QUANTUM QUENCHES AND DYNAMICAL PHASE TRANSITIONS

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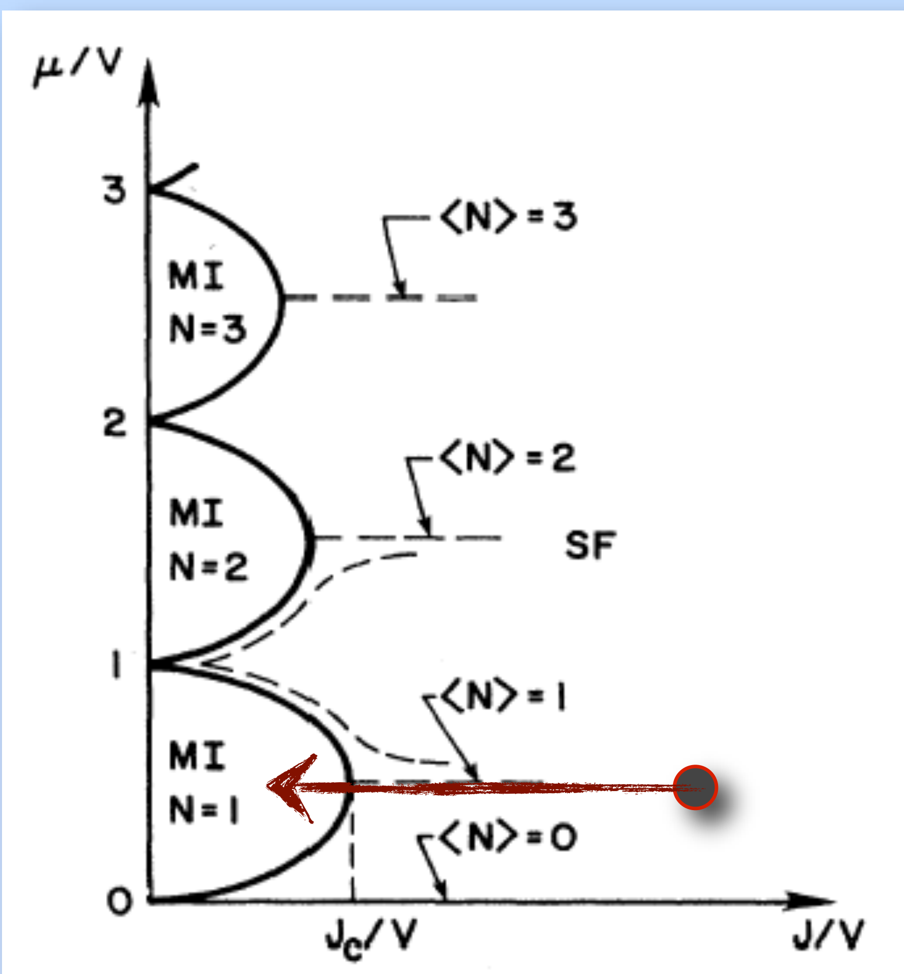
Motivations

Cold atoms:

