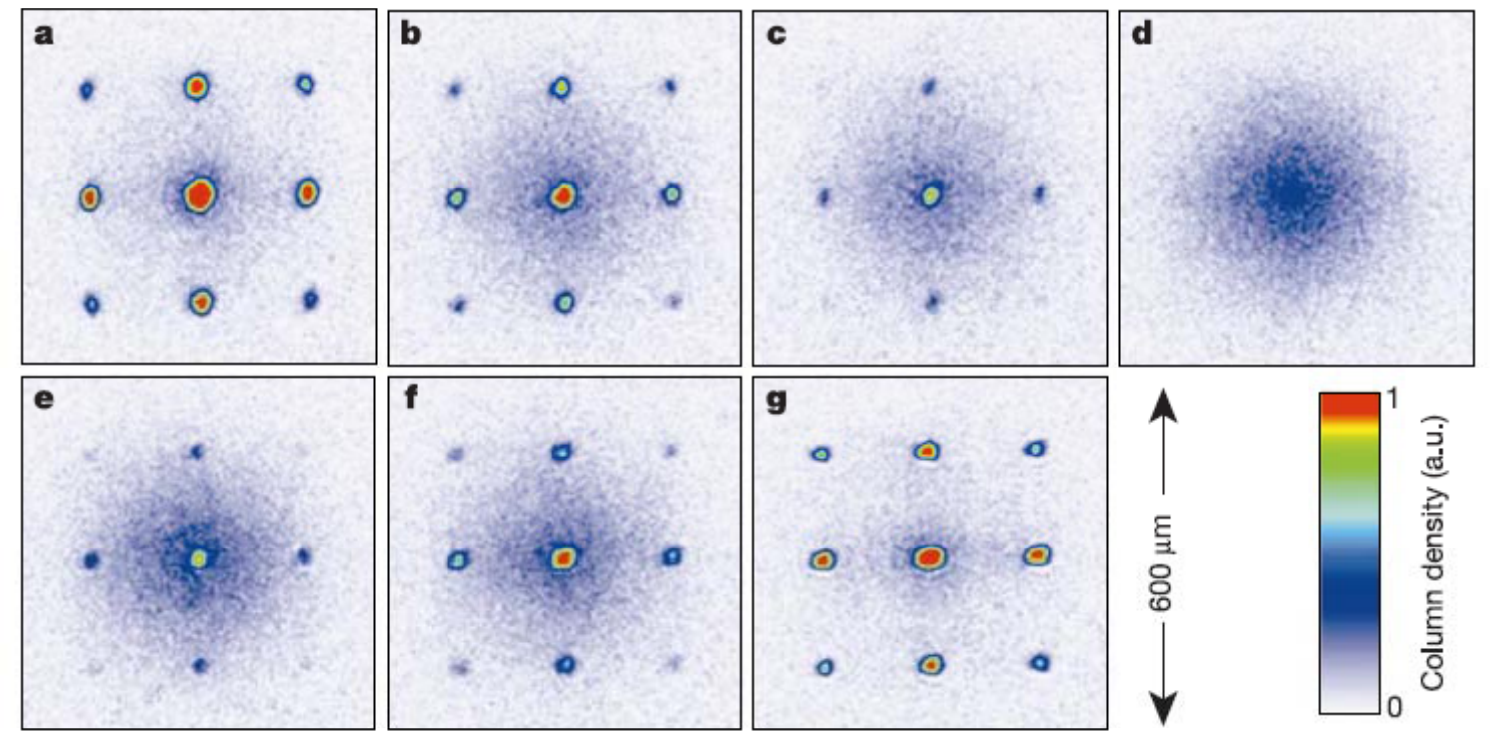
# The Collapse and Revival




$V_A=8E_R$, $V_B=22E_R$

a) 0 ms; b) 100 ms; c) 150 ms; d) 250 ms;
e) 350 ms; f) 400 ms; and g) 550 ms

M. Greiner et al, Nature 2002

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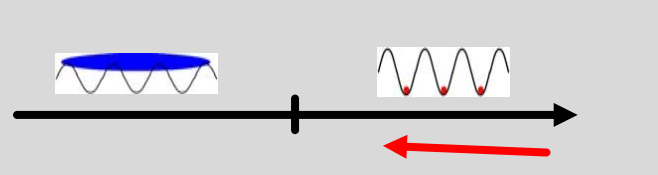
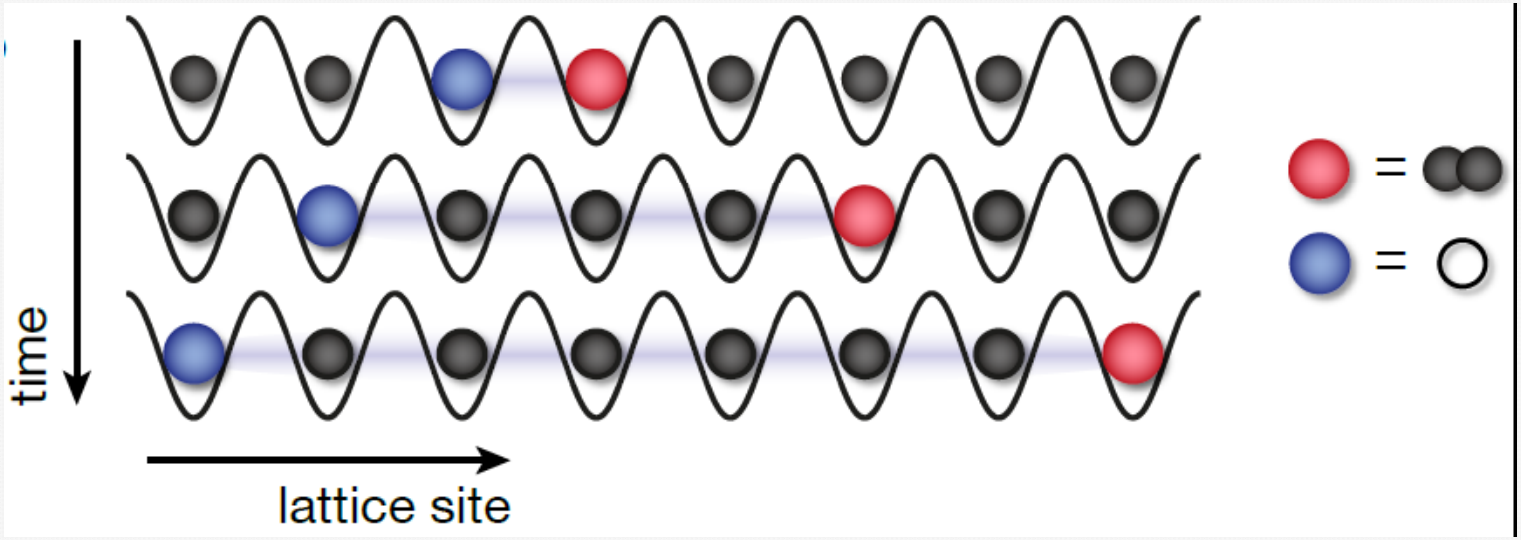
# Short time dynamics: Fermionic quasi-particles

***large interaction limit:***

symmetric coherent superposition (no change of density!)






