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Pulsed High-Power Heating of Magnetic Reconnection in TS-3/4 ST Merging Experiments

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The merging/ reconnection startup of high-beta ST has been developed in the TS-3/4 experiments, leading us to its new extension to the pulsed high-power heating for burning plasma formation. Two STs were produced inductively by swing-down of two (or four) PF coil currents without using any center solenoid (CS) and they were merged together for high-power reconnection heating. The maximum outflow speed of reconnection is equal to the Alfven speed, theoretically and experimentally. The outflow energy is converted mostly into ion thermal energy through ion viscosity and/or fast shock, indicating that the ion temperature (thermal energy) increment scales with squares of reconnecting magnetic field (Alfven speed). This unique method provides the highest heating power - MW-GW among all CS-less startups and its heating process is completed earlier than the energy confinement time, indicating that most of the heating energy is used for high-beta ST formation. In TS-3, the ion heating energy was found to be 70-90% of the dissipated magnetic energy due to the closed flux surfaces around the X-point. The TS-3/4 scaling data suggest that two merging STs with B=1-3T, n=10(20)m(-3) will be transformed into an ITER-like ST with T˜20keV within reconnection time. These facts indicate that the merging of two STs possibly provides a direct path to the burning CT/ST formation. Additional merging can be used for further reconnection heating.