Harvard University

Department of Physics

Markus Greiner
Professor of Physics
Jefferson Physical Laboratory
17 Oxford Street
Cambridge MA 02138
USA
greiner@physics.harvard.edu
Tel. +1 617 595 3811

Curriculum Vitae

Research experience

1/20 – present Co-Director, Harvard-MIT Center for Ultracold Atoms, Harvard University, Cambridge, MA

1/19 – present George Vasmer Leverett Professor of Physics, Harvard University, Cambridge, MA.

1/18 – present Co-Director, Max Planck-Harvard Research Center for Quantum Optics, Harvard University, Cambridge, MA.

2/12 – 12/18 Professor of Physics, Harvard University, Cambridge, MA.
Development of quantum gas microscope for creating highly controllable many-body quantum systems of ultracold atoms; Application: Quantum simulation of condensed matter systems.
- Cold atom Fermi-Hubbard antiferromagnet
- Fermi gas microscope
- Interacting Harper Hofstadter model
- Measurement of entanglement entropy through quantum interference
- Quantum thermalization

7/10 – 2/12 Associate Professor of Physics, Harvard University, Cambridge, MA.
- Quantum magnetism in optical lattices

8/05 – 6/10 Assistant Professor of Physics, Harvard University, Cambridge, MA.
- Single atom - single lattice site imaging in a Hubbard regime optical lattice
- Direct detection of Mott insulator with quantum gas microscope

4/03 – 8/05 Postdoctoral research position at JILA, Boulder, CO., with Deborah Jin.
- Creation of a fermionic condensate of ultracold atoms. This condensate of generalized Cooper pairs is considered to be the first realization of a fermionic superfluid in the strongly interacting BCS-BEC crossover regime.
- Realization of a molecular Bose-Einstein condensate, created from an ultracold gas of fermionic atoms.

3/00 – 4/03 PhD in experimental Physics:
- First experiments with Bose-Einstein condensates in three dimensional optical lattices.
- Quantum Phase transition from a superfluid to a Mott insulator in an ultracold gas of atoms.
- Experiments on topics of quantum information and quantum optics in the group of T. Hänsch, Ludwig–Maximilians-Universität, Munich, and Max-Planck Institut für Quantenoptik, Garching.
- The thesis was awarded with the American Physical Society prize for best thesis in AMO physics, DAMOP 2004, and the William L. McMillan award for outstanding contributions in condensed matter physics

1/99 – 2/00	Diploma Thesis in experimental Physics: ”Transport of magnetically trapped atoms: a simple approach to Bose-Einstein condensation”. (T. Hänsch, Ludwig-Maximilians-Universität, Munich)
1/90 –1/00	Research projects on Holography, wave dynamics, and holographic fraud prevention, final laureate of the German national science competition “Jugend Forscht”

Education

4/03	**Ludwig-Maximilians-Universität in Munich, Germany** PhD in experimental physics, ***Summa cum laude***
4/94 – 2/00	**Ludwig-Maximilians-Universität in Munich, Germany** Completed the German diploma in physics; final grade: ***with distinction***
8/80 – 8/93	School in Munich; completed with Abitur 1993;

Awards

- **Vannevar Bush Faculty Fellowship** (2018)
- **APS Fellowship** (2017)
- **I.I. Rabi Prize in Atomic, Molecular and Optical Physics, (APS)** DAMOP 2013
- **2013 BEC Award** (Saint Feliu BEC conference)
- **AAAS Newcomb Cleveland Prize** (2012, most outstanding research article published in *Science* in 2010/2011)
- **The MacArthur Foundation Fellowship** (2011)
- **Alfred P. Sloan Award** (2007)
- **Otto Klung – Weberbank Award** (2005) (award for outstanding young scientists in Germany)
- **William L. McMillan Award** (2004) (University of Illinois) (for outstanding contributions in condensed matter physics)
- **Thesis award of the American Physical Society (APS)** DAMOP 2004.

