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# Generation of Energetic Electrons by Magnetic Reconnection with Presence of High Guide Field

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Magnetic reconnection allows highly-conducting plasma to change its magnetic topology in nuclear fusion plasmas, such as sawtooth crash, internal reconnection event, and so on. Recent theoretical and numerical works revealed that the presence of guide field (GF) greatly changes the collisionless reconnection in a qualitative way. One of the essential changes is that electrons are efficiently accelerated near the X-point to achieve high kinetic energy. Those fast electrons then cause secondary modification on reconnection structure, sometimes involving excitation of waves by electron beam instability. In this paper, we report some evidences of accelerated electrons in the UTST device, which provides well-controlled reconnection condition with toroidal GF 20 times higher than the reconnection field.
During the non-steady reconnection process in the UTST, a sharp ring-shape emission was found near the X-point. Toroidally accelerated electrons by reconnection electric field are supposed to ionize singly charged carbon impurities in the middle phase of reconnection. The SXR from the X-point region was observed simultaneously with the reconnection electric field. Generation of electron high energy tail up to 300 eV was confirmed by comparison of SXR signals through various filters. The SXR emission showed almost linear increasing trend with the toroidal GF when it exceeds the threshold value of GF ~ 0.12 T, suggesting that the number of accelerated electrons is determined by the duration of electrons remaining near the X-point. As a consequence, highly-efficient electron acceleration takes place in the magnetic reconnection with high GF even though the released magnetic energy was not very large. In contrast, the ion flow acceleration was observed only in the cases with reconnection electric field higher than 100 V/m. Thus, in the high GF case, the released magnetic energy is mainly converted to the kinetic energy of bulk ions, which then is converted to thermal energy; however, some electrons are effectively accelerated by the reconnection electric field to form a high energy tail. The accelerated fast electrons could excite low frequency modes near the reconnection region, which may cause bad influences on confinement property of tokamak plasmas.

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