Integrability of cohomogeneity one Nambu-Goto string:

The motion of point particles are described by geodesics in a spacetime. The geodesic equation is equivalent to the dynamical system whose Hamiltonian is spacetime metric, and so the existence of a sufficient number of conserved quantities makes the system integrable. Geodesics in a spacetime admitting Killing vector fields are integrable if a sufficient number of the conserved quantities associated with the Killing vectors exists. Kerr spacetime admits only two Killing vectors, whereas the geodesics are integrable. This is well-known as an example of ″hidden symmetry″ generated by a second order Killing tensor field.

Similarly as hidden symmetry corresponding the motion of point particle (0-dimensional object), there maybe exists another ″hidden symmetry″ corresponding the motion of string (1-dimensional object). So, we consider the hidden symmetry assuring that the motion of string is integrable.

Nambu-Goto string described by the action proportional to the area of the world sheet of the string is a natural generalization of geodesic. The condition that all Nambu-Goto strings are integrable is too strong, and it is difficult to treat. So, we limit our consideration to cohomogeneity-one string (a string whose world sheet is tangent to a Killing vector field of the target space). All cohomogeneity-one strings in the maximally symmetric spacetimes are integrable, that is not the case for the quasi maximally symmetric spacetimes. We investigate the criterion whether all cohomogeneity-one strings are integrable or not.

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.