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Scaling Study of Reconnection Heating in Torus Plasma Merging Experiments YASUSHI ONO, MOE AKIMITSU, ASUKA SAWADA, QINGHONG CAO, HIDEYA KOIKE, HIRONORI HATANO, TAISHI KANEDA, HIROSHI TANABE, Univ of Tokyo — We have been investigating toroidal plasma merging and reconnection for high-power heating of spherical tokamak (ST) and field-reversed configuration (FRC), using TS-3 (ST, FRC: R=0.2m, 1985-), TS-4 (ST, FRC: R=0.5m, 2000-), UTST (ST: R=0.45m, 2008-) and MAST (ST: R=0.9m, 2000-) devices. The series of merging experiments made clear the promising scaling and characteristics of reconnection heating: (i) its ion heating energy that scales with square of the reconnecting magnetic field B_{rec}, (ii) its energy loss lower than 10%, (iii) its ion heating energy (in the downstream) 10 time larger than its electron heating energy (at around X-point) and (iv) low dependence of ion heating on the guide (toroidal) field B_g. The B_{rec}^2-scaling was obtained when the current sheet was compressed to the order of ion gyrodadius. When the sheet was insufficiently compressed, the measured ion temperature was lower than the scaling prediction. Based on this scaling, we realized significant ion heating up to 1.2keV in MAST [1,2] after 2D elucidation of ion heating up to 250eV in TS-3 [3,4]. This promising scaling leads us to new high B_{rec} reconnection heating experiments for future direct access to burning plasma: TS-U (2017-) in Univ. Tokyo and ST-40 in Tokamak Energy Inc. (2017-). This presentation reviews major progresses in those toroidal plasma merging experiments for physics and fusion applications of magnetic reconnection. [1] Y. Ono, et al., Phys. Plasma 22, 055708 (2015). [2] Y. Ono, et al., Phys. Rev. Lett. 107, 185001, (2011).

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