Teaching

- Development of lab sequences: “Principles of Scientific Inquiry” covering topics of oscillations, waves, optics, acoustics. The lab includes an exploratory term project; Development of a teaching lab sequence for non-physicists on mechanics, electromagnetism, waves and optics;
- Design of an advanced course on “Laser Physics and modern Optics”
- Teaching of classes on: “Electromagnetism,” “Wave Phenomena,” and “Quantum Optics”

Outreach

- Deutsches Museum, Munich, Germany: Member of the board of curators, development of exhibition objects for new optics exhibition, e.g. large beam imaging white light interferometer
- Art collaboration with Julianne Swartz, New York: Outreach through “moments of wonder”

Publications - Research Highlights

Markus Greiner’s research interest is centered on exploring many-body quantum mechanics with ultracold quantum gases. The main research topic is quantum simulations of condensed matter models. This opens the possibility of addressing fundamental questions of modern solid-state physics with ultracold atom experiments. Other research topics include quantum information and quantum optics experiments.

Recent research highlights include the first **realization of a Fermi-Hubbard antiferromagnet,** the first **measurement of entanglement entropy of an itinerant quantum system,** the observation of **quantum thermalization through entanglement**, the first **quantum magnetism in optical lattices**, and the first **direct detection of Mott insulators through single atom - single lattice site imaging.** This was achieved in a novel type of quantum simulator he developed with his group, a “**quantum gas microscope,”** providing pristine single atom quantum control. Previous research achievements include the first realization of a **fermionic superfluid** in ultracold atoms (D. Jin), and the first realization of a **Mott insulator** in optical lattices (I. Bloch, T.W. Hänsch).

Citation statistics

Total citations: 28157 citations

h-index: 49

Complete List of Publications

1. S. Ebadi, T.T. Wang, H. Levine, A. Keesling, G. Semeghini, A. Omran, D. Bluvstein, R. Samajdar, H. Pichler, W.W. Ho, S. Choi, S. Sachdev, M. Greiner, V. Vuletic, M.D. Lukin, **Quantum Phases of Matter on a 256-Atom Programmable Quantum Simulator**, *Nature* 595: 227-232, doi:10.1038/s41586-021-03582-4 (2021).

2. C. Miles, A. Bohrdt, R. Wu, C. Chiu, Muqing Xu, G. Ji, M. Greiner, K.Q. Weinberger, E. Demler, E.-A. Kim, **Correlator Convolutional Neural Networks: An Interpretable Architecture for Image-like Quantum Matter Data**, *Nature Communications* 12, 3905, doi:10.1038/s41467-021-23952-w (2021).

3. G. Semeghini, H. Levine, A. Keesling, S. Ebadi, T.T. Wang, D. Bluvstein, R. Verresen, H. Pichler, M. Kalinowski, R. Samajdar, A. Omran, S. Sachdev, A. Vishwanath, M. Greiner, V. Vuletic, M.D. Lukin, **Probing Topological Spin Liquids on a Programmable Quantum Simulator**, arXiv:2104.04119 (2021).

4. D. Bluvstein, A. Omran, H. Levine, A. Keesling, G. Semeghini, S. Ebadi, T.T. Wang, A.A. Michailidis, N. Maskara, W.W. Ho, S. Choi, M. Serbyn, M. Greiner, V. Vuletic, Mikhail D. Lukin, **Controlling many-body dynamics with driven quantum scars in Rydberg atom arrays**, *Science* **371**, 6536:1355-1359 doi:10.1126/science.abg2530 (2021).

