(2-2) 今後の研究計画 (英訳文)

■ *Stability Analysis of Squashed Kaluza-Klein Black Holes with Charge*

The effective theories reduced from unified theories based on string theory usually contains not only gravity but also gauge fields. So it is useful to consider the black holes with gauge field to understand such the effective theories. The simplest such solution is four and higher dimensional Reissner-Nordström black holes associated with a $U(1)$ gauge field. The stability of higher dimensional Reissner-Nordström black holes were studied by A.Isihbashi and H.Kodama. They also showed that the perturbation equation reduced to single master equations even in the case where perturbation of the metric and the electromagnetic field are coupled. Recently, H.Ishihara and K.Matsuno constructed squashed Kaluza-Klein black holes with charge in five dimensional Einstein-Maxwell theory. This solutions have the $SU(2) \times U(1)$ symmetry as same as neutral squashed Kaluza-Klein black hole, so we can use the same techniques in [8][9] to analyze the perturbations of squashed Kaluza-Klein black holes with charge. I would like to study the stability of squashed Kaluza-Klein black hole with charge by extending the analysis in [8][9].

■ *Kaluza-Klein Black Holes in Odd Dimensions.*

The angular part of five-dimensional black holes is three-dimensional spaces, usually the three sphere S^3. S^3 have a structure of S^1 bundle over S^2, called the Hopf bundle. The technical reason why we can construct the exact black hole solutions in five-dimensional space-times with a compactified extra dimension as discussed in refs. [1][2][5][10] is that the angular parts of five dimensional black holes can have the Hopf bundle structure. Note that the direction of S^1 corresponds to the that of a extra-dimension.

I would like to extend the analysis in five dimensional case to odd dimensional case larger than five. Since it is known that odd-dimensional spheres $S^5, S^7 \cdots$ have also Hopf bundle structures, we expect that the situation is like five-dimensional case. In fact, if there are no black holes, we can construct similar solutions as like five dimensional case, which are called higher-dimensional Kaluza-Klein monopoles. However, by now, the exact black hole solutions have not been found. The only previous study is the numerical work where the existence of black hole horizon were confirmed in seven dimensional case.

As a first step, we would like to consider the case where the mass of the black hole is equal to its charge. In such the case, the Einstein equation and the Maxwell equation reduce to the Laplace equation on higher-dimensional Kaluza-Klein monopole. So it is expected that the we can analyze the geometrical structures of black holes as like five dimensional case.