first order perturbation in J/U (more complicated expression for quasiparticles):

$$|\psi(t)\rangle = |\bar{n}\rangle + i\frac{2\sqrt{2}J}{U}\sum_k \sin(k) c^\dagger_{k,+} c^\dagger_{-k,-}|\bar{n}\rangle$$
$$- i\frac{2\sqrt{2}J}{U}\sum_k \sin(k) e^{i6J\cos(k)t/\hbar} c^\dagger_{k,+} c^\dagger_{-k,-}|\bar{n}\rangle \,.$$

*M. Cheneau et al, Nature (2012)*
*P. Barmettler et al, PRA (2012)*

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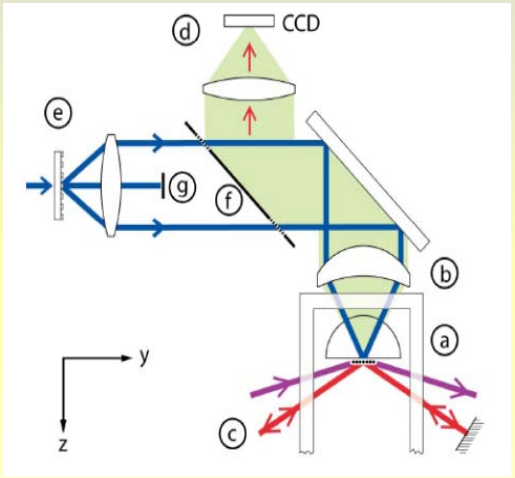
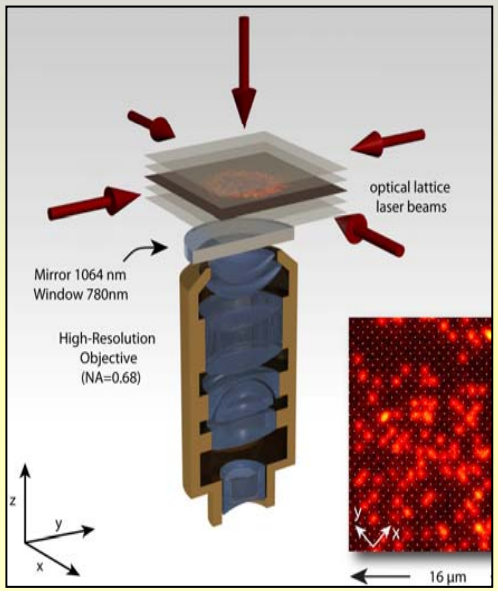
# Real space imaging

