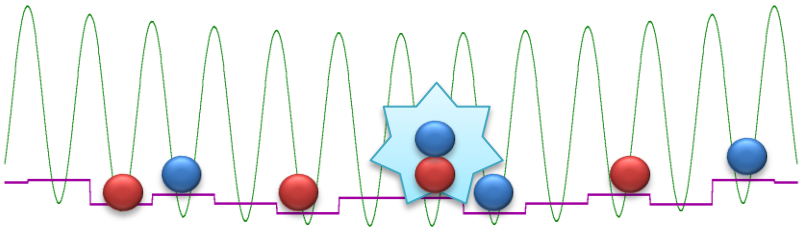
PS-D-2

Dynamics of an interacting 1d Fermi system in a quasiperiodic potential



NQS2011 Poster Preview
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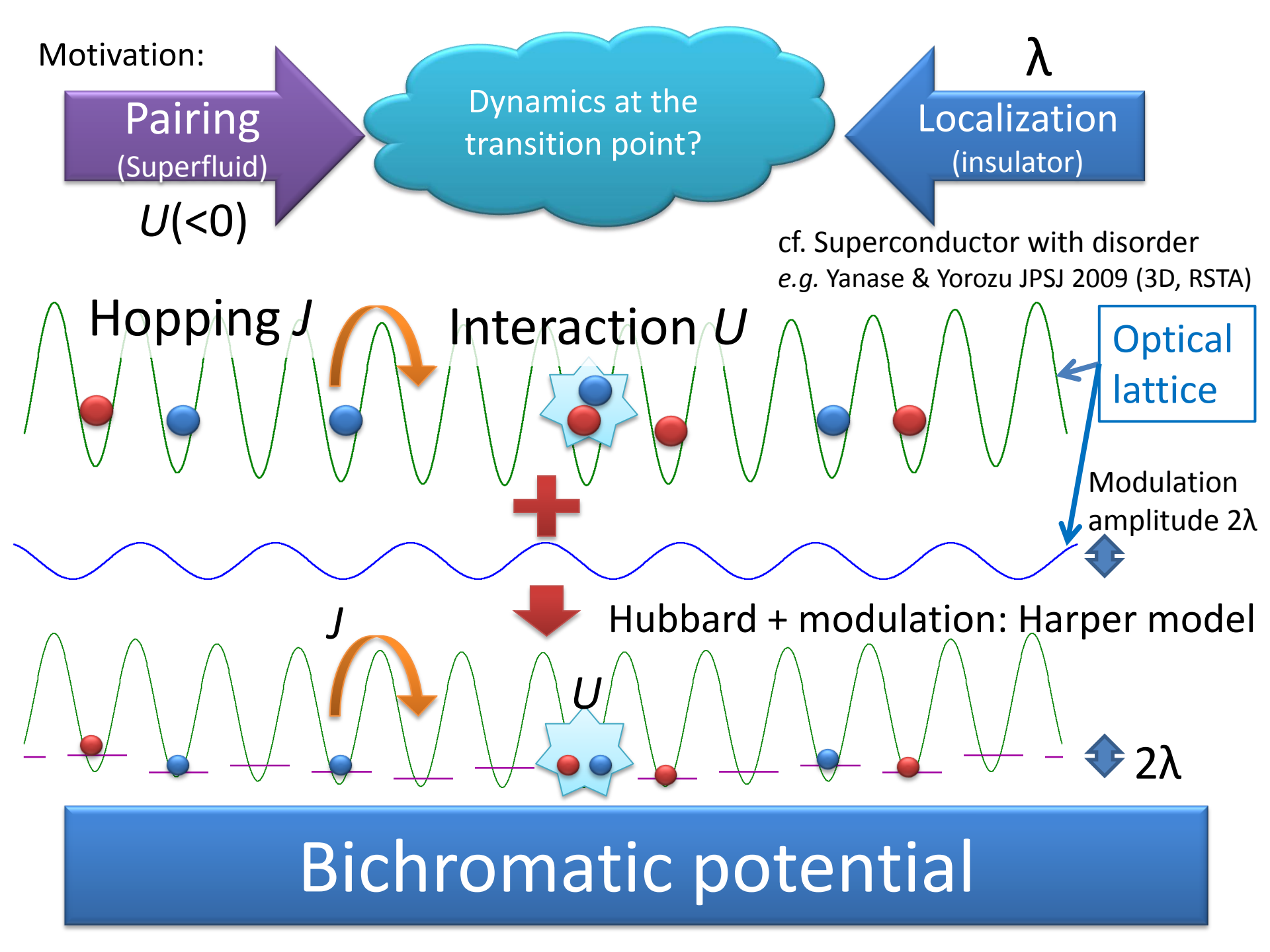
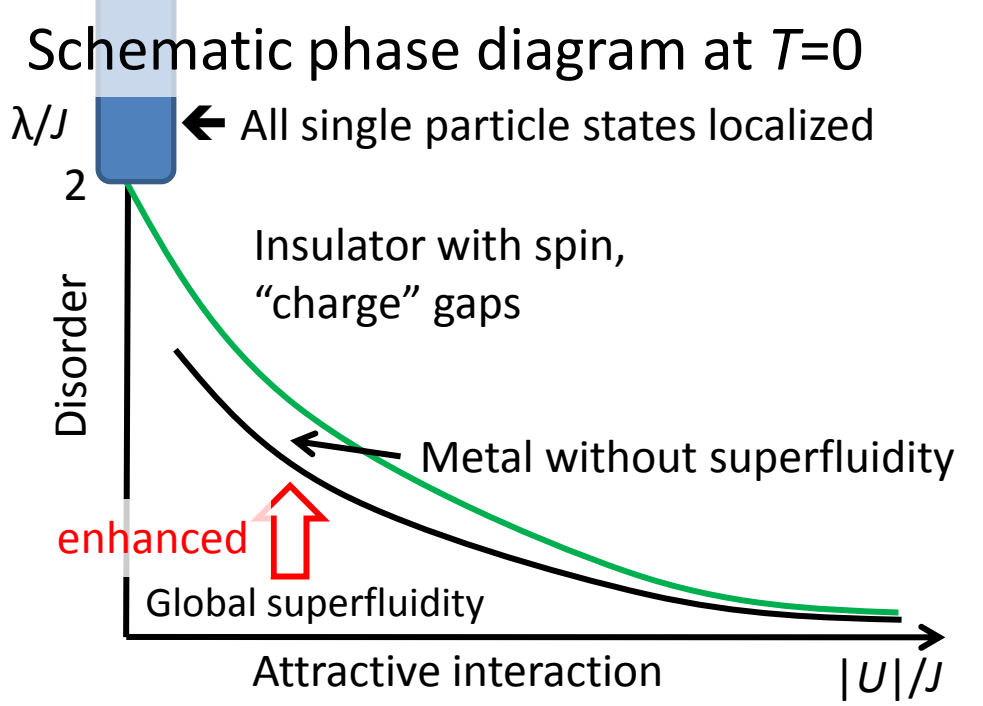
arXiv:1109.4037; 0912.2263 (PRA **82**, 043613 (2010))