5. E. Altman, K.R. Brown, G. Carleo, L.D. Carr, E. Demler, C. Chin, B. DeMarco, S.E. Economou, M.A. Eriksson, K.-M.C. Fu, M. Greiner, K.R.A. Hazzard, R.G. Hulet, A.J. Kollar, B.L. Lev, M.D. Lukin, R. Ma, X. Mi, S. Misra, C. Monroe, K. Murch, Z. Nazario, K.-K. Ni, A.C. Potter, P. Roushan, M. Saffman, M. Schleier-Smith, I. Siddiqi, R. Simmonds, M. Singh, I.B. Spielman, K. Temme, D.S. Weiss, J. Vuckovic, V. Vuletic, J. Ye, M. Zwierlein, **Quantum Simulators: Architectures and Opportunities**, *PRX Quantum*, 2, 017003, doi:10.1103/PRXQuantum.2.017003 (2021).

6. J. Léonard, M. Rispoli, A. Lukin, R. Schittko, S. Kim, J. Kwan, D. Sels, E. Demler, M. Greiner, **Signatures of bath-induced quantum avalanches in a many-body--localized system**, arXiv:2012.15270 (2020).

7. A. Bohrdt, S. Kim, A. Lukin, M. Rispoli, R. Schittko, M. Knap, M. Greiner, J. Leonard, **Analyzing non-equilibrium quantum states through snapshots with artificial neural networks**, arXiv:2012.11586 (2020).

8. G.A. Phelps, A. Hebert, A. Krahn, S. Dickerson, F. Ozturk, S. Ebadi, L. Su, M. Greiner, **Sub-second production of a quantum degenerate gas**, arXiv:2007.10807 (2020).

9. G. Ji, M. Xu, L.H. Kendrick, C.S. Chiu, J.C. Bruggenjurgen, D. Greif, A. Bohrdt, F. Grusdt, E. Demler, M. Lebrat, M. Greiner, **Dynamical interplay between a single hole and a Hubbard antiferromagnet**, arXiv:2006.06672 (2020).

10. G. Torlai, B. Timar, E.P.L. van Nieuwenburg, H. Levine, A. Omran, A. Keesling, H. Bernien, M. Greiner, V. Vuletić, M.D. Lukin, R.G. Melko, M. Endres, **Integrating Neural Networks with a Quantum Simulator for State Reconstruction**, *Phys. Rev. Lett.* 123, 230504, doi:10.1103/PhysRevLett.123.230504 (2019).

11. H. Levine, A. Keesling, G. Semeghini, A. Omran, T.T. Wang, S. Ebadi, H.Bernien, M. Greiner, V. Vuletić, H. Pichler, M.D. Lukin, **Parallel Implementation of High-fidelity Multi-qubit Gates with Neutral Atoms**, *Phys. Rev. Lett.* 123, 170503, doi:10.1103/PhysRevLett.123.170503 (2019).

12. M. Rispoli, A. Lukin, R. Schittko, S. Kim, M.E. Tai, J. Leonard, M. Greiner, **Quantum critical behavior at the many-body localization transition**, *Nature* 573: 385-389, doi:10.1038/s41586-019-1527-2 (2019).

13. A. Omran, H. Levine, A. Keesling, G. Semeghini, T.T. Wang, S. Ebadi, H. Bernien, A.S. Zibrov, H. Pichler, S.Choi, J. Cui, M. Rossignolo, P. Rembold, S. Montangero, T. Calarco, M. Endres, M. Greiner, V. Vuletić, M.D. Lukin, **Generation and Manipulation of Schrödinger Cate States in Rydberg Atom Arrays**, *Science* 365, 6453: 570-574, doi: 10.1126/science.aax9743 (2019).

14. J. Cotler, S. Choi, A. Lukin, H. Gharibyan, T. Grover, M.E. Tai, M. Rispoli, R. Schittko, P.M. Preiss, A.M. Kaufman, M. Greiner, H. Pichler, P. Hayden, **Quantum virtual cooling**, *Phys. Rev. X* 9, 031013, doi:10.1103/PhysRevX.9.031013 (2019).

15. C.S.Chiu, G. Ji, A. Bohrdt, M. Xu, M. Knap, E. Demler, F. Grusdt, M. Greiner, D. Greif, **String patterns in the doped Hubbard model**, *Science* 365, 6450: 251-256, doi: 10.1126/science.aav3587 (2019).

