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Impacts of STOR tokamaks on fusion research

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STOR-1M and STOR-M tokamaks have been impacting a fusion research in two areas: [1] Alternating current (AC) operation, and [2] Central solenoid (CS)-less plasma current start-up in a tokamak. I would like to look back on these researches and talk about their possible future impacts.

[1] AC operation in STOR-1M and STOR-M: In design of STOR-1M and -M tokamaks, the iron core image field was taken into account since Prof. Hirose derived a simple formula for the infinitely long cylinder of the iron core. The image field from the iron core transformer is measured by saturating the iron core in STOR-1M. This inspired the recent iron core saturable operation in STOR-M. AC operation was demonstrated in Feb. 1984, and the first paper was published in NF at 1987. Since then, AC operations have been conducted in JET (1992), STOR-M (1993), CSTN, ISTTOK, CT-6B and HT-7. In future, a D-T high aspect ratio tokamak with $R \sim 10$ m could be operated by AC operation. Vertical field induction relaxes the AC operation condition for achieving equal AC discharge length by supplying an additional flux.

[2] CS-less plasma current start-up in STOR-M: Based on our knowledge on iron core transformer obtained in STOR-1M and STOR-M experiments, the CS-less plasma current start-up has been demonstrated after removing CS in STOR-M at 2007. In 2012~2014 the active studies have been conducted, and it was demonstrated that the plasma current can be maintained during the iron core saturation phase. This type of discharge was first demonstrated in the world. This operation scenario can be applied specifically to an initial plasma current start-up in spherical tokamak (ST) reactor aiming at D-3He fusion.

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