Motivation:
Pairing
(Superfluid)
U(<0)
Dynamics at the transition point?
λ
Localization
(insulator)
cf. Superconductor with disorder
e.g. Yanase & Yorozu JPSJ 2009 (3D, RSTA)
Hopping J
Interaction U
Optical lattice
Modulation amplitude 2λ
Hubbard + modulation: Harper model
J
U
2λ
Bichromatic potential

Schematic phase diagram at T=0



Tezuka and García-García: PRA **82**, 043613 (2010)

Attraction strength $|U|$

Weak Strong

$|U| \ll \lambda_c$ $\lambda_c \ll |U|$

Almost free fermions gradually localize

Hard-core bosons suddenly localize

At localization line, we expect

$\langle x^2(t)\rangle \sim t$ (~random walk) $\langle x^2(t)\rangle \sim t^2$

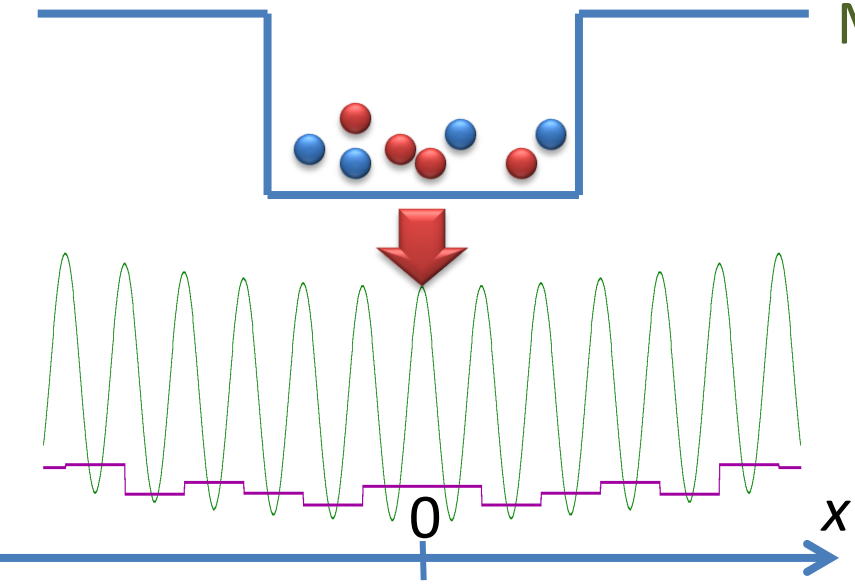
What happens in a trap-release experiment?

For intermediate U

Anomalous exponent of diffusion ($\langle x^2(t)\rangle \sim t^\alpha$) expected

Anderson localization + interaction?