16. A. Bohrdt, C.S. Chiu, G. Ji, M. Xu, D. Greif, M. Greiner, E. Demler, **Classifying snapshots of the doped Hubbard model with machine learning**, *Nature Phys.* 15: 921-924, doi:10.1038/s41567-019-0565-x (2019).

17. D. Kim, A. Keesling, A. Omran, H. Levine, H. Bernien, M. Greiner, M.D. Lukin, D.R. Englund, **Large-Scale Uniform Optical Focus Array Generation with a Phase Spatial Light Modulator**, *Optics Lett.* 44, 12: 3178-3181, doi:10.1364/OL.44.003178 (2019).

18. A. Lukin, M. Rispoli, R. Schittko, M.E. Tai, A.M. Kaufman, S. Choi, V. Khemani, J. Leonard, M. Greiner, **Probing entanglement in a many-body-localized system**, *Science* 364, 6437: 256-260, doi:10.1126/science.aau0818 (2019).

19. A. Keesling, A. Omran, H. Levine, H. Bernien, H. Pichler, S. Choi, R. Samajdar, S. Schwartz, P. Silvi, S. Sachdev, P. Zoller, M. Endres, M. Greiner, V. Vuletic, M.D. Lukin, **Quantum Kibble-Zurek mechanism and critical dynamics on a programmable Rydberg simulator**, *Nature* 568: 207-211, doi:10.1038/s41586-019-1070-1 (2019).

20. H. Levine, A. Keesling, A. Omran, H. Bernien, S. Schwartz, A.S. Zibrov, M. Endres, M. Greiner, V. Vuletic, M.D. Lukin, **High-fidelity control and entanglement of Rydberg atom qubits**, *Phys. Rev. Lett.* 121, 123603, doi:10.1103/PhysRevLett.121.123603 (2018).

21. C.S.Chiu, G. Ji,, A. Mazurenko, D. Greif, M. Greiner, **Quantum state engineering of a Hubbard system with ultracold fermions**, *Phys. Rev. Lett.* 120, 243201, doi:10.1103/PhysRevLett.120.243201 (2018).

22. F. Grusdt, M. Kanasz-Nagy, A. Bohrdt, C. S. Chiu, G. Ji, M. Greiner, D. Greif, E. Demler, **Parton theory of magnetic polarons: Mesonic resonances and signatures in dynamics**, *Phys. Rev. X* 8, 011046, doi:10.1103/PhysRevX.8.011046 (2018).

23. D. Greif, M. Greiner, **Mit kalten Atomen der Hochtemperatur-Supraleitung auf der Spur**, *Physik in Unserer Zeit* 48: 219-220 (2017).

24. H. Bernien, S. Schwartz, A. Keesling, H. Levine, A. Omran, H. Pichler, S. Choi, A. Zibrov, M. Endres, M. Greiner, V. Vuletić, M. Lukin, **Probing many-body dynamics on a 51-atom quantum simulator**, *Nature* 551, 579-584, doi:10.1038/nature24622 (2017).

25. Y-C. He, F. Grusdt, A. Kaufman, M. Greiner, A. Vishwanath, **Realizing and Adiabatically Preparing Bosonic Integer and Fractional Quantum Hall states in Optical Lattices**, *Phys. Rev. B* 96, 201103, doi:10.1103/PhysRevB.96.201103 (2017).

26. A. Mazurenko, C.S. Chiu, G. Ji, M. Parsons, M. Kanasz-Nagy, R. Schmidt, F. Grusdt, E. Demler, D. Greif, M. Greiner, **A cold-atom Fermi-Hubbard antiferromagnet**, *Nature* 545: 462-466, doi:10.1038/nature22362 (2017).

