

GPPU PROGRESS REPORT

“INFORMATION ON SPACETIME STRUCTURE”



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MY RESEARCH

➤ Our spacetime is described by Riemann geometry (i.e. metric $g_{\mu\nu}$ (+boundary)).

➤ How to know this spacetime structure ?

➡ Let us consider a quantum field theory on the spacetime.

$$\Rightarrow g_{\mu\nu} \propto \lim_{x \rightarrow y} \frac{\partial}{\partial x^i} \frac{\partial}{\partial y^j} (G(x, y)^{\frac{2}{2-D}})$$

thus if we let a detector run on the spacetime and measure the green functions of “**ALL POINTS**”, we can know exact structure of spacetime in principle. (Not realistic !!!)

➤ We are going to construct the “**Detectors Network**”.

- Detectors connect (interact) each other and exchange their information.
- Some machine learning technics to optimize interactions (field to detector & detector to detector) including detectors trajectory.

SO FAR, AND PLAN

➤ So far

We investigate the how to storage the information on a collapsing star in a black hole evaporation process.

[arXiv:1906.05009]

I presented this research in RQI-N-2019 (Relativistic Quantum Information-North) in Taiwan.

➤ Goal (in GPPU term)

Construction of the detectors network and knowing the principal limitation of detection (efficiency, fidelity etc...).

➤ Problem

machine learning including quantum process (QML) has not been clear yet. Many people suggest many variety of QML...

➡ We must consider an appropriate QML to our network.

PROGRESS TO DATE

- We now consider some toy models using Quantum Circuit which imitate the detector network and let this circuit learn.
(now proceeding)
- Our group find the inequality about a fundamental upper bound for signal to noise ratio of quantum detector.
(manuscript in preparation)
⇒ Maybe useful for our detector network.
- We find the duality between “entanglement harvesting” on conformal equivalent spacetimes.
(this work is collaboration with Waterloo univ. group)
(manuscript in preparation)

OVERSEAS WORK

THIS YEAR

- RQI-N 2019 school and conference in Taiwan.
- I went to the Waterloo University in Canada and worked with Achim Kempf group.
 - ⇒ **new collaboration projects start !!**

NEXT YEAR

- RQI 2020 in Australia on February.
RQI-N 2020 in Greece on June.
- I will go to Canada and proceed some projects. (TBD...)