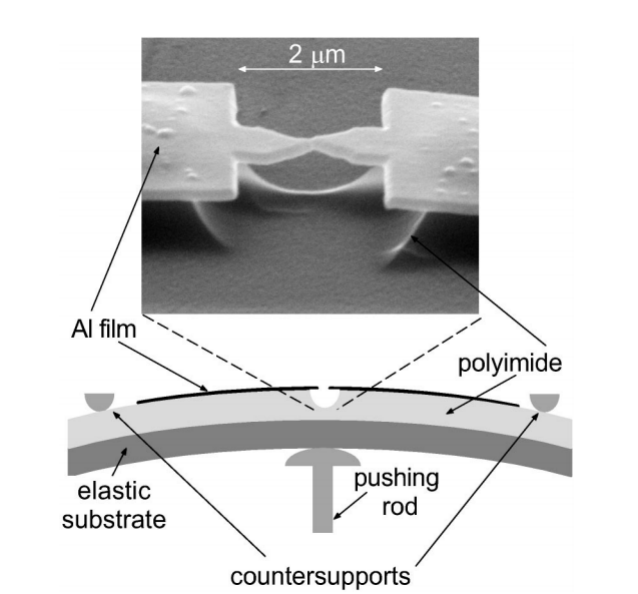
DQMP Department of Quantum Matter Physics

http://dqmp.unige.ch/giamarchi/

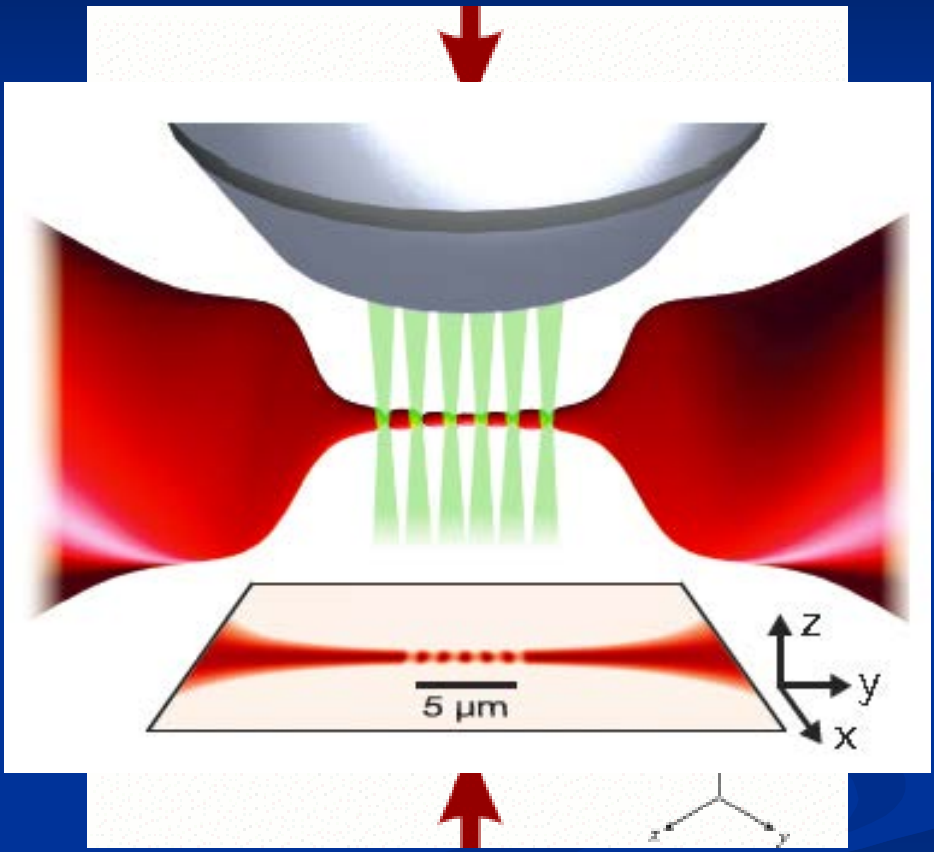
Theorist working on quantum systems

What are we doing ??

