First heated elongated plasmas with an actively water cooled liquid lithium limiter on FTU

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Power exhaust is one of the main issues to be tackled to achieve steady state operation of future reactors. In the last years liquid metals have demonstrated to be a possible candidate to improve the situation. Since 2006, experiments using a liquid lithium limiter were successfully performed on FTU: heat loads of 1-2 MW/m² were withstood without troubles and transient phenomena, i.e. disruptions, in the order of 10-15 MW/m² didn’t cause any damage to the limiter surface. Recently a new, actively cooled, liquid lithium limiter (CLLL) has been built and installed in FTU that will enable sustaining up to 10 MW/m² [1]. Water flowing in the coolant circuit at a temperature of about 200 °C plays a double role: it heats the lithium up to the melting point and removes the heat during the experiments. In 2013, first elongated FTU plasmas heated by 650kW of Electron Cyclotron Resonance Heating (ECRH) have been obtained with the new CLLL. The magnetic configuration (Ip=200kA, BT=5.5T, k~1.25, <δ95>=0.18, magnetic shear ~40% higher than in circular plasma) presents the X-point close to the first wall with the 3λ surface (λ, energy e-folding length, ~1cm in FTU) opened on the CLLL. In these discharges the CLLL does not act as first limiter, the D-shaped FTU plasma is indeed in contact with the outer Molibden poloidal limiter. These discharges aim at investigating the access to H-mode, as done at JET with MarkIIGB divertor by moving the X-point up to 5cm inside the septum [2]. No L-mode to H-mode transition was observed so far, consistent with the threshold being above the injected power at B_T = 5.5T [3]. Neither damage on CLLL nor plasma pollution were observed despite the CLLL was located near (~1cm) the Last Closed Magnetic Surface (LCMS). Further experiments are planned in April 2014, considering discharges with a lower value of the toroidal magnetic field (2.7T) to reduce the power requirement [3] for accessing H-mode, thus having the possibility to study the impact of Edge Localized Modes (ELMs) on the CLLL used as first limiter. Preliminary results on possible modifications of PF coil connections and power supplies, still under investigation, to move the X-point into the camera will be also presented.

References

*See the appendix of P. Buratti et al., Proceedings of the 24th IAEA Fusion Energy Conf., San Diego, USA, 2012