5th Asia-Pacific Conference on Plasma Physics, 26 Sept-1Oct, 2021, Remote e-conference

# Ion and Electron Heating/Acceleration in Magnetic Reconnection

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Magnetic reconnection plays a crucial role in converting electromagnetic energy into plasma energy. The magnetic energy is mostly converted to the ions, and experiments have shown that the ion temperature gain in the downstream region is proportional to the square of the reconnecting magnetic field component, and the guide field does not affect the bulk ion heating [1, 2]. Electrons are accelerated by the reconnection electric field in the separatrix and X-line regions [3]. The magnetic reconnection mechanism that produces high ion temperature plasmas using plasma merging of two spherical tokamak plasmas has been proposed to create the initial fusion plasmas in the fusion reactors.

To understand the key magnetic reconnection experimental results, we have developed theoretical models and performed PIC simulations of magnetic reconnection to understand mechanisms of ion and electron heating/acceleration and reconnection layer structure for driven magnetic reconnection in 2-1/2 dimensional collisionless plasmas [4-7]. The theoretical models allow to compute the plasma and electric field and magnetic field structures in the current sheet and downstream region. From the electric and magnetic field structures we will discuss how ions and electrons gain energy for both small and large guide field cases. We can also achieve analytic results which agree reasonably well with both the PIC simulation results. In particular, we will show that ion energy in the downstream region is proportional to $B_{rec}^2$ where $B_{rec}$ is the reconnecting magnetic field component for both small and large guide field cases, however, with different physical mechanisms. The electron energy is associated with the reconnection electric field, but with different physical mechanisms for small and large guide field cases. Comparison between theory and experiments will be discussed.

**References**

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