Materials and cold atoms

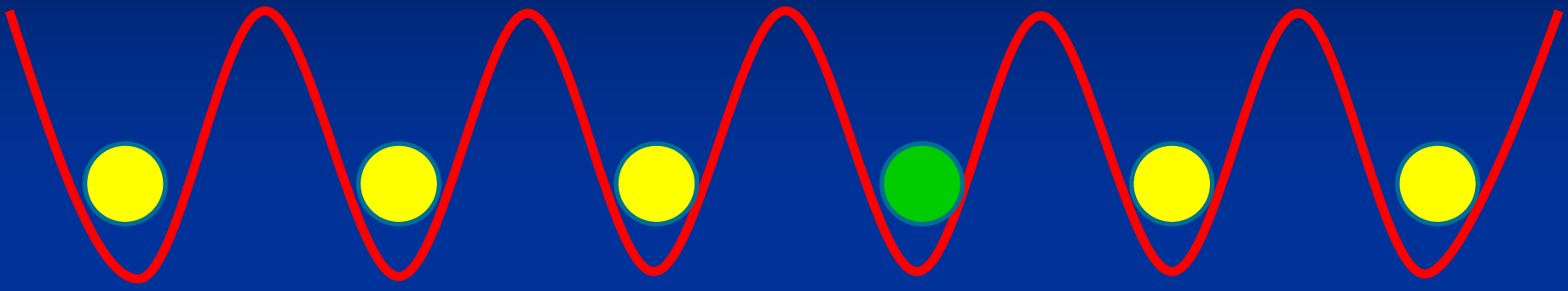


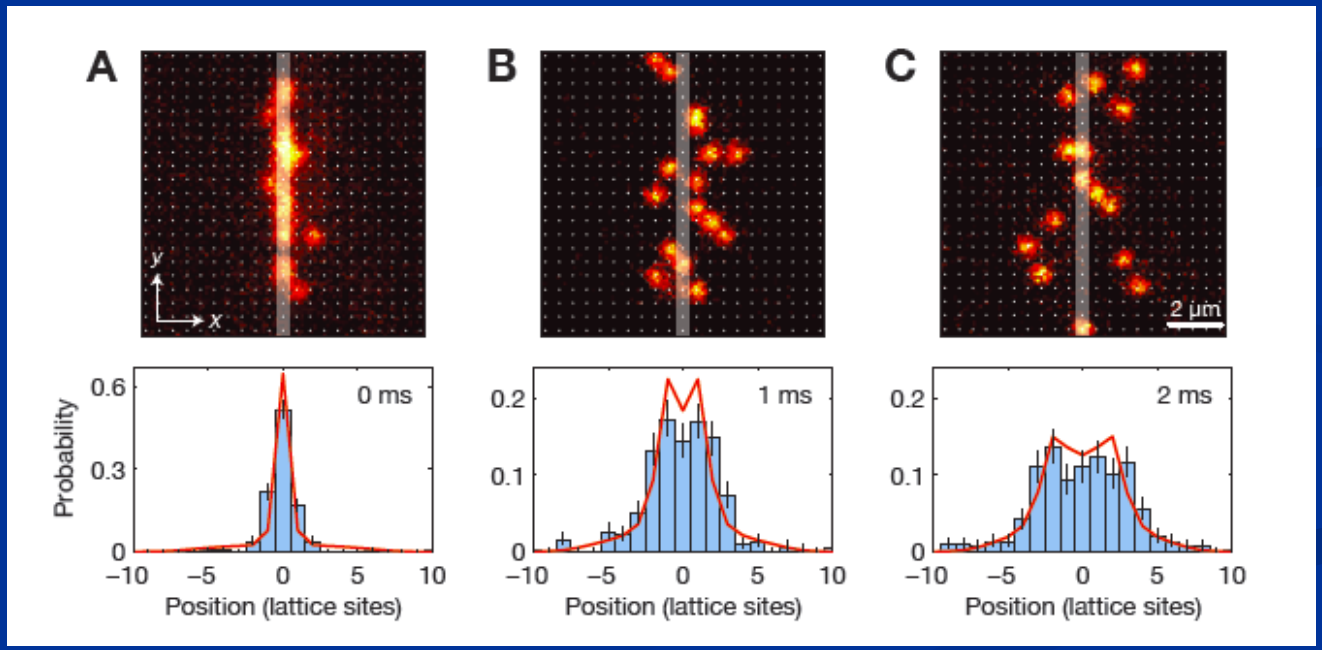
E. Scheer et al. PRL 78 3535 (1997)



