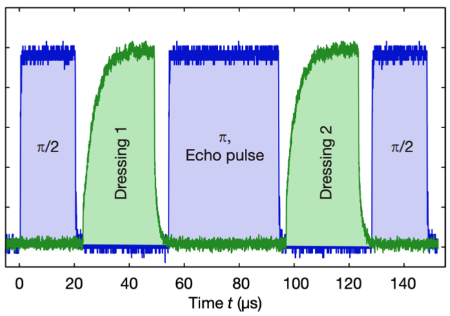
Results from Ising 1D chain simulation

> [20210303]
>
> Github

Ramsey/echo

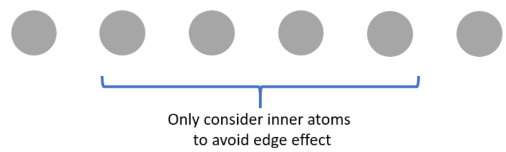


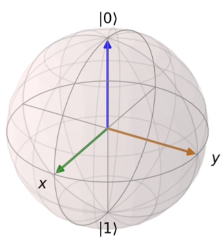
$\pi/2$: rotates around x axis

$$H_{int} = J_z \sum \sigma_z \cdot \sigma_z + B_z \sum \sigma_z$$

fluctuation

- Difference of two dressing pulses leads to global fluctuation but random from shot to shot





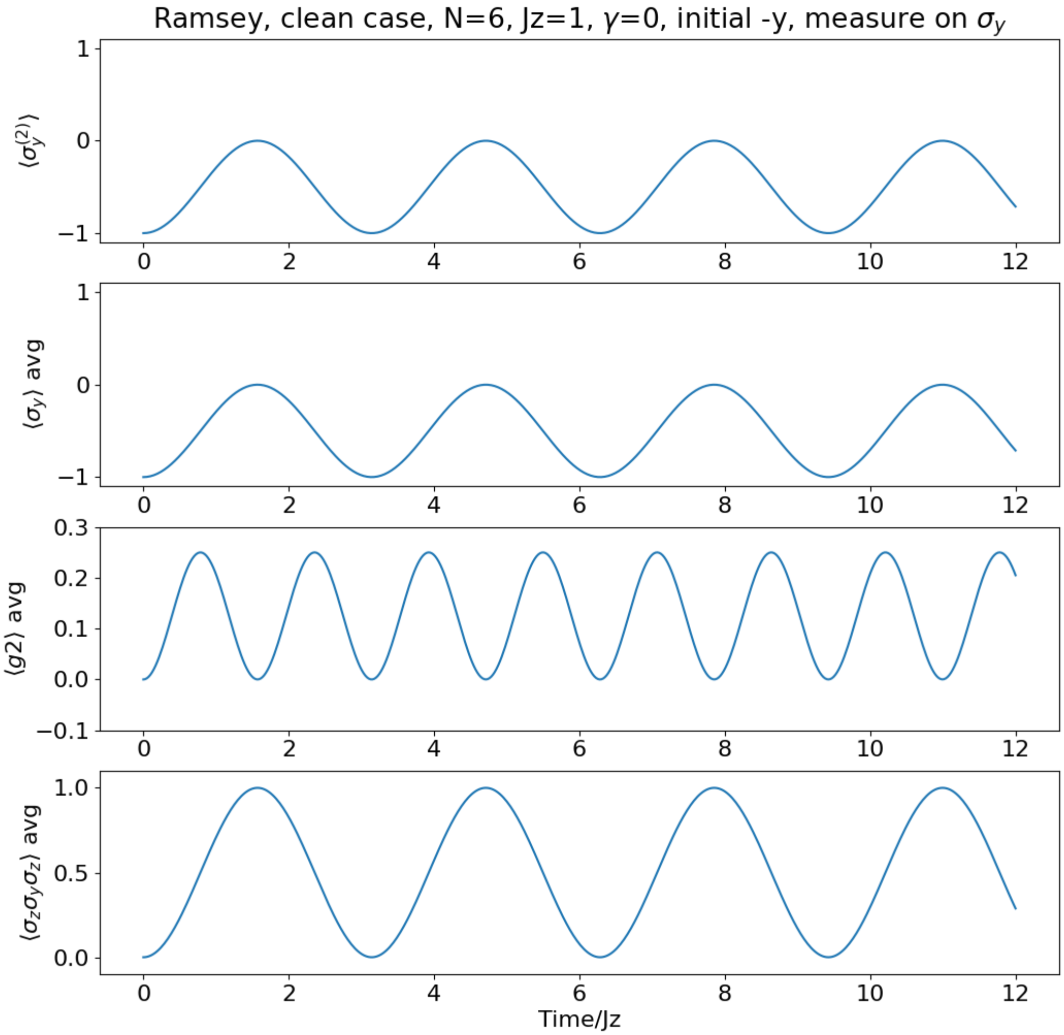
$$|-y\rangle \xrightarrow{H_{int}} \langle \sigma_y \rangle$$

Consider $\pi/2$ pulses by initially prepare $|-y\rangle$ and measure $\langle \sigma_y \rangle$ instead.