highly isolated = little decoherence

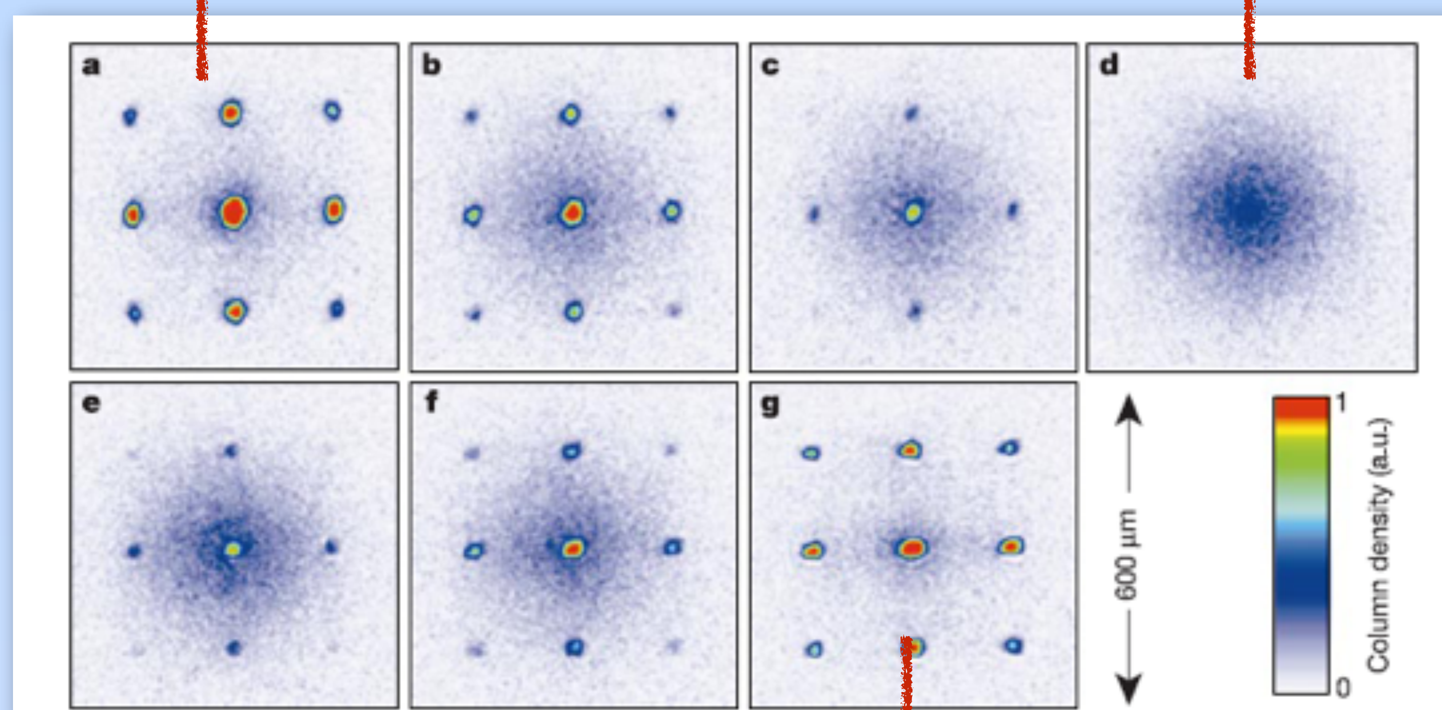
highly tunable = dimensionality, interactions

highly versatile = equilibrium+nonequilibrium



Superfluid

Mott



Superfluid

Quantum quench

istantaneous

Paradigmatic protocol: $H(\Gamma_0) \to H(\Gamma_1)$ Calabrese, Cardy ('06)

local or global

Characterization:

Expectation values of observables

Entanglement evolution

Statistics of observables

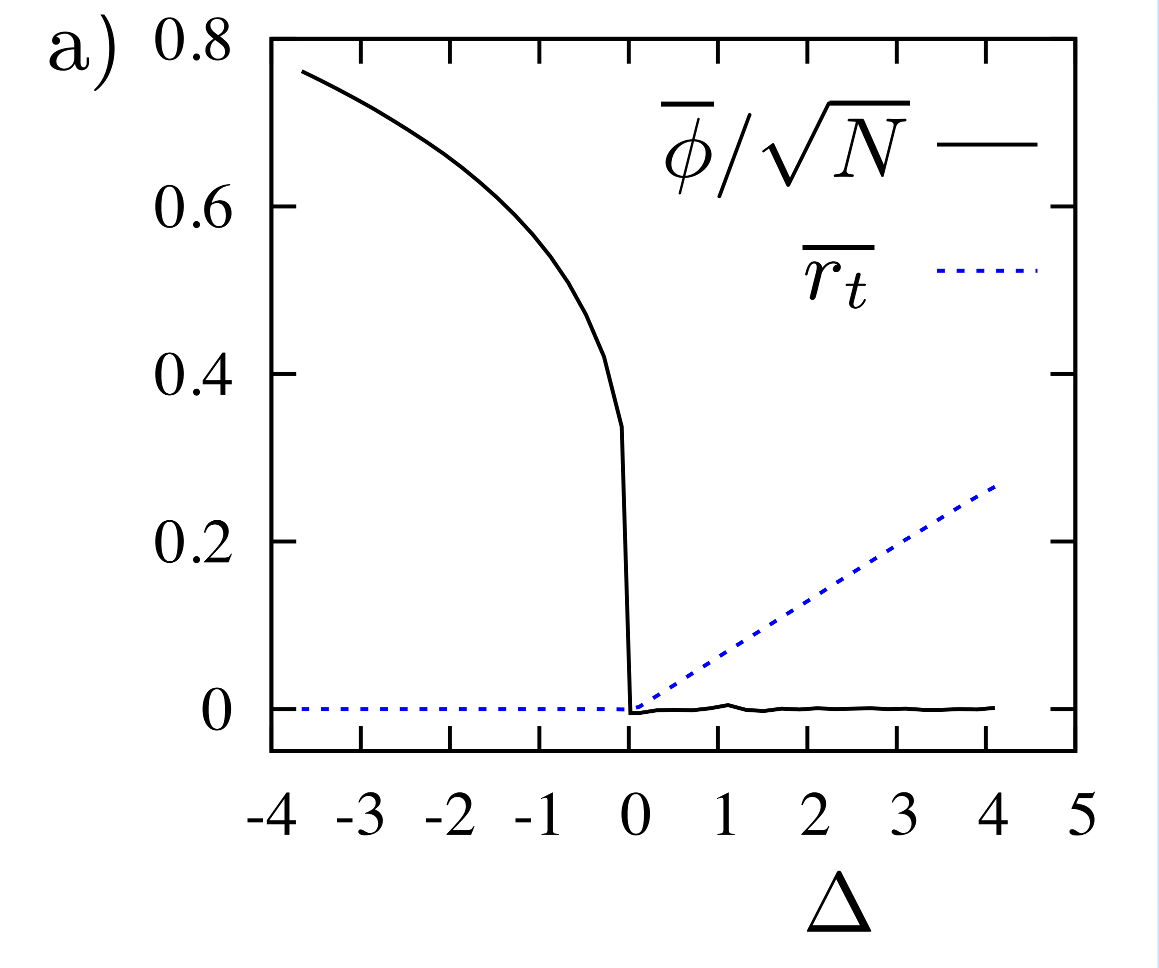
Different qualitative behaviors?

