40 Years of high-temperature laser-aided plasma diagnostics (Honorary)

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The field of high-temperature laser-aided plasma diagnostics started already in the 1960-ies with first applications of incoherent Thomson scattering. Noteworthy are the measurements of a British team from UKAEA on the Russian T3 tokamak in the early days of fusion research has led to a worldwide focus of magnetic fusion research on the tokamak. Despite these early applications of high-temperature laser-aided plasma diagnostics, this talk will mainly focus on developments that have taken place since the first Symposium on Laser-Aided Diagnostics in Fukuoka, Japan in 1983. The emphasis will be on diagnostics in magnetic confinement fusion.

Already back in 1983 laser-aided plasma diagnostics were routinely used at many experiments:

- Incoherent Thomson scattering for measuring the electron density and temperature.
- Collective Thomson scattering and Phase-Contrast Imaging for measuring electron density fluctuations.
- Laser-induced fluorescence for diagnosing parameters of ions and neutral atoms.
- Interferometry/polarimetry for measuring electron density and internal magnetic fields.

Many of these diagnostics had a limited number of viewing chords as well as spatial and temporal resolutions that were constrained by the available technology at that time.

Ever since 1983 there has been a continuous improvement of lasers, detectors, and control hard- and software, making the diagnostics more sophisticated. Also new diagnostics have joined the scene like ion Thomson scattering for diagnosing fast ions, microwave reflectometry to measure the electron density and fluctuations in this quantity as well as zonal flows, laser-induced breakdown and desorption spectroscopy for studying the wall composition and fuel retention. Some of these diagnostics have been developed from earlier applications in the field of low-temperature plasma physics, and the LAPD Symposium has played an important role in this cross-fertilisation.

This talk will go one by one through the various known high-temperature laser-aided plasma diagnostics and will sketch the situation around the time of the first LAPD Symposium in 1983, followed by several developments that have taken place during the last 40 years and a description of the present status of the various diagnostics. The talk will be sketchy (using a limited number of examples) and is by no means intended to be an exhaustive overview of the developments during the last 40 years.

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