27. M.Kanasz-Nagy, I. Lovas, F. Grusdt, D. Greif, M. Greiner, E.A. Demler, **Quantum Correlations at infinite temperature: the dynamical Nagaoka effect**, *Phys. Rev. B* 96, 014303, doi:10.1103/PhysRevB.96.014303 (2017).

28. M.E. Tai, A. Lukin, M. Rispoli, R. Schittko, T. Menke, D. Borgnia, P.M. Preiss, F. Grusdt, A.M. Kaufman, M. Greiner, **Microscopy of the interacting Harper-Hofstadter model in the few-body limit**, *Nature* **546**, 519-523, doi:10.1038/nature22811 (2017).

29. M. Endres, H. Bernien, A. Keesling, H. Levine, E.R. Anschuetz, A. Krajenbrink, C. Senko, V. Vuletic, M. Greiner, M.D. Lukin, **Atom-by-atom assembly of defect-free one-dimensional cold atom arrays**, *Science* 375, 6315: 1024-1027, doi:10.1126/science.aah3752 (2016).

30. M.F. Parsons, A. Mazurenko, C.S. Chiu, G. Ji, D. Greif, M. Greiner, **Site-resolved measurement of the spin-correlation function in the Fermi-Hubbard model**, *Science* 353, 6305: 1253-1256, doi:10.1126/science.aag1430 (2016).

31. A.M. Kaufman, M.E. Tai, A. Lukin, M.N. Rispoli, R. Schittko, P.M. Preiss, M. Greiner, **Quantum thermalization through entanglement in an isolated many-body system**, *Science* 353, 6301: 794-800, doi:10.1126/science.aaf6725 (2016).

32. P. Zupancic, P.M. Preiss, R. Ma, A. Lukin, M.E. Tai, M.N. Rispoli, R. Islam, M. Greiner, **Ultra-precise holographic beam shaping for microscopic quantum control**, *Optics Express* 24, 13: 13881-13893, doi:10.1364/OE.24.013881 (2016).

33. D. Greif, M.F. Parsons, A. Mazurenko, C.S. Chiu, W. Setiawan, K. Wooley-Brown, S. Blatt, M. Greiner, **Site-resolved imaging of a fermionic Mott insulator**, *Science* 351, 6276: 953-957, doi:10.1126/science.aad9041 (2016).

34. R. Islam, R. Ma, P.M. Preiss, M.E. Tai, A. Lukin, M. Rispoli, M. Greiner, **Measuring entanglement entropy in a quantum many-body system**, *Nature* 528: 77-83, doi: 10.1038/nature15750 (2015).

35. M.F. Parsons, F. Huber, A. Mazurenko, C.S. Chiu, W. Setiawan, K. Wooley-Brown, S. Blatt, M. Greiner, **Site-Resolved Imaging of a Fermion in 6Li in an Optical Lattice**, *Phys. Rev. Lett.* 114, 213002, doi:10.1103/PhysRevLett.114.213002 (2015).

36. S. Blatt, A. Mazurenko, M.F. Parsons, C.S. Chiu, F. Huber, M. Greiner, **Low-noise optical lattices for ultracold 6Li**, *Phys. Rev. A* 92**,** 021402(R), doi:10.1103/PhysRevA.92.021402 (2015).

37. P.M. Preiss, R. Ma, M.E. Tai, J. Simon, M. Greiner. **Quantum gas microscopy with spin, atom-number, and multilayer readout**, *Phys. Rev. A* 91, 041602, doi:10.1103/PhysRevA.91.041602 (2015).

38. P.M. Preiss, R. Ma, M.E. Tai, A. Lukin, M. Rispoli, P. Zupancic, Y. Lahini, R. Islam, M. Greiner, **Strongly Correlated Quantum Walks in Optical Lattices**, *Science* 347: 1229-1233, doi: 10.1126/science.1260364 (2015).

39. J. Simon, M. Greiner, **Condensed-matter physics: a duo of graphene mimics,** *Nature* 483: 282-284, doi:10.1038/483282a (2012).

