

## Real-time plasma control of fully non-inductive operation in EAST 1056s long pulse discharge

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Feedback controlled fully non-inductive plasma discharge have been sustained in EAST long-pulse operation up to 1056s with a new world record of injected–extracted energy exceeding 1.7 GJ. This steady-state real-time plasma control requires integrated accurate control of plasma equilibrium, current and loop voltage [1]. An improvement of the plasma position and shape control within a few millimeters range, together with zero loop voltage control by the injected LHW power. The fiber optic current sensors (FOCS), based on the Faraday Effect, with no signal drift, are firstly used and provide higher precision current measurement compared with Rogowski coil in plasma current control [2]. Low zero drift integrators are applied for magnetic measurements used to reconstruct and control the plasma position and shape [3]. Small drifts were observed during the dry-run operation and corrected in EAST plasma control system (PCS) for long-pulse operation. Magnetic measurement signals selection and fitting uncertainty in real-time equilibrium reconstruction are based on error analysis with 500s dry-run operation. With delicately optimizing loop voltage PID controller and 4.6Ghz LHW feedforward power, loop voltage is controlled within  $0.5 \times 10^{-5}$  V. Advanced tools, experimental results and analysis in EAST long-pulse oriented plasma control provide important experience and reference for long-pulse operation on fusion devices.

### References

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