E111-P009 **Room: Poster Session Hall** **Time: May 20**

Relativistic magnetic reconnection including radiative cooling effect

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In the field of the astrophysical plasma, magnetic reconnection is an important process when thinking of the dynamics of the systems, especially from the view of the energy release of the magnetic field in a short period of time. It is indeed the well-known phenomenon which affects different parts of solar-terrestrial physics from microscopic to macroscopic scales. On the other hand, it is also thought to be a key process to solve outstanding problems related to the compact astronomical objects such as neutron stars. Among others, sigma-problem in the pulsar magnetosphere is the longstanding problem in high-energy astrophysics, which is to say, the mechanism to convert electromagnetic energy to particle kinetic energy is not known, though magnetic reconnection is generally believed to be concerned with the energy dissipation process there, in varying degrees. Additionally, magnetic reconnection in conjunction with relativistic effects is not fully understood, and this effect, usually not negligible around the compact objects due to the strong magnetic field, might play a significant role. Furthermore, radiative effect can also be important because energy loss of the plasma by synchrotron emission is inevitable under such strong magnetic field. Thus it is a crucial issue to evaluate the efficiency of the energy conversion quantitatively caused by the magnetic reconnection under highly relativistic regime, including radiative cooling.

In this study we performed two-dimensional simulations using relativistic two-fluid plasma code, in which positron fluid and electron fluid are developed independently (pair plasma is assumed) and Maxwell equations are fully solved. Radiation effect is also included on the simplified assumption, such as optically thin situation. We will show various simulation results and discuss about the dependency on sigma (ratio of electromagnetic energy to plasma kinetic energy) or radiative cooling time scale.