M. Lebrat, P. Grisins et al., PRX 8 011053 (18)

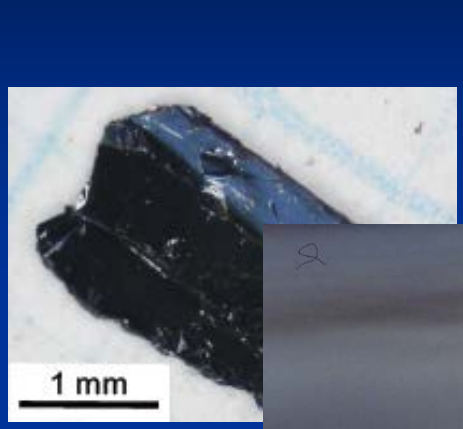
Mobile impurity

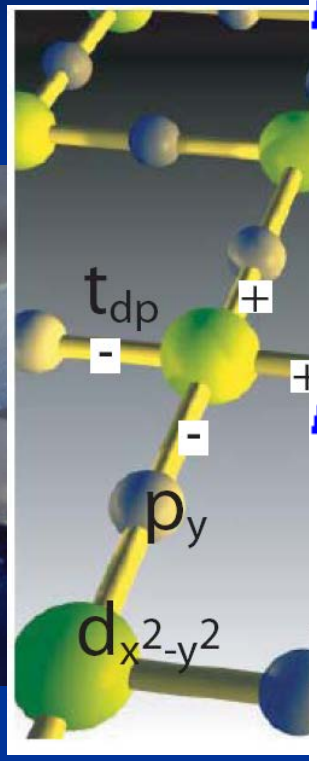


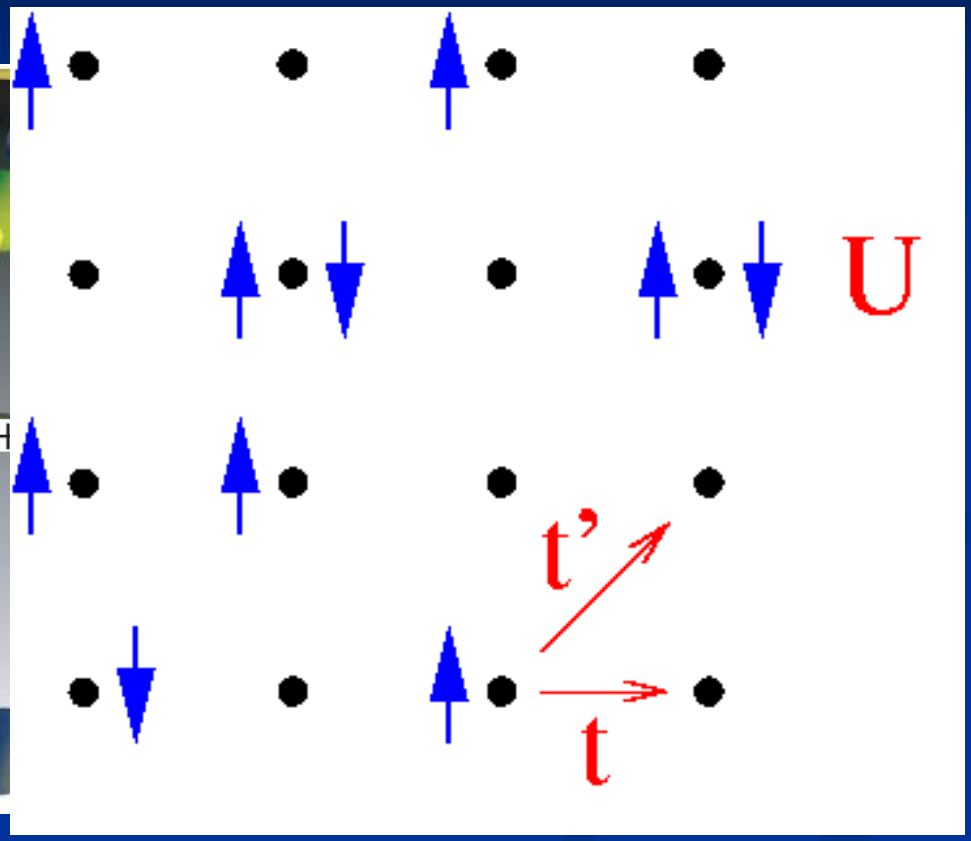


T. Fukuhara, et al. , Nat. Phys. (2013)

Hubbard model (1963)

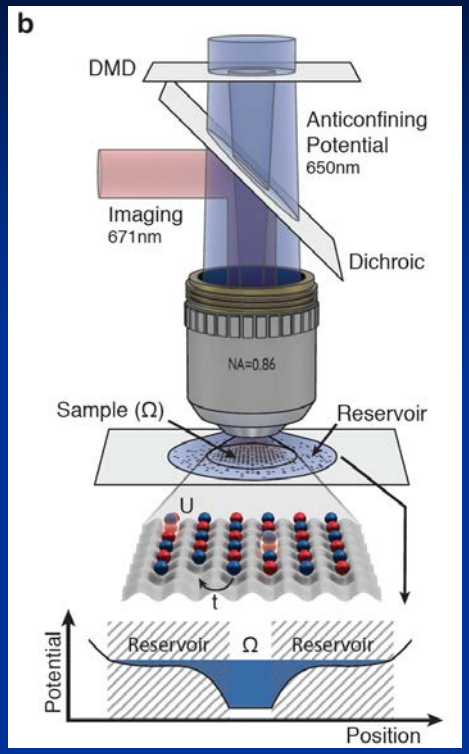


