Summary of my research

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(1) "Quasi-normal frequency of black holes in superstring theory"

In string theory, black holes are considered to be described using D-branes. We investigated quasi-normal frequencies of such D-brane black holes. Especially, we derived quasi-normal frequencies of D3-brane black holes and showed that those frequencies have almost the same qualitative behavior with those of the corresponding black brane solutions in supergravity. This result supports AdS/CFT correspondence in string theory. (This work was reported in the paper labeled as [1] in my lists of publications.)

(2) "CFT description of three dimensional Hawking-Page transition"

According to AdS/CFT correspondence in string theory, it is claimed that gravitational theory on Anti-de Sitter (AdS) spacetime is equivalent to conformal field theory. One of gravitational phenomena in AdS spacetime is so-called Hawking-Page transition, which is transition between thermal AdS spacetime and AdS black hole with heat bath. We constructed a CFT model describing the three-dimensional Hawking-Page transition, indicating the possibility that quantum effect makes the Hawking-Page transition no phase transition. ([2])

(3) "Thermodynamics of black objects in lower dimensional brane-world"

We investigated thermodynamic properties and stability of black hole and black string solutions in lower dimensional brane-world found by Emparan et al. It was shown that, in the lower dimensional brane-world, the black string connecting two branes is thermodynamically more preferable than brane-localized black holes. Furthermore, we found that there is phase transition between the black string and the brane configuration without black hole, which corresponds to the Hawking-Page transition in brane-world. ([3])

(4) "Quasi-normal modes in acoustic black hole at low temperature"

There are many researches investigating field theory on curved spacetime, using analogy between field on curved spacetime and excited field on fluid. In order to verify such an analogy in Bose-Einstein condensates directly, we proposed a method using quasi-normal frequencies. Concretely, quasi-normal frequencies of acoustic black holes in Bose-Einstein condensates was investigated. It was shown that analogous black hole spacetime can be distinguished and the analogy can be verified by detecting the quasi-normal frequencies. ([4])

(5) "Cylindrically symmetric gravitational collapse"

It is known that, in cylindrically symmetric null dust collapse, tidal force of freely falling observer diverges at cylindrically symmetric axis. In this sense, a naked singularity is formed. We showed that, if the boundary condition that null dust pass through the symmetric axis imposed, radial geodesics hitting the singularity along the axis can be extended uniquely. ([5])

Furthermore, applying this boundary condition, we investigated cylindrically symmetric gravitational collapse of thick dust shell numerically, and constructed a numerical solution describing singularity formation and resolution in cylindrical gravitational collapse. ([6])