- Initial state $|-y\rangle$
- Random B_z
- Study $\langle \sigma_i \rangle, g2, \langle \sigma_z \sigma_i \sigma_z \rangle$

Clean case Ising interaction

- $H_{int} = J_z \sum_{<i,j>} \sigma_z \cdot \sigma_z$
- N = 6 particles and consider only inner particles to avoid edge effect.
- Initialy prepare atoms in $|-y\rangle = \frac{1}{\sqrt{2}}(|0\rangle - i|1\rangle)$.
- Only $\langle \sigma_y \rangle$ shows the dynamic of H_{int}.
- $\langle \sigma_z \sigma_y \sigma_z \rangle$ is multibody correlation for Cluster state. It oscillates at the same period as magnitization.

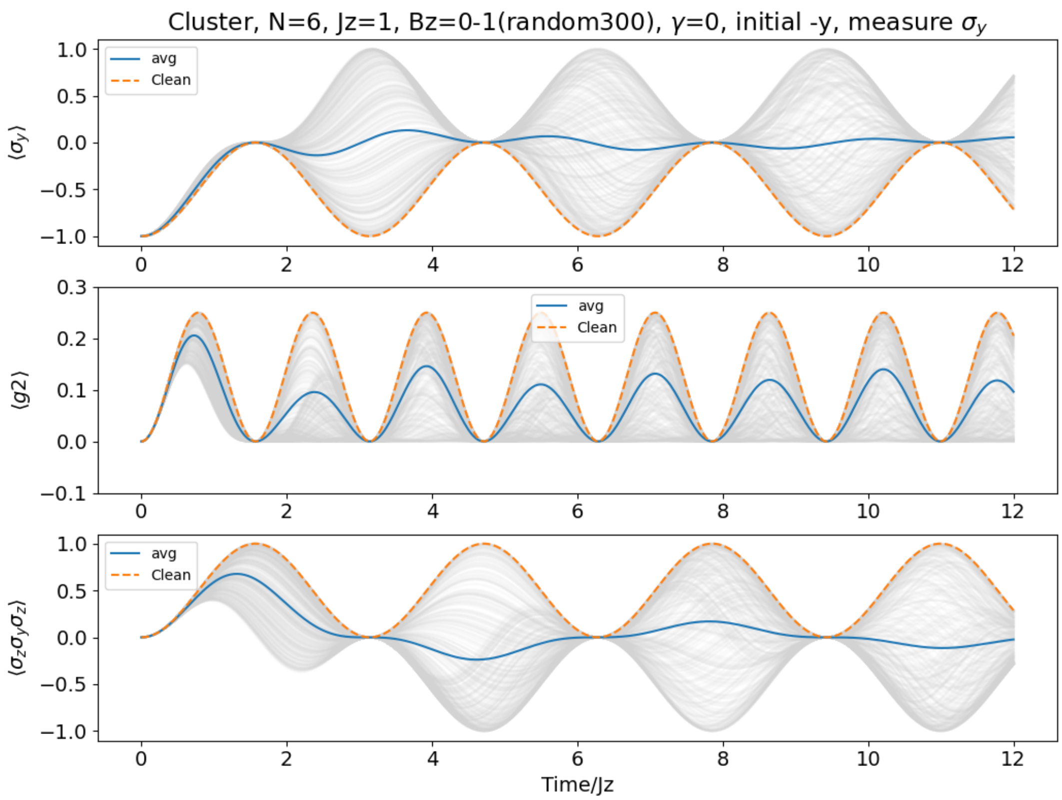


Put random fluctuation on Bz

- $H_{int} = J_z \sum_{<i,j>} \sigma_z \cdot \sigma_z + B_z \sigma_z$
- This is a global fluctuation phase but different between shot to shot leads to random vector on equatorial plane of bloch sphere.
- B_z is random between 0 to $0.1J_z, 1J_z, 10J_z$.
- Both $\langle\sigma_x\rangle$ and $\langle\sigma_y\rangle$ have a correlation dynamic but $\langle\sigma_z\rangle$ is not.
- Looking from measurement on both $\langle\sigma_x\rangle$ and $\langle\sigma_y\rangle$, the random phase makes the $\sigma_z \cdot \sigma_z$ interaction term cross-talk to both x and y basises. This also consistance with the decreasing of g2 on $\langle\sigma_y\rangle$ and appears on $\langle\sigma_x\rangle$.

