Nonequilibrium dynamics of magnon BEC in the spin dimer system

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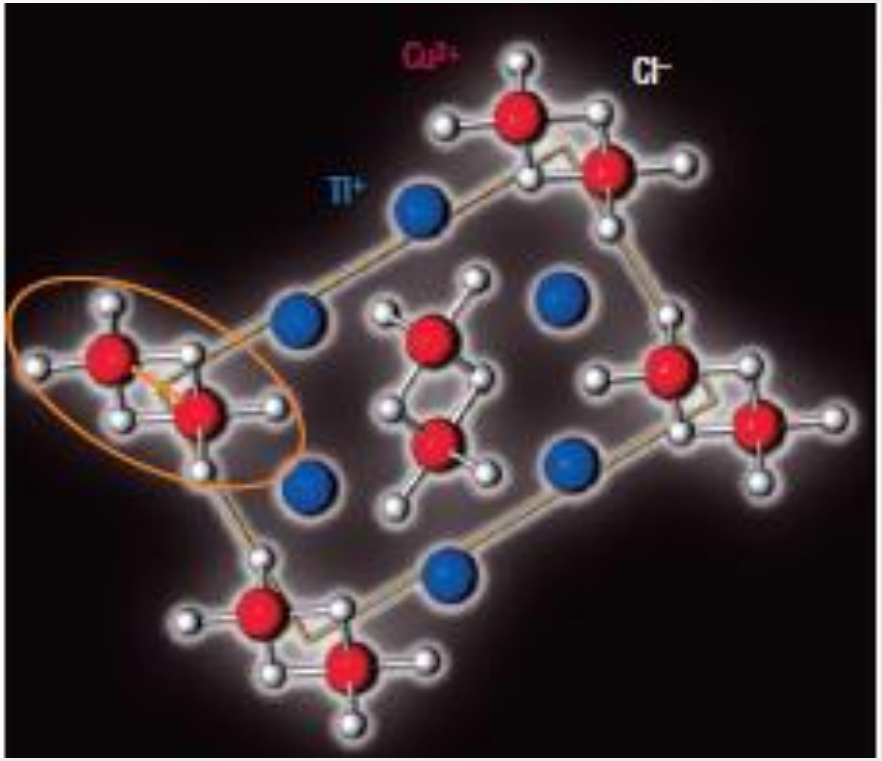
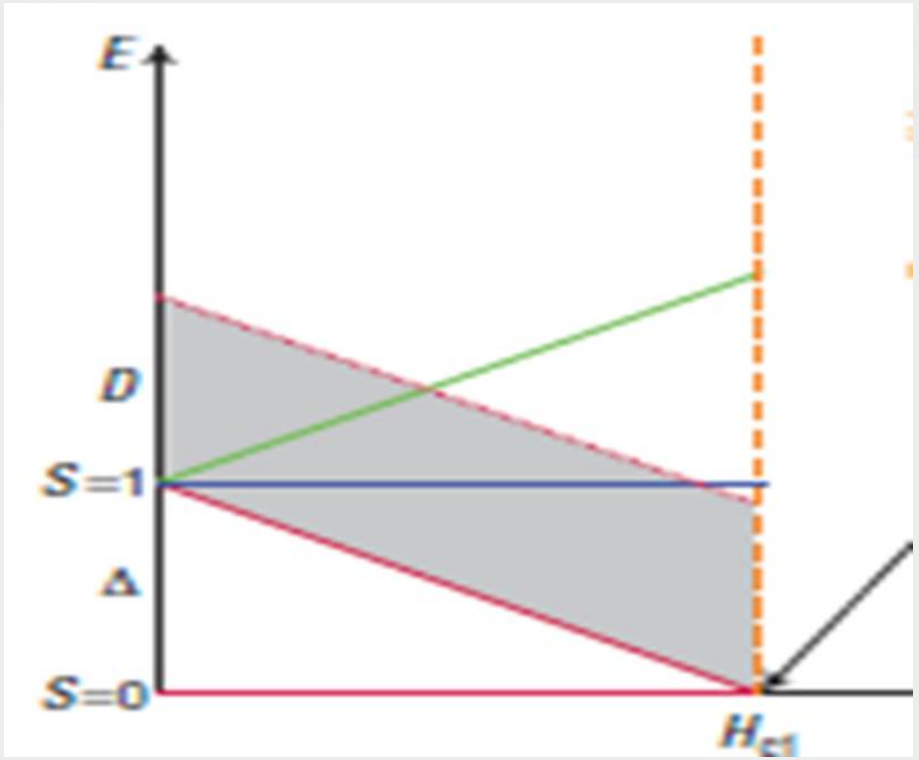
Introduction:Spin dimer system

$$H = \sum_i J_0 \mathbf{S}_{l,i} \cdot \mathbf{S}_{r,i} + \sum_{<mnij>} J_{mnij} \mathbf{S}_{m,i} \cdot \mathbf{S}_{n,j} - g\mu_B h \sum_{<ni>} S^z_{m,i}$$





T. Giamarchi et al. Nature 4, 198 - 204

System and model Hamiltonian

We can rewrite spin Hamiltonian by boson operator.

Phase transition: BEC of magnon!