40. W.S. Bakr, R. Ma, M.E. Tai, P.M. Preiss, J. Simon, and M. Greiner, **Orbital Excitation Blockade and Algorithmic Cooling in Quantum Gases**, *Nature* 480: 500-503, doi:10.1038/nature10668 (2011).

41. R. Ma, M.E. Tai, P.M. Preiss, W.S. Bakr, J. Simon, and M. Greiner, **Photon-Assisted Tunneling in a Biased, Strongly Correlated Bose Gas**, *Phys. Rev. Lett.* 107, 095301, doi:10.1103/PhysRevLett.107.095301 (2011).

42. J. Simon, W.S. Bakr, R. Ma, M. E. Tai, P. M. Preiss, and M. Greiner, **Quantum Simulation of Anti-ferromagnetic Spin Chains in an Optical Lattice**, *Nature* 472, 307, doi:10.1038/nature09994 (2011).

43. J.F.S. Brachmann, W.S. Bakr, J. Gillen, A. Peng, and M. Greiner, **Inducing Vortices in a Bose-Einstein Condensate using Holographically Produced Light Beams**, *Optics Express* 19, 12984, doi:10.1364/OE.19.012984 (2011).

44. T. Kitagawa, A. Aspect, M. Greiner, and E. Demler, **Phase-sensitive Measurements of Order Parameters for Ultracold Atoms through Two-particle Interferometry**, *Phys. Rev. Lett* 106, 115302, doi:10.1103/PhysRevLett.106.115302 (2011).

45. W. S. Bakr, A. Peng, M. E. Tai, R. Ma, J. Simon, J. I. Gillen, S. Fölling, L. Pollet, and M. Greiner, **Probing the Superfluid–to–Mott Insulator Transition at the Single-Atom Level**, *Science* 329, 547, doi:10.1126/science.1192368 (2010).

46. W. Bakr, J. Gillen, A. Peng, S. Foelling and M. Greiner, **A Quantum Gas Microscope for Imaging Individual Atoms in a Hubbard Regime Optical Lattice**, *Nature* 462, 74, doi:10.1038/nature08482 (2009).

47. J.I. Gillen, W.S. Bakr, A. Peng, P. Unterwaditzer, S. Foelling, and M. Greiner, **Two-dimensional Quantum Gas in a Hybrid Surface Trap**, *Phys. Rev. A* 80**,** 021602(R), doi:10.1103/PhysRevA.80.021602 (2009).

48. A.M. Rey, R. Sensarma, S. Foelling, M. Greiner, E. Demler, and M.D. Lukin, **Controlled Preparation and Detection of D-wave Superfluidity in Two-dimensional Optical Superlattices**, *Europhysics Lett. Assn.* 87, 60001, doi:10.1209/0295-5075/87/60001 (2009).

49. M. Greiner, and S. Foelling, **Condensed-matter Physics: Optical Lattices**, *Nature* 453: 736-738, doi:10.1038/453736a (2008).

50. A.V. Gorshkov, L. Jiang, M. Greiner, P. Zoller, and M.D. Lukin, **Coherent Quantum Optical Control with Subwavelength Resolution**, *Phys. Rev. Lett.* 100, 093005, doi:10.1103/PhysRevLett.100.093005 (2008).

51. Q. Chen, C.A Regal, M. Greiner, D.S. Jin, and K. Levin, **Understanding the Superfluid Phase Diagram in Trapped Fermi Gases**, *Phys. Rev. A* 73, 041601, doi:10.1103/PhysRevA.73.041601 (2006).

52. P. Treutlein, T. Steinmetz, Y. Colombe, B. Lev, P. Hommelhoff, J. Reichel, M. Greiner, O. Mandel, A. Widera, T. Rom, I. Bloch, and T.W. Hänsch, **Quantum Information Processing in Optical Lattices and Magnetic Microtraps**, *Fortschr. Phys.* 54, 8-10: 702-718, doi:10.1002/prop.200610325 (2006).