1. $\langle\sigma_y\rangle$ measurement

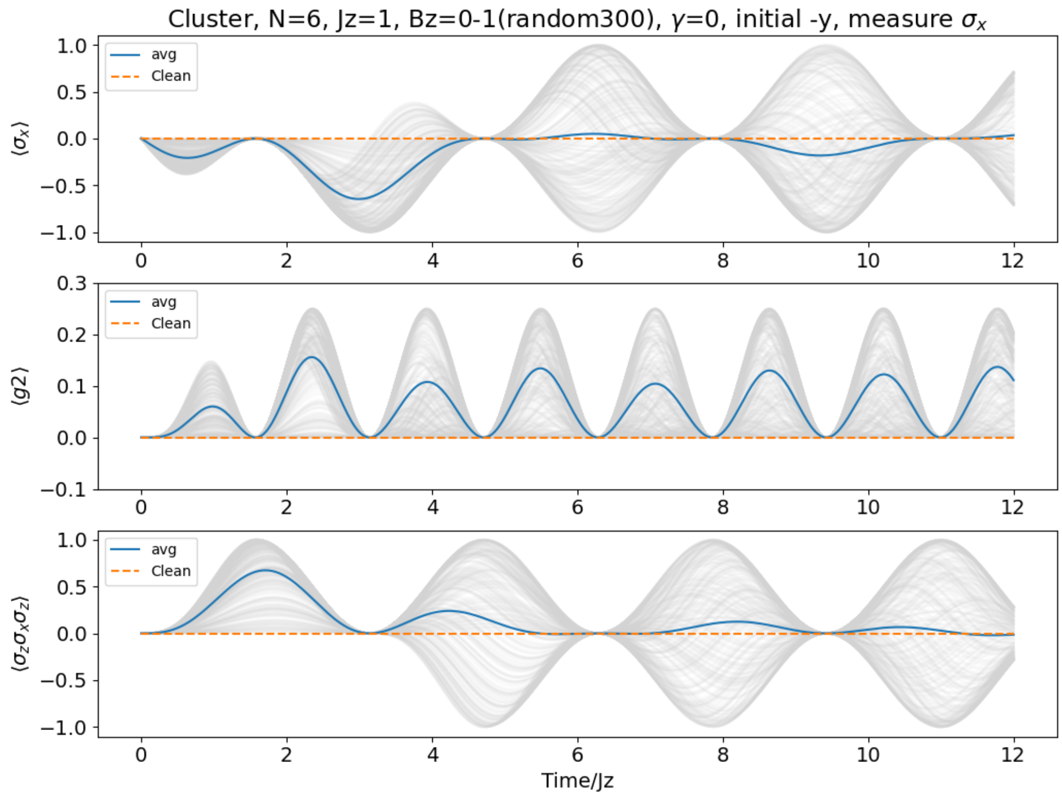
- Random phase makes total magnitization $\sum_i \langle \sigma_y^i \rangle$ go to zero.
- The g2 correlation due to $\sigma_z \cdot \sigma_z$ still survives but the mplitude reduces by factor of 0.5 and stays constant at fully random phase.
- $\langle \sigma_y^i \rangle$ plot has a signature loops where the envelope is governed by clean case (No B_z fluctuation). The minimum uncertainty are presented at the same position as zero magnitization for clean case (Can we use this to clame for entanglement state of the system in random phase case?).
- Multibody correlation is also disappear when the is fluctuation.
- Compare with Random phase where $J_z = 0$, $\langle \sigma_y^i \rangle$ plot shows fully uncertainty.



** gray lines show global dynamic where B_z different from shot to shot.

2. $\langle \sigma_x \rangle$ measurement

- Random phase makes total magnitization $\sum_i \langle \sigma_x^i \rangle$ stay at zero.
- The g2 correlation of $\langle \sigma_x \rangle$ is zero for clean case. In contrust, the g2 correlation appears and increases to 0.13(50% of clean case in $\langle \sigma_y \rangle$ measurement) on random phase.
- Multibody correlation is also disappear when the is fluctuation.
- The $\langle \sigma_x^i \rangle$ plot also shows the same signature loops as measured in $\langle \sigma_y^i \rangle$.



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Created in **Deepnote**