MT and García-García: arXiv:1109.4037v2

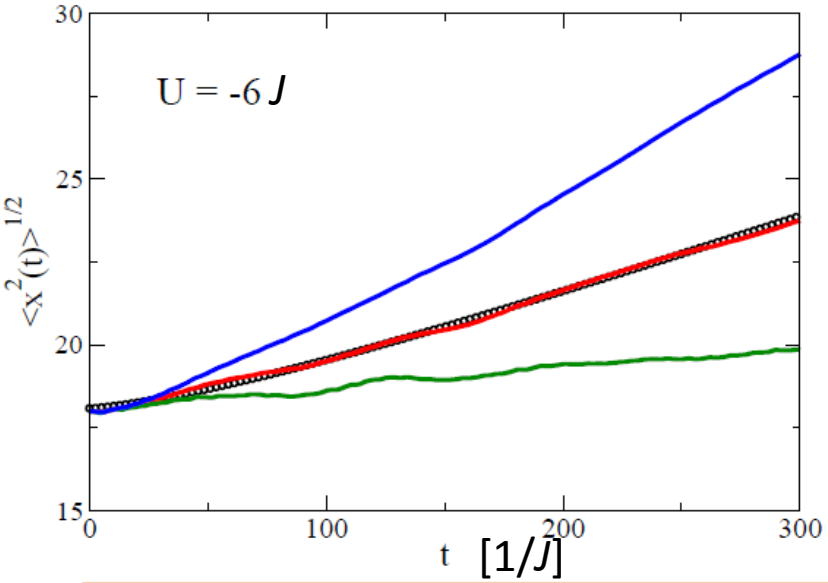


Release the interacting atoms from a box-shaped trap

to the incommensurately modulated optical lattice ➔ t-DMRG simulation

Calculate second momentum $\langle \sum x^2(t) \rangle / N$ to extract exponent

Fit with $\langle x^2(t) \rangle = x_0^2(1 + (t/t_0)^\alpha)$



α=1.36 at λ_c(U=-6*J*) : anomalous exponent

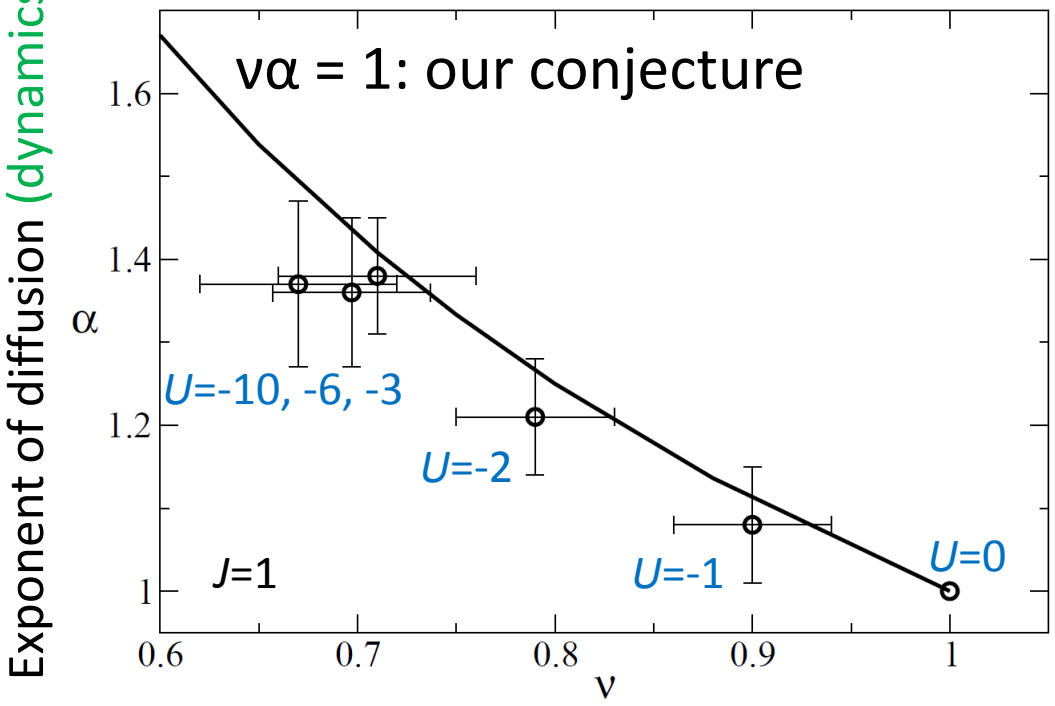
Diffusive (α=1) in |*U*|→0 limit

Ballistic : α=2

Trap-release dynamics by t-DMRG

12+12 fermions, 64→160+ sites

Tezuka and García-García: arXiv:1109.4037v2



Summary

Trap-release dynamics of Interacting fermions in 1D bichromatic lattice studied by time-dependent DMRG

Anomalous diffusion exponents observed at localization transition point

Exponent of localization length ξ obtained from

$$\Delta E = E_{\text{periodic}} - E_{\text{antiperiodic}} \propto e^{-L/\xi}$$

(static property)

$$\xi \propto |\lambda - \lambda_c|^{-\nu}$$

cf. Experiments of bosons in quasiperiodic trap

[Roati *et al.*: Nature 453, 895 (2008); Lucioni *et al.*: PRL 106, 230403 (2011)]

Anomalous values of exponents ν and α