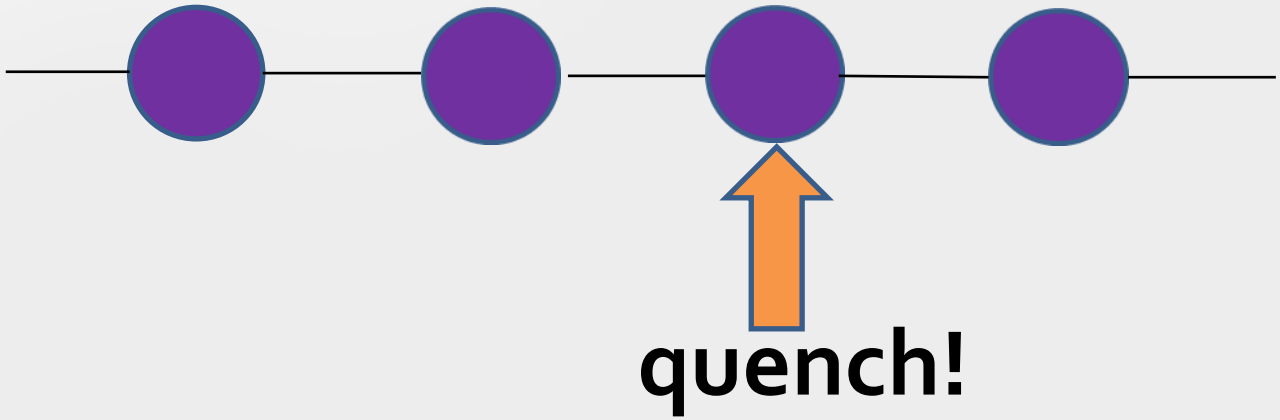
System: Bose-Hubbard model

$$
\begin{aligned}
H &= \sum -t(b_{i+1}^{\dagger} b_i + b_i^{\dagger} b_{i-1} + (h.c.)) \\
&+ \frac{U}{2} \sum b_i^{\dagger} b_i^{\dagger} b_i b_i \\
&- \sum \mu_i b_i^{\dagger} b_i \qquad \mu_i = g\mu_B h_i - \Delta
\end{aligned}
$$

Magnetic field acts as the chemical potential !

Problem setting

We study the evolution of the order parameter $< b_i >$ after magnetic field quench around the critical point, at a specific site.



Method: Truncated Wigner Approximation

- We apply truncated Wigner approximation(TWA) to the problem.
- TWA: describing the evolution of observables semiclassicaly.

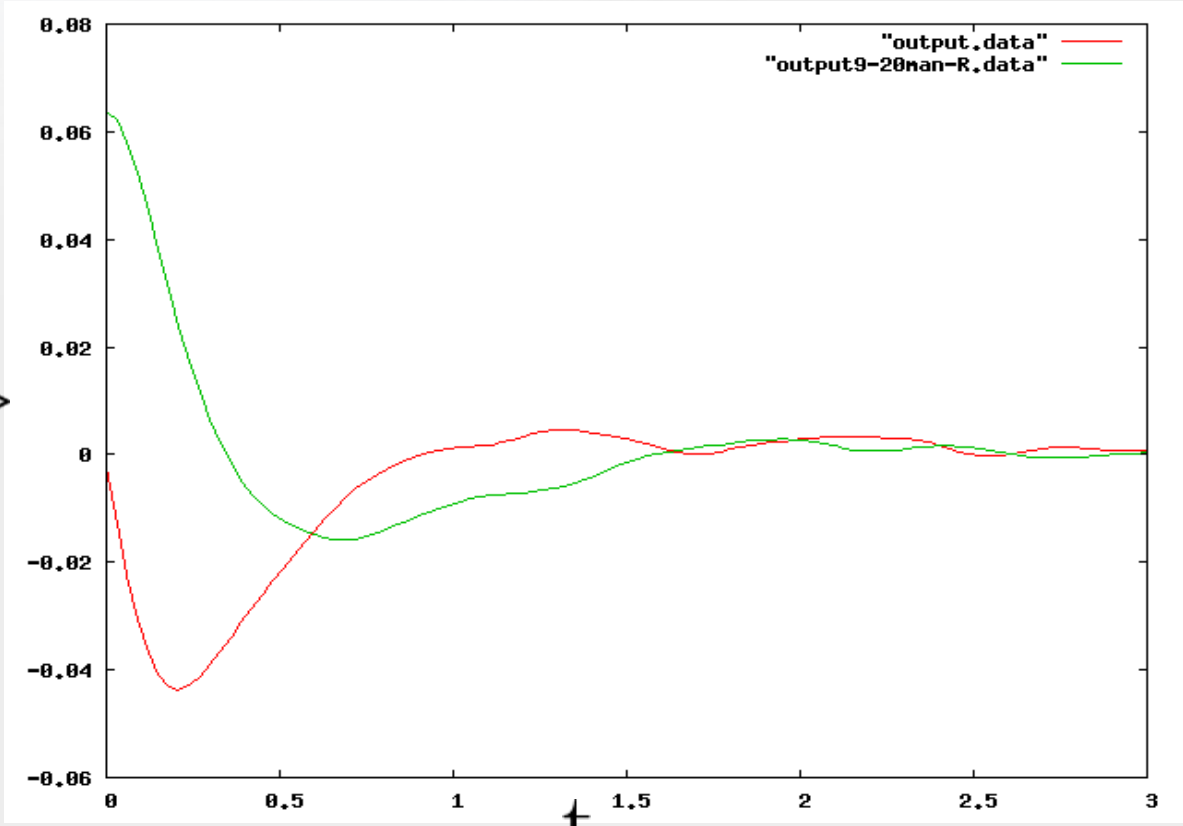
What's the meaning of "semiclassicaly"?

- Phase space variables evolves according to the classical tragectries.
- Fluctuation is considered in the initial condition.

Time evolution of the order parameter

- By using truncated Wigner approximation, we calculate $< b_i(t) >$ at the quenched site .

$< b_i >$



Summary and Future works

Summary

- We study the dynamics of magnon BEC after chemical potential quench, by using TWA.
- As a result, we observe the exponential decay of the order parameter describing magnon BEC.

Future works

- We have to understand this result more deeply.
- We should apply this scheme to the larger system.

Reference

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