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Impulsively Fast Magnetic Reconnection in Solar Flares and Coronal Mass Ejections and in Laboratory Plasma Merging Experiments
CHIO Z. CHENG, Plasma and Space Science Center, National Cheng Kung University, Taiwan, YASUSHI ONO, Department of Advanced Energy, University of Tokyo, Japan, YA-HUI YANG, Institute of Space Science, National Central University, Taiwan, GWANGSON CHOE, Department of Astronomy and Space Sciences, Kyung Hee University, Korea — Impulsively fast magnetic reconnection has been shown to be the major mechanism responsible for explosive flare non-thermal energy release and acceleration of coronal mass ejection (CME) motion. It has been observed that for most large solar flares non-thermal emissions in hard X-rays (HXR) and millimeter/submillimeter waves impulsively rise and decade during the soft X-ray (SXR) emission rise phase. Moreover, the filament/CME upward motion is accelerated temporally in correlation with the impulsive enhancement of flare non-thermal emission and reconnection electric field in the current sheet in both simulations and observations. The peak reconnection electric field during flare impulsive phase is on the order of a few kV/m for X-class flares. Here, we demonstrated for the first time in laboratory plasma merging experiments the correlation of the magnetic reconnection rate with the acceleration of plasmoid ejected from the current sheet using the TS-4 device of the Tokyo University. Moreover, we have also found that the electron heating occurs in the current sheet and the ion heating occurs in the down-stream outflow region. Thus, we conclude that the plasmoid/CME acceleration is a key mechanism for the impulsive enhancement of magnetic reconnection rate (electric field).

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