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High-beta spherical tokamak startup in TS-4 merging experiment by use of toroidal field ramp-up YASUHIRO KAMINOU, Univ of Tokyo, TORU II, National Institute for Fusion Science, JOJI KATO, MICHIAKI INOMOTO, YASUSHI ONO, Univ of Tokyo, TS GROUP TEAM, NATIONAL INSTITUTE FOR FUSION SCIENCE COLLABORATION — We demonstrated the formation method of an ultrahigh-beta spherical tokamak by use of a field-reversed configuration and a spheromak in TS-4 device (R $\sim$ 0.5m, A $\sim$ 1.5, Ip $\sim$ 30-100kA, B $\sim$ 100mT). This method is composed of the following steps: 1. Two spheromaks are merged together and a high-beta spheromak or FRC is formed by reconnection heating. 2. External toroidal magnetic field is added (current rising time $\sim 50\mu$s), and spherical tokamak-like configuration is formed. In this way, the ultrahigh-beta ST is formed. The ultrahigh-beta ST formed by FRC has a diamagnetic toroidal field, and it presumed to be in a second-stable state for ballooning stability, and the one formed by spheromak has a weak paramagnetic toroidal magnetic field, while a spheormak has a strong paramagnetic toroidal magnetic field. This diamagnetic current derives from inductive electric field by ramping up the external toroidal magnetic field, and the diamagnetic current sustains high thermal pressure of the ultrahigh-beta spherical tokamak. And the beta of the ultrahigh-beta ST formed by FRC reaches about 50%. To sustain the high-beta state, 0.6MW neutral beam injection and center solenoid coils are installed to the TS-4 device. In the poster, we report the experimental results of ultrahigh-beta spherical tokamak startup and sustainment by NBI and CS current driving experiment.

Yasuhiro Kaminou
Univ of Tokyo

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