Research plan

I have been working on theoretical researches for gravitational wave physics so far. I would like to promote these researches to gain a deep understanding of various phenomena in the universe by using gravitational waves, and would like to contribute the progress of gravitational wave astronomy.

I plan to work on the following topics.

Self-force effects on unbound orbits in black hole spacetime

In my past works, I mainly focused on the self-force for bound orbits. I am planning to extend the self-force calculation to unbound case. In addition, I will try to apply the self-force corrections to unbound orbits to calibrate the undetermined potantial functions of the effective-one-body model.

Secular evolution of a spinning particle

In my previous works, I calculated the secular variations of the orbital parameters in Kerr geometry under the adiabatic approximation. The calculation was done assuming the orbiting particle is spinless. To investigate the effect of the particle's spin on the orbital evolution and the emitted gravitational waves, I will extend the calculation to a spinning particle orbiting a Kerr black hole.

Self-force calculation in Kerr geometry

The strategy for calculating the self-force effect in the framework of black hole perturbation theory is as follows:

(1) Calculate the perturbation induced by a particle moving along the background geodesic.
(2) Derive the self-force from the calculated perturbation.
(3) Extract the orbital corrections from the self-force data.

In my previous works, I succeeded to implement the scheme to a numerical code in Schwarzschild case. I would like to extend the implementation to Kerr case.

Construction of the waveform template for data analysis

The accurate prediction of theoretical waveforms is essential to the matched filtering analysis to search gravitational wave signals. I am planning to work on the construction of waveform templates focusing on binaries with extreme mass ratio, based on the black hole perturbation theory. In addition, I would like to develop a method of data analysis making use of the template bank.

According to the approval of the Laser Interferometer Space Antenna (LISA) for a L3 mission of European Space Agency in 2017, the international consortium, consisting of scientists involved in LISA, have been reorganized for the future phase of the mission. I participate in the consortium as a member of a science group in the LISA Japan. I would like to contribute the LISA mission through collaborations in the consortium and to show the presence of the Japanese group in gravitational wave astronomy.

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