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P3.011 Status scientific results and technical improvements of the NBH on TCV tokamak

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The TCV tokamak contributes to physics understanding in fusion reactor research by a wide set of experimental tools, like flexible shaping and high power ECRH. Plasma regimes with high pressure, a wider range of temperature ratios and significant fast-ion population are now attainable with the TCV heating system upgrade. A 1 MW, 25 keV deuterium heating neutral beam (NB) has been installed in 2015 and it was operated from 2016 in SPC-TCV domestic and EUROfusion experimental campaigns (~50/50%). The rate of failures of the beam is <5% and mostly due to arc between grids of ion optical system. The beam also stopped due to plasma density limits (to avoid excessive shine-through) or plasma disruptions.
Ion temperatures up to 3.5 keV have been achieved in ELMy H-mode, with a good agreement with ASTRA simulations adding the NB. The NB enables TCV to access ITER-like βN values (1.8) and Te/Ti ~1, allowing investigations of innovative plasma features in ITER relevant ELMy H-mode.
The advanced Tokamak route was also pursued, with stationary, fully non-inductive discharges sustained by ECCD and NBCD reaching βN~1.4-1.7. Loss channel are mostly related to charge-exchange, especially in low-collisionality plasmas as transport simulations and FIDA spectroscopy measurements confirm. Furthermore, with ECRH a new transport channel appears and might be explained by turbulent transport.
Real-time control of the NB power is planned for 2018 and will be presented together with the statistics of NB operation on the TCV. During commissioning, the NB showed unacceptable heating of the TCV duct, indicating a higher power deposition than expected. A high beam divergence has been found by dedicated measurement of 3-D beam power density distribution with an expressly designed device featuring a tungsten target on which the beam is deposited. The identification of the problem is ongoing.

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