Dynamical crossover or transitions

Dynamical transitions

Sudden change in the dynamical behavior of observables as a function of quench parameters

Predicted in a variety of models, mostly at mean field



Sciolla, Biroli, 2012

O(N) model

$$H=\sum_{a=1}^{N}\frac{1}{2}\int d^dx\left[\Pi_a\Pi_a+(\vec{\nabla}\phi_a)(\vec{\nabla}\phi_a)+r_0\phi_a\phi_a+\frac{\lambda}{12N}\left(\phi_a\phi_a\right)^2\right]$$

$N\to\infty$ model exactly solvable=quadratic theory

Equilibrium QPT: paramagnetic $\longrightarrow$ ferromagnetic

$\langle\phi_a\rangle=0$ $\qquad$ $\langle\phi_a\rangle\neq 0$

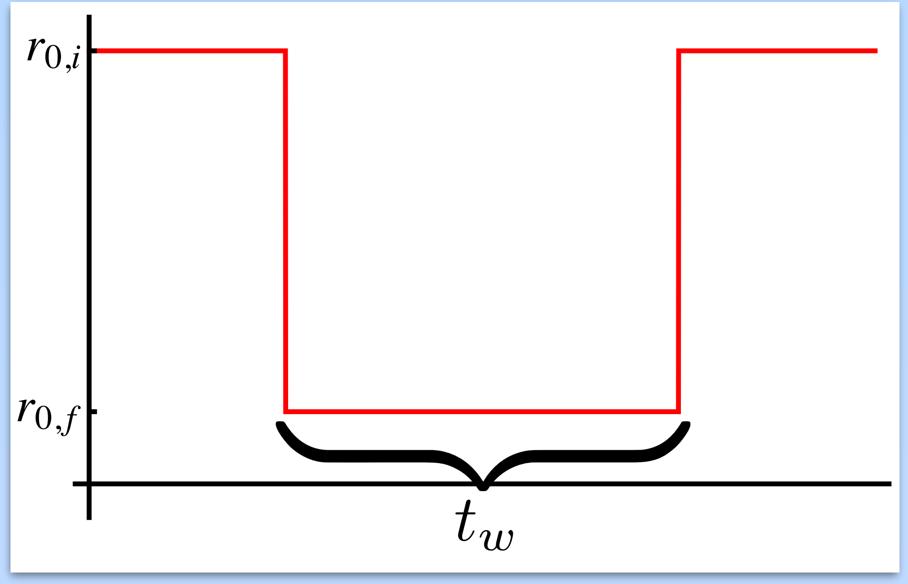
Quenches from paramagnetic phase:

Dynamical phase transition

Same critical properties as finite temperature

Statistics of excitations

Double quench:



Strong signature in the fluctuations

Suitable for cold atoms experiments