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. We also extend the discussion to integrability of cohomogeneity-one membranes.

Loop quantum gravity and complexity:

Loop quantum gravity (LQG) is an approach to non-perturbative and background independent quantization of general relativity. Spin-network states span the kinematic state space of LQG as an orthonormal basis. Spin-network state is labeled with spin-network, which is a graph whose edges are colored by half integers satisfying simple relations at the vertices. In LQG, Geometrical operators (area operator and volume operator) are constructed. Their eigenstates are spin-network states and they have discrete eigenvalues.

From informational viewpoint on volume operator in LQG, following conjecture is suggested: A logic gate must have finite minimum volume, and number of logic gates contained within a region of space are bounded by the volume of the region.

It seems to say “Complexity is Volume.”

We want to consider the possibility of LQG as a foundation where complexity is discussed.