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WITHDRAWN (I) Resolving Ion features for Collective Thomson Scattering on Laser-produced Tin Microdroplet Plasmas

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Thomson scattering (TS), the elastic scattering of light photons by charged particles, is a powerful diagnostic for the measurements of electron properties (density and temperature) in low-temperature plasmas (LTP). It is in fact one of the few diagnostics capable of providing simultaneously electron density (ne) and electron temperature (Te) information at the nanosecond timescale. As a result of the implementation of this diagnostic, many insights have been gained on electron kinetics in diverse low temperature discharges. In most of the situations, TS in LTP is encountered in the non-collective (or incoherent) regime, meaning that scattering signals from individual charged particles are added together. Besides, because ions are generally in thermal equilibrium with the neutrals constituting the background gas, TS is essentially giving information about the hot electrons. However, for high density plasmas (typically ne > 1017 cm-3), the collective (or coherent) TS regime is generally observed. In the collective regime. light photons are scattered off plasma waves (instead of individual charged particles). In such a configuration two different spectral features are observed: electron and ion features, which result from scattering off the so-called electron plasma waves (EPW) and ion acoustic waves (IAW), respectively. While the ion feature is observed near the probe laser spectral location, the electron feature is observed far from it. Conversely, scattering off IAW results in stronger collected signals than scattering off EPW. Probing simultaneously electron and ion features of a high density plasma would in principle provide a plethora of information regarding the plasma conditions: ne, Te, Ti (ion temperature), Z (average charge state), vei (electron-ion relative drift velocity) and V (fluid velocity).
We show through forward modeling the feasibility of implementing such a diagnostic for laser-produced tin droplet plasmas generated during the ablation of 30-80 µm tin droplets by a 10 ns Nd:YAG laser emitting at 1064 nm. Such plasmas are currently employed as extreme ultraviolet light sources (at 13.5 nm ± 1%) for the semiconductor industry.

Keyword-1

Collective Thomson scattering

Keyword-2

EUV

Keyword-3

Laser-produced tin plasma

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