Survey of MHD activity in Wendelstein 7-X stellarator in the first divertor phase

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The Wendelstein 7-X stellarator (W7-X) located in Greifswald, Germany, is currently in preparation for the next operation phase and has been upgraded for tests of the NBI heating capabilities. In the previous experimental campaign, which ended in December 2017, long discharge lengths of up to 30 s have been achieved by means of ECRH heating and a peak diamagnetic energy of 1 MJ has been measured.

The Wendelstein 7-X stellarator was optimized to have good MHD stability properties for plasma betas of up to 5 %. The W7-X magnetic configuration space is quite flexible due to the seven different shapes of two planar and five 3D-shaped modular magnetic field coils, which comprise one-half module of W7-X magnet system, and can be operated with different currents. Up to now, this experimental flexibility has been explored only to a small extend in a set of four different magnetic field configurations, for which quantities like the bootstrap current and the confinement are predicted to have significantly distinguishable values. This could be confirmed in recent experiments.

Several important MHD diagnostic systems are available, including sets of diamagnetic loops, Rogowski coils (segmented and continuous ones), Mirnov coils and, most recently, a soft X-ray multi-camera tomography (XMCTS) and a phase contrast imaging system (PCI). Both, PCI and XMCTS went into operation during the last campaign.

Even though the yet achieved plasma beta is not in the range of reaching the predicted beta limit, and the NBI as fast particle source is yet to be commissioned, there are observations of Alfvénic activity as well as small plasma crashes in scenarios with ECH-driven current densities.

In the repeated fast crashes during co-ECCD, a decrease of the diamagnetic energy in the order of 100 kJ has been found. Mirnov and X-ray data show an oscillatory pre-trigger prior to the crash. Also in the high performance 1 MJ discharge (without ECCD), a crash with similar features has been observed. In this contribution, we report about the investigation of these MHD events in the Wendelstein 7-X stellarator.