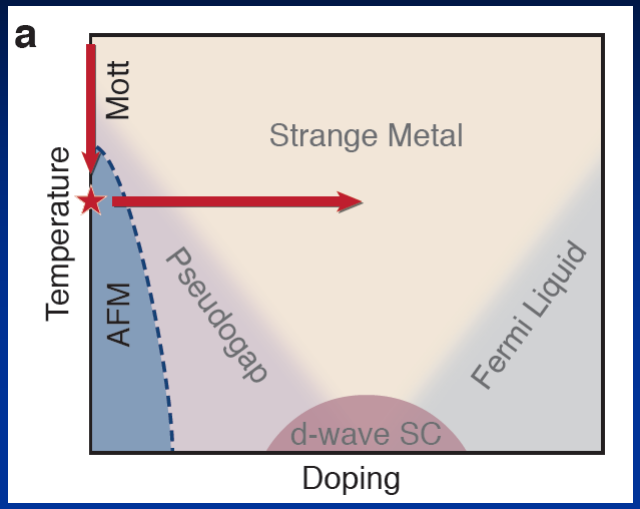


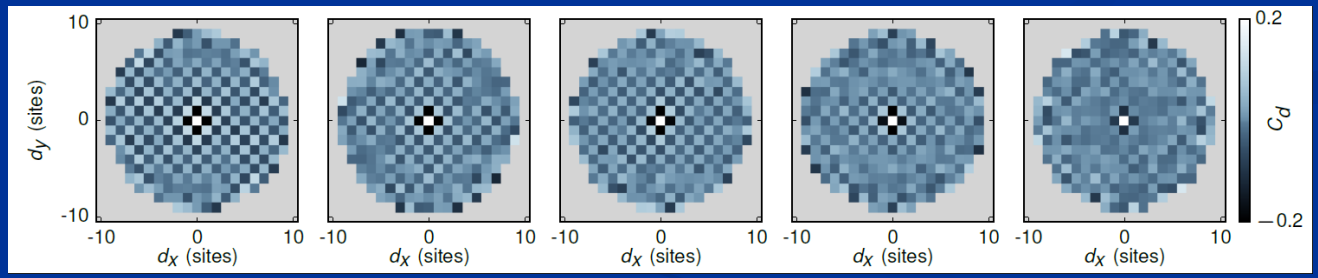


$$H = -t \sum_{<i,j>,\sigma} (c^{\dagger}_{i,\sigma} c_{j,\sigma} + h.c.) + U \sum_{i=1}^{N} n_{i\uparrow} n_{i\downarrow}$$

Mazurenko, A. et al. Nature 545, 462–466 (2017).





