E-FISH for Electric Field Measurements in Non-Equilibrium Plasmas: Prospects for Future Use

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Electric field induced second harmonic generation, or E-FISH, is a laser based diagnostic which has recently been repurposed for the measurement of electric fields in plasmas. This method involves probing a non-polar gas sample with laser light, and quantifying its second harmonic response to an externally applied electric field that is to be measured. This second harmonic signal varies quadratically with the applied field strength, and is otherwise absent if no field is imposed. Calibration may be performed in a known electrostatic field so as to obtain absolute field information, for instance in a plasma. Key advantages of the E-FISH method include its versatility, excellent signal localization in time, and relatively straightforward implementation. The versatility of the method is demonstrated by its non-resonant nature - the technique is in theory applicable to any non-polar gas or gas mixture and does not demand a specific probe laser wavelength. The temporal resolution of the measurement is only physically limited by the laser pulse duration since the signal generation is effectively instantaneous, with pulses as short as 50 fs being shown to yield good signals. However, recent work has also shown that the E-FISH diagnostic possesses certain limitations with respect to the spatial origin of the signal. In this talk, I will elaborate on the foregoing strengths and limitations associated with effective use of E-FISH, including some strategies that our group has been pursuing to address existing problems, and the challenges we have faced. I will also present some electric field measurements in a fast ionization wave discharge made using picosecond E-FISH, and elaborate on some prospects for measuring the sign of the electric field vector using optical homodyne detection.

Acknowledgements

The work was partially supported by the French General Directorate of Armaments (DGA) under the EP-DGA convention N2790, the French National Research Agency, ANR ("Atomic Species Production via Electronically excited states in high eNergy density Plasmas" (ASPEN) Project) and the French–Russian international Research Project KaPPA 'Kinetics and Physics of Pulsed Plasmas and their Afterglow'.

Références

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Statut: Postdoc