Isometry of spacetime and Killing tensor field on orbit space:

A spacetime admitting isometry admits the Killing vector field generating the infinitesimal isometry. We can introduce an appropriate metric on the orbit space which is the set of the orbits under the action of the isometry. In some cases, subgroup of the isometry of the spacetime can be also the isometry of the orbit space. Such orbit space admits Killing vector field.

It is known that some orbit space constructed from the maximally symmetric spacetime admits not only Killing vector field but also irreducible Killing tensor filed. This Killing tensor field comes from a conformal Killing tensor field on the maximally symmetric spacetime. In this case, the conformal Killing tensor field is reducible and can be written by the tensor product of the Killing vector fields on the maximally symmetric spacetime. It can be interpreted as a partial breaking isometry of the spacetime.

I will study such Killing tensor field on orbit space. I will investigate a condition for existence of an irreducible Killing tensor field on orbit space and explore the possibility of reconstruction of the well known irreducible Killing tensor field on Kerr spacetime as a Killing tensor field on orbit space.

Categorical quantum mechanics and linear logic:

Categorical quantum mechanics pioneered by Abramsky and Coecke is a formalism for quantum mechanics based on category theory. Category with Hilbert spaces as objects, and linear operators as morphisms is considered there. The formalism succeeds to capture quantum information protocols such as quantum teleportation.

On the other hand, category with propositions as objects, proofs as morphisms is considered in categorical semantics. Although it seems that these are unrelated to each other at a glance, they have common structure in view of category theory. For example, rule of contraction "A -> A,A" which means duplication of information is allowed in classical logic but is rejected in linear logic.

It is pointed out that the duplication of information by contraction corresponds to duplication of quantum state: "|A> -> |A>|A>". Non-cloning theorem may imply that one must use logic without contraction to describe the structure of quantum mechanics. Using partial structure logic, such as linear logic, I will try to redescribe quantum physics.