Research plans

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- **Hawking radiation from four-dimensional Einstein-Gauss-Bonnet black holes and four-dimensional loop quantum gravity ones based on a generalized uncertainty principle**

We consider the Hawking radiation with the quantum gravity effects inspired from the modification on the commutation relation of the matter field in the fixed Kaluza-Klein background geometry [25]. When the black hole mass approaches the order of the Planck mass due to the radiation, it would be expected that some quantum gravity effects would lead to some quantum fluctuations in the background metric. In four dimensions, such modified background geometries would be given by the quantum deformed Schwarzschild black holes and the black holes in the noncommutative model, the asymptotically safe gravity and the loop quantum gravity. Since these black hole solutions are analogous to the Reissner-Nordström solution, the quantum corrections in these frameworks affect things in the same way as the black hole charge. If there would exist a correspondence between the charged Kaluza-Klein black holes with squashed horizons and some quantum-corrected black holes in five dimensions, the black hole charge in the squashed Kaluza-Klein spacetime might have something to do with the very structure of the spacetime manifold and result in some quantum fluctuations in the background geometry as a quantum gravity effect. Moreover, if we take into account the effect of the emitted particle's self-gravitation in the Hawking evaporation process, the mass and the charge of the black hole may decrease to satisfy the energy conservation. Then the background metric may become dynamical by the backreaction effect of the quantum tunneling radiation. We might regard such a dynamical geometry associated with the radiation as a modified background spacetime with some quantum fluctuations. Then we study the Hawking radiation from the four-dimensional Einstein-Gauss-Bonnet black holes and the four-dimensional polymerized loop quantum gravity ones by the tunneling of charged scalar particles [26, 27]. In contrast to the previous studies of Hawking radiation from these black holes, we consider the phenomenological quantum gravity effects predicted by the generalized uncertainty principle with the minimal measurable length.

- **Soliton accelerations, stationary flows and plasma oscillations in a magnetic field**

The magnetic field plays important roles in most astrophysical phenomena. It would be possible to generalize the soliton acceleration mechanism [23] in the environment of nonvanishing magnetic field. We propose an acceleration mechanism of charged particles using nonlinear density waves propagating in an ion-electron plasma in a radial magnetic field [28]. Moreover, to explain the observations of the cosmic rays, it is important to investigate the fully nonlinear solutions for the ion-acoustic waves rather than the weakly nonlinear wave solutions described by the Korteweg-de Vries equation. Then we investigate behaviors of such ion-acoustic solitons and shocks in plasma [29], and stationary flows, plasma oscillations and electric fields around compact objects in two-component plasma [30].