

# Harvesting mutual information from BTZ black hole spacetime

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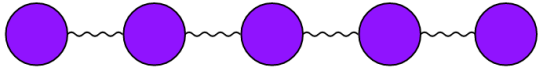


[arXiv:2205.07891](https://arxiv.org/abs/2205.07891) [quant-ph]

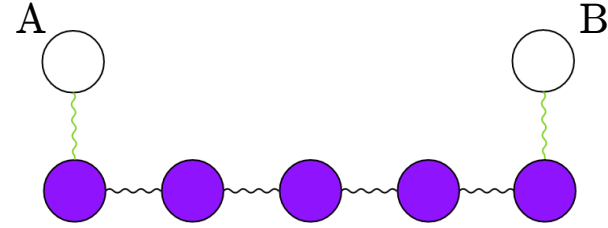
# WHAT IS ENTANGLEMENT HARVESTING?

## Entanglement harvesting

coupled harmonic oscillator



The ground state is entangled



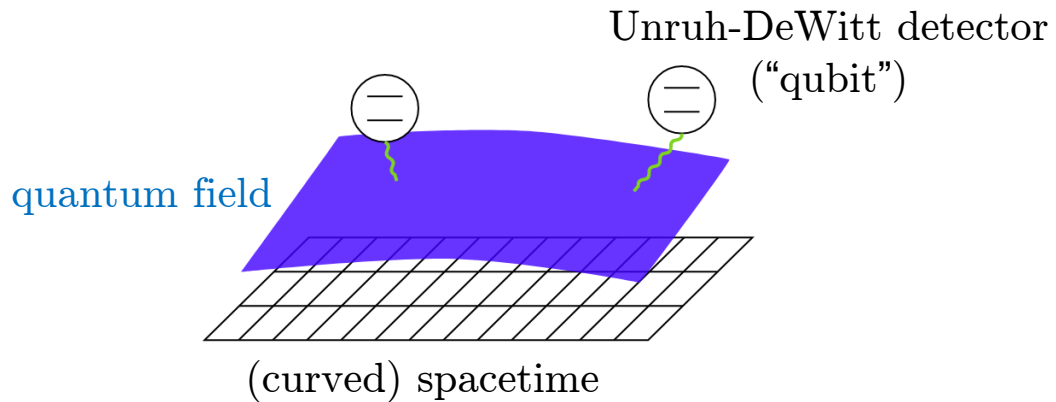
Coupling particles A and B through the chain



A and B entangle = extraction of entanglement from the chain  
entanglement harvesting



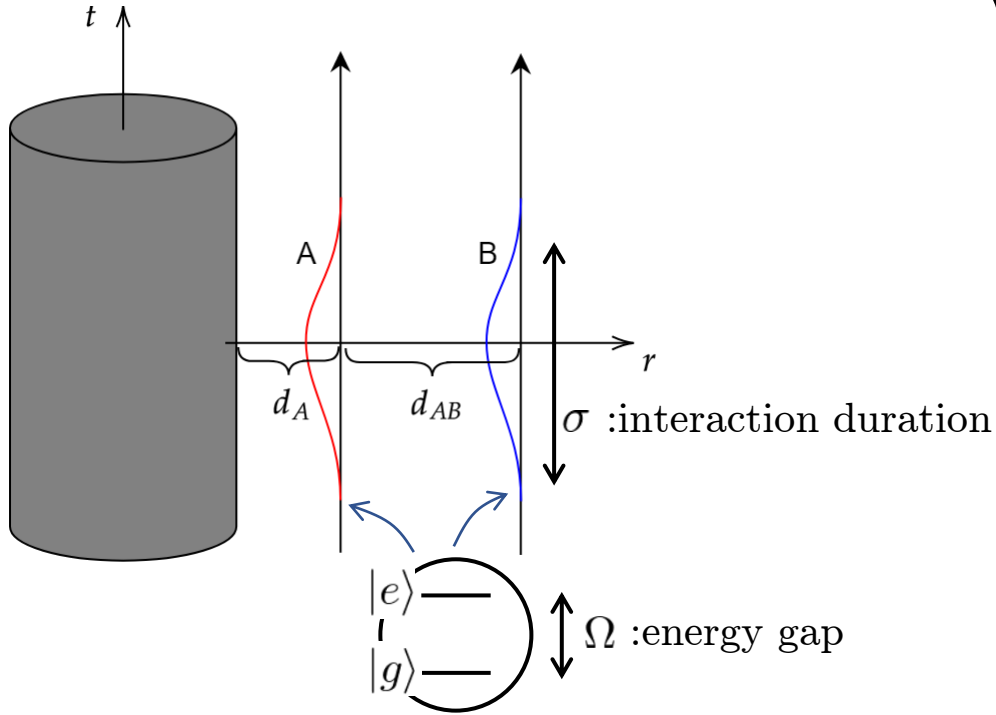
## In the context of QFT



- The quantum field is in entangled state even in the vacuum
- Multiple particle detectors (qubits) extract entanglement
- Background geometry affects the amount of extracted entanglement

