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Scaling Physics of Reconnection Heating and Acceleration in Tokamak Merging Experiments YASUSHI ONO, H. TANABE, S. KAMIYA, H. TANAKA, Y. CAI, Q. H. CAO, X. JUNGUANG, Univ of Tokyo, M. GRYAZNEVICH, Tokamak Energy Inc., S. USAMI, R. HORIUCHI, NIFS, TS TEAM, ST-40 TEAM — The high-power reconnection heating of merging tokamak plasma has been developed in TS-3, TS-4 and MAST experiments. This unique method is based on the promising scaling of ion heating energy that increases with squire of reconnecting magnetic field B_rec. We studied mechanisms for this scaling of reconnection (ion) heating mainly using TS-3U (TS-6) experiment and PIC simulations and found the following features: (i) the ion heating energy is as high as ˜40-50% of poloidal magnetic energy of two merging tokamak plasmas, (ii) the ion heating energy is not affected by (guide) toroidal field B_t, in the region of B_t/ B_rec >1 under two conditions: (a) compression of current sheet to the order of ion gyroradius and (b) full-isolation of the merging tokamak plasmas from coils and walls. The sheet compression to ion gyro radius was found to be a key condition to realize the fast reconnection as well as the high power ion heating consistent with the B_recˆ2-scaling prediction. Under this condition, the ion heating energy is determined uniquely by B_rec ˜B_p not by B_t in the conventional tokamak operation region: B_t/ B_rec >1. This promising scaling realized ion temperature as high as 2.2keV in 2019 and is expected to realize the burning ion temperature >10keV (under electron density n_e˜1.5x10ˆ19 [mˆ-3]) just by increasing B_rec over 0.6T.

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