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Development of KTX reversed field pinch facility in China

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Keda Torus eXperiment (KTX), a medium-sized reversed field pinch (RFP) device commissioned in 2015 at the University of Science and Technology of China, serves as a complementary facility to existing international RFP programs. Designed for plasma confinement optimization through enhanced wall conditions and high plasma currents up to 1 MA, KTX has undergone systematic upgrades in critical systems including ohmic power supply, density regulation, edge magnetic feedback control, and plasma diagnostics. Significant technical advancements include the upgrade of poloidal field coil power supply to 5 MJ stored energy, enabling plasma currents exceeding 500 kA with peak heating power reaching 30 MW. A sophisticated 96-channel active feedback control system has been implemented for effective MHD mode suppression and error field correction, extending plasma current duration beyond 100 ms (exceeding five times the shell time constant). The installation of a dual-biasing electrodes system facilitates edge electric field manipulation for turbulence transport studies and rotation control. A novel compact torus injection system (KTX-CTI) with midplane horizontal injection capability has been developed for multi-parameter plasma control, including fueling optimization, current profile modification, and momentum/helicity injection. For three-dimensional (3D) physics investigations, advanced diagnostic suites have been deployed including Thomson scattering, terahertz polarimeter/interferometry, and dual-foil soft X-ray imaging systems. Current research initiatives on KTX focus on two primary directions: 1) Plasma confinement enhancement through MA-level current operation, and 2) Investigation of universal toroidal confinement physics applicable to tokamaks and stellarators, addressing challenges such as high-density operational limits, electromagnetic turbulence transport mechanisms, and 3D magnetic field effects. Combined experimental and computational efforts aim to provide multi-faceted insights into critical physics issues for next-generation fusion reactor development.

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Keyword-2

reversed field pinch

Keyword-3

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