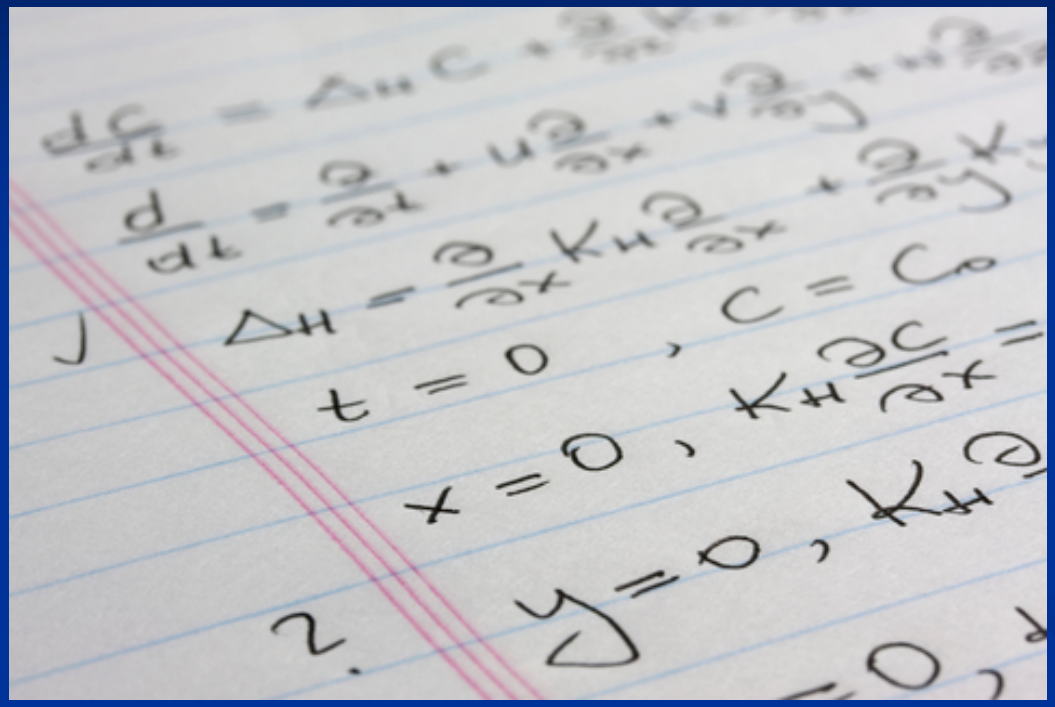


QUANTUM PHYSICS

A firmer grip on the Hubbard model

TG Nature 545, 414–415 (2017).

Analytics



The Nobel Prize in Physics 2016

Photo: A. Mahmoud
David J. Thouless
Prize share: 1/2

Photo: A. Mahmoud
F. Duncan M. Haldane
Prize share: 1/4

Photo: A. Mahmoud
J. Michael Kosterlitz
Prize share: 1/4

The Nobel Prize in Physics 2016 was awarded with one half to David J. Thouless, and the other half to F. Duncan M. Haldane and J. Michael Kosterlitz *"for theoretical discoveries of topological phase transitions and topological phases of matter"*.

Analytic methods: Field theory, Bosonization, Keldysh technique, Renormalization group, Topology……

Numerics

CPUs : 1052 coeurs, Intel &

Swiss supercomputing center (Mano); machines with 7 10^15 operations per second

To explore further

- Peut-on toucher la mécanique quantique

https://www.youtube.com/watch?v=yGI-0MEzoT0

- Introduction to ulracold fermions

https://www.youtube.com/watch?v=hplDq7Pn-TE

- Much more advanced: Quantum physics in 1D

https://www.youtube.com/watch?v=h1tyqwZ6S_A&t=3s

- For fun: Card tricks and quantum mechanics

https://www.youtube.com/watch?v=WLKnh_oDQxo&t=1999s