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Endoscopes for observation of plasma-wall interactions in the divertor of Wendelstein 7-X

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The stellarator Wendelstein 7-X has been prepared for long pulse operation in the first operational campaign. Forschungszentrum Jülich has contributed diagnostics for investigation of plasma wall interaction processes in presence of an island divertor and steady state plasma at high density and low temperature.

A versatile optical observation system has been developed for local characterization of the divertor plasma and the divertor target surface. At two opposite divertor locations linked by magnetic field lines, temperature and density profiles, impurity transport and recycling, hydrogen recycling, and transient heat load deposition are analysed. The analysis is assisted by two gas inlets in the divertor, a fast probe manipulator and a poloidal correlation reflectometer located along the same magnetic structure.

The optical systems consist of two endoscopes each with perpendicular fields of view with the opportunity of tomographic reconstruction. Mirror based optics has been chosen in order to be independent of wavelength. A narrow field of view allows for high spatial resolution while rotation of the first mirror covers the full poloidal divertor sections. An integrated shutter mechanism and a vacuum window far back minimize coating of optic components. For assessment of change of transmission, a relative calibration function is implemented. The output light is split into wavelength ranges. Both, cameras equipped with narrow band filters as well as spectrometers are connected. Six cameras and four spectrometers can be attached simultaneously to each endoscope.

In this contribution, the detailed optics, mechanic, and thermal concept, experience from assembly and adjustment as well as first results will be presented.

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