Esslinger (Zürich).
Format: Three-week programme (August 12–30, 2013).
Location & Funding: Max Planck Institute (MPI-PKS), Dresden, Germany.
Website: http://www.pks.mpg.de/∼qsoe13/

Other initiatives

Organizing various lectures, talks, journal clubs, locally, *e.g.*,

- a journal club on non-equilibrium physics (quenches & ramps), May 2012 – present.
- a journal club on cold-atom experiments, Oct. 2011 – present.
- a discussion sequence & journal club on interacting fractional Chern insulators, 2011.
- a series of talks on "Cold atoms & BEC", 2008–2010.
- a lecture series on "1D & Exact Integrability" in Utrecht, spring 2006.
- the condensed matter theory seminar sequence at Utrecht, 2004–2006.

..... *etc.*

Publication List

- **Published or Accepted:**

1. *Slow interaction ramps in trapped many-particle systems: universal deviations from adiabaticity*. — M. Haque & F. E. Zimmer, Phys. Rev. A **87**, 033613 (2013). ▲
2. *Linear quantum quench in the Heisenberg XXZ chain: time dependent Luttinger model description of a lattice system*.
   F. Pollmann, M. Haque, and B. Dora; Phys. Rev. B **87**, 041109 (2013).
3. *Strongly interacting bosons in multi-chromatic potentials supporting mobility edges: localization, quasi-condensation and expansion dynamics*. ▲
   P. Ribeiro, M. Haque, and A. Lazarides; Phys. Rev. A, accepted (2013).
   Preprint: arXiv:1211.6012.
4. *Spin modulation instabilities and phase separation dynamics in trapped two-component Bose condensates*. — I. Vidanovic, N. J. Van Druten, and M. Haque,
   New Journal of Physics, **15**, 035008 (2013).
5. *Non-equilibrium dynamics in Bose-Hubbard ladders*.
   W. Tschischik, M. Haque, and R. Moessner; Phys. Rev. A **86**, 063633 (2012).
6. *Boundary-locality and perturbative structure of entanglement spectra in gapped systems*.
   V. Alba, M. Haque, and A. M. Läuchli; Phys. Rev. Lett. **108**, 227201 (2012).
7. *Itinerant electrons in the Coulomb phase*.
   L. D. C. Jaubert, S. Piatecki, M. Haque, and R. Moessner;
   Phys. Rev. B **85**, 054425 (2012).
8. *Strongly interacting one-dimensional bosons in optical lattices of arbitrary depth: from the Bose-Hubbard to the sine-Gordon regime and beyond*. ▲
   A. Lazarides and M. Haque, Phys. Rev. A **85**, 063621 (2012).
9. *Entanglement spectrum of the Heisenberg XXZ chain near the ferromagnetic point*.
   V. Alba, M. Haque, and A. M. Läuchli; J. Stat. Mech. P08011 (2012).
10. *Crossover from adiabatic to sudden interaction quench in a Luttinger liquid*.
    B. Dóra, M. Haque, and G. Zaránd; Phys. Rev. Lett. **106**, 156406 (2011).
11. *Analysis of a fully packed loop model arising in a magnetic Coulomb phase*.
    L. D. C. Jaubert, M. Haque, and R. Moessner; Phys. Rev. Lett. **107**, 177202 (2011).
12. *Three-vortex configurations in trapped Bose-Einstein condensates*.
    J. A. Seman, E. A. L. Henn, M. Haque, R. F. Shiozaki, E. R. F. Ramos,
    M. Caracanhas, P. Castilho, C. Castelo Branco, P. E. S. Tavares,
    F. J. Poveda Cuevas, G. Roati, K. Magalhaes, and V. S. Bagnato;
    Phys. Rev. A, **82**, 033616 (2010).

13. *Self-similar spectral structures and edge-locking hierarchy in open-boundary spin chains*. — M. Haque, Phys. Rev. A **82**, 012108 (2010).

14. *Disentangling Entanglement Spectra of Fractional Quantum Hall States on Torus Geometries*. — A. M. Laeuchli, E. J. Bergholtz, J. Suorsa, and M. Haque; Phys. Rev. Lett. **104**, 156404 (2010).

15. *Entanglement Scaling of Fractional Quantum Hall states through Geometric Deformations*. — A. M. Laeuchli, E. J. Bergholtz, and M. Haque; New Journal of Physics **12**, 075004 (2010).

16. *Interaction induced fractional Bloch and tunneling oscillations*. R. Khomeriki, D. O. Krimer, M. Haque, and S. Flach; Phys. Rev. A **81**, 065601 (2010).

17. *Finite-rate quenches of site bias in the Bose-Hubbard dimer*. T. Venumadhav, M. Haque, and R. Moessner; Phys. Rev. B **81**, 054305 (2010).

18. *Entanglement between particle partitions in itinerant many-particle states*. M. Haque, O. S. Zozulya, and K. Schoutens; J. Phys. A: Math. Theor. **42**, 504012 (2009).