Local flourescence imaging



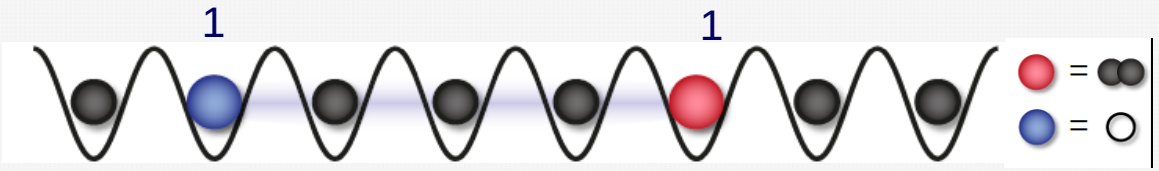

Bakr et al. 2009




Sherson et al. Nature 2010

parity distribution in real space

parity correlations $C_d(t) \propto \left\langle n_j^{even} n_{j+d}^{even} \right\rangle - \left\langle n_j^{even} \right\rangle \left\langle n_{j+d}^{even} \right\rangle$

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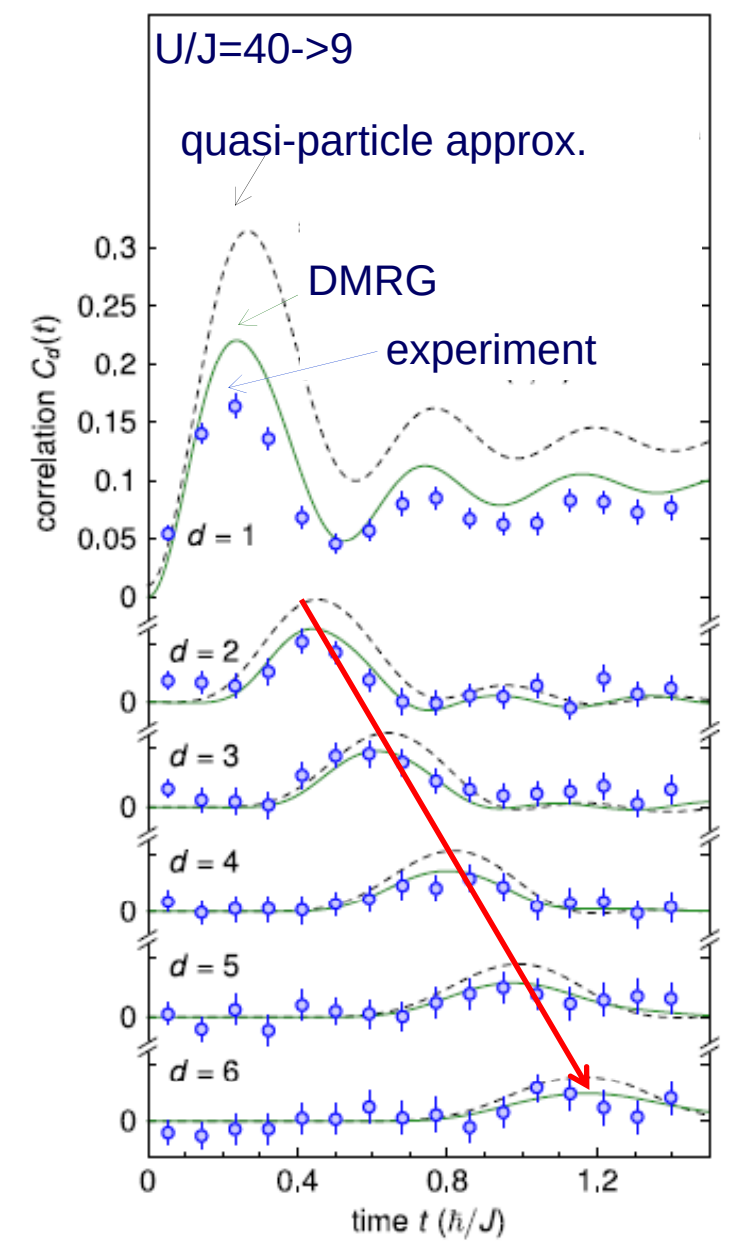
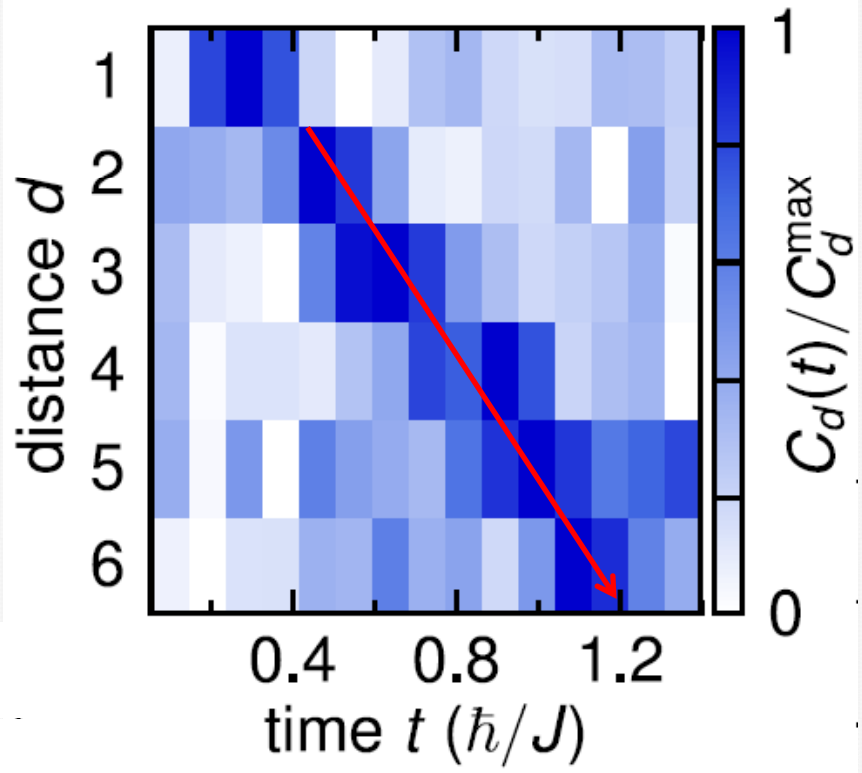
# Coherent propagation in Mott-insulator




density remains constant!




