Summary of Reseach Achievements

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As a solution of Einstein's gravity theory, there is a black hole solution discovered by Chen, Lü and Pope. This solution describes rotating balck holes in a vaccum of higher-dimensional (A)dS spaces, which is called higher-dimensional Kerr-NUT-(A)dS black hole. In some symmetries of such a black hole spacetime, I have studied Killing-Yano symmetry and obtained the following results:

- I examined curvature properties of the higher-dimensional Kerr-NUT-(A)dS black hole spacetime [1].

- I demonstrated that the geodesic equation on spacetimes with Killing-Yano symmetry can be solved by separation of variables. This means, when we consider motion of free particles, the orbits are fully characterized by first integrals. In particular, the obtained first integrals include nontrivial ones which can't be responsible for isometries of the spacetime [2].

- I obtained metrics of spacetimes with Killing-Yano symmetry.

  - I showed that if and only if Killing-Yano symmetry is not degenerate, the metric is written in the form (see [8])

$$\mathrm{d}s^2 = \sum_{\mu=1}^{n} \frac{\mathrm{d}x_\mu^2}{Q_\mu} + \sum_{\mu=1}^{n} Q_\mu \Big(\sum_{k=0}^{n-1} A_\mu^{(k)} \mathrm{d}\psi_k \Big)^2 + \varepsilon S \Big(\sum_{k=0}^{n} A^{(k)} \mathrm{d}\psi_k \Big)^2 .$$

    Furthermore, I showed that if we impose Einstein's vacuum equation, the spacetime is uniquely determined by the metric found by Chen, Lü and Pope [3].

  - I derived that if Killing-Yano symmetry is degenerate, the spacetime has a structure of fiber bundle. It is a spacetime where the Kerr-NUT-(A)dS black hole is fibered on a direct product of some Kähler manifolds [4,5].

Since it was pointed out that a generalization of Killin-Yano symmetry, introduced by Kubizňák, Kunduri and Yasui, exists in various black hole spacetimes appearing as solutions of supergravity theory, there are incresingly strong moves to understand symmetry of black holes from a more unified view point. Then, I examined general properties of spacetimes admitting this generalized Killing-Yano symmetry and presented some results about integrability of geodesic equations [7] and the properties to several operators [6].

The above results are summarized in the review paper [8].