

Plan of My Research

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I study supergravities which are low-energy effective theories of string theories. A first goal is to solve higher-dimensional gravitational theories and construct a cosmic model well describing our universe, especially in the frame of string theories or supergravity theories. In particular, I try to construct a model which enable us to determine not only spectra but also absolute value of for the cosmic microwave background (CMB).

To do this, what we have to do first is to solve supergravity theories. In this study, with use of Killing-Yano symmetry with torsion, we calssify exact solutions in supergravity theories. This symmetry is known as “Hidden Symmetry” of balck hole spacetimes and there are many works on Killing-Yano symmetry without torsion. Black holes in four dimensions have a remakable property that the spacetime is uniquely given if given a mass, angular momoenta and charge. However, in higher dimensions than five, this “uniequeness theorem” doesn’t hold. The idea of Killing-Yano symmetry plays an imprtant role. Indeed, if we impose Killing-Yano symmetry without torsion to a spacetime, then the symmetry strongly affects the spacetime and the spacetime is uniquely determined. In supergravity theoreis there are several matter fields, we must consider the effects from these matters, but the effects can be often regarded as torsion. Therefore, it is natural to consider the notion of Killing-Yano symmetry with torsion. In this way, I classify spacetimes in the unified study of symmetry and make a list of exact solutions in supergravity theories.

The study of Killing-Yano symmetry with torsion is interesting as one of approaches to “problem of compactification” in supergravity theories. Since supersymmetry is required in supergravity theories, spacetimes are strongly restricted from symmetry. There is an possibility not only to classify spacetimes but also to construct exact solutions concretely. It is known, in particular, that compact Eistein’s manifolds obtained by compactification of string theories are classified by both the Killing-Yano symmetry with torsion and a certain condition. On the other hand, it was pointed out that by taking a BPS limit of vacuum rotating black holes, we can obtain compact Einstein’s manifolds. According to recent works, it was found that “Hidden symmetry” such as Killing-Yao of higher-dimensional black holes exist behind this construction. For this reason, in this study, I construct compact manifolds appearing in supergravity theories from higher-dimensional black holes.