M. Cheneau et al, Nature (2012)

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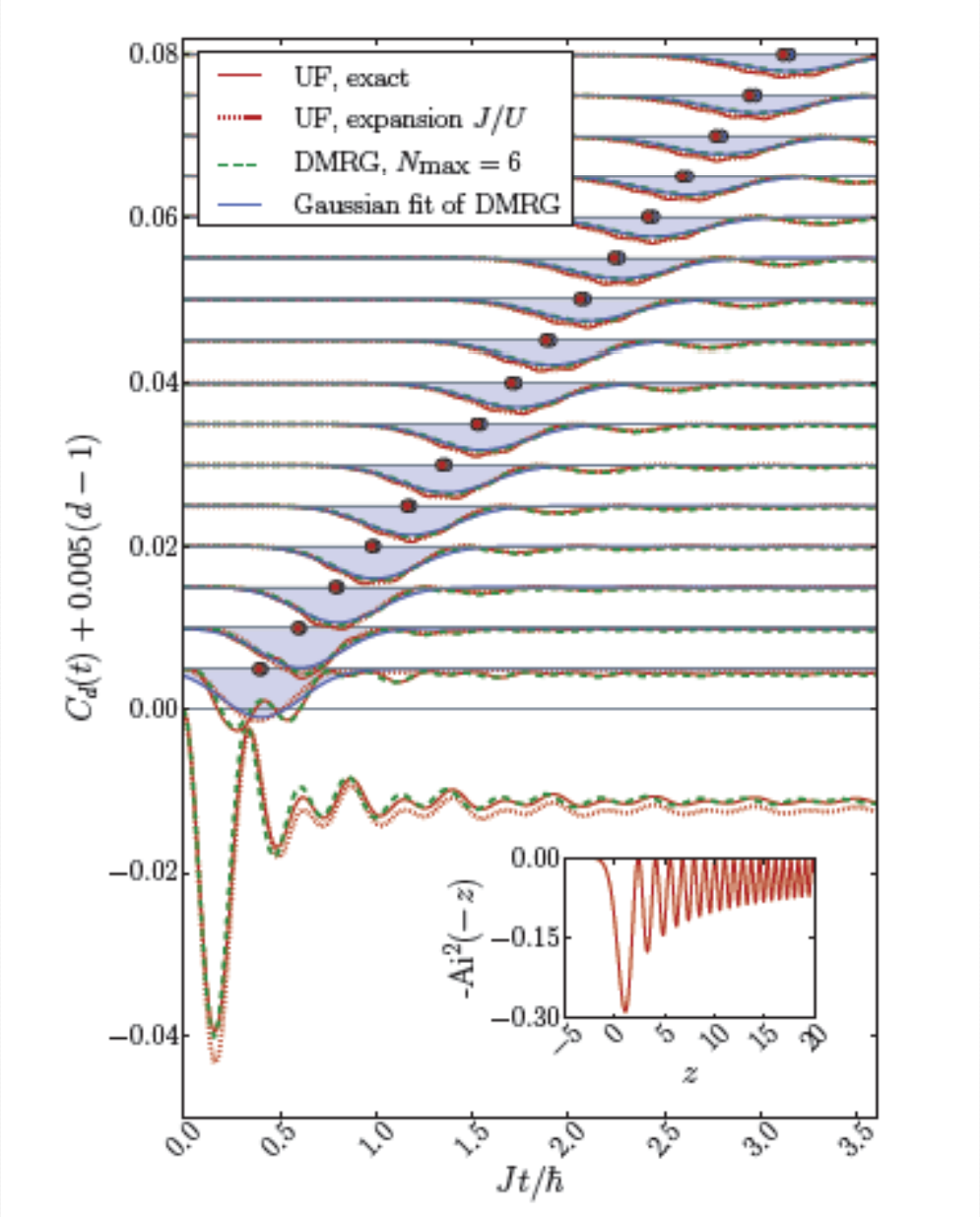
# High interaction strength




