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OV/4-4: Overview of Recent and Current Research on the TCV Tokamak

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Through a diverse research program, TCV addresses physics issues and develops tools for ITER and for the longer-term goals of nuclear fusion, relying especially on its extreme plasma shaping and ECRH launching flexibility and preparing for an ECRH and NBI power upgrade. Localized edge heating was unexpectedly found to decrease the period and relative energy loss of ELMs. Successful ELM pacing has been demonstrated by following individual ELM detection with an ECRH power cut before turning the power back on to trigger the next ELM, the duration of the cut determining the ELM frequency. In a parallel study, negative triangularity was also seen to reduce the ELM energy release. Both stabilizing and destabilizing agents (ECCD on or inside the q=1 surface, respectively) were used in a similar scheme to pace sawtooth oscillations, permitting precise control of their period. Locking of the sawtooth period to a pre-defined ECRH modulation period has also been demonstrated. In parallel with fundamental investigations of NTM seed island formation by sawtooth crashes, sawtooth control has permitted nearly failsafe NTM prevention when combined with backup NTM stabilization by ECRH. Additional work has addressed the destabilization of NTMs in the absence of a sawtooth trigger, and particularly its relation to plasma rotation. Further real-time control developments include the demonstration of joint current and internal inductance control using the Ohmic transformer and the validation of an ECRH power absorption observer based on transmitted stray radiation, for eventual polarization control. A new profile control methodology was also introduced, relying on real-time modelling to supplement diagnostic information; the RAPTOR current transport code in particular has been employed for joint control of the internal inductance and temperature profile. H-mode studies have focused on the L-H threshold dependence on the main ion species and on the divertor leg length. In L-mode, a systematic scan of the auxiliary power deposition profile, with no effect on confinement, has ruled it out as the cause of confinement degradation. Both L- and H-modes have been explored in the snowflake regime with emphasis on edge measurements, revealing that the heat flux to the strike points on the secondary separatrix increases as the X-points approach each other, well before they coalesce.

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