53. C.A. Regal, M. Greiner, S. Giorgini, M. Holland, and D.S. Jin, **Momentum Distribution of a Fermi Gas of Atoms in the BCS-BEC Crossover**, *Phys. Rev. Lett.* 95, 250404, doi: 10.1103/PhysRevLett.95.250404 (2005).

54. M. Greiner, C.A. Regal, J.T. Stewart, and D.S. Jin, **Probing Pair-Correlated Fermionic Atoms through Correlations in Atom Shot Noise**, *Phys. Rev. Lett.* 94, 110401, doi:10.1103/PhysRevLett.94.110401 (2005).

55. M. Greiner, C.A. Regal, and D.S. Jin, **Fermi Condensates**, In Proceedings of the XVII International Conference on Atomic Physics, doi:10.1063/1.1928855 (ICAP 2004, Rio de Janeiro).

56. M. Greiner, C.A. Regal, and D.S. Jin, **Probing the Excitation Spectrum of a Fermi Gas in the BCS-BEC Crossover Regime**, *Phys. Rev. Lett.* 94, 070403, doi:10.1103/PhysRevLett.94.070403 (2005).

57. E. Hodby, S.T. Thompson, C.A.Regal, M. Greiner, A.C. Wilson, D.S. Jin, E.A. Cornell, and C.E. Wieman, **Production Efficiency of Ultracold Feshbach Molecules in Bosonic and Fermionic Systems**, *Phys. Rev. Lett.* 94, 120402, doi:10.1103/PhysRevLett.94.120402 (2005).

58. C.A. Regal, M. Greiner, and D.S. Jin, **Observation of Resonance Condensation of Fermionic Atom Pairs**, *Phys. Rev. Lett.* 92, 040403, doi:10.1103/PhysRevLett.92.040403 (2004).

59. A. Widera, O. Mandel, M. Greiner, S. Kreim, T.W. Hänsch, and I. Bloch, **Entanglement Interferometry for Precision Measurement of Atomic Scattering Properties**, *Phys. Rev. Lett.* 92, 160406, doi:10.1103/PhysRevLett.92.160406 (2004).

60. M. Greiner, C.A. Regal, and D.S. Jin, **Emergence of a Molecular Bose-Einstein Condensate from a Fermi Gas**, *Nature* 426, 537, doi:10.1038/nature02199 (2003).

61. T. Rom, T. Best, O. Mandel, A. Widera, M. Greiner, T.W. Hänsch, and I. Bloch, **State Selective Production of Molecules in Optical Lattices**, *Phys. Rev. Lett.* 93, 073002, doi:10.1103/PhysRevLett.93.073002 (2004).

62. C.A. Regal, M. Greiner, and D.S Jin, **Lifetime of Molecule-atom Mixtures near a Feshbach Resonance in 40K**, *Phys. Rev. Lett.* 92, 083201, doi:10.1103/PhysRevLett.92.083201 (2004).

63. M. Greiner, C.A Regal, C. Ticknor, J.L. Bohn, and D.S. Jin, **Detection of Spatial Correlations in an Ultracold Gas of Fermions**, *Phys. Rev. Lett.* 92, 150405, doi:10.1103/PhysRevLett.92.150405 (2004).

64. O. Mandel, M. Greiner, A. Widera, T. Rom, T.W. Hänsch, and I. Bloch, **Controlled Collisions for Multi-particle Entanglement of Optically Trapped Atoms**, *Nature* 425, 937-940, doi:10.1038/nature02008 (2003).

65. I. Bloch, M. Greiner, O. Mandel, and T.W. Hänsch, **Coherent Cold Collisions with Neutral Atoms in Optical Lattices**, *Philosophical Transactions of the Royal Society* 361, 1808: 1409-1416, doi:10.1098/rsta.2003.1210 (2003).

