Fast camera imaging of visible light : when the electron temperature matters

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High speed camera imaging is a powerful tool to probe the spatiotemporal features of unsteady processes in plasmas, usually assuming light fluctuations to be a proxy for the plasma density fluctuations [1, 2, 3]. In this work [4], we present a systematic comparison of high speed camera imaging with simultaneous measurements of the plasma parameters – plasma density, electron temperature, floating potential – in a magnetized Argon plasma column at low pressure (1 mTorr, magnetic fields from 160 to 640 G) [5]. The light emission was filtered around 488 ± 5 nm, 750 ± 5 nm, 810 ± 5 nm.

We show that the light intensity cannot be interpreted as a proxy for the plasma density and that the electron temperature cannot be ignored when interpreting high speed imaging, both for the time-averaged profiles and for the fluctuations. The features of plasma parameter fluctuations are investigated, with a focus on ion acoustic waves (at frequency around 70 kHz) at low magnetic field and low-frequency azimuthal waves (around a few kHz) at larger magnetic fields. An excellent match is found between the high speed images fluctuations and an Arrhenius law functional form which incorporates fluctuations of the plasma density and of the electron temperature. These results explain the discrepancies between ion saturation current and narrow-band imaging measurements previously reported in the literature [6].

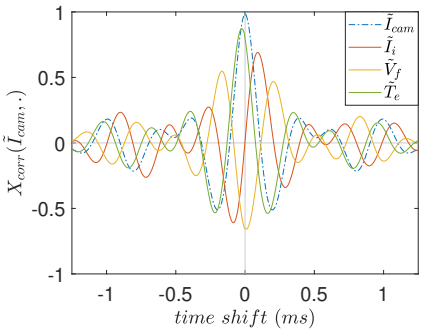

Figure 1: Typical correlation between camera intensity ($\tilde{I}_{cam}$) and plasma parameters fluctuations ($\tilde{I}_i$, $\tilde{T}_e$, $\tilde{V}_f$).

References

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