P. Barmettler et al, PRA, (2012)

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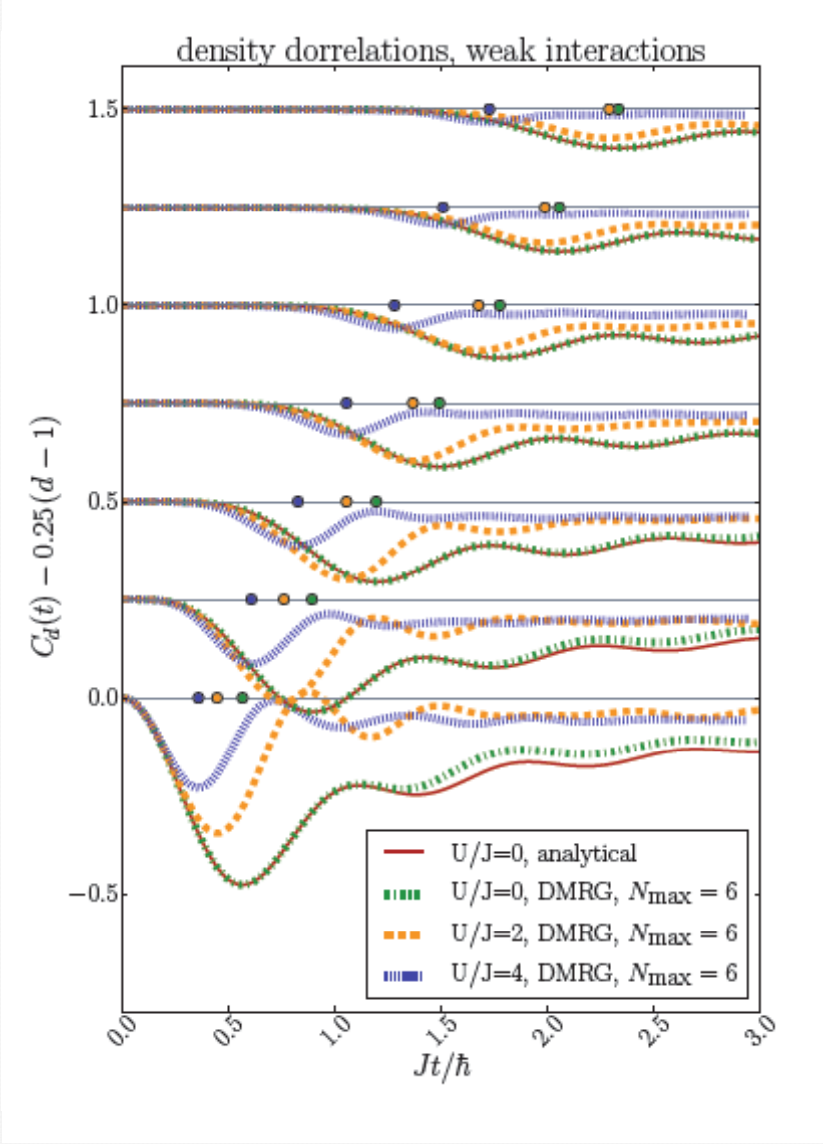
# Low interaction strength




