In situ laser ablation particle velocity and angular distribution measurements in magnetic fusion devices

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Laser based methods are investigated as in situ diagnostic for plasma facing materials in magnetic fusion research [1].

In Laser Induced Ablation Spectroscopy (LIAS) [2] a laser beam is used to ablate wall material into the edge plasma region of a fusion experiment. Ablated material entering the plasma edge region is excited and the radiation is recorded by radiometrically calibrated spectroscopic observation. To conclude from the observed photons to the number of ablated atoms a detailed knowledge of the ablation process is required.

An in situ method to deduce the velocity and angular distributions of the ablated particles in the presence of magnetically confined plasma is introduced. For this, single pulse and time resolved measurements utilizing a fast camera with microsecond time resolution are used and the line radiation of neutral species is analyzed. Additionally the spatial resolution allows for analysis of the angular distribution.

In case of nanosecond laser ablation of tungsten the measured velocity distribution can be described by a stream modified Maxwellian distribution with a stream velocity of 7.6±0.2 mm/μs and a thermal velocity of 3.2±0.2 mm/μs.

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[2] N Gierse, S Brezinsek, J W Coenen, T F Giesen, A Huber et al., In situ deuterium inventory measurements of a-c:d layers on tungsten in textor by laser induced ablation spectroscopy. Physica Scripta, 2014(T159):014054, 2014.