Preliminary investigation of the helical current induced by electrode biasing in the SOL on the J-TEXT tokamak

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An essential problem for future burning plasma is that the Edge-Localized Modes (ELMs) could erode and melt the plasma-facing components. Therefore, the effective control of ELMs is of great importance. Extensive experiments have demonstrated that the resonant magnetic perturbations (RMPs) generated by in-vessel or ex-vessel saddle coils can change the edge magnetic topology and hence mitigate or even suppress the ELMs. Similar as the RMPs, the helical current filaments (HCFs) induced by lower hybrid waves has been observed to change the magnetic topology and strongly mitigate ELMs in EAST [1]. The HCFs could be a new attractive method to apply RMPs. According to analytical calculation, the sufficient SOL helical current could be produced by biasing the divertor plates asymmetrically in order to control ELMs in ITER [2].

In this paper, we will present the recent results on the HCFs actively driven by a moveable biased electrode in the SOL of J-TEXT. Once the biasing voltage (e.g. +200V) was applied to the electrode, significant current (~150 A) was induced through the electrode. The perturbed magnetic fields produced by the biasing current were measured at two poloidal cross-sections. The total magnetic fields, generated by the helical currents flowing both along and against the magnetic field lines at the location of the electrode, were calculated at the same cross-sections. The measured and calculated magnetic fields are highly consistent, which confirmed that the current induced by the electrode flowed helically along and against the local magnetic field lines. In addition, the radiation of the HCFs were observed from the images captured by a fast frame visible camera with the CIII filter. The spectrum of the magnetic field generated by the HCFs were calculated, which resonate with the edge rational surfaces and hence modify the edge magnetic topology significantly.

References:

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