

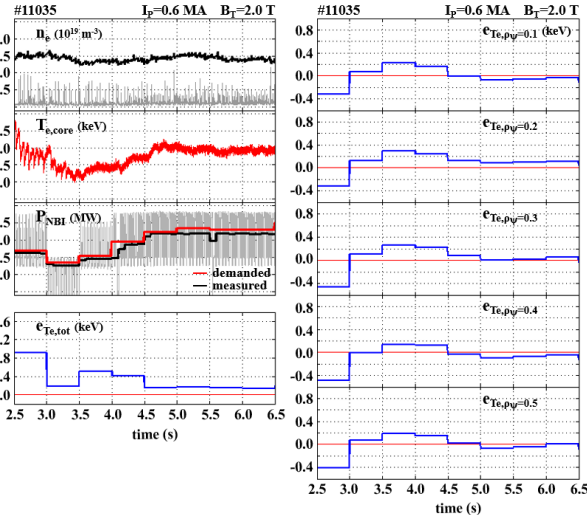
➤ Successful demonstration of real-time feedback T_e profile control system in KSTAR

- Validation of the implemented physics-based profile response model^[1].
- Designated control experiments:

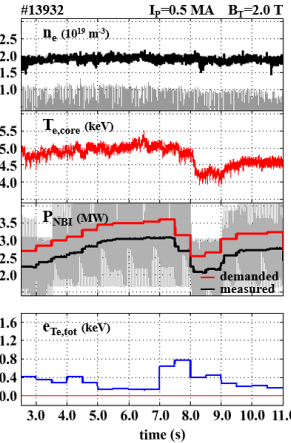
^[1]S.H. Kim, et al., Nucl. Fusion 52 (2012) 074002

- ① changing the control target with a step variation,
- ② suffering an external disturbance,
- ③ applying multiple actuators using a static version of control matrix.
- ④ real-time update of the control matrix was attempted.

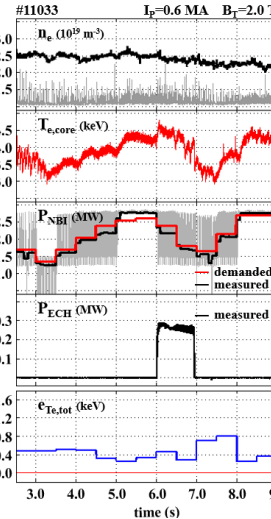
⊙ Real-time T_e profile control with single actuator, NBI



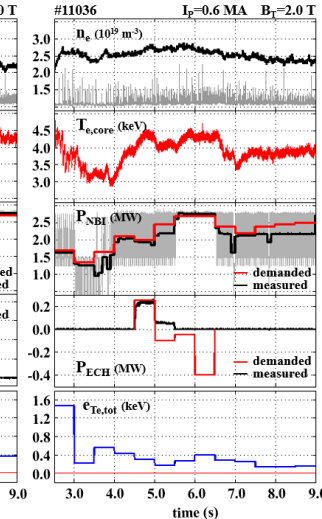
① Step variation on control target



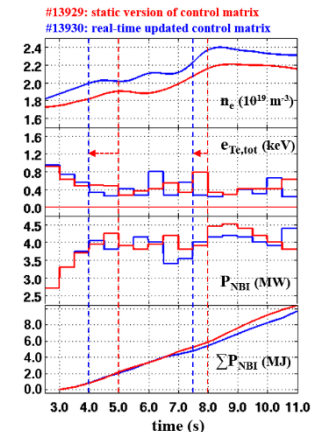
② External disturbance



③ Multiple actuators, NBI and ECH



④ Real-time update of control matrix



- Not only the total sum of the control errors ($e_{T_e,tot}$) but also the control error at each control location were reduced by the control actions on P_{NBI} .
- 4 control intervals required to reduce the total sum of the control errors to the minimum to be achieved (~ 0.2 keV).

- The T_e profile controller required almost 4-5 control intervals to reduce $e_{T_e,tot}$ close to its minimum, before and after the step change of the control target. (in ①)
- The T_e profile could be controlled using NBI in the presence of external disturbances (ECH), but in delayed manner due to large control intervals. (in ②)
- The controllability of T_e profile was improved in the local region with addition of ECH as the actuator. The applied control approach with multiple actuators can potentially be beneficial for handling minor faults such as malfunctioned actuator action. (in ③)
- The real-time update of the control matrix produced slightly faster control behaviour and required less control actions compared with the static version. (in ④)