19. *Entanglement signatures of Quantum Hall phase transitions*. ▲ O. Zozulya, M. Haque, and N. Regnault; Phys. Rev. B **79**, 045409 (2009).

20. *Edge-localized states in quantum one-dimensional lattices*. R. A. Pinto, M. Haque, and S. Flach; Phys. Rev. A **79**, 052118 (2009).

21. *Entanglement and level crossings in frustrated ferromagnetic rings*. ▲ M. Haque, J. N. Bandyopadhyay, and V. Ravi Chandra; Phys. Rev. A **79**, 042317 (2009).

22. *Probing topological order in quantum Hall states using entanglement calculations*. M. Haque; AMS Contemp. Math. **482**, 213 (2009).

23. *Survival benefits in mimicry: a quantitative framework*. ▲ A. Mikaberidze and M. Haque; J. Theor. Biol. **259**, 462 (2009).

24. *Particle partitioning entanglement in itinerant many-particle systems*. O. Zozulya, M. Haque, and K. Schoutens; Phys. Rev. A **78**, 042326 (2008).

25. *A vortex dipole in a trapped two-dimensional Bose condensate*. ▲ W. Li, M. Haque and S. Komineas; Phys. Rev. A **77**, 053610 (2008).

26. *Symmetry-breaking Fermi surface deformations from central interactions in two dimensions*. J. Quintanilla, M. Haque, and A. J. Schofield; Phys. Rev. B, **78**, 035131 (2008).

27. *Pomeranchuk instability: symmetry breaking and experimental signatures*. J. Quintanilla, C. Hooley, B. J. Powell, A. J. Schofield, and M. Haque; Physica B: Condensed Matter, **403**, 1279 (2008).

28. *Bipartite entanglement entropy in fractional quantum Hall states*.
O. Zozulya, M. Haque, K. Schoutens, and E. H. Rezayi;
Phys. Rev. B **76**, 125310 (2007).

29. *Entanglement entropy in fermionic Laughlin states*.
M. Haque, O. Zozulya, and K. Schoutens; Phys. Rev. Lett. **98**, 060401 (2007).

30. *Trapped fermionic clouds distorted from the trap shape due to many-body effects*.
M. Haque and H. T. C. Stoof; Phys. Rev. Lett., **98**, 260406 (2007).

31. *Deformation of a Trapped Fermi Gas with Unequal Spin Populations*.
G. B. Partridge, Wenhui Li, Y. A. Liao, R. G. Hulet, M. Haque, and H. T. C. Stoof;
Phys. Rev. Lett. **97**, 190407 (2006).

32. *Pairing of a trapped resonantly interacting fermion mixture with unequal spin populations*. — M. Haque and H. T. C. Stoof; Phys. Rev. A **74**, 011602 (2006).

33. *Ring-shaped luminescence pattern in biased quantum wells studied as a steady state reaction front*. — M. Haque; Phys. Rev. E **73**, 066207 (2006).

34. *Squeezing in the weakly interacting uniform Bose-Einstein condensate*.
M. Haque and A. E. Ruckenstein; Phys. Rev. A, **74**, 043622 (2006).

35. *Ultracold superstring in atomic boson-fermion mixtures*.
M. Snoek, M. Haque, S. Vandoren, and H. T. C. Stoof;
Phys. Rev. Lett. **95**, 250401 (2005).

36. *Dynamics of a molecular Bose-Einstein condensate near a Feshbach resonance*.
M. Haque and H. T. C. Stoof; Phys. Rev. A **71**, 063603 (2005).

37. *Structural Transition of Wigner Crystal on Liquid Substrate*. ▲
M. Haque, I. Paul and S. Pankov; Phys. Rev. B **68**, 045427 (2003).

38. *Anomaly in the normalization constant of the (^{3}He,p) reaction*.
M. Haque *et. al*., Nuovo Cimento A, **111A**, 1131 (1998).

39. *^{64}Cu levels from the ^{62}Ni(^{3}He,p) reaction at 18 MeV*.
A. K. Basak *et. al*., Phys. Rev. C **56**, 1983 (1997).

- **Publicly available preprints (under review or unpublished):**

40. *Quantum quenches and work distributions in ultra-low-density systems.*
Y. E. Shchadilova, P. Ribeiro, and M. Haque; arXiv:1303.4103.

41. *Quantum Bowling: Particle-hole transmutation in one-dimensional strongly interacting lattice models.*
M. Ganahl, M. Haque, and H. G. Evertz; arXiv:1302.2667.

42. *Entanglement spectrum of the two dimensional Bose-Hubbard model.*
V. Alba, M. Haque, and A. M. Läuchli; arXiv:1212.5634.

43. *Non-adiabatic interaction ramps in a trapped Bose condensate*. ▲
F. E. Zimmer and M. Haque, arXiv:1012.4492.
44. *Transition Temperature of Dilute Weakly Repulsive Bose Gas*.
M. Haque and A. E. Ruckenstein, cond-mat/0212590.
45. *Weakly Non-ideal Bose Gas: Comments on Critical Temperature Calculations*.
M. Haque, cond-mat/0302076.