Quantum Gas Microscope papers

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I. HISTORY

1. MOT with ONE ATOM (Hu and Kimble 1994 [1] and Meschede 1996 [2])
2. Optical tweezer with one atom (Meschede 2001 [3] and Grangier 2001 [4])
3. 5 tweezers (Meschede 2004) [5]
4. Single atom/site imaging in a BIG lattice, no tunneling: Weiss 2007 [6]
5. SEM on a BEC in a 1D lattice (Herwig Ott 2008 [7])
6. Single atom/site imaging in a 1D lattice (433 nm): Meschede 2008/9 [8]
7. Almost single site imaging in a normal lattice: Chin 2009 [9]
8. First real (bosonic) QGM: Greiner 2009 [10]
9. Second QGM: Bloch 2009 [11]
10. Five Fermion QGMs (2015, in order): Kuhr (K-40) [12], Zwierlein (K-40) [13], Gross and Bloch (Li-6) [14], Thywissen (K-40) [15], and Greiner (Li-6) [16]. (Note: Li and K are light and have dense HF structure, so molasses doesn't work. Thywissen and Kuhr used EIT cooling, and others used Raman sideband cooling)
11. Ytterbium QGMs from Japan: Kozuma 2015 [17] and Takahashi 2015/6 [18]

II. BOSONIC STUDIES

1. Mott Insulator in Bose-Hubbard Model: Greiner (2010) [19], Kuhr/Bloch (2010, Rb-87, considered 2nd QGM) [11] and (2011) [20].
2. Addressing a single atom in the lattice with an off-res gaussian beam + microwaves [21]

3. Using SLMs to create arbitrary lattices (Bloch 2013 [22] and Greiner 2016 [23])

4. Light-cone spreading of correlations between doublons and holes (Gross/Kuhr/Bloch 2012) [24]

5. Strongly correlated quantum walks in optical lattices (Greiner 2015) [25]

6. Topology: flux ladder (Greiner 2017) [26]

7. Many-body localization

   (a) 2D half-circle thermalizing (Bloch 2016) [27]

   (b) 1D Aubry Andre entanglement (Greiner 05/2018) [28]

   (c) MBL transition critical behavior (Greiner 12/2018) [29]

8. Rydberg atoms in QGMs (Bloch 2018) [30]

9. Magnetism

   (a) 1D Ising chain with spin encoded by pop imbalance in pairs of wells (Greiner 2011) [31]

   (b) 1D Heisenberg model using two HF states (Gross/Kuhr/Bloch 2013) [22]

   (c) 1D Heisenberg spin transport studies: magnetic solitons from flipping two spins [32] (2013) and entanglement waves generated by flipping one spin in a 1D chain [33] (2015), both by Fukuhara from Bloch/Gross

III. FERMIONIC STUDIES

1. 1D Fermi-Hubbard model: lots of stuff by Bloch

   (a) AFM spin correlations beyond NN, showing spin-sensitive imaging (S-G + superlattice) and showing density fluctuations can't be used to gauge temperature [34]

   (b) "Hidden AFM order" [35]

   (c) Incommensurate magnetism: in 1D, holes, doublons, and excess spin increase distance b/w AFM-ordered spins, but in 2D doublons **block** AFM order [36]

2. AFM correlations in 2D: Greiner 2016 [37] and Zwierlein 2016 [38]

3. 2D antiferromagnet in Fermi-Hubbard model: Greiner 2017 [39]

4. POLARONS in 2D [40]

5. Transport in 2D

   (a) Charge transport: imprint a sine wave potential and release, watch strange metal relax. Resistivity goes as temperature, not T^2 (Bakr 2019) [41]

   (b) Spin transport: non-doped FHM shows diffusive transport scaling like t^2/U cause of superexchange but speeds up for larger t/U due to doublons/holes, exceeding previous studies' measures of diffusion (Zwierlein 2019) [42]

6. Recent Greiner stuff: trying to get colder by entropy reservoir tricks and combining measurements (?), trying to machine learn out the string patterns from holes, etc. in 2D FHM images

IV. LIST OF GROUPS

1. Greiner: Rb-87 (B) [10], Li-6 (F) [16], and Erbium in progress

2. Zwierlein: F [13]

3. Stefan Kuhr: Potassium-40 (F) [12]

4. Joseph Thywissen: K-40 (F) [15]

5. Takahashi: Ytterbium-174 (B) [18]

6. Kozuma: Yb [17]

7. Bloch: Rb-87 (B) [11], Lithium-6 (F) [14]

8. Monika Aidelsburger under Bloch: Cesium (B) under construction

9. Waseem Bakr: Li-6 (F) [43]

10. Jacob Sherson @ Aarhus: Rb-87 (B) 2018 [44]

11. Florian Schreck: Strontium (B) under construction
12. Sebastian Blatt under Bloch: Strontium (B) under construction
13. Simon Cornish @ Durham university: (Rb87-Cs133) molecule QGM under construction
14. Jun Ye: KRb molecule QGM under construction? Proposal is out. [45]

V. REVIEWS/NICE RESOURCES

1. Herwig Ott 2016 review [46]
2. Stefan Kuhr 2016 review [47]
3. Christian Gross+Immanuel Bloch 2017 review [48]

VI. TALK OUTLINE

1. Intro + motivation + outline
2. What are quantum gas microscopes? (single atom + single site imaging)
3. A history of QGMs [1 slide]
4. A map of QGMs
5. How to build a QGM
6. What can QGMs do?
   (a) Huge whiteboard of ideas
   (b) Maybe put this at the beginning?
   (c) Different techniques
7. A few new QGM pappers

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