66. O. Mandel, M. Greiner, A. Widera, T. Rom, T.W. Hänsch, and I. Bloch, **Coherent Transport of Neutral Atoms in Spin-dependent Optical Lattice Potentials**, *Phys. Rev. Lett.* 91, 010407, doi:10.1103/PhysRevLett.91.010407 (2003).

67. M. Greiner, **Ultracold Quantum Gases in Three-dimensional Optical Lattice Potentials**, PhD thesis, in Sektion Physik. Ludwig-Maximilians-Universität: München, (2003).

68. M. Greiner, O. Mandel, T. Rom, A. Altmeyer, A. Widera, T.W. Hänsch, and I. Bloch, **Quantum phase transition from a superfluid to a Mott insulator in an ultracold gas of atoms**, *Physica B: Condensed Matter* 329: 11-12, doi:10.1016/S0921-4526(02)01872-0 (2003).

69. M. Greiner, O. Mandel, T.W. Hänsch, and I. Bloch, **Collapse and Revival of the Macroscopic Wave Function of a Bose-Einstein Condensate**, *Nature* 419**,** 6902, doi: 10.1038/nature00968 (2002).

70. M. Greiner, T.W. Hänsch, and I. Bloch, **Mott-Isolator-Zustand - Perfekte Ordnung am Nullpunkt**, *Physik in unserer Zeit* 33, 2: 51, doi:10.1002/1521-3943(200203)33:23.0.CO;2-8 (2002).

71. M. Greiner, O. Mandel, T. Esslinger, T.W. Hänsch, and I. Bloch, **Quantum Phase Transition from a Superfluid to a Mott Insulator in Gas of Ultracold Atoms**, *Nature* 415: 39-44, doi: 10.1038/415039a (2002).

72. M. Greiner, I. Bloch, O. Mandel, T.W. Hänsch, and T. Esslinger, **Bose-Einstein Condensates in 1D-and 2D Optical Lattices**, *Appl. Phys. B* 73, 8: 769-772, doi:10.1007/s003400100 (2001).

73. M. Greiner, I. Bloch, O. Mandel, T.W. Hänsch, and T. Esslinger, **Exploring Phase Coherence in a 2D Lattice of Bose-Einstein Condensates**, *Phys. Rev. Lett.* 87, 160405, doi:10.1103/PhysRevLett.87.160405 (2001).

74. I. Bloch, M. Kohl, M. Greiner, T.W. Hänsch, and T. Esslinger, **Optics with an Atom Laser Beam**, *Phys. Rev. Lett.* 87, 030401, doi:10.1103/PhysRevLett.87.030401 (2001).

75. I. Bloch, M. Greiner, O. Mandel, T.W. Hänsch, and T. Esslinger, **Sympathetic Cooling of ^{85}Rb and ^{87}Rb**, *Phys. Rev. A* 64**,** 021402(R), doi:10.1103/PhysRevA.64.021402 (2001).

76. M. Greiner, I. Bloch, T.W. Hänsch, and T. Esslinger, **Magnetic Transport of Trapped Cold Atoms over a Large Distance**, *Phys. Rev. A* 63**,** 031401(R), doi:10.1103/PhysRevA.63.031401 (2001).

77. M. Greiner, **Magnetischer Transport gefangener Atome – ein Weg zur einfachen Bose-Einstein Kondensation**, in Sektion Physik. Ludwig-Maximilians-Universität: München, (2000).

78. T. Esslinger, I. Bloch, M. Greiner, and T.W. Hänsch, **Generating and Manipulating Atom Laser Beams**, In Proceedings of the International School of Quantum Electronics, 27th course, doi:10.1007/0-306-47103-5_8 (1999).

79. M. Greiner, **Phasenkontrastverfahren zur nichtdestruktiven Abbildung eines Rubidium Bose-Einstein Kondensats**, in Sektion Physik. Ludwig-Maximilians-Universität: München (1998).