Signatures of the magnetic configuration observed with the video diagnostic at Wendelstein 7-X stellarator

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Wendelstein W7-X is a highly optimized stellarator experiment with a modular superconductive coil system operating at a magnetic field of 2.5 T. Commissioning started in 2015 with plasmas up to 20s. W7-X is stepwise upgraded: beginning from uncooled fine-grain graphite limiters, then installing uncooled divertor units, and finally implementing actively water-cooled high-heat flux divertor structures made of graphite. At W7-X the island divertor concept is applied, with intrinsic island chains at the plasma edge producing multiple X-points directing the out flowing plasma in the scrape-off layer to dedicated target plates of the divertor. To verify the magnetic field configuration and measure magnetic field errors, which cause asymmetries in the heat flux to the island-divertor, a set of 10 1.3MPixel-CMOS cameras has been installed [1]. These cameras give a toroidal overview of the magnetic field lines and flux surfaces visualized by an adjustable electron gun and a fluorescent rod [2] and further of the light emission from the edge plasma in the visible spectral range. The main objective of the video diagnostic is to visualize plasma shape, position as well as plasma-wall interaction during the discharge operation for supervision and scientific exploration. During the first operational phase with the uncooled divertor unit a variety of magnetic configurations have been executed and the emission of visible light during extensive external as well as intrinsic gas fuelling was observed. To help the understanding of the recorded radiation distributions a synthetic diagnostic including the viewing geometry of different magnetic field configurations has been developed. The set of 10 camera channels with Event Detection Intelligent Camera (EDICAM) sensors allows coverage of the whole torus interior and visualization of the island structure. In this contribution we present an overview of the camera system and capabilities and summarize the observed signatures of the different magnetic field configurations.

[1] G. Kocsis et al. Fusion Engineering and Design **96-97** (2015) 808.
[2] M. Otte et al. Plasma Phys. Contr. Fusion **58** (2016) 064003.