Integrability of cohomogeneity one Nambu-Goto string and Killing tensor field:

A spacetime admitting isometry admits a Killing vector field generating the infinitesimal isometry. We consider a string whose world sheet is tangent to a Killing vector field of the target space --- so-called cohomogeneity one string.

A cohomogeneity one Nambu-Goto string can be described by an ordinary differential equation, which is the geodesic equation with respect to an appropriate metric on the orbit space which is the set of the orbits identified under the action of the isometry. This is equivalent to Hamiltonian system whose Hamiltonian is the metric, and the system is integrable if a sufficient number of conserved quantities exist.

The orbit space corresponding to the cohomogeneity one Nambu-Goto string in a maximally symmetric spacetime admits a sufficient number of Killing vector fields and irreducible Killing tensor fields. These Killing tensor fields on the orbit space come from conformal Killing tensor fields on the maximally symmetric spacetime. In this case, the conformal Killing tensor fields are reducible and can be written by the linear combinations of the tensor products of the Killing vector fields on the maximally symmetric spacetime. It can be interpreted as partial breaking of isometries of the spacetime.

In general, not all of cohomogeneity one strings in non-maximally-symmetric spacetime are integrable. There are interesting examples. $T^{p,q}$ ($pq \neq 0$) spaces where all geodesics are integrable but cohomogeneity one strings are not. A sub-maximally-symmetric space with Fubini-Study metric where all cohomogeneity one strings are integrable. I will investigate the condition for integrability of all cohomogeneity one strings or existence of irreducible Killing tensor fields 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.