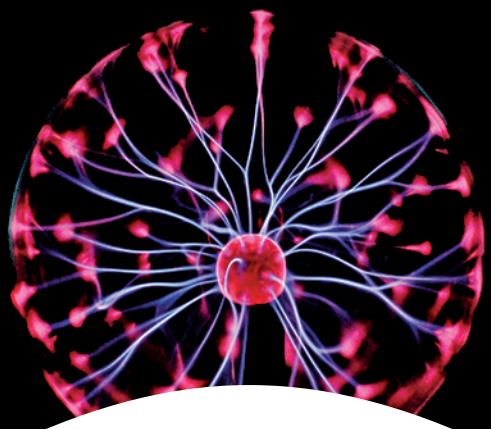

asphericon

Optimized line ratio spectroscopy

Aspheres for an experimental fusion reactor

Project description:

Research at ASDEX (Axially Symmetric Divertor Experiment) Upgrade, an experimental facility for the development of fusion reactors, provides essential results for the potential switch from nuclear fission to nuclear fusion as a safer and more environmentally friendly way of sourcing energy. To make the results by Max-Planck-Institute for plasma physics in Garching (GER) applicable for trial power plants, like the French experimental nuclear fusion reactor ITER (International Thermonuclear Experimental Reactor), research at ASDEX Upgrade is conducted under power-plant-like conditions. To access the temperature and density of the electrons in the plasma edge region, a new diagnostic, based on line ratio spectroscopy of neutral helium, was implemented. Combined with a photomultiplier tube based light detection system, high precision optics help to improve the imaging quality and grant a high spatial and temporal resolution of the measurement.

Project realization:

Two lenses from asphericon's StockOptics range were used, which are offered with common diameter ranges from 10 to 100 mm and a surface form deviation of 300 nm RMSi. To make them suitable for the set-up, the lenses were centered down to the required diameter. The research team thus benefits from maximum flexibility and quality: Not only could all quality requirements be met, the optics were also made available with an extremely short delivery time of only 2 weeks. Both aspheric lenses have an effective focal length (EFL) of 85 mm and were installed into the optical head (see Fig. 1 & 2) of the helium line ratio spectroscopy diagnostic at ASDEX Upgrade to optimize the imaging effect. The lenses are used to capture light from the locally injected helium cloud and bundle it into optical fibers for subsequent spectrometric analysis in the laboratory.

In-vessel components - Functionality of optical head

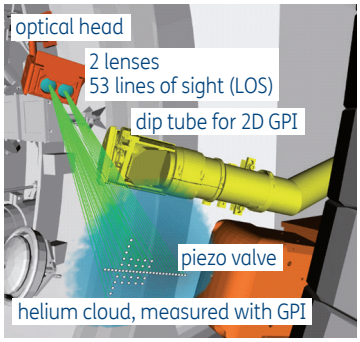

Fig. 1 Injected helium cloud excited by collision with plasma electrons and emitted light to be spectroscopically analyzed

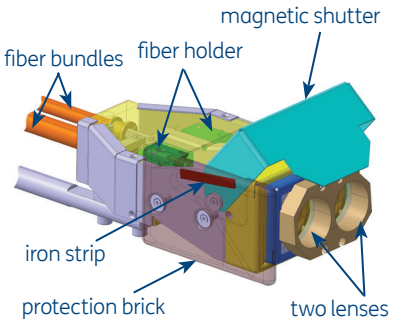

Fig. 2 CAD drawing of the optical head

Asphere specifications

The figure shows exemplarily the beam path of one of the two lenses (yellow area). The Light is bundled into the bare end of optical fibers with a 0.4 mm core diameter and NA of 0.22. The NA determines the acceptance angle of the fiber (green-shaded area).

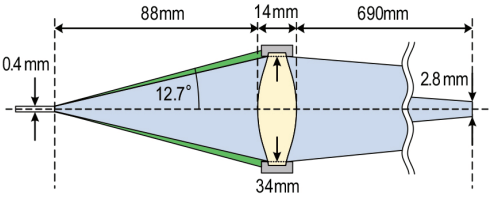

Fig. 3 Schematic representation of optical head

Reference: M. Griener, E. Wolfrum, M. Cavedon, R. Dux, V. Rohde, M. Sochor, J.M. Muñoz Burgos, O. Schmitz, U. Stroth, and ASDEX Upgrade Team: "Helium line ratio spectroscopy for high spatiotemporal resolution plasma edge profile measurements at ASDEX Upgrade", In: Review of Scientific Instruments, Vol. 89, Issue 10, 12 July 2018

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