Japan Geoscience Union Meeting 2010
(May 23-28 2010 at Makuhari, Chiba, Japan)

PEM031-07 Room: Exibition hall 7 subroom 1 Time: May 24 10:18-10:30

Generalized GRMHD equations and their suggesting peculiar phenomena of plasmas around black holes

Shinji Koide[1*]

[1]Kumamoto University

To study phenomena of plasmas around black holes, we have derived a set of 3+1 formalism of generalized general relativistic magnetohydrodynamic (GRMHD) equations using the general relativistic two-fluid approximation [1].
The generalized general relativistic Ohm's law of the equations clearly shows the electromotive forces due to the gravitation, centrifugal force, and frame-dragging effect in plasmas near the black holes. Among these electromotive forces, the gravitational electromotive force can cause the magnetic reconnection even in a case with zero resistivity. The gravitational magnetic reconnection requires the charge separation at the reconnection point. It has been believed that averaged effective charge of such charge separation is reduced to be zero because of plasma oscillation caused by the net charge.

Here, we report a linear analysis of the charge separation oscillation in a plasma disk around a Schwarzschild black hole on the basis of the generalized GRMHD equations. It clarifies that the plasma charge separation is unstable when the wave number is larger than a certain critical limit. This result suggests that we can not assume the charge quasi-neutrality of plasma around black holes and very complex and energetic phenomena may be caused by the complex charge structure.
In my talk, I will present peculiar phenomena of plasmas near black holes suggested by the generalized GRMHD equations.

[1] S. Koide, Astrophys. J. 708, 1459 (2010).

Keywords: black hole magnetosphere, general relativity, plasma oscillation, accretion disk, generalized GRMHD equations