# ENTANGLEMENT HARVESTING IN BTZ SPACETIME

BTZ black hole and detectors A and B



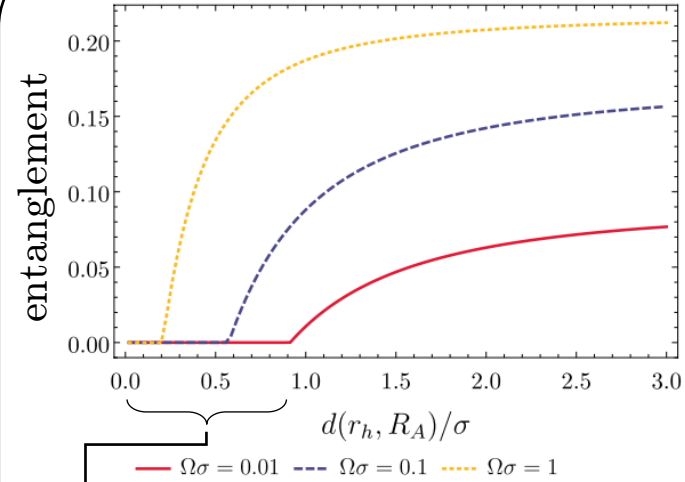
BTZ spacetime: (2+1)-dim. black hole

$$ds^2 = -\left(\frac{r^2 - r_h^2}{\ell^2}\right) dt^2 + \left(\frac{\ell^2}{r^2 - r_h^2}\right) dr^2 + r^2 d\phi^2$$

Two detectors A, B are static outside a BH, interacting with a quantum field



Previous paper



“entanglement shadow”: if detector-A is too close to the horizon, entanglement cannot be extracted

Henderson et al., Class. Quantum Grav. 35, 21LT02 (2018)



reason

- Gravitational redshift
- High Hawking temperature

# MUTUAL INFORMATION HARVESTING IN BTZ SPACETIME

## Motivation

The reasons for “entanglement shadow” were

- Gravitational redshift
- High Hawking temperature

But which one actually “kills” correlation near the BH?



our paper

Separate redshift and temperature effects and see how they affect the total correlation (called “mutual information”)

mutual information

classical correlation

quantum correlation

- entanglement

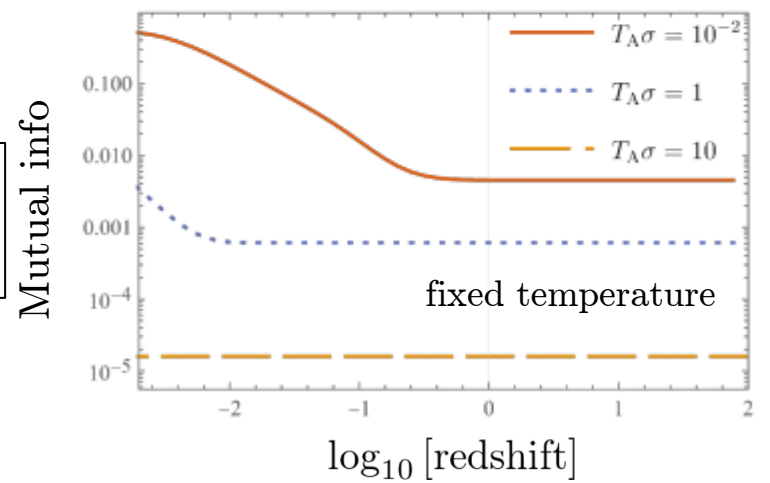
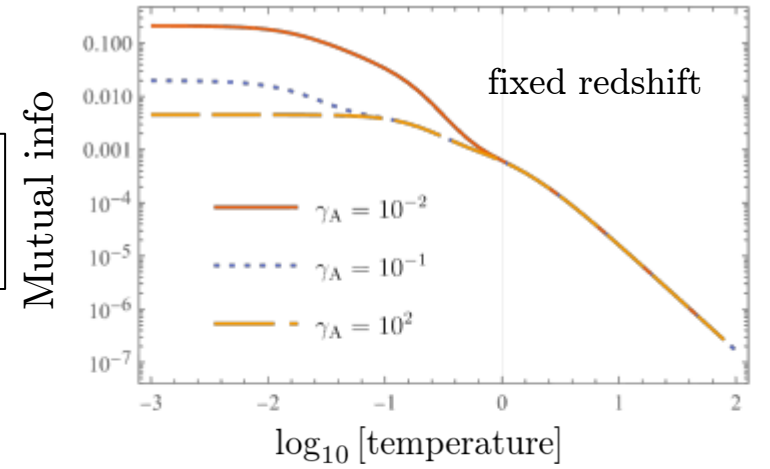


results

## Results

High Hawking temperature kills correlation

Correlation is nonzero for all values of redshift



It is intense Hawking radiation that kills mutual information!