P. Barmettler et al, PRA, (2012)

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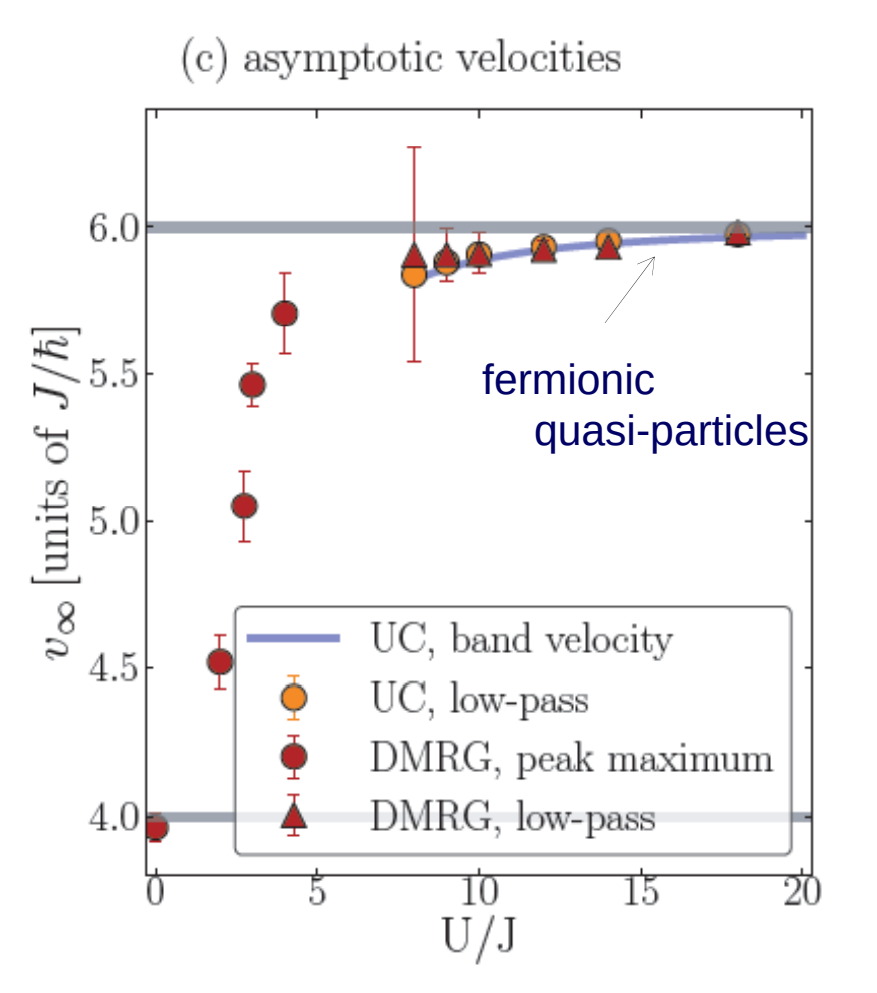
# Velocity of correlation spreading




***velocity:***

generic maximal velocity in bounded model

coherent evolution in Mott-insulator

similar evolution in fermionic model

**open questions:**

- nature of quasi-particles close to transition?

***Pre-/Thermalization inside light cone***

C. Kollath, A. Läuchli, E. Altman, PRL (2007)
A. Läuchli and C. Kollath J.Stat Phys. (2008)
G. Roux (2009)
G. Biroli, C. Kollath, and A. Läuchli , PRL (2010)

many others in different models

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